DEPT OF BLDGS 121192618 Job Number

ES343746643 Scan Code

McNAMARA · SALVIA
STRUCTURAL ENGINEERS

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March 5, 2015

Via E-Mail: scott.fehmel@related.com

Mr. Scott E. Fehmel, P.E
The Related Companies, L.P.
60 Columbus Circle
New York, NY 10023

RE: 35 Hudson Yards, New York
Structural Peer Review

Dear Mr. Fehmel,

At the request of Ery Tenant, LLC c/o The Related Companies, L.P., McNamara Salvia, Inc has conducted a structural Peer Review of the design of the 35 Hudson Yards project as required by the New York City Building Code Section BC1617. This reports summaries the extent and findings of our review.

As part of the process, we have reviewed the design plans prepared by SOM and relevant reports noted below:

- Structural Drawings: “Issued to DOB” dated 15-Jan-2015
- Architectural Drawings: “Issued to DOB” dated 15-Jan-2015
- Geotechnical Report: prepared by Langan Engineering dated 26 April 2013
- Wind Tunnel Report: prepared by RWDI dated November 21, 2014

Through our review, we have confirmed the following aspects of the structural design, as required by building code section 1617.5.1:

- The design loads conform to the New York City Building Code;
- The structural design criteria, and design assumptions, conform to this code and are in accordance with generally accepted engineering practice;
- The design properly incorporates the results and recommendations of the geotechnical investigations;
- The structure has a complete load path;
- Based on our independent calculations of representative foundations, columns, walls, beams and slabs, we found that the design of the structure has adequate strength;

- The structural plans are in general conformance with the architectural plans regarding loads and other conditions that may affect the structural design;
- There are no performance-specified structural components that are part of the primary building structure;
- Design engineer of record complied with the structural integrity provisions of the code;
- Major mechanical items are accommodated in the structural plans; and
- Structural plans and specifications are generally complete.

Accordingly, we find the design of the structure to be in general conformance with the structural design provisions of the New York City Building Code.

The opinions expressed in this letter represent our professional view, based on the information made available to us. This review was performed based on the provisions of the New York City Building Code Section BC1617 and conducted following the ACEC Recommended Practice Guidelines for Peer Review for Code Compliance. The review does not relieve any responsibilities of the Engineer of Record for the structural design. No other warranty, expressed or implied, is made as to the professional opinion included in this letter.

Very truly yours,
McNamara/Salvia, Inc.

STATE OF NEW YORK
BART A. SULLIVAN
093540
LICENSED PROFESSIONAL ENGINEER

Bart Sullivan, PE
Principal

cc: Mr. Nick Veikos
Mr. Greg Gushee
Mr. Mark Boekenheide
Mr. Vlad Seijas, P.E.

APPENDIX A – Drawing List

General

		Issue #	Description	Date
G-000	COVER SHEET	4	ISSUED TO DOB	1/15/2015
G-001	GENERAL NOTES	2	ISSUED TO DOB	1/15/2015
G-002	ABBREVIATIONS, LEGENDS & SYMBOLS	1	ISSUED TO DOB	1/15/2015
G-003	ADA REQUIREMENTS	1	ISSUED TO DOB	1/15/2015
G-004	FLOOD ZONE DATA	1	ISSUED TO DOB	1/15/2015
G-006	BUILDING LOCATION PLAN	1	ISSUED TO DOB	1/15/2015

Architectural

		Issue #	Description	Date
A-001	GROUND FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-002	2ND FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-003	3RD FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-004	4TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-005	5TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-006	6TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-007	7TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-008	8TH-13TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-014	14TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-015	15TH FLOOR CODE ANAYLSIS	1	ISSUED TO DOB	1/15/2015
A-016	16TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015

A-017	17TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-018	18TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-019	19TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-020	20TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-021	21ST-26TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-027	27TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-028	28TH-29TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-030	30TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-032	31ST -40TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-042	41ST-50TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-052	51ST & 53RD & 56TH-60TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-054	54TH-55TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-062	61ST-67TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-069	68TH-70TH FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-071	71ST FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-072	72ND FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-091	3M FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-092	7M FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-093	14M FLOOR CODE ANALYSIS	1	ISSUED TO DOB	1/15/2015
A-100	PLATFORM LEVEL PLAN	2	ISSUED TO DOB	1/15/2015
A-101	GROUND FLOOR PLAN	3	ISSUED TO DOB	1/15/2015

A-102	2ND FLOOR PLAN	3	ISSUED TO DOB	1/15/2015
A-103	3RD FLOOR PLAN	3	ISSUED TO DOB	1/15/2015
A-104	4TH FLOOR PLAN	3	ISSUED TO DOB	1/15/2015
A-105	5TH FLOOR PLAN	3	ISSUED TO DOB	1/15/2015
A-106	6TH FLOOR PLAN	2	ISSUED TO DOB	1/15/2015
A-107	7TH FLOOR PLAN - MECHANICAL	2	ISSUED TO DOB	1/15/2015
A-108	8TH FLOOR PLAN - TYPICAL OFFICE	2	ISSUED TO DOB	1/15/2015
A-114	14TH FLOOR PLAN - MECHANICAL	2	ISSUED TO DOB	1/15/2015
A-115	15TH FLOOR PLAN - HOTEL AND RESIDENTIAL OFFICE	2	ISSUED TO DOB	1/15/2015
A-116	16TH FLOOR PLAN - HOTEL OFFICE	2	ISSUED TO DOB	1/15/2015
A-117	17TH FLOOR PLAN - HOTEL AND RESIDENTIAL OFFICE	2	ISSUED TO DOB	1/15/2015
A-118	18TH FLOOR PLAN - HOTEL OFFICE	2	ISSUED TO DOB	1/15/2015
A-119	19TH FLOOR PLAN - HOTEL	2	ISSUED TO DOB	1/15/2015
A-120	20TH FLOOR PLAN - HOTEL	2	ISSUED TO DOB	1/15/2015
A-121	21ST FLOOR PLAN - HOTEL	2	ISSUED TO DOB	1/15/2015
A-122	22ND - 27th FLOOR PLAN - TYPICAL HOTEL	1	ISSUED TO DOB	1/15/2015
A-128	28TH FLOOR PLAN - RESIDENTIAL	2	ISSUED TO DOB	1/15/2015
A-129	29TH FLOOR PLAN - RESIDENTIAL	2	ISSUED TO DOB	1/15/2015
A-130	30TH FLOOR PLAN - MECHANICAL	2	ISSUED TO DOB	1/15/2015
A-131	31ST FLOOR PLAN - RESIDENTIAL	2	ISSUED TO DOB	1/15/2015
A-132	32ND FLOOR PLAN - RESIDENTIAL/TERRACE LEVEL	2	ISSUED TO DOB	1/15/2015

A-133	33RD - 41ST FLOOR PLAN - TYPICAL RESIDENTIAL STACK 1	1	ISSUED TO DOB	1/15/2015
A-142	42ND FLOOR PLAN - RESIDENTIAL/TERRACE LEVEL	2	ISSUED TO DOB	1/15/2015
A-143	43RD-51ST FLOOR PLAN TYPICAL RESIDENTIAL STACK 2	1	ISSUED TO DOB	1/15/2015
A-152	52ND FLOOR PLAN - RESIDENTIAL TERRACE LEVEL	2	ISSUED TO DOB	1/15/2015
A-153	53RD & 55TH-61ST FLOOR PLAN - TYPICAL RESIDENTIAL STACK 3	2	ISSUED TO DOB	1/15/2015
A-154	54TH FLOOR PLAN - RESIDENTIAL/ FIRE PUMP	2	ISSUED TO DOB	1/15/2015
A-155	55TH FLOOR PLAN - RESIDENTIAL/ FIRE TANK	1	ISSUED TO DOB	1/15/2015
A-162	62ND FLOOR PLAN - RESIDENTIAL TERRACE LEVEL	2	ISSUED TO DOB	1/15/2015
A-163	63RD-66TH FLOOR PLAN TYPICAL RESIDENTIAL STACK 4	1	ISSUED TO DOB	1/15/2015
A-167	67TH FLOOR PLAN - RESIDENTIAL/TERRACE LEVEL	2	ISSUED TO DOB	1/15/2015
A-168	68TH FLOOR PLAN - RESIDENTIAL/TERRACE LEVEL	2	ISSUED TO DOB	1/15/2015
A-169	69TH FLOOR PLAN - RESIDENTIAL/TERRACE LEVEL	2	ISSUED TO DOB	1/15/2015
A-170	70TH FLOOR PLAN - RESIDENTIAL TERRACE LEVEL	2	ISSUED TO DOB	1/15/2015
A-171	71ST FLOOR PLAN - MECHANICAL	2	ISSUED TO DOB	1/15/2015
A-172	72ND FLOOR PLAN - MECHANICAL ROOF	2	ISSUED TO DOB	1/15/2015
A-173	ROOF PLAN	1	ISSUED TO DOB	1/15/2015
A-191	3RD FLOOR MEZZANINE PLAN - MECHANICAL	1	ISSUED TO DOB	1/15/2015
A-192	7TH FLOOR MEZZANINE PLAN - MECHANICAL	1	ISSUED TO DOB	1/15/2015
A-193	14TH FLOOR MEZZANINE PLAN - MECHANICAL	1	ISSUED TO DOB	1/15/2015
A-194	30TH FLOOR MEZZANINE PLAN - MECHANICAL	1	ISSUED TO DOB	1/15/2015
A-200	BUILDING ELEVATIONS - NORTH AND SOUTH	2	ISSUED TO DOB	1/15/2015

A-201	BUILDING ELEVATIONS - EAST AND WEST			
		2	ISSUED TO DOB	1/15/2015
A-250	OVERALL BUILDING SECTIONS			
		2	ISSUED TO DOB	1/15/2015
A-310	ENLARGED CORE PLANS			
		1	ISSUED TO DOB	1/15/2015
A-311	ENLARGED CORE PLANS			
		1	ISSUED TO DOB	1/15/2015
A-312	ENLARGED CORE PLANS			
		1	ISSUED TO DOB	1/15/2015
A-350	STAIR SECTIONS			
		1	ISSUED TO DOB	1/15/2015
A-351	STAIR SECTIONS			
		1	ISSUED TO DOB	1/15/2015
A-352	STAIR SECTIONS			
		1	ISSUED TO DOB	1/15/2015
A-353	STAIR SECTIONS			
		1	ISSUED TO DOB	1/15/2015
A-360	STAIR DETAILS			
		1	ISSUED TO DOB	1/15/2015
A-361	PHOTOLUMINESCENT MARKING DETAILS			
		1	ISSUED TO DOB	1/15/2015
A-550	PARTITION TYPES			
		1	ISSUED TO DOB	1/15/2015
A-601	HOTEL-GENERAL NOTES, ACCESSIBILITY DIAGRAMS FOR A-600-799 SERIES			
		1	ISSUED TO DOB	1/15/2015
A-602	HOTEL-GENERAL NOTES, ABBREVIATIONS, AND SYMBOLS			
		1	ISSUED TO DOB	1/15/2015
A-625	HOTEL 19TH FLOOR PLAN			
		1	ISSUED TO DOB	1/15/2015
A-626	HOTEL 20TH FLOOR PLAN			
		1	ISSUED TO DOB	1/15/2015
A-627	HOTEL 21-26TH FLOOR PLAN			
		1	ISSUED TO DOB	1/15/2015
A-628	HOTEL 27TH FLOOR PLAN			
		1	ISSUED TO DOB	1/15/2015
A-629	HOTEL 28TH & 29TH FLOOR PLAN			
		1	ISSUED TO DOB	1/15/2015
A-630	HOTEL - PARTITION TYPES			
		1	ISSUED TO DOB	1/15/2015
A-800	ARCHITECTURAL GENERAL NOTES			
		1	ISSUED TO DOB	1/15/2015

A-801	ABBREVIATIONS & SYMBOLS	1	ISSUED TO DOB	1/15/2015
A-802	ACCESSIBILITY REQUIREMENTS 1	1	ISSUED TO DOB	1/15/2015
A-803	ACCESSIBILITY REQUIREMENTS 2	1	ISSUED TO DOB	1/15/2015
A-804	ACCESSIBILITY REQUIREMENTS 3	1	ISSUED TO DOB	1/15/2015
A-805	PARTITION TYPE 1	1	ISSUED TO DOB	1/15/2015
A-806	PARTITION TYPE 2	1	ISSUED TO DOB	1/15/2015
A-807	MISCELLANEOUS DETAILS	1	ISSUED TO DOB	1/15/2015
A-808	DOOR SCHEDULES & DETAILS @ TYPICAL RESIDENTIAL FLOORS	1	ISSUED TO DOB	1/15/2015
A-809	DOOR THRESHOLD & SADDLE DETAILS @ TYPICAL RESIDENTIAL FLOORS	1	ISSUED TO DOB	1/15/2015
A-832	TYPICAL RESIDENTIAL PLAN 31-40 (5DU PER FLOOR)	1	ISSUED TO DOB	1/15/2015
A-842	TYPICAL RESIDENTIAL PLAN 41-50 (4DU PER FLOOR)	2	ISSUED TO DOB	1/15/2015
A-852	TYPICAL RESIDENTIAL PLAN 51-53 & 56-60 (3DU PER FLOOR)	1	ISSUED TO DOB	1/15/2015
A-854	TYPICAL RESIDENTIAL PLAN 54-55 (3DU PER FLOOR)	1	ISSUED TO DOB	1/15/2015
A-862	TYPICAL RESIDENTIAL PLAN 61-67 (2DU PER FLOOR)	1	ISSUED TO DOB	1/15/2015
A-869	TYPICAL RESIDENTIAL PLAN 68-70 (1DU PER FLOOR)	1	ISSUED TO DOB	1/15/2015
A-870	TYPICAL RESIDENTIAL KITCHEN LAYOUTS	1	ISSUED TO DOB	1/15/2015
A-880	TYPICAL RESIDENTIAL BATHROOM LAYOUTS	1	ISSUED TO DOB	1/15/2015

Structural

		Issue #	Description	Date
S-001	STUCTURAL SYSTEM DESCRIPTION, DESIGN CRITERIA & DRAWING LIST	2	ISSUED TO DOB	1/15/2015

S-002	TYPICAL STRUCTURAL SYMBOLS AND ABBREVIATIONS	2	ISSUED TO DOB	1/15/2015
S-003	GRID LAYOUT & WORKPOINT DEFINITIONS	2	ISSUED TO DOB	1/15/2015
S-004	STRUCTURAL CONCRETE NOTES	2	ISSUED TO DOB	1/15/2015
S-005	STRUCTURAL STEEL NOTES	3	ISSUED TO DOB	1/15/2015
S-010	LOADING DIAGRAMS	2	ISSUED TO DOB	1/15/2015
S-011	LOADING DIAGRAMS	2	ISSUED TO DOB	1/15/2015
S-012	LOADING DIAGRAMS	2	ISSUED TO DOB	1/15/2015
S-013	LOADING DIAGRAMS	2	ISSUED TO DOB	1/15/2015
S-014	LOADING DIAGRAMS	2	ISSUED TO DOB	1/15/2015
S-100	GROUND LEVEL TRANSITION FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-101	GROUND LEVEL FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-102	LEVEL 2 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-103	LEVEL 3 MEP FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-104	LEVEL 4 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-105	LEVEL 5 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-106	LEVEL 6 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-107	LEVEL 7 MEP/BELT WALL FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-108	LEVEL 8 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-109	LEVEL 9-13 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-114	LEVEL 14 MEP FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-115	LEVEL 15 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015

S-116	LEVEL 16 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-117	LEVEL 17 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-118	LEVEL 18 FRAMING PLAN	1	ISSUED TO DOB	1/15/2015
S-121	LEVEL 20TH - 28TH FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-129	LEVEL 29 FRAMING PLAN	1	ISSUED TO DOB	1/15/2015
S-130	LEVEL 30 MEP/BELT WALL FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-131	LEVEL 31 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-132	LEVEL 32-40 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-133	LEVEL 33-41 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-142	LEVEL 42 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-143	LEVEL 43-51 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-152	LEVEL 52 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-153	LEVEL 53, 56-61 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-154	LEVEL 54 FRAMING PLAN	1	ISSUED TO DOB	1/15/2015
S-155	LEVEL 55 FRAMING PLAN	1	ISSUED TO DOB	1/15/2015
S-162	LEVEL 62 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-164	LEVEL 63-66 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-167	LEVEL 67 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-168	LEVEL 68 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-169	LEVEL 69 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-170	LEVEL 70 FRAMING PLAN	2	ISSUED TO DOB	1/15/2015

S-171	LEVEL 71 MEP FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-172	LEVEL 72 MEP FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-173	ROOF PLAN	2	ISSUED TO DOB	1/15/2015
S-191	LEVEL 3 MEP MEZZ FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-192	LEVEL 7 MECH MEZZ FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-193	LEVEL 14 MEP MEZZ FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-194	LEVEL 30 MEP/BELT WALL MEZZ FRAMING PLAN	2	ISSUED TO DOB	1/15/2015
S-301	CORE WALL REINF. PLAN PLATFORM-L2	1	ISSUED TO DOB	1/15/2015
S-302	CORE WALL REIN. PLAN L2-L7	1	ISSUED TO DOB	1/15/2015
S-303	CORE WALL REINF. PLAN L7-L8	1	ISSUED TO DOB	1/15/2015
S-304	CORE WALL REINF. PLAN L8-L14M	1	ISSUED TO DOB	1/15/2015
S-305	CORE WALL REINF. PLAN L14MECH-L14 MEZZ	1	ISSUED TO DOB	1/15/2015
S-306	CORE WALL REINF. PLAN L14M-L15	1	ISSUED TO DOB	1/15/2015
S-307	CORE WALL REINF. PLAN L15-L16, L17-L19	1	ISSUED TO DOB	1/15/2015
S-308	CORE WALL REINF. PLAN L16-L17	1	ISSUED TO DOB	1/15/2015
S-309	CORE WALL REINF. PLAN L19-L28	1	ISSUED TO DOB	1/15/2015
S-310	CORE WALL REINF. PLAN L28-L30 MECH	1	ISSUED TO DOB	1/15/2015
S-311	CORE WALL REINF. PLAN L30MECH-L30 MEZZ	1	ISSUED TO DOB	1/15/2015
S-312	CORE WALL REINF. PLAN L30 MECH - L31	1	ISSUED TO DOB	1/15/2015
S-313	CORE WALL REINF. PLAN L31-L42	1	ISSUED TO DOB	1/15/2015
S-314	CORE WALL REINF. PLAN L42-L52	2	ISSUED TO DOB	1/15/2015

S-315	CORE WALL REINF. PLAN L52-L62	1	ISSUED TO DOB	1/15/2015
S-316	CORE WALL REINF. PLAN L62-L-63	1	ISSUED TO DOB	1/15/2015
S-317	CORE WALL REINF. PLAN L63-L72	1	ISSUED TO DOB	1/15/2015
S-318	CORE WALL REINF. PLAN L72-ROOF	1	ISSUED TO DOB	1/15/2015
S-351	CORE WALL 1 ELEVATION	2	ISSUED TO DOB	1/15/2015
S-352	CORE WALL 1 ELEVATION	2	ISSUED TO DOB	1/15/2015
S-353	CORE WALL 2 ELEVATION	2	ISSUED TO DOB	1/15/2015
S-354	CORE WALL 2 ELEVATION	2	ISSUED TO DOB	1/15/2015
S-355	CORE WALL 3 ELEVATION	2	ISSUED TO DOB	1/15/2015
S-356	CORE WALL 3 ELEVATION	2	ISSUED TO DOB	1/15/2015
S-357	CORE WALL 4 ELEVATION	2	ISSUED TO DOB	1/15/2015
S-358	CORE WALL 5 ELEVATION	2	ISSUED TO DOB	1/15/2015
S-359	CORE WALL 6 ELEVATION	2	ISSUED TO DOB	1/15/2015
S-360	CORE WALL 7 ELEVATION	1	ISSUED TO DOB	1/15/2015
S-361	CORE WALL 8 ELEVATION	1	ISSUED TO DOB	1/15/2015
S-362	CORE WALL 9 ELEVATION	1	ISSUED TO DOB	1/15/2015
S-363	CORE WALL 10 ELEVATION	1	ISSUED TO DOB	1/15/2015
S-371	BELT WALL ELEVATIONS 1	2	ISSUED TO DOB	1/15/2015
S-372	BELT WALL ELEVATIONS 2	2	ISSUED TO DOB	1/15/2015
S-373	BELT WALL ELEVATIONS 3	2	ISSUED TO DOB	1/15/2015
S-391	TRANSFER WALL ELEVATIONS 1	2	ISSUED TO DOB	1/15/2015

S-401	RC WALL DETAILS	2	ISSUED TO DOB	1/15/2015
S-402	RC WALL DETAILS	2	ISSUED TO DOB	1/15/2015
S-411	RC SHEAR WALL LINK BEAM SCHEDULE	2	ISSUED TO DOB	1/15/2015
S-412	RC SHEAR WALL LINK BEAM DETAILS	1	ISSUED TO DOB	1/15/2015
S-421	HAMMERHEAD COLUMN SCHEDULE & DETAILS	2	ISSUED TO DOB	1/15/2015
S-422	HAMMERHEAD COLUMN DETAILS	1	ISSUED TO DOB	1/15/2015
S-431	RC GRAVITY COLUMN SCHEDULES	2	ISSUED TO DOB	1/15/2015
S-432	RG GRAVITY COLUMN SCHEDULES	2	ISSUED TO DOB	1/15/2015
S-434	RC GRAVITY COLUMN DETAILS	2	ISSUED TO DOB	1/15/2015
S-441	RC GRAVITY BEAM SCHEDULE AND DETAILS	2	ISSUED TO DOB	1/15/2015
S-451	RC SLAB SCHEDULES & DETAILS	2	ISSUED TO DOB	1/15/2015
S-452	RC TWO WAY SLAB DETAILS	2	ISSUED TO DOB	1/15/2015
S-453	RC SLAB DETAILS	2	ISSUED TO DOB	1/15/2015
S-455	WAFFLE SLAB SCHEULDES AND DETAILS	2	ISSUED TO DOB	1/15/2015
S-456	CONCRETE STAIR TYPICAL DETAILS	1	ISSUED TO DOB	1/15/2015
S-461	GROUND FLOOR SECTIONS AND DETAILS	2	ISSUED TO DOB	1/15/2015
S-481	BELTWALL SECTIONS	1	ISSUED TO DOB	1/15/2015
S-501	TYPICAL STEEL CORE SCHEDULE AND DETAILS	3	ISSUED TO DOB	1/15/2015
S-502	TYPICAL STEEL CORE SCHEDULE AND DETAILS	3	ISSUED TO DOB	1/15/2015
S-511	TYPICAL STEEL SECTIONS AND DETAILS	2	ISSUED TO DOB	1/15/2015
S-512	TYPICAL STEEL SECTIONS AND DETAILS	1	ISSUED TO DOB	1/15/2015

S-521	MISCELLANEOUS STEEL, PARTIAL PLANS, DETAILS AND SECTIONS			
		1	ISSUED TO DOB	1/15/2015
S-531	TYPICAL METAL DECK SECTIONS AND DETAILS			
		2	ISSUED TO DOB	1/15/2015
S-601	TYPICAL METAL DECK SECTIONS AND DETAILS			
		1	ISSUED TO DOB	1/15/2015

APPENDIX B – Design Criteria

1 CODES & STANDARDS

1.1 General

The structural engineering work was performed according to the following building codes & standards:

- New York City Building Code (NYCBC), 2014
- International Building Code (IBC), 2009
- American Society of Civil Engineers, ASCE 7-10
- ACI 318, Latest Edition (Reinforced Concrete Design)
- AISC, Latest Edition (Structural Steel Design)
- AISC Design Guide

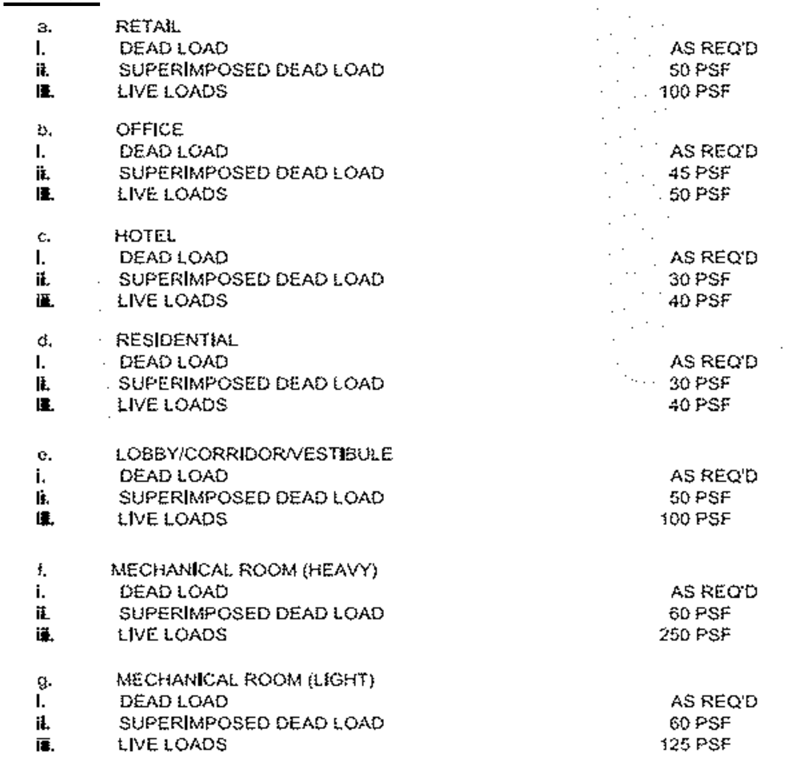
2 DESIGN LOADING CRITERIA

2.1 Gravity Uniform Loads

The gravity design loads are reflected on structural drawings S-010 to S-014.

The following uniform loads were considered:

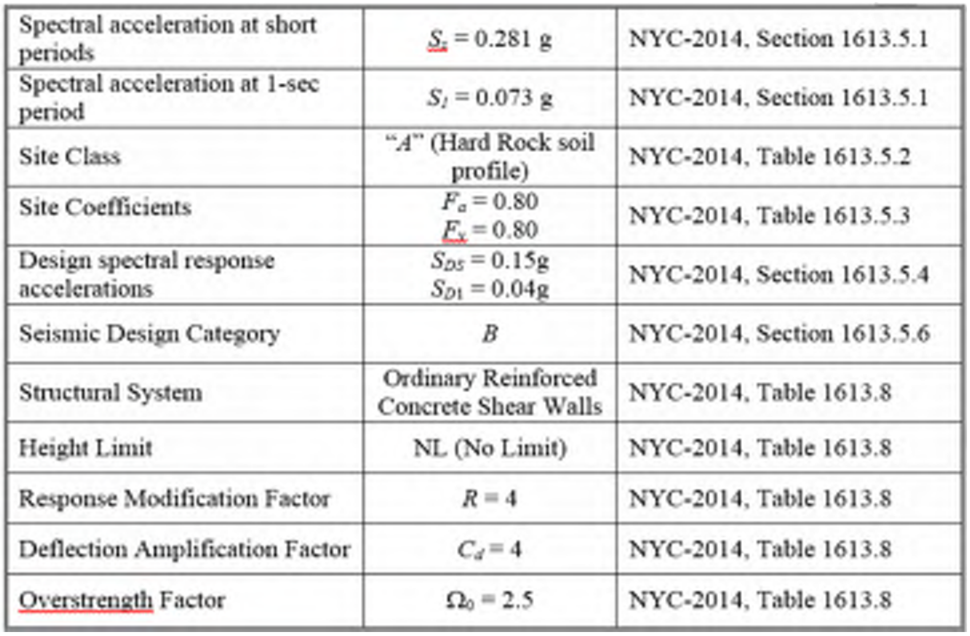
<u>**Tower:**</u>



a.	RETAIL	
i.	DEAD LOAD	AS REQ'D
ii.	SUPERIMPOSED DEAD LOAD	50 PSF
iii.	LIVE LOADS	100 PSF
b.	OFFICE	
i.	DEAD LOAD	AS REQ'D
ii.	SUPERIMPOSED DEAD LOAD	45 PSF
iii.	LIVE LOADS	50 PSF
c.	HOTEL	
i.	DEAD LOAD	AS REQ'D
ii.	SUPERIMPOSED DEAD LOAD	30 PSF
iii.	LIVE LOADS	40 PSF
d.	RESIDENTIAL	
i.	DEAD LOAD	AS REQ'D
ii.	SUPERIMPOSED DEAD LOAD	30 PSF
iii.	LIVE LOADS	40 PSF
e.	LOBBY/CORRIDOR/VESTIBULE	
i.	DEAD LOAD	AS REQ'D
ii.	SUPERIMPOSED DEAD LOAD	50 PSF
iii.	LIVE LOADS	100 PSF
f.	MECHANICAL ROOM (HEAVY)	
i.	DEAD LOAD	AS REQ'D
ii.	SUPERIMPOSED DEAD LOAD	60 PSF
iii.	LIVE LOADS	250 PSF
g.	MECHANICAL ROOM (LIGHT)	
i.	DEAD LOAD	AS REQ'D
ii.	SUPERIMPOSED DEAD LOAD	60 PSF
iii.	LIVE LOADS	125 PSF

2.2 Seismic Loads & Criteria

The seismic design parameters are documented in the design drawings as follows:



Spectral acceleration at short periods	$S_s = 0.281$ g	NYC-2014, Section 1613.5.1
Spectral acceleration at 1-sec period	$S_1 = 0.073$ g	NYC-2014, Section 1613.5.1
Site Class	"*A*" (Hard Rock soil profile)	NYC-2014, Table 1613.5.2
Site Coefficients	$F_a = 0.80$ $F_v = 0.80$	NYC-2014, Table 1613.5.3
Design spectral response accelerations	$S_{DS} = 0.15$g $S_{D1} = 0.04$g	NYC-2014, Section 1613.5.4
Seismic Design Category	*B*	NYC-2014, Section 1613.5.6
Structural System	Ordinary Reinforced Concrete Shear Walls	NYC-2014, Table 1613.8
Height Limit	NL (No Limit)	NYC-2014, Table 1613.8
Response Modification Factor	$R = 4$	NYC-2014, Table 1613.8
Deflection Amplification Factor	$C_d = 4$	NYC-2014, Table 1613.8
Overstrength Factor	$\Omega_0 = 2.5$	NYC-2014, Table 1613.8

Table 2.1 – Seismic design parameters per Schematic Design Drawings

2.3 Wind Loads

The wind loads are established via wind tunnel testing by RWDI. A report by RWDI dated November 21, 2014 indicates the following overall loads for two different surrounding conditions:

Test		Base Shear (kips)		Base Moments (ft-kips)		
Configuration	Description	Fx	Fy	My	Mx	Mz
C1	Towers A, C, D, E + existing	6,450	5,620	4,220,000	3,620,000	59,900
C2	C1 + 55 Hudson + Future	6,020	6,330	3,840,000	4,020,000	67,600

Base wind speed for NYC = 98mph per NYCBC 2014
Importance Factor on Wind Speed = 1.*0*

Table 2.2 – Base reactions from wind as per RWDI report

Figure 2.1a – Wind tunnel proximity models for test configuration C1

Figure 2.1b – Wind tunnel proximity models for test configuration C2

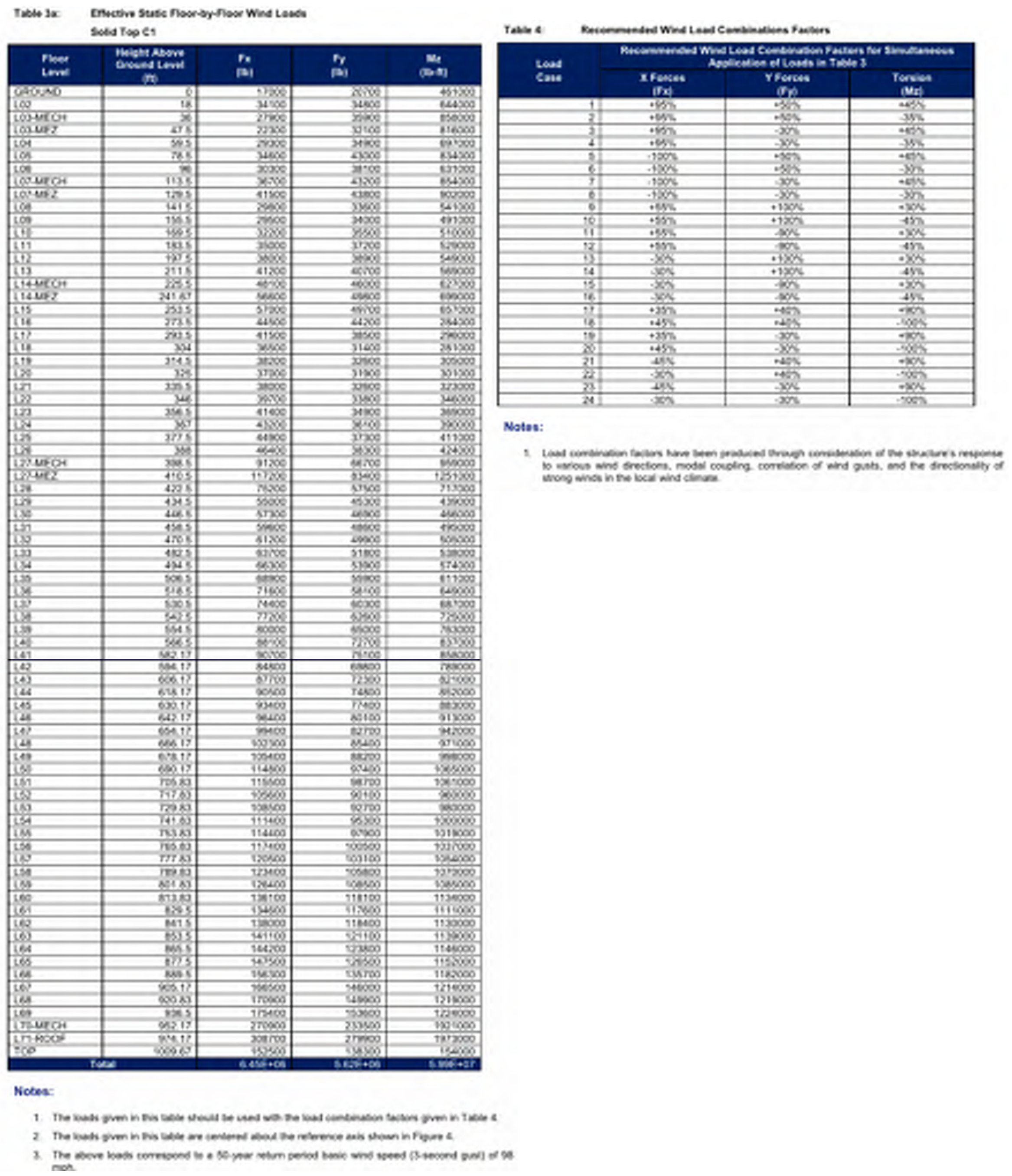


Table 3a: Effective Static Floor-by-Floor Wind Loads
Solid Top C1

Floor Level	Height Above Ground Level (ft)	Fx (lb)	Fy (lb)	Mz (lb-ft)
GROUND	0	17000	20700	461000
L02	18	34100	34800	644000
L03-MECH	36	27900	35900	858000
L03-MEZ	47.5	22300	32100	816000
L04	59.5	29300	34900	697000
L05	78.5	34600	43000	834000
L06	98	30300	38100	631000
L07-MECH	113.5	36700	43200	854000
L07-MEZ	129.5	41900	43800	902000
L08	141.5	29800	33600	541000
L09	155.5	29600	34000	491000
L10	169.5	32200	35500	510000
L11	183.5	35000	37200	529000
L12	197.5	38800	38900	549000
L13	211.5	41200	40700	569000
L14-MECH	225.5	46100	46000	627000
L14-MEZ	241.67	56600	49800	699000
L15	253.5	57000	49700	657000
L16	273.5	44500	44200	284000
L17	293.5	41500	38500	296000
L18	304	36500	31400	281000
L19	314.5	38200	32800	305000
L20	325	37300	31900	301000
L21	335.5	38000	32800	323000
L22	346	39700	33800	346000
L23	356.5	41400	34900	369000
L24	367	43200	36100	390000
L25	377.5	44800	37300	411000
L26	388	46400	38300	424000
L27-MECH	398.5	91200	66700	859000
L27-MEZ	410.5	117200	83400	1251000
L28	422.5	76200	57500	717000
L29	434.5	55000	45300	439000
L30	446.5	57300	46900	466000
L31	458.5	59600	48600	495000
L32	470.5	61200	49900	509000
L33	482.5	63700	51800	538000
L34	494.5	66300	53900	574000
L35	506.5	68900	55900	611000
L36	518.5	71600	58100	649000
L37	530.5	74400	60300	687000
L38	542.5	77200	62600	725000
L39	554.5	80000	65000	763000
L40	566.5	86100	72700	837000
L41	582.17	90700	75100	858000
L42	594.17	84800	69800	789000
L43	606.17	87700	72300	821000
L44	618.17	90500	74800	852000
L45	630.17	93400	77400	883000
L46	642.17	96400	80100	913000
L47	654.17	99400	82700	942000
L48	666.17	102300	85400	971000
L49	678.17	105400	88200	998000
L50	690.17	114800	97400	1065000
L51	705.83	115500	98700	1061000
L52	717.83	105600	90100	960000
L53	729.83	108500	92700	980000
L54	741.83	111400	95300	1000000
L55	753.83	114400	97900	1019000
L56	765.83	117400	100500	1037000
L57	777.83	120500	103100	1054000
L58	789.83	123400	105800	1072000
L59	801.83	126400	108500	1085000
L60	813.83	136100	118100	1134000
L61	829.5	134600	117600	1111000
L62	841.5	138000	118400	1130000
L63	853.5	141100	121100	1139000
L64	865.5	144200	123800	1146000
L65	877.5	147500	126500	1152000
L66	889.5	156300	135700	1182000
L67	905.17	166500	146000	1214000
L68	920.83	170900	149900	1219000
L69	936.5	175400	153600	1224000
L70-MECH	952.17	270900	233500	1921000
L71-ROOF	974.17	308700	279900	1973000
TOP	1009.67	152500	138300	154000
Total		6.45E+06	5.62E+06	5.99E+07

Notes:

1. The loads given in this table should be used with the load combination factors given in Table 4.
2. The loads given in this table are centered about the reference axis shown in Figure 4.
3. The above loads correspond to a 50-year return period basic wind speed (3-second gust) of 98 mph.

Table 4: Recommended Wind Load Combinations Factors

Load Case	Recommended Wind Load Combination Factors for Simultaneous Application of Loads in Table 3		
	X Forces (Fx)	Y Forces (Fy)	Torsion (Mz)
1	+95%	+50%	+45%
2	+95%	+50%	-35%
3	+95%	-30%	+45%
4	+95%	-30%	-35%
5	-100%	+50%	+45%
6	-100%	+50%	-30%
7	-100%	-30%	+45%
8	-100%	-30%	-30%
9	+55%	+130%	+30%
10	+55%	+130%	-45%
11	+55%	-90%	+30%
12	+55%	-90%	-45%
13	-30%	+130%	+30%
14	-30%	+130%	-45%
15	-30%	-90%	+30%
16	-30%	-90%	-45%
17	+35%	+40%	+90%
18	+45%	+40%	-100%
19	+35%	-30%	+90%
20	+45%	-30%	-100%
21	-45%	+40%	+90%
22	-30%	+40%	-100%
23	-45%	-30%	+90%
24	-30%	-30%	-100%

Notes:

1. Load combination factors have been produced through consideration of the structure's response to various wind directions, modal coupling, correlation of wind gusts, and the directionality of strong winds in the local wind climate.

Table 2.3 – Floor by floor wind loads per RWDI report for Configuration C1

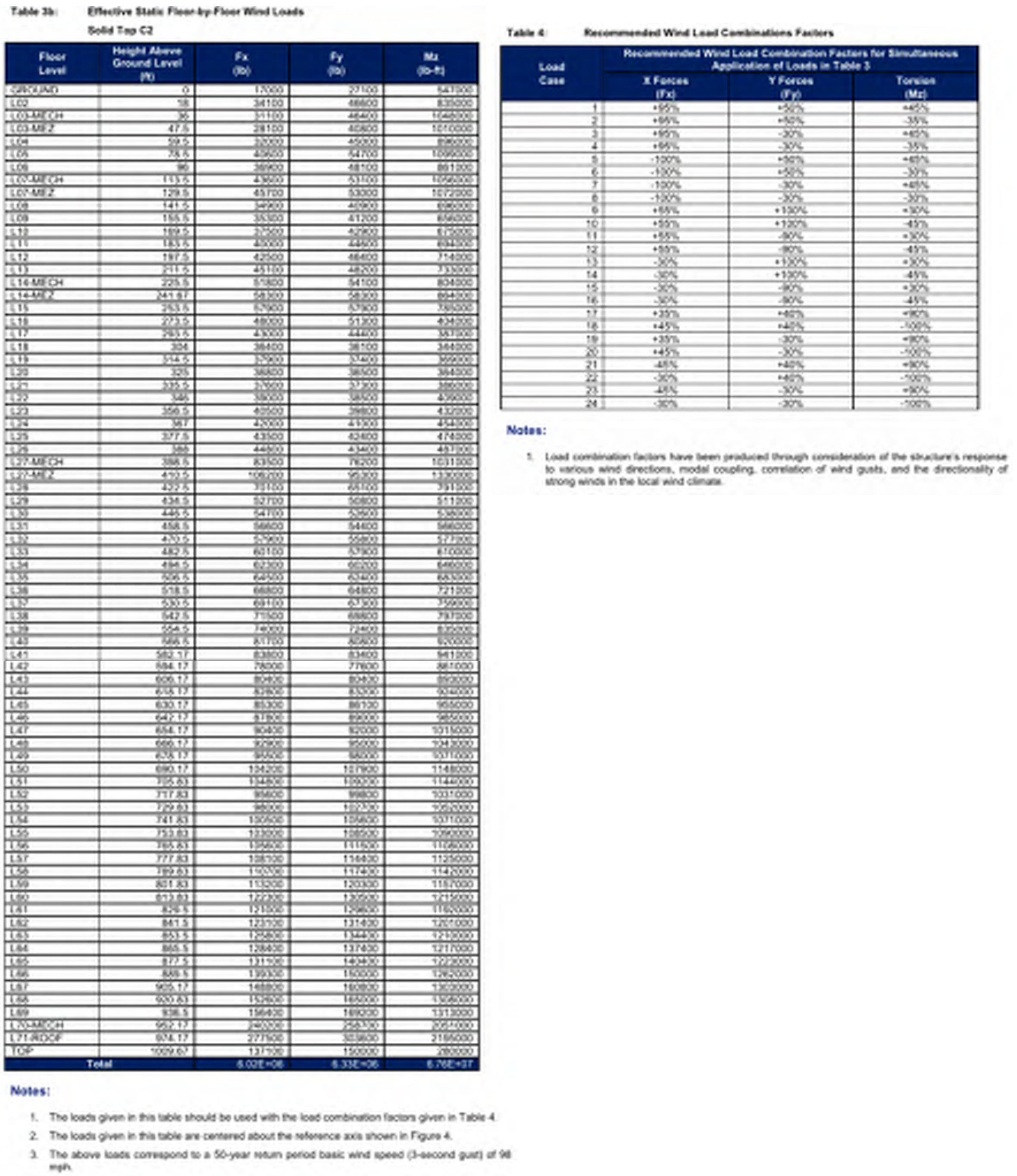


Table 3b: Effective Static Floor-by-Floor Wind Loads
Solid Top C2

Floor Level	Height Above Ground Level (ft)	Fx (lb)	Fy (lb)	Mz (lb-ft)
GROUND	0	17000	27100	547000
L02	18	34100	48800	835000
L03-MECH	36	31100	46400	1046000
L03-MEZ	47.5	28100	40800	1010000
L04	59.5	32000	45000	896000
L05	78.5	40800	54700	1099000
L06	96	36900	48100	881000
L07-MECH	113.5	43600	53100	1056000
L07-MEZ	129.5	45700	53000	1072000
L08	141.5	34900	40900	696000
L09	155.5	35300	41200	656000
L10	169.5	37500	42900	675000
L11	183.5	40000	44900	694000
L12	197.5	42500	46400	714000
L13	211.5	45100	48200	733000
L14-MECH	225.5	51800	54100	804000
L14-MEZ	241.67	58300	58300	864000
L15	253.5	57900	57900	785000
L16	273.5	48000	51300	436000
L17	285.5	43000	44400	387000
L18	304	38400	38100	344000
L19	314.5	37900	37400	359000
L20	325	38800	38500	384000
L21	335.5	37600	37300	386000
L22	346	38000	38500	439000
L23	356.5	40500	39800	432000
L24	367	42000	41000	454000
L25	377.5	43500	42400	474000
L26	388	44800	43400	497000
L27-MECH	398.5	83500	76200	1031000
L27-MEZ	410.5	106200	95300	1330000
L28	422.5	73100	65100	791000
L29	434.5	52700	50800	511000
L30	446.5	54700	52500	538000
L31	458.5	56600	54400	566000
L32	470.5	57900	55800	577000
L33	482.5	60100	57900	610000
L34	494.5	62300	60200	646000
L35	506.5	64500	62400	683000
L36	518.5	66800	64800	721000
L37	530.5	69100	67300	759000
L38	542.5	71500	69800	797000
L39	554.5	74000	72400	832000
L40	566.5	81700	80800	920000
L41	582.17	83800	83400	941000
L42	594.17	78000	77600	861000
L43	606.17	80400	80400	892000
L44	618.17	82900	83200	924000
L45	630.17	85300	86100	955000
L46	642.17	87800	89000	985000
L47	654.17	90400	92000	1015000
L48	666.17	92900	95000	1043000
L49	678.17	95500	98000	1071000
L50	690.17	104200	107900	1148000
L51	705.83	104800	109200	1144000
L52	717.83	95600	99800	1031000
L53	729.83	98000	102700	1052000
L54	741.83	100500	105600	1071000
L55	753.83	103000	108500	1090000
L56	765.83	105600	111500	1108000
L57	777.83	108100	114400	1125000
L58	789.83	110700	117400	1142000
L59	801.83	113200	120300	1157000
L60	813.83	122300	130500	1215000
L61	829.5	121000	129600	1192000
L62	841.5	123100	131400	1201000
L63	853.5	125800	134400	1210000
L64	865.5	128400	137400	1217000
L65	877.5	131100	140400	1223000
L66	889.5	139300	150000	1262000
L67	905.17	148800	160800	1302000
L68	920.83	152600	165000	1308000
L69	936.5	156400	169000	1313000
L70-MECH	952.17	240200	258700	2051000
L71-ROOF	974.17	277500	303800	2185000
TOP	1009.67	137100	150000	280000
Total		6.02E+06	6.33E+06	6.76E+07

Notes:

1. The loads given in this table should be used with the load combination factors given in Table 4.
2. The loads given in this table are centered about the reference axis shown in Figure 4.
3. The above loads correspond to a 50-year return period basic wind speed (3-second gust) of 98 mph.

Table 4: Recommended Wind Load Combinations Factors

Load Case	Recommended Wind Load Combination Factors for Simultaneous Application of Loads in Table 3		
	X Forces (Fx)	Y Forces (Fy)	Torsion (Mz)
1	+95%	+50%	+45%
2	+95%	+50%	-35%
3	+95%	-30%	+45%
4	+95%	-30%	-35%
5	-100%	+50%	+45%
6	-100%	+50%	-30%
7	-100%	-30%	+45%
8	-100%	-30%	-30%
9	+55%	+100%	+30%
10	+55%	+100%	-45%
11	+55%	-90%	+30%
12	+55%	-90%	-45%
13	-30%	+100%	+30%
14	-30%	+100%	-45%
15	-30%	-90%	+30%
16	-30%	-90%	-45%
17	+35%	+40%	+90%
18	+45%	+40%	-100%
19	+35%	-30%	+90%
20	+45%	-30%	-100%
21	-45%	+40%	+90%
22	-30%	+40%	-100%
23	-45%	-30%	+90%
24	-30%	-30%	-100%

Notes:

1. Load combination factors have been produced through consideration of the structure's response to various wind directions, modal coupling, correlation of wind gusts, and the directionality of strong winds in the local wind climate.

Table 2.4 – Floor by floor wind loads per RWDI report for Configuration C2

APPENDIX C – Wind Tunnel Report

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Hudson Yards Tower E

New York, New York

Draft Report

Wind-Induced Structural Responses

RWDI # 1300388
November 21, 2014

SUBMITTED TO	SUBMITTED BY
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Appendices

Appendix A: Wind Tunnel Procedures
Appendix B: Dynamic Properties

1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained by the Related Companies of New York, NY to study the structural wind loading and building accelerations on the proposed Hudson Yards Tower A. This report provides wind loading and acceleration results for the tower based on testing of a scale mode in the wind tunnel.

The objectives of this study were:

i. to provide wind loading information for the overall structural design; and,

ii. to determine the wind-induced accelerations at the uppermost occupied floors.

The following table summarizes relevant information about the design team, methods used, results of the study and the governing parameters:

Project Details:		
	Structural Engineer	SOM
	Architect	SOM
	Measurement Technique	High Frequency Force Balance (HFFB)
Key Results and Recommendations:		
	Coordinate System for Structural Loading	Figure 4
	Summary of Predicted Peak Overall Structural Wind Loads	Table 2
	Effective Static Floor-by-Floor Wind Loads	Table 3
	Recommended Wind Load Combinations	Table 4
	Predicted Peak Accelerations at Top Occupied Floor	Figure 6a and 6b
Selected Analysis Parameters:		
	Design Wind Speed per NYC code 2008	98 mph 3-second gust speed at 33 ft in open terrain
	Importance Factor on Wind Speed	1.0

The wind tunnel test procedures met or exceeded the requirements set out in Section 6.6 of the ASCE 7-05 Standard. The following sections outline the test methodology for the current study, and discuss the results and recommendations. Appendix A provides additional background information on the testing and analysis procedures for this type of study. For detailed explanations of the procedures and underlying theory, refer to RWDI's Technical Reference Document - Wind Tunnel Studies for Buildings (RD2-2000.1), which is available upon request.

2. WIND TUNNEL TESTS

2.1 Study Model and Surroundings

A 1:400 scale model of the proposed development was constructed using the architectural drawings listed in Table 1. The model was tested in the presence of all surroundings within a full-scale radius of 1600 ft, in RWDI's 16 ft × 10 ft boundary layer wind tunnel facility in Guelph, Ontario for the following test configurations:

Configuration 1 – Hudson Yards Tower E with existing surroundings including Hudson Yards Towers C, D and A.

Configuration 2 – Same as Configuration 1 with the inclusion of the One Hudson Tower and the Manhattan West Southwest Tower.

The scenarios above were tested with options of a solid parapet as well as a 75% solid parapet. Photographs of the wind tunnel study model are shown in Figures 1a, 1b, 1c, and 1d corresponding to test configurations 1 and 2 for the solid top and 75% solid top options. An orientation plan showing the location of the study site is given in Figure 2.

2.2 Upwind Profiles

Beyond the modelled area, the influence of the upwind terrain on the planetary boundary layer was simulated in the testing by appropriate roughness on the wind tunnel floor and flow conditioning spires at the upwind end of the working section for each wind direction. This simulation, and subsequent analysis of the data from the model, was targeted to represent the following upwind terrain conditions. Wind direction is defined as the direction from which the wind blows, measured clockwise from true north.

Upwind Terrain	Wind Directions (Inclusive)
Open \ Suburban – open water immediately upwind of the surrounding model with varying lengths of suburban terrain (i.e., many low buildings) beyond	200° to 210°
Suburban – varying lengths of open water and suburban terrain	10° ,20°, 220° to 360°
Urban- built up Manhattan core	30° to190°

3. WIND CLIMATE

In order to predict the full-scale structural responses as a function of return period, the wind tunnel data were combined with a statistical model of the local wind climate. The wind climate model was based on local surface wind measurements taken at JFK, LaGuardia, and Newark International Airports, between 1948 and 2012, and a computer simulation of hurricanes. The hurricane simulation was provided by Applied Research Associates, Raleigh, NC using the Monte Carlo Technique. ARA provided simulations both at the surface and upper levels, corresponding to heights of 33 ft and 1600 ft respectively. The difference between the two simulations which affects our predictions is the directionality of the wind climate (i.e. the relative probability that the design wind speed will occur from different directions). Based on the height of the proposed tower, the upper level simulation was used to develop the wind climate for this study, which is consistent with RWDI's earlier studies of the taller towers in this area. The meteorological and hurricane simulation data sets were analyzed to determine the probabilities of exceeding various wind speeds from within each of 36 wind sectors.

The wind climate for New York City is illustrated by the plots in Figure 3. The upper two plots show, based on the wind climate model, the relative probability that wind speeds associated with various return periods will be exceeded from each wind direction. The lower plot shows the overall wind speed as a function of return period.

For strength considerations, a 50 year return period wind velocity of 98 mph 3-second gust at a height of 33 ft in open terrain was used for our analysis. This value is consistent with that identified in the 2008 New York City Building Code.

For serviceability considerations, it is appropriate to consider a more realistic wind climate rather than the code-matched one used for strength design. This is reflected by the curve in Figure 3.

4. RESULTS AND RECOMMENDATIONS

4.1 Predicted Peak Shear Forces and Moments

The reference axis system used to define the forces and moments is illustrated in Figure 4. The overall wind-induced overturning moments, shear forces and torsional moments acting at the first floor level, “Ground”, have been predicted for the design return period and are presented for all test configurations in Table 2.

The loads were determined using the fundamental building vibration frequencies listed in Table 2, and the corresponding mode shapes provided by the structural engineer on October 27th, 2014. Appendix B contains a summary of the provided dynamic properties. The damping ratio was taken as 2% of critical.

For illustrative purposes, the overall wind-induced loads for each wind direction are presented in Figure 5. The loads in this figure are the values based on the design wind speed, assuming this wind speed applies equally to all directions. In other words, there is no allowance for the relative probability that the design wind speed will occur from different directions. This information simply illustrates the raw source data used in predicting the peak design loads.

Effective static wind loads that correspond to the predicted overall moments and shears are provided on a floor-by-floor basis in Table 3, corresponding to the worst-case test results. To account for the simultaneous action of the x, y, and torsional components in Table 3, recommended wind load combination factors are provided in Table 4. There are 24 basic combinations in the table, representing each of eight possible sign sets (+++, ++-, +-+, etc.) with each of Fx, Fy and Mz reaching their individual maximum percentages for that sign set. As an example of applying the combination factors, let us consider Load Case 1 of Table 4. This load case requires the application of +95% of the Fx, +55% of the Fy, and +40% of the Mz, Fx*, and Fy* floor-by-floor loads from Table 3. **It is recommended that all load cases be considered for overall structural design.**

The wind loads provided in this report include the effects of directionality in the local wind climate. These loads do not contain safety or load and are to be applied to the building’s structural system in the same manner as would wind loads calculated by code analytical methods.

4.2 Deflections

Deflections have not been specifically evaluated in this study. Normally the structural engineer evaluates floor-to-floor and overall deflections by applying the wind load distributions derived from the wind tunnel tests to a structural computer model of the building. These deflections may then be reviewed by the structural engineer to assess the potential for excessive shearing in wall systems and partitions.

4.3 Accelerations

The predicted wind-induced accelerations at the top occupied floor, taken as the VIP Level (1123.91 ft above “Ground” floor), are summarized in Figure 6. Figure 6 show the accelerations measured at the top occupied level floor Structural Level 69 (936 ft. above “Ground” floor).

In addition to the peak values shown in Figures 6, the peak X, Y and torsional components are also tabulated. The peak accelerations were determined as a function of return period for the provided frequencies, and an overall damping ratio of 1.5% of critical as requested by the structural engineer.

Figures 6a and 6b also present acceleration criteria from the International Organization for Standardization (ISO 10137:2007(E)), and RWDI’s suggested criteria based on different occupancies.

From Figure 6, it can be seen that the predicted accelerations exceed the ISO based residential criteria for the 1-year acceleration at Level 69 and are above the RWDI residential criteria for the 10-year acceleration. Therefore, it would be desirable to reduce the chance of occupant complaints by improving the response of the building. The use of supplemental damping could reduce the accelerations to within the criteria. It should be noted that building accelerations are a serviceability issue and typically not a safety issue, provided the associated deflections are accounted for in the structural design and the cladding/glazing system design.

4.4 Torsional Velocities

Also of interest for occupant comfort are the peak torsional velocities. The Council on Tall Buildings and Urban Habitat (CTBUH) have suggested torsional velocity limits for the 1- and 10-year return periods. **Note that these guidelines are tentative and based on limited research which is still ongoing.** The predicted torsional velocities at the top occupied floor of the tower, for the worst-case test configuration, are also shown along with the tentative criteria in Figures 6a and 6b. It can be seen that the predicted torsional velocities are within the criteria for the 1- and 10-year return period. Therefore, in our opinion the torsional velocities are acceptable for human comfort.

5. APPLICABILITY OF RESULTS

5.1 The Proximity Model

The structural wind loads and building motions determined by the wind tunnel tests and the associated analysis are applicable for the particular configurations of surrounding buildings modelled. City development over time can cause changes in the surroundings from those tested, resulting in loads and accelerations that could differ from those predicted in this report.

Changes in surroundings can be divided into two categories:

a) addition or demolition of buildings far upwind, having the effect of changing the roughness of the earth's surface and thereby changing the general wind exposure of the site; and

b) addition or demolition of buildings close to the site, which can cause changes in the local flow patterns about the study building.

Based on the past history of city developments it appears that, with respect to Category (a), development over time is far more likely to increase rather than reduce building density. This implies that the development over time would more likely diminish loads on the study building rather than increase them. With respect to Category (b), the wind tunnel tests were conducted to represent the current state of the development of the nearby surroundings, including known projects expected to be completed in the near future. If, at a later date, additional buildings besides those considered in the tested configuration are constructed near the project site, then some load changes could occur. Unless, however, a building of unusual stature is constructed nearby, the normal use of safety or load factors can be expected to cover the potential increases in structural loads. The consequence of increased motion, should it occur, is that a greater percentage of the occupants would notice the motions or find them objectionable.

5.2 Study Model and Structural Properties Information

The results presented in this report pertain to 1) the structural properties, as shown in Appendix B; and, 2) the scale model of the proposed development, constructed using the architectural information listed in Table 1; and, 3) the phasing of the proposed development, as reflected in the test configurations. Should there be any design changes that deviate substantially from the above information, the results for the revised design may differ from those presented in this report. Therefore, if the design changes, RWDI should be contacted and requested to review the impact on the wind loads and building responses.

TABLES

TABLE 1: DRAWING LIST FOR MODEL CONSTRUCTION

The drawings and information listed below were received from SOM and were used to construct the scale model of the proposed Hudson Yards Tower E. Should there be any design changes that deviate from this list of drawings, the results may change. Therefore, if changes in the design area made, it is recommended that RWDI be contacted and requested to review their potential effects on wind conditions.

File Name	File Type	Date Received (dd/mm/yyyy)
35 HY_Tower Massing_141021	Rhino 3-D Model	14/10/2014

Table 2: **Summary of Predicted Peak Overall Structural Wind Loads**

Test Configuration	Description	Moments			Shears	
		My (N-m)	Mx (N-m)	Mz (N-m)	Fx (N)	Fy (N)
C1	HYE + HYC + HYA + HY D Existing	4.22E+09	3.62E+09	5.99E+07	6.45E+06	5.62E+06
C2	C1 + 55 Hudson + Future Surround	3.84E+09	4.02E+09	6.76E+07	6.02E+06	6.33E+06

Notes:

(1) The above loads are the cumulative summation of the wind-induced loads at Structural Level 'GROUND' (i.e. grade) centered about the reference axis shown in Figure 4, exclusive of combination factors.

(2) A total damping ratio of 2.0% of critical was used for structural load calculations.

(3) The above loads are based on the structural properties as provided on October 27, 2014. The natural building frequencies were as follows:

Mode 1:	0.156 Hz	(primarily Y coupled with X)
Mode 2:	0.170 Hz	(primarily X coupled with Y)
Mode 3:	0.326 Hz	(primarily torsion).

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Table 3a: Effective Static Floor-by-Floor Wind Loads

Solid Top C1

Floor Level	Height Above Ground Level (ft)	Fx (lb)	Fy (lb)	Mz (lb-ft)
GROUND	0	17000	20700	461000
L02	18	34100	34800	644000
L03-MECH	36	27900	35900	858000
L03-MEZ	47.5	22300	32100	816000
L04	59.5	29300	34900	697000
L05	78.5	34600	43000	834000
L06	96	30300	38100	631000
L07-MECH	113.5	36700	43200	854000
L07-MEZ	129.5	41500	43800	902000
L08	141.5	29800	33600	541000
L09	155.5	29500	34000	491000
L10	169.5	32200	35500	510000
L11	183.5	35000	37200	529000
L12	197.5	38000	38900	549000
L13	211.5	41200	40700	569000
L14-MECH	225.5	48100	46000	627000
L14-MEZ	241.67	56600	49800	699000
L15	253.5	57000	49700	657000
L16	273.5	44500	44200	284000
L17	293.5	41500	38500	296000
L18	304	36500	31400	281000
L19	314.5	38200	32600	305000
L20	325	37000	31900	301000
L21	335.5	38000	32600	323000
L22	346	39700	33800	346000
L23	356.5	41400	34900	369000
L24	367	43200	36100	390000
L25	377.5	44900	37300	411000
L26	388	46400	38300	424000
L27-MECH	398.5	91200	66700	959000
L27-MEZ	410.5	117200	83400	1251000
L28	422.5	75200	57500	717000
L29	434.5	55000	45300	439000
L30	446.5	57300	46900	466000
L31	458.5	59600	48600	495000
L32	470.5	61200	49900	505000
L33	482.5	63700	51800	538000
L34	494.5	66300	53900	574000
L35	506.5	68900	55900	611000
L36	518.5	71600	58100	649000
L37	530.5	74400	60300	687000
L38	542.5	77200	62600	725000
L39	554.5	80000	65000	763000
L40	566.5	88100	72700	837000
L41	582.17	90700	75100	858000

Floor Level	Height Above Ground Level (ft)	Fx (lb)	Fy (lb)	Mz (lb-ft)
L42	594.17	84800	69800	789000
L43	606.17	87700	72300	821000
L44	618.17	90500	74800	852000
L45	630.17	93400	77400	883000
L46	642.17	96400	80100	913000
L47	654.17	99400	82700	942000
L48	666.17	102300	85400	971000
L49	678.17	105400	88200	998000
L50	690.17	114800	97400	1065000
L51	705.83	115500	98700	1061000
L52	717.83	105600	90100	960000
L53	729.83	108500	92700	980000
L54	741.83	111400	95300	1000000
L55	753.83	114400	97900	1019000
L56	765.83	117400	100500	1037000
L57	777.83	120500	103100	1054000
L58	789.83	123400	105800	1070000
L59	801.83	126400	108500	1085000
L60	813.83	136100	118100	1134000
L61	829.5	134600	117600	1111000
L62	841.5	138000	118400	1130000
L63	853.5	141100	121100	1139000
L64	865.5	144200	123800	1146000
L65	877.5	147500	126500	1152000
L66	889.5	156300	135700	1182000
L67	905.17	166500	146000	1214000
L68	920.83	170900	149900	1219000
L69	936.5	175400	153600	1224000
L70-MECH	952.17	270900	233500	1921000
L71-ROOF	974.17	308700	279900	1973000
TOP	1009.67	152500	138300	154000
Total		6.45E+06	5.62E+06	5.99E+07

Notes:

1. The loads given in this table should be used with the load combination factors given in Table 4.
2. The loads given in this table are centered about the reference axis shown in Figure 4.
3. The above loads correspond to a 50-year return period basic wind speed (3-second gust) of 98 mph.

Table 3b: Effective Static Floor-by-Floor Wind Loads

Solid Top C2

Floor Level	Height Above Ground Level (ft)	Fx (lb)	Fy (lb)	Mz (lb-ft)
GROUND	0	17000	27100	547000
L02	18	34100	46600	835000
L03-MECH	36	31100	46400	1048000
L03-MEZ	47.5	28100	40800	1010000
L04	59.5	32000	45000	896000
L05	78.5	40600	54700	1099000
L06	96	36900	48100	861000
L07-MECH	113.5	43600	53100	1056000
L07-MEZ	129.5	45700	53000	1072000
L08	141.5	34900	40900	696000
L09	155.5	35300	41200	656000
L10	169.5	37500	42900	675000
L11	183.5	40000	44600	694000
L12	197.5	42500	46400	714000
L13	211.5	45100	48200	733000
L14-MECH	225.5	51800	54100	804000
L14-MEZ	241.67	58300	58300	864000
L15	253.5	57900	57900	785000
L16	273.5	48000	51300	404000
L17	293.5	43000	44400	387000
L18	304	36400	36100	344000
L19	314.5	37900	37400	369000
L20	325	36800	36500	364000
L21	335.5	37600	37300	386000
L22	346	39000	38500	409000
L23	356.5	40500	39800	432000
L24	367	42000	41000	454000
L25	377.5	43500	42400	474000
L26	388	44800	43400	487000
L27-MECH	398.5	83500	76200	1031000
L27-MEZ	410.5	106200	95300	1330000
L28	422.5	70100	65100	791000
L29	434.5	52700	50800	511000
L30	446.5	54700	52600	538000
L31	458.5	56600	54400	566000
L32	470.5	57900	55800	577000
L33	482.5	60100	57900	610000
L34	494.5	62300	60200	646000
L35	506.5	64500	62400	683000
L36	518.5	66800	64800	721000
L37	530.5	69100	67300	759000
L38	542.5	71500	69800	797000
L39	554.5	74000	72400	835000
L40	566.5	81700	80800	920000
L41	582.17	83800	83400	941000

Floor Level	Height Above Ground Level (ft)	Fx (lb)	Fy (lb)	Mz (lb-ft)
L42	594.17	78000	77600	861000
L43	606.17	80400	80400	893000
L44	618.17	82800	83200	924000
L45	630.17	85300	86100	955000
L46	642.17	87800	89000	985000
L47	654.17	90400	92000	1015000
L48	666.17	92900	95000	1043000
L49	678.17	95500	98000	1071000
L50	690.17	104200	107900	1148000
L51	705.83	104800	109200	1144000
L52	717.83	95600	99800	1031000
L53	729.83	98000	102700	1052000
L54	741.83	100500	105600	1071000
L55	753.83	103000	108500	1090000
L56	765.83	105600	111500	1108000
L57	777.83	108100	114400	1125000
L58	789.83	110700	117400	1142000
L59	801.83	113200	120300	1157000
L60	813.83	122300	130500	1215000
L61	829.5	121000	129600	1192000
L62	841.5	123100	131400	1201000
L63	853.5	125800	134400	1210000
L64	865.5	128400	137400	1217000
L65	877.5	131100	140400	1223000
L66	889.5	139300	150000	1262000
L67	905.17	148800	160800	1303000
L68	920.83	152600	165000	1308000
L69	936.5	156400	169200	1313000
L70-MECH	952.17	240200	258700	2051000
L71-ROOF	974.17	277500	303600	2195000
TOP	1009.67	137100	150000	280000
Total		6.02E+06	6.33E+06	6.76E+07

Notes:

1. The loads given in this table should be used with the load combination factors given in Table 4.
2. The loads given in this table are centered about the reference axis shown in Figure 4.
3. The above loads correspond to a 50-year return period basic wind speed (3-second gust) of 98 mph.

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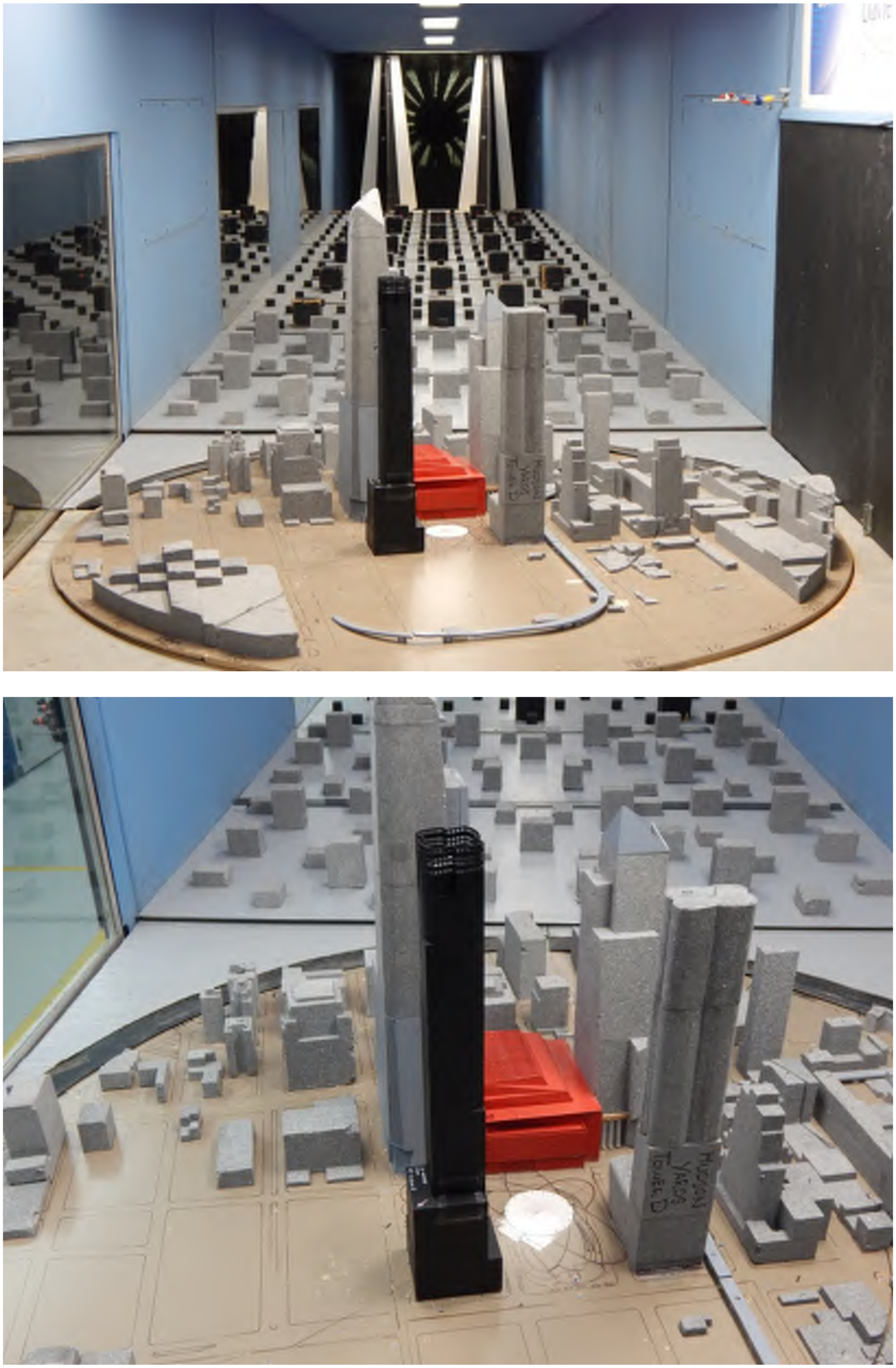
Table 4: Recommended Wind Load Combinations Factors

Load Case	Recommended Wind Load Combination Factors for Simultaneous Application of Loads in Table 3		
	X Forces (Fx)	Y Forces (Fy)	Torsion (Mz)
1	+95%	+50%	+45%
2	+95%	+50%	-35%
3	+95%	-30%	+45%
4	+95%	-30%	-35%
5	-100%	+50%	+45%
6	-100%	+50%	-30%
7	-100%	-30%	+45%
8	-100%	-30%	-30%
9	+55%	+100%	+30%
10	+55%	+100%	-45%
11	+55%	-90%	+30%
12	+55%	-90%	-45%
13	-30%	+100%	+30%
14	-30%	+100%	-45%
15	-30%	-90%	+30%
16	-30%	-90%	-45%
17	+35%	+40%	+90%
18	+45%	+40%	-100%
19	+35%	-30%	+90%
20	+45%	-30%	-100%
21	-45%	+40%	+90%
22	-30%	+40%	-100%
23	-45%	-30%	+90%
24	-30%	-30%	-100%

Notes:

1. Load combination factors have been produced through consideration of the structure’s response to various wind directions, modal coupling, correlation of wind gusts, and the directionality of strong winds in the local wind climate.

FIGURES



Wind Tunnel Study Model
25% Porous Top - Configuration 1

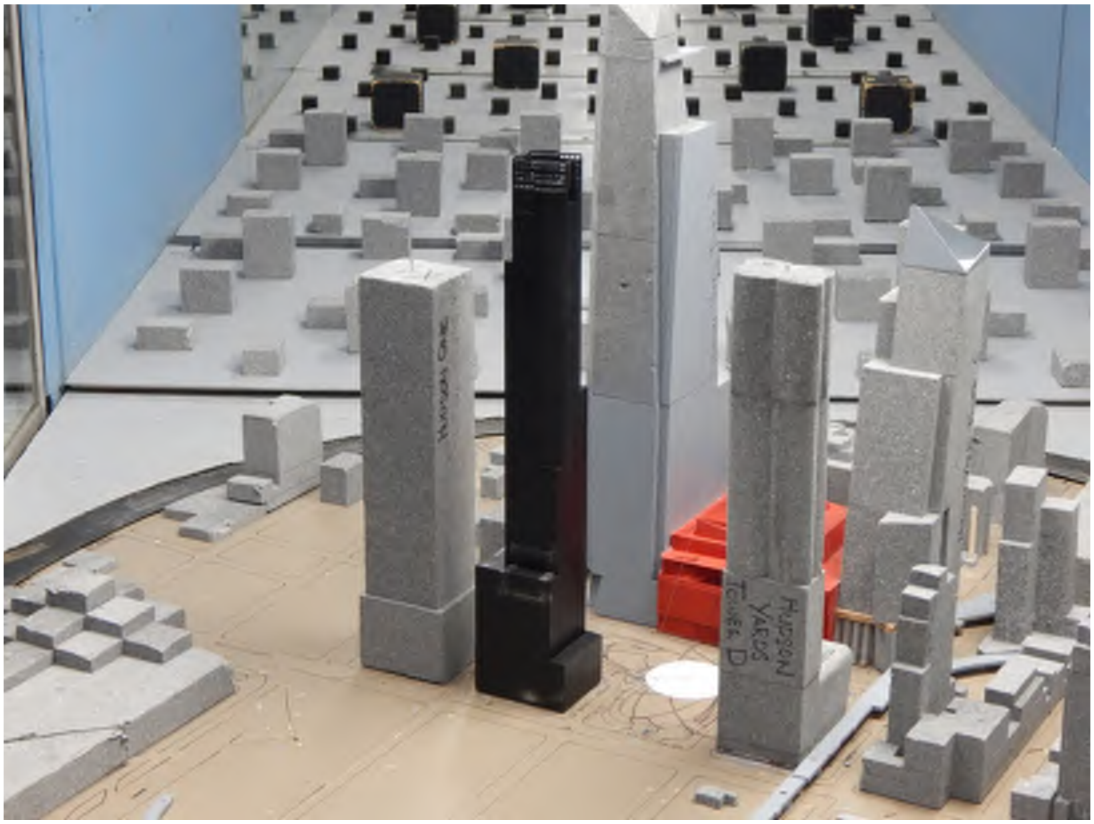
Hudson Tower E – New York City, New York

Project #1300088

Figure No. 1a

Date: Nov. 21, 2014

RWDI



Wind Tunnel Study Model
25% Porous Top - Configuration 2

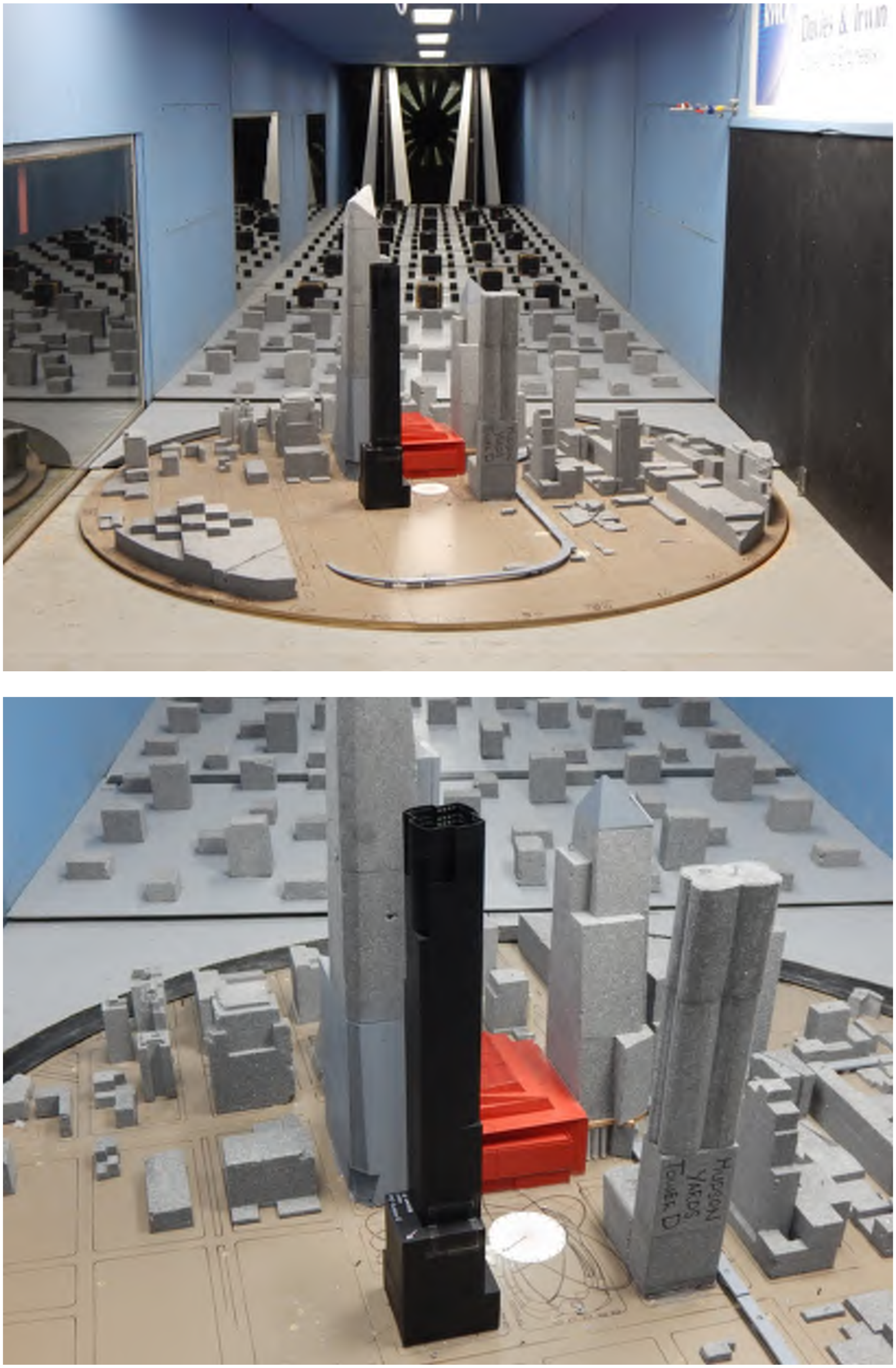
Hudson Tower E – New York City, New York

Project #1300088

Figure No. 1b

Date: Nov. 21, 2014

RWDI



Wind Tunnel Study Model
Solid Top - Configuration 1

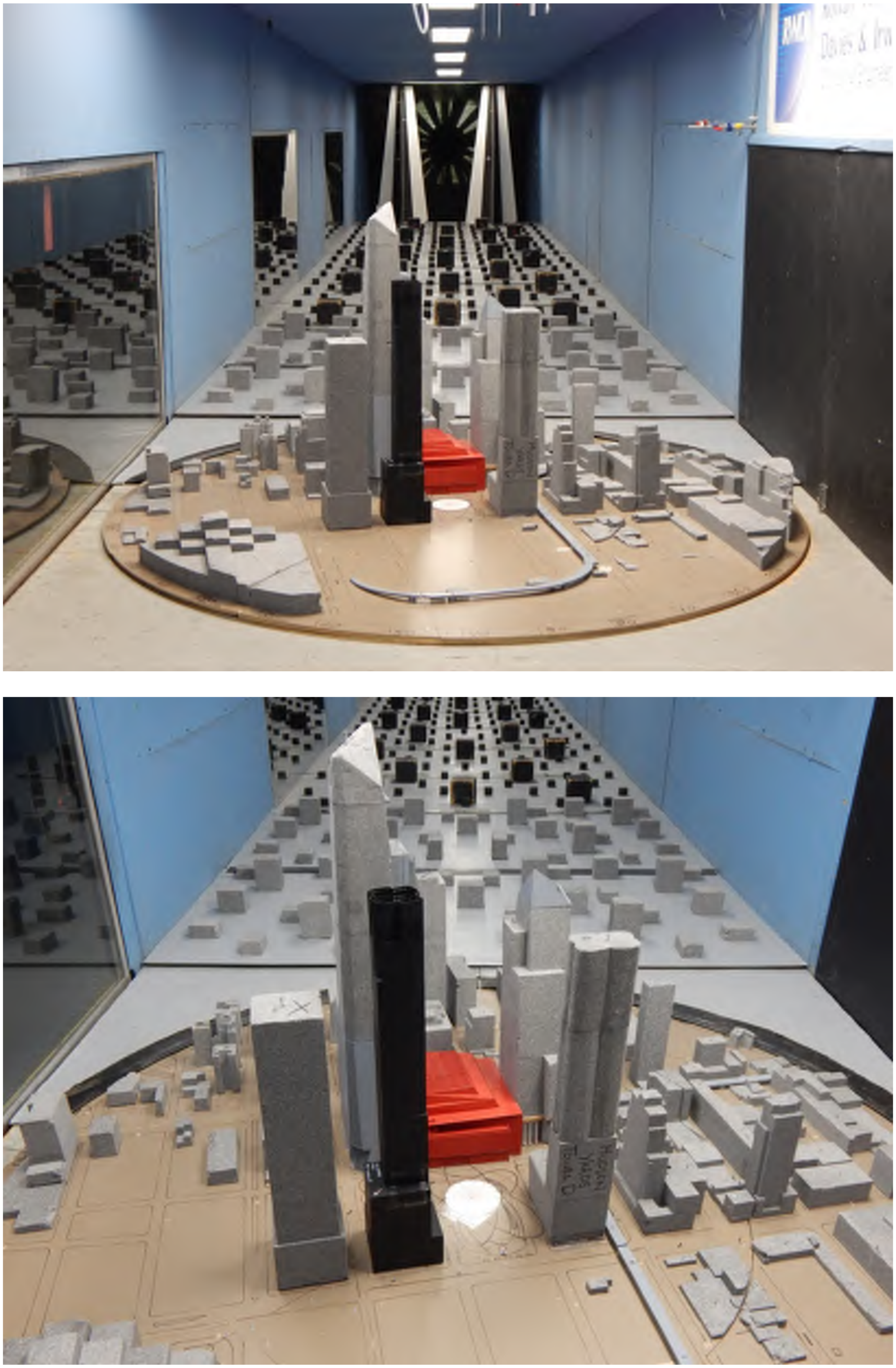
Hudson Tower E – New York City, New York

Project #1300088

Figure No. 1c

Date: Nov. 21, 2014

RWDI

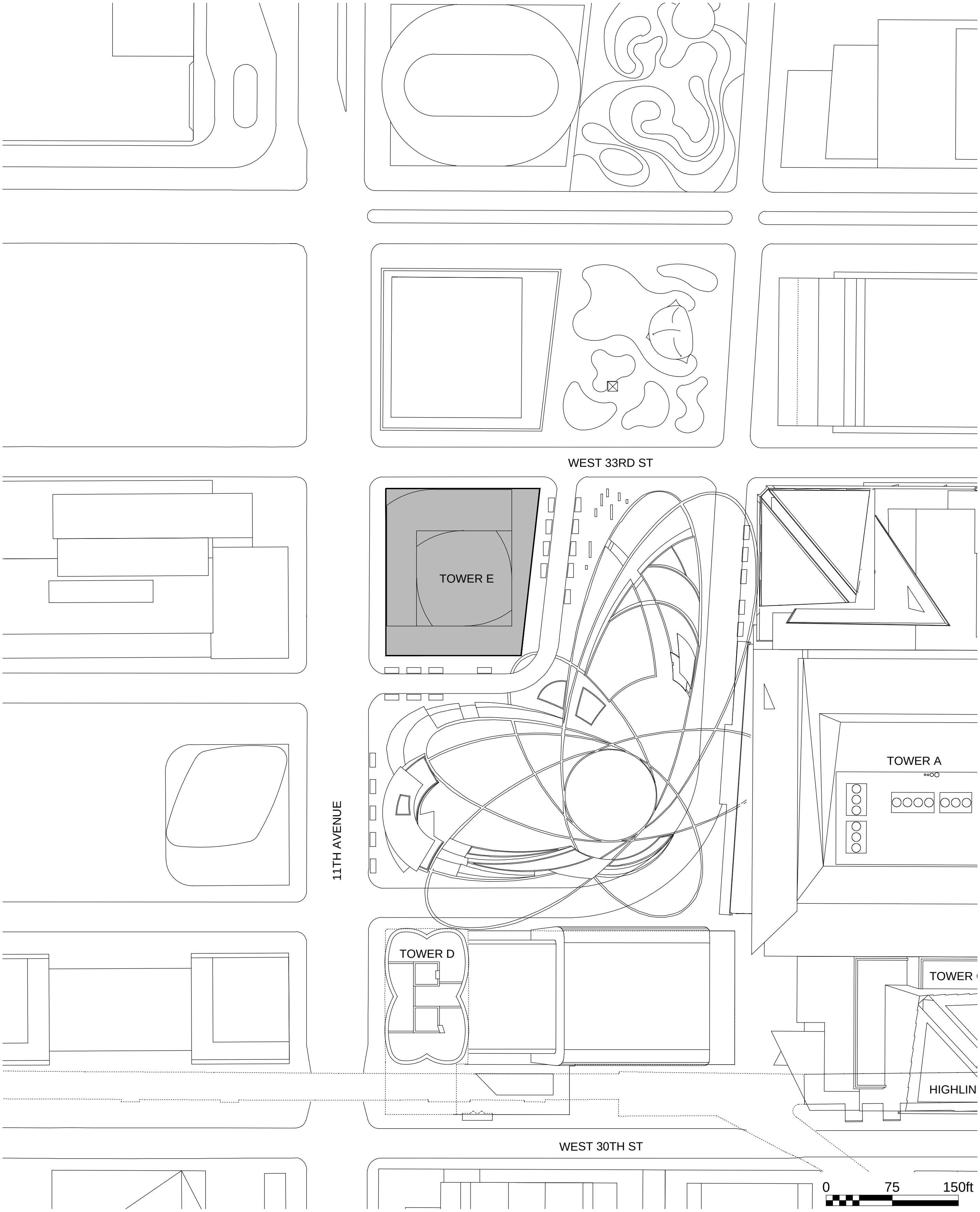


Wind Tunnel Study Model
Solid Top - Configuration 2

Hudson Tower E – New York City, New York
Project #1300088

Figure No. 1d

Date: Nov. 21, 2014



Site Plan

True North

Hudson Yards -Tower E - New York, NY

Project #1300388

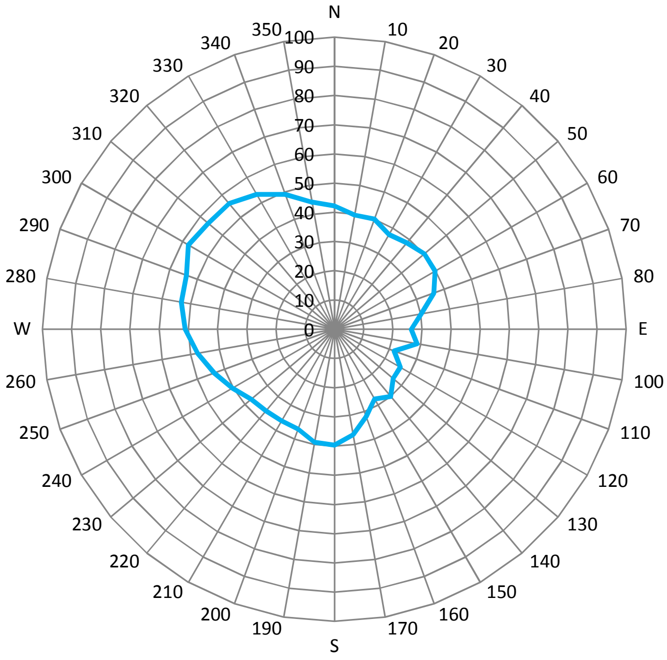
Drawn by: MDN

Figure: 2

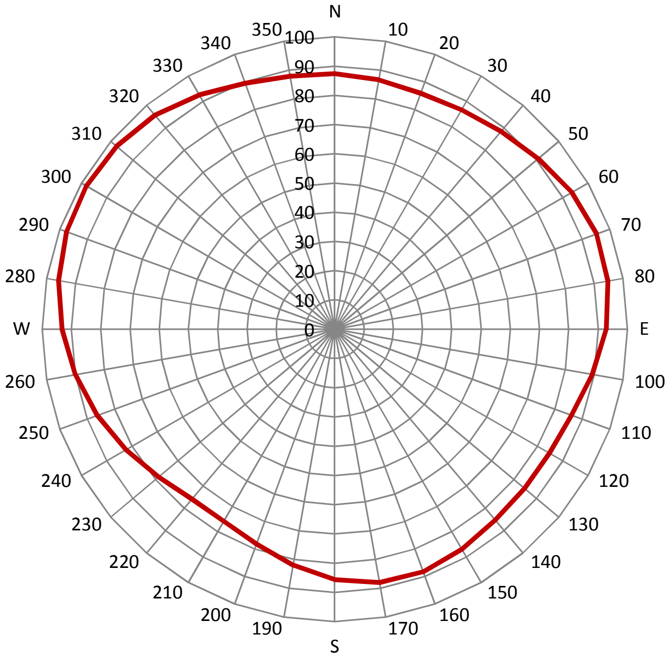
Approx. Scale: 1"=150'

Date Revised: Nov. 21, 2014

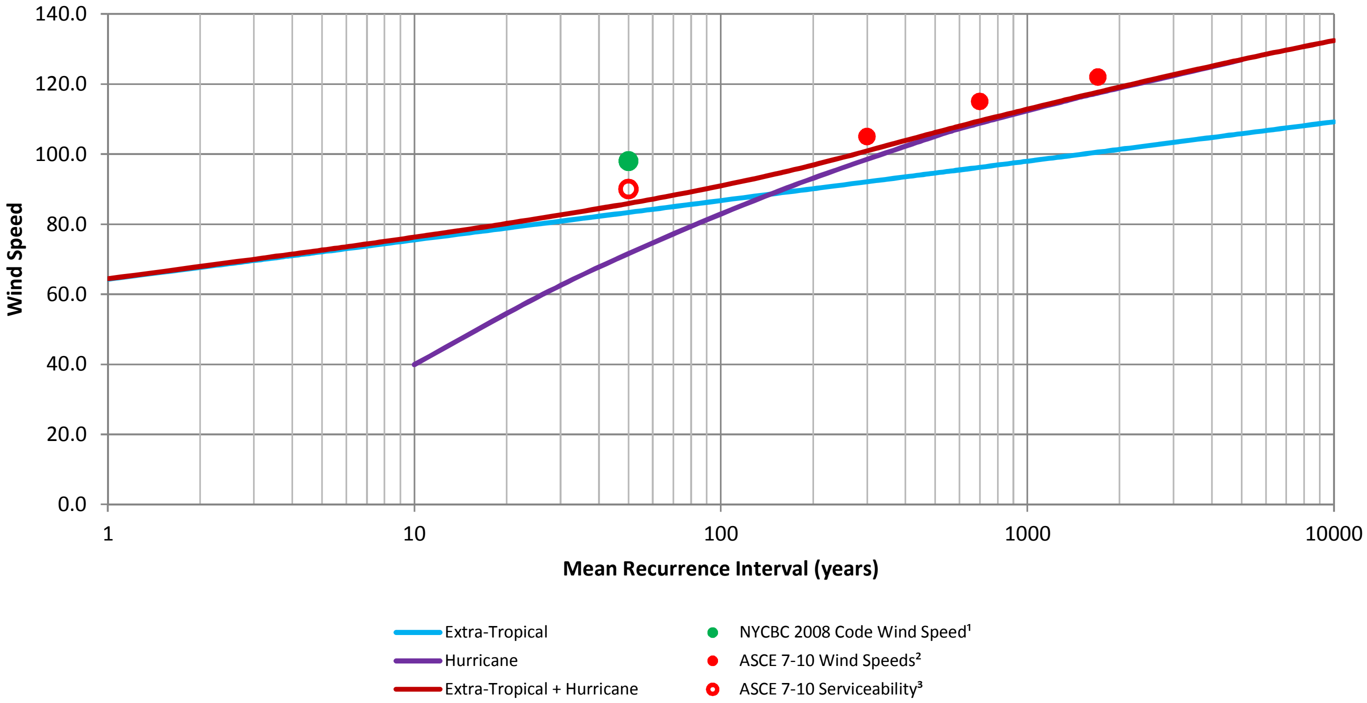
RWDI



Common Winds



Design Winds



1) 2008 Building Code, City of New York
2) ASCE 7-10, American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures, 2010
3) ASCE 7-10, American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures, Commentary C: Serviceability Considerations, 2010

Note: Wind Speeds shown are 3-second Gust Wind Speeds (mph) at 10 m height in Open Terrain

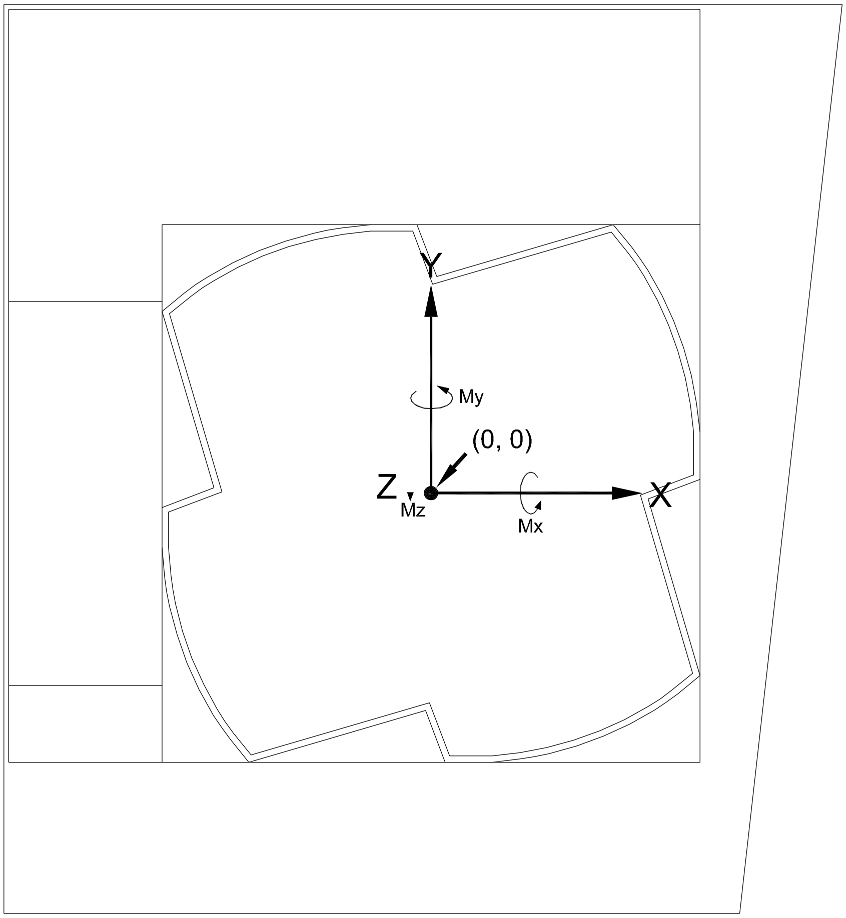
Directional Distribution of Local Wind Speeds

Figure No. 3

Hudson Yards Tower E - New York City, New York

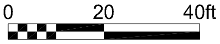
Project #1300388

Date: November 21, 2014



ROOF PLAN

Note:
Point (0,0) indicates co-ordinate origin provided by the structural engineer.



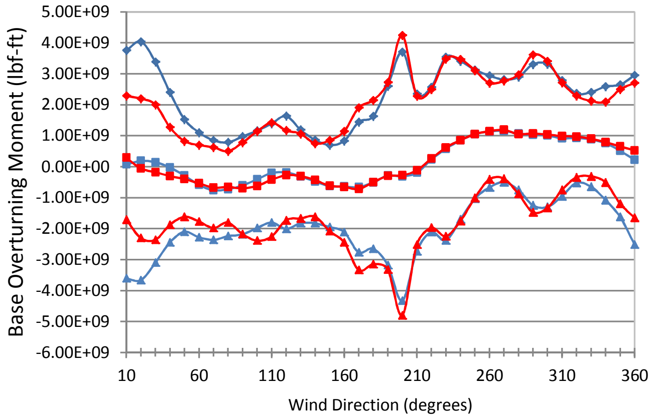
Co-ordinate System for Structural Loading

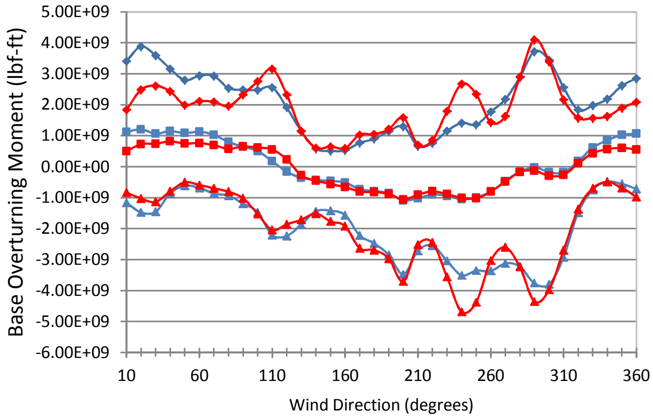
True North

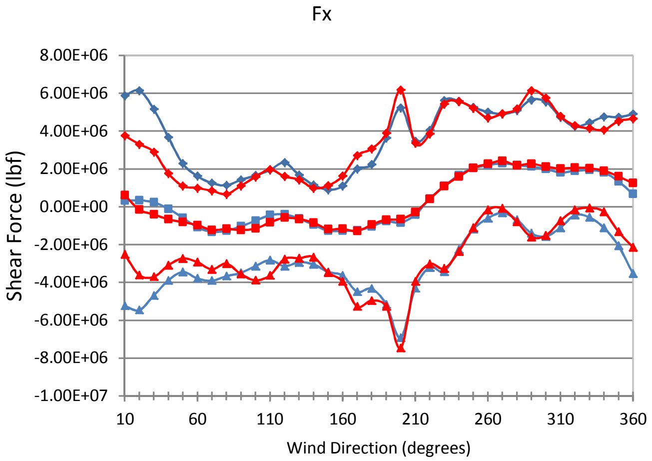
Drawn by: WNY	Figure: 4	RWDI
Approx. Scale: 1"=40'		
Date Revised: Sept 11, 2014		

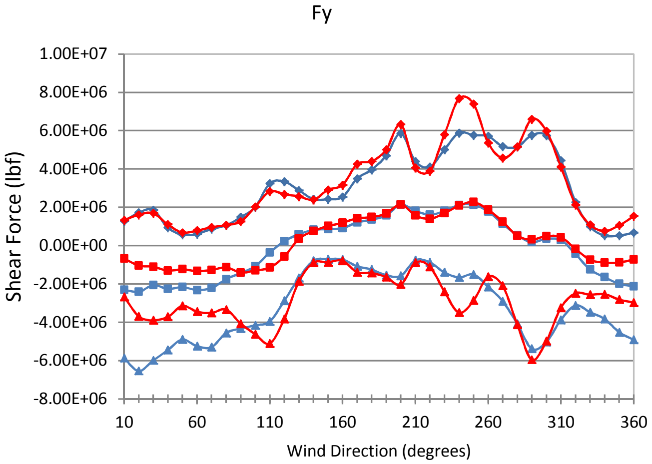
Hudson Yards Tower E - New York City, New York

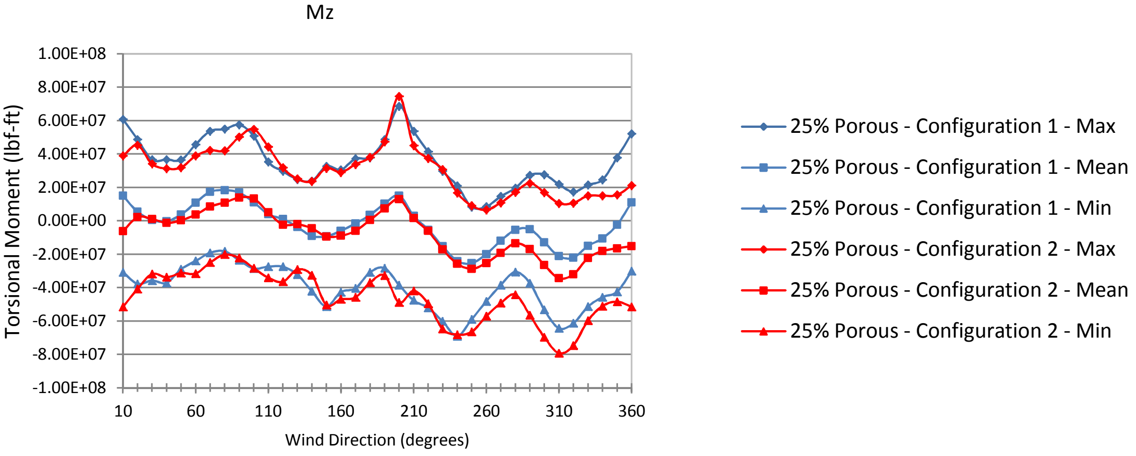
Project #1300388











Note:

1) Above loads are based on properties as provided on October 27, 2014.
The natural frequencies were as follows:

Mode 1:	0.156 Hz
Mode 2:	0.170 Hz
Mode 3:	0.326 Hz

2) A total damping ratio of 2.0% of critical was used for structural load calculations.

Raw Overall Base Moments, Shears and Torsion
at level GROUND - Maximum Values to 50 Year Return Period Wind Speed

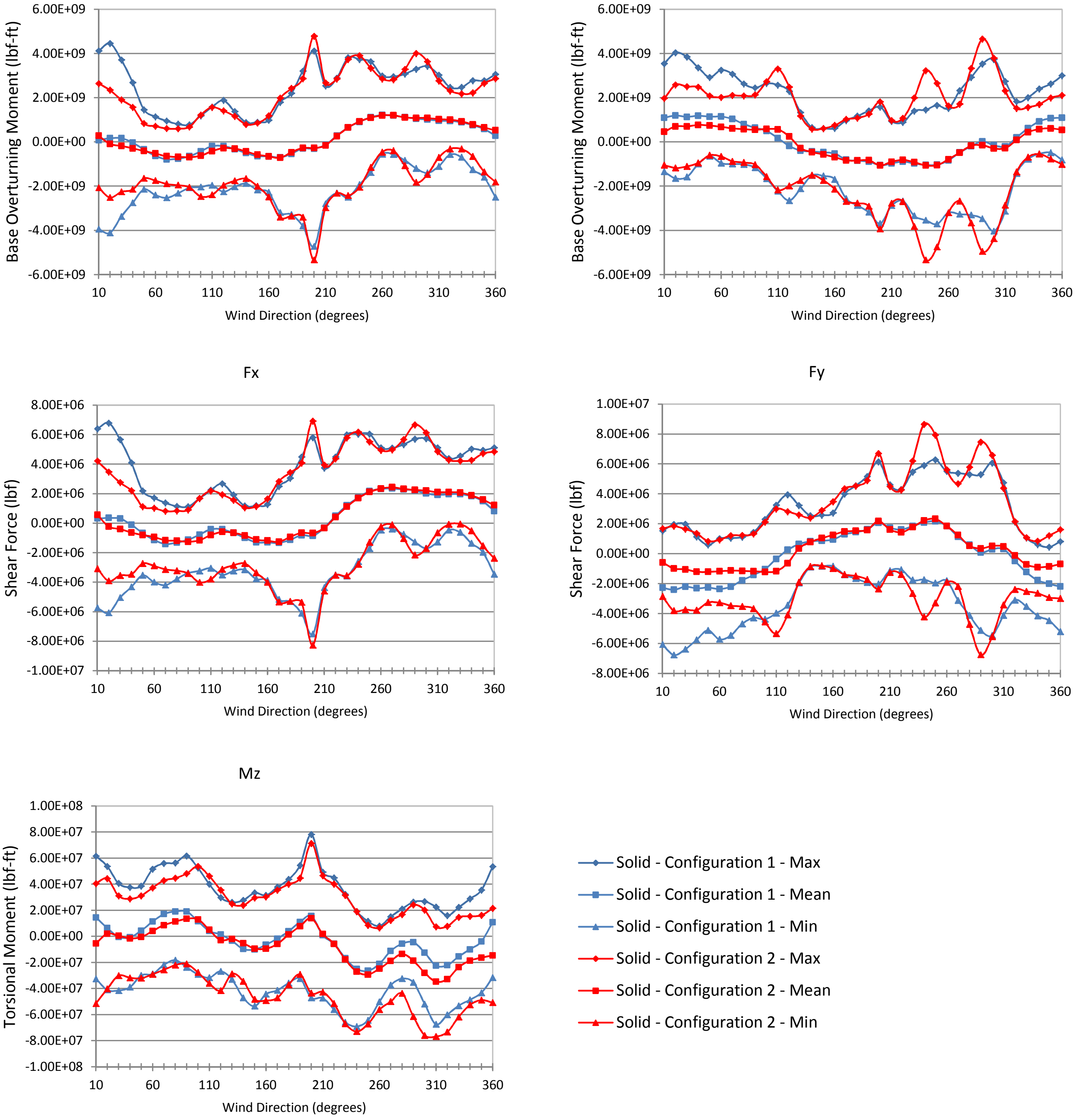
Figure No. 5a

Hudson Yards Tower E - New York City, New York

Project #1300388

Date: Nov. 21, 2014

RWDI



Note:

1) Above loads are based on properties as provided on October 27, 2014.
The natural frequencies were as follows:

Mode 1:	0.156 Hz
Mode 2:	0.170 Hz
Mode 3:	0.326 Hz

2) A total damping ratio of 2.0% of critical was used for structural load calculations.

Raw Overall Base Moments, Shears and Torsion
at level GROUND - Maximum Values to 50 Year Return Period Wind Speed

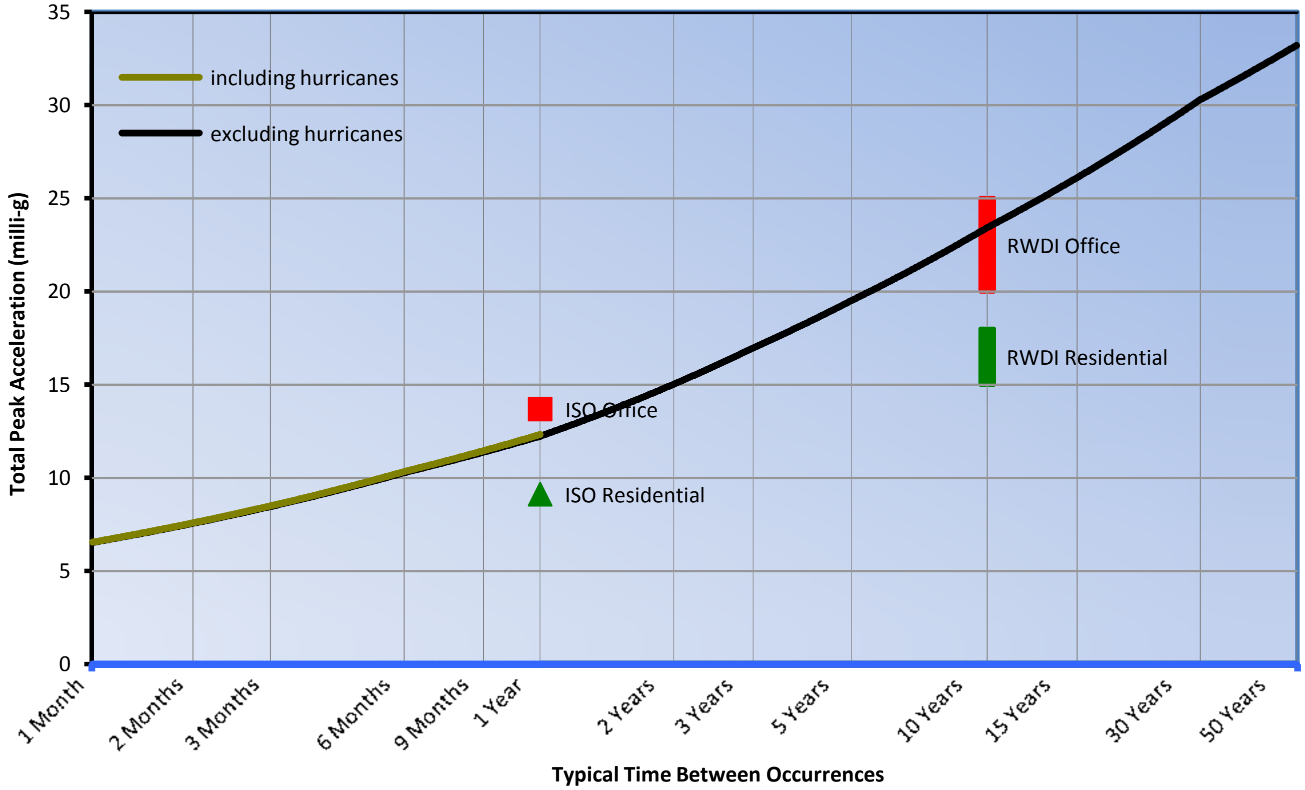
Figure No. 5b

Hudson Yards Tower E - New York City, New York

Project #1300388

Date: Nov. 21, 2014

RWDI



Return Period (Years)	Peak Accelerations[2] (milli-g) Total - [X, Y and torsional components]		Peak Torsional Velocities (milli-rads/sec)		
	without hurricanes	with [6] hurricanes	without hurricanes	with hurricanes	CTBUH[5] Criteria
1	12 - [11, 11, 1.8]	12 - [11, 11, 1.8]	0.7	0.7	1.5
5	20 - [17, 18, 2.5]	-	1.0	-	-
10	23 - [21, 21, 2.8]	-	1.1	-	3

Notes:

(1) A damping ratio of 1.75% of critical was used, along with frequencies of 0.1563, 0.1701, and 0.3257 Hz.

(2) Accelerations are predicted at Structural Level 'L69' (936 ft. above Structural Level 'GROUND') at a radial distance of 42 ft. from the central axis of the tower (given in Figure 4).

(3) ISO is the International Organization for Standardization, and the current standard (ISO 10137:2007) provides acceleration criteria for buildings at the 1-year return period. The criteria plotted on the graph have been generated based on a response-weighted interpretation of the individual modal component of the ISO criteria.

(4) RWDI's criteria for residential and office buildings are based on research, experience and surveys of existing buildings, and is in agreement with general practice in North America.

(5) The Council on Tall Buildings and Urban Habitat (CTBUH) provides tentative torsional velocity criteria for the 1- and 10-year return periods.

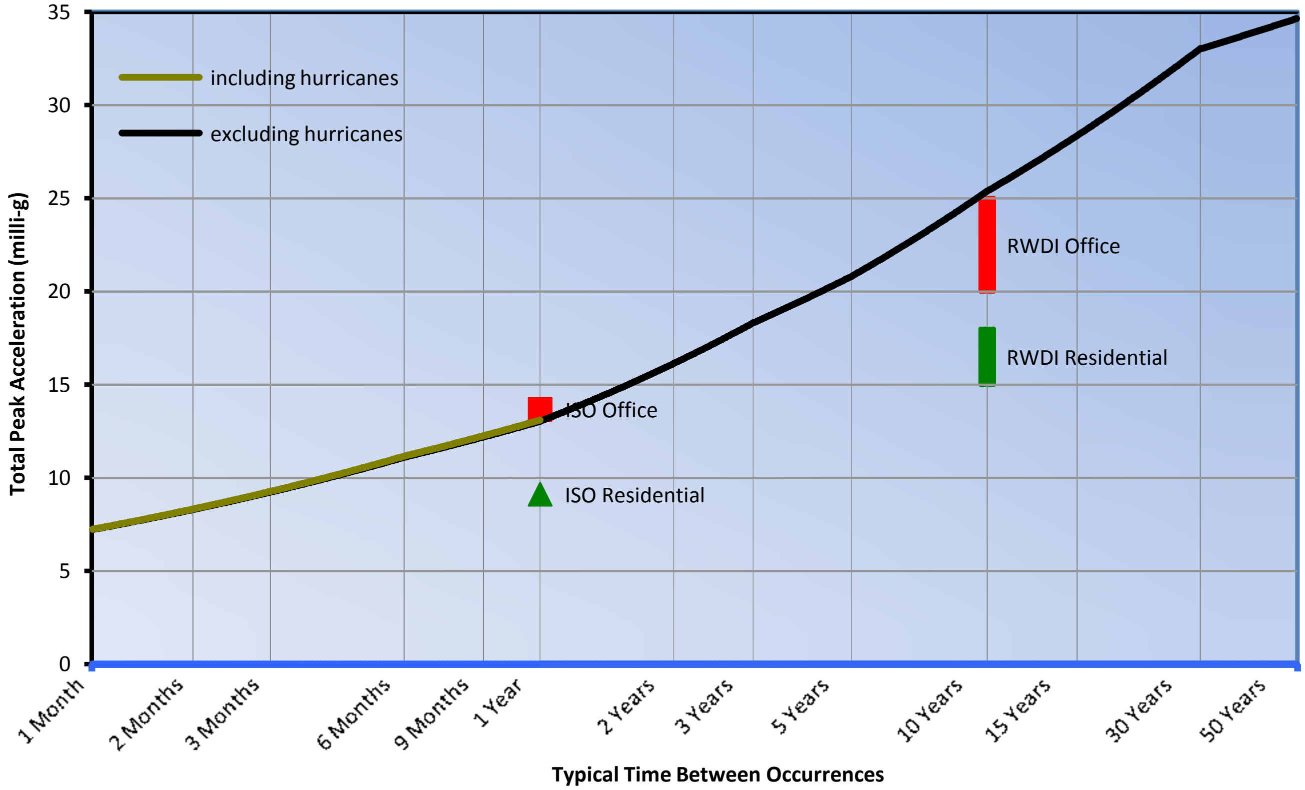
(6) With the inclusion of hurricanes, it is not appropriate to consider events beyond the 1-year return period when evaluating occupant comfort. Therefore, longer return period values with hurricanes are not provided.

Predicted Peak Accelerations and Torsional Velocities
75% Porous Parapet

Figure No. 6a

Hudson Yards Tower E - New York City, New York
Project #1300388
Date: October 31, 2014

RWDI



Return Period (Years)	Peak Accelerations(2) (milli-g) Total - [X, Y and torsional components]		Peak Torsional Velocities (milli-rads/sec)		
	without hurricanes	with (6) hurricanes	without hurricanes	with hurricanes	CTBUH(5) Criteria
1	13 - [12, 12, 2.0]	13 - [12, 12, 2.0]	0.8	0.8	1.5
5	21 - [19, 19, 2.6]	-	1.1	-	-
10	25 - [23, 22, 3.2]	-	1.3	-	3

Notes:

(1) A damping ratio of 1.75% of critical was used, along with frequencies of 0.1563, 0.1701, and 0.3257 Hz.

(2) Accelerations are predicted at Structural Level 'L69' (936 ft. above Structural Level 'GROUND') at a radial distance of 42 ft. from the central axis of the tower (given in Figure 4).

(3) ISO is the International Organization for Standardization, and the current standard (ISO 10137:2007) provides acceleration criteria for buildings at the 1-year return period. The criteria plotted on the graph have been generated based on a response-weighted interpretation of the individual modal component of the ISO criteria.

(4) RWDI's criteria for residential and office buildings are based on research, experience and surveys of existing buildings, and is in agreement with general practice in North America.

(5) The Council on Tall Buildings and Urban Habitat (CTBUH) provides tentative torsional velocity criteria for the 1- and 10-year return periods.

(6) With the inclusion of hurricanes, it is not appropriate to consider events beyond the 1-year return period when evaluating occupant comfort. Therefore, longer return period values with hurricanes are not provided.

Predicted Peak Accelerations and Torsional Velocities

Solid Parapet

Figure No. 6b

Hudson Yards Tower E - New York City, New York

Project #1300388

Date: October 31, 2014

APPENDIX A

APPENDIX A: WIND TUNNEL PROCEDURES

OVERVIEW OF WIND TUNNEL PROCEDURES FOR THE PREDICTION OF WIND-INDUCED STRUCTURAL RESPONSES

A.1 Wind Tunnel Test and Analysis Methods

A.1.1 Wind Tunnel Tests

RWDI's boundary layer wind tunnel facility simulates the mean speed profile and turbulence of the natural wind approaching the modeled area by having a long working section with a roughened floor and specially designed turbulence generators, or spires, at the upwind end. Floor roughness and spires have been selected to simulate four basic terrain conditions, ranging from open terrain, or water, to built-up urban terrain. During the tests, the upwind profile in the wind tunnel is set to represent the most appropriate of these four basic profiles, for directions with similar upwind terrain. Scaling factors are also introduced at the analysis stage to account for remaining minor differences between the expected wind speed and turbulence properties, and the basic upwind flow conditions simulated in the wind tunnel. The full-scale properties are derived using the ESDU methodology[1, 2] for predicting the effect of changes in the earth's surface roughness on the planetary boundary layer. For example, this procedure distinguishes between the flows generated by a uniform open water fetch upwind of the site, versus a short fetch of suburban terrain immediately upwind of the site with open water in the distance.

Wind direction is defined as the direction from which the wind blows in degrees measured clockwise from true north. The test model (study model and surroundings) is mounted on a turntable, allowing any wind direction to be simulated by rotating the model to the appropriate angle in the wind tunnel. The wind tunnel test is typically conducted for 36 wind directions at 10° intervals.

A.1.2 Measurement Techniques

This study addresses the horizontal wind loads on the structural system of a building, the moments produced by those loads and the horizontal accelerations of the upper part of the building. Predictions of these responses are required in order that the structural system can be designed to safely resist the wind loads and, at the same time, provide an environment in which sensations of motion by occupants do not exceed normal guidelines for comfort. In special cases, vertical wind loads can also be addressed, but they are typically not significant for tall buildings. There are two techniques, based on wind tunnel testing of rigid models that are commonly used to make these predictions. The first technique uses measurements on a base balance and the second involves the integration of simultaneous pressure measurements. In the case of structures that are unusually tall or flexible, an aeroelastic model may be used.

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[1] Wind speed profiles over terrain with roughness changes for flat or hilly sites. Item No. 84011, ESDU International London, 1984 with amendments to 1993.

[2] Longitudinal turbulence intensities over terrain with roughness changes for flat or hilly sites. Item No. 84030, ESDU International London, 1984 with amendments to 1993.

A.1.2.1 The High-Frequency Force-Balance (HFFB) Technique

The mathematical basis of the HFFB technique is the well-established modal analysis theory. The practical basis of the approach is that base moments and shears, as measured on a very rigid (hence “high-frequency”) wind tunnel model of a building, can be used to determine the wind-induced mean and dynamic loads, that can be expected to occur under given conditions. These loads can then be combined analytically with the dynamic properties of the full-scale structure to determine the wind-induced responses.

For the test, a model of the building is constructed with the aim of being as light and stiff as possible. The model is then mounted on the HFFB (Figure 1a), which consists of a stiff rectangular sway flexure mounted on top of a stiff torsional flexure. The resulting mass and stiffness of the assemblage (i.e., flexures and model) should produce sway and torsional natural frequencies well above the range of interest for the subsequent analysis. Residual dynamic amplification effects associated with the model frequencies are removed during the post-test analysis.

During the HFFB test, instantaneous overturning and torsional moments are recorded from strain gauges attached to the force-balance flexures. The sway flexure consists of two levels of strain gauges, from which the base moments may be determined at the appropriate level (e.g., grade). The instantaneous shear is computed from the difference in strain gauge readings at the two levels. The strain gauges are calibrated by applying a range of known static loads (sway and torsion) to the flexures prior to the wind tunnel tests.

For each of the test wind directions, the recorded data are analysed to obtain mean and root-mean-square (RMS) values of the base moments, shears and torsional moments. In addition, the RMS values and the power spectral density functions of the modal forces and torque acting on the building are calculated. A modal force (or torque) is the integral of the force (or torque), weighted by the modal deflection shape, over the height of the building. To calculate this from the HFFB data, the base overturning moments and shears are used to determine a linear distribution of pressure with height for each sway direction, from which a force distribution with height can then be obtained. The distribution of torque with height is predicted from a weighted average of the sway pressure distributions.

Where the project involves two or more towers that are structurally linked, the HFFB technique can be extended to these cases by use of multiple force balances recording data simultaneously. The details of the methodology for these cases may be found in Xie and Irwin[3,4].

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[3] Xie, J., and Irwin, P.A., “Application of the Force Balance Technique to a Building Complex”, Journal of Wind Engineering and Industrial Aerodynamics, Vols. 77 & 78 (1998), pg. 579-590.

[4] Xie, J., and Irwin, P.A., “Wind-Induced Response of a Twin-Tower Structure”, Wind and Structures, Vol. 4, No. 6 (2001), pg. 495-504.

A.1.2.2 The High Frequency Pressure Integration (HFPI) Technique

The mathematical basis of this technique is also the modal analysis theory. The practical basis of this approach is that wind pressure measurements, taken simultaneously over the surface of a building, can be summed (or integrated) to determine the wind-induced mean and dynamic loads, which can be expected to occur under given wind conditions. These loads can then be combined analytically with the dynamic properties of the full-scale structure to determine the wind-induced responses.

For the test, a model is constructed and instrumented with pressure taps at enough locations (Figure 1b) to fully describe the overall wind loading at any instant in time. During the testing, time series of the simultaneous pressures are recorded for post-test processing. The measured data are converted into pressure coefficients based on the measured upper level mean dynamic pressure in the wind tunnel.

During the post-test analysis, the integration is carried out to determine time series of the base moments, shears, torsional moments and modal forces. From these time series, the mean and RMS values and power spectral density functions may be determined and then the analysis proceeds in the same manner as for an HFFB study.

An advantage of the HFPI method is that it lends itself to the testing of more complex structures since the modal loads are determined directly with no assumptions necessary about the form of the pressure distribution. It also allows the overall structure to be broken down into multiple substructures and the loads on each identified separately.

A.1.2.3 Aeroelastic Model Testing

An aeroelastic model is designed to simulate the mass, stiffness and damping properties of the actual structure. The responses of the model, in the form of moments, forces, displacements and accelerations, therefore reflect the total response including the inertial loading. Because the motion of the structure is simulated, aeroelastic forces arising from the relative motion between the structure and the wind are also inherent in the measured responses. The result is a more precise prediction of the structural responses. This appendix focuses primarily on rigid model techniques, and details on aeroelastic modelling techniques may be found elsewhere[5].

A.1.3 Determination of Structural Responses

The rigid model (i.e., HFFB or HFPI) data are used to determine the modal loads for each of the 36 tested wind directions. The modal loads are then combined with the specific properties of the building, provided by the structural engineer, to determine the dynamic components of the various structural responses. These properties included the mass distribution, natural frequencies for the fundamental sway and torsional modes of vibration, and selected structural damping values. For each principal wind direction, mean, root-mean-square, maximum, and minimum values of the important overall structural loads are calculated for a range of full-scale wind speeds.

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[5] Irwin, P.A., “Model Studies of the Dynamic Response of Tall Buildings in Wind”, Proceedings, Canadian Society for Civil Engineering, 1982 Annual Conference, Edmonton, Alberta.

For assessing building motions, the quantity of interest is the total acceleration at the uppermost, occupied floors. Total acceleration is a result of two components due to the sway motions of a building, a_x and a_y and a component due to the rotational motion of the building, a_z. The rotation-induced component varies with position in the floor plan, being negligible near the center of rotation and greatest at the far corner locations. The total acceleration would therefore be greatest at such corner locations, but this would not be representative of where most occupants are likely to be. As an effective compromise between extreme options, a radial arm equivalent to the mass radius of gyration of the top occupied floor from the center of the building is typically selected by RWDI as the representative distance for calculating the rotational component.

A.1.4 Determination of Peak Factors

The RMS value of a structural response multiplied by a peak factor gives the peak dynamic value for the response. For a Gaussian process, which is the common case for the random vibrations, the peak factor can be calculated as follows:

$$g_p = \sqrt{2\ln(NT)} + \frac{0.577}{\sqrt{2\ln(NT)}}$$

where N is the average fluctuation rate and T is the duration to be considered. As the response of a tower tends to be a narrow band process (i.e., the energy of the response is highly concentrated around the tower’s natural frequency), N is approximately equal to the building’s natural frequency. When the reference wind speed is converted to a mean hourly speed, T can be taken as 3600 seconds. The peak factor calculated in this manner is used for an HFFB or HFPI analysis. Aeroelastic model tests simulate the total response and therefore allow the peak factor to be measured directly. Lower values of the peak factor are generally measured in cases where vortex-induced oscillations, or some other aerodynamic instability, are present.

A.1.5 Consideration of the Local Wind Climate

Carrying out the procedures described in the previous sections determines the structural responses to be expected at full-scale for a given set of building properties and for any given wind direction and mean wind speed. However, in order to account for the varying likelihood of different wind directions and the varying strengths of winds that may be expected from different directions, the calculated structural responses are integrated with statistical records of the local wind climate to produce predicted peak values as a function of return period. In the case of structural loads, it is appropriate to consider peak loads associated with return periods comparable to the design life of the structure. The choice of return period will be governed by local code requirements, that consider the intended use of the building, but 50 years is often used (with the appropriate load or safety factors applied) for structural design. In the case of building motions, the concern is one of occupant comfort and it is common to consider much shorter return periods, typically in the range of 1 to 10 years.

Wind records taken from one or more locations near to the study site are generally used to derive the wind climate model. In areas affected by hurricanes or typhoons, Monte Carlo simulations are typically used to generate a better database since full scale measurements, if available for a given location, typically provide an inadequate sample for statistical purposes. The data in either case are analysed to determine the probabilities of exceeding various hourly mean wind speeds from within each of 36 wind sectors at an upper level reference height, typically taken to be 600 m (2000 ft) above open terrain. This coincides with the height used to measure the reference dynamic pressure in the wind tunnel.

In order to predict the wind-induced responses for a given return period, the wind tunnel results are integrated with the wind climate model. There are two methods typically used by RWDI to perform this integration. In one method, the historical (or simulated as is the case with hurricanes or typhoons) wind record is used to determine the full-scale wind-induced responses for each hour, given the recorded wind speed and direction and the wind tunnel predictions for that direction. By stepping through the wind speed and direction data on an hour-by-hour basis, a time history of the desired response is generated. Then, through the use of extreme value fitting techniques, statistically valid peak responses for any desired return period are determined.

The second method is the Upcrossing Method as described by Irwin[6] and Irwin and Sifton[7]. In simple terms, this can be thought of as an analytical representation of the first method, in which a fitted mathematical model of the wind statistics is used in place of the detailed wind records themselves. The Upcrossing Method is currently used by RWDI for HFFB and HFPI studies of the structural loads and responses of tall buildings.

A.1.6 Design Wind Speeds in Hurricane/Typhoon Regions

It may be of interest to compare design wind speeds with the Saffir-Simpson hurricane categories, although this should be done with caution. In particular, while associating the building strength or performance with a given category of hurricane may sound appealing, it ignores the likelihood of that category of storm actually occurring at a given site. It also ignores the distinction between a direct hit from a weak hurricane compared with a glancing blow from a strong one. For this reason, when adopting criteria for both strength and serviceability, building codes and standards relate design wind speeds to return period rather than simply to storm categories or other similar systems.

The commentary to the ASCE 7-05 has a discussion in Section C6.5.4 regarding the relationship between the Basic Wind Speeds in the standard and the Saffir-Simpson scale. The Basic Wind speeds given currently in the ASCE 7 are 3-second gust speeds at 33 feet over land. The ASCE commentary also provides guidance on conversion to other wind speed durations *in the same terrain conditions*, which may be considered if the design wind speeds are taken from other sources.

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[6] Irwin, P.A., “Pressure Model Techniques for Cladding Loads”, Journal of Wind Engineering and Industrial Aerodynamics 29 (1988), pg. 69-78.

[7] Irwin, P.A. and Sifton, V. L., “Risk Considerations for Internal Pressures”, Journal of Wind Engineering and Industrial Aerodynamics, 77 & 78 (1998), pg. 715-723.

Hurricane wind speeds commonly referred to with the Saffir-Simpson scale are 1-minute averages over water. The conversion between these different averaging times and terrain conditions is complicated by the fact that the effective roughness of the sea surface varies with wind speed. The ASCE commentary (Table C6-2) provides the following approximate conversions, although they are the topic of ongoing research:

Saffir/Simpson Hurricane Category	1-minute average speed, 33 ft (10 m) over water, mph (m/s)	3-second gust speed, 33 ft (10 m) over land, mph (m/s)
1	74-95 (33.1-42.5)	82-108 (36.7-48.3)
2	96-110 (42.6-49.2)	109-130 (48.4-58.1)
3	111-130 (49.6-58.1)	131-156 (58.2-69.7)
4	131-155 (58.2-69.3)	157-191 (69.8-85.4)
5	>155 (>69.3)	>191 (>85.4)

When relating the design speed for a particular area to the above categories, it is worth considering the impact of the load factor. For example, a basic wind speed of 120 mph specified by the ASCE 7-05 corresponds to a Category 2 hurricane, as is. With the load factor of 1.6 (or 1.26 on wind speed), this corresponds to 152 mph and a Category 3 storm.

A.1.7 Determination of Wind Load Distribution with Height

The wind-induced forces generated within a building are constantly changing due to turbulence in the wind as well as the inertia of the building as it sways and twists. However, it is convenient for structural design computations to convert these fluctuating wind loads into equivalent static wind load distributions. Such wind load distributions are determined by accounting for the vertical distributions of the quasi-static and resonant components of the wind loads independently. The quasi-static wind loads essentially represent the direct wind loading on the building, which may be characterized by a mean component and a fluctuating background component. The resonant wind loads are produced by the inertial loads of the building as it oscillates in its primary modes of vibration. The distribution of the resonant forces and moments may be inferred to a good approximation from the building accelerations, mode shapes for sway and twisting motion, and from the building's mass distribution. The quasi-static loads are then determined from the difference between the overall loads and the resonant loads. The quasi-static loads are distributed based on the resulting quasi-static shear forces and overturning moments, and the building geometry.

These distributions correspond to the predicted peak overall loads in each of the two sway directions, and also in torsion. These three load distributions will not necessarily occur at the same instant in time or during the same storm and, therefore, should not be treated as simultaneous loads. Reduction factors are subsequently introduced to account for the peak design values occurring at different times. These reduction factors can be determined by a process that compares the peak overall loads in each of the two sway directions, and in the torsional direction to the building's force data measured on a direction by direction basis and factored by its meteorological directional probability. This procedure produces a set of load combinations that are simply defined and expected to provide adequate loading of all members of the primary structural system.

A.2 Discussion of Acceleration Criteria

Acceleration levels that are acceptable to people are dependent on many physiological factors and consequently are subjective to some degree. Some background to the suggested criteria for acceptability of building accelerations is discussed in this section.

As with any other response to wind loading, acceleration is a random, fluctuating quantity, which must be described in statistical terms. There are two statistics that are commonly used in the literature to describe accelerations: the root-mean-square (RMS) values and the peak. The acceleration predictions that are provided for the various return periods in this report are peak values, expected to occur a few times each hour during a windstorm.

Research indicates that people first begin to perceive accelerations when they reach about 5 milli-g (where milli-g is 1/1000 of the acceleration of gravity). However, it is not realistic to require that no accelerations ever occur above this level. In addition, there is a distinction to be made between the perception of motion, and the tolerance of it. That is, simply because occupants can perceive motion does not necessarily mean they will object to it, as long as such motions do not occur too often. Criteria have therefore been developed that relate acceleration levels and their acceptability to various frequencies of occurrence.

The first building code document to give guidance on building motions was the National Building Code of Canada (NBCC). It suggested that 10-year return period accelerations in the range of 1.0% to 3.0% of gravity (10 to 30 milli-g) were acceptable, with the upper end of the range being appropriate for office buildings and the lower end for residential buildings.

Research conducted during the development of the acceleration criteria in the NBCC indicated that peoples' sensitivity to motion becomes less as the natural frequency of the building becomes lower (at least in the range of interest for tall buildings, 0.1 Hz to 1.0 Hz). This dependence is not reflected in the NBCC, which provides a single set of criteria based on results for frequencies primarily in the range 0.15 to 0.3 Hz. The criteria suggested by the International Organization for Standardization (ISO) are expressed as a function of frequency. The upper limit of the ISO criteria is based on magnitudes of acceleration which approximately 2% of those occupying the upper third of a building may find objectionable. The ISO Criteria generally have used shorter return periods than 10 years.

ISO initially published criteria (ISO 6897:1984) based on a 5-year return period, which were expressed in terms of the RMS acceleration. The corresponding 1-year criterion was tentatively suggested by ISO to be 0.72 times the 5-year criterion. It should be noted that the ISO 6897 made reference to "buildings used for general purposes," in reference to the above criteria, with no distinction between commercial and residential occupancies as suggested in the NBCC.

In the new ISO standard (ISO 10137:2007(E) – Annex D) on building serviceability, the acceleration criteria are expressed as peak values at the 1-year return period. The expression for building frequencies ranging from .06 Hz to 1 Hz (which is the range of interest for high-rise buildings) is as follows:

$$\text{1-Year Peak Criterion in milli} - g = \text{constant x } f^{-0.445}$$

where f is the building frequency in Hz, and the constant is 6.12 for office buildings, and 4.08 for residential buildings. In other words, the residential criteria are 2/3 of the office criteria. In the absence of information to the contrary, it is assumed that the corresponding 5-year criterion can be obtained by dividing the 1-year criteria by the 0.72 factor given in ISO 6897.

In addition to the NBCC and ISO guidelines, acceleration criteria were developed based on a consensus between design teams, developers, and the wind engineering community's experience with many towers constructed and wind tunnel tested during the 1980's and 1990's. The Council on Tall Buildings and Urban Habitat (CTBUH) recommends 10-year accelerations of 10 to 15 milli-g for residential buildings and 20 to 25 milli-g for office buildings[8]. Based on discussions between RWDI and the designers of numerous high-rise towers, we have found it desirable to relax the residential criteria to a range of 15 to 18 milli-g, noting that the consequence of higher accelerations is an increased likelihood of occupant discomfort, rather than an issue of life safety. After numerous studies using this less stringent criteria[9], we are not aware of any complaints of building performance. It should be noted that these criteria, which are not expressed as functions of frequency, may not be appropriate particularly for buildings with unusually high or low frequencies. For more typical frequencies, these criteria essentially follow the trend of the ISO-derived 1-year and 5-year criteria.

A hotel will fall somewhere between office and residential buildings as far as criteria for occupant comfort are concerned, unless the upper floors are occupied by long term residents in which case the residential building criteria would apply.

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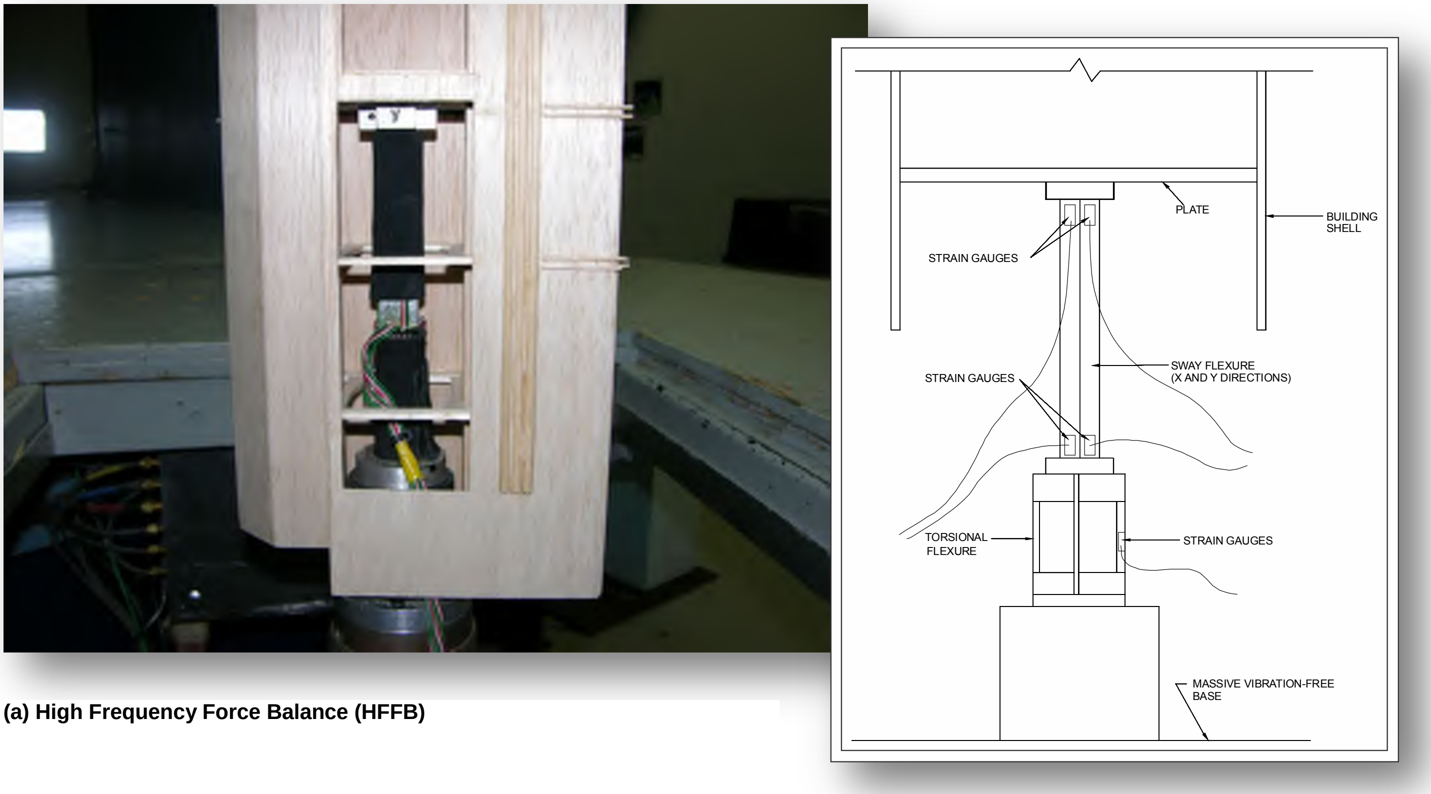
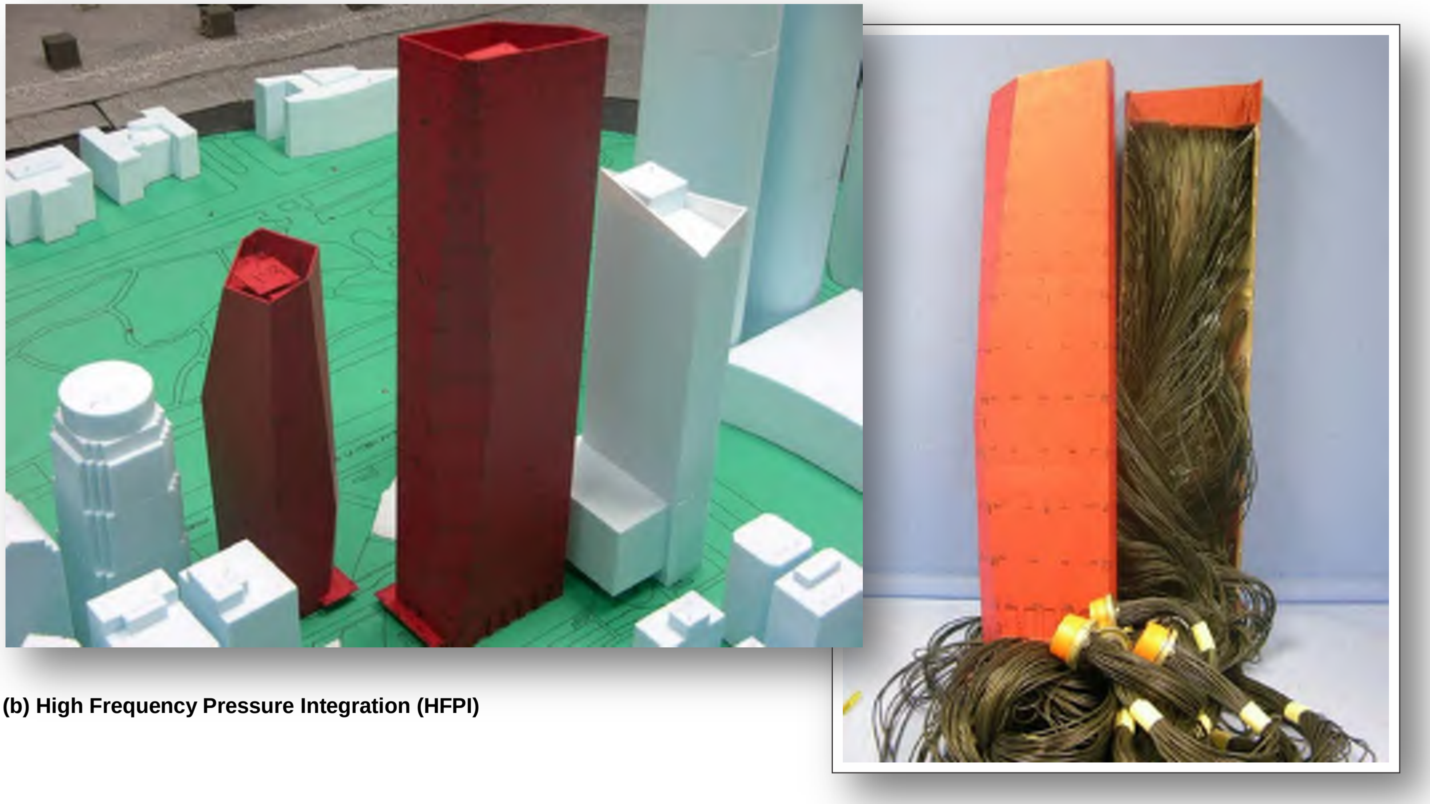
[8] Isyumov, N. "Criteria for Acceptable Wind-Induced Motions of Tall Buildings," International Conference on Tall Buildings, CTBUH, Rio De Janerio, 1993.

[9] Irwin, P. and Myslimaj, B. "Practical Experience with Wind-Tunnel Predicted Tall Building Motions" – 17-th Congress of IABSE, Chicago, September 17-19, 2008.

The above-mentioned reference, which contains the CTBUH criteria, also suggests that the North American practice of using the 10-year return period for assessing accelerations and occupant comfort is not appropriate for areas subjected to hurricanes, and recommends the 1-year return period be considered in such regions. Use of the 1-year return period is consistent with current practice in Japan, where typhoons are a significant consideration for the design of high-rise towers. If building occupants choose to remain during a hurricane, it is reasonable to suggest that they should not expect normal conditions to prevail. Furthermore, research into occupant comfort indicates that motions tend to be more tolerable as long as they are not completely unexpected. While structural modifications and/or auxiliary damping could be employed to reduce the motions during hurricanes, such measures are typically undertaken to address motions during more common wind events. Therefore, simply educating building occupants as to the likelihood of motion during stronger hurricanes might be a more appropriate way to address occupant comfort, particularly in tall slender towers.



(a) High Frequency Force Balance (HFFB)



(b) High Frequency Pressure Integration (HFPI)

Measurement Techniques for the Prediction of Wind-Induced Structural Responses

Appendix A - Wind Tunnel Procedures

Figure No. 1

Date: May 1, 2012

APPENDIX B

35 Hudson Yards

SOM Structures New York October 27 2014
FileName: 20141021 Scheme7 Stack_Res11_5_ResOpenings_Pdelta.EDB

Dynamic Properties							MODE 1 T = 6.40 s Translation			MODE 2 T = 5.88 s Translation			MODE 3 T = 3.07 s Rotation			MODE 4 T = 1.99 s Translation			MODE 5 T = 1.56 s Translation			MODE 6 T = 1.37 s Rotation		
Level	Floor Height (ft)	Elevation (ft)	Dynamic Mass (kips)	Dynamic MMI (kip-ft^2)	Center of Mass (X) (ft)	Center of Mass (Y) (ft)	UX (ft)	UY (ft)	RZ (rad)	UX (ft)	UY (ft)	RZ (rad)	UX (ft)	UY (ft)	RZ (rad)	UX (ft)	UY (ft)	RZ (rad)	UX (ft)	UY (ft)	RZ (rad)	UX (ft)	UY (ft)	RZ (rad)
TOP	0.00	1009.67	25	10,335	1.71	0.79	-0.00319	0.00711	1.870E-07	0.00677	0.00315	5.487E-06	0.00102	-0.00017	-1.386E-04	0.00077	-0.00694	-1.200E-07	-0.00813	-0.00123	-2.006E-05	0.00214	-0.00095	-8.304E-05
L71-ROOF	35.50	974.17	145	241,672	0.66	0.16	-0.00301	0.00672	2.220E-07	0.00641	0.00297	5.503E-06	0.00081	-0.00003	-1.382E-04	0.00065	-0.00591	-4.410E-07	-0.00682	-0.00097	-1.991E-05	0.00165	-0.00070	-8.220E-05
L70-MECH	22.00	952.17	135	242,481	0.39	0.07	-0.00291	0.00648	2.490E-07	0.00619	0.00286	5.511E-06	0.00072	0.00000	-1.379E-04	0.00058	-0.00526	-6.950E-07	-0.00601	-0.00082	-1.971E-05	0.00138	-0.00058	-8.125E-05
L69	15.67	936.50	89	153,687	-2.46	-2.05	-0.00283	0.00630	2.810E-07	0.00604	0.00276	5.510E-06	0.00037	0.00039	-1.375E-04	0.00052	-0.00479	-9.530E-07	-0.00546	-0.00066	-1.935E-05	0.00102	-0.00028	-8.020E-05
L68	15.67	920.83	89	153,687	-2.46	-2.05	-0.00275	0.00612	3.260E-07	0.00588	0.00269	5.502E-06	0.00032	0.00038	-1.369E-04	0.00047	-0.00432	-1.284E-06	-0.00487	-0.00056	-1.881E-05	0.00084	-0.00022	-7.885E-05
L67	15.67	905.17	89	153,687	-2.46	-2.05	-0.00267	0.00595	3.810E-07	0.00572	0.00261	5.492E-06	0.00027	0.00037	-1.363E-04	0.00041	-0.00385	-1.675E-06	-0.00428	-0.00046	-1.816E-05	0.00067	-0.00016	-7.719E-05
L66	15.67	889.50	86	151,059	-2.63	-2.13	-0.00259	0.00577	4.460E-07	0.00556	0.00253	5.480E-06	0.00021	0.00038	-1.355E-04	0.00035	-0.00337	-2.112E-06	-0.00370	-0.00037	-1.740E-05	0.00049	-0.00009	-7.523E-05
L65	12.00	877.50	84	148,462	-2.81	-2.26	-0.00253	0.00563	4.990E-07	0.00544	0.00247	5.470E-06	0.00016	0.00040	-1.349E-04	0.00030	-0.00301	-2.462E-06	-0.00327	-0.00030	-1.678E-05	0.00036	-0.00004	-7.350E-05
L64	12.00	865.50	84	148,462	-2.81	-2.26	-0.00247	0.00550	5.540E-07	0.00532	0.00241	5.460E-06	0.00012	0.00039	-1.341E-04	0.00025	-0.00264	-2.817E-06	-0.00284	-0.00024	-1.614E-05	0.00024	0.00000	-7.155E-05
L63	12.00	853.50	84	148,462	-2.81	-2.26	-0.00241	0.00536	6.100E-07	0.00520	0.00235	5.452E-06	0.00009	0.00037	-1.332E-04	0.00021	-0.00229	-3.165E-06	-0.00242	-0.00019	-1.550E-05	0.00013	0.00003	-6.932E-05
L62	12.00	841.50	84	148,462	-2.81	-2.26	-0.00235	0.00523	6.620E-07	0.00508	0.00230	5.442E-06	0.00006	0.00036	-1.322E-04	0.00016	-0.00193	-3.477E-06	-0.00202	-0.00014	-1.484E-05	0.00002	0.00007	-6.672E-05
L61	12.00	829.50	83	147,613	-0.22	-1.27	-0.00229	0.00509	6.990E-07	0.00496	0.00225	5.426E-06	0.00017	0.00001	-1.309E-04	0.00011	-0.00159	-3.681E-06	-0.00162	-0.00015	-1.419E-05	0.00000	-0.00006	-6.350E-05
L60	15.67	813.83	86	152,737	-0.34	-1.95	-0.00222	0.00492	6.720E-07	0.00481	0.00218	5.357E-06	0.00005	0.00001	-1.290E-04	0.00005	-0.00116	-3.418E-06	-0.00115	-0.00012	-1.329E-05	-0.00014	0.00001	-5.867E-05
L59	12.00	801.83	83	148,650	-0.42	-1.86	-0.00216	0.00478	6.480E-07	0.00469	0.00213	5.278E-06	0.00005	0.00002	-1.274E-04	0.00001	-0.00084	-3.156E-06	-0.00079	-0.00011	-1.237E-05	-0.00019	0.00006	-5.454E-05
L58	12.00	789.83	83	148,650	-0.42	-1.86	-0.00210	0.00465	6.230E-07	0.00458	0.00208	5.184E-06	0.00003	0.00001	-1.256E-04	-0.00003	-0.00052	-2.871E-06	-0.00044	-0.00010	-1.130E-05	-0.00024	0.00011	-5.015E-05
L57	12.00	777.83	83	148,650	-0.42	-1.86	-0.00204	0.00451	5.970E-07	0.00446	0.00202	5.077E-06	0.00002	0.00000	-1.236E-04	-0.00007	-0.00021	-2.571E-06	-0.00009	-0.00009	-1.013E-05	-0.00029	0.00016	-4.553E-05
L56	12.00	765.83	83	148,650	-0.42	-1.86	-0.00198	0.00438	5.720E-07	0.00435	0.00197	4.962E-06	0.00001	0.00000	-1.216E-04	-0.00011	0.00009	-2.264E-06	0.00024	-0.00007	-8.888E-06	-0.00033	0.00020	-4.072E-05
L55	12.00	753.83	83	148,650	-0.42	-1.86	-0.00193	0.00425	5.470E-07	0.00423	0.00192	4.842E-06	0.00000	-0.00001	-1.194E-04	-0.00015	0.00039	-1.953E-06	0.00056	-0.00006	-7.606E-06	-0.00037	0.00025	-3.576E-05
L54	12.00	741.83	83	148,650	-0.42	-1.86	-0.00187	0.00411	5.200E-07	0.00412	0.00187	4.721E-06	-0.00001	-0.00001	-1.172E-04	-0.00018	0.00068	-1.638E-06	0.00087	-0.00004	-6.325E-06	-0.00040	0.00029	-3.066E-05
L53	12.00	729.83	83	148,650	-0.42	-1.86	-0.00181	0.00398	4.910E-07	0.00400	0.00181	4.605E-06	-0.00002	-0.00002	-1.148E-04	-0.00022	0.00096	-1.320E-06	0.00117	-0.00002	-5.094E-06	-0.00043	0.00032	-2.547E-05
L52	12.00	717.83	83	148,650	-0.42	-1.86	-0.00176	0.00385	4.560E-07	0.00389	0.00176	4.501E-06	-0.00002	-0.00002	-1.124E-04	-0.00025	0.00124	-9.960E-07	0.00144	0.00000	-3.977E-06	-0.00046	0.00036	-2.021E-05
L51	12.00	705.83	93	167,890	-1.69	-1.05	-0.00170	0.00372	4.090E-07	0.00378	0.00170	4.426E-06	0.00005	0.00011	-1.099E-04	-0.00028	0.00150	-6.600E-07	0.00170	0.00003	-3.108E-06	-0.00047	0.00041	-1.496E-05
L50	15.67	690.17	96	173,808	-2.15	-0.89	-0.00163	0.00355	3.320E-07	0.00364	0.00163	4.347E-06	0.00006	0.00015	-1.064E-04	-0.00031	0.00182	-1.810E-07	0.00198	0.00007	-2.196E-06	-0.00050	0.00044	-7.939E-06
L49	12.00	678.17	91	167,830	-2.15	-0.79	-0.00158	0.00343	2.760E-07	0.00353	0.00158	4.273E-06	0.00006	0.00014	-1.036E-04	-0.00033	0.00206	1.920E-07	0.00219	0.00010	-1.426E-06	-0.00051	0.00046	-2.415E-06
L48	12.00	666.17	91	167,830	-2.15	-0.79	-0.00152	0.00330	2.230E-07	0.00342	0.00152	4.187E-06	0.00006	0.00013	-1.007E-04	-0.00035	0.00228	5.530E-07	0.00239	0.00013	-5.830E-07	-0.00053	0.00047	3.120E-06
L47	12.00	654.17	91	167,830	-2.15	-0.79	-0.00147	0.00318	1.750E-07	0.00332	0.00147	4.091E-06	0.00005	0.00012	-9.768E-05	-0.00037	0.00249	8.960E-07	0.00258	0.00016	3.240E-07	-0.00053	0.00048	8.627E-06
L46	12.00	642.17	91	167,830	-2.15	-0.79	-0.00142	0.00305	1.310E-07	0.00321	0.00142	3.987E-06	0.00004	0.00011	-9.457E-05	-0.00039	0.00269	1.220E-06	0.00275	0.00019	1.281E-06	-0.00054	0.00048	1.407E-05
L45	12.00	630.17	91	167,830	-2.15	-0.79	-0.00137	0.00293	9.000E-08	0.00311	0.00137	3.877E-06	0.00004	0.00010	-9.137E-05	-0.00041	0.00287	1.524E-06	0.00292	0.00022	2.271E-06	-0.00055	0.00048	1.942E-05
L44	12.00	618.17	91	167,830	-2.15	-0.79	-0.00132	0.00281	5.300E-08	0.00301	0.00132	3.763E-06	0.00003	0.00009	-8.810E-05	-0.00043	0.00304	1.809E-06	0.00307	0.00024	3.275E-06	-0.00055	0.00048	2.465E-05
L43	12.00	606.17	91	167,830	-2.15	-0.79	-0.00127	0.00270	1.800E-08	0.00291	0.00127	3.648E-06	0.00003	0.00008	-8.478E-05	-0.00045	0.00319	2.072E-06	0.00321	0.00026	4.275E-06	-0.00055	0.00048	2.972E-05
L42	12.00	594.17	91	167,848	-2.15	-0.79	-0.00122	0.00258	-1.500E-08	0.00281	0.00122	3.537E-06	0.00002	0.00007	-8.142E-05	-0.00046	0.00333	2.312E-06	0.00333	0.00028	5.248E-06	-0.00055	0.00047	3.457E-05
L41	12.00	582.17	100	190,368	-1.08	0.31	-0.00117	0.00247	-3.800E-08	0.00270	0.00118	3.445E-06	0.00010	-0.00002	-7.808E-05	-0.00048	0.00345	2.492E-06	0.00344	0.00031	6.142E-06	-0.00059	0.00050	3.913E-05
L40	15.67	566.50	102	196,625	-0.81	0.82	-0.00110	0.00233	-1.000E-09	0.00258	0.00113	3.360E-06	0.00013	-0.00005	-7.362E-05	-0.00050	0.00357	2.487E-06	0.00356	0.00032	7.184E-06	-0.00062	0.00050	4.476E-05
L39	12.00	554.50	97	188,659	-0.82	0.85	-0.00106	0.00223	2.800E-08	0.00248	0.00108	3.276E-06	0.00012	-0.00005	-7.009E-05	-0.00051	0.00365	2.510E-06	0.00364	0.00033	8.009E-06	-0.00062	0.00048	4.893E-05
L38	12.00	542.50	97	188,659	-0.82	0.85	-0.00101	0.00213	5.800E-08	0.00239	0.00104	3.183E-06	0.00011	-0.00006	-6.652E-05	-0.00052	0.00371	2.537E-06	0.00371	0.00034	8.819E-06	-0.00062	0.00047	5.286E-05
L37	12.00	530.50	97	188,659	-0.82	0.85	-0.00096	0.00203	8.800E-08	0.00230	0.00100	3.086E-06	0.00010	-0.00006	-6.292E-05	-0.00053	0.00376	2.567E-06	0.00377	0.00034	9.601E-06	-0.00062	0.00045	5.654E-05
L36	12.00	518.50	97	188,659	-0.82	0.85	-0.00092	0.00193	1.160E-07	0.00220	0.00096	2.984E-06	0.00009	-0.00007	-5.932E-05	-0.00053	0.00380	2.600E-06	0.00381	0.00035	1.034E-05	-0.00061	0.00043	5.994E-05
L35	12.00	506.50	97	188,659	-0.82	0.85	-0.00087	0.00184	1.440E-07	0.00212	0.00092	2.880E-06	0.00009	-0.00008	-5.574E-05	-0.00054	0.00383	2.636E-06	0.00385	0.00035	1.104E-05	-0.00060	0.00041	6.303E-05
L34	12.00	494.50	97	188,659	-0.82	0.85	-0.00083	0.00175	1.700E-07	0.00203	0.00088	2.776E-06	0.00008	-0.00008	-5.221E-05	-0.00054	0.00384	2.672E-06	0.00386	0.00036	1.167E-05	-0.00059	0.00039	6.579E-05
L33	12.00	482.50	97	188,659	-0.82	0.85	-0.00079	0.00166	1.930E-07	0.00194	0.00085	2.672E-06	0.00008	-0.00009	-4.878E-05	-0.00054	0.00385	2.708E-06	0.00387	0.00036	1.224E-05	-0.00057	0.00036	6.821E-05
L32	12.00	470.50	97	189,541	-0.82	0.85	-0.00075	0.00158	2.120E-07	0.00186	0.00081	2.570E-06	0.00007	-0.00009	-4.547E-05	-0.00053	0.00384	2.741E-06	0.00387	0.00037	1.272E-05	-0.00056	0.00034	7.027E-05
L31	12.00	458.50	98	199,158	-0.10	0.02	-0.00071	0.00150	2.250E-07	0.00178	0.00078	2.471E-06	0.00003	-0.00013	-4.237E-05	-0.00053	0.00383	2.769E-06	0.00386	0.00038	1.312E-05	-0.00048	0.00037	7.194E-05
L30	12.00	446.50	98	200,519	0.04	-0.11	-0.00068	0.00143	2.280E-07	0.00171	0.00075	2.377E-06	0.00003	-0.00013	-3.955E-05	-0.00052	0.00381	2.792E-06	0.00384	0.00039	1.342E-05	-0.00045	0.00035	7.321E-05
L29	12.00	434.50	98	200,519	0.04	-0.11	-0.00065	0.00136	2.160E-07	0.00163	0.00072	2.292E-06	0.00002	-0.00013	-3.711E-05	-0.00051	0.00377	2.805E-06	0.00380	0.00039	1.361E-05	-0.00043	0.00033	7.407E-05
L28	12.00	422.50	145	350,162	-0.03	-0.11	-0.00062	0.00130	2.020E-07	0.00156	0.00069	2.244E-06	0.00002	-0.00013	-3.556E-05	-0.00050	0.00374	2.802E-06	0.00375	0.00039	1.368E-05	-0.00041	0.00031	7.444E-05
L27-MEZ	12.00	410.50	241	621,370	-0.05	-0.25	-0.00059	0.00125	2.030E-07	0.00149	0.00066	2.243E-06	0.00001	-0.00014	-3.551E-05	-0.00048	0.00370	2.802E-06	0.00370	0.00040	1.368E-05	-0.00039	0.00029	7.444E-05
L27-MECH	12.00	398.50	195	474,913	-0.05	-0.37	-0.00056	0.00120	2.020E-07	0.00143	0.00064	2.242E-06	0.00000	-0.00014	-3.546E-05	-0.00047	0.00366	2.800E-06	0.00365	0.00040	1.368E-05	-0.00036	0.00028	7.442E-05
L26	10.50	388.00	99	209,526	0.01	-0.61	-0.00054	0.00115	1.850E-07	0.00137	0.00062	2.210E-06	-0.00002	-0.00014	-3.454E-05	-0.00046	0.00361	2.720E-06	0.00360	0.00040	1.363E-05	-0.00033	0.00026	7.390E-05
L25	10.50	377.50	99	211,698	0.01	-0.61	-0.00051	0.00110	1.580E-07	0.00131	0.00059	2.157E-06	-0.00002	-0.00014	-3.307E-05	-0.00045	0.00356	2.576E-06	0.00354	0.00041	1.353E-05	-0.00031	0.00024	7.296E-05
L24	10.50	367.00	99	211,698	0.01	-0.61	-0.00049	0.00105	1.270E-07	0.00126	0.00057	2.092E-06	-0.00003	-0.00013	-3.136E-05	-0.00043	0.00350	2.389E-06	0.00347	0.00041	1.339E-05	-0.00030	0.00021	7.172E-05
L23	10.50	356.50	99	211,698	0.01	-0.61	-0.00046	0.00100	9.100E-08	0.00120	0.00054	2.019E-06	-0.00003	-0.00013	-2.952E-05	-0.00042	0.00343	2.165E-06	0.00341	0.00041	1.322E-05	-0.00028	0.00018	7.025E-05
L22	10.50	346.00	99	211,698	0.01	-0.61	-0.00044	0.00095	5.200E-08	0.00115	0.00052	1.942E-06	-0.00003	-0.00012	-2.760E-05	-0.00040	0.00336	1.902E-06	0.00333	0.00041	1.302E-05	-0.00026	0.00015	6.858E-05
L21	10.50	335.50	99	211,698	0.01	-0.61	-0.00042	0.00091	7.000E-09	0.00109	0.00050	1.861E-06	-0.00003	-0.00011	-2.564E-05	-0.00039	0.00329	1.597E-06	0.00326	0.00041	1.281E-05	-0.00025	0.00011	6.675E-05
L20	10.50	325.00	101	212,788	-0.19	-0.66	-0.00039	0.00086	-4.700E-08	0.00104	0.00048	1.775E-06	-0.00004	-0.00009	-2.370E-05	-0.00037	0.00322	1.237E-06	0.00318	0.00041	1.257E-05	-0.00022	0.00006	6.478E-05
L19	10.50	314.50	111	234,918	-0.17	-0.61	-0.00037	0.00082	-1.070E-07	0.00099	0.00046	1.686E-06	-0.00004	-0.00008	-2.180E-05	-0.00036	0.00315	8.300E-07	0.00309	0.00041	1.232E-05	-0.00021	0.00002	6.271E-05
L18	10.50	304.00	111	234,918	-0.17	-0.61	-0.00035	0.00078	-1.690E-07	0.00094	0.00043	1.596E-06	-0.00004	-0.00006	-1.991E-05	-0.00034	0.00307	3.990E-07	0.00301	0.00042	1.206E-05	-0.00019	-0.00001	6.055E-05
L17	10.50	293.50	128	265,268	-0.17	-0.71	-0.00033	0.00073	-2.290E-07	0.00089	0.00041	1.506E-06	-0.00005	-0.00005	-1.807E-05	-0.00033	0.00299	-3.700E-08	0.00292	0.00042	1.178E-05	-0.00017	-0.00005	5.831E-05
L16	20.00	273.50	148	300,160	-0.17	-0.79	-0.00030	0.00066	-3.330E-07	0.00080	0.00038	1.342E-06	-0.00005	-0.00003	-1.474E-05	-0.00030	0.00285	-8.150E-07	0.00275	0.00042	1.126E-05	-0.00013	-0.00012	5.405E-05
L15	20.00	253.50	225	830,984	-10.33	12.36	-0.00026	0.00060	-3.960E-07	0.00070	0.00033	1.234E-06	0.00010	0.00011	-1.249E-05	-0.00026	0.00272	-1.285E-06	0.00244	0.00030	1.097E-05	-0.00077	-0.00069	5.098E-05
L14-MEZ	11.83	241.67	236	867,999	-11.06	13.50	-0.00024	0.00057	-3.960E-07	0.00065	0.00031	1.231E-06	0.00011	0.00012	-1.243E-05	-0.00024	0.00266	-1.291E-06	0.00234	0.00029	1.096E-05	-0.00080	-0.00074	5.089E-05
L14-MECH	16.17	225.50	212	753,224	-13.62	17.02	-0.00022	0.00053	-3.880E-07	0.00059	0.00028	1.160E-06	0.00015	0.00015	-1.209E-05	-0.00022	0.00256	-1.462E-06	0.00217	0.00025	1.067E-05	-0.00095	-0.00088	5.020E-05
L13	14.00	211.50	195	699,562	-14.07	17.65	-0.00020	0.00050	-3.910E-07	0.00054	0.00026	1.075E-06	0.00015	0.00016	-1.169E-05	-0.00020	0.00247	-1.685E-06	0.00205	0.00024	1.026E-05	-0.00095	-0.00092	4.937E-05
L12	14.00	197.50	195	699,562	-14.07	17.65	-0.00018	0.00046	-4.010E-07	0.00049	0.00024	9.830E-07	0.00014	0.00016	-1.126E-05	-0.00018	0.00237	-1.939E-06	0.00192	0.00022	9.782E-06	-0.00092	-0.00094	4.842E-05
L11	14.00	183.50	195	699,562	-14.07	17.65	-0.00016	0.00043	-4.170E-07	0.00044	0.00022	8.930E-07	0.00014	0.00016	-1.082E-05	-0.00016	0.00227	-2.204E-06	0.00180	0.00021	9.277E-06	-0.00089	-0.00096	4.740E-05
L10	14.00	169.50	195	699,562	-14.07	17.65	-0.00015	0.00039	-4.380E-07	0.00040	0.00020	8.100E-07	0.00013	0.00017	-1.039E-05	-0.00015	0.00217	-2.459E-06	0.00167	0.00019	8.779E-06	-0.00086	-0.00097	4.635E-05
L09	14.00	155.50	195	699,479	-14.06	17.65	-0.00013	0.00036	-4.600E-07	0.00035	0.00018	7.400E-07	0.00013	0.00017	-9.990E-06	-0.00013	0.00207	-2.682E-06	0.00155	0.00018	8.330E-06	-0.00083	-0.00098	4.533E-05
L08	14.00	141.50	228	844,378	-11.89	14.31	-0.00011	0.00033	-4.790E-07	0.00032	0.00017	7.010E-07	0.00009	0.00015	-9.688E-06	-0.00013	0.00198	-2.828E-06	0.00147	0.00019	8.042E-06	-0.00065	-0.00089	4.452E-05
L07-MEZ	12.00	129.50	373	1,463,125	-12.22	14.39	-0.00010	0.00031	-4.730E-07	0.00029	0.00016	6.950E-07	0.00009	0.00015	-9.653E-06	-0.00011	0.00193	-2.816E-06	0.00139	0.00018	8.017E-06	-0.00063	-0.00091	4.441E-05
L07-MECH	16.00	113.50	352	1,355,484	-12.59	15.47	-0.00009	0.00028	-4.630E-07	0.00025	0.00014	6.850E-07	0.00009	0.00015	-9.604E-06	-0.00010	0.00186	-2.790E-06	0.00127	0.00018	7.976E-06	-0.00065	-0.00093	4.425E-05
L06	17.50	96.00	253	1,070,574	4.65	-6.52	-0.00008	0.00024	-4.500E-07	0.00022	0.00014	6.450E-07	-0.00012	-0.00002	-9.041E-06	-0.00014	0.00172	-2.710E-06	0.00130	0.00030	7.560E-06	0.00032	-0.00017	4.221E-05
L05	17.50	78.50	322	1,542,923	-3.77	1.48	-0.00006	0.00022	-4.220E-07	0.00018	0.00012	5.790E-07	-0.00004	0.00006	-8.278E-06	-0.00010	0.00165	-2.560E-06	0.00110	0.00023	6.891E-06	-0.00001	-0.00052	3.934E-05
L04	19.00	59.50	282	1,342,567	-5.87	7.41	-0.00005	0.00019	-3.710E-07	0.00013	0.00010	5.050E-07	0.00001	0.00007	-7.484E-06	-0.00007	0.00156	-2.312E-06	0.00092	0.00021	6.136E-06	-0.00023	-0.00058	3.619E-05
L03-MEZ	12.00	47.50	373	1,906,283	-6.38	8.02	-0.00004	0.00018	-3.130E-07	0.00011	0.00010	4.550E-07	0.00001	0.00006	-7.026E-06	-0.00007	0.00151	-2.058E-06	0.00084	0.00020	5.648E-06	-0.00024	-0.00057	3.429E-05
L03-MECH	11.50	36.00	394	1,965,722	-6.34	8.08	-0.00003	0.00017	-2.420E-07	0.00010	0.00009	3.950E-07	0.00002	0.00006	-6.592E-06	-0.00006	0.00147	-1.785E-06	0.00077	0.00020	5.106E-06	-0.00024	-0.00054	3.242E-05
L02	18.00	18.00	283	1,306,800	-5.90	12.28	-0.00003	0.00015	-1.380E-07	0.00007	0.00008	2.920E-07	0.00004	0.00004	-5.873E-06	-0.00005	0.00139	-1.387E-06	0.00065	0.00020	4.151E-06	-0.00036	-0.00049	2.921E-05
GROUND	18.00	0.00	264	1,230,052	-5.95	7.90	-0.00002	0.00013	-5.000E-08	0.00005	0.00007	2.120E-07	0.00002	0.00004	-5.207E-06	-0.00005	0.00133	-1.027E-06	0.00059	0.00020	3.301E-06	-0.00023	-0.00046	2.615E-05
PLATFORM	7.00	-7.00	143	823,986	-4.55	9.16	-0.00002	0.00013	-2.600E-08	0.00005	0.00007	1.960E-07	0.00003	0.00003	-5.013E-06	-0.00004	0.00130	-9.060E-07	0.00056	0.00020	3.093E-06	-0.00026	-0.00041	2.523E-05
TRACK	22.00	-29.00																						
BASE	21.50	-50.50																						

Notes: 1. The above values are based upon a second-order analysis.
2. The ETABS analysis model has Rigid Diaphragms assigned at all levels. The Rigid Diaphragms connect all nodes at their respective levels.

APPENDIX D – Geotechnical Report

Geotechnical Engineering Study

for

Hudson Yards – Tower E
Manhattan, New York

Prepared For:

Related Companies
60 Columbus Circle
New York, New York 10023

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26 April 2013
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INTRODUCTION

This report presents the results of our geotechnical engineering study, and provides geotechnical recommendations for the design and construction of Tower E within the Eastern Rail Yard of Hudson Yards. All services were performed in general accordance with our 19 October 2012 proposal (revised 28 February 2013). This revised report includes the results of supplemental boreholes, two caisson load tests and updated recommendations.

Our understanding of the project is based on discussions with the design team, review of the historical and current documents provided to us, and our ongoing work associated with the Hudson Yards development. Architectural information was provided by the project architect (Kohn Pedersen Fox Associates – KPF), and structural information was provided by the project structural engineer (Thornton Tomasetti – TT).

All elevations in this report correspond to the Borough President of Manhattan Datum (BPMD), which is 2.75 feet above the National Geodetic Vertical Datum (mean sea level at Sandy Hook, New Jersey, 1929). Typical datum conversions are presented in Table 1.

Table 1: Typical Elevation Conversions from BPMD

National Geodetic Vertical Datum of 1929 (NGVD29)	BPMD + 2.75 feet
North American Vertical Datum of 1988 (NAVD88)	BPMD + 1.65 feet
Pennsylvania Railroad Tunnel Datum (PENN)	BPMD + 300.025 feet
New York City Transit Datum (NYCT)	BPMD + 100.097 feet

SITE DESCRIPTION

Tower E is located within the eastern half of the Metropolitan Transportation Authority (MTA) – Long Island Rail Road (LIRR) West Side Yards. The West Side Yards is split by Eleventh Avenue into the Western Rail Yard (west of Eleventh Avenue) and the Eastern Rail Yard (east of Eleventh Avenue). Tower E is situated at the northwest corner of the Eastern Rail Yard (ERY), occupying part of Block 702, Lot 110. The site is bordered by West 33rd Street to the north, Eleventh Avenue to the west, and the proposed elevated Platform to the east and south. The site location is overlain on the USGS topographic map, included as Drawing No. 1.

Tower E, with a footprint of about 30,000 square feet (about 0.7 acres), will be constructed over the ERY. The rail yard will remain active during and after construction. In addition, four tunnels are located under the rail yard within or adjacent to Tower E:

1) the Amtrak North Access Tunnel (Empire Line),
2) the Amtrak North River Tunnels,

3) the Amtrak Emergency Evacuation Tunnel, and
4) the MTA No. 7 Line Extension (34th street station cavern, south interlocking tunnel section, T1A-T1B, and T2 tunnels).

Additional details pertaining to existing structures and utilities within and adjacent to the site follow. Existing site conditions are shown on Drawing No. 2.

EXISTING STRUCTURES, SITE IMPROVEMENTS, AND UTILITIES

The following sections present brief descriptions of structures and utilities within and in the vicinity of the site.

West Side Yards (MTA-LIRR)

The yards encompass the superblock bound by West 33rd Street to the north, former West 31st Street to the south, Tenth Avenue to the east, and Twelfth Avenue to the west. The LIRR yards were built in 1983, but the area has been used as rail yards for more than 100 years. The property is primarily used for storage and maintenance of LIRR commuter trains. Several structures and facilities are present at grade throughout the site, serving various uses including maintenance and cleaning facilities, electrical substations, and control towers. A concrete retaining wall is located along the north side of the yards supporting West 33rd Street. A more detailed discussion of these structures and facilities within or near the Tower E footprint follows.

Rail Yard

The rail yard encompasses much of the ERY including the entire area below Tower E. The rail yard consists of 31 tracks oriented in the east-west direction, and is used for train storage and maintenance. The tracks converge on the east end, near Tower A, in the “throat” area, before entering Pennsylvania Station (Penn Station) to the east. The tracks below Tower E are generally supported directly on concrete slabs (“concrete track slab”) or on ballast underlain by a restrained concrete subslab. The ground surface between adjacent tracks consists of ballast and concrete walkways. Top of rail grades within the Tower E footprint are about elevation 8.5 feet. The rail yard and track support conditions are shown on the existing condition plans, Drawing Nos. 2 and 2A. Select design drawings are included in Appendix A, and more are available.

The rail yard is to remain and be protected during construction.

Extraordinary Interior Cleaning (EIC) Platform

The EIC platform extends through the north end of the Tower E site and is oriented in the east-west direction parallel to the tracks. The EIC platform is used to access trains for cleaning and maintenance and is covered by a canopy. Design drawings indicate that the platform is supported on isolated footings bearing in soil. The EIC platform is about 8.5-feet wide and extends about 210 feet east of Eleventh Avenue. The top of the platform is at about elevation 13 feet, and the top of the canopy is at about elevation 25 feet. The EIC platform is shown on the existing condition plan, Drawing No. 2. Select design drawings are included in Appendix A, and more are available.

The EIC platform is to remain and be protected during construction. The canopy may be removed.

Retaining Wall along West 33rd Street and Tenth Avenue

A retaining wall is located along the south side of West 33rd Street, the northern boundary of Tower E. The retaining wall runs from Eleventh to Tenth Avenue, and then south about 55 feet along Tenth Avenue. The retaining wall supports West 33rd Street and Tenth Avenue, and varies in height from about 14 to 23.5 feet. Sidewalk grades along West 33rd Street that front Tower E vary from about elevation 31 to 26 feet, gradually sloping down from west to east. Grades inside the rail yard adjacent to the retaining wall are about elevation 7.5 feet. Design drawings indicate that the retaining wall is a cantilever concrete gravity wall keyed into bedrock, with rock tie-down anchors for additional support. The retaining wall is shown on the existing conditions plan, Drawing No. 2. Select design drawings are included in Appendix A, and more are available.

The retaining wall will need to be modified to support the proposed raising of West 33rd Street; the wall is not covered in this report.

Utilities

Numerous utilities are present within and adjacent to the site. Utilities within the Tower E footprint include A.C. conduit ducts, D.C. conduit ducts, communication conduit ducts, gas lines, ground wires, storm sewers, and sanitary sewers. Other notable utilites include storm storm sewers, sanitary sewers, electrical conduits, and gas lines within West 33rd Street. The reader is referred to utility surveys and the site/civil engineering drawings for additional details pertaining to existing utilities.

Tutor Perini Corporation performed test pits to investigate utilities throughout the ERY; these test pits are not included in this report.

Amtrak North Access Tunnel (Empire Line)

The Amtrak North Access Tunnel (NAT), also known as the "Empire Line," is located beneath the ERY and about 7.5 feet off the southwest corner of Tower E. The tunnel was constructed in the late 1980's by Amtrak to provide rail access through the Westside of Manhattan to points north. The tunnel runs west-northwest below the West Side Yards in a sweeping arc before heading north-northeast below the Eleventh Avenue viaduct and Jacob Javits Truck Mashalling Yard.

The tunnel was built using cut and cover construction and consists of a box-shaped reinforced concrete structure. The tunnel is partially embedded in soil and partially embedded in bedrock. The tunnel is relatively shallow, with the deepest point located beneath the yards; ground cover decreases to the north and the tunnel daylights into a U-shaped, reinforced concrete portal north of West 34th Street. The top of rail grades vary within the ERY from about elevation -19.5 to -14 feet. The crown of the tunnel is located approximately 19.5 feet above top of rail, or about 2.5 to 3.5 feet below the surface adjacent to the Tower E footprint. A vent/emergency egress enclosure is located at grade below the Eleventh Avenue viaduct and above the tunnel (under West 33rd Street at the west side of Eleventh Avenue). The NAT is shown on the existing conditions plan, Drawing No. 2. Select "As-Built" drawings are included in Appendix A, and more are available. The location of the tunnel should be considered approximate and must be verified in the field.

The NAT will remain and be protected during construction. The New York City Department of Buildings (NYC DOB) requires that any foundation elements within 200 feet of a tunnel be approved by the appropriate authority. Amtrak approval of the design and construction will be required for NYC DOB permits (Tower E foundations are within 200 feet of the tunnel).

Amtrak North River Tunnels

The Amtrak North River Tunnels (NRTs), twin single track tubes, run below the West Side Yards and are located about 12 feet south of Tower E (roughly coincident with the former West 32nd Street). The NRTs were constructed by the Pennsylvania Railroad in the early 1900's to provide rail access to Manhattan via Penn Station. The tunnels currently carry commuter trains for Amtrak and New Jersey Transit.

The tunnels were built using drilling and blasting techniques and tunnelling shields, and consist of arch sections (i.e. inverted U-shape) with concrete and brick liners. The majority of the tunnel within the ERY is fully embedded in bedrock; however, there is a 170-foot section beneath the center of the ERY that is partially embedded in soil. Part of the tunnel adjacent to Tenth Avenue may also be partially embedded in soil as a result of excavation that took place during construction of the West Side Yards in the 1980's. Both the north and south tunnels slope down to the west with a gradient of about 1.9 percent. Top of rail grades vary from about elevation -24 to -43 feet from Tenth Avenue to Eleventh Avenue. The crowns of the tunnels are located approximately 20.3 to 23.5 feet above top of rail, or about 25 to 28 feet below the surface, adjacent to the Tower E footprint. The NRTs are shown on the existing conditions plan, Drawing No. 2. Several "Plan of Work as Constructed" drawings are included in Appendix A. The location of the tunnel should be considered approximate and must be verified in the field.

The NRTs will remain and be protected during construction. Amtrak approval of the design and construction will be required for NYC DOB permits (Tower E foundations are within 200 feet of the tunnel).

Amtrak Emergency Evacuation Tunnel (for NRTs)

A new emergency evacuation tunnel from the NRTs was constructed in 1982 in conjunction with the West Side Yards project. The emergency evacuation tunnel from the NRTs runs below the southeast corner of Tower E in a roughly southwest-northeast alignment. The evacuation tunnel connects to an egress enclosure located immediately adjacent to the sidewalk south of West 33rd Street.

The evacuation tunnel was built using cut and cover construction and consists of reinforced concrete liner walls. The tunnel has a bottom of shaft floor slab at about elevation -10 feet and is almost entirely embedded in bedrock. A small part of the tunnel adjacent to the egress at West 33rd Street, as well as the egress itself, is partially embedded in soil and partially embedded in bedrock. The top of the tunnel is about 6 to 7 feet below the surface within the Tower E footprint. The emergency evacuation tunnel is shown on the existing conditions plan, Drawing No. 2. Select "As-Built" drawings are included in Appendix A, and more are available.

The emergency evacuation tunnel will remain and be protected during construction; however, we understand that the egress enclosure on West 33rd Street may be moved and reconstructed. Amtrak approval of the design and construction will be required for NYC DOB permits (foundations are within 200 feet of the tunnel).

Eleventh Avenue Viaduct (New York City Department of Transportation)

The Eleventh Avenue viaduct is located on the west border of Tower E. The viaduct runs from West 30th Street to West 37th Street. The viaduct generally consists of a steel-frame structure with a reinforced concrete deck. Sections of the viaduct were reconstructed during development of the West Side Yards in the 1980s. Improvements included new driven piles and caisson foundations extending to bedrock. The road deck was recently replaced on the viaduct between West 30th and West 33rd streets. The Eleventh Avenue viaduct is shown on the existing conditions plan, Drawing No. 2. Available "As-Built" drawings are included in Appendix A.

The viaduct is anticipated to remain and be protected during construction.

Existing MABSTOA Caissons and Footings

Existing caissons and footings are present within the Tower E footprint. The caissons and footings were constructed with the West Side Yards for the planned Manhattan and Bronx Surface Transit Operating Authority (MABSTOA) bus garage, which was never built. The approximate locations of these caissons and footings are highlighted on the existing conditions plan, Drawing No. 2. Available drawings indicate the caissons have a 32-inch diameter, 3/8-inch-thick steel casing filled with 5,000 psi concrete and are socketed at least 7 feet into bedrock. The drawings indicate the caissons may have W14x32 stub core beams, W14x109 steel cores, or W14x233 steel cores. The drawings indicate that the footings are 5.5 feet by 5.5 feet by 3 feet thick with 4,000 psi concrete and bear on sound rock. The caissons and footings were to be socketed and be founded on sound rock with a bearing capacity of at least 60 tons per square foot (tsf) (ref. *MABSTOA Bus Garage Foundations*, BG-1 thru BG-7, dated 15 February 1982). Available "As-Built" drawings for these foundations are included in Appendix A.

Several of the caissons and footings within the Tower E footprint will be incorporated into the foundation for Tower E, while others will be abandoned.

FUTURE AND ON-GOING CONSTRUCTION

The following sections present brief descriptions of future and on-going construction projects within and adjacent to the site.

West 33rd Street Reconstruction

The proposed reconstruction of West 33rd Street is in design. Construction of West 33rd Street will include replacement of existing utilities, regrading of the road (grades being raised along a substantial length of the road between Tenth and Eleventh Avenues), modifying the existing wall or constructing a new retaining wall along the south side of the road to support the street, and construction of an LIRR electrical substation below the roadway on the eastern part of the block. Construction is anticipated to be performed by the New York City Department of Design and Construction (DDC).

West 33rd Street will be closed to traffic during reconstruction. If the West 33rd Street reconstruction is concurrent with the construction of Tower E, limited site access and increased traffic volume on adjacent cross streets should be expected.

MTA No. 7 Line Extension

The MTA No. 7 Line Extension project is on-going. The project consists of extending the No. 7 subway line from Eighth Avenue to Eleventh Avenue along West 41st Street, and then south down Eleventh Avenue terminating at West 25th Street. The south part of the West 34th Street station cavern is located at West 33rd Street and Eleventh Avenue, adjacent to the northeast corner of the ERY. The West 34th Street station will consist of interlocking tracks (south interlocking tunnel section) that run south for about 140 feet before transitioning into running tunnels under Eleventh Avenue . "Site J" of the MTA No. 7 Line Extension is located on Eleventh Avenue between West 33rd and West 34th Street. Site J will include a ventilation building as well as an escalator that daylights in the station entrance within Hudson Boulevard Park. In addition, support tunnels, referred to as tunnels T1A-T1B and T2, will connect Site J to the West 34th Street Station Cavern beneath Eleventh Avenue. The T1A-T1B tunnel runs directly beneath the northwest corner of the ERY, within the Tower E footprint, as shown on Drawing No. 2.

The station cavern is being excavated by a combination of bored excavation via a tunnel boring machine (TBM) and controlled blasting, the running tunnels are being excavated via a TBM, and the support tunnels are being excavated via drilling and controlled blasting. The roof of the station cavern, south interlocking tunnel section, and running tunnels are about 60, 85, and 95 feet, respectively, below the existing grade of the ERY. The crown of the T1A-T1B tunnel is about 70 feet below the existing grade of the ERY. The area of the NYCT No. 7 Line Extension that exists within the ERY is shown on the existing conditions plan, Drawing No. 2. Select contract drawings are included in Appendix A, and more are available.

The MTA No. 7 Line will remain and be protected during construction. MTA approval of the design and construction will be required for New York City Department of Buildings (NYC DOB) permits (Tower E is within 200 feet of the tunnel). We have prepared technical analysis for MTA review and are negotiating for approval.

PROPOSED CONSTRUCTION

The proposed construction for Tower E includes an approximately 900-foot tall reinforced concrete mixed-use structure supported by a steel framed platform spanning over the rail yard. Tower E will be bordered by the Platform structure to the east and south, (the Platform structure is discussed in a separate geotechnical engineering study). The approximate limits for Tower E along with proposed adjacent structures within the ERY are shown on Drawing No. 3.

All existing tracks within the Tower E footprint will be maintained. The platform structure beneath Tower E will span over the existing tracks and consist of a concrete slab over metal deck with top of slab varying from about elevation 26.25 to 31.5 feet. Built-up solid steel columns and hollow steel infill walls filled with concrete will be supported on foundations located along five east-west column lines between the tracks. The majority of the columns will bear on new caissons and footings, with the remaining columns bearing on previously installed caissons and footings built for the MABSTOA garage, as shown on Drawing No. 3. Several footings will be located above the MTA No. 7 Line T1A-T1B tunnel. Several footings and caissons will be located adjacent to or above the MTA No. 7 Line station cavern, MTA No. 7 Line south interlocking tunnel section, and Amtrak tunnels.

Structural information was obtained from the “Hudson Yards LIRR 90% Platform LIRR Submission” drawing set, prepared by Thornton Tomasetti, dated 9 August 2013.

- Service compression loads are anticipated to vary from about 6,000 to 32,000 kips.
- Total base shear service loads in the east/west and north/south directions are anticipated to be 8,500 and 6,000 kips, respectively.

SITE DEVELOPMENT HISTORY

Historical maps show the original Hudson River shoreline cutting through the southwestern part of Tower E. The shoreline was extended west into the river by the placement of fill in the 18th and 19th centuries. The *Sanitary and Topographical Map of the City and Island of New York* by E.G. Viele (1865) shows no historic streams or marshes within or immediately adjacent to the site, as shown on Drawing No. 4. Historical maps depicting the site conditions circa 1814 and 1867 (by which time the East Rail Yards had been filled) are attached as Drawing Nos. 5 and 6, respectively.

From the late 1800s to the 1950s, the site was occupied by the New York Central and Hudson River Railroad Company and the New York Ontario and Western Railroad Company freight yards. The historical rail yards occupied an area much larger than the proposed development site, extending west to the Hudson River and north to West 39th Street. From 1890 to 1950, a lumberyard occupied part of the property along West 30th Street between Eleventh and Twelfth avenues. An oil refinery and foundry were located on the northern part of the ERY in the late 1800s prior to the site’s use as a freight terminal. From 1950 through 1984, the majority of the site was occupied by a railroad freight yard.

In 1984, the area between former West 31st Street (demapped) and West 33rd Street was reconstructed for use by LIRR as a passenger-train storage yard. The existing tracks were removed and a concrete slab placed across the western one-half to two-thirds of the West Side

Yards. The eastern balance of the yards contains ballast-supported track. The area between West 30th and West 31st streets was asphalt-paved and used for parking and storage by various entities. Five structures were built to support LIRR operations, including the DC substation, control tower, and transformer access area in the northeast corner of the site. A rock cut in the northeast corner of the ERY was made during the construction of these LIRR structures. New east-west rails were then constructed on top of the slabs and ballast, connecting to Penn Station to the east.

LOCAL GEOLOGY

Tower E is located on Manhattan Island, which is within the southern terminus of the Manhattan Prong of the New England Upland province. Bedrock in the vicinity of the site generally consists of granite, schist, and gneiss. Bedrock is overlain by glacial and fluvial soil, as well as extensive fill. Although altered by urban development, original topography within Manhattan typically mimicked the contours of the underlying bedrock.

According to Baskerville (1994), bedrock stratigraphy in the vicinity of the site is part of the Hartland formation, with rock of the Lower Cambrian (about 500 to 520 million years ago) to Middle Ordovician (about 461 to 472 million years ago) age and intrusive rock presumably of the Silurian age (about 416 to 444 million years ago), consisting of granite and megacrystalline pegmatite. The geologic map for the site vicinity is included as Drawing No. 7. A large sill of intrusive granite is mapped north of the site from West 35th Street to West 40th Street; however, historical boring data indicates that this granite sill extends further south than mapped. Boundaries between the intrusive granite and Hartland formation rocks are not well-defined as evidenced by intermittent contacts and inclusions observed in rock cores throughout the area.

Generalized descriptions of rocks mapped in the vicinity of the site are:

- Hartland Formation – Interbedded units of (1) gray, fine-grained quartz-feldspar granulite containing minor biotite and garnet; (2) fine-to-coarse grained, gray-to-tan weathering, quartz-feldspar-muscovite-biotite-garnet schist (mica schist); (3) dark greenish-black quartz-biotite-hornblende amphibolite. Intrusions of granite and pegmatite are common (Baskerville 1994). Metamorphism has resulted in foliation – a distinct planar alignment of mineral grains – within rocks of the Hartland Formation. This grain alignment is commonly referred to as schistosity in the more platy schistose rock or compositional banding in gneissic rocks. Foliation is typically oriented either northwest or southeast and dips steeply within Manhattan as discussed by Baskerville, but may be altered locally as a result of folding.

- Granite and Pegmatite – Gray-white-pink medium- to coarse-grained, biotite-muscovite-microcline-quartz granite and megacrystalline pegmatite in dikes less than 3 feet thick and sills greater than 3 feet thick. Accessory minerals include tourmaline, pyrite, garnet, and epidote. A thick sill cuts across the rock of the Hartland Formation as shown in Drawing No. 7. Pegmatite has been found in Penn Station and within the West Yards.

FEMA 100-YEAR FLOOD ZONE

Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) show the site falls within Zone AE "Special Flood Hazard Areas Subject to Inundation by the 1% annual chance flood" or the 100-year flood plain. The Zone AE designation corresponds to areas having a mapped 100-year base flood elevation of 7.25 feet (elevation 10 feet NGVD29). An excerpt of the FEMA FIRM map illustrating the site location is attached as Drawing No. 8.

Because of significant flooding that resulted from Hurricane Sandy that was in excess of the current adopted FIRM's, preliminary revisions to the FIRM were released by FEMA on 5 December 2013. The revised flood elevation for this area is 2.1 feet higher than the previously mapped base flood elevation. The site is located within the limits of Flood Hazard Zone AE, "areas subject to inundation by the 1 percent annual chance flood (100-year flood)" or with flood elevations of 9.35 feet (elevation 11 feet NAVD88). An excerpt of the preliminary FIRM illustrating the site location is attached as Drawing No. 9.

The owner and design team have selected a design flood level of elevation 13.35 feet.

SUBSURFACE INVESTIGATION

Our geotechnical study included (1) reviewing available historical boring data and recent test pit data, (2) performing a supplemental boring investigation to better define the rock elevation and rock quality, and (3) laboratory testing of recovered rock cores. A site investigation plan showing the historical borings and test pits, as well as the supplemental boring location, is included as Drawing No. 10.

Previous Investigations and Borings

2008 Langan Investigation

Langan performed 31 environmental test borings as part of a Phase II Environmental Site Investigation within the ERY. Three borings (denoted as EC-1-1, EC-1-2, and EC-1-6) fall within the Tower E footprint. In situ geotechnical test data obtained from these boring locations were used to supplement our known subsurface conditions information. The boring logs indicated that the subsurface generally consisted of miscellaneous historical fill underlain by alternating deposits of sandy silt to silty fine sand, over dense glacial till, over bedrock. The boring logs are included in Appendix B.

Borings by Others

We also reviewed available historical boring data in the vicinity of the proposed development to supplement the subsurface data collected during our 2013 field investigation. The following data sources were reviewed:

- Boring data compiled by the New York City Department of Design and Construction (NYCDDC), various dates
- West Side Storage Yard – Geologic sections by Mueser Rutledge Johnston & DeSimone Consulting Engineers dated 16 July 1981
- Mabstoa Garage Area – Soils report by Mueser Rutledge Johnston & DeSimone and Woodward-Clyde Consultants, Inc. dated 14 March 1986
- No. 7 Subway Line Extension – Borings by Parsons Brinckerhoff Quade & Douglas, Inc. dated 2003
- Trans-Hudson Express ARC Tunnel – Borings by The Partnership dated 2007 and 2008

Much of the historical data only documents subsurface stratigraphy via profiles and does not include boring logs. Rock descriptions noted in some of the historical borings do not clearly define bedrock quality. In general, the subsurface conditions observed in recent Langan investigations in the area correlates well with the historical data, particularly the top of rock elevations. The historical boring logs and subsurface profiles are provided in Appendix C.

Langan 2013 Test Borings

Langan performed 21 geotechnical test borings within the ERY as part of a supplemental investigation to confirm previous findings. Five borings (denoted as BH-13 through BH-17) were within or adjacent to the Tower E footprint. The borings were drilled by Warren George, Inc., of Jersey City, New Jersey between 31 May 2013 and 5 October 2013. The boreholes were performed using several different truck-mounted drill rigs. A Langan geotechnical engineer performed New York City Building Code (NYCBC) special inspection of all borings. The five boreholes within or adjacent to the Tower E footprint were advanced to depths ranging from 34 to 73 feet below grade. Boring locations are shown on Drawing No. 10.

Each boring was cleared for utilities via hand or vacuum excavation or using standard drilling techniques with minimal water and no down-pressure on the drill string. The borings were advanced through soil overburden using mud-rotary drilling techniques with tri-cone roller bits. Support of the borehole was provided by drilling fluid consisting of a mixture of bentonite and water. Temporary flush-joint steel casing was installed through the fill and native overburden soils, as required, to stabilize the boreholes and prevent fluid loss during drilling.

The Standard Penetration Test (SPT)[1] was performed in general accordance with ASTM D1586. SPT N-values and visual soil classifications were recorded by Langan's engineer. Extra SPT tests and samples were obtained through loose and soft materials. Soils were sampled using a standard 2-inch outer-diameter split-spoon sampler. Recovered soil samples were visually examined and classified in accordance with Unified Soil Classification System (USCS) and assigned classification numbers in accordance with the New York City Building Code.

Rock coring was performed in all five borings in accordance with ASTM D2113 using a double-wall, wire-line core barrel. Rock samples were visually examined and assigned classification numbers in accordance with the New York City Building Code. Rock core recovery (REC)[2] and rock-quality designation (RQD)[3] for each core run were logged by our engineer.

Detailed logs of the 2013 geotechnical borings are included as Appendix D.

Laboratory Testing

Laboratory testing was performed on representative rock core samples to evaluate engineering characteristics and strength parameters of the bedrock within or adjacent to the Tower E footprint. Laboratory testing of rock core samples obtained within or adjacent to the Tower E footprint included:

- Unconfined Compressive Strength – ASTM D7012 (6 tests)
- Unconfined Compressive Strength with Elastic Moduli – ASTM D7012 (4 tests)

Summaries of the rock laboratory test data are presented in the Subsurface Conditions section below. The complete laboratory test results are provided in Appendix E.

SUBSURFACE CONDITIONS

The general subsurface profile within the Tower E footprint consists of miscellaneous historical fill underlain by either (1) alternating deposits of sandy silt to silty fine sand with varying amounts of gravel, over bedrock; or (2) directly underlain by bedrock. A till layer exists within

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[1] The Standard Penetration Test (SPT) is a measure of soil density and consistency. The SPT N-value is defined as the number of blows required to drive a 2-inch outer diameter split-barrel sampler 1 foot, after an initial penetration of 6 inches, using a 140-pound hammer falling freely from a height of 30 inches.

[2] Rock core recovery (REC) is defined as the length of all core pieces recovered divided by the total core run length.

[3] Rock Quality Designation (RQD) is defined as the sum of all recovered sound rock core pieces measuring 4-inches or more in length (for type NX, NQ or PQ cores) divided by the total core run length. RQD is a relative indicator of rock quality.

the northwest corner of the Tower E footprint and boulders were encountered throughout the western half of Tower E. A thin layer of decomposed rock was encountered below the center of Tower E. The top of bedrock was encountered at a depth of about 1 to 20 feet below existing grade, corresponding to about elevation 7 to -12 feet. Bedrock generally slopes down from east to west within the Tower E footprint.

A plan showing the approximate top of rock is attached as Drawing No. 11. Top of rock contours shown on this plan are a simplified representation of the subsurface conditions. The plan is provided for information only and variations from the elevations shown should be expected. Subsurface profiles taken in the north-south and east-west orientations of the proposed Tower E are presented on Drawing Nos. 12, 13, and 14.

Surface Material

The ground surface within the track area below Tower E consists of tracks that are supported by concrete track slab on the west side of the site and ballast underlain by a concrete subslab on the east side of the site. The ground surface between the tracks consists of ballast and concrete walkways areas.

Stratum 1 – Uncontrolled Fill [NYCBC Class 7][4]

Uncontrolled fill is present beneath any surface pavement/concrete and ballast, or at the ground surface across the entire Tower E footprint. The fill is generally a mixture of sand, gravel, and silt with variable amounts of brick and concrete. The fill was also observed to contain boulders within the western half of site. The fill varies from about 2 to 18-feet thick, corresponding to about elevations 8 to -10 feet.

The borings indicate that the density of the fill varies from very loose to very dense as evidenced by Standard Penetration Test (SPT) SPT N-values, which varied from 2 blows per foot (bpf) to greater than 100 bpf. In many instances, the higher recorded SPT N-values appear attributed to the presence of obstructions (cobbles, gravel, boulders, timber, construction debris, etc.) and are generally not considered to be representative of in situ density. Overall, the fill is anticipated to generally vary from loose to medium dense.

Stratum 2 – Sandy Silt and Silty Fine Sand [Class 3b, 5b]

Sandy silt to silty fine sand is present below the fill in the center as well as along the majority of the western half of the Tower E footprint. These soils are glacial outwash deposits. The stratum is predominantly reddish-brown to brown sandy silt and silty fine sand with varying amounts of gravel. Greater amounts of gravel were encountered in the center of the site.

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[4] Numbers in brackets indicate classification of soil and rock materials in accordance with the 2008 New York City Building Code.

Sporadic cobbles and boulders were also encountered within this layer. This stratum typically varied from about 2- to 18-feet thick, with greater thicknesses in areas where rock is deepest. The bottom of the sandy silt and silty fine sand layer was typically observed varying between about elevation -1 and -11 feet. SPT N-values within this layer varied from 10 to greater than 100 bpf, but were typically about 15 to 30 bpf, indicating the soil is generally "medium dense." The higher recorded SPT N-values appear attributed to the presence of cobbles/boulders, or directly prior to encountering denser stratums below.

This stratum generally classifies as SM (silty sand) or ML (silt) in accordance with USCS, and is typically classified as Class 3b "Medium Dense Granular Soils" and 5b "Medium Dense Silts" in accordance with the NYC Building Code.

Stratum 3 – Glacial Till [Class 3a]

Glacial till is present below the sandy silt and silty fine sand in one boring (MR-428) in the northwest corner of the Tower E footprint. However, till could be encountered in other areas where the rock is deep. The till consists of reddish-brown fine- to coarse-grained sand with variable amounts of silt and gravel. The till was about 5-feet thick with the bottom of the till layer observed at elevation -10 feet. A single SPT N-value within this layer was 45 bpf. Indicating the soil is generally "very dense."

The glacial till typically classifies as SM (silty sand) or SP (poorly graded sand) in accordance with the USCS and is typically classified as Class 3a "Dense Granular Soils" in accordance with the NYC Building Code.

Stratum 4 – Bedrock [Class 1a, 1b, 1c, and 1d]

Bedrock is present below the slabs, fill, sandy silt to silty fine sand, and glacial till. The top of the bedrock layer was observed at depths varying from about 1 (where directly below a slab) to 20 feet below existing grade, corresponding to elevations of about elevation 7 feet to -12 feet. In general, the bedrock is shallower in the eastern half of Tower E and slopes down to the west.

Bedrock typically consists of schist with miscellaneous layers of granite and quartzite. The schist is typically comprised of quartz, feldspar, muscovite, biotite, and garnet. The rock appears to be complexly folded with distinct foliation. Weathering of the bedrock was generally slightly weathered to fresh. In general, fracture spacing was observed to vary from close to moderate. The bedrock was typically hard to very hard.

Rock core recovery (REC) varied from about 50 to 100 percent and the rock-quality designation (RQD) varied from about 10 percent (poor quality) to 100 percent (excellent quality). The rock is generally of a competent nature with greater than 80 percent of the RQD values exceeding 50 percent (fair quality, NYC Building Code Class 1b). Highly weathered and fractured zones, typically present in the schist, were observed in several historical borings across the site. The full extent of the highly weathered, highly fractured bedrock zones is unknown and these conditions should be considered possible anywhere across the Tower E footprint.

Laboratory testing on intact rock cores was performed to evaluate the strength and deformation characteristics of the rock. Compressive strength and elastic modulus of the intact rock was performed on 10 rock cores within or adjacent to the Tower E footprint in accordance with ASTM D7012 "Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures." The rock cores were prepared in accordance with ASTM D4543 "Standard Practice for Preparing Rock Core Specimens and Determining Dimensional and Shape Tolerances." The unconfined compressive strength and young's modulus are provided in Table 2 below. The complete laboratory test results are provided in Appendix E.

Table 2: Intact Rock Core Compression Test Results

Boring	Depth (feet)	Rock Type	Unconfined Compressive Strength (psi)	Strain to Peak (%)	Young's Modulus (psi)	Poisson's Ratio
BH-13	22-23	Schist	5,230	0.14	4.3E+06[1]	----
BH-13	55.5-56	Pegmatite	17,070	0.75	6.2E+06	0.13
BH-13	63.5-64.5	Granite	15,570	0.27	6.3E+06[1]	----
BH-14	17.5-18	Granite	19,270	0.24	9.0E+06	0.24
BH-14	65.5-66	Granite	8,450	0.28	3.1E+06[1]	----
BH-15	17.5-18	Granite	12,580	0.25	6.0E+06	0.20
BH-15	18.5-18.9	Granite	17,820	0.28	6.8E+06[1]	----
BH-15	30.5-30.9	Pegmatite	12,440	0.22	6.2E+06[1]	----
BH-15	48-49	Granite	16,240	0.24	7.2E+06[1]	----
BH-15	64-65	Granite	11,560	0.34	5.0E+06	0.18

1) Modulus values estimated from platen to platen measurement.

The bedrock is designated as Class 1a "hard rock," Class 1b "medium rock," Class 1c "intermediate rock," and Class 1d "soft rock," in accordance with the NYC Building Code.

Groundwater

Groundwater was encountered during our 2008 Phase II Environmental Site Investigation. Groundwater was generally observed between about elevation -4 and 0 feet. Where bedrock is shallow in the east half of the Tower E footprint, groundwater is anticipated to be perched on top of rock and will follow the rock surface contour above about elevation 1 foot. Where rock is deeper to the west, groundwater will be within the soil.

SEISMIC DESIGN PARAMETERS

Seismic design parameters presented herein are in accordance with the 2008 New York City Building Code.

Subsurface Conditions

The general subsurface profile within the Tower E footprint consists of miscellaneous historical fill underlain by either alternating deposits of sandy silt to silty fine sand with varying amounts of gravel, over bedrock; or directly underlain by bedrock. A till layer exists within the northwest corner of the Tower E footprint and boulders were encountered throughout the western half of Tower E. A thin layer of decomposed rock was encountered below the center of Tower E. The top of bedrock was encountered at a depth of about 1 to 20 feet below existing grade, corresponding to about elevation 7 to -12 feet. Bedrock generally slopes down from east to west within the Tower E footprint.

Shear Wave Velocity

Bedrock shear wave testing was completed for the adjacent Terra Firma site, No. 7 Line Extension project, and Jacob Javits Convention Center project, which are located within the same rock formation as Tower A. Shear wave velocity measurements within rock ranged from about 5,000 feet/second to 12,000 feet/second.

NYC Building Code Seismic Design Parameters

The foundation elements for Tower E will consist of footings bearing directly on shallow rock and large diameter caissons to rock that will have a small slenderness ratio (L/D), and therefore a stiff response similar to piers bearing on rock. We believe the soil surrounding the caissons will not have a significant impact or amplification to the response of the caissons because of the stiff behavior. Therefore, we recommend Tower E be designed as bearing entirely on rock. A shear wave velocity greater than 5,000 feet/second can be used based on testing in the same rock formation at nearby sites as discussed above, corresponding to NYC Building Code Site Class A. Based on the shear wave velocity and corresponding Site Class, the following parameters are recommended for design in accordance with the Building Code.

Table 3: Seismic Design Parameters

Description	Parameter	Recommended Value	Building Code Reference
Mapped Spectral Acceleration for short periods:	S_s	0.365 g	Section 1615.1
Mapped Spectral Acceleration for 1-sec period:	S_1	0.071 g	
Site Class	Vs_{100} > 5,000 ft/sec	**A**	Table 1615.1.1
Site Coefficient:	F_a	0.8	Table 1615.1.2
Site Coefficient:	F_v	0.8	
5 percent damped design spectral response acceleration at short periods:	$\mathbf{S_{DS}}$	**0.195 g**	Section 1615.1.3
5 percent damped design spectral response acceleration at 1-sec period:	$\mathbf{S_{D1}}$	**0.038 g**	

Seismic Design Category

We understand Tower E is designed as Building Code Occupancy Category II. According to Building Code Table 1604.5, Occupancy Category II is considered Seismic Use Group I. For Seismic Use Group I, the recommended design spectral accelerations obtained from our seismic analysis result in Seismic Design Category B. Note that this is the minimum Seismic Design Category allowed by the NYC Building Code. The Seismic Design Category must be confirmed by the structural engineer.

Liquefaction Evaluation

The seismic provisions of the Building Code require an evaluation of the liquefaction potential of sand, silt, and non-cohesive materials below the groundwater table and up to a depth of 50 feet below the ground surface. Liquefaction potential was evaluated using the procedure outlined by Youd et al. (2001).

The Youd et al. evaluation is based on the Seed and Idriss (1982) procedure for liquefaction evaluation and is currently considered to be State-of-Practice procedure, as recommended by the National Earthquake Hazard Reduction Program (NEHRP). This evaluation presents an empirical relationship between the earthquake demand, represented by the Cyclic Stress Ratio (CSR), and the soil's resistance to dynamic loading, represented by the Cyclic Resistance Ratio (CRR). The CSR is correlated to the Peak Ground Acceleration (PGA) of the design earthquake event, as well as the in-situ stresses, whereas the CRR is correlated to SPT N-values. The field SPT N-values are normalized by applying correction factors for soil overburden pressure (C_N), hammer energy efficiency (C_E) and percent fines to obtain the equivalent, normalized value for a clean sand to obtain the design $(N_1)_{60,cs}$.

Our analysis parameters included a Magnitude 5.75 earthquake event, a PGA of 0.12g, and a Magnitude Scaling Factor of 2. A plot of the calculated factor of safety with depth using the Youd et al. (2001) procedure for each boring within the Tower E footprint is shown on Drawing No. 15. We recommend a minimum factor of safety of 1.1 when evaluating liquefaction. The boring data suggests that the Tower E site has a factor of safety greater than 2.5. We believe the potential for liquefaction, liquefaction-induced settlement, and other seismic ground failure at the site is low, based on our evaluation of the available boring data and estimated seismic parameters for the site. Therefore, liquefaction need not be considered in the design.

DESIGN AND CONSTRUCTION CONSIDERATIONS

The following section briefly summarizes significant design and construction considerations relative to the proposed development.

- Tower E is expected to have high structural loading and shallow rock conditions. Therefore, the heavy tower loads will require a combination of drilled caissons socketed into rock, and continuous and isolated footings embedded in rock.
- The Tower E foundations will be within the existing track area and will require construction between the existing tracks that are to remain.
- Rock is shallow on the north side of Tower E, therefore shallow foundations may be used. Footings may be embedded into sound rock if required. Tie-down anchors may be necessary for uplift resistance. Careful rock removal techniques should be carried out while limiting vibration levels and properly supporting the localized excavations (i.e. rail tracks and adjacent structures).
- Unstable rock wedges may daylight within excavations, requiring temporary support during excavation for shallow foundations in rock. Also, localized areas of soft or weathered rock will likely require support of excavation.
- Localized excavations for shallow foundations on the north side of Tower E may extend below the groundwater table requiring temporary construction dewatering.
- Existing caissons socketed in rock and footings bearing directly on rock constructed for the planned MABSTOA bus garage can be incorporated into the Tower E foundation system. Test pits will be performed (by others) to locate the as-built foundation locations.
- New caissons within the Tower E footprint will be located in close proximity to existing Amtrak tunnels. Coordination with Amtrak will be required to determine the minimum clear distances between caissons and tunnels. Lateral and vertical deviation tolerances should also be determined. Exact locations of the existing tunnels must be verified by a surveyor. Means and methods necessary to construct caissons in close proximity of

the tunnels must mitigate potential for soil loss and disturbance to the adjacent tunnels. A detailed study of the foundation impacts on the existing tunnels will likely be required; we have started this evaluation and the results will be presented under separate cover.

- New caissons and shallow foundations within the Tower E footprint will be located adjacent to the NYCT No. 7 Line Extension south interlocking tunnel section and station cavern beneath Eleventh Avenue and directly above the T1A- T1B tunnels. A detailed study of the foundation impacts on the tunnels will likely be required by NYCT; we have started this evaluation and the results will be presented under separate cover.
- Protection of adjacent structures, tracks, and the existing Amtrak and NYCT tunnels, will be necessary during construction. A detailed monitoring program will be required to evaluate the performance of the structures and determine if construction methods need to be modified. The specifics for monitoring of existing Amtrak tunnels and the on-going No. 7 Line structures during foundation construction will need to be coordinated with Amtrak, NYCT, and LIRR.
- Drilling caissons within the track area will be required. Scheduling of the work to be done within the track area must be coordinated through LIRR. This scheduling will include detailed work plans, arranging for LIRR escorts while on LIRR property, and any power outages and track closures required.

DESIGN RECOMMENDATIONS

Our recommendations for foundation systems and other geotechnical-related design parameters follow.

Foundation Discussion

Service compression loads for caissons are anticipated to vary from about 18,000 to 32,000 kips. Total base shear service loads in the east/west and north/south directions is anticipated to be 8,500 and 6,000 kips, respectively. Rock is anticipated to be within about 15 feet of existing grade within the Tower E footprint. Because of the high anticipated loads, shallow rock, and existing tracks to remain, we recommend that Tower E be supported on a combination of drilled caissons socketed into rock, and continuous and isolated footings embedded in rock where rock is shallow. Existing MABSTOA caissons and footings can be incorporated into the foundation system where sufficient capacity is afforded by the existing foundations.

Drilled Caissons

Caissons are recommended to support the majority of Tower E. Caissons consist of a permanent steel casing drilled through soil to bedrock, with an uncased socket extending into bedrock. The casing and rock socket are filled with steel reinforcing and concrete. Steel reinforcing may consist of rolled steel sections, built-up plate steel shapes, or rebar cages. Caissons develop axial load capacity through a combination of peripheral shear resistance between the concrete and rock, and end-bearing on the rock.

The caissons anticipated to support Tower E vary in diameter from 4.5 to 5.5 feet and have design capacities varying from 18,000 to 32,000 kips.

Geotechnical Design Parameters

We recommend that the caisson rock sockets be proportioned assuming an allowable peripheral bond strength of 300 psi for compression and 150 psi for uplift. These values assume rock meeting NYC Building Code Class 1b or better, and have been confirmed based on site-specific load-transfer data obtained from two instrumented load tests performed on caissons installed within the Tower A footprint. The load test results are provided in Appendix F.

The NYC Building Code allows a maximum allowable foundation pressure of 60 tons per square foot (tsf) for NYC Building Code Class 1a rock; however, this value may be increased up to 25 percent to a maximum of 75 tsf provided that tests and/or analyses substantiate the increase. Borings indicate that rock within the Tower E footprint meets NYC Building Code Class 1a and 1b. Based on a bearing capacity analysis and the site-specific load-transfer data obtained, we recommend that the allowable end-bearing be increased to 75 tsf plus a 10 percent increase for each foot of embedment into rock up to a maximum of 150 tsf. Inspection during construction (see later discussion) is required to verify the rock quality and the increased allowable bearing capacity.

Axial Compressive Resistance

The proposed caisson axial compressive design loads, varying from about 18,000 to 32,000 kips, can generally be accommodated by caissons having a casing diameter of 4.5 feet to 5.5 feet. Typical capacities for various caisson diameters are presented in Table 4. Final design is typically by the caisson specialty contractor such that the contractor’s preferences can be considered.

Table 4: Typical Caisson Designs

Compression Capacity	Casing Diameter	Casing Thickness	Casing Corrosion Allowance Thickness	Rock Socket Diameter	Rock Socket Bond Length	min. f'_c (conc.)	min. f_y (casing)	min. f_y (core)	Estimated Reinf.
kips	inches	inches	inches	inches	feet	ksi	ksi	ksi	
12,000	54	0.75	0.125	48	16	12	50	65	W14x665
18,000	66	0.75	0.125	60	18	12	50	65	W14x730 10 #18
20,000	66	0.75	0.125	60	21	12	50	65	W14x808 24 #18
22,000	66	0.75	0.125	60	24	12	50	65	Built-up Plate 16”x24” 24 #18
26,000	66	0.875	0.125	60	30	12	50	65	Built-up Plate 20”x24” 30 #18
32,000	66	1.375	0.125	60	39	12	50	65	Built-up Plate 24”x28” 32 #18

1) Rock socket bond length assumes an allowable end bearing resistance equal to 150 tsf and side shear resistance of 300 psi.

2) Caisson structural capacities can be adjusted by modifying material properties. The material properties shown herein are for demonstration purposes and do not represent recommendations for final design. Final design should be predicated based on feedback from contractors with respect to material availability, lead time, and commodity pricing.

Axial Uplift Resistance

Caissons can be used to resist uplift forces. The uplift resistance of caissons should be designed by neglecting end-bearing and using a higher factor of safety for peripheral shear resistance in the rock socket. We recommend an allowable uplift peripheral shear resistance of 150 psi.

Lateral Resistance

Caissons can be used to resist lateral loads. The lateral capacity of caissons will be strongly influenced by the diameter of the caisson and the depth to rock.

We recommend the behavior of the caissons under lateral loading be analyzed using the p-y method whereby the soil and rock are modeled as a series of discrete resistances (i.e. springs) with nonlinear behavior. Nonlinear caisson material properties should also be included in the model (such as reduced pile stiffness from concrete cracking). Our lateral caisson analysis and recommended p-y curves our summarized in a memo dated 30 November 2012, attached as Appendix G.

The NYC Building Code requires that lateral loads greater than 1 ton must be substantiated by load tests. Lateral load tests for caissons are discussed below.

Group Effects

The caissons should have a minimum center-to-center spacing of at least two diameters to prevent axial group effects. The outer three caissons that support the inner shear walls along column lines E2, E3, and E4 are shown to be closely spaced, and group effects must be considered. A group reduction factor of 0.85 is recommended for these caissons, requiring that the rock socket length be increased by about 18 percent.

Because of the relatively shallow depth to rock, the lateral capacity provided by the overburden material will be negligible. Thus, lateral group effects need not be considered.

Minimum Clearances (Amtrak tunnels and MTA No. 7 Line Extension Structures)

New caissons within the Tower E footprint will be located in close proximity to existing Amtrak tunnels. The perimeter caissons adjacent to the NAT are anticipated to extend to about elevation -33 to -37 feet, corresponding to about 16 to 20 feet beneath the bottom of the tunnel. The perimeter caissons adjacent to the NRTs are anticipated to extend to about elevation -23 to -37 feet, corresponding to about 6.5 to 17.5 feet beneath the crown of the tunnel. The perimeter caissons adjacent to the emergency evacuation tunnel are anticipated to extend to about elevation -23 to -27 feet, corresponding to about 11.5 to 15.5 feet beneath the bottom of the tunnel. We are performing a finite element method (FEM) study to analyze the impact of the Tower E foundations on existing Amtrak tunnels. This study will be issued under separate cover.

New caissons supporting Tower E will also be located in close proximity to the south interlocking tunnel section and T1A-T1B tunnel of the MTA No. 7 Line Extension. The perimeter caissons are anticipated to extend to about elevation -37 feet, corresponding to about 37 feet above and adjacent to the crown of the south interlocking tunnel section. The interior caissons are anticipated to extend to as deep as about elevation -50 feet, corresponding to about 10 feet above and adjacent to the crown of the T1A-T1B tunnel. We are performing a finite element method (FEM) study to analyze the impact of the Tower E foundations on the MTA No. 7 Line Extension tunnels. This study will be issued under separate cover.

Coordination with Amtrak and the MTA will be required to determine the minimum clear distances between caissons and tunnel structures. Means and methods necessary to construct caissons in close proximity of the tunnels must mitigate potential for soil loss and disturbance to the adjacent tunnels. Lateral and vertical deviation tolerances should also be determined with Amtrak and the MTA. Through prior experiences on projects with existing Amtrak tunnels, we recommend that all caissons installed less than 25 feet from adjacent tunnels (as measured at the tunnel structure) be monitored during construction to ensure the caisson is installed plumb. Standard construction tolerances dictate that the caissons deviate no more than 2 percent from vertical alignment. Where required, casings should be survey monitored prior to initial penetration to ensure proper vertical alignment. Periodic or real-time measurement of caisson deviation with depth may be required by Amtrak and the MTA during drilling. For caissons located within 5 feet of existing tunnels, we recommend that the tops of these tunnels be exposed to verify clearance of the caissons.

Plumbness Monitoring

Through prior experiences on projects with existing Amtrak tunnels, we recommend that all caissons installed less than 25 feet from adjacent tunnels (as measured at the tunnel structure) be monitored during construction to ensure the caisson is installed plumb. Standard construction tolerances dictate that the caissons deviate no more than 2 percent from vertical alignment. Where required, casings should be survey monitored prior to initial penetration to ensure proper vertical alignment. Periodic or real-time measurement of caisson deviation with depth may be required by Amtrak and the MTA during drilling.

Bond Breakers

Bond breakers may be necessary for some caissons located in close proximity to the existing Amtrak tunnels and MTA No. 7 Line Extension tunnels to limit imparting new loads on the tunnels. The necessity for bond breakers is being evaluated under separate cover. While many methods are available for providing bond breakers, we recommend that the specific means and methods be proposed by the Contractor. Conceptually, bond breakers can be provided by:

1) drilling a temporarily cased oversized borehole to the top of rock socket;
2) installing a smaller bituminous coated permanent casing inside the temporary casing and grouting the annulus;
3) removal of the temporary casing; and
4) drilling the final rock socket from within the remaining permanent casing.

Drilling Methods

Drilling of the caissons through overburden can be performed using rotary or auger drilling techniques. Given the potential for "running sand" conditions within loose fine silty sand soils, we recommend that temporary casing and a mineral (i.e. bentonite) or polymer slurry be used to stabilize the borehole, as opposed to water. In addition, we recommend the drill stem be kept inside the casing while drilling through overburden soils to minimize the potential for bottom heave or running-sand conditions. The drill stem should be kept inside the casing a minimum of 1 foot until the casing is seated into rock.

A down-the-hole hammer must be used to advance the rock socket. Observations during the Tower C caisson construction and the test caissons at Tower A show the down-the-hole hammer creates a rougher rock sidewall surface within the socket compared to augering, potentially increasing the average side shear values as observed in the load tests. The caissons should be flushed using water or compressed air (or other approved methods) upon completion of the rock socket to remove all debris accumulated on the bottom of the rock socket. Thorough cleaning of the bottom of the rock socket is critical for caissons designed with end-bearing (particularly given the assumed high bearing values), and proper cleaning must be verified through inspection, as discussed below.

Obstructions, such as remnant foundations and debris in the historical fill, should be anticipated in any area of the site. The Contractors' means and methods should consider the need for penetrating or bypassing such obstructions. Means to bypass the obstructions may include predrilling using oversized cased boreholes and then backfilling.

Isolation Casing

The LIRR has previously stated that caissons located within or in close proximity to tracks must be installed using isolation casings to prevent transferring of lateral loads to the adjacent tracks. The requirement may only apply to areas of track slab (as opposed to ballast), but should be confirmed with the LIRR. If required, the isolation casing will likely be 6 inches larger in diameter than the permanent casing and will extend a minimum depth of 4 feet below the top of the caisson. The annulus between the isolated casing and permanent casing must be filled with a compressible elastic foam or other means to seal the gap without allowing load transfer.

Rock Socket Verification

The NYC Building Code requires that all rock sockets be inspected to verify the quality of the bedrock before installing reinforcing steel and concreting. We recommend that verification be performed through video inspection with a down-the-hole camera, as opposed to entering the caisson.

Reinforcing Steel Splices

The NYC Building Code requires that core-beam splices be milled and full-depth welded. Given that very large core beams will likely be required to achieve the highest load capacities, a waiver for this requirement may be necessary for constructability. The connection must be capable of achieving the necessary stress and moment transfer at the splice depth. We note that mechanical connections could inhibit constructability because the splice can require significant volume within the caisson section, thus potentially limiting concrete flow or installation of concrete tremie tubes. Deformed bar and threadbar cages can be spliced using staggered mechanical or lap splices. We recommend that only mechanical couplers capable of developing full capacity of the bars be used for tension elements.

Centralizers

All reinforcing steel must be centered within the caisson. Where rebar cages are implemented, centralizers should be spaced no more than 10 feet on center. Steel core beams should be provided with at least one centralizer at the base; the tops of core beams should be aligned at the top of the casing using either a template or by manual wedges.

Concrete Placement

Concrete should be placed as soon as possible following cleaning and within four hours of inspection of the rock socket. If placement is delayed the socket must be reinspected. Concrete must be placed using tremie methods, and must be performed in a continuous operation. Concrete must consist of a flowable mixture and must remain workable throughout the anticipated duration of the pour.

Caisson Axial Load Testing

Axial load tests are not required by the NYC Building Code. However, a load test program is being considered for two test caissons at Tower A in an attempt to justify a higher skin friction value, and to further justify the 75/150 tsf end-bearing design.

Caisson Lateral Load Testing

Lateral load tests are required by NYC Building Code for allowable lateral capacity greater than 1 ton. We recommend two caissons be lateral load-tested according to the procedures in ASTM D3966 "Standard Test Methods for Deep Foundations Under Lateral Load." We recommend that the lateral load tests be performed on two adjacent production caissons by jacking them apart from each other. The test caissons should be cast with inclinometers so the deflected shape of the caisson with depth and the deflection at the caisson head can both be measured.

Footings on or Embedded in Rock

The foundation area within the northern part of Tower E will be supported on continuous and isolated footings bearing on or embedded in rock (slots cut into rock). The embedded footings will develop axial load capacity through a combination of peripheral shear resistance between the concrete and rock, and end-bearing on the rock.

Geotechnical Design Parameters

We recommend that the footings embedded in rock be proportioned assuming an allowable peripheral bond strength of 300 psi for compression and 150 psi for uplift. These values assume rock meeting NYC Building Code Class 1b or better, and have been confirmed based on site-specific load-transfer data obtained from two instrumented load tests performed on caissons installed within the Tower A footprint. The load test results are provided in Appendix F.

The NYC Building Code allows a maximum allowable foundation pressure of 60 tons per square foot (tsf) for NYC Building Code Class 1a rock; however, this value may be increased up to

25 percent to a maximum of 75 tsf provided that tests and/or analyses substantiate the increase. Borings indicate that rock within the Tower E footprint meets NYC Building Code Class 1a and 1b. Based on a bearing capacity analysis and the site-specific load-transfer data obtained from the caisson load tests at Tower A, we recommend that the allowable end-bearing be increased to 75 tsf plus a 10 percent increase for each foot of embedment into rock up to a maximum of 150 tsf. Inspection during construction (see later discussion) is required to verify the rock quality and the increased allowable bearing capacity.

Uplift Resistance

We recommend the uplift resistance of footings in rock at Tower E be neglected. The footings will only be embedded about 5 feet in rock such that only a small wedge of rock could be mobilized. Unfavorable jointing in the upper part of the rock mass could significantly reduce the uplift capacity of the footing. Uplift resistance provided from peripheral side shear will also depend on the quality of the rock encountered and the verticality of the side slopes, which will be difficult to maintain and will depend on construction means and methods.

We recommend uplift forces be resisted by post-tensioned tie-down anchors socketed into bedrock and embedded into the footings. Rock anchors should be double corrosion protected consisting of a PVC sheathing and grout encapsulation around the anchor bar. The free stressing length for bar anchors should be at least 10 feet, and the free stressing length for strand anchors should be at least 15 feet, regardless of the depth to rock (which may require over-drilling rock). The free stressing length of bar or strand anchors should be proportioned such that the dead weight of the engaged rock mass is greater than the individual anchor load or the sum of the group anchor loads. The engaged rock mass should be defined as the wedge formed by extending a plane 45 degrees from vertical from the midpoint of the bond length. Where multiple anchors are installed in a group, the rock mass wedge should extend upward from the outermost anchors, and the bottom of the wedge should be a level plane through the midpoint of the anchors. The anchor bond length should be proportioned using an allowable peripheral shear resistance in uplift of 150 psi. At least 10 percent of anchors should be performance-tested in accordance with PTI standards and the remaining anchors should all be proof-tested.

Lateral Resistance

For footings embedded in rock, lateral loads can be resisted by friction on the bottom of the footing. We recommend an ultimate frictional coefficient of 0.70 for mass concrete poured on clean sound rock. We recommend a minimum factor of safety of 1.5 when evaluating frictional resistance.

If additional lateral resistance is needed, passive pressures can also be evaluated.

Impact on MTA No. 7 Line Extension Tunnels (Footings)

Footings within the Tower E footprint will be located adjacent to the south interlocking tunnel section, station cavern, and T1A-T1B tunnel of the MTA No. 7 Line Extension. The footings are anticipated to extend to about elevation -10, corresponding to about 64, 42, and 50 feet above the crown of the south interlocking tunnel section, station cavern, and T1A-T1B tunnel, respectively. We are performing a finite element method (FEM) study to analyze the impact of the Tower E foundations on the MTA No. 7 Line Extension tunnels. This study will be issued under separate cover.

Excavation Methods

Rock is expected to be shallow where footings will be constructed, such that construction slopes can likely be used to excavate overburden material with slopes no steeper than 1 horizontal to 1 vertical or in small sheeted pits. The contractor or responsible subcontractor should design temporary construction slopes or sheeted pits in accordance with all OSHA, local, state and federal safety regulations. Temporary slope inclinations should be determined by the contractor or responsible subcontractor based the subsurface conditions exposed at the time of construction.

Rock excavation within the site will require careful removal techniques because of the close proximity of existing structures and tracks. The bedrock was generally high quality and hard (Class 1a and 1b) and will likely be difficult to excavate, requiring rock chipping and splitting techniques. Channel drilling is recommended around the perimeter of each footing to minimize rock overbreak during subsequent chipping and splitting work. Channel drilling consists of overlapping drill holes such that a continuous channel is constructed along the excavation line. Because of the close proximity of adjacent structures and tracks, blasting operations to remove the bedrock will likely not be permitted. To limit vibrations and assist in excavation, expansive chemical splitting agents may be considered.

Rock Verification

The NYC Building Code requires that all rock subgrade be inspected to verify the quality of the bedrock before installing reinforcing steel and concreting. In addition, because of the increased allowable bearing value, rock subgrade must be inspected by Langan to verify bearing capacity and that footings have been adequately cleaned.

Foundation Settlement

Caissons should have very small deflections, generally with a magnitude similar to elastic shortening. For the caissons shown in Table 3, the elastic compression and settlement is expected to range from less than ¼ inch to about ½ inch. Footings embedded in rock should have settlement less than ½ inch, such that differential movement between the caisson supported area and footing supported area is less than ½ inch.

Design Groundwater Level

Groundwater was encountered during our 2008 Phase II Environmental Site Investigation. Groundwater was generally observed between about elevation -4 to 0 feet. Where bedrock is shallow in the east half of the Tower E footprint, groundwater is anticipated to be perched on top of rock and will follow the rock surface contour above about elevation 1 foot. We recommend a design static groundwater level of 1 foot above the top of rock elevation or elevation 1 foot, whichever is greater.

The owner has selected a design flood level at elevation 13.35 feet.

CONSTRUCTION RECOMMENDATIONS

Subgrade Preparation for Footings Embedded in Rock

Footing bearing surfaces should be level and clear of debris, standing or frozen water, and other deleterious materials. Compressed air should be used to clean all rock surfaces. Sloping top of rock, joints, foliation, and local zones of weathered or fractured rock may require locally deepening the footing excavations further into rock. Final subgrade below all footings must be inspected by a Langan engineer.

Temporary Support of Excavation

Where sloping or sheeting is required within the overburden material, the contractor or responsible subcontractor should design temporary construction slopes or sheeting in accordance with all OSHA, local, state and federal safety regulations. Temporary slope inclinations should be determined by the contractor based on the subsurface conditions exposed at the time of construction. We recommend that all vehicles and surcharge loads be kept at least 10 feet away from the top of temporary slopes. If temporary slopes are left open for extended periods of time, exposure to weathering and rain could have detrimental effects such as sloughing and erosion. Temporary slopes should be protected from weather and damage from vehicles during construction.

Where site restrictions prevent the use of temporary slopes, temporary excavation support will be required. Temporary excavation support must be designed by the Contractor's professional engineer. The Contractor must retain a qualified geotechnical engineer to be approved by the construction manager, owner, and owner's engineer. Temporary excavation support through soil should be designed assuming a minimum soil unit weight of 130 pounds per cubic foot and a friction angle of 30 degrees. Temporary excavation support should also be designed to resist lateral pressures from surface surcharge loads from standard construction equipment as well as surcharge loads from trains. At a minimum, all temporary excavation support should conform to the requirements outlined in the MTA document "Field Design Standards" (DG-

453). The Contractor's design must be reviewed by the Owner or Owner's geotechnical engineer prior to any excavation work; however, performance of the system rests solely with the Contractor

Temporary Construction Dewatering

Localized excavations for the footings may be below the static groundwater level; therefore, temporary construction dewatering may be required. Controlling the groundwater will be critical in order to allow for subgrade preparation and foundation construction. We expect that groundwater should be controllable with sump pumps during foundation work.

All groundwater discharged from the site into NYC sewers will require temporary dewatering permits from the NYCDEP. Treatment may be required where the groundwater is found insufficient for meeting water quality standards dictated by the regulatory agencies having jurisdiction.

Fill Materials, Placement, and Compaction

Fill should be limited to utility trenches and minor earthwork. Fill placed to establish the finished subgrade should consist of a well-graded durable granular material having a maximum particle size of 4 inches in any dimension, and no more than 10 percent fines passing the No. 200 sieve. All fill should be free of trash, debris, roots, vegetation, peat, or other deleterious materials and should be approved by the geotechnical engineer prior to placement. Lean concrete or controlled low-strength material (CLSM) may be substituted for structural fill.

Fill should be placed in uniform loose lifts not exceeding 8 inches in open areas and 4 inches in confined areas. All fill should be compacted to at least 95 percent of the soil's maximum dry density as determined by ASTM D1557 "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort." The water content at the time of compaction should be within a 2 percent of the optimum value determined by ASTM D1557.

All voids created during construction must be backfilled.

Fill should not be placed on subgrades not inspected and approved by the geotechnical engineer. All fill must meet the requirements of the approved Remedial Action Work Plan (see below).

E-Designated Soil Management

Per City Environmental Quality Review (CEQR), the ERY is E-Designated (E-137) for Hazardous Materials and Noise. This designation requires oversight of remedial investigations and actions by the New York City Office of Environmental Remediation (OER). Soil management (excavation, staging, transport, disposal and importing) must follow all requirements of the approved Remedial Action Work Plan (RAWP).

Monitoring

We recommend that a monitoring program be developed and incorporated into the Contract Documents. Monitoring should include means to measure both structural movement and vibrations from construction operations. The type and locations of specific monitoring equipment, threshold values, and durations should be developed based on review of the anticipated construction means and methods in conjunction with proximity to existing structures and utilities. The purpose of performing monitoring is to provide reasonable feedback to the engineer as to performance of the contractor with respect to protecting existing structures and utilities, and to assess any necessary changes to means and methods of construction.

Specific requirements for monitoring are likely to be imposed by governing agencies including NYCDOT, MTA, and Amtrak. Critical structures which are likely to require monitoring include:

1) the rail tracks (LIRR),
2) the West 33rd Street/Tenth Avenue retaining wall (NYCDOT),
3) the Amtrak North Access Tunnel (Amtrak),
4) the Amtrak North River Tunnels (Amtrak)),
5) the Amtrak emergency evacuation tunnel (Amtrak),
6) the Eleventh Avenue viaduct (NYCDOT), and
7) the No. 7 Line Extension structures (NYCT).

We recommend that a dialog be established with all governing agencies as soon as possible to determine specific monitoring requirements.

The monitoring program would likely include optical surveying, seismographs (vibration monitoring), and crack gauges. We recommend that a plan be developed after discussion with the governing agencies noted above and further development of design drawings. Given the expected duration for excavation, consideration should be given to installing remote sensors capable of relaying data in real-time via wireless communications. The monitoring plan should address means and methods for measuring ground and structural deformation, and vibration levels. We recommend that all monitoring be performed by a third-party consultant independent of the contractor; however, the contractor should reserve the right to perform additional monitoring. Monitoring should be performed throughout excavation and foundation construction.

Preconstruction Conditions Documentation

We recommend that preconstruction conditions documentation be performed, for any structures to remain, about one month prior to commencing construction activities. This would most likely include the tracks, West 33rd Street and Tenth Avenue retaining wall, existing Amtrak tunnels, Eleventh Avenue viaduct, and MTA No. 7 Line Extension structures. The purpose of these observations is to provide photographic and video documentation representative of general existing conditions and identify obvious visual deficiencies. The preconditions observations should also identify areas requiring specific monitoring during construction. Structural integrity is not addressed in such documentation. This baseline information is often critical in the event of future damage claims resulting from construction activities.

Special Inspections

Excavation and foundation work are subject to various Special Inspections as per the requirements outlined in Chapter 17 of the NYC Building Code and the Rules of the City of New York. Construction activities that require geotechnical quality control inspections include installation of the caisson foundations, excavation, subgrades, and lateral support systems, backfilling, and compaction. This work must be performed under the inspection of a qualified geotechnical engineer and should be performed by Langan. Inspection of the rock subgrade must be performed by Langan to justify the higher capacity. The inspecting engineer should be familiar with the subsurface conditions, as well as the proposed and existing construction onsite. We recommend that all inspectors meet the requisite qualifications outlined in 1RCNY 101-06.

CONSTRUCTION DOCUMENTS

Technical specifications and design drawings should incorporate our recommendations to ensure that subsurface conditions and other geotechnical issues at the site are adequately addressed in the construction documents. Langan should assist the design team in preparing specification sections related to geotechnical issues such as earthwork, deep foundation installation, and excavation support. Langan should also review foundation drawings and details, and all contractor submittals and construction procedures related to geotechnical work.
We recommend that the language in foundation and earthwork specifications emphasize the potential for encountering buried obstructions during excavation and foundation drilling with the intent of mitigating change-of-conditions claims arising during construction. All excavation and drilling should be assumed to be unclassified such that the contractor is responsible for providing the necessary performance of the foundation system regardless of conditions encountered.

OWNER AND CONTRACTOR OBLIGATIONS

The contractor is responsible for construction quality control, which includes satisfactorily constructing the foundation system and any associated temporary works to achieve the design intent while not adversely impacting or causing loss of support to neighboring structures. Proper management of excavated soil is also solely the responsibility of the contractor.

Construction activities that can alter the existing ground conditions such as excavation, fill placement, foundation construction, ground improvement, dewatering, etc. can also potentially induce stresses, vibrations, and movement in nearby structures and utilities, and disturb occupants of nearby structures. Contractors working at the site must ensure that their activities will not adversely affect the performance of the structures and utilities, and will not disturb occupants of nearby structures. Contractors must also take all necessary measures to protect the existing structures during construction. By using this report, the Owner agrees that Langan will not be held responsible for any damage to adjacent structures.

The preparation and use of this report is based on the condition that the project construction contract between the Owner and their Contractor(s) will include: 1) Langan being added to the Project Wrap and/or Contractor’s General Liability insurance as an additional insured, and 2) language specifically stating the Foundation Contractor will defend, indemnify, and hold harmless the Owner and Langan against all claims related to disturbance or damage to adjacent structures or properties.

LIMITATIONS

The conclusions and recommendations provided in this report are based on subsurface conditions inferred from a limited number of borings, in situ testing, and test pits performed within the Tower E site, and information provided by others.

This report has been prepared to assist the owner, architect, and structural engineer in the design process and is only applicable to the envisioned project discussed herein. Any proposed changes in structures or their locations should be brought to our attention so that we can determine whether such changes affect our recommendations. Langan cannot assume responsibility for use of this report for any areas beyond the limits of this study or for any projects not specifically discussed herein. This report shall not be used for the design of temporary works including scaffolding, construction hoists, and crane pads.

Information on subsurface strata and groundwater levels shown on the logs represents conditions encountered only at the locations indicated and at the time of investigation. If different conditions are encountered during construction, they should immediately be brought to our attention for evaluation as this may affect our recommendations.

Environmental issues (such as potentially contaminated soil and groundwater) are outside the scope of this study. This site is within the E-designated area and must follow all requirements of the approved RAWP.

REFERENCES

Baskerville, C.A. (1994) "Bedrock and Engineering Geology Maps of New York County, and parts of Kings and Queens Counties, New York, and parts of Bergen and Hudson Counties, New Jersey". I-MAP 2306, Sheets 1&2, USGS.

Viele (1865) "Sanitary & Topographical Map of the City and Island of New York" Prepared for the Council of Hygiene and Public Health of the Citizens Association. Under the direction of Egbert L. Viele, Topographical Engineer. Entered 1865 by Egbert L. Viele New York. Ferd. Mayer & Co. Lithographers, 96 Fulton St. N.Y.

Youd, T.L., and Idress, I.M. et al, (2001) "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils" ASCE Journal of Geotechnical and Geoenvironmental Engineering, Vol. 127, No. 4, April.

DRAWINGS

DEPT OF BLDGS 121192618 Job Number

ES132058835 Scan Code

REFERENCE:

USGS QUADRANGLE MAPS (WEEHAWKEN , CENTRAL PARK, BROOKLYN, JERSEY CITY)

LEGEND

- ☐ TERRA FIRMA SITE
- ☐ TOWER A
- ☐ RETAIL PODIUM
- ☐ PLATFORM
- ▨ TOWER E

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Langan International LLC
Collectively known as Langan

Project

HUDSON YARDS
TOWER E

MANHATTAN NEW YORK

Drawing Title

SITE LOCATION MAP

Project No.
170019120

Date
11/15/2013

Scale
N.T.S.

Drawn By
JSH

Submission Date
11/15/2013

Drawing No.
1

LANGAN

GENERAL NOTES:

1. EXISTING CONDITIONS INFORMATION TAKEN FROM TOPOGRAPHIC & BOUNDARY SURVEY PREPARED BY LANGAN ENGINEERING & ENVIRONMENTAL SERVICES, P.C. TITLED "HUDSON YARDS FINAL TOPO SURVEY," DATED 15 JANUARY 2013.

2. ALL ELEVATIONS CONTAINED WITHIN THIS DRAWING REFERENCE THE BOROUGH PRESIDENT OF MANHATTAN DATUM (BPMD) WHICH IS 2.75 FT ABOVE MEAN SEA LEVEL AT SANDY HOOK, NJ AS DEFINED BY THE UNITED STATES GEOLOGIC SURVEY (USGS NGVD 1929).

DATUM CONVERSIONS:

NGVD29 = BPMD + 2.75'
NAVD88 = BPMD + 1.65'
PENN = BPMD + 300.025'
NYCT = BPMD + 100.097'

30 0 15 30
SCALE IN FEET

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Collectively known as Langan

HUDSON YARDS
TOWER E

MANHATTAN NEW YORK

Drawing Title

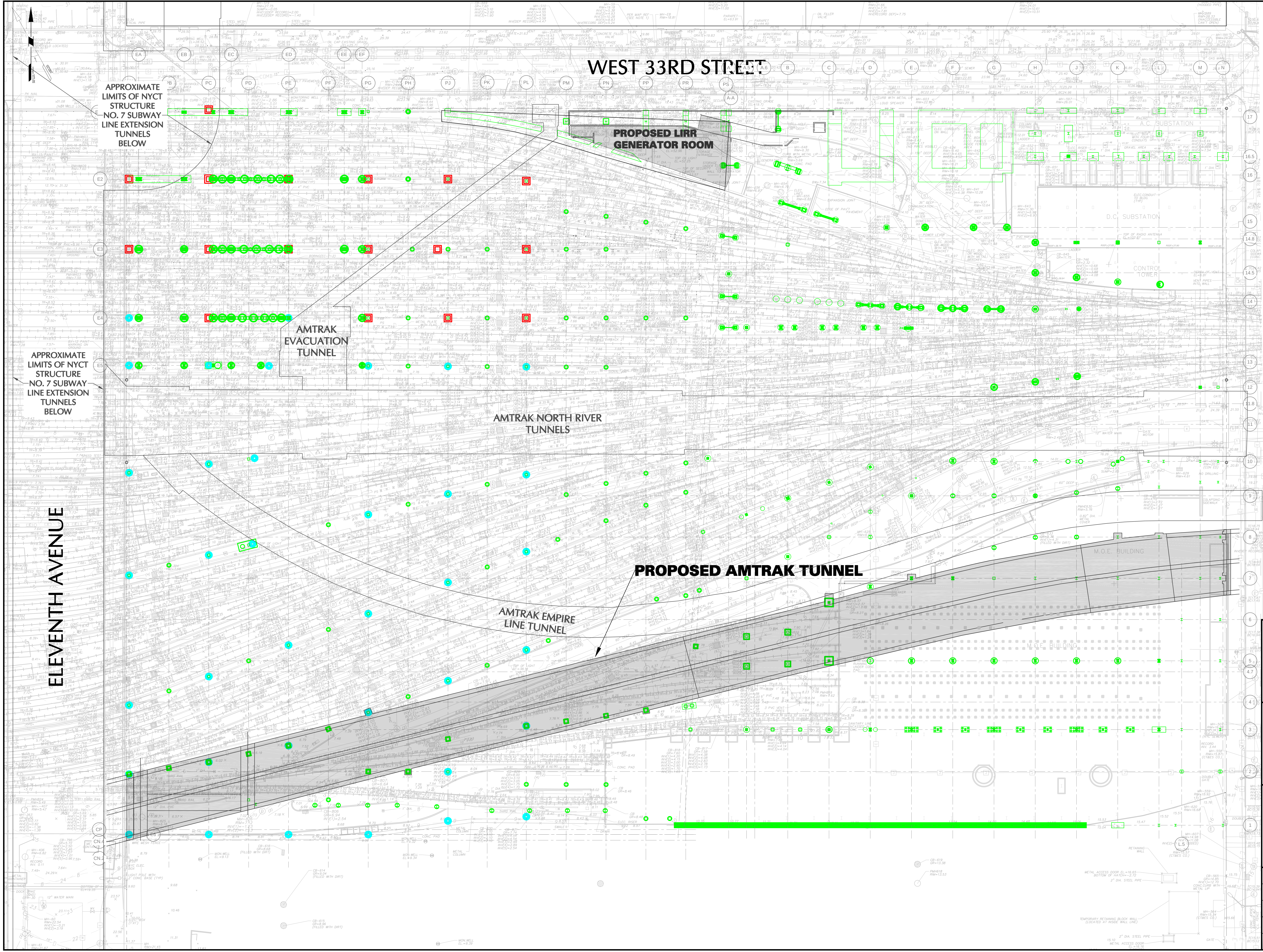
EXISTING CONDITIONS

Project No.
170019120
Date
11/15/2013
Scale
1" = 30'
Drawn By
JSH
Submission Date
11/15/2013

Drawing No.
2

DEPT OF BLDGS 121192618 Job Number

ES499335469 Scan Code



GENERAL NOTES:

1. EXISTING CONDITIONS INFORMATION TAKEN FROM TOPOGRAPHIC & BOUNDARY SURVEY PREPARED BY LANGAN ENGINEERING & ENVIRONMENTAL SERVICES, P.C. TITLED "HUDSON YARDS FINAL TOPO SURVEY," DATED 15 JANUARY 2013.
2. PROPOSED CONSTRUCTION INFORMATION TAKEN FROM DRAWINGS S-102 PREPARED BY THORNTON TOMASETTI, TITLED "PLATFORM PHASE 1 – FOUNDATIONS, LIRR 60% SUBMISSION" DATED 29 MARCH 2013.
3. ALL ELEVATIONS CONTAINED WITHIN THIS DRAWING REFERENCE THE BOROUGH PRESIDENT OF MANHATTAN DATUM (BPMD) WHICH IS 2.75 FT ABOVE MEAN SEA LEVEL AT SANDY HOOK, NJ AS DEFINED BY THE UNITED STATES GEOLOGIC SURVEY (USGS NGVD 1929).

DATUM CONVERSIONS:

NGVD29 = BPMD + 2.75'
NAVD88 = BPMD + 1.65'
PENN = BPMD + 300.025'
NYCT = BPMD + 100.097'

LEGEND

🟥 EXISTING MABSTOA FOOTING (RED)
● EXISTING MABSTOA CAISSON (BLUE)
🟩 PROPOSED FOUNDATION ELEMENT (GREEN)

30 0 15 30
SCALE IN FEET

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Collectively known as Langan

HUDSON YARDS TOWER E

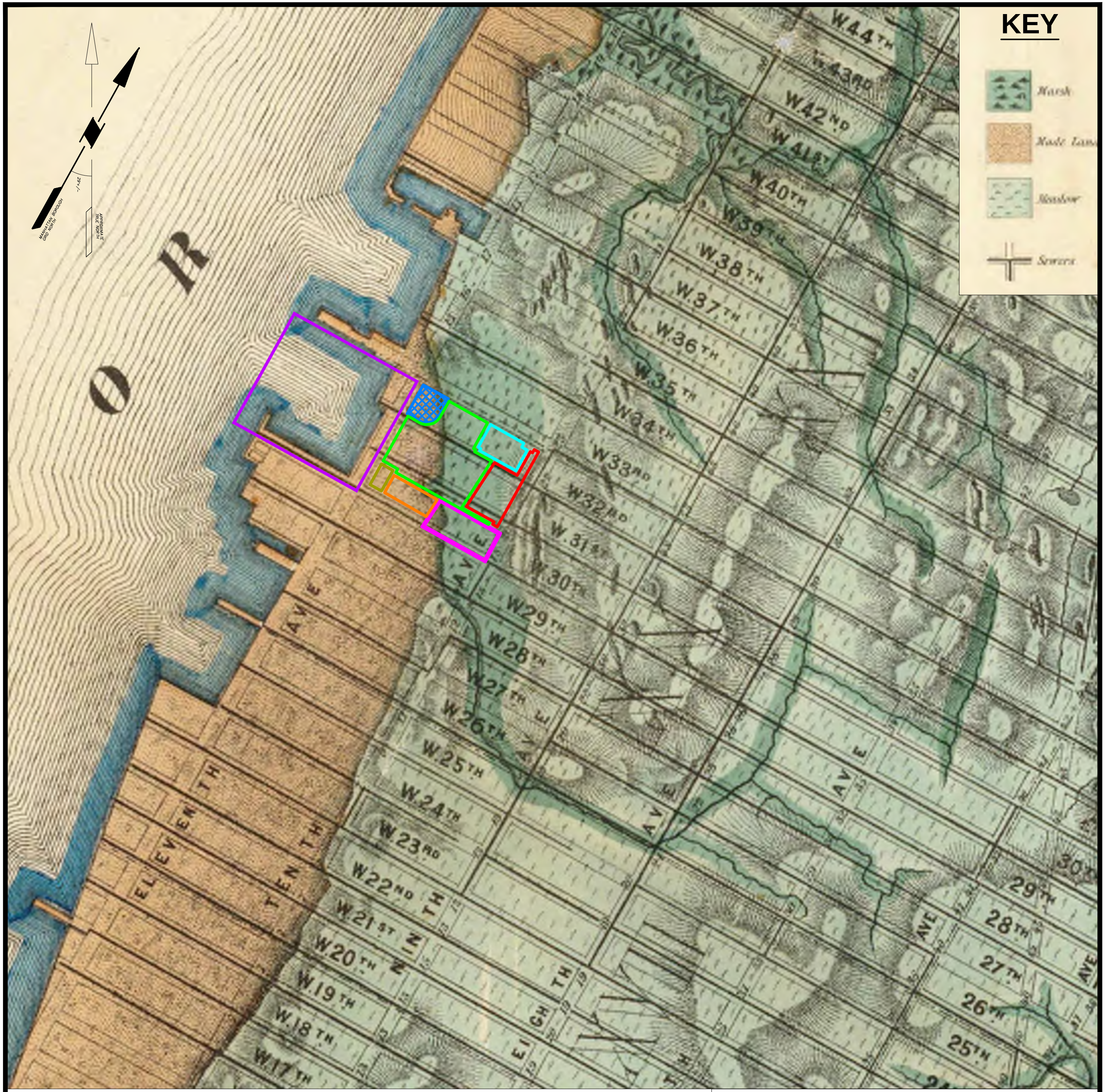
MANHATTAN NEW YORK

Drawing Title

PROPOSED CONSTRUCTION

Project No.
170019120
Date
11/15/2013
Scale
1" = 30'
Drawn By
JSH
Submission Date
11/15/2013

Drawing No.
3



SOURCE:

SANITARY & TOPOGRAPHICAL MAP OF THE CITY AND ISLAND OF NEW YORK (VIELE, 1865)

LEGEND

☐ TOWER C	☐ TOWER A
☐ TOWER D	☐ RETAIL PODIUM
☐ CULTURE SHED	☐ PLATFORM
☐ WEST YARDS	▨ TOWER E

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Collectively known as Langan

Project

HUDSON YARDS
TOWER E

MANHATTAN NEW YORK

Drawing Title

1865 SANITARY AND TOPOGRAPHICAL MAP

Project No. 170019120
Date 11/15/2013
Scale N.T.S.
Drawn By JSH
Submission Date 11/15/2013

Drawing No.
4

DEPT OF BLDGS 121192618 Job Number

ES109358301 Scan Code

LANGAN

REFERENCE:
MAP OF THE CITY OF NEW YORK AND ISLAND OF MANHATTAN, W. BRIDGES, 1814.

LEGEND

- 🟪 TOWER C
- 🟦 TOWER A
- 🟨 TOWER D
- 🟥 RETAIL PODIUM
- 🟧 CULTURE SHED
- 🟩 PLATFORM
- 🟪 WEST YARDS
- ▨ TOWER E

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Collectively known as Langan

HUDSON YARDS
TOWER E

MANHATTAN   NEW YORK

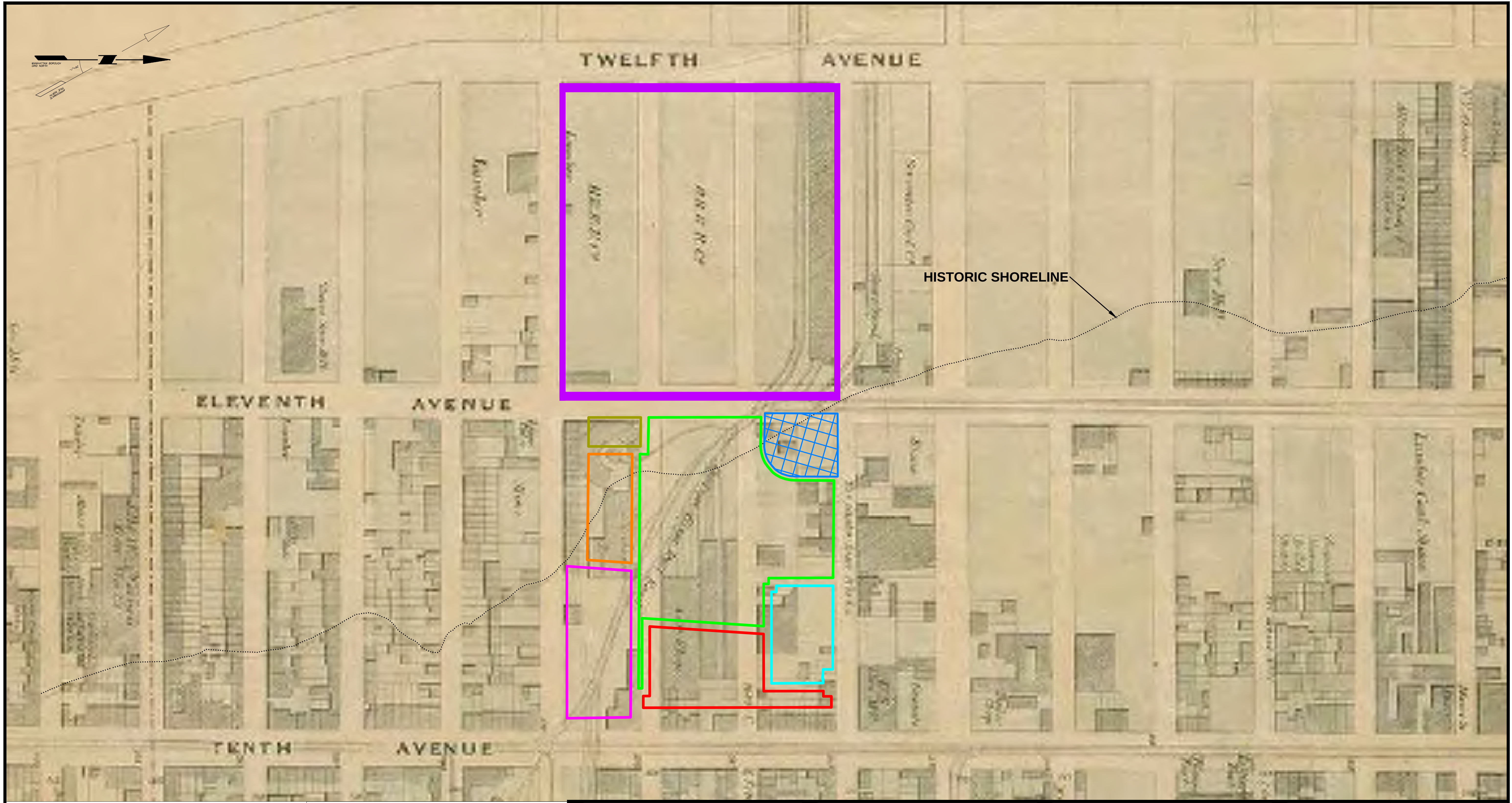
HISTORIC SITE MAP
(W. BRIDGES, 1814)

Project No.
170019120
Date
11/15/2013
Scale
NTS
Drawn By
JSH
Submission Date
11/15/2013

Drawing No.
5

DEPT OF BLDGS 121192618 Job Number

ES137490182 Scan Code



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REFERENCE:

PLAN OF THE CITY OF NEW YORK FROM THE BATTERY SPUYTEN DUYVIL CREEK, PLATE 9 OF 20, M. DRIPPS, 1867.

NOTE: HISTORIC SHORELINE HAS BEEN HIGHLIGHTED FOR CLARITY

LEGEND

☐ TOWER C	☐ TOWER A
☐ TOWER D	☐ RETAIL PODIUM
☐ CULTURE SHED	☐ PLATFORM
☐ WEST YARDS	▨ TOWER E

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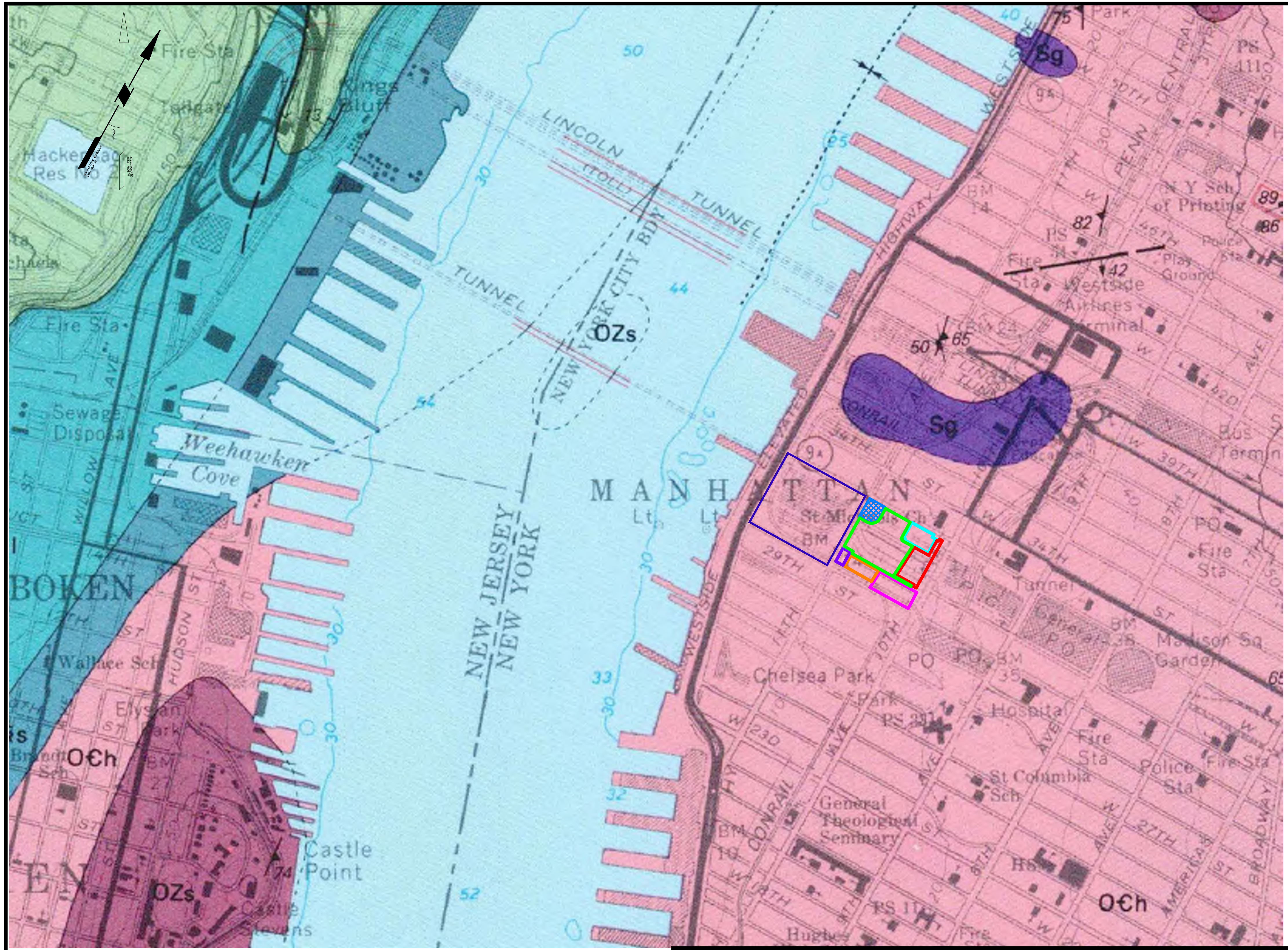
HUDSON YARDS TOWER E

MANHATTAN NEW YORK

HISTORIC SITE MAP (M. DRIPPS, 1867)

Project No.
170019120
Date
11/15/2013
Scale
NTS
Drawn By
JSH
Submission Date
11/15/2013

Drawing No.
6



KEY:

OCh / OChm **Hartland Formation (Middle Ordovician to Lower Cambrian)**— *West of the East River*—Interbedded units of the following:

1. Gray and gray-weathering, fine-grained quartz-feldspar granulite containing minor biotite and garnet;
2. Fine- to coarse-grained, gray- to tan-weathering, quartzofeldspathic, muscovite-biotite-garnet schist. The muscovite flakes are commonly large and may give outcrops a "spangled" or shiny metallic look; some outcrops have knotty kyanite surfaces;
3. Dark-greenish-black quartz-biotite-hornblende amphibolite; weathers black or rusty along fractures.

Much of the schist is magnetic. The Hartland here is in thrust-fault contact with the underlying Manhattan Schist on the Cameron's Line thrust, which goes beneath the Jurassic and Triassic Newark basin sediments (see sections *C–C'* and *D–D'*).

Sg **Granite pegmatite or granitoid (Silurian?)**—Grayish-white to white, medium- to coarse-grained, biotite-muscovite-microcline-quartz granite and megacrystalline pegmatite in dikes generally less than 3.3 ft thick and sills generally more than 3.3 ft thick. Accessory minerals are tourmaline, pyrite, garnet, and epidote. Megacrystalline thick sills occur in the Hartland Formation. Thinner sills are present in all units and are commonly exposed in cuts. These rocks are assigned a Silurian(?) age because of their general crosscutting relationship to the Ordovician rock units in which they are found

NOTES

1. ELEVATIONS CONTAINED WITHIN THIS MAP REFERENCE THE UNITED STATES GEOLOGICAL SURVEY NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29).

   DATUM CONVERSIONS:
   NGVD29 = BPMD + 2.75'
   NAVD88 = BPMD + 1.65'
   PENN = BPMD + 300.025'
   NYCT = BPMD + 100.097'

2. REFERENCE: USGS BEDROCK AND ENGINEERING GEOLOGY MAPS OF NEW YORK COUNTY, AND PARTS OF KINGS AND QUEENS COUNTIES, NEW YORK AND PARTS OF BERGEN AND HUDSON COUNTIES, NEW JERSEY. USGS 1994, C.A. BASKERVILLE.

LEGEND

☐ TOWER C	☐ TOWER A
☐ TOWER D	☐ RETAIL PODIUM
☐ CULTURE SHED	☐ PLATFORM
☐ WEST YARDS	▨ TOWER E

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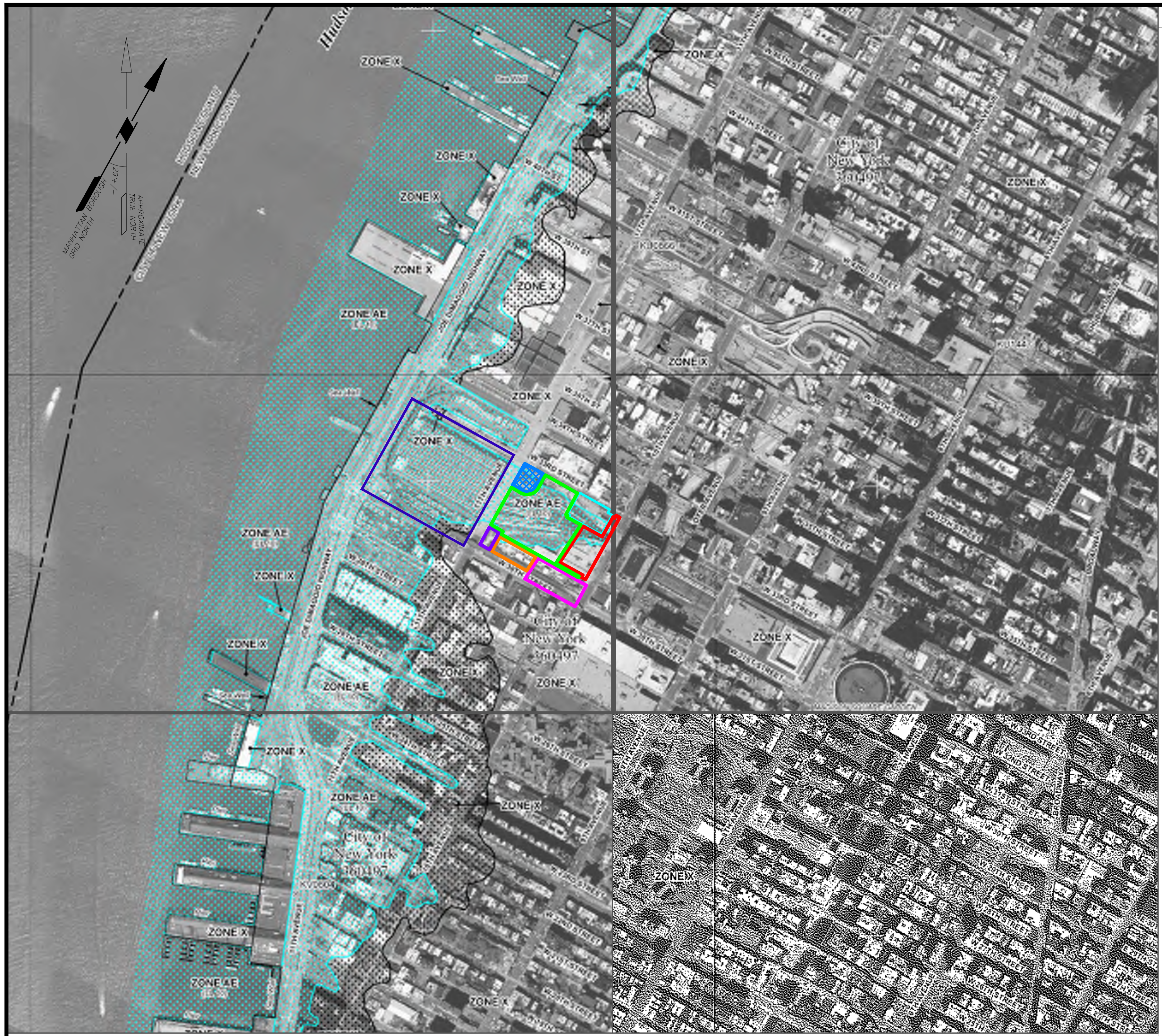
HUDSON YARDS
TOWER E

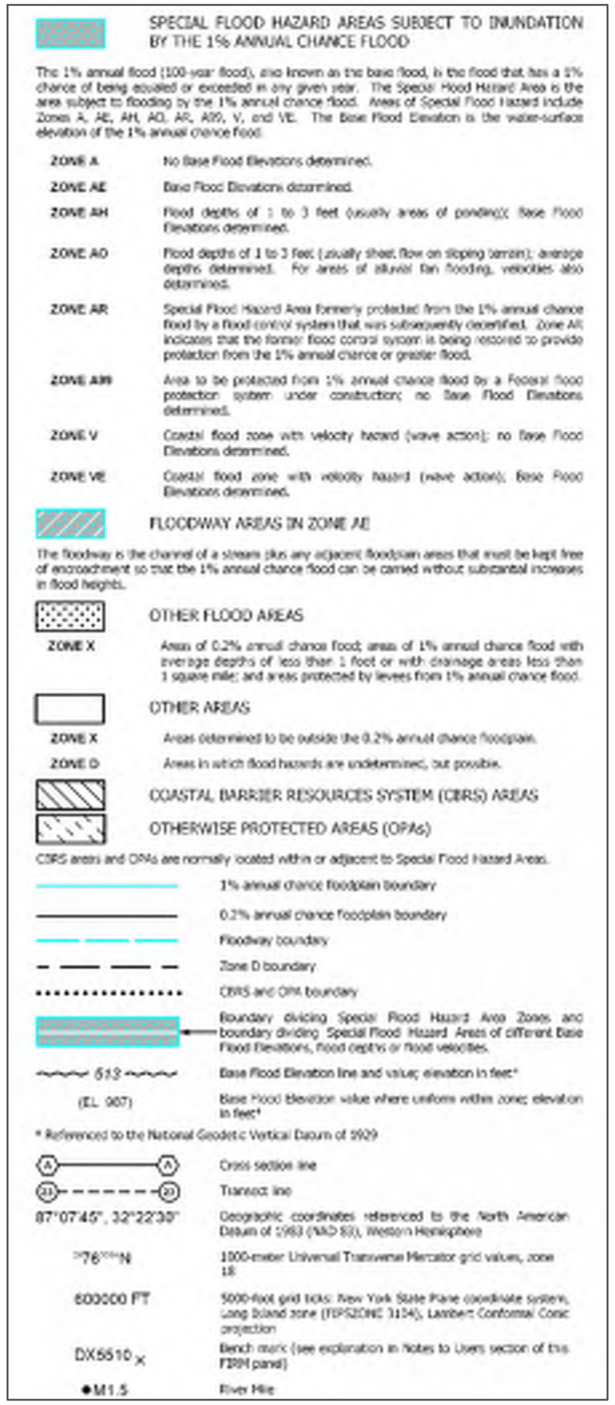
MANHATTAN NEW YORK

GEOLOGIC MAP

Project No. 170019120
Date 11/15/2013
Scale NTS
Drawn By JSH
Submission Date 11/15/2013

Drawing No. 7





SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

———	1% annual chance floodplain boundary
———	0.2% annual chance floodplain boundary
— — —	Floodway boundary
– — — –	Zone D boundary
• • • • • • • •	CBRS and OPA boundary
▨	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the National Geodetic Vertical Datum of 1929

Ⓐ——Ⓐ	Cross section line
㉓- - - -㉓	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
⁴⁹76⁰⁰⁰N	1000-meter Universal Transverse Mercator grid values, zone 18
600000 FT	5000-foot grid ticks: New York State Plane coordinate system, Long Island zone (FIPSZONE 3104), Lambert Conformal Conic projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
●M1.5	River Mile

NOTES

1. ELEVATIONS CONTAINED WITHIN THIS MAP REFERENCE THE UNITED STATES GEOLOGICAL SURVEY NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29).

   DATUM CONVERSIONS:
   NGVD29 = BPMD + 2.75'
   NAVD88 = BPMD + 1.65'
   PENN = BPMD + 300.025'
   NYCT = BPMD + 100.097'

2. REFERENCE: FEDERAL EMRGENCY MANAGEMENT AGENCY (FEMA) FLOOD INSURANCE RATE MAP (FIRM), CITY OF NEW YORK, NEW YORK, PANELS 69, 88, 182, AND 201 OF 457, REVISED 5 SEPTEMBER 2007, MAP NOs. 3604970069F, 3604970088F, 3604970182F, 3604970201F

LEGEND

☐ TOWER C	☐ TOWER A
☐ TOWER D	☐ RETAIL PODIUM
☐ CULTURE SHED	☐ PLATFORM
☐ WEST YARDS	▦ TOWER E

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HUDSON YARDS TOWER E

MANHATTAN NEW YORK

FEMA 100-YEAR FLOOD PLAIN MAP

Project No. 170019120
Date 11/15/2013
Scale N.T.S.
Drawn By JSH
Submission Date 11/15/2013
Drawing No. 8

DEPT OF BLDGS 121192618 Job Number

ES762003830 Scan Code

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
	Limit of Moderate Wave Action
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

	Cross section line
	Transect line
	Culvert, Flume, Penstock or Aqueduct
	Road or Railroad Bridge
	Footbridge
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4276000mN	1000-meter Universal Transverse Mercator grid values, zone 18
600000 FT	5000-foot grid values: New York State Plane coordinate system, Long Island zone (FIPSZONE 3104), Lambert Conformal Conic projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

NOTES

1. ELEVATIONS CONTAINED WITHIN THIS MAP REFERENCE THE UNITED STATES GEOLOGICAL SURVEY NATIONAL GEODETIC VERTICAL DATUM OF 1929 (USGS NGVD).

   DATUM CONVERSIONS:

   NGVD29 = BPMD + 2.75'
   PENN = USGS + 300.025'

2. REFERENCE: FEDERAL EMRGENCY MANAGEMENT AGENCY (FEMA) FLOOD INSURANCE RATE MAP (FIRM), CITY OF NEW YORK, NEW YORK, PANELS 69, 88, 182, AND 201 OF 457, REVISED 5 DECEMBER 2013, MAP NOs. 3604970069G, 3604970088G, 3604970182G, 3604970201G.

LEGEND

☐ TOWER C	☐ TOWER A
☐ TOWER D	☐ RETAIL PODIUM
☐ CULTURE SHED	☐ PLATFORM
☐ WEST YARDS	▨ TOWER E

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NJ Certificate of Authorization No: 24GA27996400

HUDSON YARDS
TOWER E

MANHATTAN NEW YORK

FEMA PRELIMINARY REVISED FLOOD MAP

Project No.	170019120
Date	11/15/2013
Scale	N.T.S.
Drawn By	JSH
Submission Date	11/15/2013
Drawing No.	9

LANGAN

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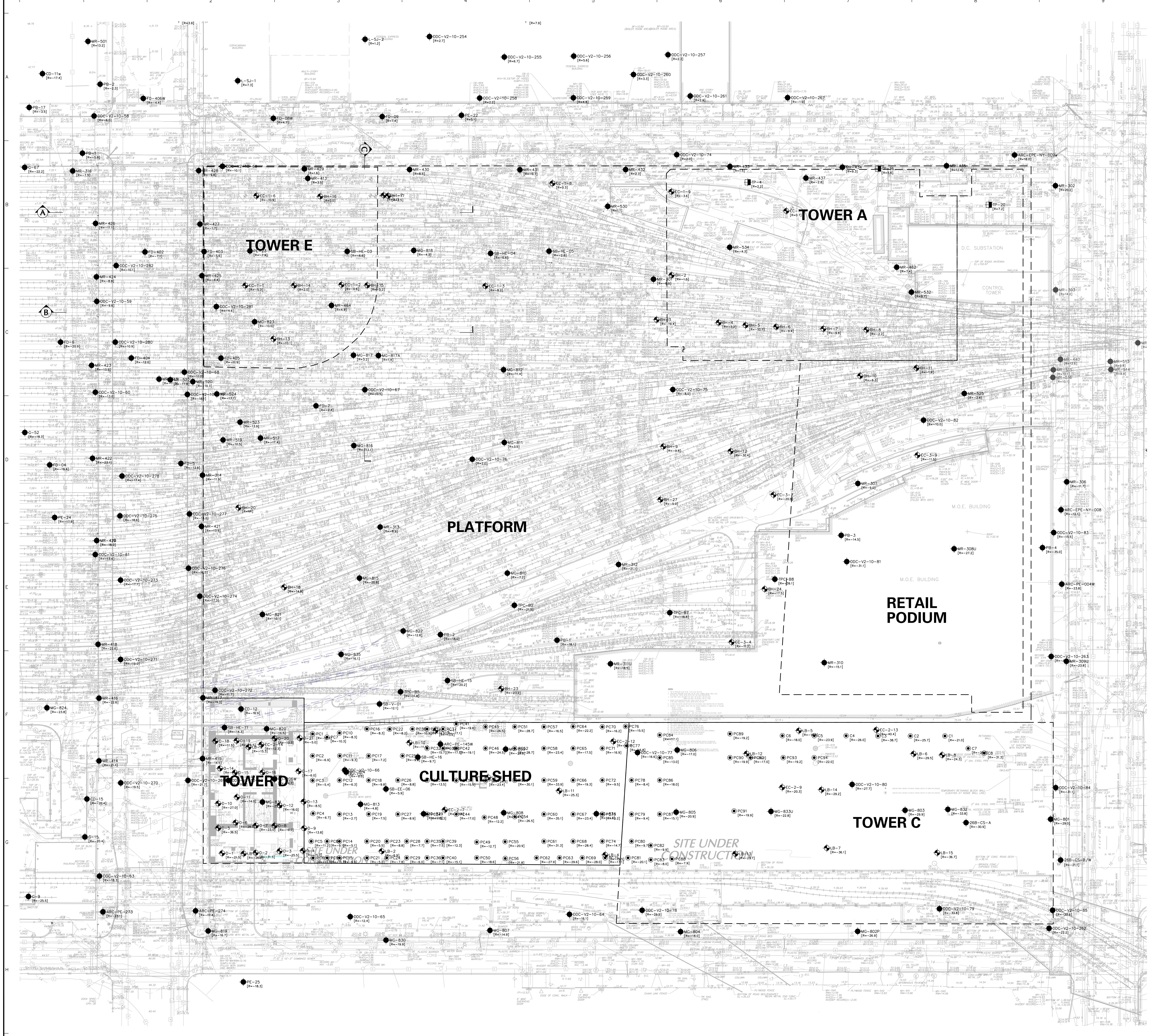

GENERAL NOTES:

1. EXISTING CONDITIONS INFORMATION TAKEN FROM TOPOGRAPHIC & BOUNDARY SURVEY PREPARED BY LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING AND LANDSCAPE ARCHITECTURE, D.P.C. TITLED "HUDSON YARDS FINAL TOPO SURVEY," DATED 20 JUNE 2013.
2. PROPOSED CONSTRUCTION INFORMATION TAKEN FROM STRUCTURAL DRAWINGS PREPARED BY WSP CANTOR SEINUK, REVISED SD ISSUE DATED 6 MAY 2013.
3. ALL ELEVATIONS CONTAINED WITHIN THIS DRAWING REFERENCE THE BOROUGH PRESIDENT OF MANHATTAN DATUM (BPMD) WHICH IS 2.75 FT ABOVE MEAN SEA LEVEL AT SANDY HOOK, NJ AS DEFINED BY THE UNITED STATES GEOLOGIC SURVEY (USGS NGVD 1929).

DATUM CONVERSIONS:
NAVD88 = BPMD + 1.65'
NGVD29 = BPMD + 2.75'
PENN = BPMD + 300.025'
NYCT = BPMD + 100.097'

4. ALL LANGAN BORING AND TEST PIT LOCATIONS WERE SURVEYED BY LANGAN. ALL OTHER BORING LOCATIONS SHOULD BE CONSIDERED APPROXIMATE.
5. BEDROCK ELEVATIONS CONTAINED HEREIN HAVE BEEN DETERMINED USING MULTIPLE DATA SOURCES. LANGAN MAKES NO WARRANTY AS TO THE ACCURACY OF THIS DATA.
6. BORINGS SHOWN HEREON WERE USED IN DEVELOPING ROCK EVALUATION; SOME HISTORICAL BORINGS WERE OMITTED AS LACKING INFO.
7. MR AND MG BORING SERIES WERE PERFORMED PRIOR TO ROCK EXCAVATION FOR EAST RAILYARD CONSTRUCTION. SOME OF THE BORINGS ARE NOT REPRESENTATIVE OF CURRENT CONDITIONS AND WERE NOT CONSIDERED IN ROCK CONTOUR MAP.

LEGEND:

⊕	D−1 [R=−20.0]	LANGAN BORING 2013 APPROXIMATE ELEVATION (TOP OF ROCK)
⊕	BH−1 [R=−20.0]	LANGAN BORING 2013 APPROXIMATE ELEVATION (TOP OF ROCK)
⊕	LB−1 [R=−20.0]	LANGAN BORING 2011-2012 APPROXIMATE ELEVATION (TOP OF ROCK)
●	BOR [R=−20.0]	BORINGS BY OTHERS (SEE LIST BELOW) APPROXIMATE ELEVATION (TOP OF ROCK)
●	BOR [R=−20.0]	BORINGS BY OTHERS (SEE LIST BELOW), NOT USED IN SURFACE APPROXIMATE ELEVATION (TOP OF ROCK)
◧	TP−1 [R=−20.0]	LANGAN TEST PIT (2013) APPROXIMATE ELEVATION (TOP OF ROCK)
◉	PC1 [R=−6.9]	LANGAN DRIVEN PILES (2013) APPROXIMATE ELEVATION (TOP OF ROCK)

BORING SERIES INFORMATION:

EC	HUDSON YARDS, LANGAN 2008
CD	NO. 7 SUBWAY EXTENSION, PB TEAM 2003
SB	NO. 7 SUBWAY EXTENDION, PB TEAM 2004
FD	NO. 7 SUBWAY EXTENSION, PB TEAM 2005
PE	NO. 7 SUBWAY EXTENSION, PB TEAM 2007
V2-10	VARIOUS PROJECTS COMPILED BY NYCDDC
MR	VARIOUS, WESTSIDE YARDS, MRCE 1980
MG	MABSTOA GARAGE AREA, MRCE 1982
TP	EAST RAIL YARD, LANGAN 2008
ARC	PROPOSED ARC TUNNEL, NJ TRANSIT 2007
PB	GATEWAY HUDSON YARDS, PB 2013
TPC	GATEWAY HUDSON YARDS, PB 2013

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SCALE IN FEET

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Langan Engineering and Environmental Services, Inc.
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Project

HUDSON YARDS
TOWER E

MANHATTAN NEW YORK

Drawing Title

SITE
INVESTIGATION
PLAN

Project No.
170019120
Date
11/15/2013
Scale
1"=30'
Drawn By
SMG
Submission Date
11/15/2013

Drawing No.
10

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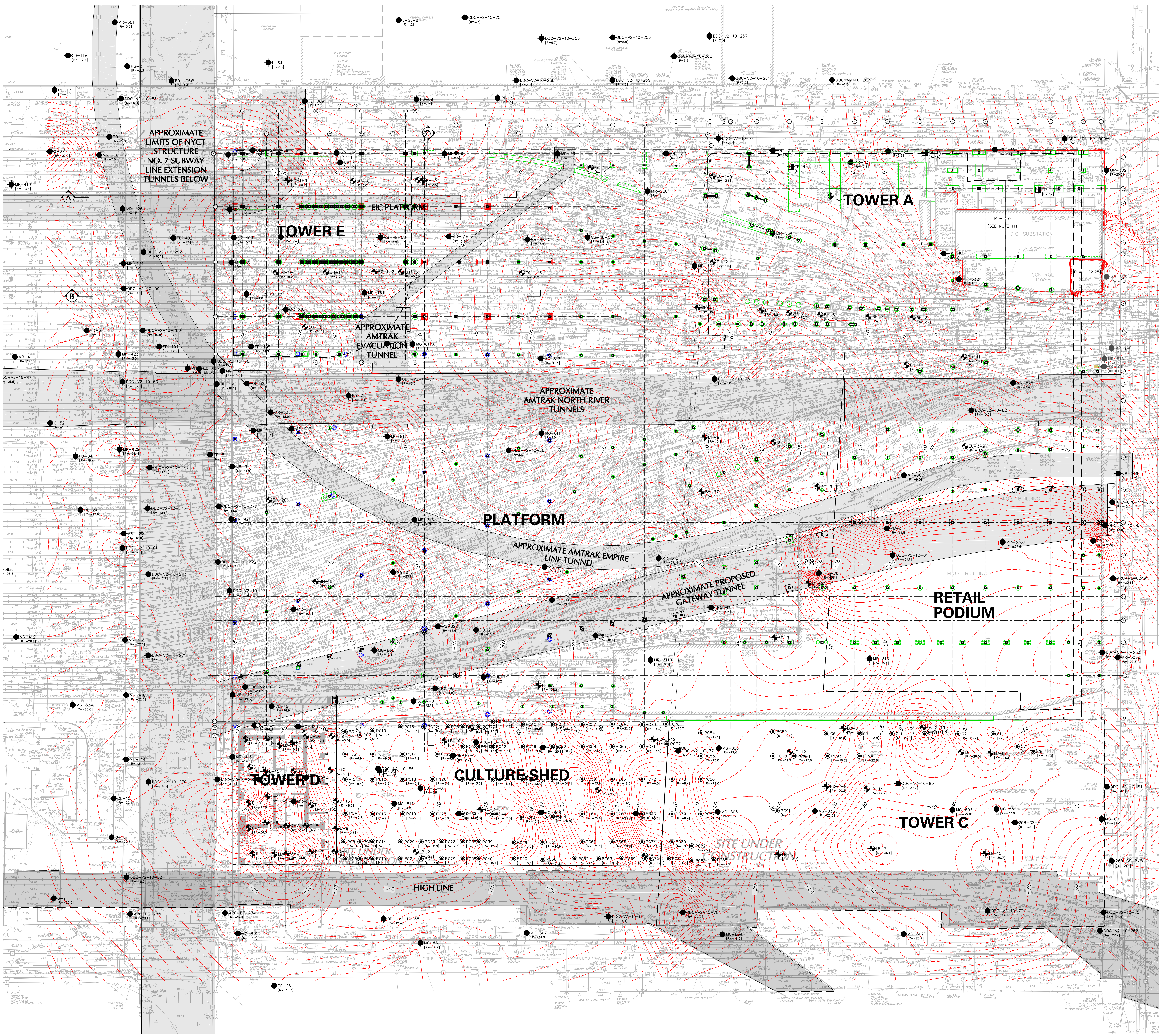

GENERAL NOTES:

1. EXISTING CONDITIONS INFORMATION TAKEN FROM TOPOGRAPHIC & BOUNDARY SURVEY PREPARED BY LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING AND LANDSCAPE ARCHITECTURE, D.P.C. TITLED "HUDSON YARDS FINAL TOPO SURVEY," DATED 20 JUNE 2013.

2. EXISTING AMTRAK TUNNELS HAVE NOT BEEN SURVEYED. ALL AMTRAK TUNNEL LIMITS SHOULD BE CONSIDERED APPROXIMATE.

3. PROPOSED CONSTRUCTION INFORMATION TAKEN FROM STRUCTURAL DRAWINGS PREPARED BY WSP CANTOR SEINUK, REVISED SD ISSUE DATED 6 MAY 2013.

4. ALL ELEVATIONS CONTAINED WITHIN THIS DRAWING REFERENCE THE BOROUGH PRESIDENT OF MANHATTAN DATUM (BPMD) WHICH IS 2.75 FT ABOVE MEAN SEA LEVEL AT SANDY HOOK, NJ AS DEFINED BY THE UNITED STATES GEOLOGIC SURVEY (USGS NGVD 1929).

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NYCT = BPMD + 100.097'

5. ALL LANGAN BORING AND TEST PIT LOCATIONS WERE SURVEYED BY LANGAN. ALL OTHER BORING LOCATIONS SHOULD BE CONSIDERED APPROXIMATE.

6. BEDROCK ELEVATIONS CONTAINED HEREIN HAVE BEEN DETERMINED USING MULTIPLE DATA SOURCES. LANGAN MAKES NO WARRANTY AS TO THE ACCURACY OF THIS DATA.

7. ROCK CONTOURS WERE DETERMINED BY LINEAR INTERPOLATION BETWEEN BOREHOLES.

8. ROCK CONTOURS ARE BASED ON A LIMITED NUMBER OF BORINGS THAT PROVIDED INFORMATION ONLY AT THE DRILLED LOCATIONS.

9. THE CONTOURS SHOWN ON THIS PLAN ARE A SIMPLIFIED REPRESENTATION OF THE SUBSURFACE CONDITIONS. THIS PLAN IS PROVIDED FOR INFORMATION ONLY AND VARIATIONS FROM THE ELEVATIONS SHOWN SHOULD BE EXPECTED.

10. BORINGS SHOWN HEREON WERE USED IN DEVELOPING ROCK EVALUATION; SOME HISTORICAL BORINGS WERE OMITTED AS LACKING INFO.

11. MR AND MG BORING SERIES WERE PERFORMED PRIOR TO ROCK EXCAVATION FOR EAST RAILYARD CONSTRUCTION. SOME OF THE BORINGS ARE NOT REPRESENTATIVE OF CURRENT CONDITIONS AND WERE NOT CONSIDERED IN ROCK CONTOUR MAP.

12. TOP OF ROCK ELEVATION REFLECTS THE ROCK CUT MADE DURING CONSTRUCTION OF THE LIRR PUMP ROOM, CONTROL TOWER, AND DC SUBSTATION AS PART OF THE WEST SIDE YARDS.

13. TOP OF ROCK ELEVATION NOT SHOWN IN AREAS OF THE EXISTING AMTRAK TUNNELS AND MTA NO. 7 LINE TUNNEL WHERE CUT-AND-COVER CONSTRUCTION WAS USED.

LEGEND:

⊕	D−1 [R=−20.0]	LANGAN BORING 2013 APPROXIMATE ELEVATION (TOP OF ROCK)
⊕	BH−1 [R=−20.0]	LANGAN BORING 2013 APPROXIMATE ELEVATION (TOP OF ROCK)
⊕	LB−1 [R=−20.0]	LANGAN BORING 2011-2012 APPROXIMATE ELEVATION (TOP OF ROCK)
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◧	TP−1 [R=−20.0]	LANGAN TEST PIT (2013) APPROXIMATE ELEVATION (TOP OF ROCK)
◉	PC1 [R=−6.9]	LANGAN DRIVEN PILES (2013) APPROXIMATE ELEVATION (TOP OF ROCK)
◎		EXISTING MABSTOA CAISSON
⧈		EXISTING MABSTOA FOOTING
○		PROPOSED FOUNDATION ELEMENT

BORING SERIES INFORMATION:

EC	HUDSON YARDS, LANGAN 2008
CD	NO. 7 SUBWAY EXTENSION, PB TEAM 2003
SB	NO. 7 SUBWAY EXTENDION, PB TEAM 2004
FD	NO. 7 SUBWAY EXTENSION, PB TEAM 2005
PE	NO. 7 SUBWAY EXTENSION, PB TEAM 2007
V2-10	VARIOUS PROJECTS COMPILED BY NYCDDC
MR	VARIOUS, WESTSIDE YARDS, MRCE 1980
MG	MABSTOA GARAGE AREA, MRCE 1982
TP	EAST RAIL YARD, LANGAN 2008
ARC	PROPOSED ARC TUNNEL, NJ TRANSIT 2007
PB	GATEWAY HUDSON YARDS, PB 2013
TPC	GATEWAY HUDSON YARDS, PB 2013

FOR REFERENCE ONLY

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SCALE IN FEET

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PENNSYLVANIA CONNECTICUT FLORIDA
ABU DHABI ATHENS DOHA
DUBAI ISTANBUL

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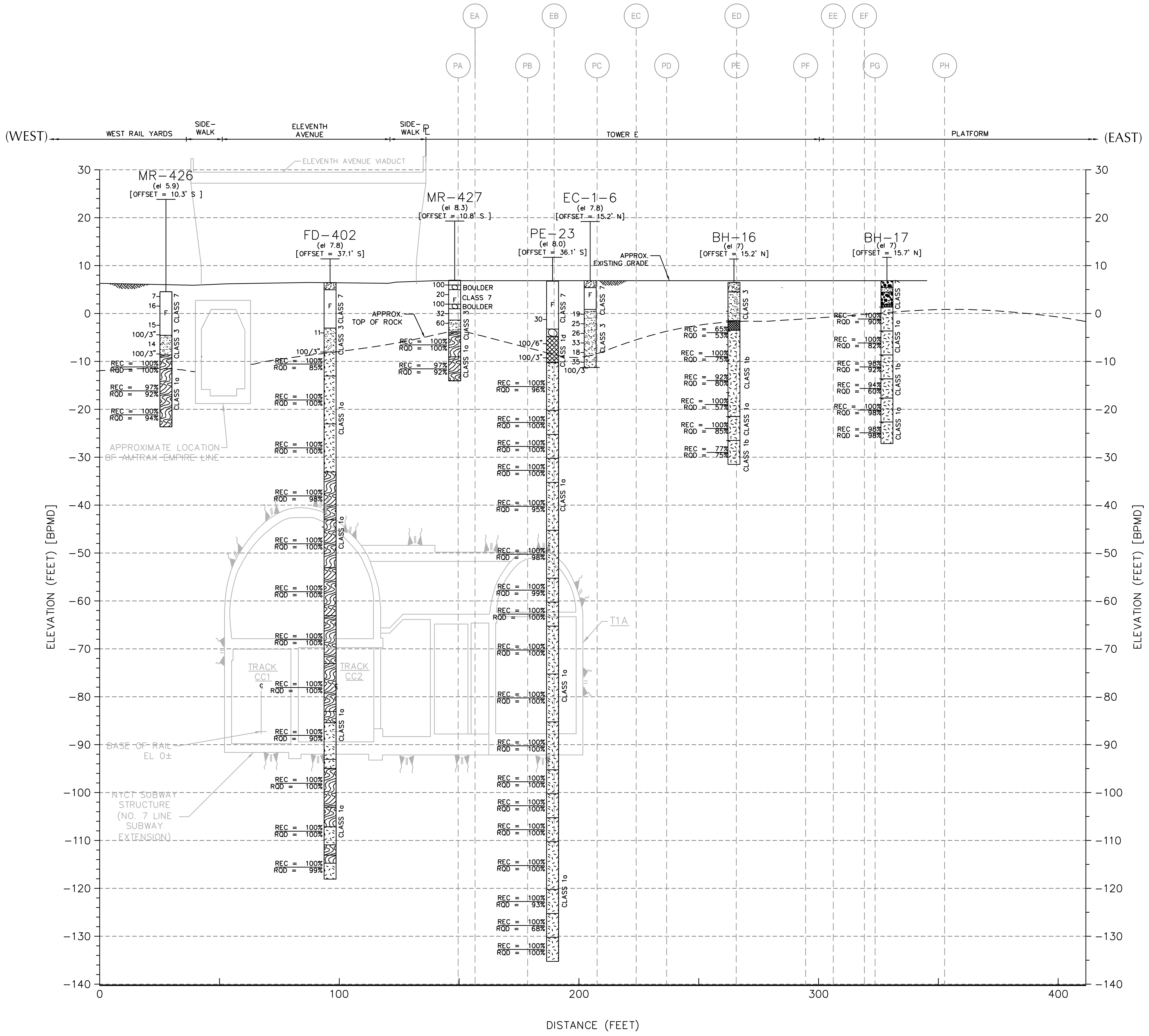
Project
HUDSON YARDS
TOWER E
MANHATTAN NEW YORK

Drawing Title
TOP OF ROCK
ELEVATION PLAN

Project No. 170019120
Date 11/15/2013
Scale 1"=30'
Drawn By SMG
Submission Date 11/15/2013
Drawing No. 11

Filename: \\langan.com\data\NY\data1\170019122\Cadd Data - 170019122\SheetFiles\Final Geotechnical Report_Tower E\DWG11 Top of Rock Elevation Plan.dwg Date: 11/12/2013 Time: 13:46 User: mzonin Style Table: Langan.stb Layout: DWG01



TOWER E - SECTION A

GENERAL NOTES

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7. REFER TO FIGURE 10 FOR LOCATION OF SECTIONS.

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- 1D (SOFT ROCK) – RQD LESS THAN 35% W/ SIXE NX CORE OR REC < 35% W/ SIZE BX CORE, OR SPT N-VALUE > 50 BPF. APPLIES ONLY TO ROCK WITH COMPLETELY WEATHERED ZONES OF LESS THAN 3-INCHES THICK.

SANDY GRAVEL AND GRAVELS (GW, GP)
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GRANULAR SOILS (GM, GC, SM, SC, SP, SW)
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- 4B (STIFF) – MATERIAL HAVING SPT N-VALUES BETWEEN 8 AND 30 BPF, UCS BETWEEN 1 AND 4 TSF
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CLASS 6 – NOMINALLY UNSATISFACTORY BEARING MATERIALS
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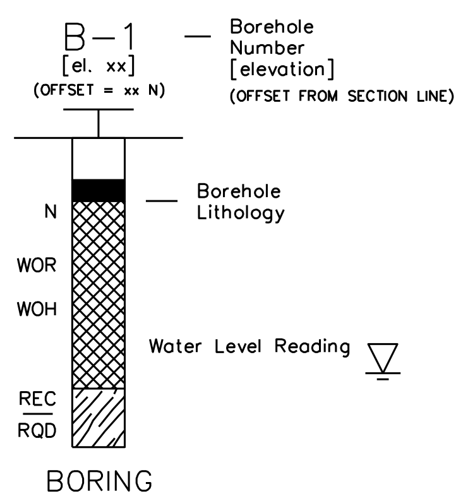
- SOFT CLAYS OF CLASS 4 HAVING SPT N-VLAUES < 4 BPF, UNCONFIEND COMPRESIVE STRENGTHS LESS THAN 0.5 TSF.

CLASS 7 – CONTROLLED AND UNCONTROLLED FILL
- ALL FILLS HAVING BEEN PLACED IN EITHER CONTROLLED OR UNCONTROLLED SETTINGS.

BORING FENCE KEY DIAGRAM AND LITHOLOGY NOTES



N STANDARD PENETRATION RESISTANCE; NUMBER OF BLOWS OF A 140 LB HAMMER FREE FALLING 30 IN TO DRIVE A 2 IN O.D. SPLIT SPOON SAMPLER 12 IN, AFTER 6 IN OF INITIAL PENETRATION

WOR 2 FT PENETRATION OF THE SPLIT SPOON SAMPLER UNDER THE WEIGHT OF DRILL RODS

WOH 2 FT PENETRATION OF THE SPLIT SPOON SAMPLER UNDER THE STATIC WEIGHT OF THE DRIVING HAMMER

U UNDISTURBED SAMPLE

REC (LENGTH OF ROCK RETRIEVED) / (LENGTH OF ROCK CORED) * 100%

RQD (LENGTH OF ROCK 4 IN OR LONGER) / (LENGTH OF ROCK CORED) * 100%

F FILL (CLASS 7)
▨ CLAYS (CLASS 4, 6)
CONCRETE
SANDS (CLASS 3, 6)
GRANITE BEDROCK (CLASS 1A-1C)
TILL (CLASS 3)
▩ SOFT BEDROCK (CLASS 1D)
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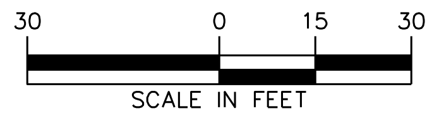
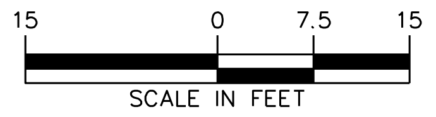
HORIZONTAL SCALE



VERTICAL SCALE



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ABU DHABI ATHENS DOHA
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Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C.
Langan Engineering and Environmental Services, Inc.
Langan International LLC
Collectively known as Langan

HUDSON YARDS TOWER E

MANHATTAN NEW YORK

Drawing Title

SUBSURFACE PROFILE A

Project No. 170019120
Date 11/15/2013
Scale AS SHOWN
Drawn By JSH
Submission Date 11/15/2013
Drawing No. 12

GENERAL NOTES

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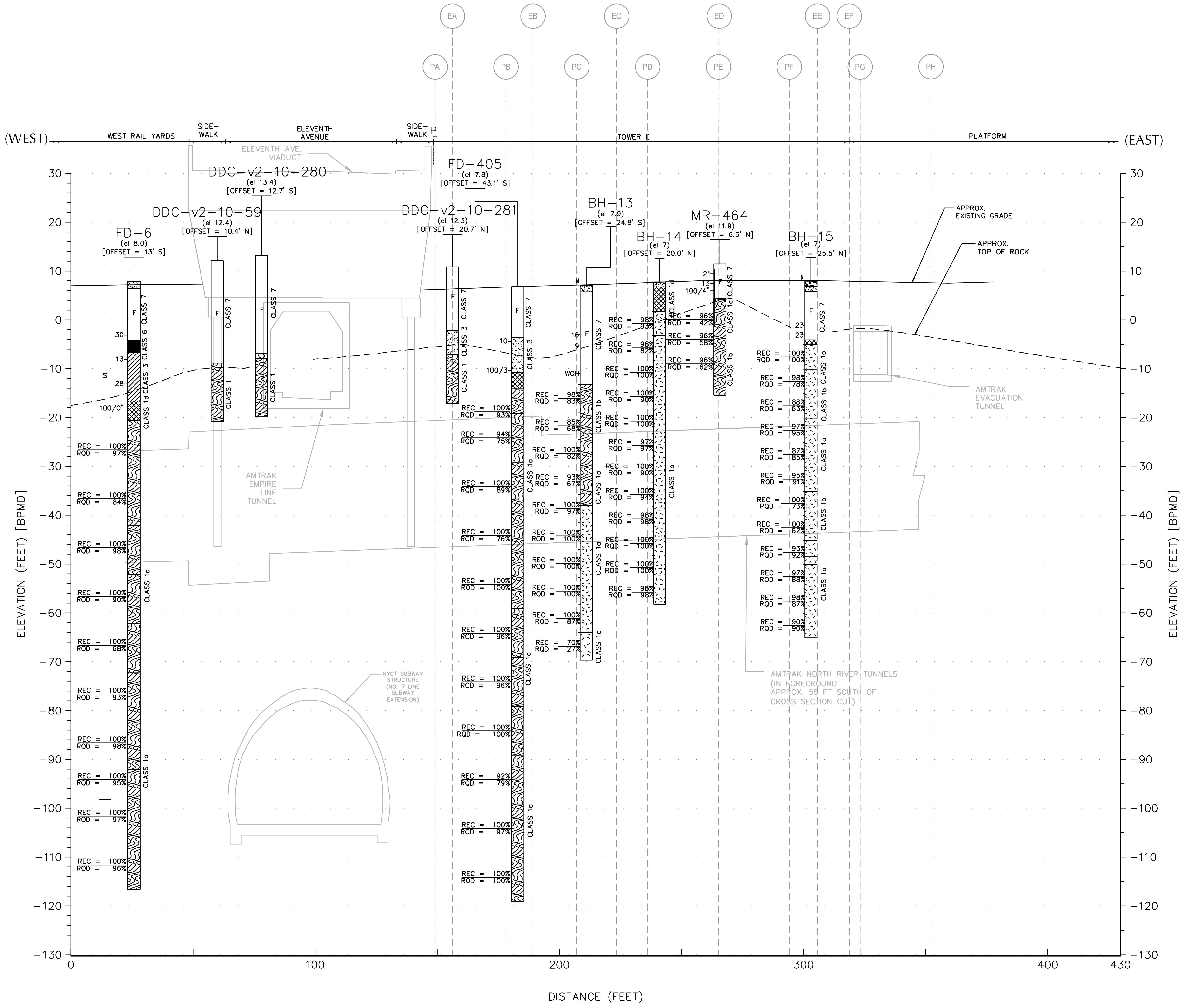
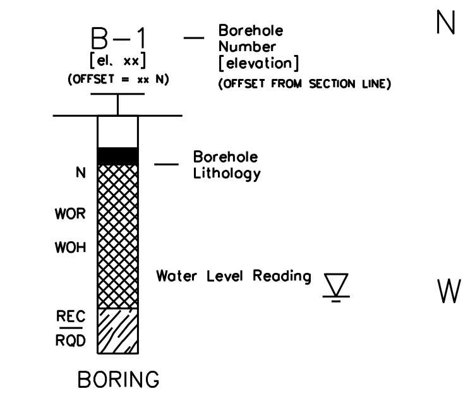


TOWER E - SECTION B

BORING FENCE KEY DIAGRAM AND LITHOLOGY NOTES



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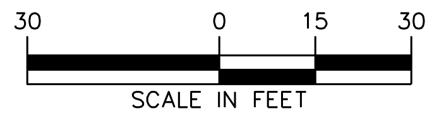

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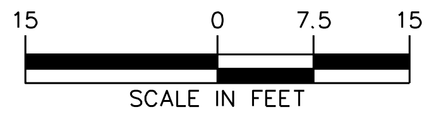

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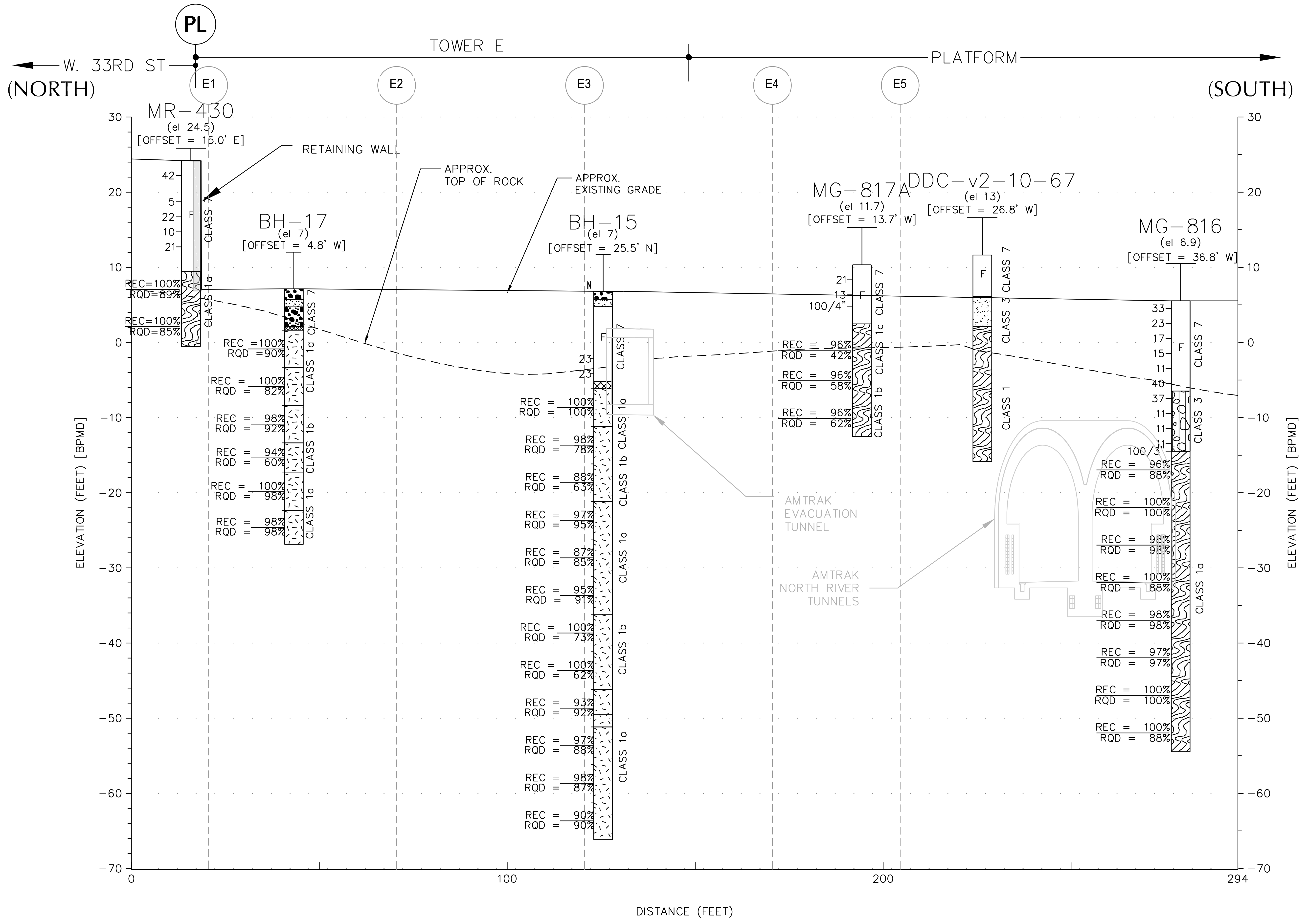
HUDSON YARDS
TOWER E

MANHATTAN **NEW YORK**

Drawing Title

SUBSURFACE
PROFILE B

Project No.
170019120
Date
11/15/2013
Scale
AS SHOWN
Drawn By
JSH
Submission Date
11/15/2013
Drawing No.
13



TOWER E - SECTION C

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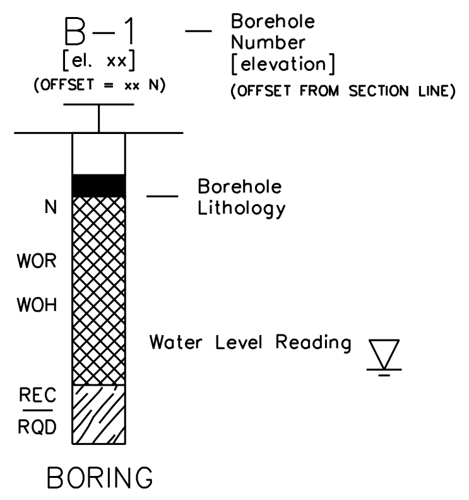

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F	FILL (CLASS 7)	▨	CLAYS (CLASS 4, 6)	▫	CONCRETE
░	SANDS (CLASS 3, 6)	⁄	GRANITE BEDROCK (CLASS 1A–1C)	○	TILL (CLASS 3)
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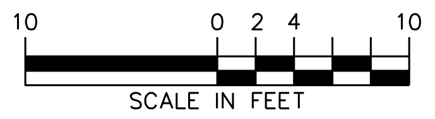
HORIZONTAL SCALE

VERTICAL SCALE



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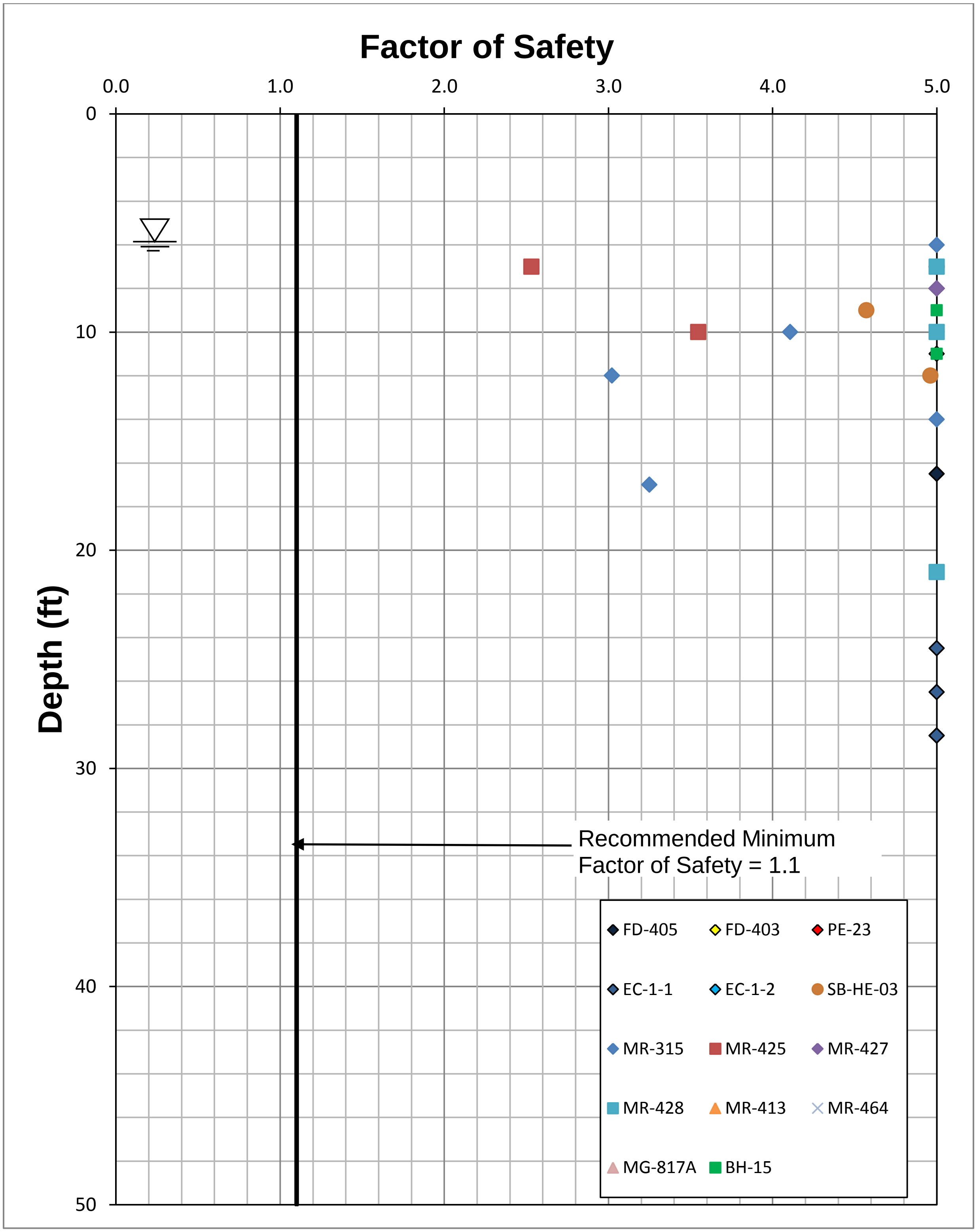
HUDSON YARDS
TOWER E

MANHATTAN NEW YORK

Drawing Title

SUBSURFACE
PROFILE C

Project No. 170019120	Drawing No. 14
Date 11/15/2013	
Scale AS SHOWN	
Drawn By JSH	
Submission Date 11/15/2013	



WARNING: IT IS A VIOLATION THE NYS EDUCATION LAW ARTICLE 145 FOR ANY PERSON, UNLESS HE IS ACTING UNER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS ITEM IN ANY WAY.

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ABU DHABI DUBAI ATHENS DOHA ISTANBUL

Project

HUDSON YARDS
TOWER E

MANHATTAN NEW YORK

Drawing Title

LIQUEFACTION
EVALUATION

Project No. 170019120

Date 10/22/2013

Scale N/A

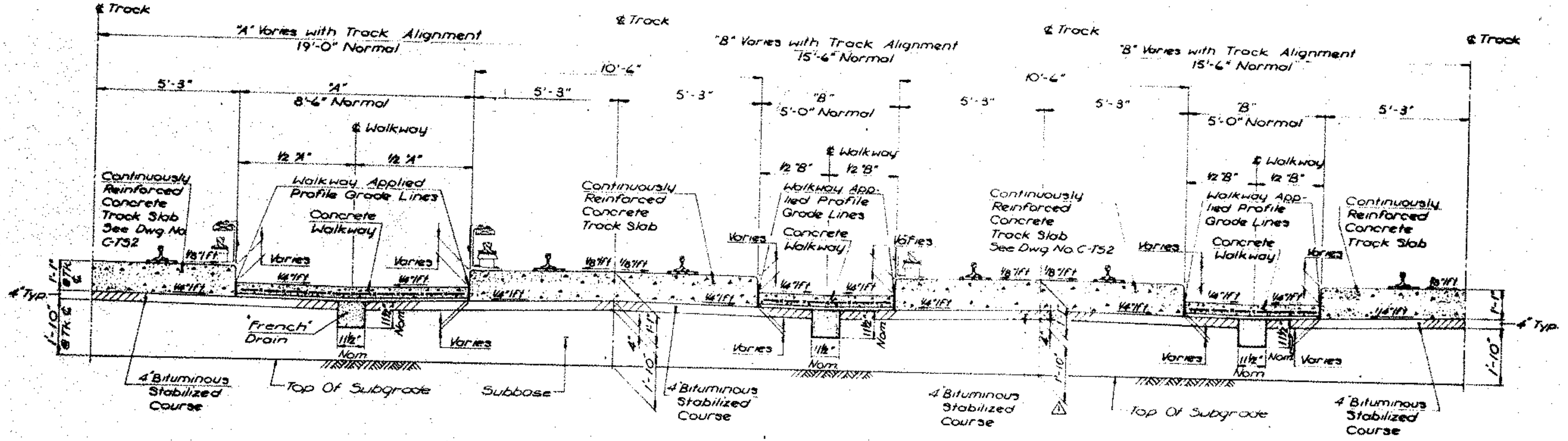
Drawn By SMG

Submission Date

Drawing No. 15

APPENDIX A
Historic Design Drawings

MTA-LIRR Rail Yard

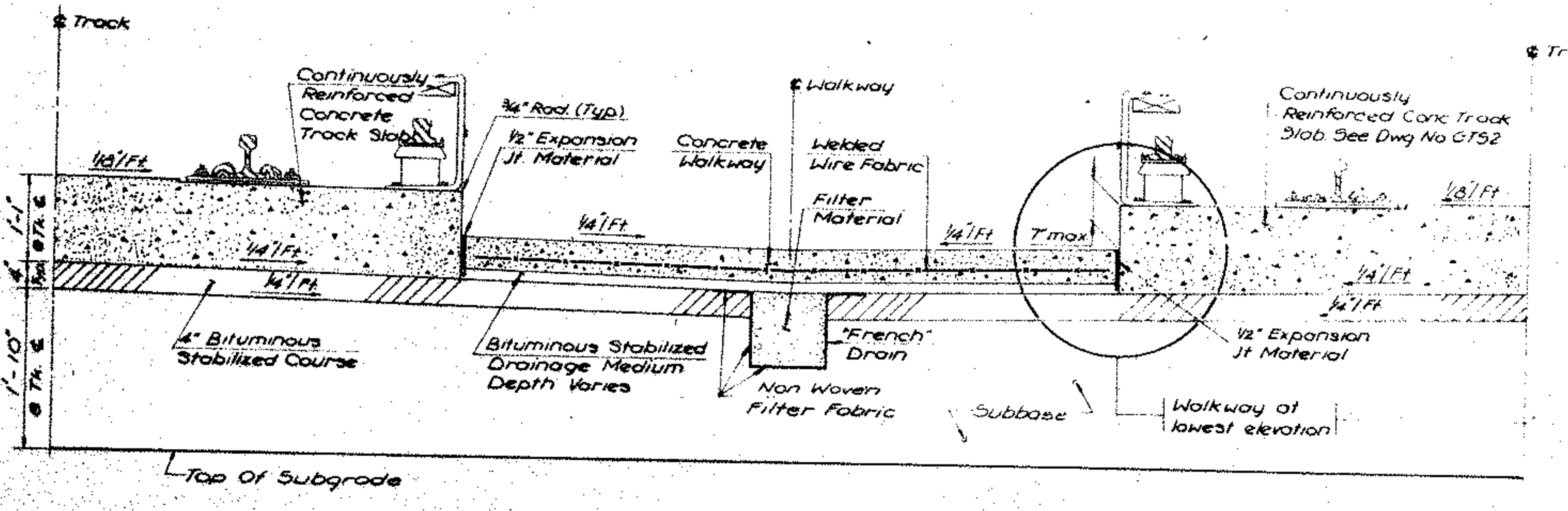


TRANSVERSE SECTION

SCALE 1/2" = 1'-0"

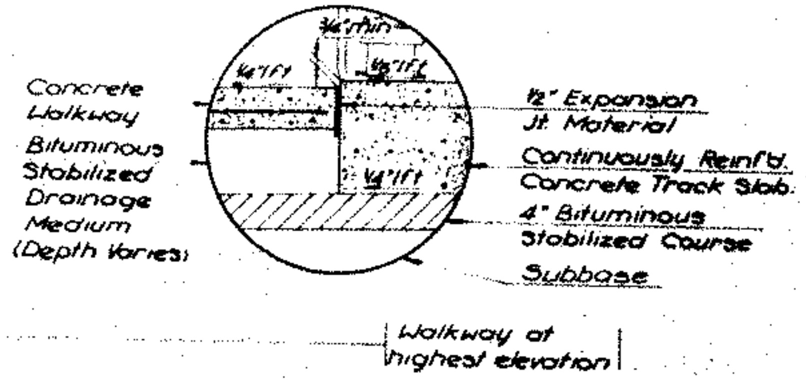
NOTES

1. French Drains Shall Be Constructed In Conformance With The Details Shown. The Drain Shall Be Discontinuous At Structures And Limited To The Following Locations.
   (A) North Of Track No. 4 And South Of Track No. 19: From The Westerly End Of The Track Slab East To Sta. 17+60 Excluding Areas Served By Subdrains.
   (B) North Of Track No. 19: From The Westerly End Of The Track Slab East To Sta. 16+65
2. For Concrete Walkway Profiles Within Limits Of Track Slab See Dwg. Nos. C-P6 To C-P9.
3. ⚠ For Typical Walkway Section Between Track Slabs, See Drawing No. C-WL13.



TRANSVERSE SECTION

SCALE 1" = 1'-0"



SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

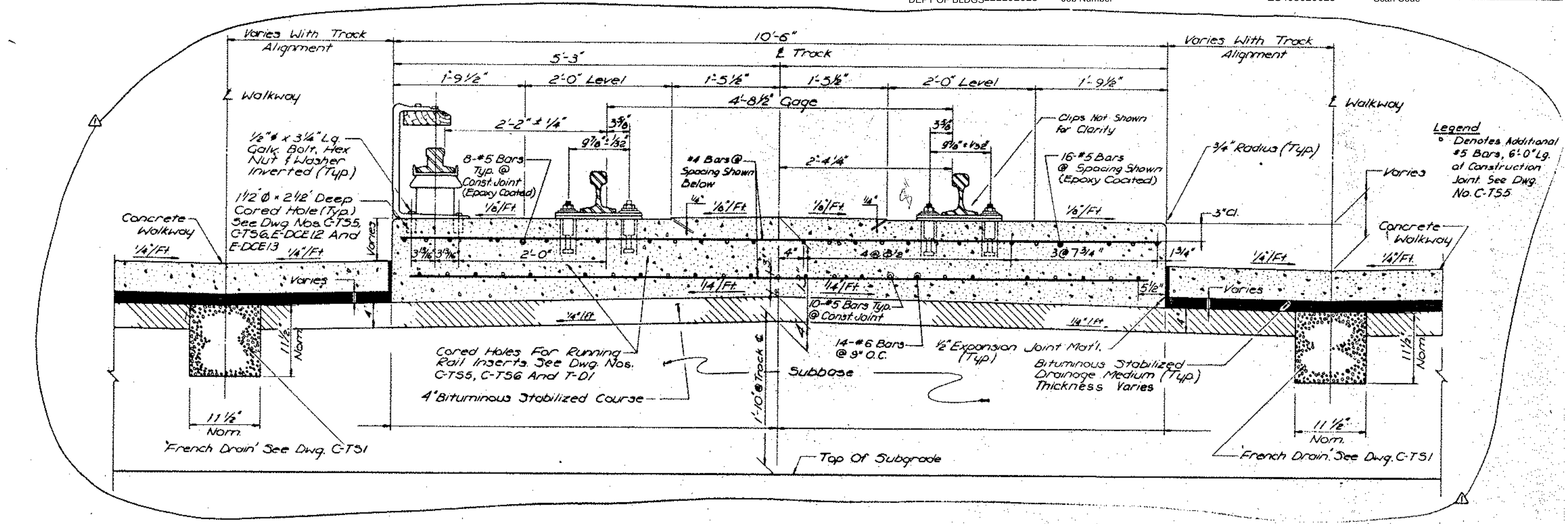
L.I.R.R.
LONG ISLAND RAIL ROAD

Metropolitan Transportation Authority

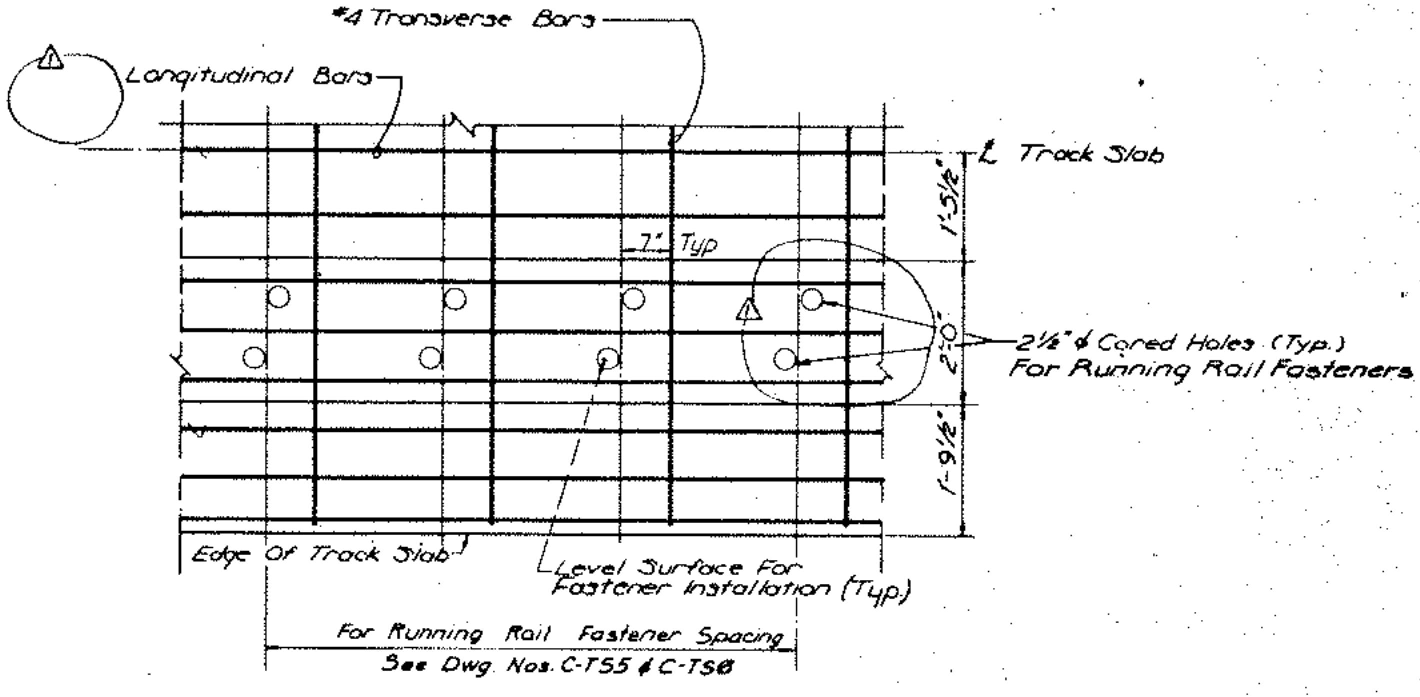
REV. NO	DESCRIPTION	DATE
⚠	ADDM #1 DESCRIPTIVE CHANGES	9-17-82

WEST SIDE STORAGE YARD COMPLEX
TYPICAL SECTION
TRACK SLAB
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO C-TS1
SHEET 43 OF 684



TYPICAL TRACK SLAB SECTION
SCALE: ½" = 1'-0"



TRACK SLAB PARTIAL PLAN
N.T.S.

REV NO	DESCRIPTION	DATE
1	Revised Reinforcement & Dwg Reference in Typical Section. Deleted Bar size & Added Leader in Part Plan	9-17-82

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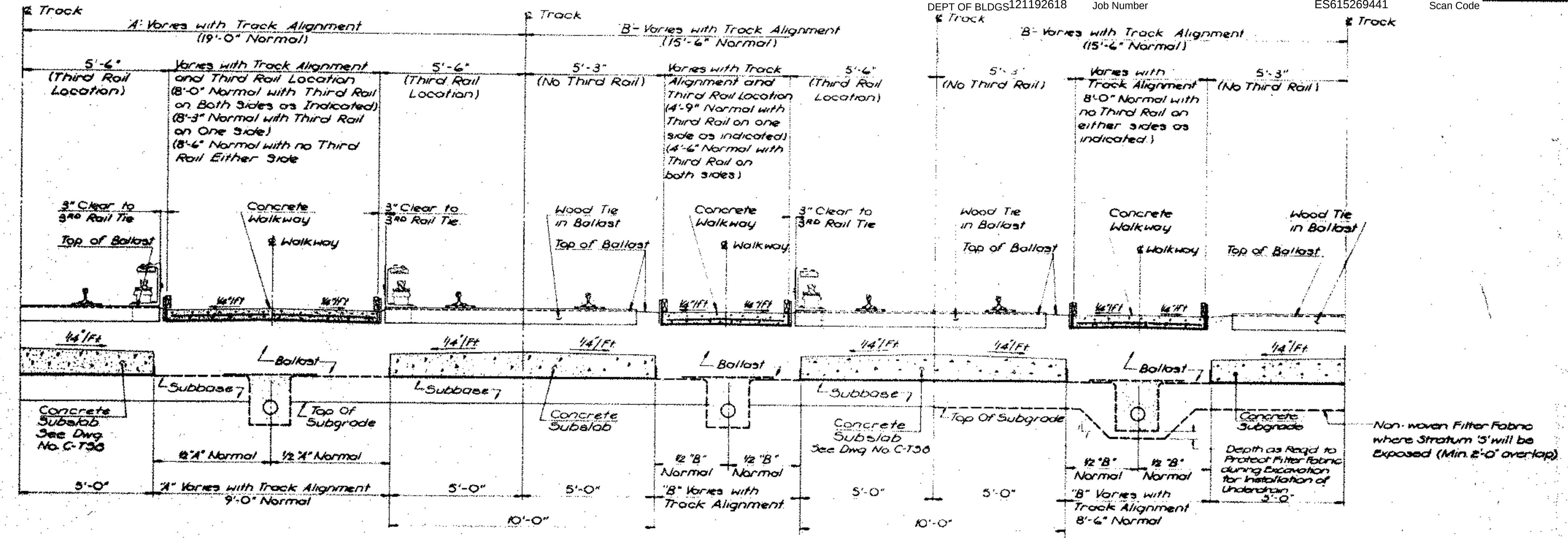
Metropolitan Transportation Authority

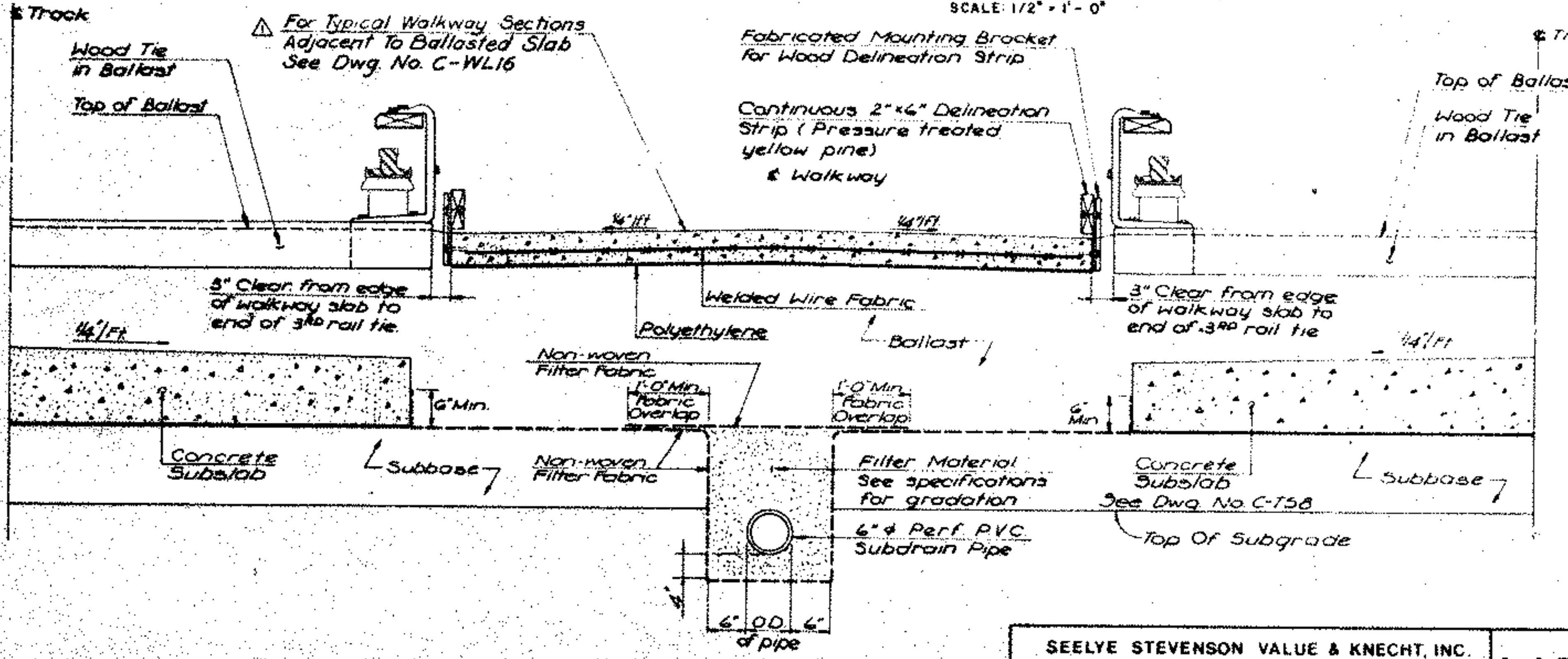
WEST SIDE STORAGE YARD COMPLEX
TYPICAL SECTION
TRACK SLAB
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG 12, 1982
SCALE AS NOTED
DRAWING NO. C-TS 2
SHEET 44 OF 684



TRANSVERSE SECTION

SCALE: 1/2" = 1'-0"



TRANSVERSE SECTION

SCALE: 1" = 1'-0"

NOTE:

UNLESS OTHERWISE INDICATED, THE TOP EDGE OF LONGITUDINAL CONCRETE WALKWAYS BETWEEN BALLASTED TRACK SHALL BE LOCATED 9" BELOW THE TOP OF THE LOWEST ADJACENT RUNNING RAIL SEE DWG. NOS. C-WL1 TO C-WL18 AND C-WT11.

⚠ RAMPING OF LONGITUDINAL WALKWAYS AT INTERSECTION WITH TRANSVERSE WALKWAYS (T.W.) IS SHOWN ON DWG. NOS. C-WT1 TO C-WT8. NO RAMPS ARE TO BE CONSTRUCTED ALONG WALKWAY W1 BETWEEN T.W. 'H' AND T.W. 'G', WALKWAY W5 BETWEEN T.W. 'M' AND T.W. 'N', AND WALKWAY W29 BETWEEN T.W. 'I' AND T.W. 'J'. THE TOP EDGE OF THE LONGITUDINAL WALKWAYS FOR THESE THREE SECTIONS SHALL BE LOCATED AT THE TOP OF THE LOWEST ADJACENT RUNNING RAIL.

WALKWAY TRANSITION FROM CROWNED SECTION BETWEEN BALLASTED TRACK TO REVERSE CROWNED SECTION BETWEEN TRACK SLABS SHALL OCCUR IN AN 8 FEET TO 10 FEET WALKWAY LENGTH, CENTERED AT END OF TRACK SLAB.

EXCEPT AT WALKWAY RAMPS, LONGITUDINAL WALKWAY W18, FROM STATION 17+65 TO STATION 20+06 SHALL HAVE A 1/8 INCH PER FOOT CROSS SLOPE, SLOPING DOWN TO THE SOUTH WITH A TOP OF WALKWAY ELEVATION OF 307.72 ALONG ITS NORTHERLY EDGE.

REV NO	DESCRIPTION	DATE
⚠	ADDM #1 DESCRIPTIVE CHANGES	9-17-82

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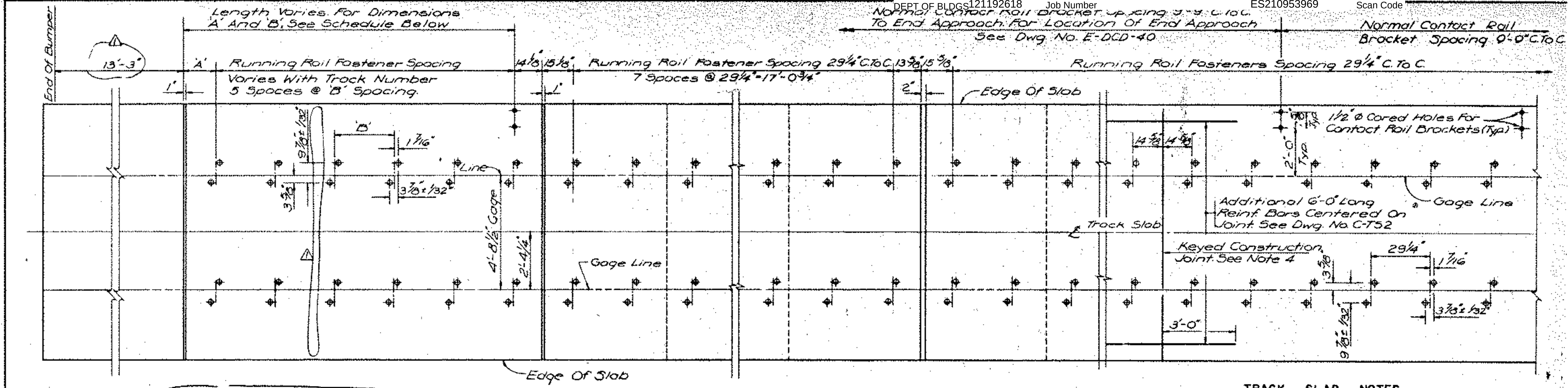
WEST SIDE STORAGE YARD COMPLEX

TYPICAL SECTION
BALLASTED TRACK

STORAGE YARD

CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. [illegible]
SHEET 45 OF 684



TYPICAL FASTENER LOCATIDN PLAN AT WEST END OF TRACK SLAB

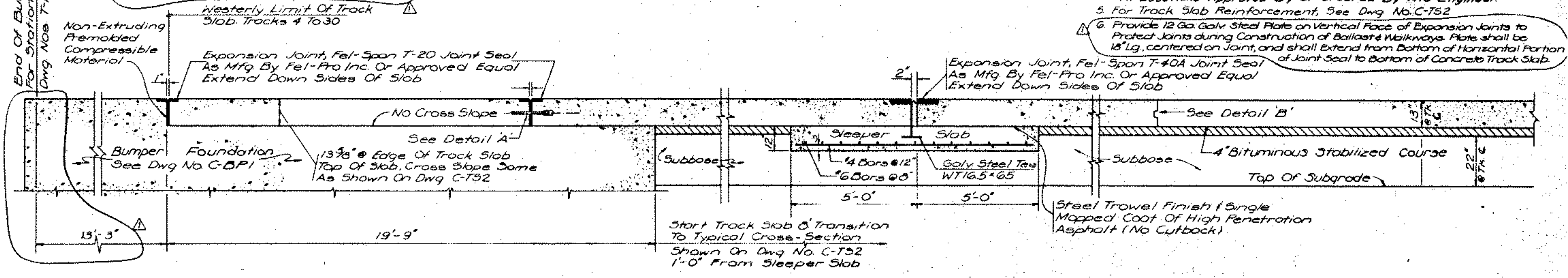
For Location Of Contact Rail See Dwg. No's E-DCE-1 to E-DCE-4. Contact Rail Brackets On North Edge Of Slab As Shown. Contact Rail Brackets On South Edge Of Slab Opposite Hand.

SCHEDULE OF DIMENSIONS 'A' & 'B'

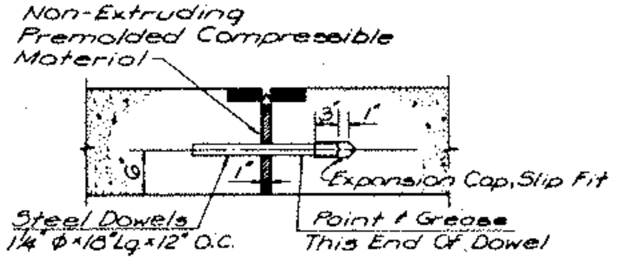
Track Number	Dimension 'A' (Inches)	Dimension 'B' (Inches)
4 To 8	15 3/8	25 3/4
9 To 15	15 3/8	23 1/2
16 To 18	14 7/8	25 1/4
19 To 21	15 3/8	24 1/2
22 To 26	14 7/8	24 3/4
27 To 30	15 7/8	27

TRACK SLAB NOTES

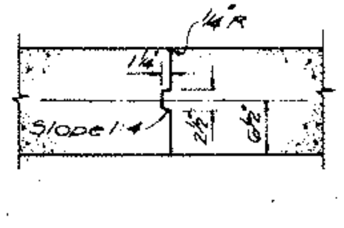
1. Coring Of Track Slab For Running Rail Fasteners Shall Not Be Done Until Concrete Has Been In Place For a Minimum Of 28 Days.
2. Coring Of Track Slab For Contact Rail Brackets And Third Rail Anchors Shall Not Be Done Until Running Rails Have Been Installed And Aligned.
3. Adjustment In Longitudinal Spacing Of Cored Holes To A Maximum Of Two (2) Inches Greater Than The Specified Dimensions Will Be Permitted To Avoid Shrinkage Cracks Present At Time Of Coring.
4. The Installation Of Transverse Construction Joints Shall Be Kept To An Absolute Minimum. Construction Joints Shall Be Installed Only At Locations Approved By Or Ordered By The Engineer.
5. For Track Slab Reinforcement, See Dwg. No. C-TS2
6. Provide 12 Ga. Galv. Steel Plate on Vertical Face of Expansion Joints to Protect Joints during Construction of Ballast & Walkways. Plate shall be 18" Lg., centered on Joint, and shall Extend from Bottom of Horizontal Portion of Joint Seal to Bottom of Concrete Track Slab.



TYPICAL SECTIDN AT WEST END OF TRACK SLAB



DETAIL 'A'
DDWELED EXPANSIDN JDINT



DETAIL 'B'
KEYED CDNSTRUCTIDN JDINT

REV. NO.	DESCRIPTION	DATE
1	Revised Bumper Dimensions, Schedule of Dimensions A & B. Added Note 6	9-17-82

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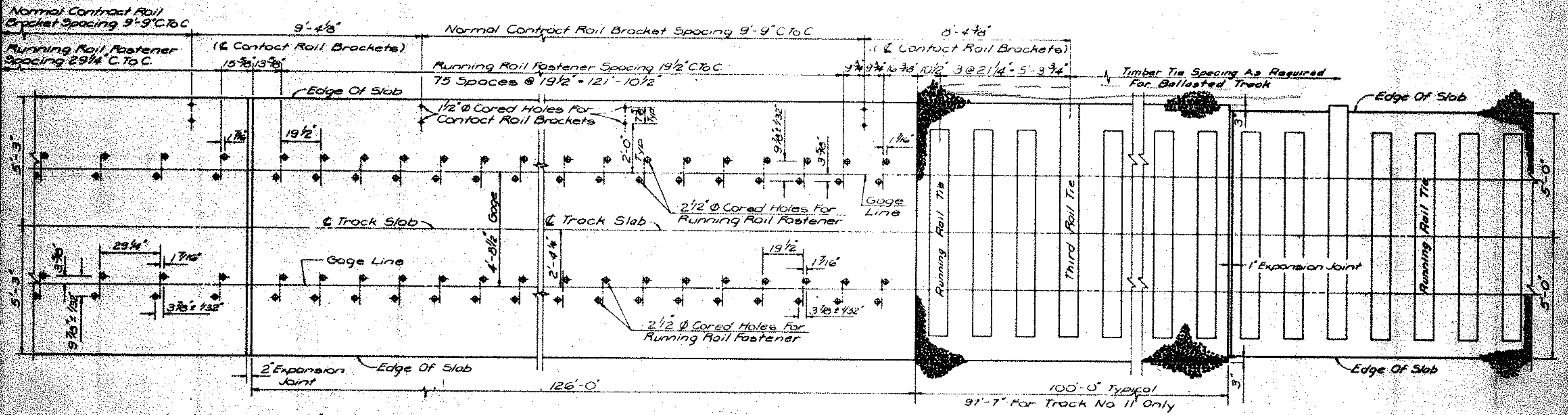
WEST SIDE STORAGE YARD COMPLEX

PLAN & SECTION
WEST END OF TRACK SLAB

STORAGE YARD

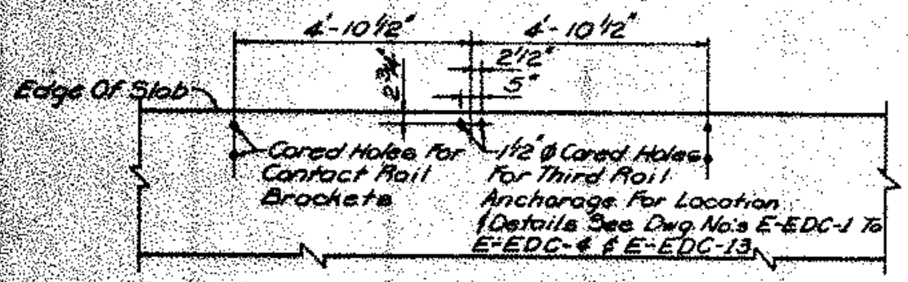
CONTRACT NO 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE 1/2"=1'-0"
DRAWING NO. C-TS5
SHEET 46 OF 684



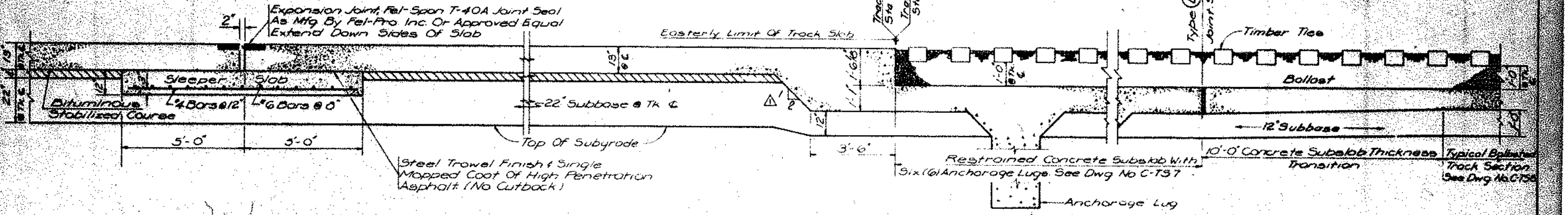
TYPICAL FASTENER LOCATION PLAN AT EAST END OF TRACK SLAB

For Location Of Contact Rail See Dwg. No.'s E-DCE-1 To E-DCE-4. Contact Rail Brackets On North Edge Of Slab As Shown. Contact Rail Brackets On South Edge Of Slab Opposite Hand.

NOTE:
1. See Track Slab Notes On Dwg. No. C-T55



THIRD RAIL ANCHORAGE



TYPICAL SECTION AT EAST END OF TRACK SLAB

2 0 2 4

REV NO	DESCRIPTION	DATE
1	ADDM. #1: DESCRIPTIVE CHANGES	9-17-82

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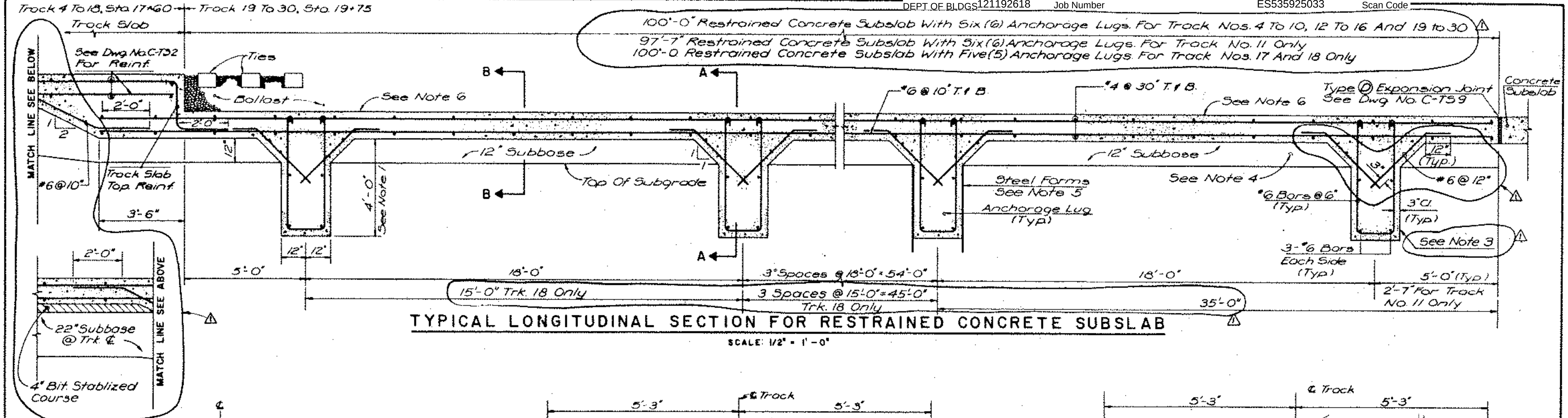
WEST SIDE STORAGE YARD COMPLEX

PLAN & SECTION
EAST END OF TRACK SLAB

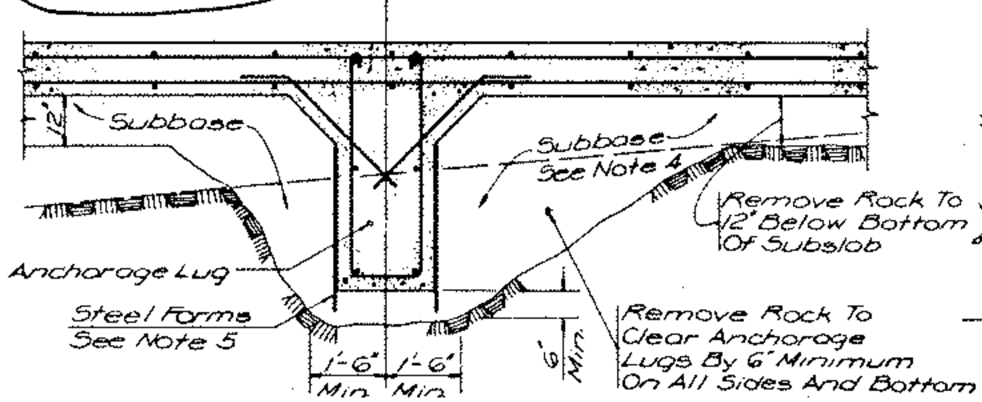
STORAGE YARD

CONTRACT NO. 1-02-21154-0-0
DATE AUG 12, 1982
SCALE ½"=1'-0"
DRAWING NO. C-T58



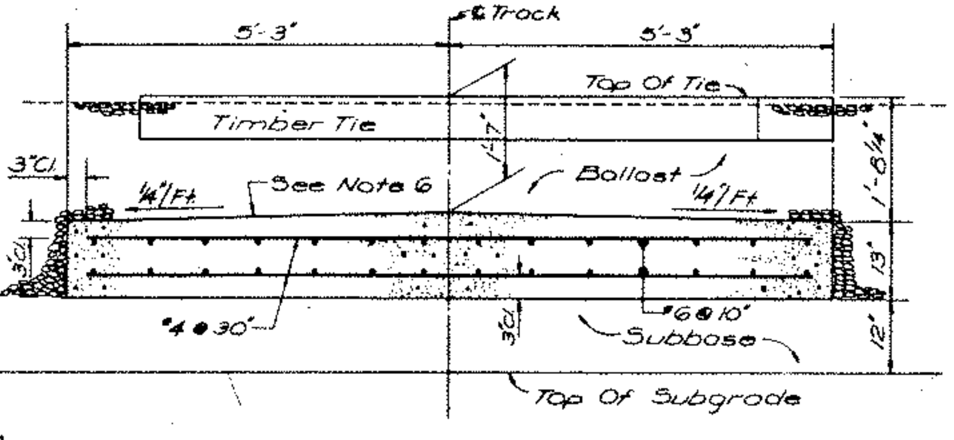
TYPICAL LONGITUDINAL SECTION FOR RESTRAINED CONCRETE SUBSLAB

SCALE: 1/2" = 1'-0"



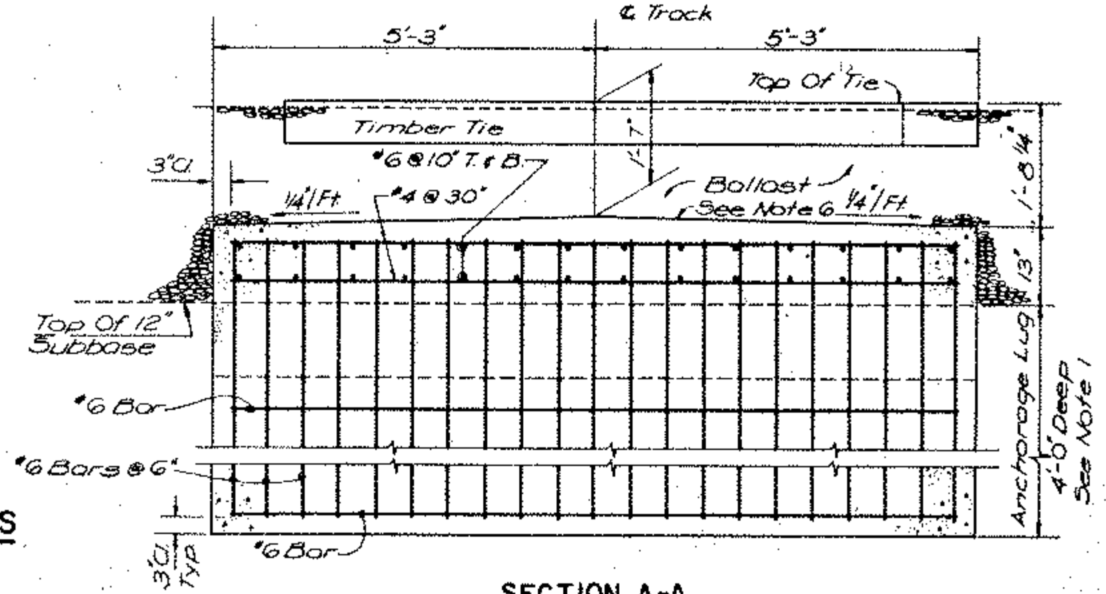
TYPICAL DETAIL FOR ROCK REMOVAL BELOW RESTRAINED SUBSLAB

N.T.S.



SECTION B-B
TYPICAL TRANSVERSE SECTION BETWEEN ANCHORAGE LUGS

SCALE: 3/4" = 1'-0"



SECTION A-A
TYPICAL TRANSVERSE SECTION AT ANCHORAGE LUG

SCALE: 3/4" = 1'-0"

NOTES:

1. WHERE THE RESTRAINED CONCRETE SUBSLAB FOR TRACK NOS. 20 TO 25 CROSS OVER THE EVACUATION TUNNEL, THE DEPTH OF THE ANCHORAGE LUG SHALL BE REDUCED TO CLEAR THE TUNNEL ROOF BY TWELVE (12) INCHES.
2. CONCRETE REQUIREMENTS FOR THE RESTRAINED CONCRETE SUBSLAB SHALL BE THE SAME AS FOR TRACK SLAB.
3. MOST EASTERLY ANCHORAGE LUG NOT REQUIRED FOR TRACK NOS. 17 & 18, ONLY FIVE (5) ANCHORAGE LUGS ARE REQUIRED FOR THESE TWO TRACKS. △
4. SUBBASE SHALL BE PLACED AND COMPACTED PRIOR TO INSTALLATION OF ANCHORAGE LUGS.
5. STEEL FORMS FOR INSTALLATION OF ANCHORAGE LUGS SHALL BE DRIVEN IN PLACE AND BRACED BEFORE REMOVAL OF SOIL BETWEEN FORMS. FORMS SHALL REMAIN IN PLACE.
6. A THIN UNIFORM LAYER OF BALLAST MATERIAL SHALL BE VIBRATED OR ROLLED INTO THE SURFACE OF THE RESTRAINED CONCRETE SUBSLAB FOR A DEPTH OF APPROXIMATELY ONE (1) INCH TO PROVIDE INTERLOCK WITH REMAINING BALLAST TO BE PLACED.

REV NO.	DESCRIPTION	DATE
△	Revised Lug Reinforcement, Track Slab Transition to Restrained Subslab, Lugs for Trks 17 & 18	9-17-82

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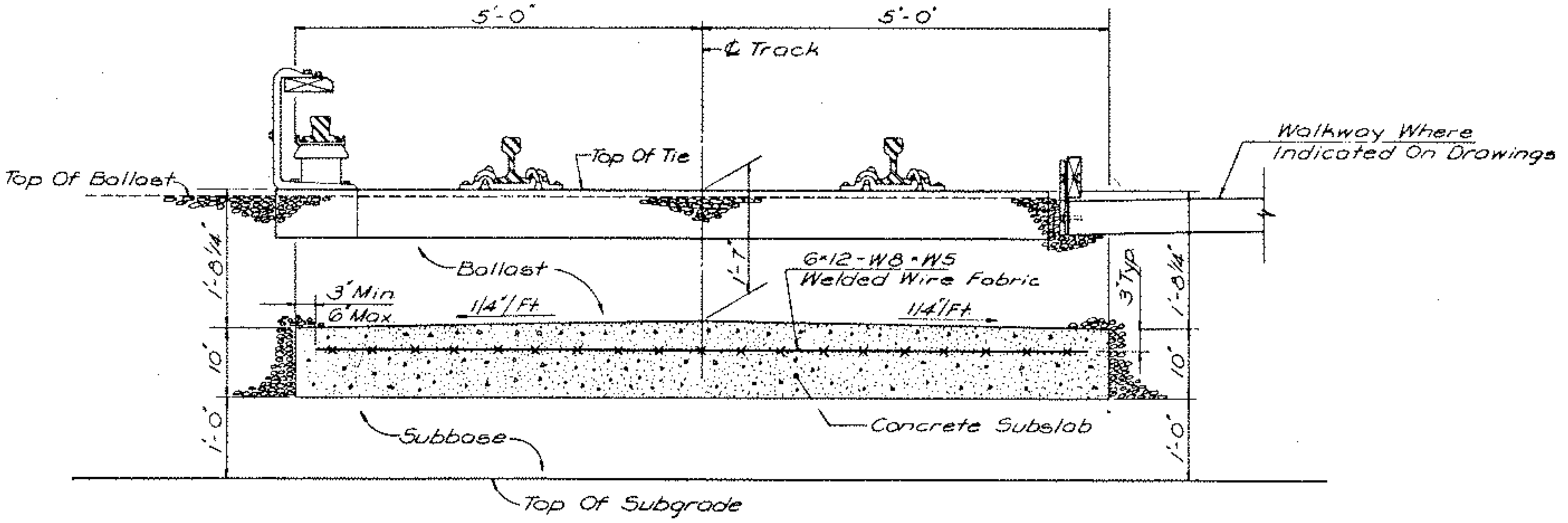
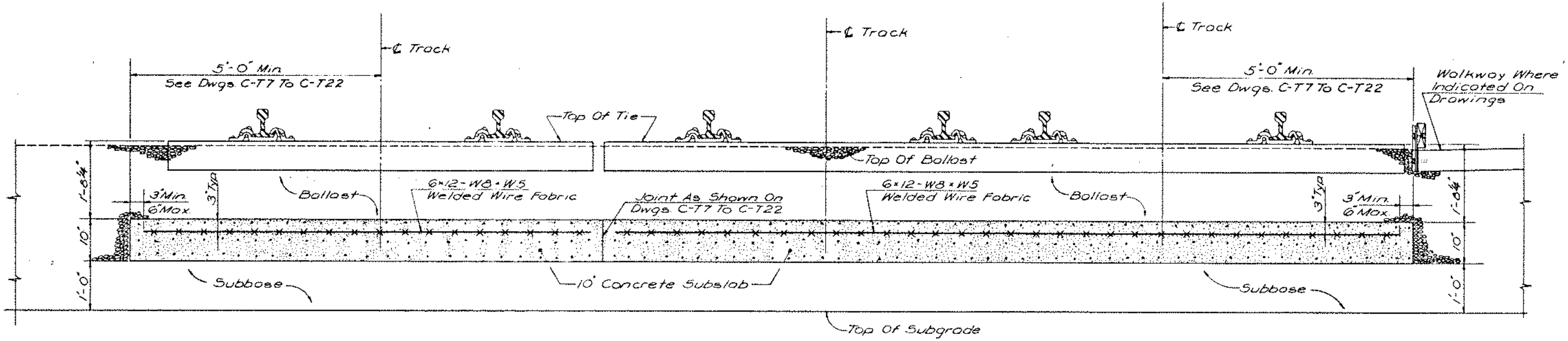
WEST SIDE STORAGE YARD COMPLEX
PLAN & SECTION
EAST END OF TRACK SLAB
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. C-TS7
SHEET 48 OF 684



TYPICAL SECTION FOR SINGLE BALLASTED TRACK

SCALE: 1" = 1'-0"



TYPICAL SECTION FOR TWO OR MORE BALLASTED TRACKS

SCALE: NTS.

REV NO	DESCRIPTION	DATE

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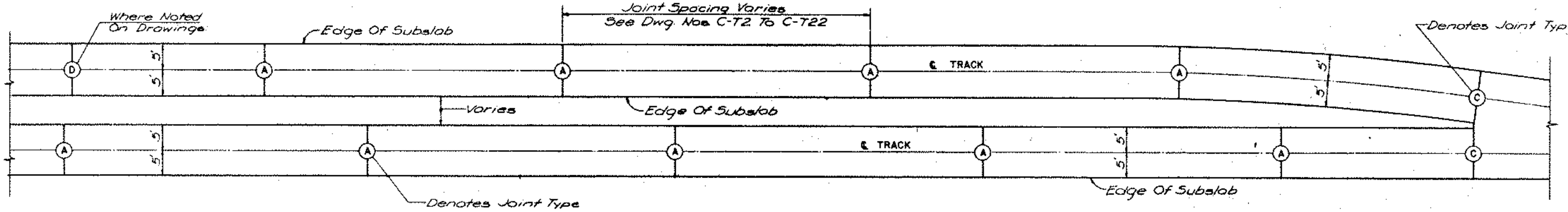
WEST SIDE STORAGE YARD COMPLEX

TYPICAL SECTIONS
BALLASTED TRACK SUBSLAB

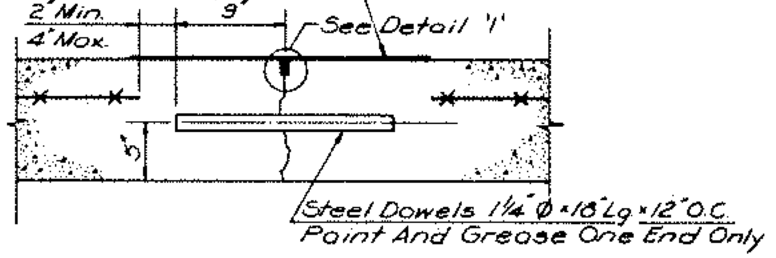
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. C-TS8
SHEET 49 OF 684



TYPICAL JOINTING PLAN FOR SINGLE BALLASTED TRACK

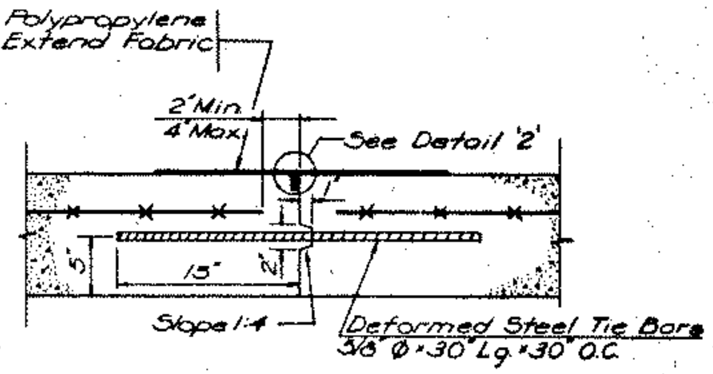
SCALE: N.T.S.



TYPE Ⓐ

DOWELED CONTRACTION JOINT

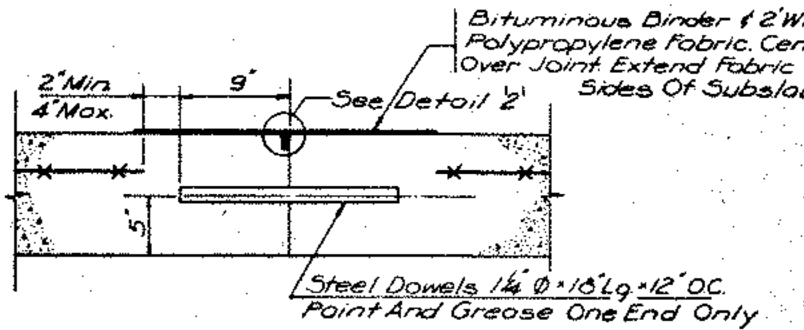
SCALE: N.T.S.



TYPE Ⓑ

HINGED CONSTRUCTION JOINT

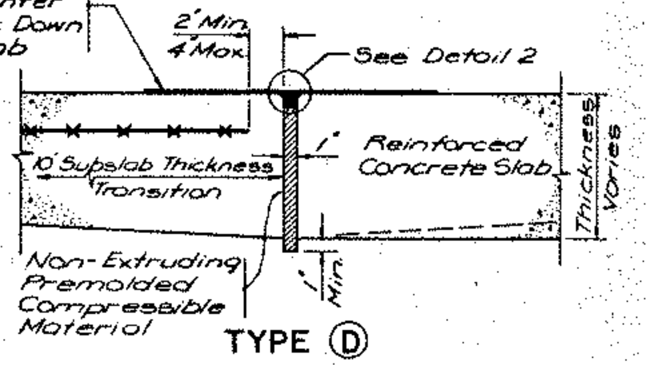
SCALE: N.T.S.



TYPE Ⓒ

DOWELED CONSTRUCTION JOINT

SCALE: N.T.S.

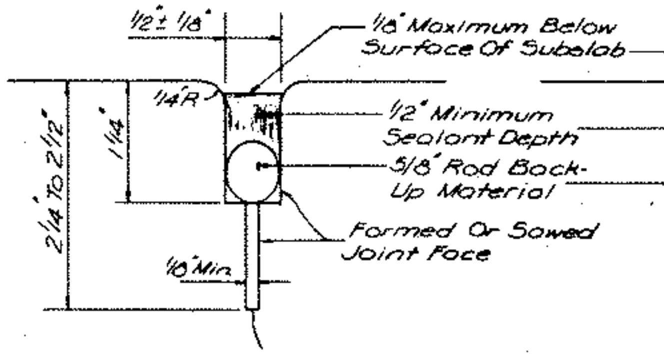


TYPE Ⓓ

EXPANSION JOINT

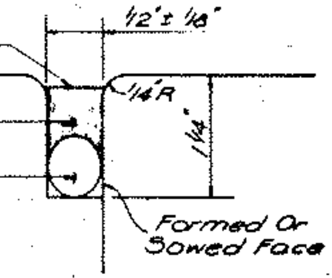
SCALE: N.T.S.

CONCRETE SUBSLAB JOINT DETAILS



DETAIL '1'

CONTRACTION JOINTS

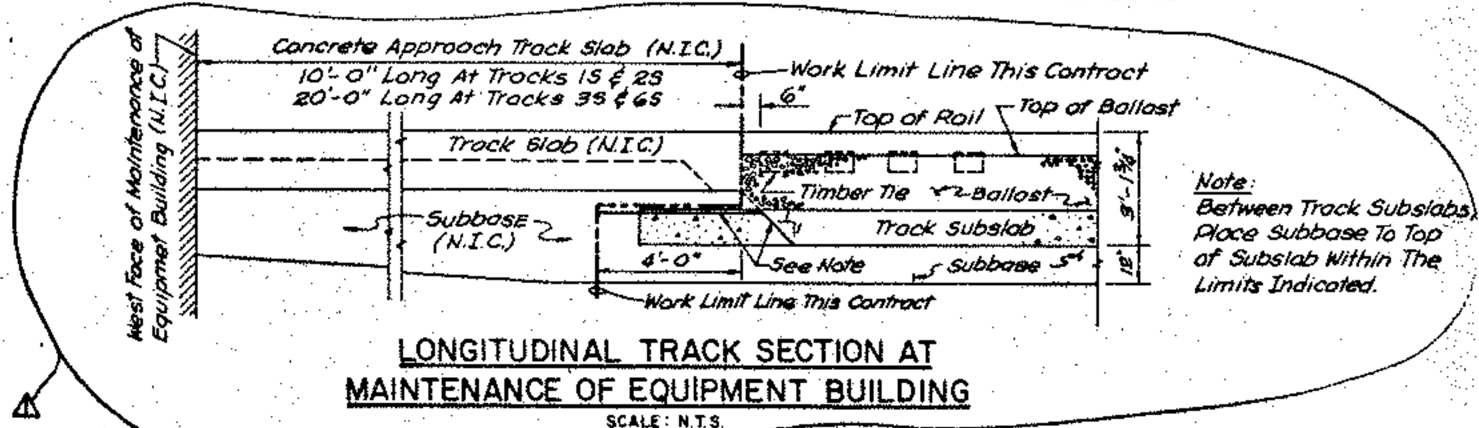


DETAIL '2'

CONSTRUCTION JOINTS

JOINT SEALING DETAILS

SCALE: N.T.S.



LONGITUDINAL TRACK SECTION AT
MAINTENANCE OF EQUIPMENT BUILDING

SCALE: N.T.S.

REV. NO.	DESCRIPTION	DATE
1	Added Section at M.O.E. Building	9-17-82

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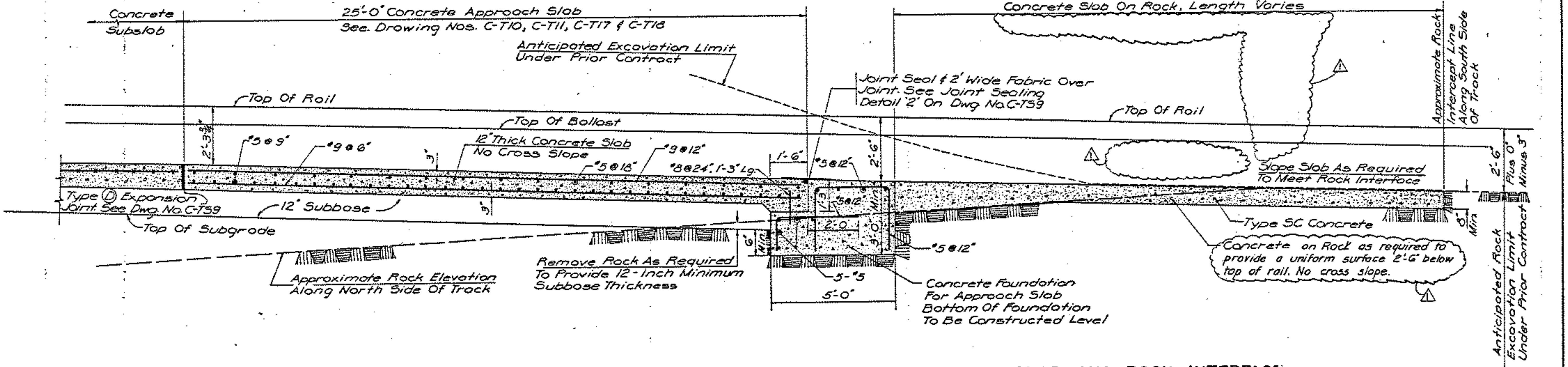
WEST SIDE STORAGE YARD COMPLEX

TYPICAL PLAN & SECTIONS
BALLASTED TRACK SUBSLAB

STORAGE YARD

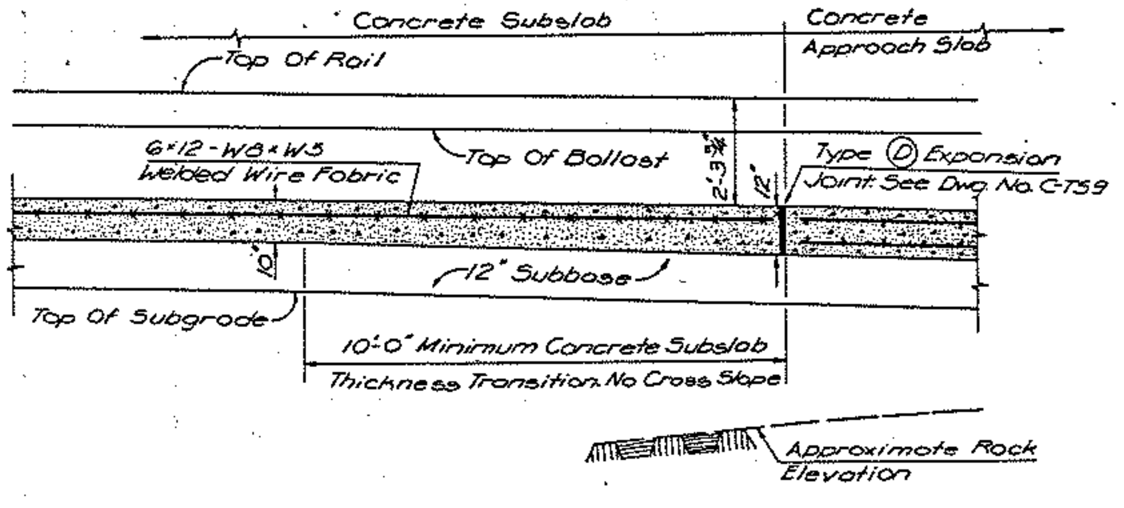
CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE N.T.S.
DRAWING NO. C-TS9
SHEET 50 OF 684



TYPICAL BALLASTED TRACK TRANSITION SECTION BETWEEN CONCRETE SUBSLAB AND ROCK INTERFACE

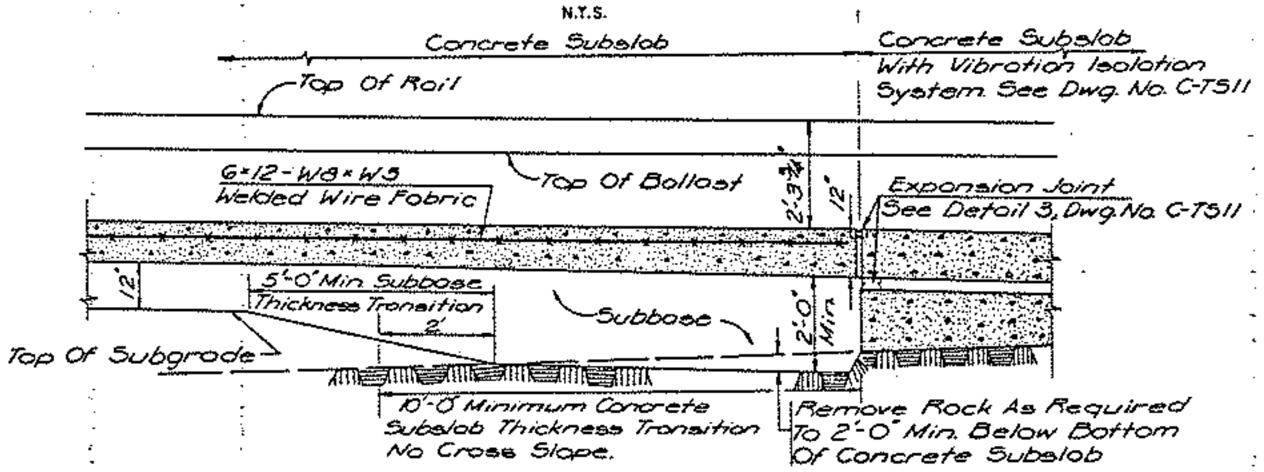
(SECTION TAKEN ALONG NORTH SIDE OF TRACK)

N.T.S.



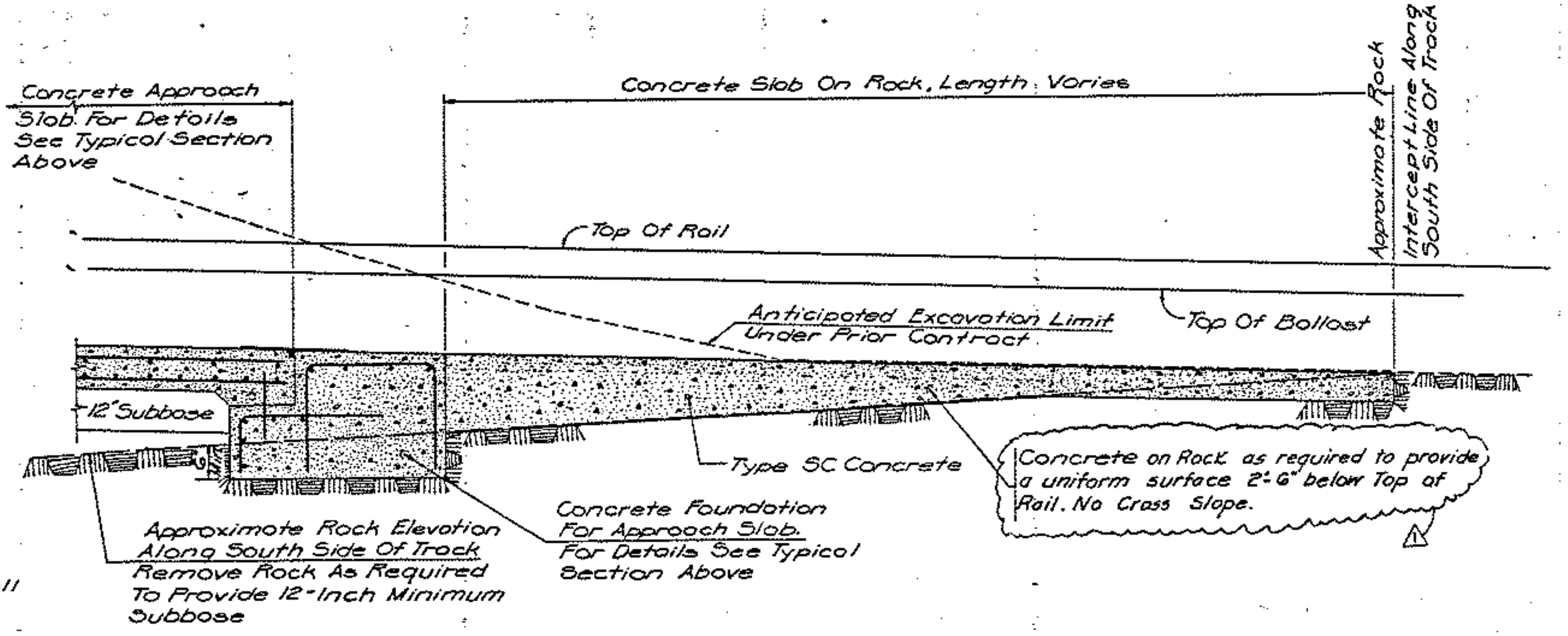
TYPICAL CONCRETE SUBSLAB THICKNESS TRANSITION AT CONCRETE APPROACH SLAB

N.T.S.



TYPICAL CONCRETE SUBSLAB THICKNESS TRANSITION AT CONCRETE SUBSLAB WITH VIBRATION ISOLATION SYSTEM

N.T.S.



PARTIAL SECTION - BALLASTED TRACK TRANSITION

(SECTION TAKEN ALONG SOUTH SIDE OF TRACK)

N.T.S

1	SSVK Tech. Bul. # Y-47 Track Subslab Revision	April 3, 1985
REV NO.	DESCRIPTION	DATE

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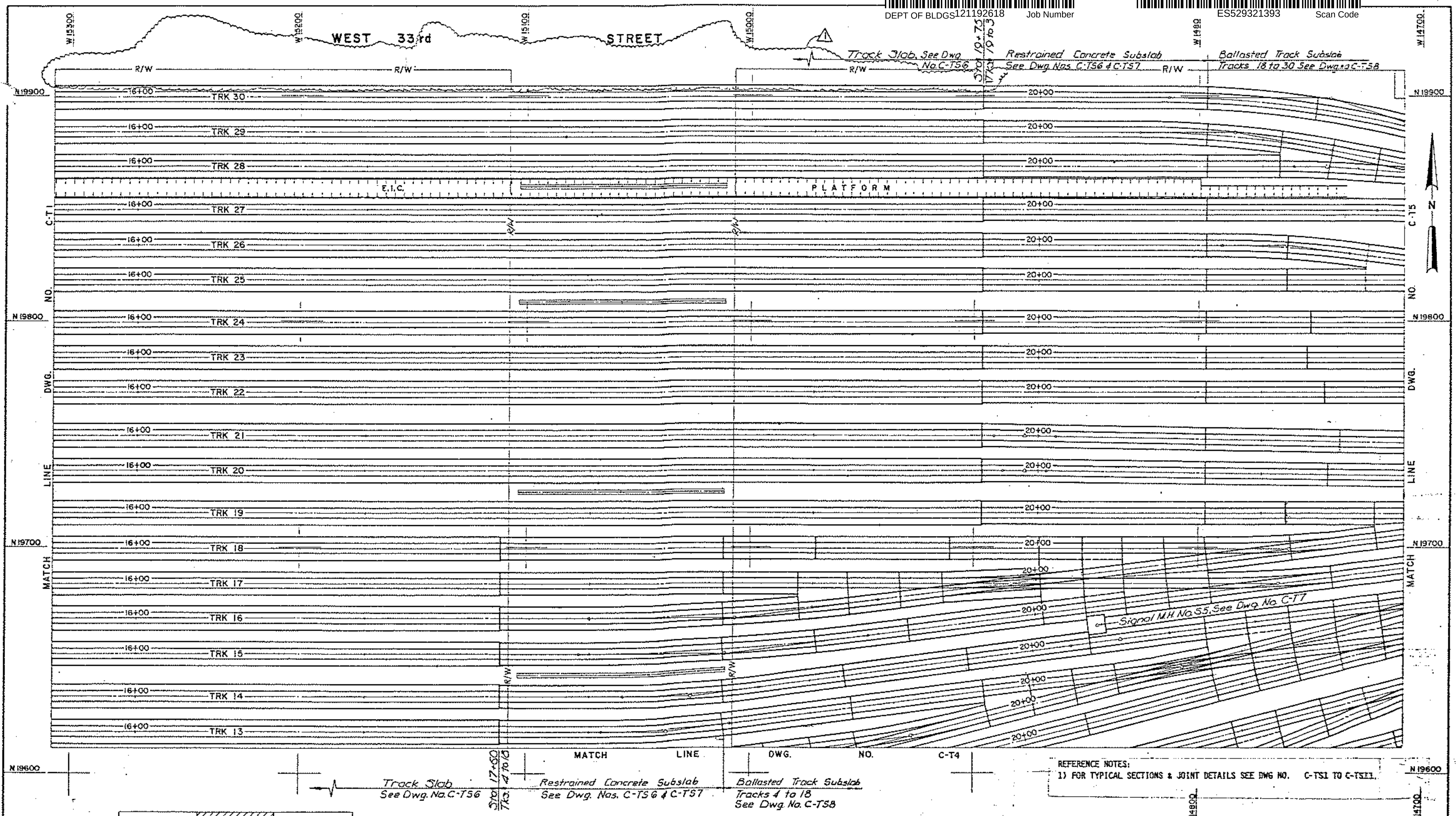
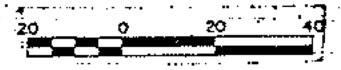
WEST SIDE STORAGE YARD COMPLEX
TYPICAL SECTIONS
BALLASTED TRACK SUBSLAB
STORAGE YARD

CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE: N.T.S
DRAWING NO. C-TS10
SHEET 51 OF 684



REFERENCE NOTES:
1) FOR TYPICAL SECTIONS & JOINT DETAILS SEE DWG NO. C-TS1 TO C-TS11.

C-T1	C-T3	C-T5
C-T2	C-T4	C-T6



REV. NO.	DESCRIPTION	DATE
1	S.S.V.K. Tech Bul. Y-45 Revised/Conv. Ctr. Platf. Deletion	FEB-28-85

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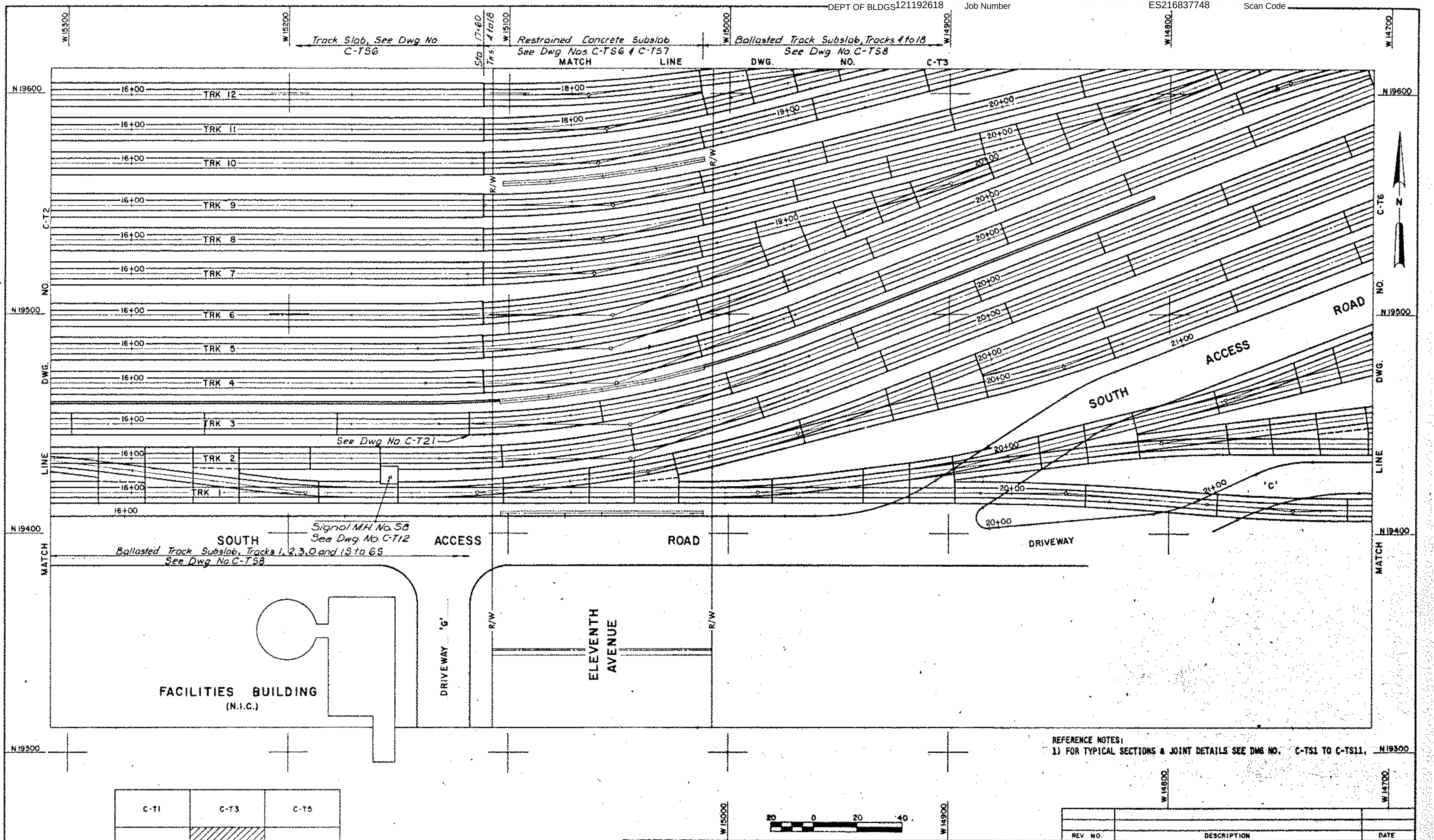
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
PLAN
TRACK SLAB AND
BALLASTED TRACK SUBSLAB
STORAGE YARD

CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE 1" = 20'-0"
DRAWING NO. C-T3
SHEET 199 OF 684



REFERENCE NOTES:
1) FOR TYPICAL SECTIONS & JOINT DETAILS SEE DWG NO. C-TS1 TO C-TS11.

REV NO.	DESCRIPTION	DATE

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Metropolitan Transportation Authority

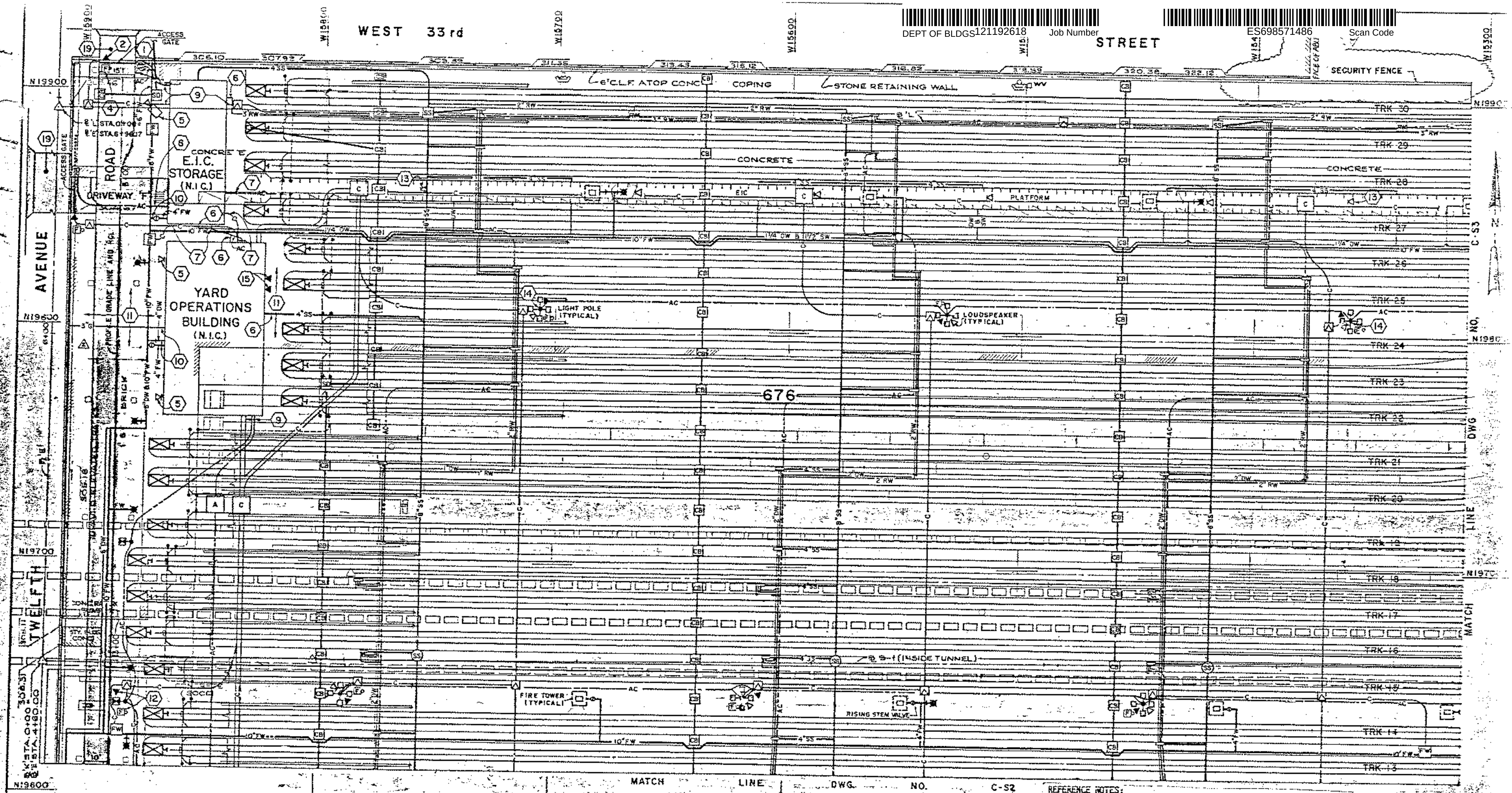
WEST SIDE STORAGE YARD COMPLEX

PLAN
TRACK SLAB AND
BALLASTED TRACK SUBSLAB

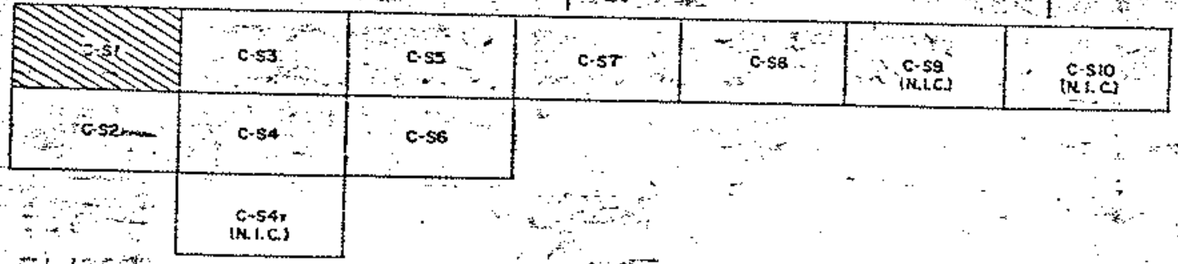
STORAGE YARD

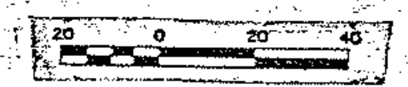
CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE 1" = 20'-0"
DRAWING NO. C-T4
SHEET 200 OF 684

MTA-LIRR Extraordinary Interior Cleaning (EIC) Platform



REFERENCE NOTES:
1) SEE COMPOSITE SITE PLAN NOTES ON DWG. NO. C-GN1 AND C-GN2.





REV NO.	DESCRIPTION	DATE
3	S.S.V.K. Tech. Bul.# Y-45 Revised/Conn. Ctr. Platf. Deletion	FEB-28-85
2	S.S.V.&K. Tech. Bul.# - Change Size of Gas Main	2-8-85
1	Addm. #2: Updated Utility Coordination	10-15-8

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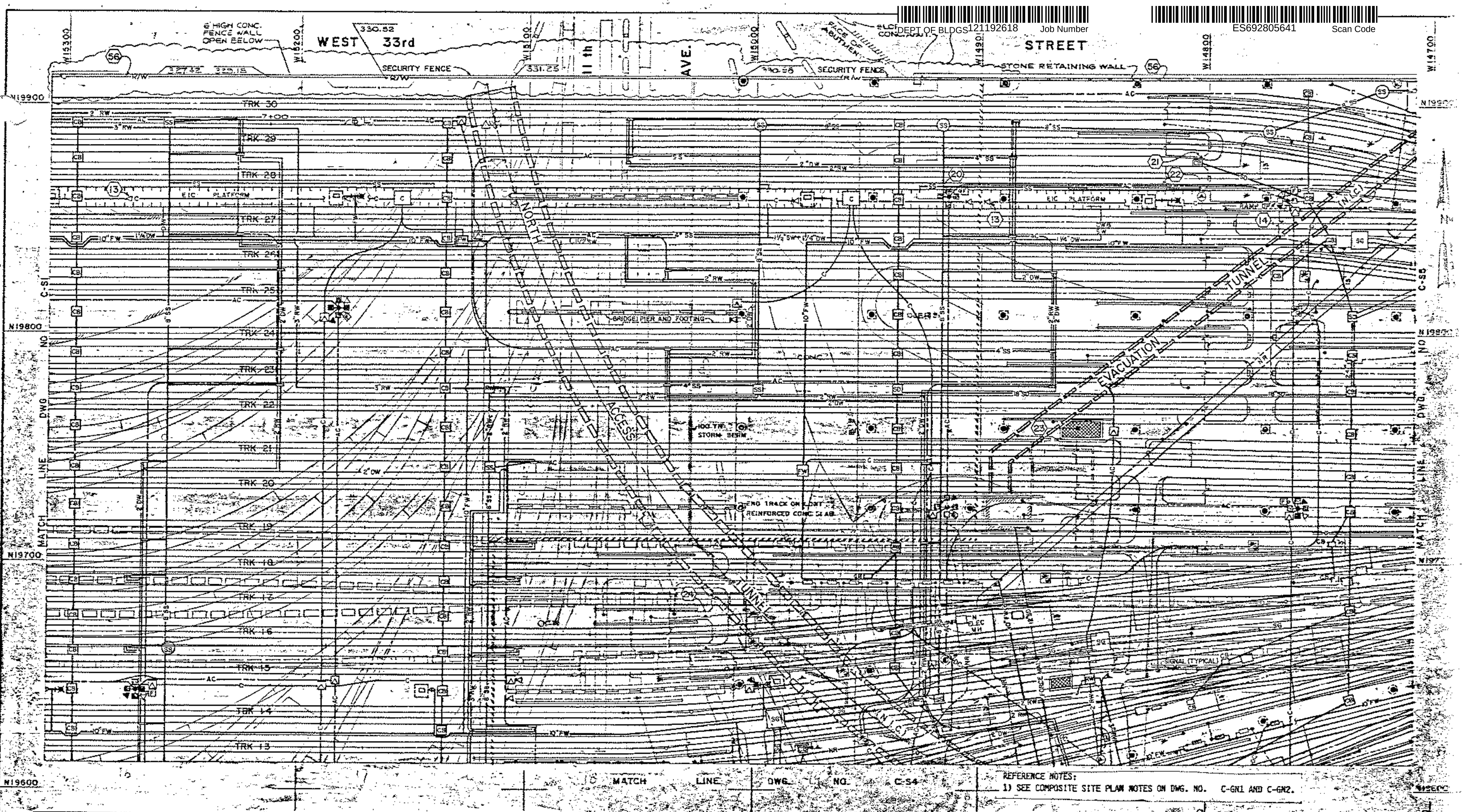
WEST SIDE STORAGE YARD COMPLEX

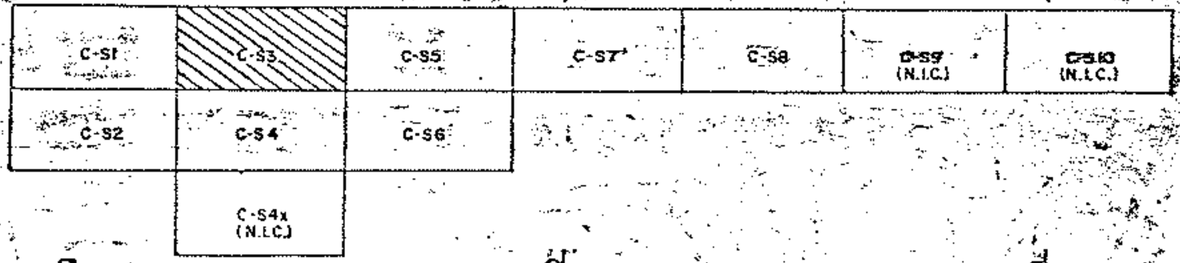
COMPOSITE SITE PLAN

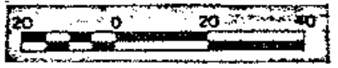
STORAGE YARD

CONTRACT NO. 1-02-2854-0-0
DATE AUG 12, 1982
SCALE 1"=30'-0"
DRAWING NO. C-S
SHEET 17 OF



REFERENCE NOTES:
1) SEE COMPOSITE SITE PLAN NOTES ON DWG. NO. C-GN1 AND C-GN2.





REV NO.	DESCRIPTION	DATE
2	55VK Tech. Bulk-6 Revised/Conv Center Platf Deletion	F-28-8
1	Addm. #2 : Updated Utility Coordination	10-15-8

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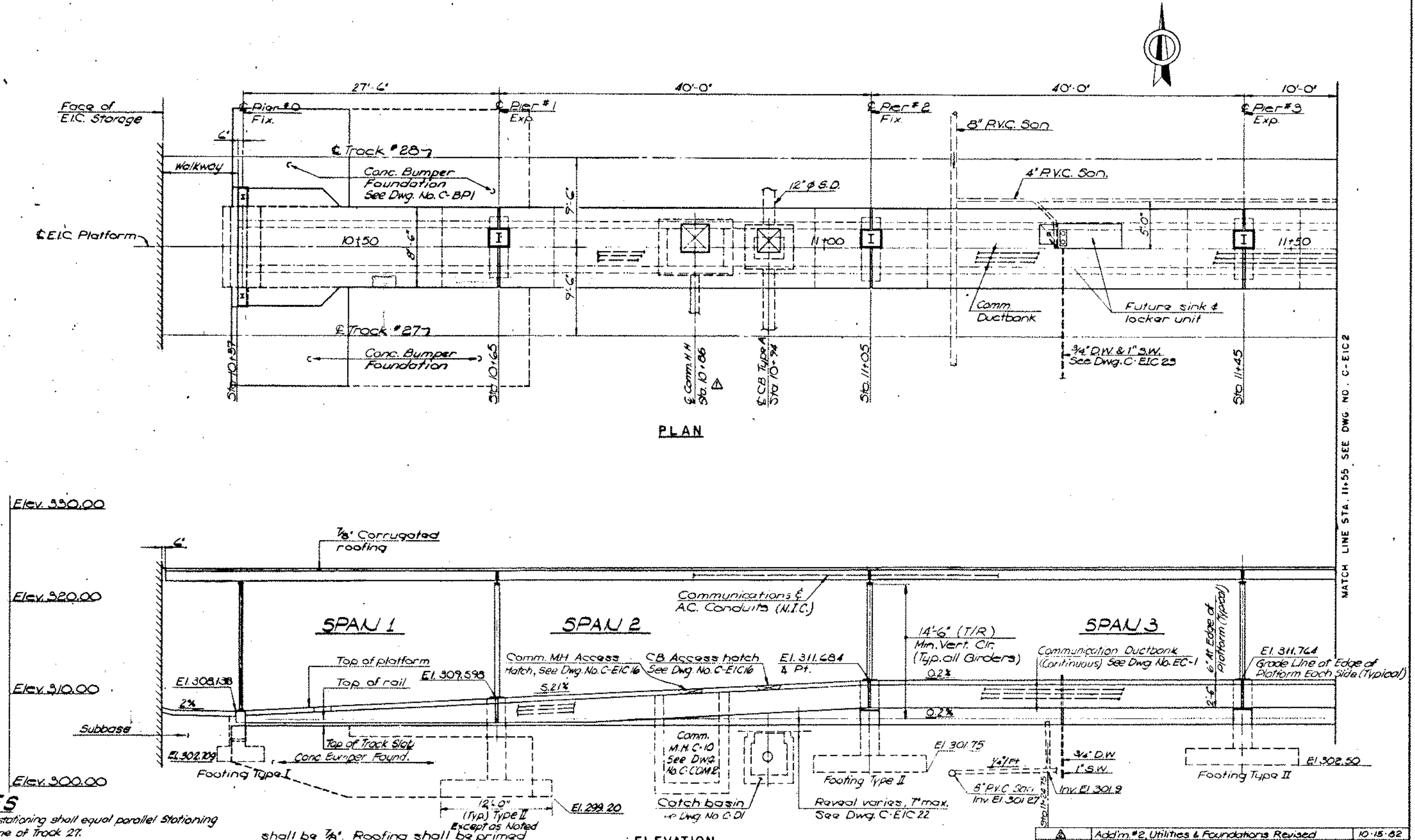
WEST SIDE STORAGE YARD COMPLEX
COMPOSITE SITE PLAN
STORAGE YARD

CONTRACT NO. 1-02-2154-0-0
DATE
SCALE 1"=20'-0"
DRAWING NO. C-S3
SHEET 19 OF 68



NOTES

1. Platform stationing shall equal parallel Stationing at centerline of Track 27.
2. For locations of Utilities see electrical dwgs. for conduits power & lighting, storm & sanitary drainage dwgs. and fire protection & potable water Dwgs.
3. All exposed steel surfaces are to be primed and painted as directed in the specification.
4. Corrugated roofing shall be made of 18 ga. steel, and depth of corrugation shall be ⅞". Roofing shall be primed and painted as directed in the specification.
5. Roofing shall be fastened to stringers using an approved method capable of resisting a uniform uplift load of 30psf.

REV. NO.	DESCRIPTION	DATE
2	Add'm. #2, Utilities & Foundations Revised	10·15·82
1	Add'm. #1, Descriptive Change	9·17·82

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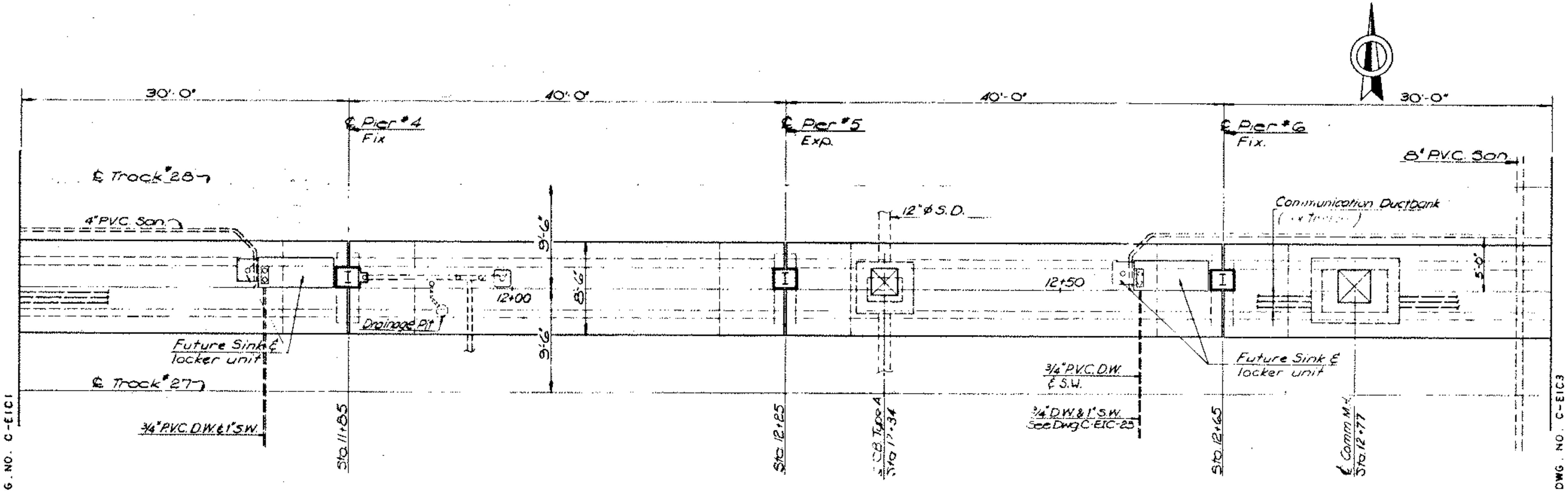
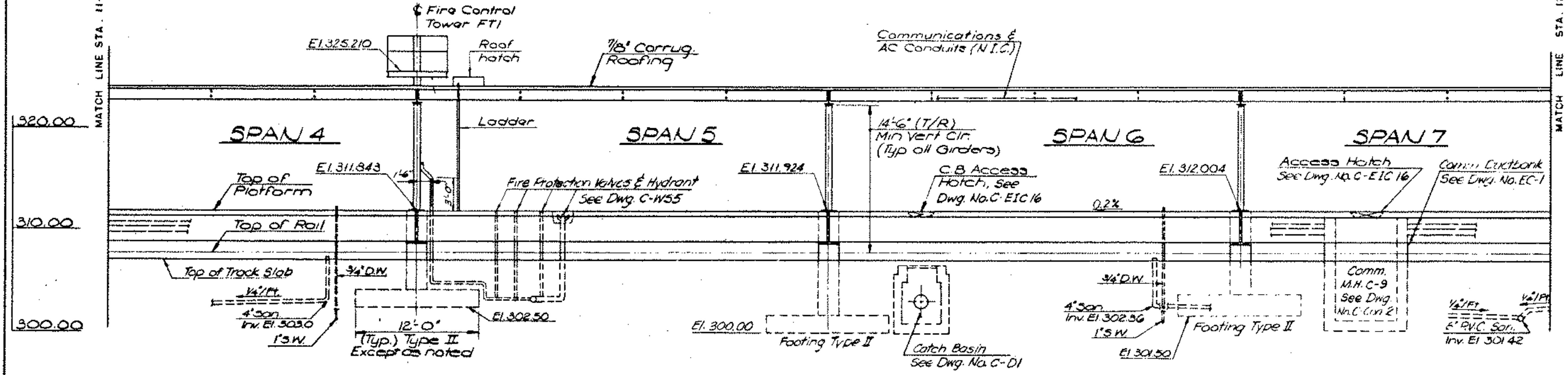
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
PLAN & ELEVATION
STA. 10+29 TO STA. 11+55
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG 12, 1982
SCALE 1"=5'-0"
DRAWING NO C-EIC 1
SHEET 438 OF 684



PLAN



ELEVATION

REV NO	DESCRIPTION	DATE
△	Add'm. #2, Utilities & Foundations Revised	10-15-82

SEELYE STEVENSON VALUE & KNECHT, INC.
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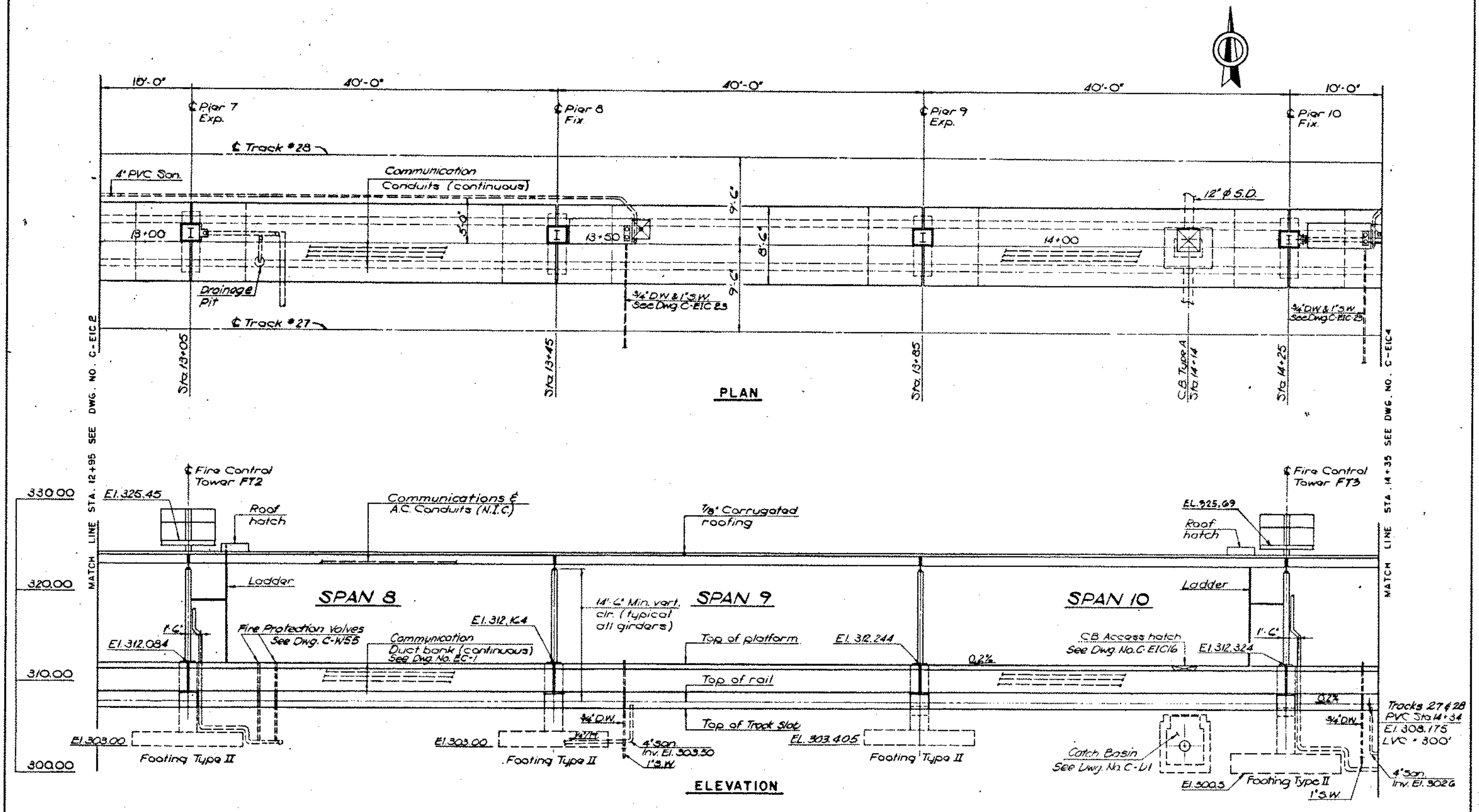
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
PLAN & ELEVATION
STA. 11+55 TO STA. 12+95
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE 1"=5'-0"
DRAWING NO C-EIC 2
SHEET 439 OF 684



REV NO.	DESCRIPTION	DATE
△	Add'm. #2, Utilities & Foundations Revised	10-15-82

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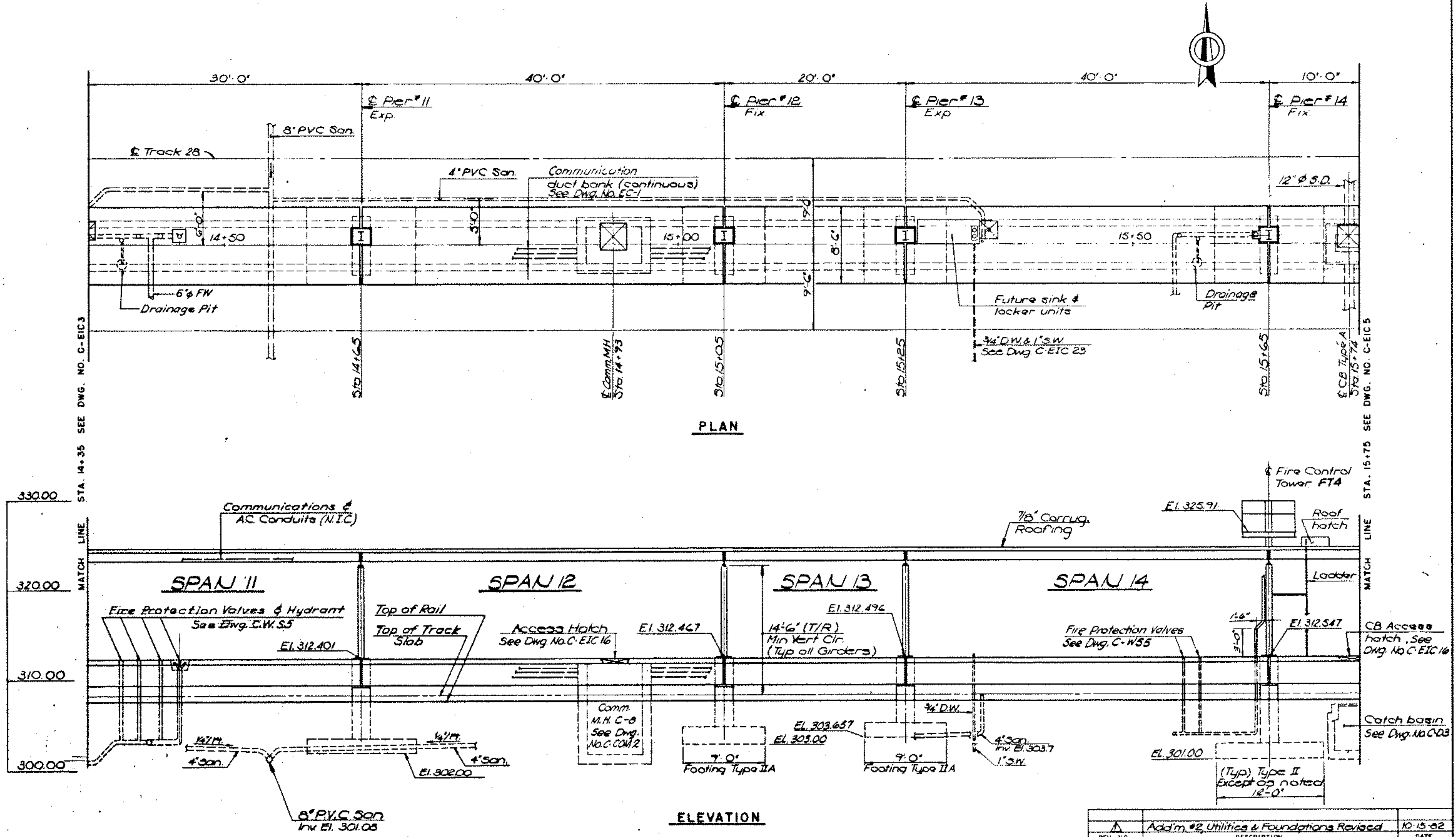
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
PLAN & ELEVATION
STA. 12+95 TO STA. 14+35
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE 1"=5'-0"
DRAWING NO. C-EIC 3
SHEET 440 OF 684



REV NO	DESCRIPTION	DATE
△	Add'm. #2, Utilities & Foundations Revised	10-15-82

SEELYE STEVENSON VALUE & KNECHT, INC.
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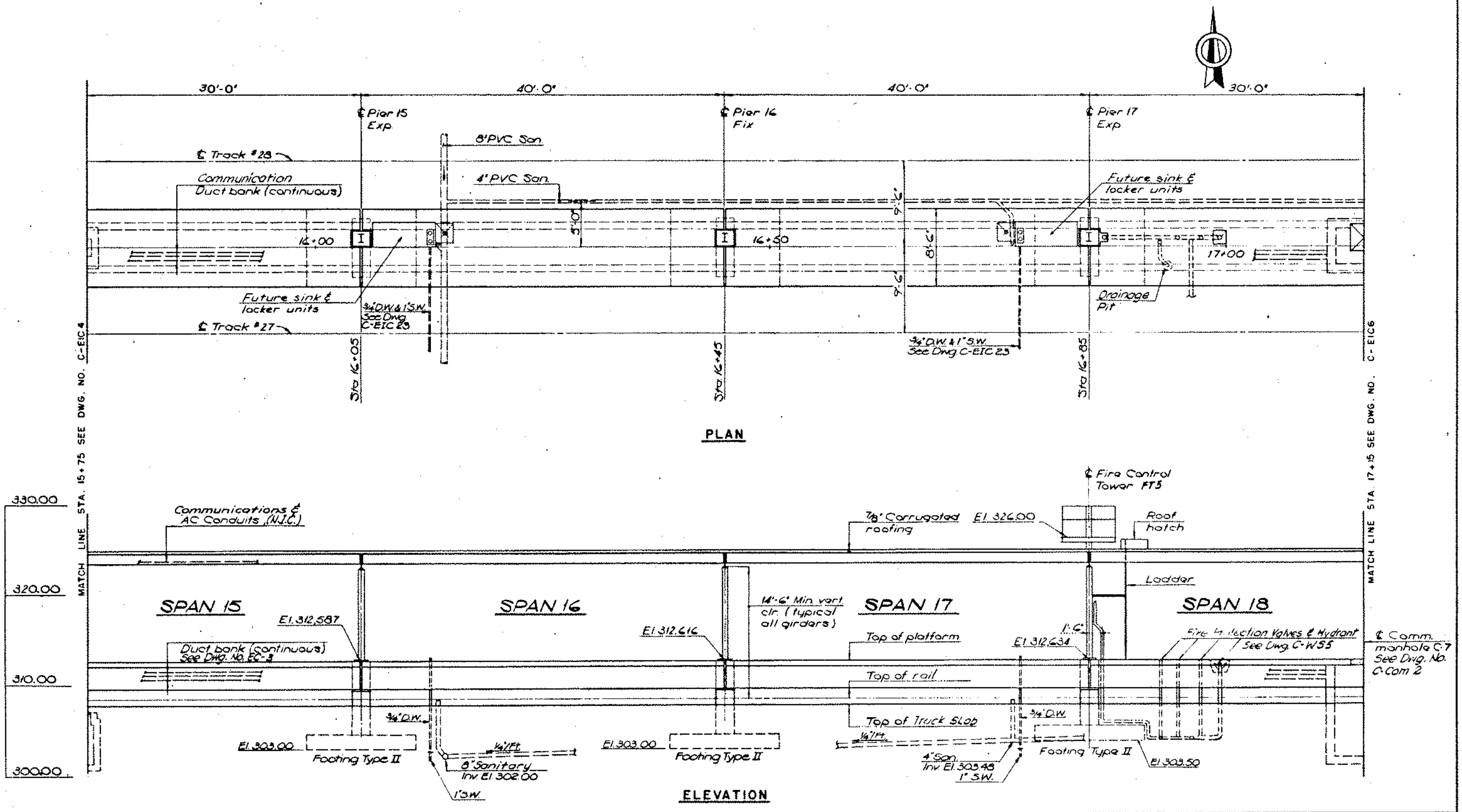
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
PLAN & ELEVATION
STA. 14+35 TO STA. 15+75
STORAGE YARD

CONTRACT NO 1-02-2154-0-0
DATE AUG. 12, 1982
SCALE 1"=5'-0"
DRAWING NO C-EIC 4
SHEET 441 OF 684



REV NO	DESCRIPTION	DATE
△	Add'm #2, Utilities & Foundations Revised	10-15-82

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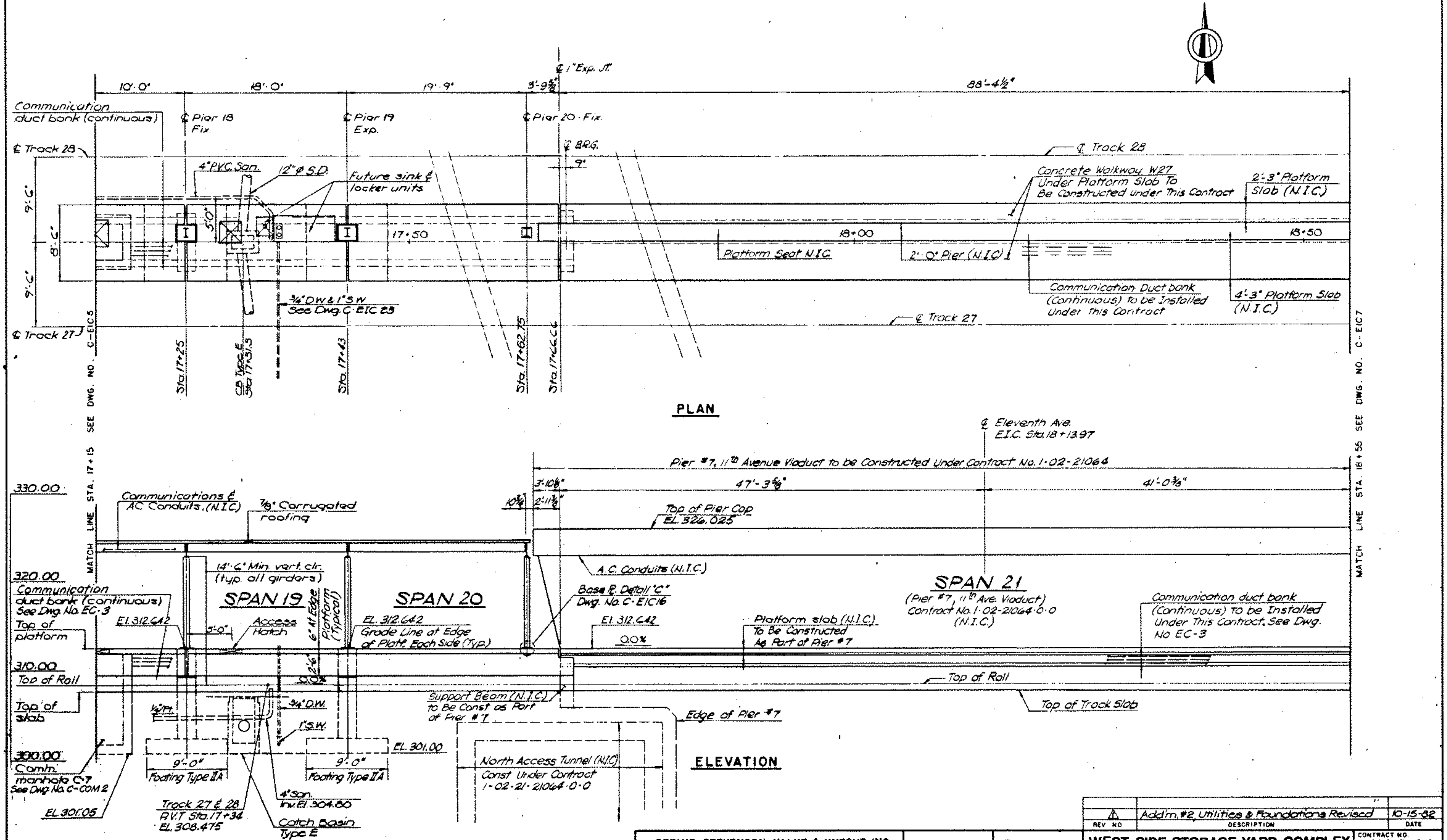
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
PLAN & ELEVATION
STA. 15+75 TO STA. 17+15
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG 12, 1982
SCALE 1"=5'-0"
DRAWING NO. C-EIC 5
SHEET 442 OF 684



REV NO	DESCRIPTION	DATE
1	Add'm. #2, Utilities & Foundations Revised	10-15-82

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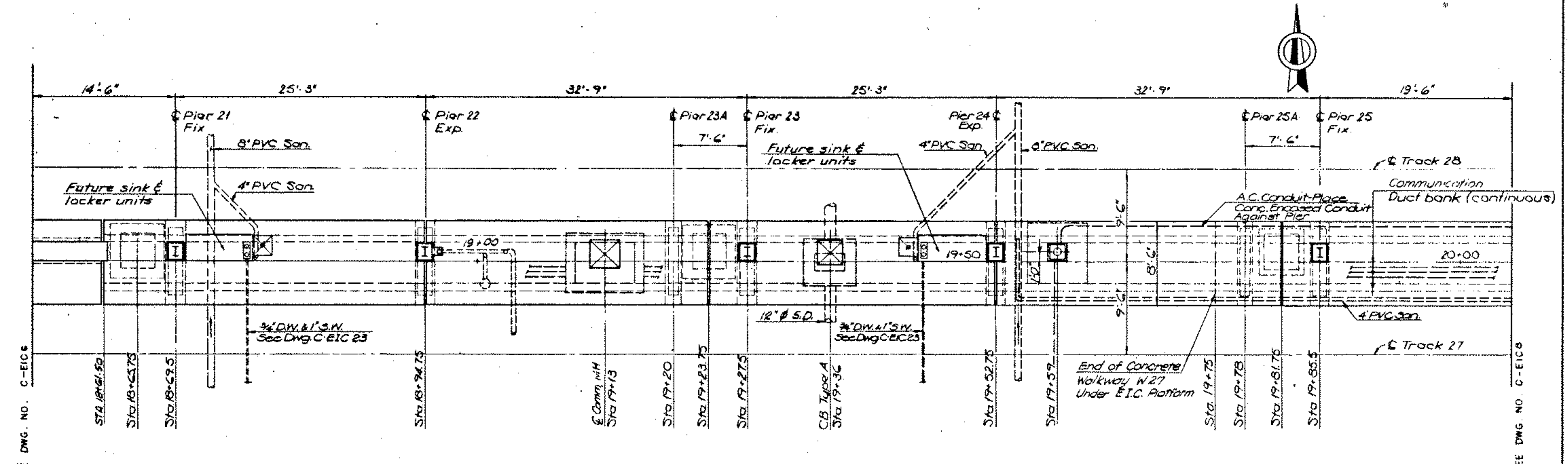
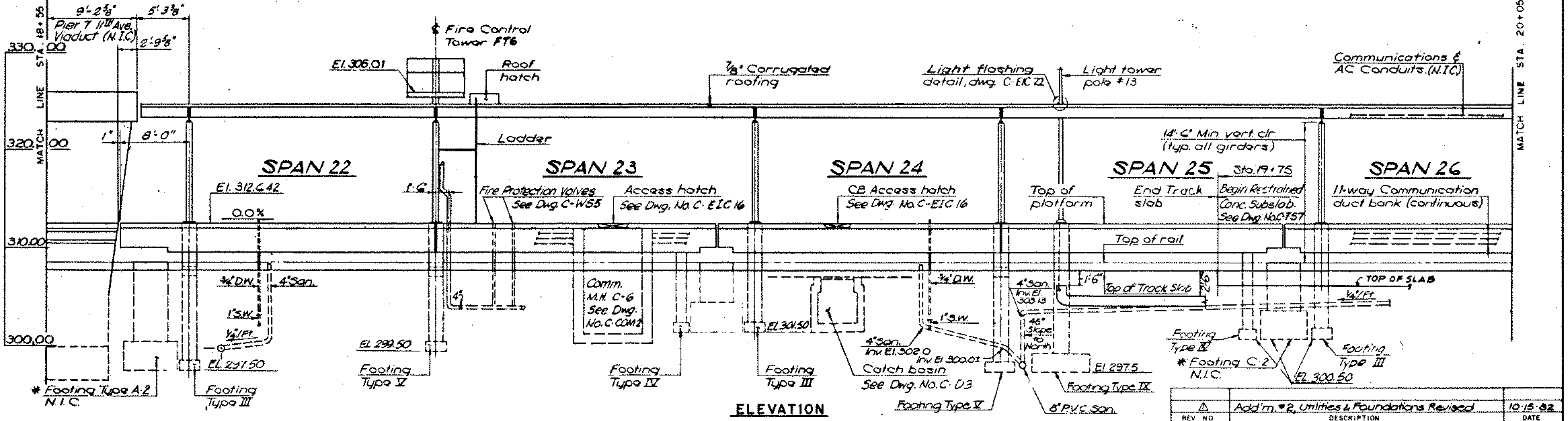
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
PLAN & ELEVATION
STA. 17+15 TO STA. 18+55
STORAGE YARD

CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE 1"=8'-0"
DRAWING NO. C-EIC 6
SHEET 443 OF 684



PLAN



ELEVATION

REV NO	DESCRIPTION	DATE
⚠	Add'm. #2, Utilities & Foundations Revised	10-15-82

* NOTE:
Footings for MABSTOA Bus Garage constructed under Contract 1-02-21064-0-0

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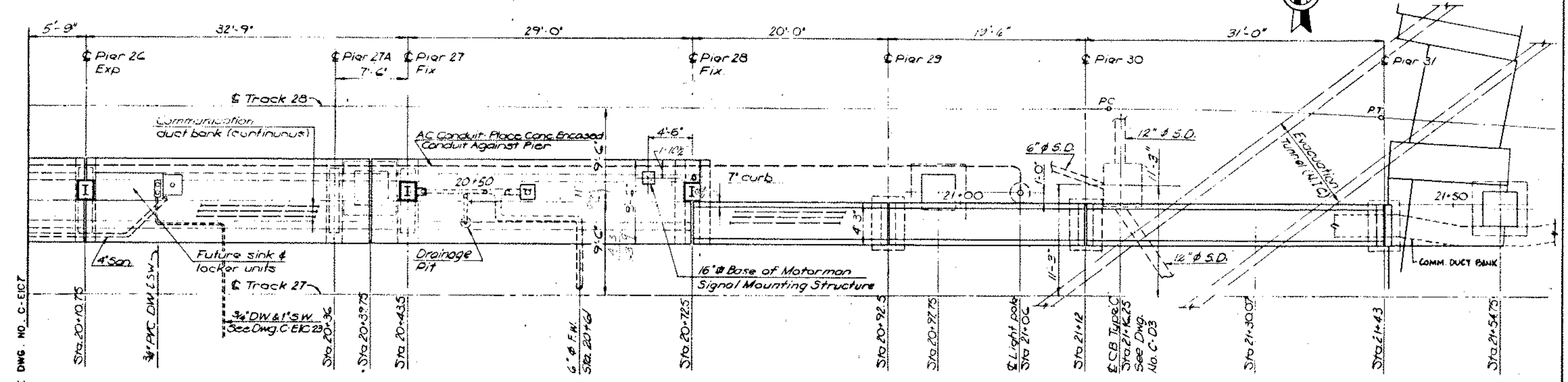
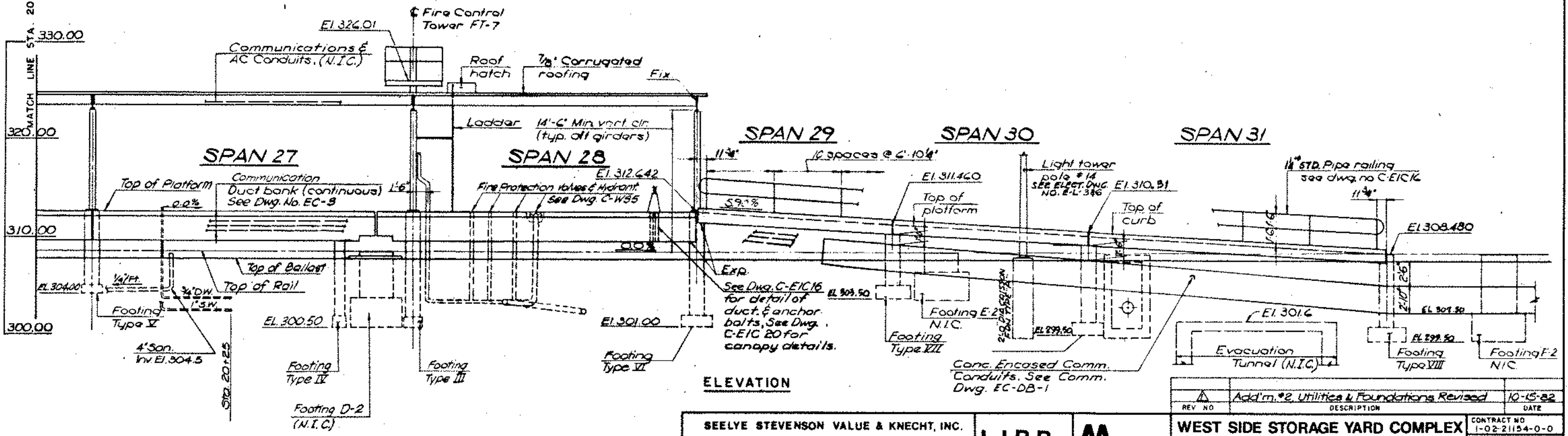
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
PLAN & ELEVATION
STA. 18+55 TO STA. 20+05
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE 1"=5'-0"
DRAWING NO C-EIC 7
SHEET 444 OF 684



PLAN



ELEVATION

REV NO	DESCRIPTION	DATE
△	Add'm. #2, Utilities & Foundations Revised	10-15-82

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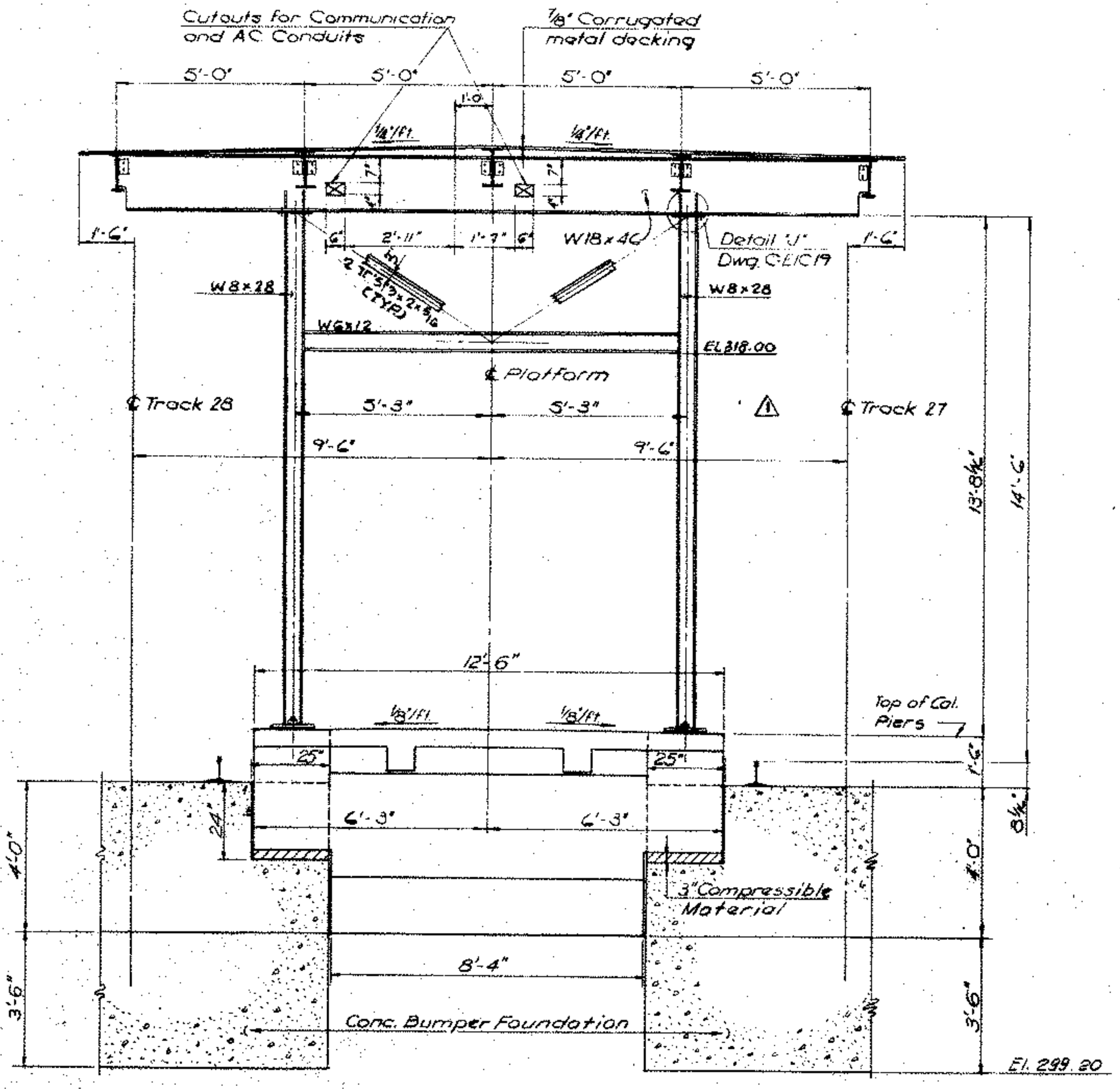
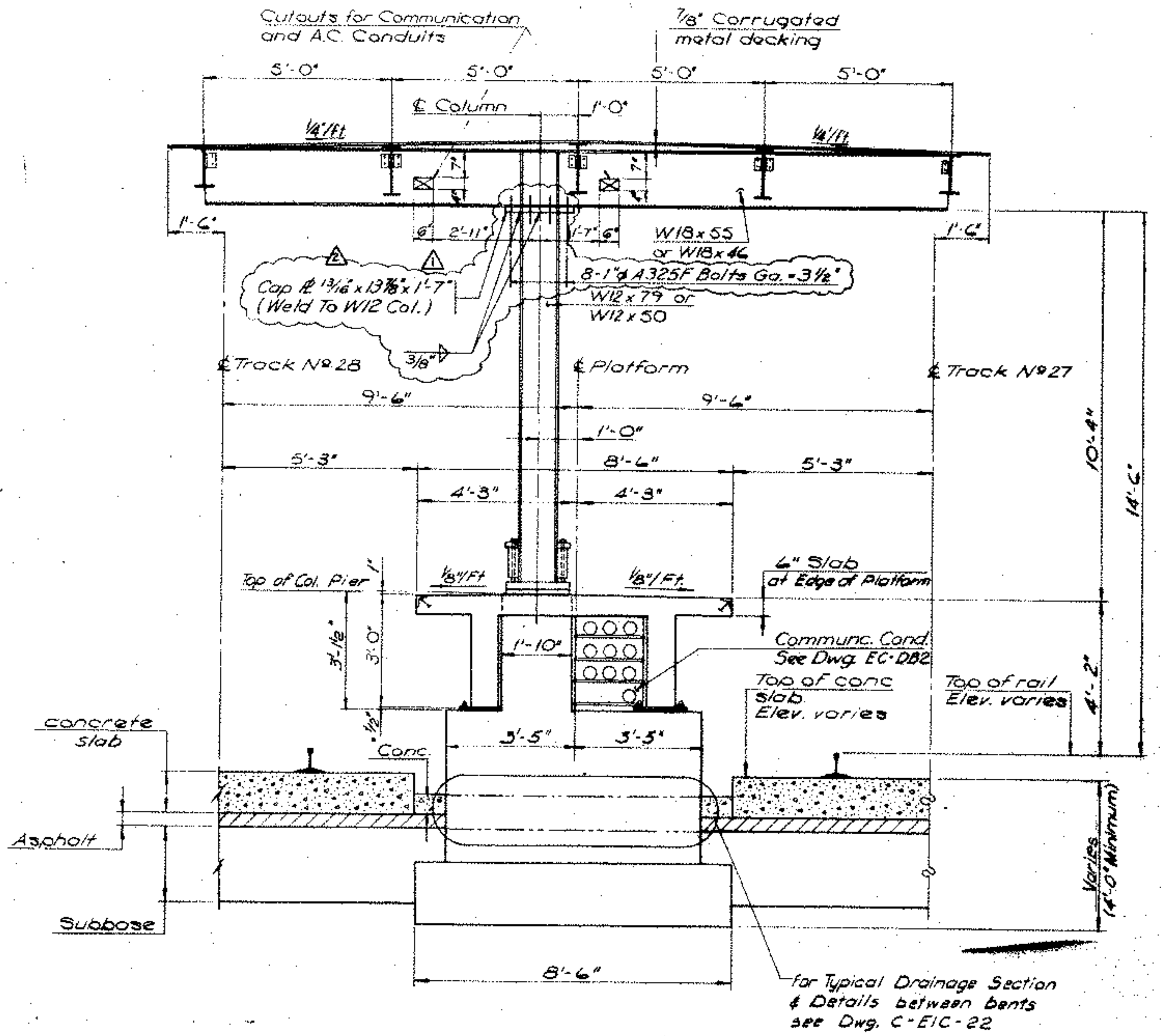
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
PLAN & ELEVATION
STA. 20+05 TO STA. 21+60
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG 12, 1982
SCALE 5'-0"
DRAWING NO C-EIC 8
SHEET 445 OF 684



TYPICAL SECTION

STA 10+37
Scale: 1/2"=1'-0"



TYPICAL SECTION

STA. 11+05 TO STA. 19+75
(Except at 11th Ave pier.)
Scale: 1/2"=1'-0"

REV NO.	DESCRIPTION	DATE
2	SSVK TECH. BUL.# Y-26 ADD CAP ℞ TYP. SEC. STA. 11+05	AUG.16,1983
1	ADD'N ⅛" ℞; REV. COL'S & ADDED VERTICAL BRACING, REV. LOC OF CONDUIT OPNG	OCT.15,1982

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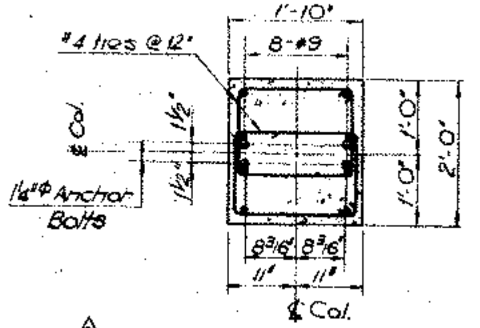
WEST SIDE STORAGE YARD COMPLEX

E.I.C. PLATFORM
CROSS SECTIONS

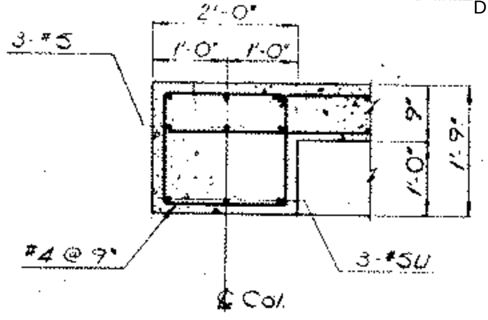
STORAGE YARD

CONTRACT NO. 1-02-21154-0-0
DATE AUG 12, 1982
SCALE 1/2"=1'-0"
DRAWING NO. C-EIC 9



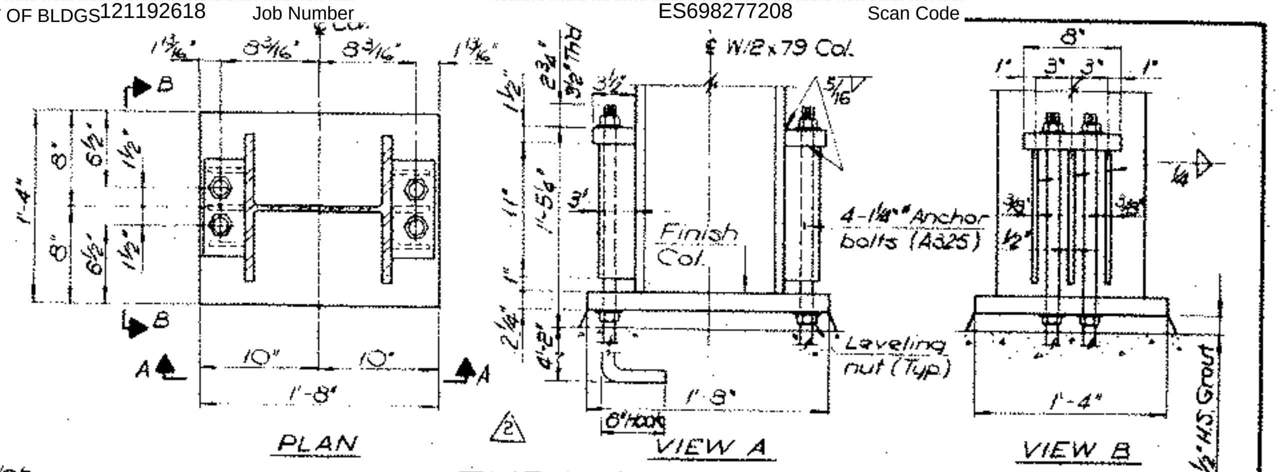
SECTION A-A

Scale: ¾"=1'-0"



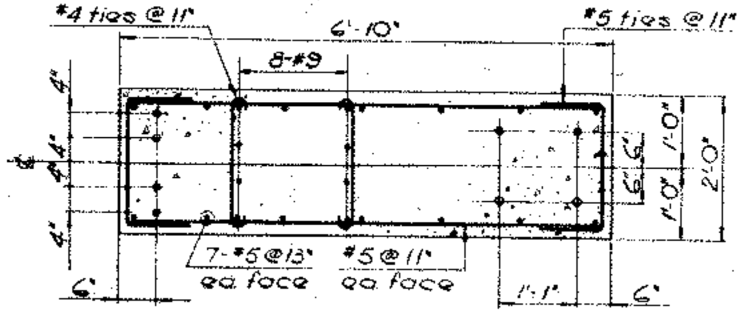
SECTION C-C

Scale: ¾"=1'-0"



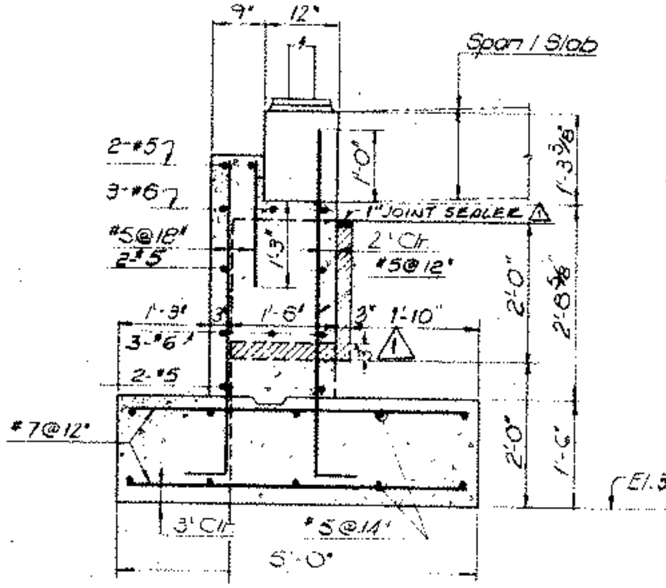
TYPE 'A' ANCHORAGE

Scale: 1½"=1'-0"



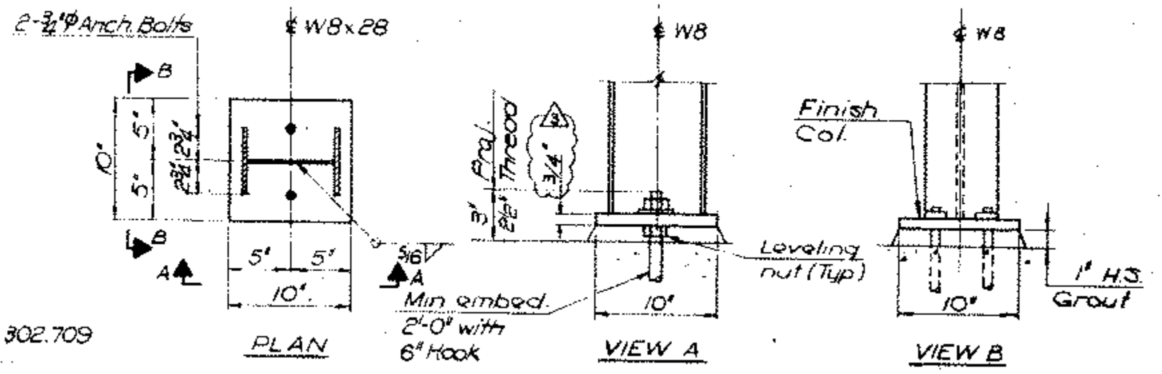
SECTION B-B

Scale: ¾"=1'-0"



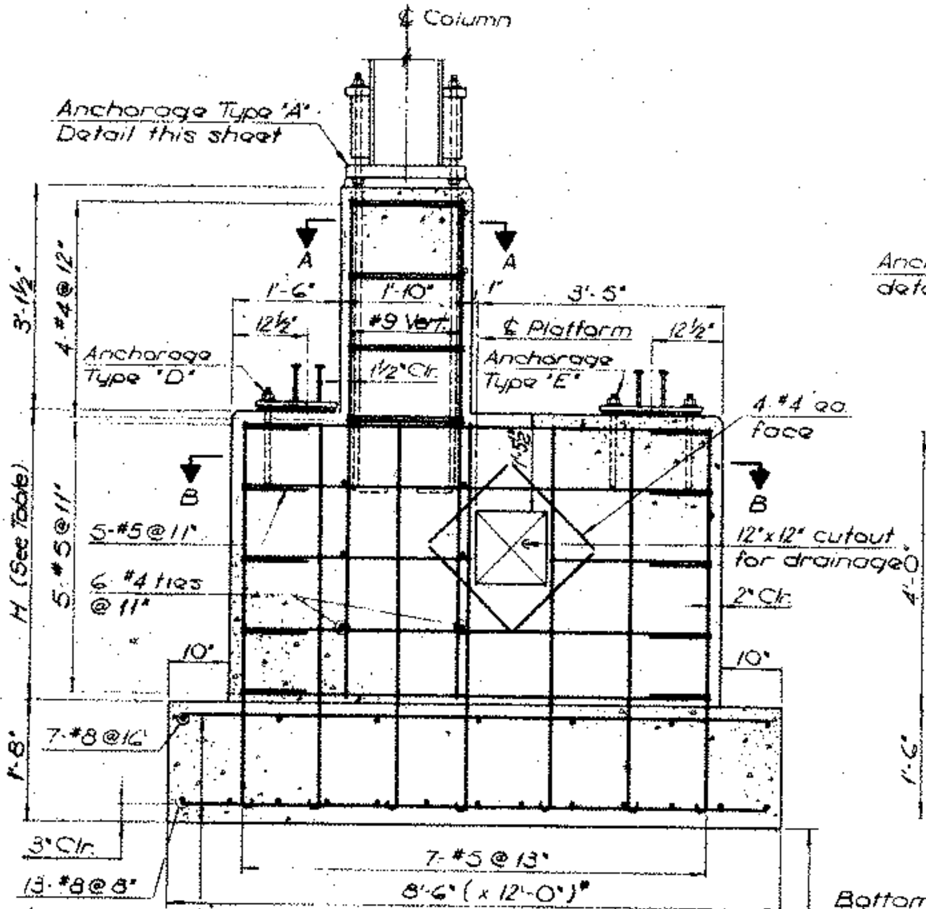
SECTION D-D

Scale: ¾"=1'-0"



TYPE 'B' ANCHORAGE

Scale: 1½"=1'-0"

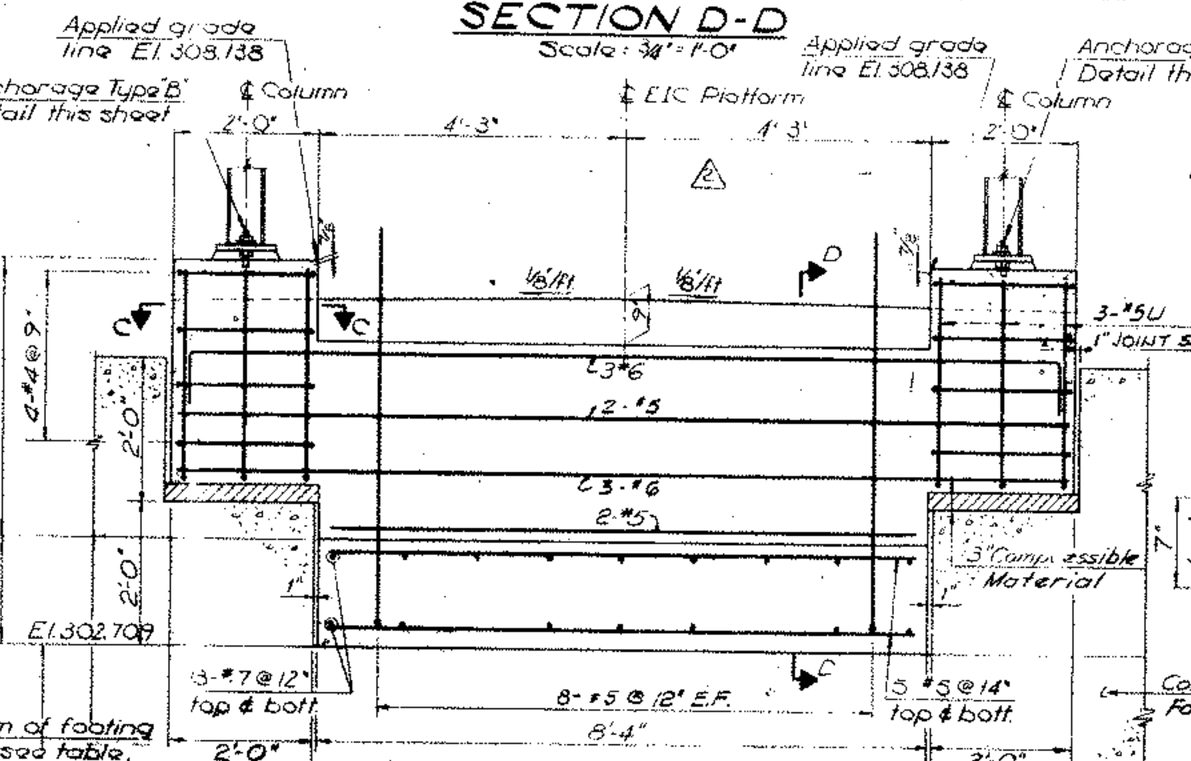


9-#8 @ 17" for 12' wide ftg.
7-#8 @ 17" for 9' wide ftg.
(top & bott.)

FOOTING - TYPE II & IIA

Scale: ¾"=1'-0"

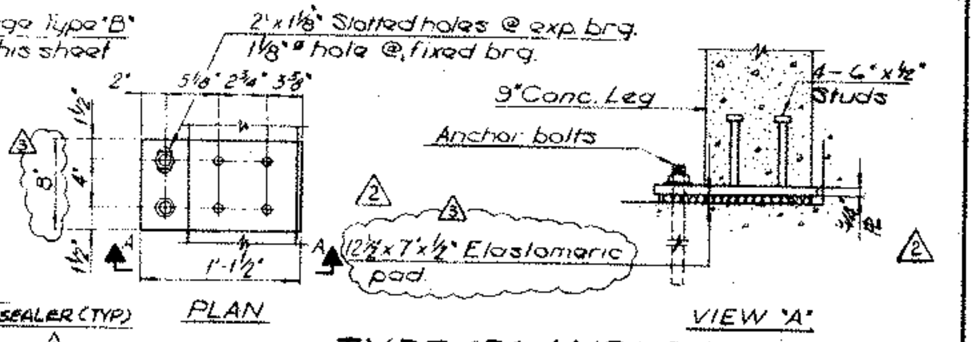
*Note: Type IIA footings shall be 8'-6"x 9'-0"



FOOTING - TYPE I

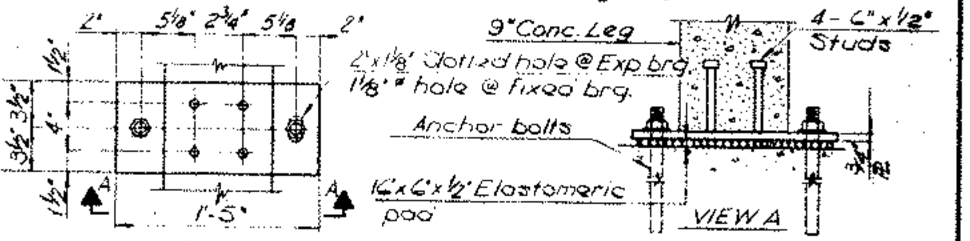
Scale ¾"=1'-0"

2'-0"
3'-6"
Bumper Footing



TYPE 'D' ANCHORAGE

Scale: 1½"=1'-0"



TYPE "E" ANCHORAGE

Scale: 1½"=1'-0"

REV NO	DESCRIPTION	DATE
3	SSVK TECH. BUL #Y-26 REV. ℞ & PAD DIM. TYPE "D" ANCH., SIZE OF ℞ TYPE "B" ANCH.	AUG. 16, 1983
2	ADDM #2: REV SECT A & B, FTG TYPE I, SECT D-D, TYPE A, B, D & E ANCHORAGE	OCT. 15, 1982
1	ADDM #1: DESCRIPTIVE CHANGES	SEPT. 17, 1982

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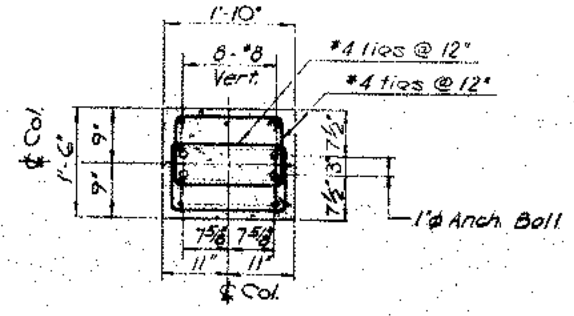
WEST SIDE STORAGE YARD COMPLEX

E.I.C. PLATFORM
FOOTING DETAILS

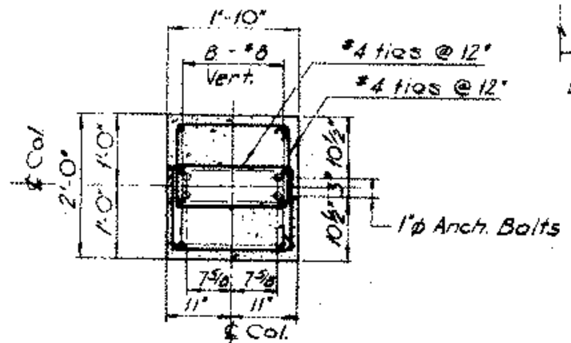
STORAGE YARD

CONTRACT NO. 02-2154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. C-EIC 10



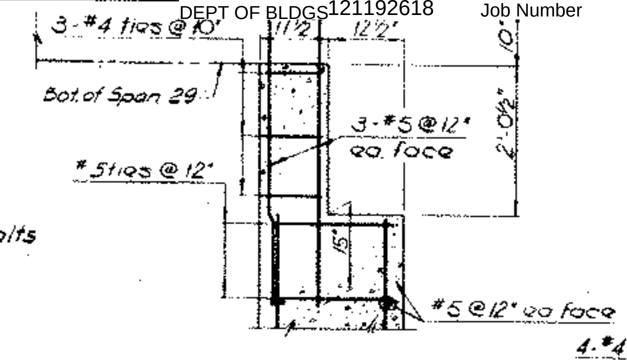
SECTION E-E

FOOTING-TYPE III ONLY



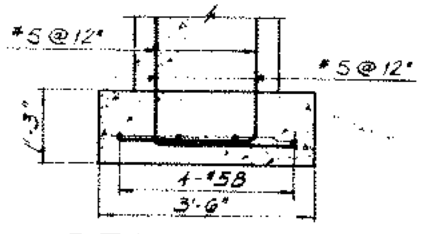
SECTION E-E

FOOTING-TYPE V & VI



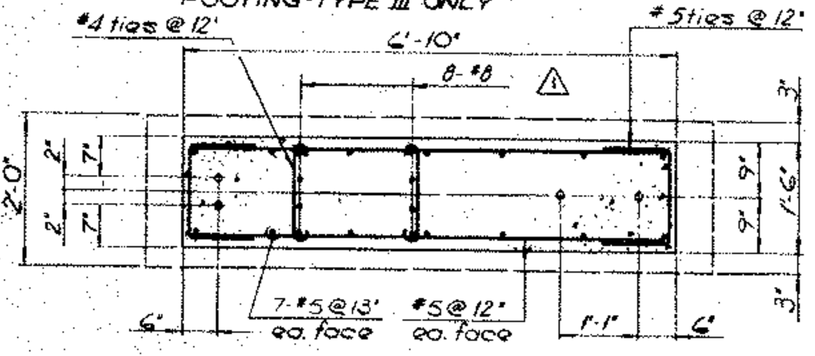
SECTION L-L

Scale: ¾"=1'-0"



SECTION K-K

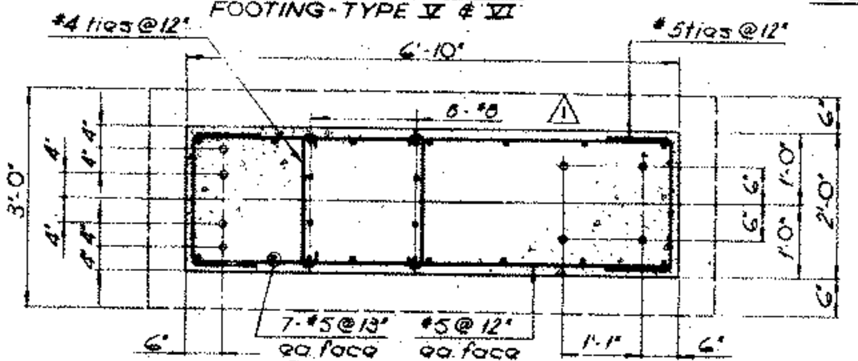
Scale: ¾"=1'-0"



SECTION F-F

FOOTING-TYPE III ONLY

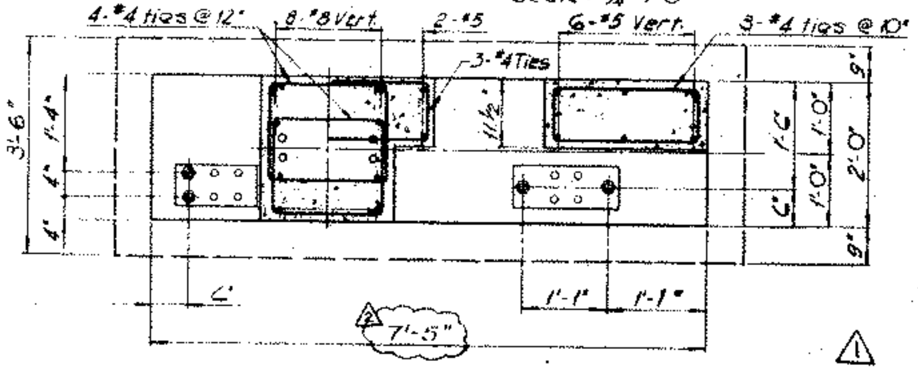
Scale: ¾"=1'-0"



SECTION F-F '

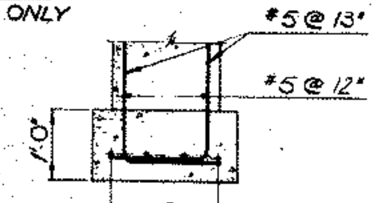
FOOTING - TYPE V ONLY

Scale: ¾"=1'-0"



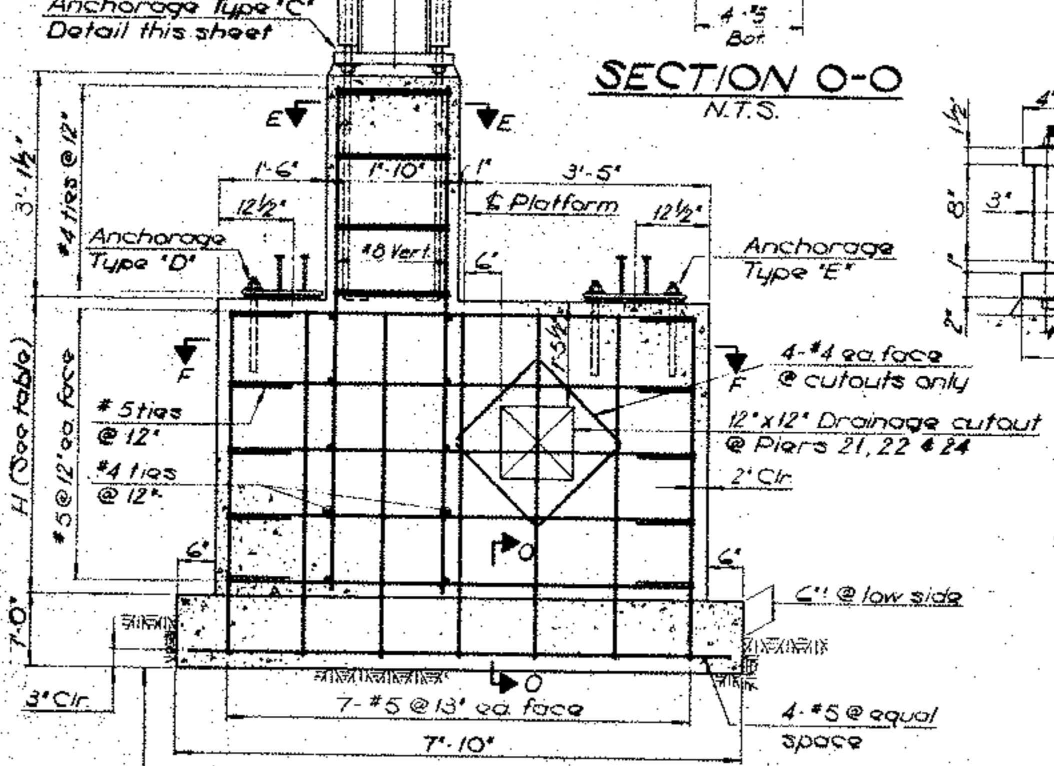
SECTION G-G

Scale: ¾"=1'-0"



SECTION O-O

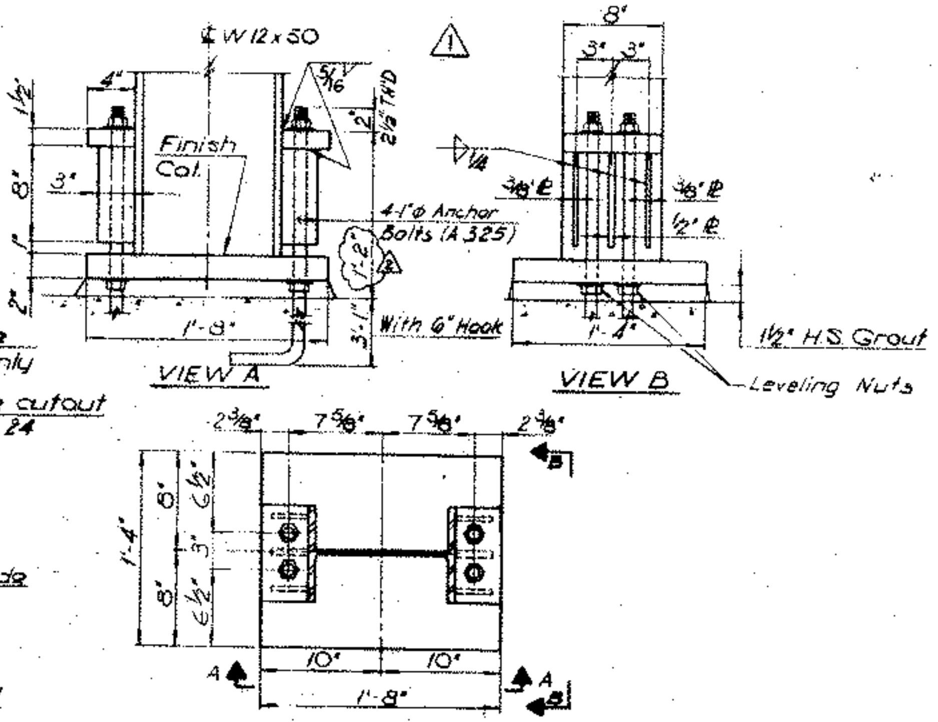
N.T.S.



FOOTING-TYPE III & V

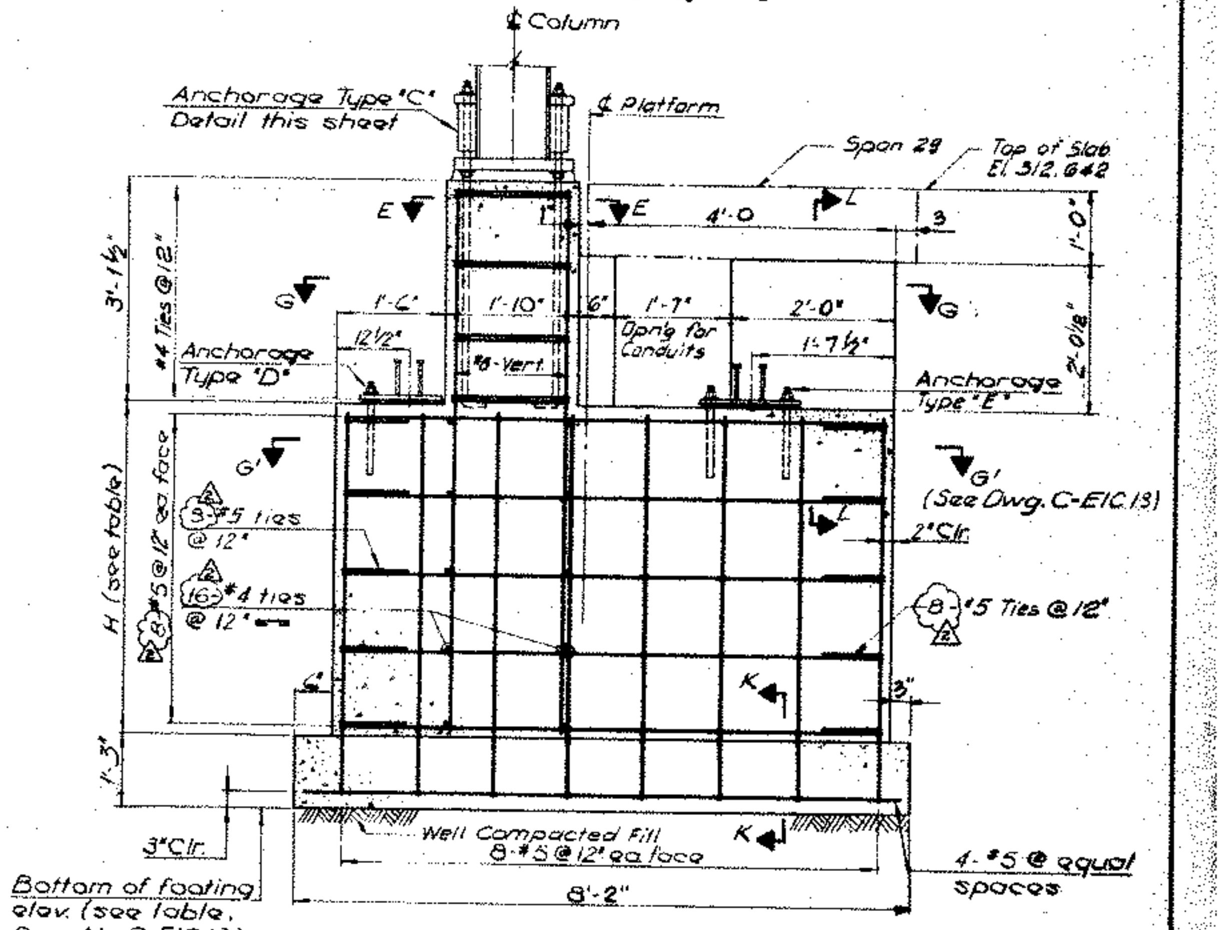
Scale: ¾"=1'-0"

Bottom of footing
elev. (see table
Dwg. No. C-EIC 13)



TYPE 'C' ANCHORAGE

Scale: 1½"=1'-0"



FOOTING-TYPE VI

Scale: ¾"=1'-0"

Bottom of footing
elev. (see table,
Dwg. No. C-EIC 13)

REV NO	DESCRIPTION	DATE
2	SSV&K TECH. BUL. #Y-26: REVISE QTY. HORIZ. BARS FTG. TYPE VI. REVISE DIM.-VIEW "A" TYPE "C" ANCH. COORD. SECT. G-G. DIM. W. TYPE VI DET.	AUG. 16, 1983
1	ADDM #2: REV. SECTS E-E, F-F, G-G, FTG TYPE III & TYPE C ANCHORAGE	OCT. 15, 1982

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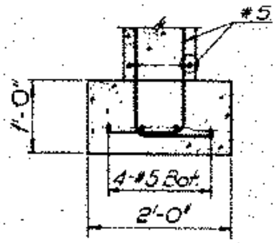
WEST SIDE STORAGE YARD COMPLEX
CONTRACT NO. 1-02-21154-0-0

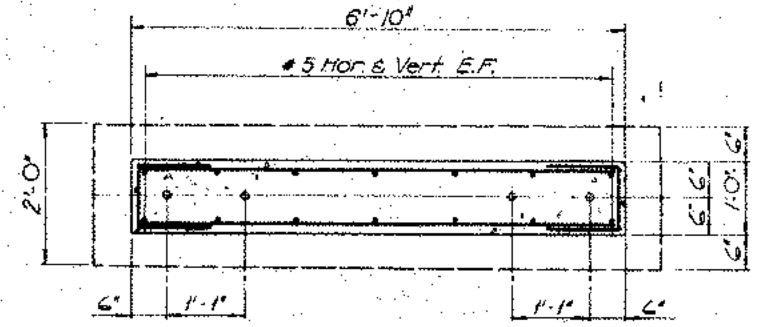
E.I.C. PLATFORM
FOOTING DETAILS

DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. C-EIC 11

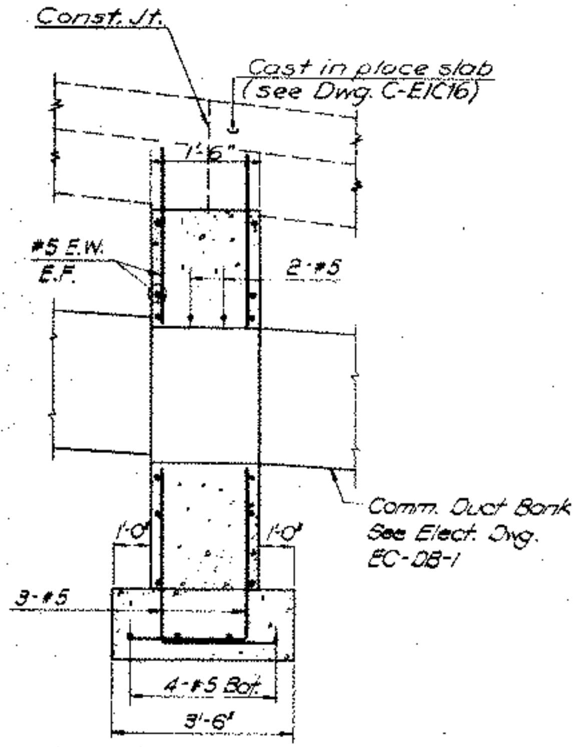
STORAGE YARD



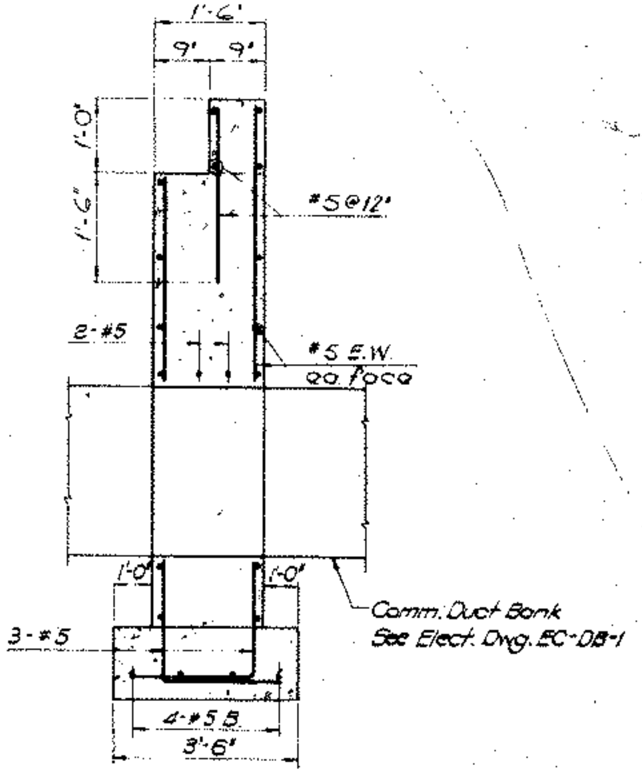
SECTION N-N
Scale : 3/4" = 1'-0"



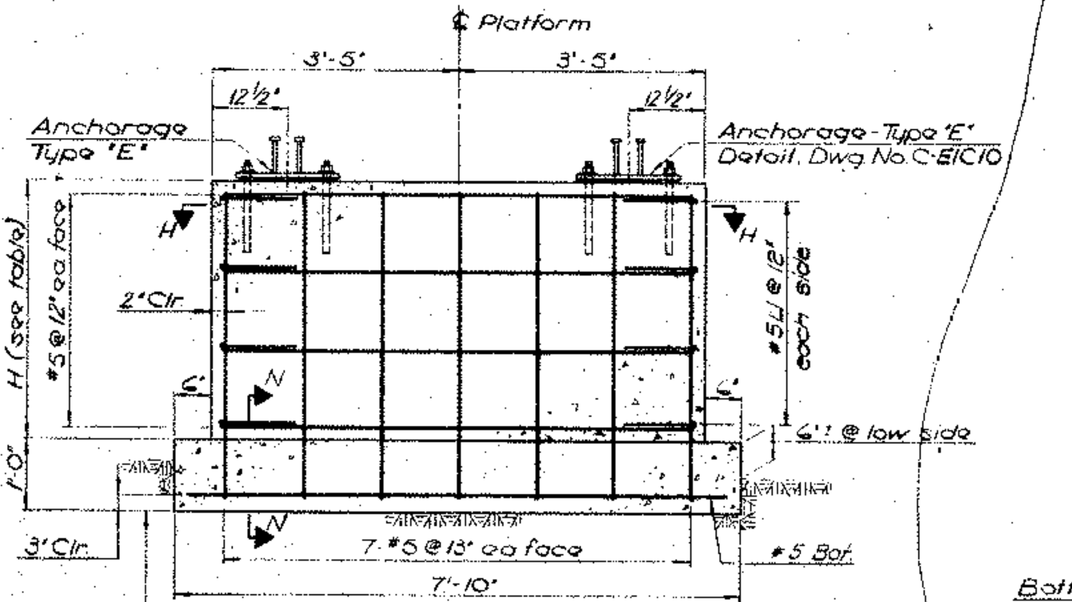
SECTION H-H
Scale : 3/4" = 1'-0"



SECTION I-I
Scale : 3/4" = 1'-0"

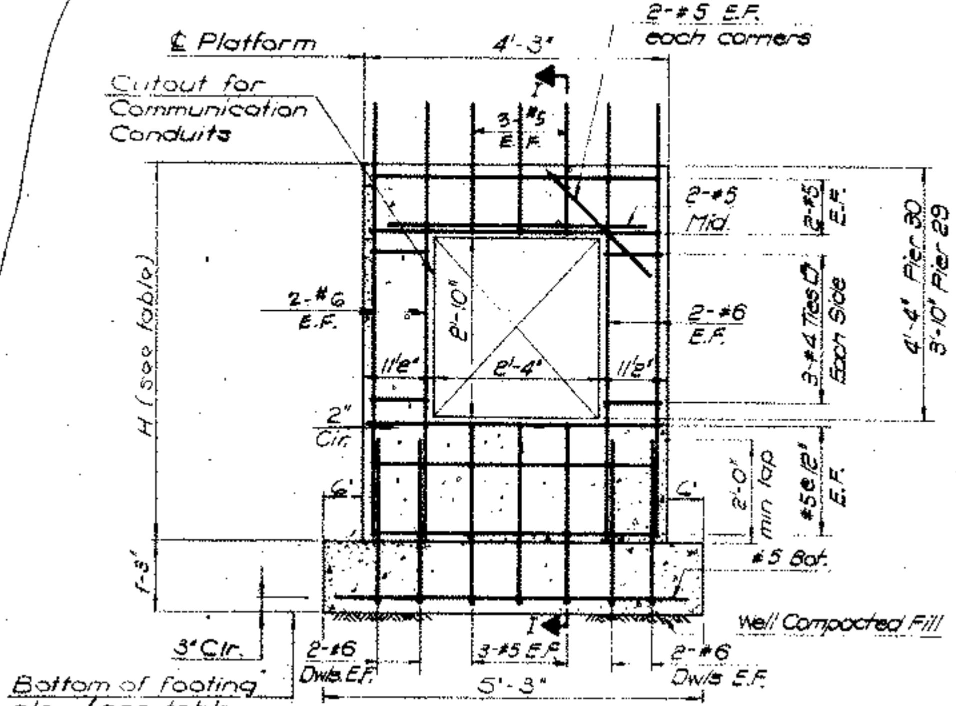


SECTION J-J
Scale : 3/4" = 1'-0"



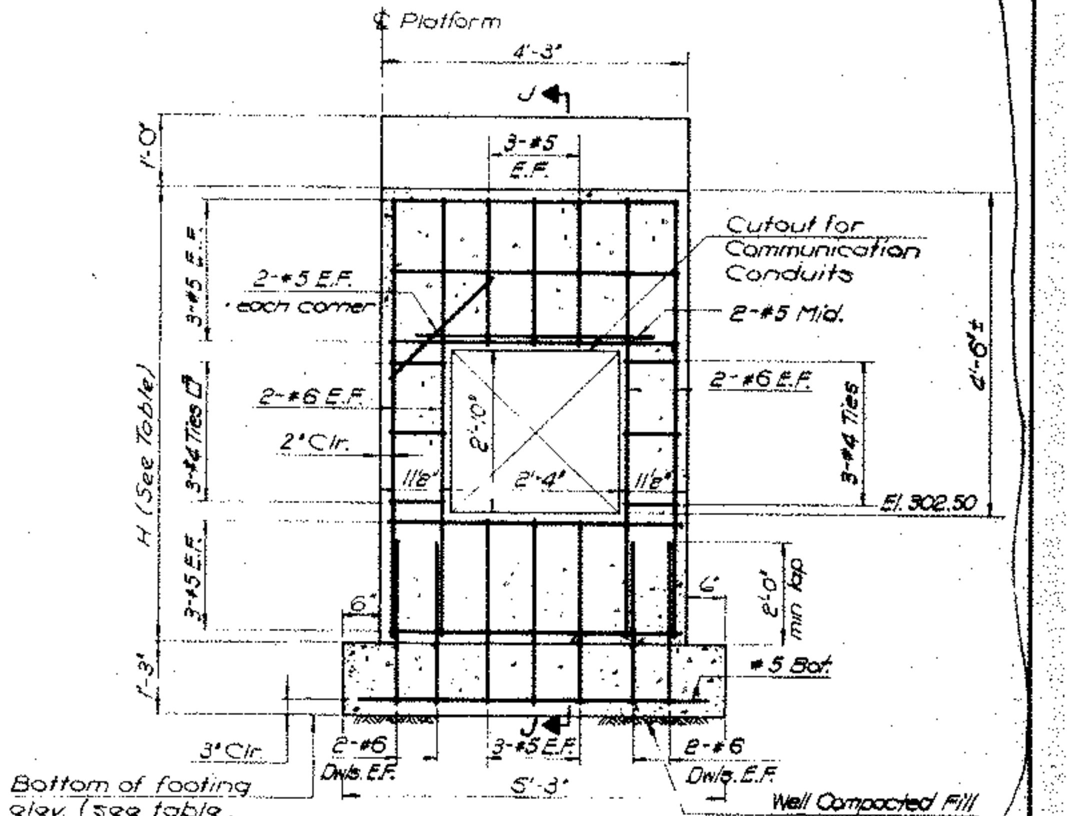
FOOTING-TYPE IV
Scale : 3/4" = 1'-0"

Bottom of footing
elev. (see table,
Dwg. No. C-EIC13)



Bottom of footing
elev. (see table,
Dwg. No. C-EIC13)

FOOTING-TYPE VII
Scale : 3/4" = 1'-0"



FOOTING-TYPE VIII
Scale : 3/4" = 1'-0"

REV NO	DESCRIPTION	DATE
⚠	ADDM #2: REVISE FTG TYPES VII & VIII	OCT. 15, 1982

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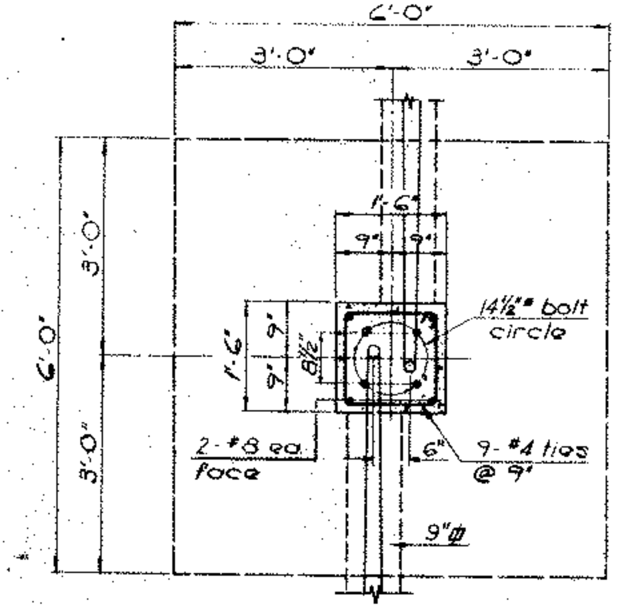
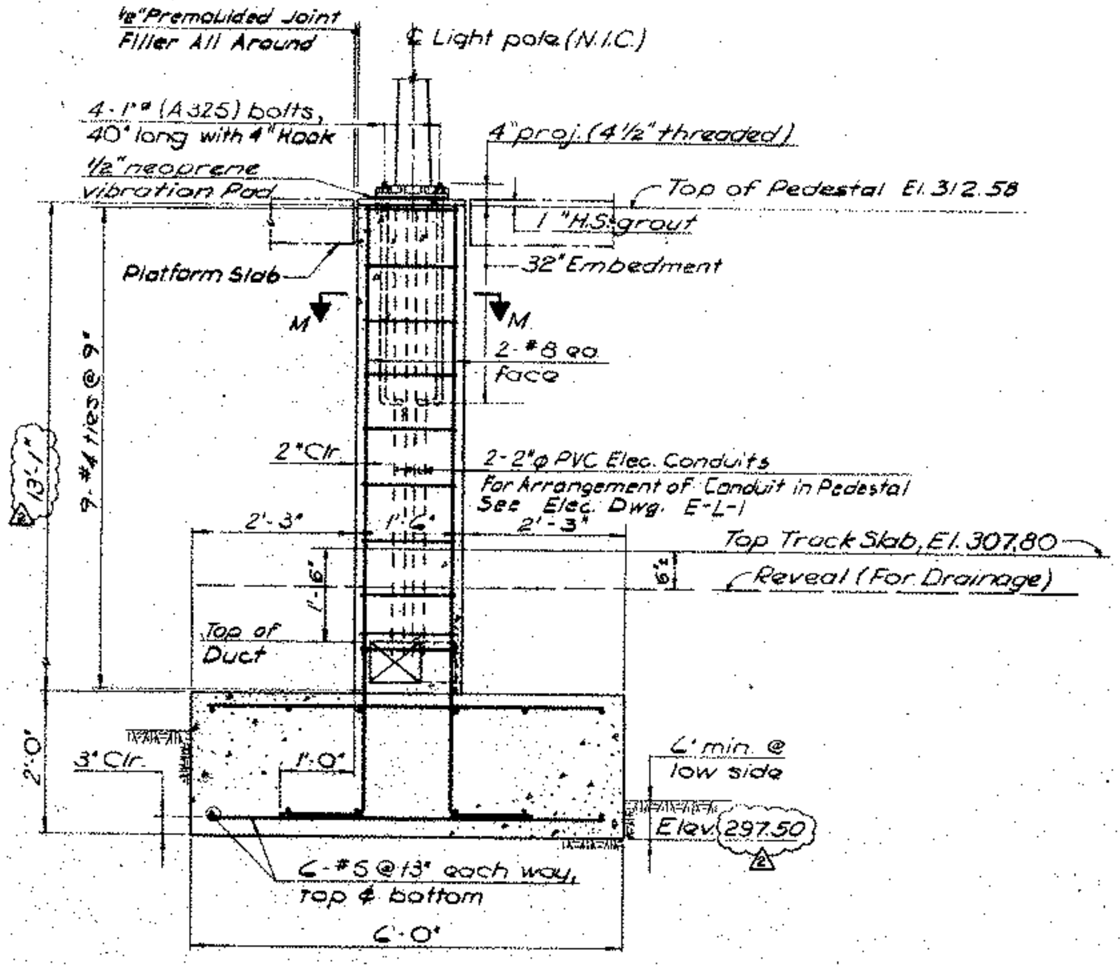
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
FOOTING DETAILS
STORAGE YARD

CONTRACT NO 1-07-21154-0-0
DATE AUG. 12, 1982
SCALE 3/4" = 1'-0"
DRAWING NO C-EIC 12
SHEET 449 OF 684



SECTION M-M

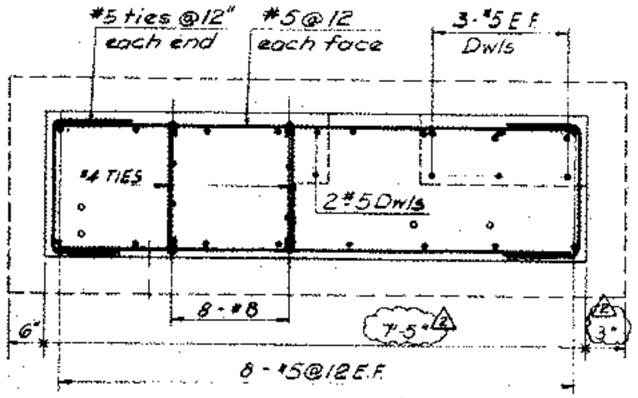
Scale: ¾"=1'-0"



FOOTING-TYPE IX

NOTES

1. Type I and II, Type VI, VII & VIII footings to be founded on undisturbed soil or on a compacted granular fill, capable of supporting a 3000 psf load.
2. Type III thru IX footings are to bear on sound rock.
3. All concrete for footings shall be 4000 psi concrete.
4. Deformed reinforcement bars shall conform to ASTM A615, grade 60.
5. Elevations given are based on Penn Station Datum on which elev. 300.025 is equal to elev. 0.0 on the Borough of Manhattan Datum.
6. Rock elevations are approximate only. Final fabrication of vertical bars and the spacing of horizontal bars is to be adjusted for actual field conditions.
7. Steel for anchor bolts for anchorage types A, B & C shall meet the requirements of ASTM A325. Nuts shall be tightened snug tight plus ½ turn. Ends of bolts are to be hooked.
8. Steel for anchor bolts for anchorage types D & E shall meet the requirements of ASTM A307. Nuts shall be tightened snug tight, then backed off ¼ turn. Bolt threads shall then be burred with a pointed tool.



SECTION G-G'

(See Dwg. C-EIC-11)
Scale: 3/4"=1'-0"

FOOTING DATA TABLE

Pier No.	Footing Type	Fix or Exp.	Approx Rock Surface Elev.	Bottom of Footing Elev.	Top of Pedestal Elev.	Height of Pedestal (h')
0	I	Fix.	217.0	302.709	306.929	2.720
1	II	Exp.	220.0	299.20	306.973	6.103
2	II	Fix.	223.5	301.75	308.642	5.272
3	II	Exp.	230.0	302.50	308.722	4.555
4	II	Fix.	235.0	302.50	308.802	4.635
5	II	Exp	241.0	300.00	308.882	8.882
6	II	Fix.	246.0	301.50	308.962	7.462
7	II	Exp.	249.5	303.00	309.042	4.375
8	II	Fix.	253.5	303.00	309.122	4.455
9	II	Exp.	257.0	303.405	309.202	4.130
10	II	Fix.	261.0	300.50	309.282	7.114
11	II	Exp	264.0	302.00	309.359	5.692
12	II A	Fix.	268.5	303.00	309.425	4.785
13	II A	Exp	270.5	303.657	309.454	4.130
14	II	Fix.	275.0	301.00	309.505	6.838
15	II	Exp.	280.0	303.00	309.545	4.878
16	II	Fix.	285.0	303.00	309.574	4.907
17	II	Exp.	287.5	303.50	309.592	4.425
18	II A	Fix.	288.5	301.00	309.600	6.933
19	II A	Exp.	289.0	301.00	309.600	6.933
20	NA	Fix				
21	III	Fix.	298.0	297.5	309.600	11.100
22	V	Exp.	300.0	299.5	309.600	9.100
23A	IV	Fix.	302.0	301.5	309.600	7.100
23	III	Fix.	302.0	301.5	309.600	7.100
24	V	Exp.	303.5	297.50	309.600	11.10
25A	IV	Fix.	305.0	300.50	309.600	8.10
25	III	Fix.	305.0	300.50	309.600	8.10
26	V	Exp.	307.0	304.00	309.600	4.60
27A	IV	Fix.	305.0	300.50	309.600	8.10
27	III	Fix	305.0	300.50	309.600	8.10
28	VI	Exp.	300.0	301.00	309.600	7.35
29	VII		299.0	303.5	310.458	5.708
30	VII		298.00	299.50	309.31	8.56
31	VIII	Fix.	297.0	299.5	307.473	6.723
NA	IX	NA	303.5	297.50	312.58	15.08

REV NO	DESCRIPTION	DATE
2	S.S.V.K. TECH. BUL. #Y-26 REVISE BOT. EL. FTG. TYPE IX, PEDESTAL HT. SECT. G-G & FTG. TABLE PIERS 10 & 28	AUG. 17, 1983
1	ADDM #2: REV FTG. TYPE IX, SECT G-G, NOTES, & FTG. DATA TABLE	OCT. 15, 1982

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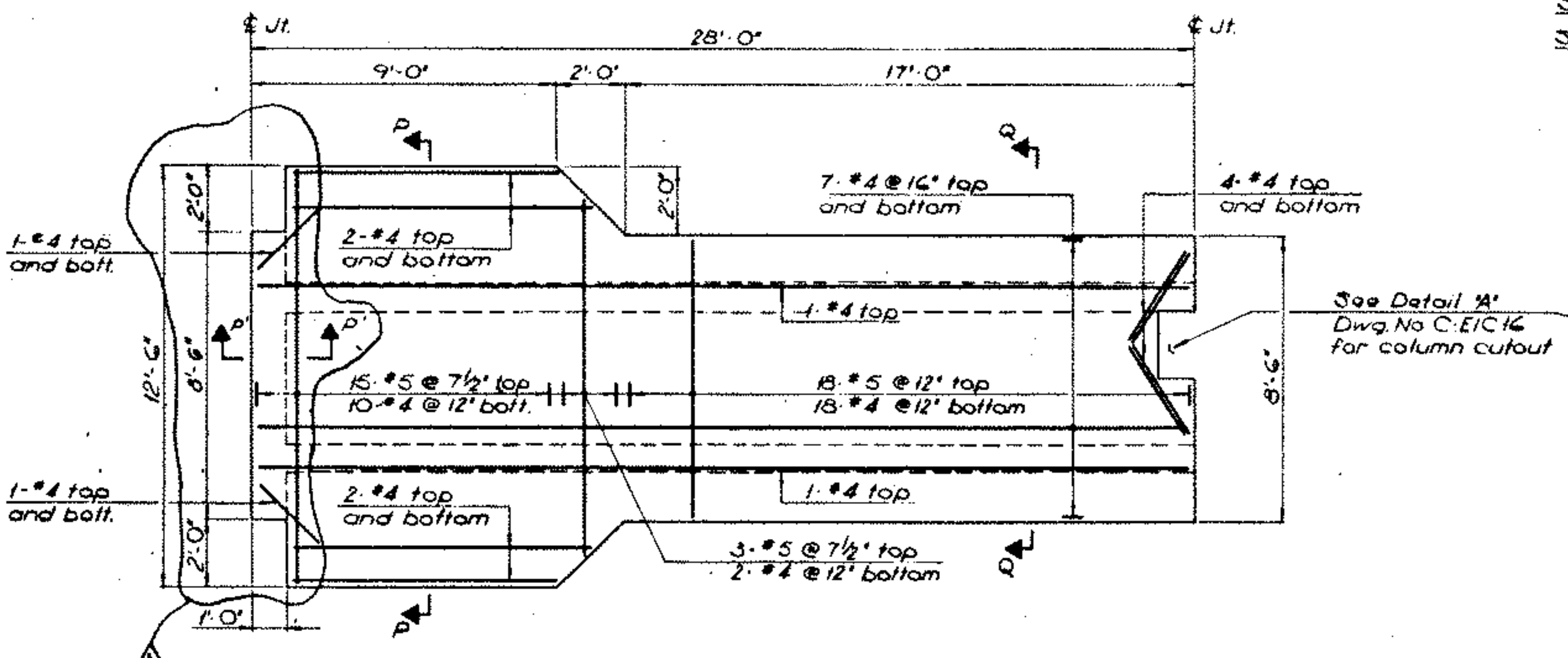
Metropolitan Transportation Authority

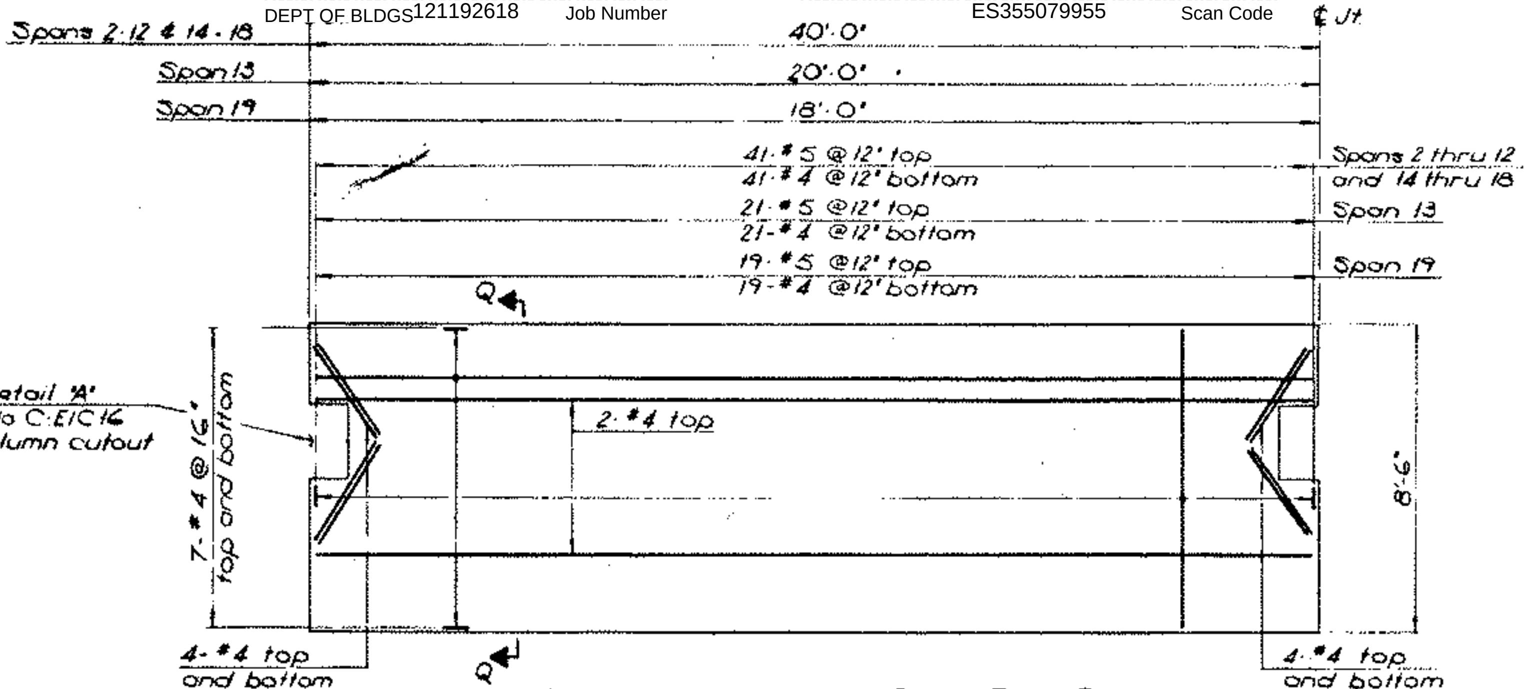
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
FOOTING DETAILS
STORAGE YARD

CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. C-EIC 13
SHEET 450 OF 684



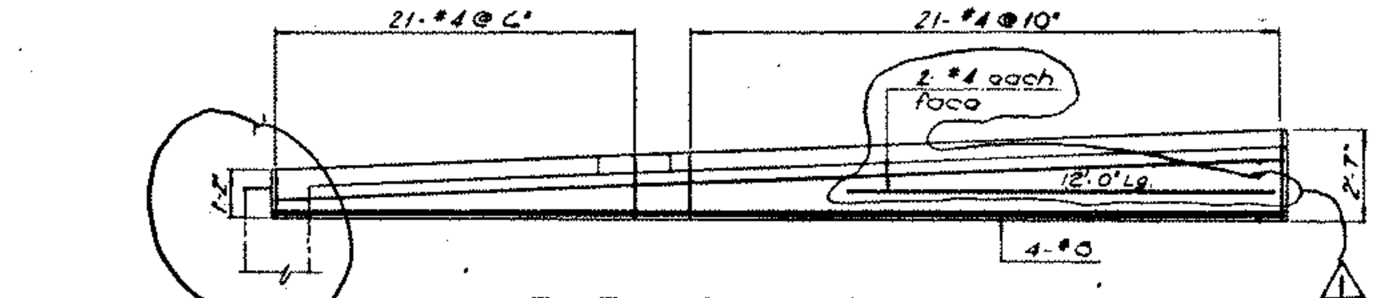
PLAN - SPAN 1

Scale: ⅜" = 1'-0"



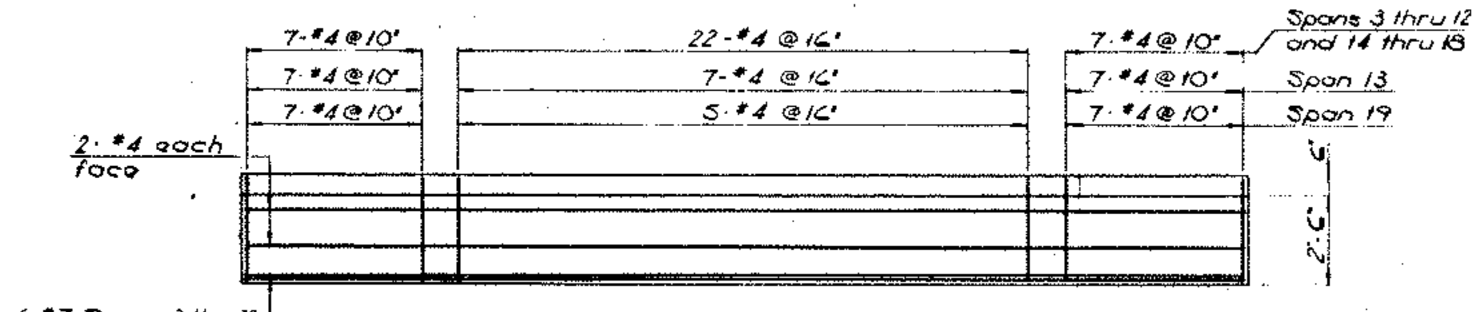
PLAN - SPANS 2 THRU 19

N.T.S.



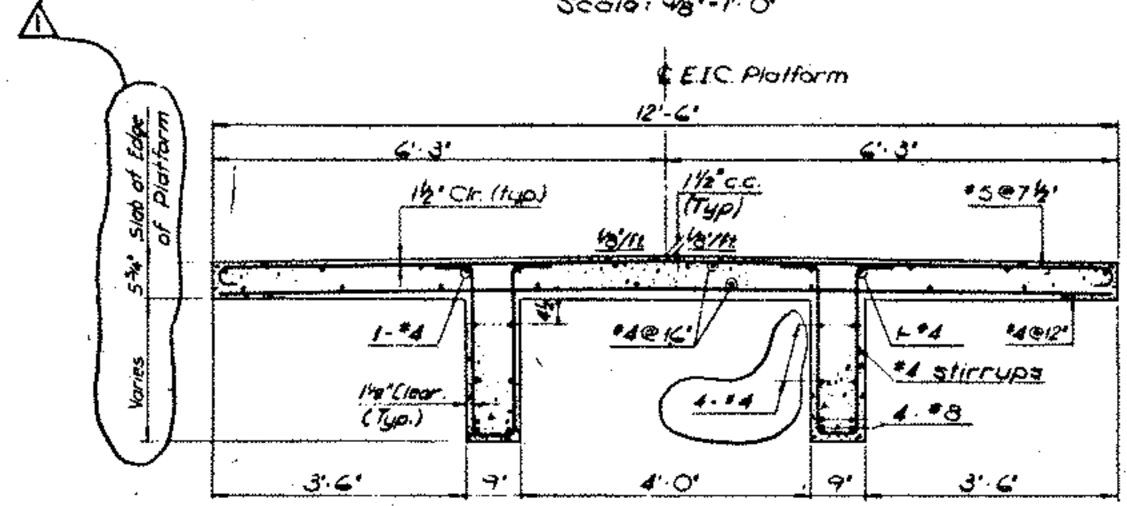
ELEVATION - SPAN 1

Scale: ⅜" = 1'-0"



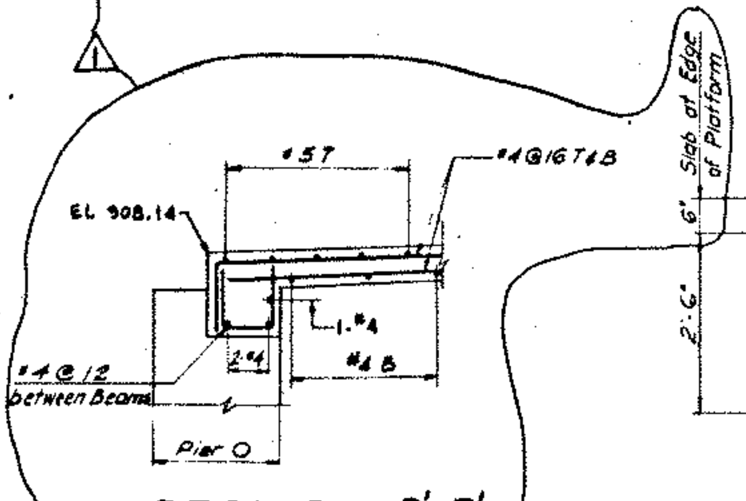
ELEVATION - SPANS 3 THRU 19

FOR ELEVATION OF SPAN 2 SEE C-EIC-15
N.T.S.



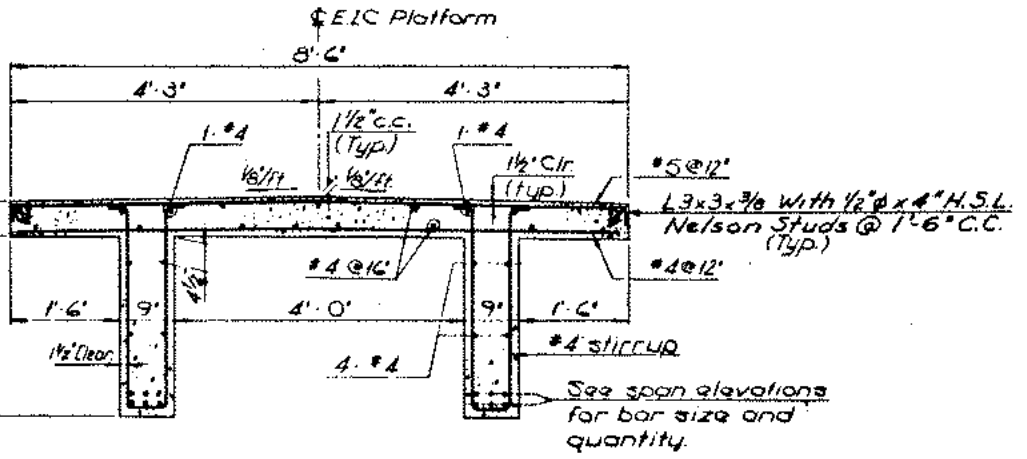
SECTION P-P

Scale: ¾" = 1'-0"



SECTION P'-P'

Scale: ¾" = 1'-0"



SECTION Q-Q

Scale: ¾" = 1'-0"

REV NO	DESCRIPTION	DATE
1	ADDM #2; REV SPAN 1, SECT'S P-P & Q-Q; ADDED SECT P'-P'	OCT 15, 1982

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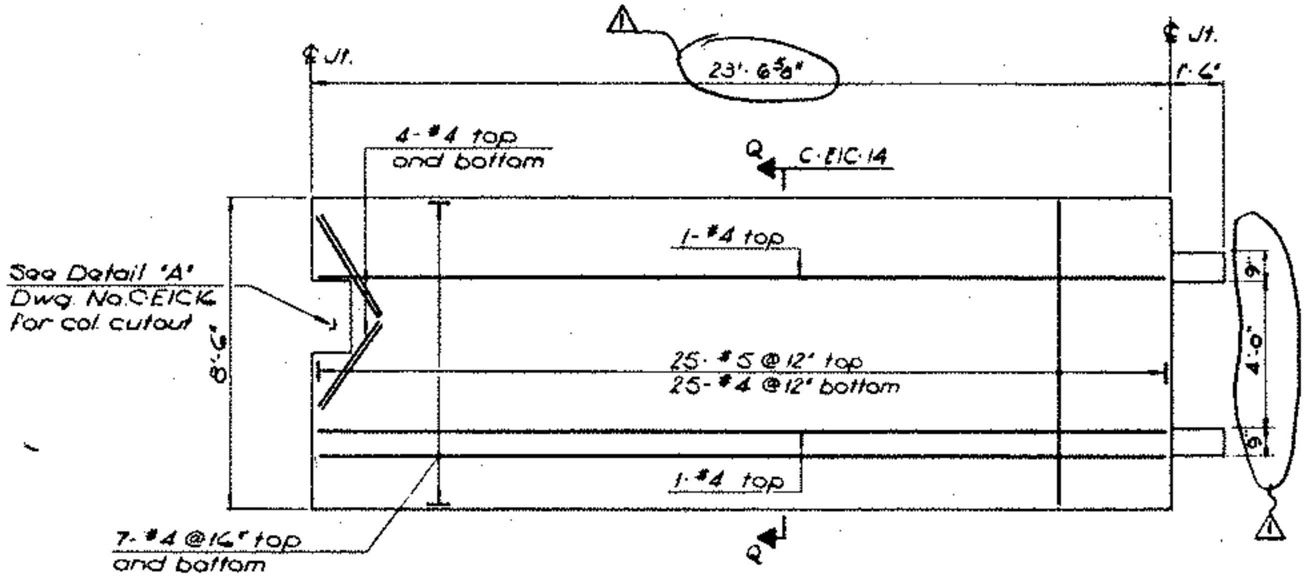
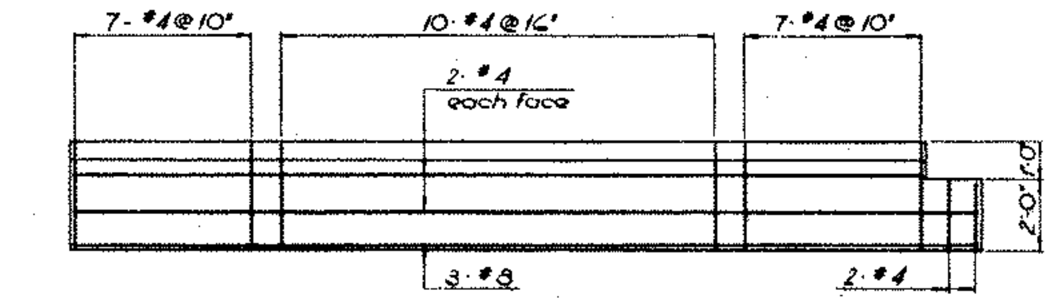
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
DOUBLE T - SECTIONS
STORAGE YARD

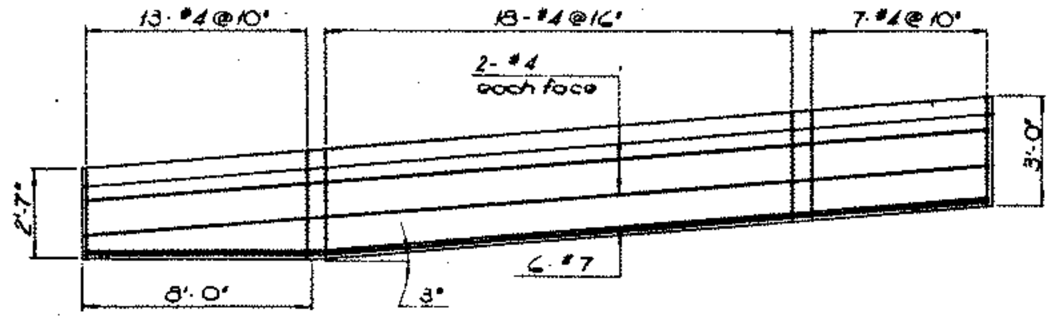
CONTRACT NO 1-02-21154-0-0
DATE AUG 12, 1982
SCALE AS NOTED
DRAWING NO C-EIC 14
SHEET 451 OF 684



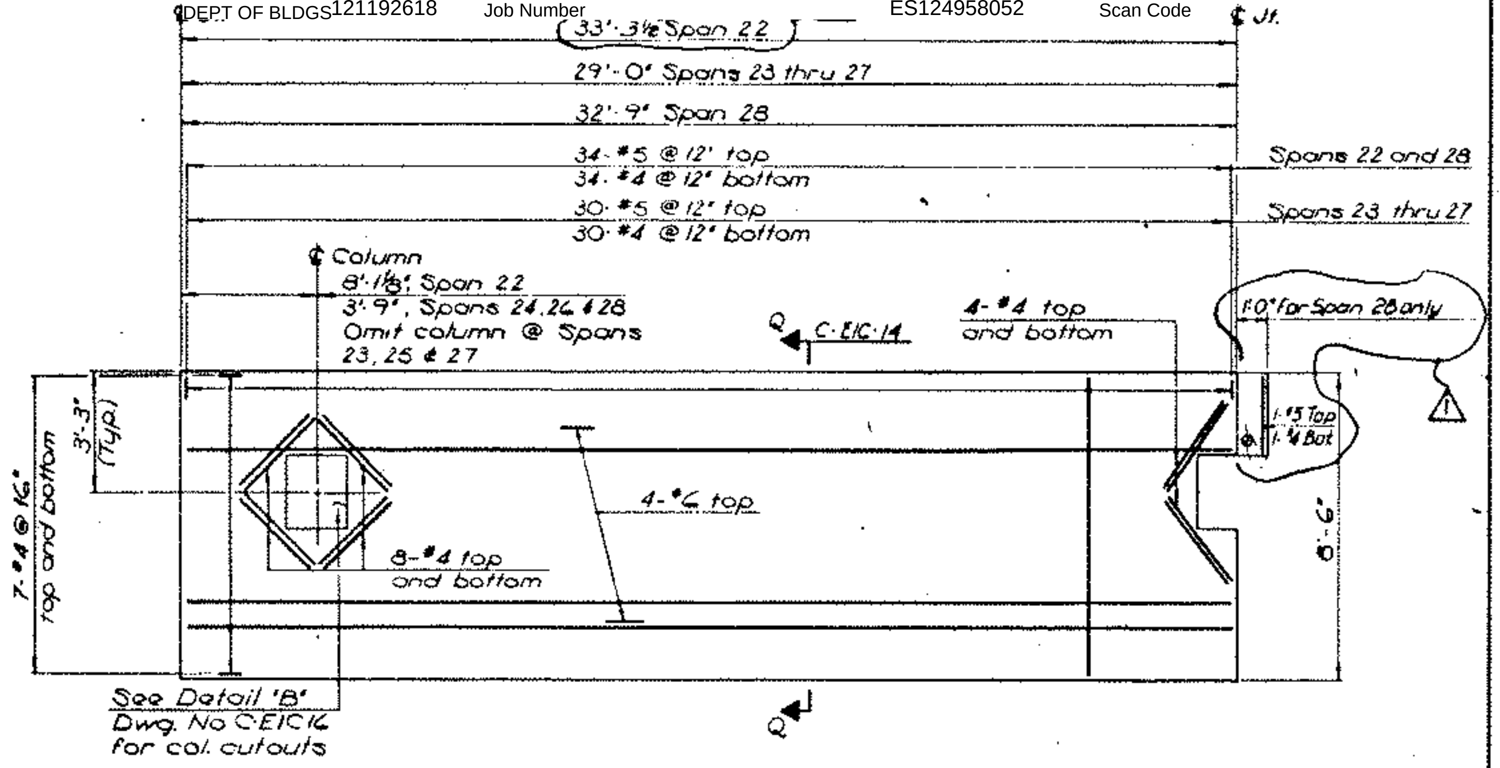
PLAN - SPAN 20
Scale: ⅜" = 1'-0"



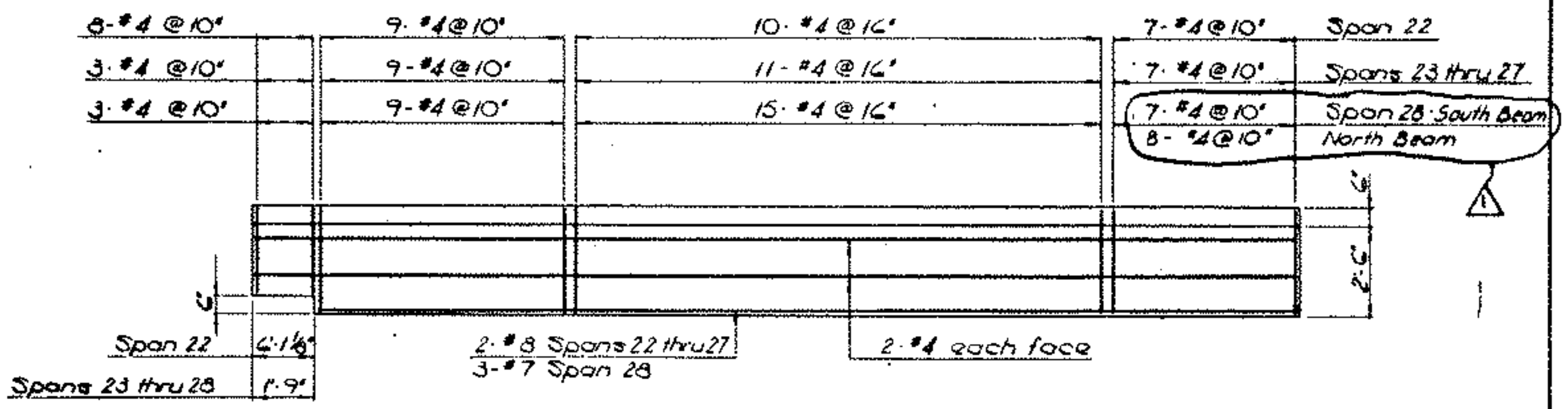
ELEVATION - SPAN 20
Scale: ⅜" = 1'-0"



ELEVATION - SPAN 2
NTS



PLAN - SPANS 22 THRU 28
N.T.S.



ELEVATION - SPANS 22 THRU 28
N.T.S.

REV NO	DESCRIPTION	DATE
1	ADDM #2: REV. SPANS 20, 22 & 28	OCT. 15, 1982

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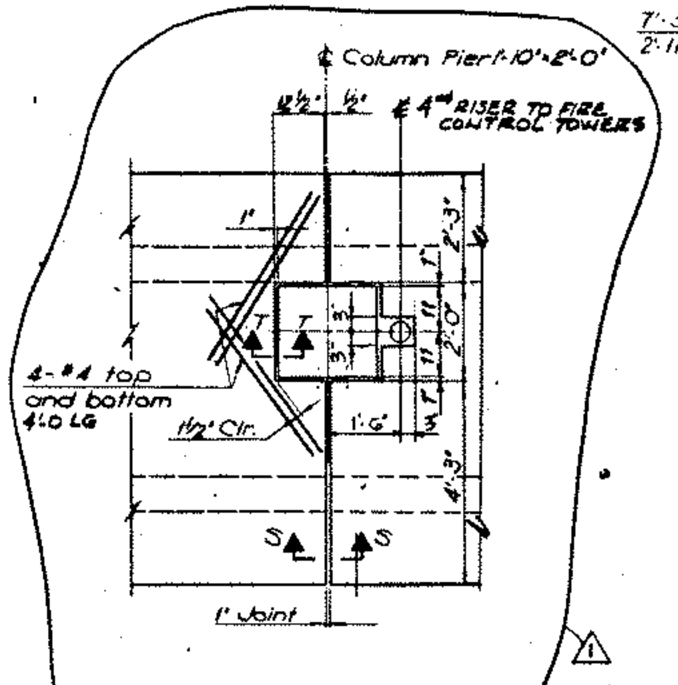
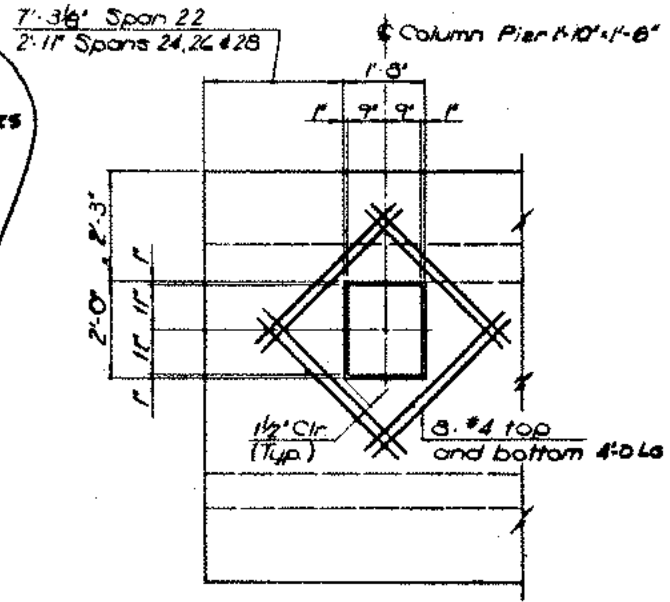
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
DOUBLE T - SECTIONS
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. C-EIC 15
SHEET 452 OF 684



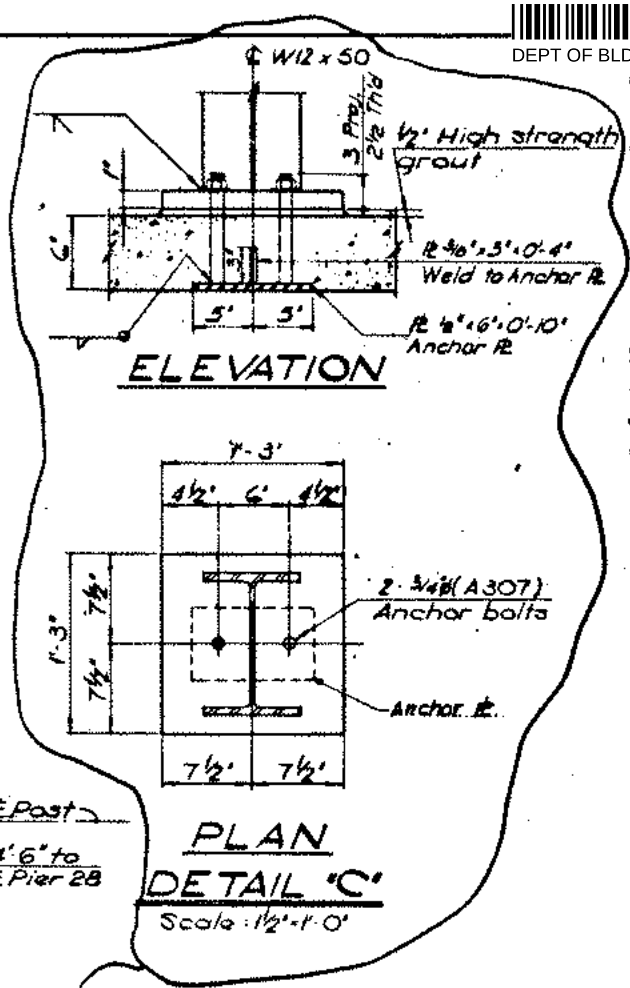
DETAIL 'A'

Scale: ½"=1'-0"



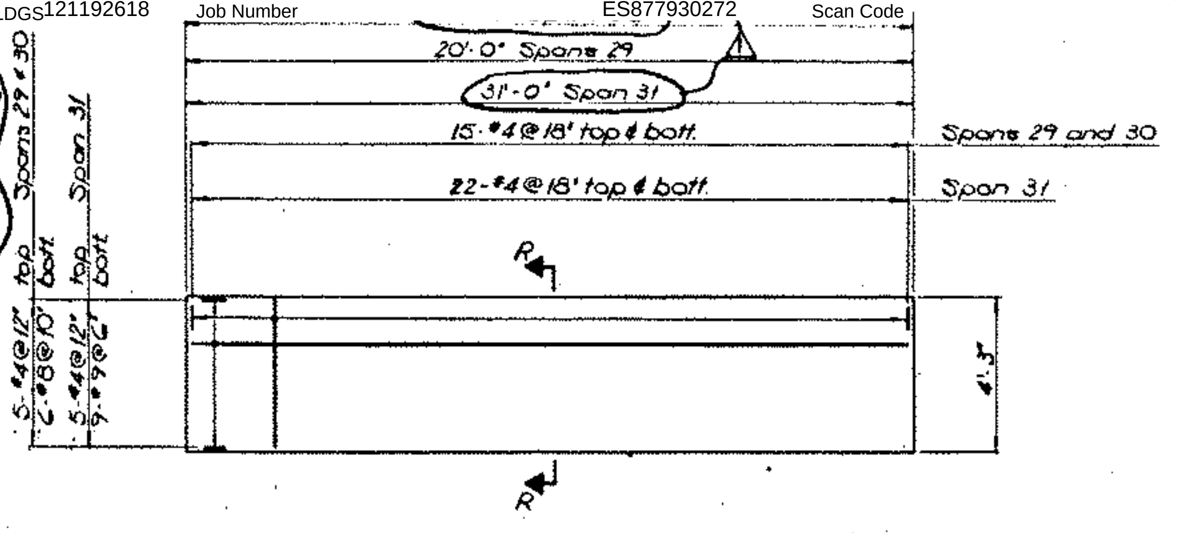
DETAIL "B"

Scale: ½"=1'-0"



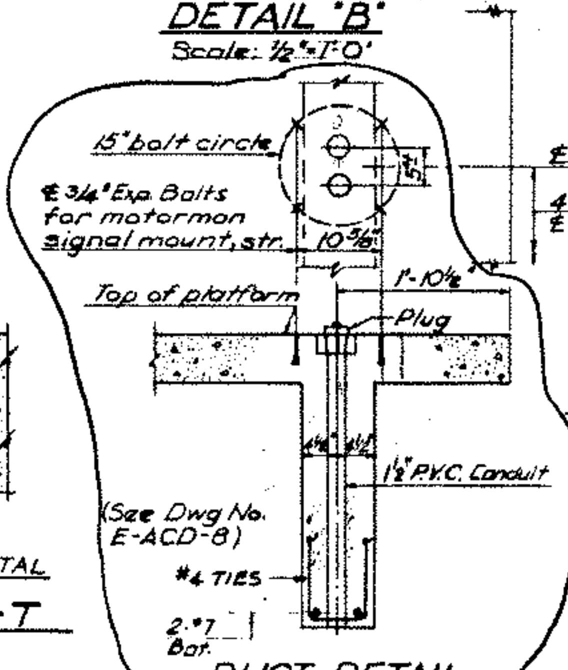
PLAN DETAIL "C"

Scale: 1½"=1'-0"



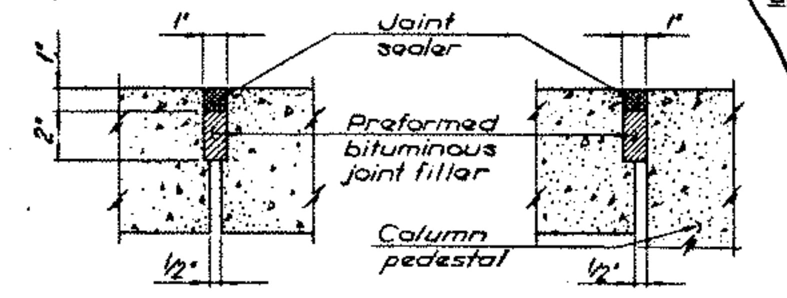
PLAN - SPANS 29, 30 & 31

N.T.S.



DUCT DETAIL

Scale: 1"=1'-0"



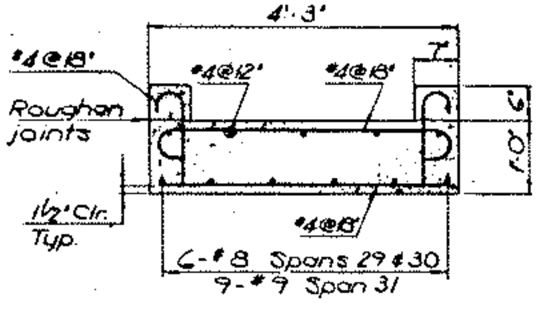
TYPICAL JOINT

SECTION S-S

@ COLUMN PEDESTAL

SECTION T-T

Scale: 3"=1'-0"

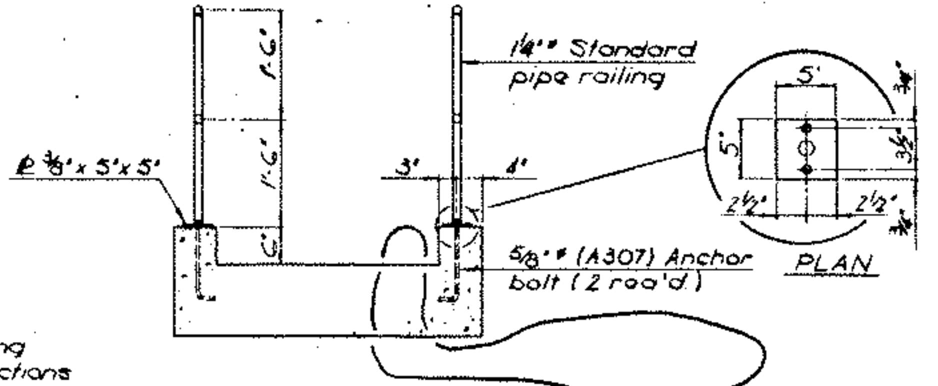


SECTION R-R

N.T.S.

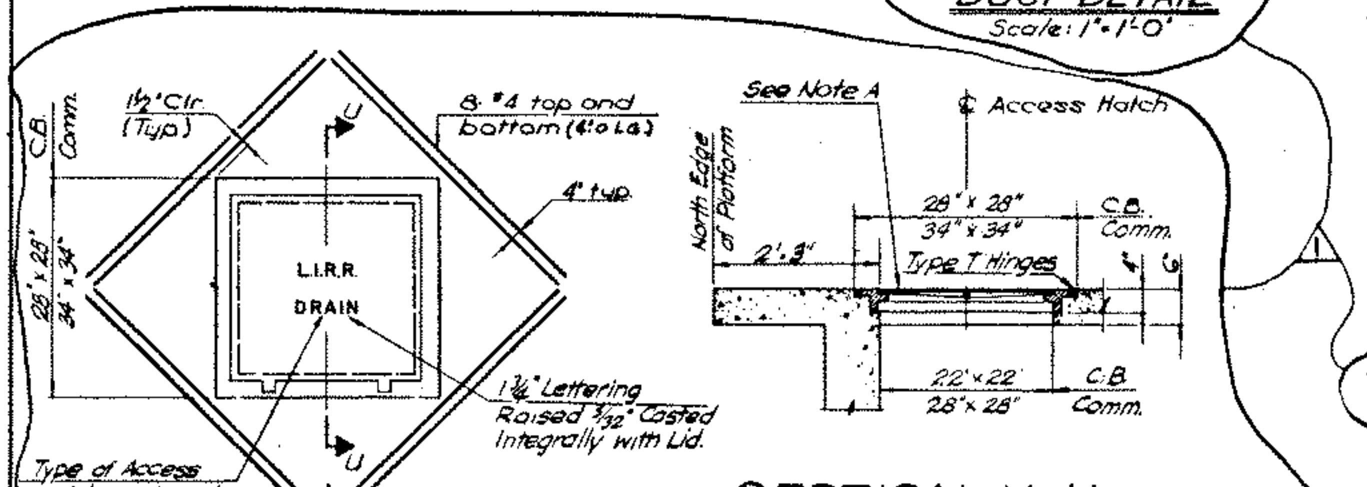
NOTES

1. Concrete platform sections for spans 1, 29, 30 & 31 are to be cast in place. Remaining spans may be precast or cast in place at contractors option.
2. Concrete for span sections shall be 4000 psi conc.
3. Deformed reinforcement shall conform to ASTM A615, grade 60.
4. Elevations given are based on Penn. Station Datum on which elevation 300.025 is equal to elevation 0.0 on the Borough of Manhattan Datum.
5. Where precast span sections are used, shim plates are to be placed beneath elastomeric pads to obtain a smooth riding surface and proper elevation.
6. Span lengths are given to centerline of joints.
7. Top of concrete shall be given a wood trowel finish.
8. Edges of slab shall be protected with Emb. L's 3×3×⅜.
9. Access hatch castings shall be set in slab framework prior to pouring of slab concrete. Tops of castings are to be flush with top of slabs. Castings for fire fighting equipment shall be cast in slabs or installed after span sections are in place, at Contractors option, with Engineer's approval.
10. Channel inserts for Communication conduit hangers shall be placed in forms at 5'± centers prior to pouring of slab concrete. See Drawing Nos. EC-1, EC-3 and EC-DB-2.
11. Transportation of precast span sections to site is the sole responsibility of the Contractor.



SECTION R-R

Scale: ¾"=1'-0"



SECTION U-U

NOTES

A. Cast Iron Access Hatch Frames and Lids Shall be Neenah Foundry Co. Catalog Nos. R-6662-KH for Catch Basins & R-6662-NH For Communication Manholes or Approved Equal.

B. For Communication Manholes, the Specific Manhole Number Given In Table on Dwg. No. C-COM 2 Shall be Cast In Lid.

ACCESS HATCH DETAILS

N.T.S

REV NO	DESCRIPTION	DATE
1	ADDM #2: REV. HATCH & DUCT DET, DET C, NOTES, SECT R-R & SPANS 30 & 31	10-15-82

SEELYE STEVENSON VALUE & KNECHT, INC.
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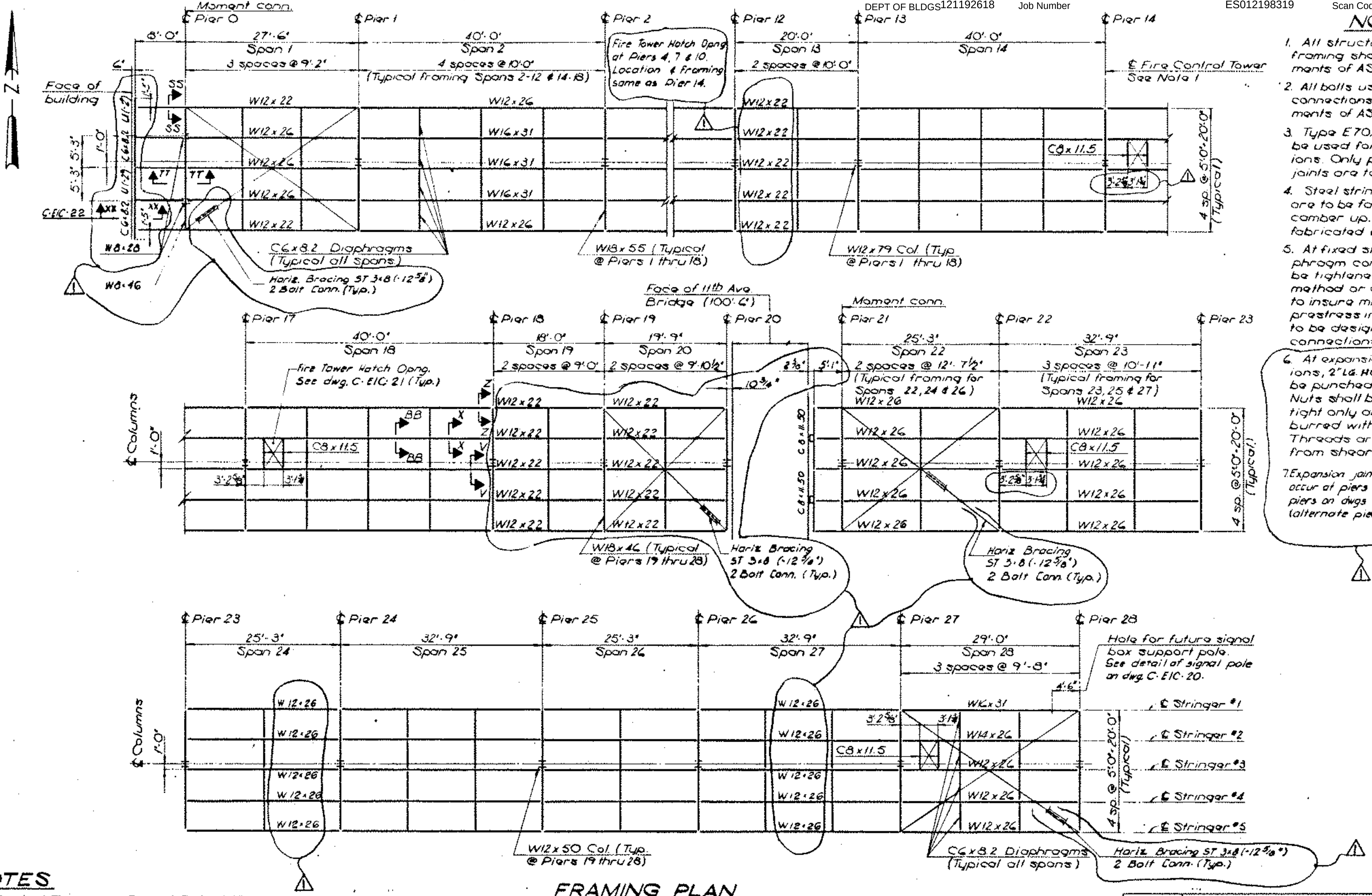
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
DOUBLE T-SECTIONS
STORAGE YARD

CONTRACT NO 02-21034-0-0
DATE AUG 12, 1982
SCALE AS NOTED
DRAWING NO C-EIC 16
SHEET 453 OF 684



FRAMING PLAN

Scale: 1/8" = 1'-0"

NOTES

1. All structural steel used for framing shall meet the requirements of ASTM A36
2. All bolts used for steel framing connections shall meet the requirements of ASTM A325.
3. Type E70XX electrodes are to be used for all welded connections. Only prequalified welded joints are to be used.
4. Steel stringers and diaphragms are to be fabricated with mill camber up. Steel piers are to be fabricated with mill camber down.
5. At fixed stringer and all diaphragm connections nuts are to be tightened by turn of the nut method or other suitable method to insure minimum proof load prestress in bolts. Connections to be designed as friction type connections.
6. At expansion joint stringer connections, 2" LG. HORIZ. SLOTTED HOLES SHALL be punched in stringer webs. Nuts shall be tightened snug tight only and bolt threads burred with a pointed tool. Threads are to be excluded from shear planes.
7. Expansion joint connections shall occur at piers identified as exp. piers on dwgs C-EIC-1 to EIC-8. (alternate piers).

NOTES

1. Fire Control Towers at Piers 4, 7, 10, 14, 17, 22 and 27. See details Dwg. No. C-EIC 21
2. Transformers located at piers See details. Dwg. No. C-EIC 20
3. Access Hatches located east of piers, except for Pier 10 which is west of Pier.

REV. NO.	DESCRIPTION	DATE
1	ADDM #2: REV. FRAMING & NOTES	10-15-82

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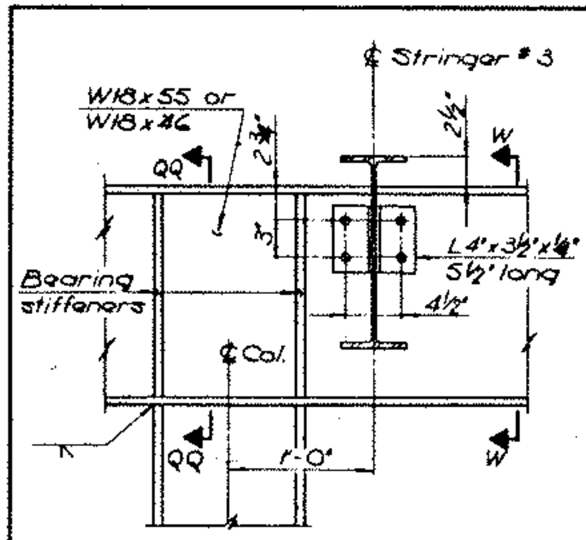
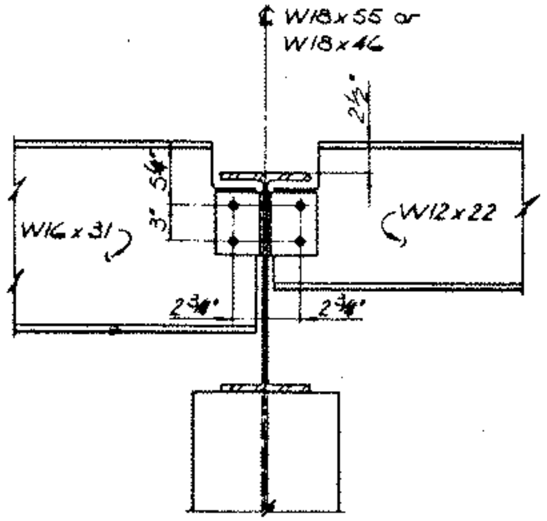
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
FRAMING PLAN
STORAGE YARD

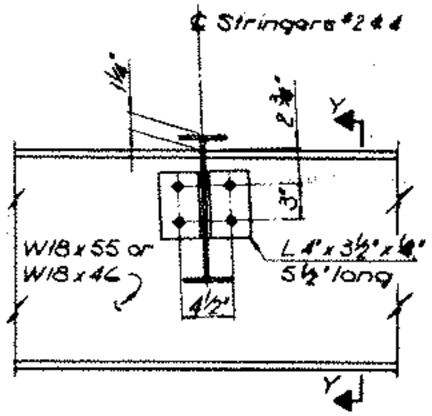
CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE 1/8" = 1'-0"
DRAWING NO. C-EIC 18
SHEET 454 OF 684



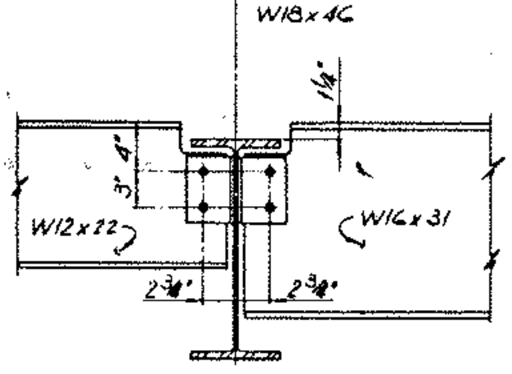
SECTION V-V



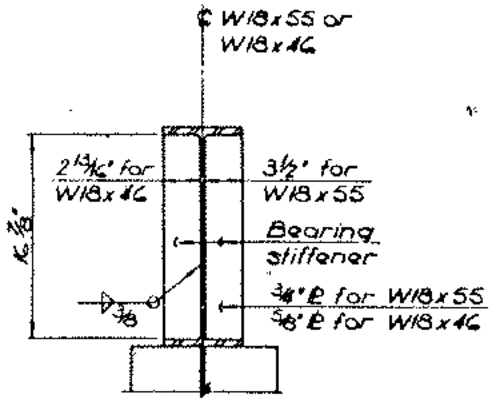
SECTION W-W



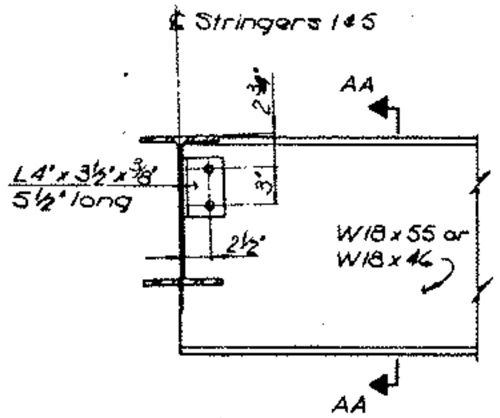
SECTION X-X



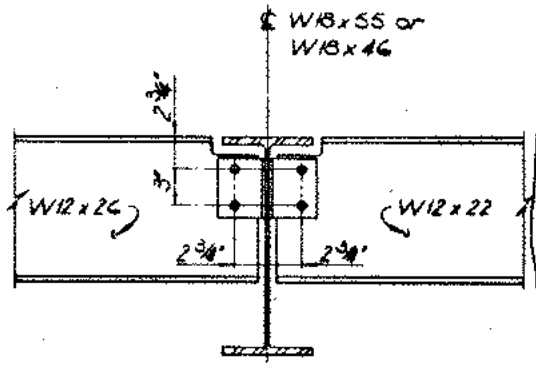
SECTION Y-Y



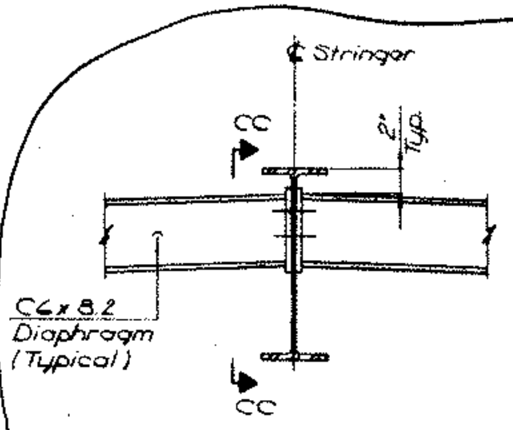
SECTION QQ-QQ



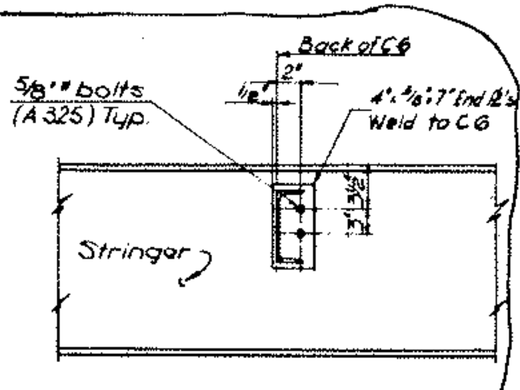
SECTION Z-Z



SECTION AA-AA

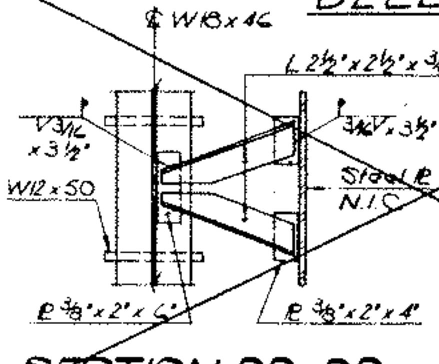


SECTION BB-BB

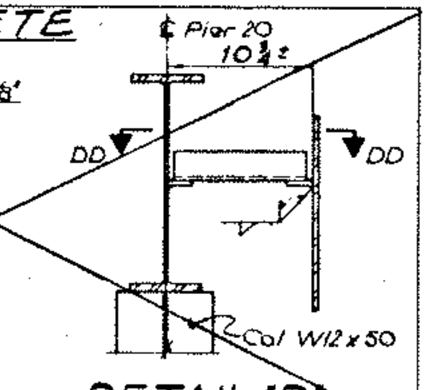


SECTION CC-CC

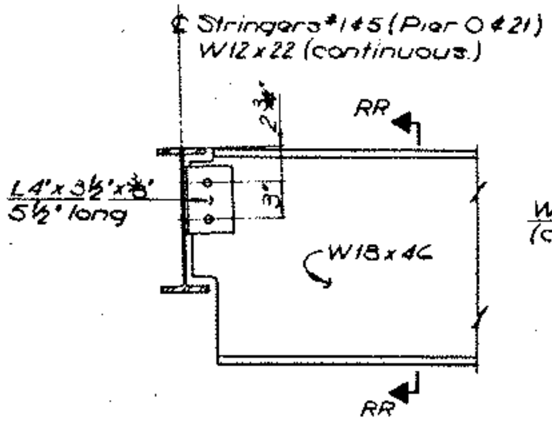
DELETE



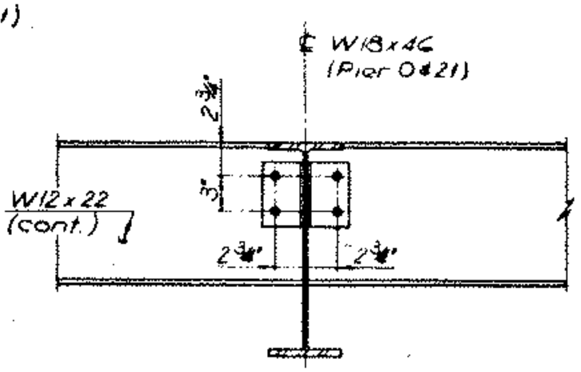
SECTION DD-DD



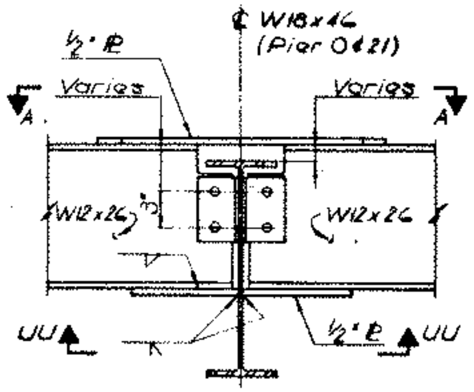
DETAIL "D"



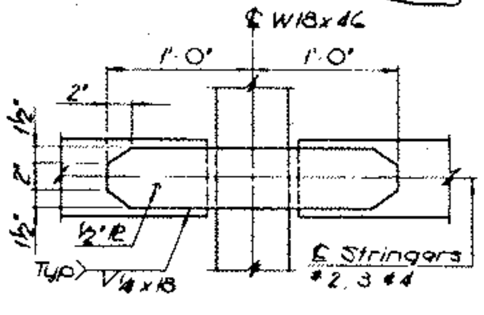
SECTION SS-SS



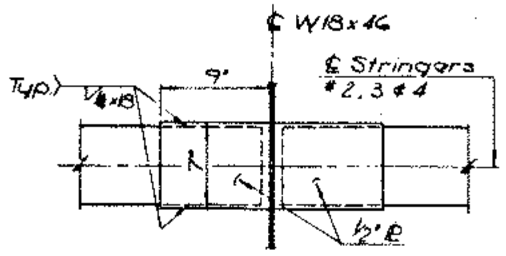
SECTION RR-RR



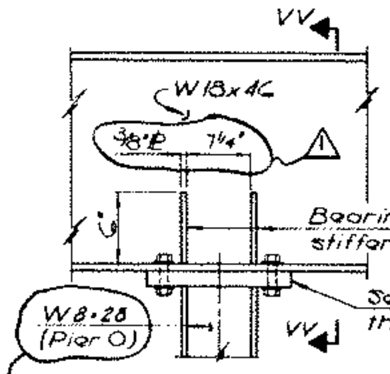
SECTION TT-TT
(Moment Connect)



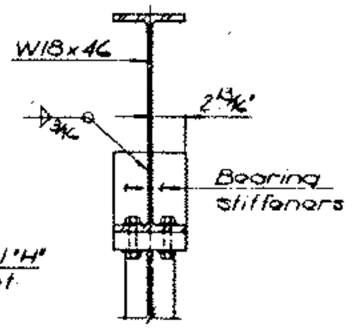
VIEW A-A



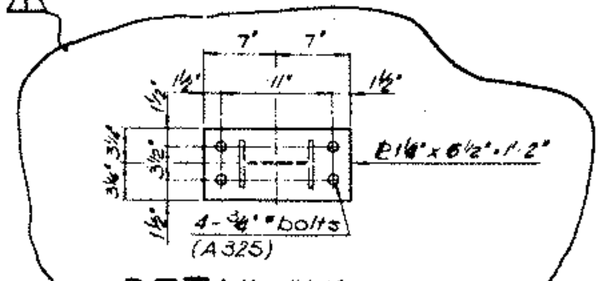
SECTION UU-UU



DETAIL "J"



SECTION VV-VV



DETAIL "H"

REV NO	DESCRIPTION	DATE
1	ADDM #2: REV SECT BB & CC, DET J & H, DELETED SECT DD & DET D	10-15-82

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

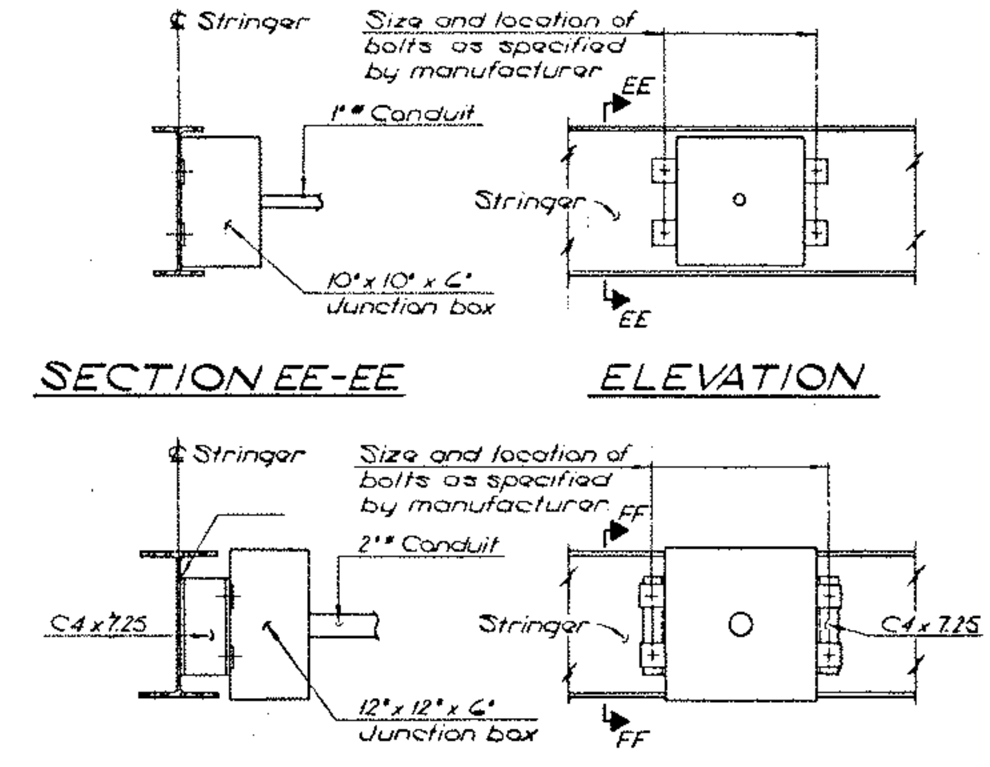
L.I.R.R.
LONG
ISLAND
RAIL ROAD

M
Metropolitan
Transportation
Authority

WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
CANOPY DETAILS

STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG 12, 1982
SCALE 1½" = 1'-0"
DRAWING NO. C-EIC 19
SHEET 455 OF 684

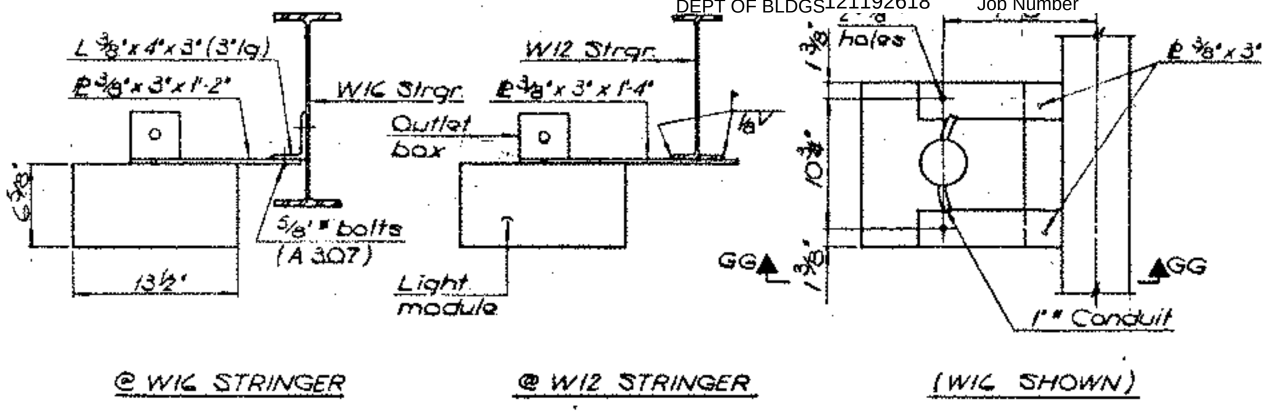


SECTION EE-EE ELEVATION

SECTION FF-FF ELEVATION

MOUNTING FOR JUNCTION BOX (N.I.C.) △

Scale: 1½"=1'-0"

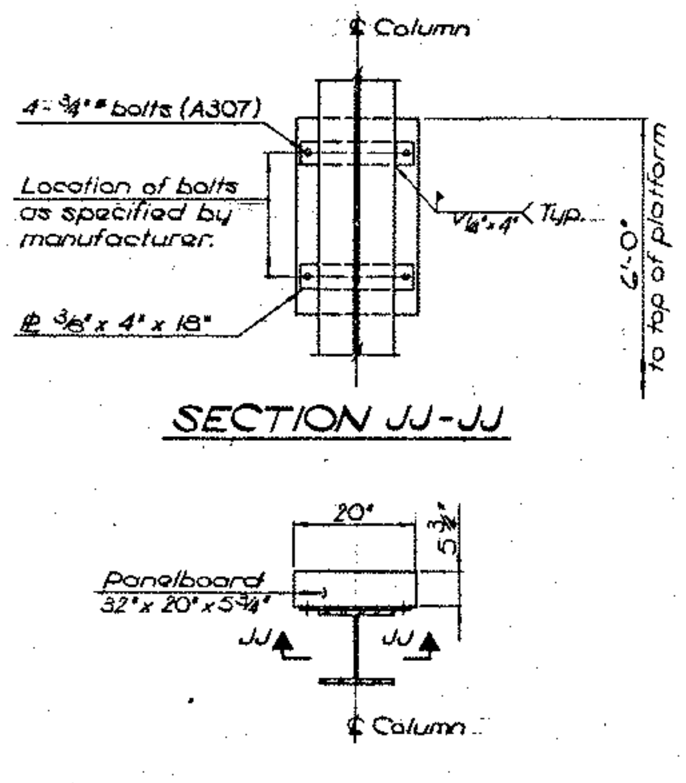


@ W16 STRINGER @ W12 STRINGER (W16 SHOWN)

SECTION GG-GG PLAN

MOUNTING FOR LIGHT MODULES (N.I.C.) △

Scale: 1½"=1'-0"

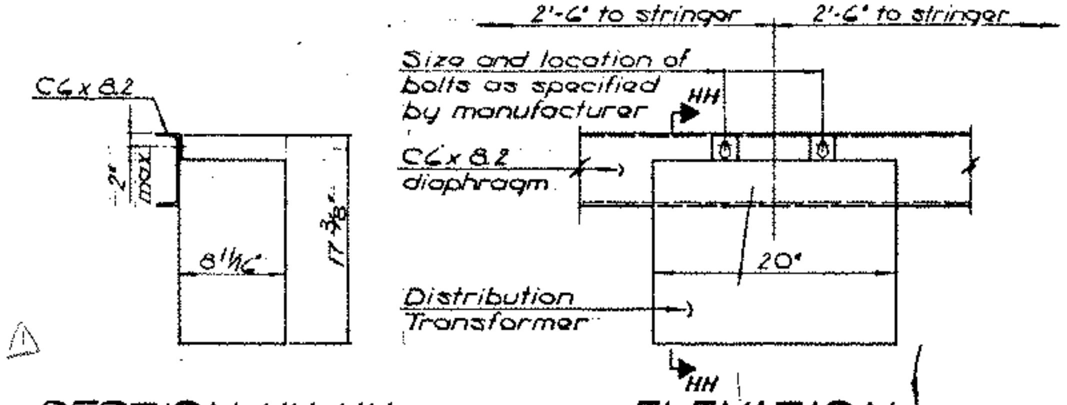


SECTION JJ-JJ

PLAN

MOUNTING FOR PANELBOARD (N.I.C.)

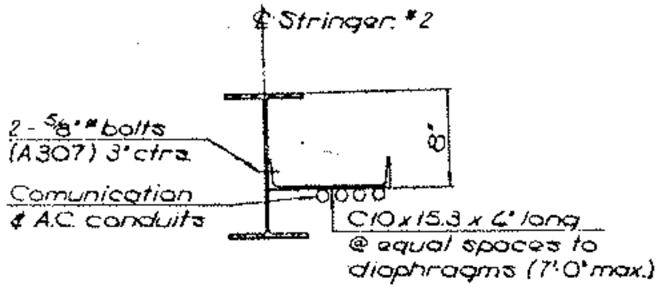
Scale: ¾"=1'-0" △



SECTION HH-HH ELEVATION

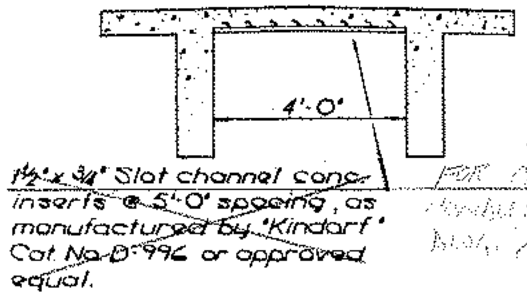
MOUNTING FOR TRANSFORMER (N.I.C.) △

Scale: 1½"=1'-0"



@ STRINGERS (N.I.C.) △

Scale: 1½"=1'-0"

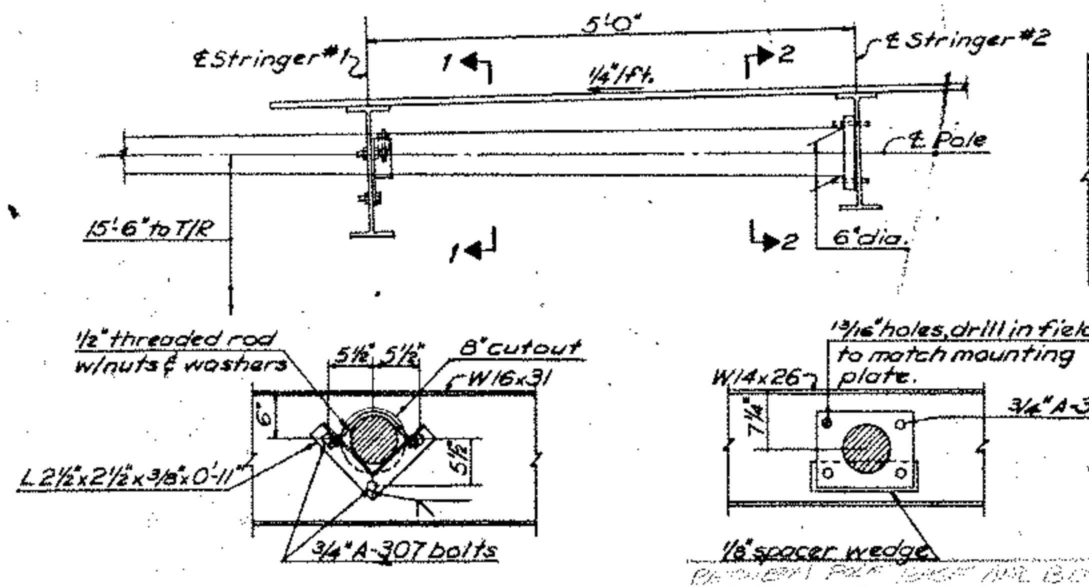


FOR CHANNEL INSERTS FOR CONDUIT HANGERS, SEE DWG. No. EC-DC-2 △

@ PRECAST DECK

Scale: ½"=1'-0"

MOUNTING FOR CONDUITS

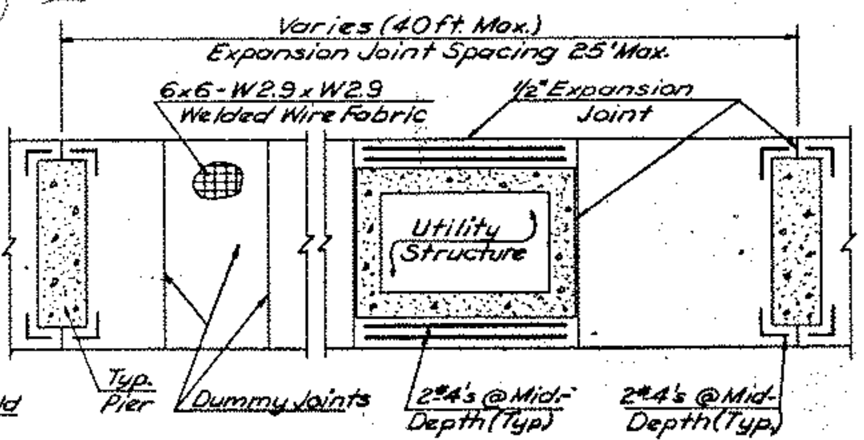


REVISED PER [illegible] △

SECTION 1-1 SECTION 2-2

DETAIL SIGNAL POLE @ CANOPY

Scale: 1"=1'-0"



PLAN

Yard Walkway Beneath Platform

Scale: ¼"=1'-0"

NOTE: For Walkway Profile See Dwg. No's. C-PG-9

REV NO.	DESCRIPTION	DATE
△	ADDENDUM [illegible]	10-15-82

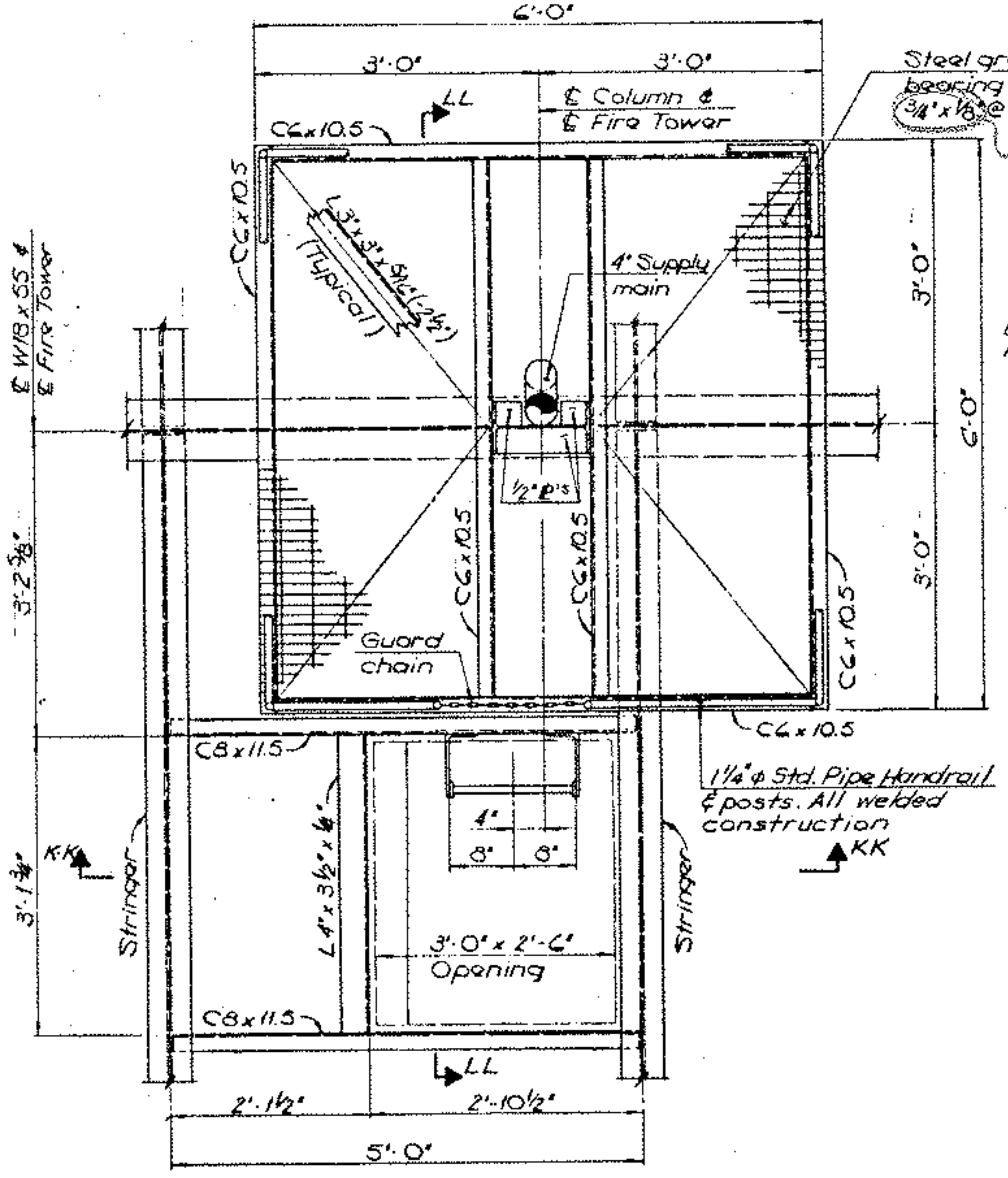
SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

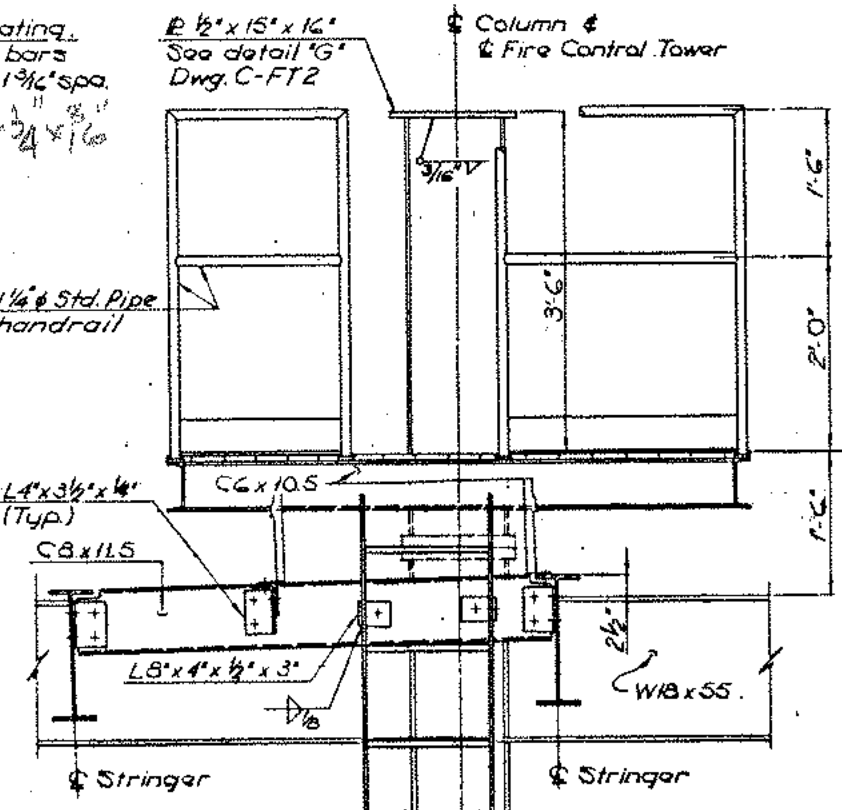
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
E.I.C PLATFORM
UTILITIES
STORAGE YARD

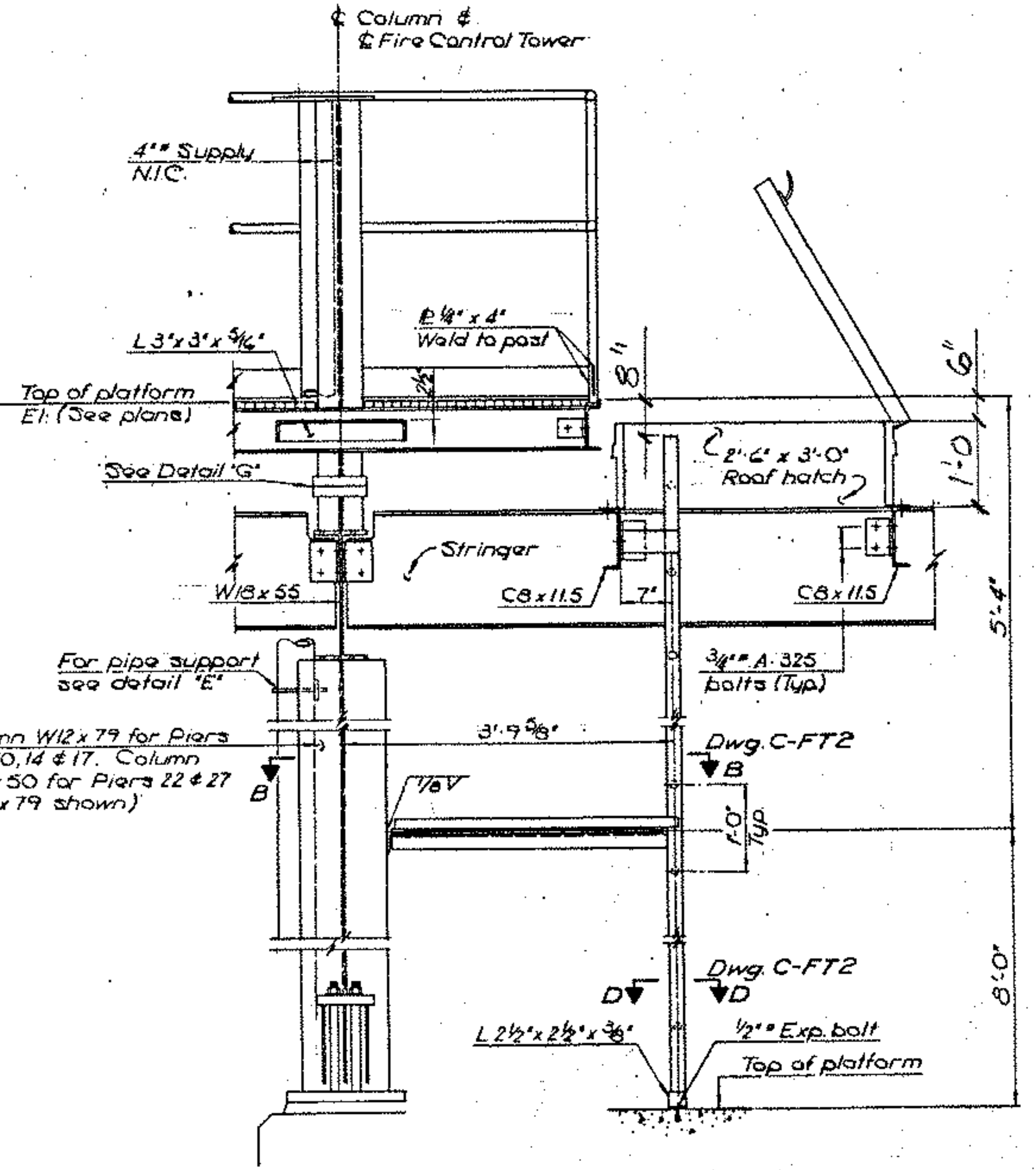
CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. C-EIC 20
SHEET 456 OF 684



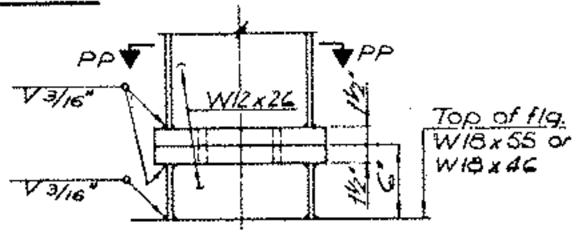
PLAN



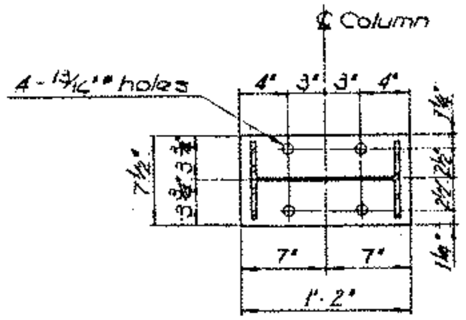
SECTION KK-KK



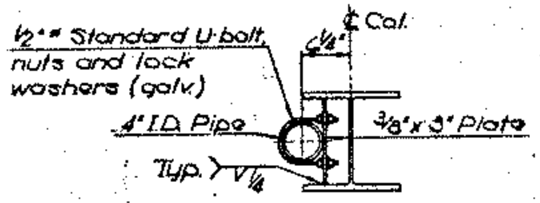
SECTION LL-LL



DETAIL 'G'



SECTION PP-PP
Scale: 1 1/2" = 1'-0"



DETAIL 'E'

REV. NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

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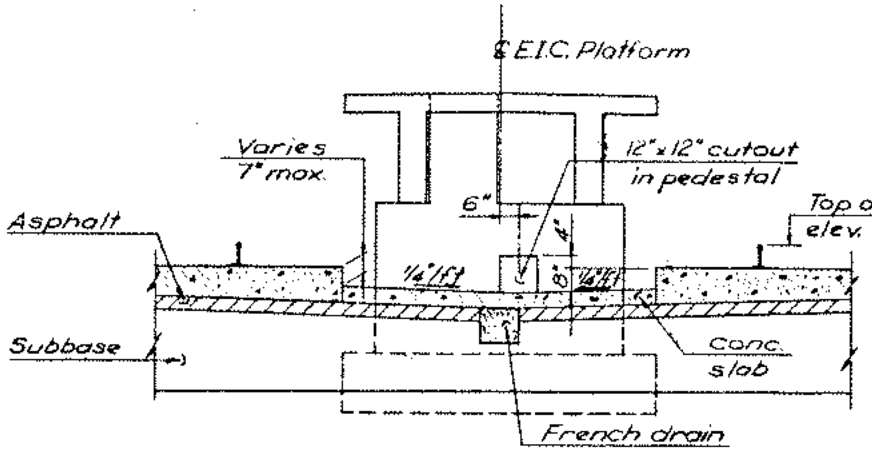
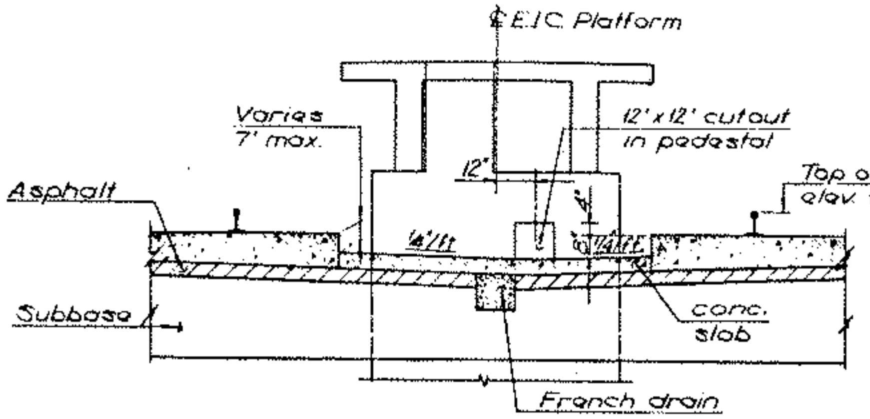
Metropolitan
Transportation
Authority

WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
FIRE CONTROL TOWER DETAILS
STORAGE YARD

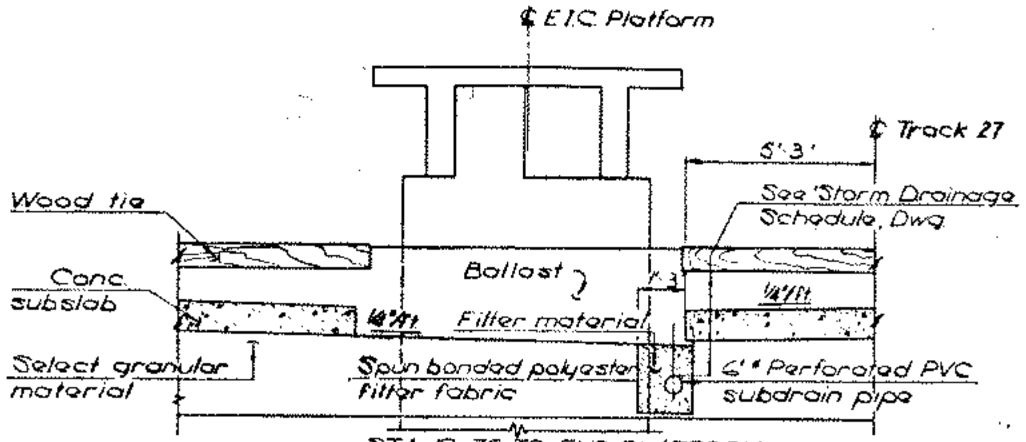
CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE 1" = 1'-0"
DRAWING NO. C-EIC 21
SHEET 457 OF 684



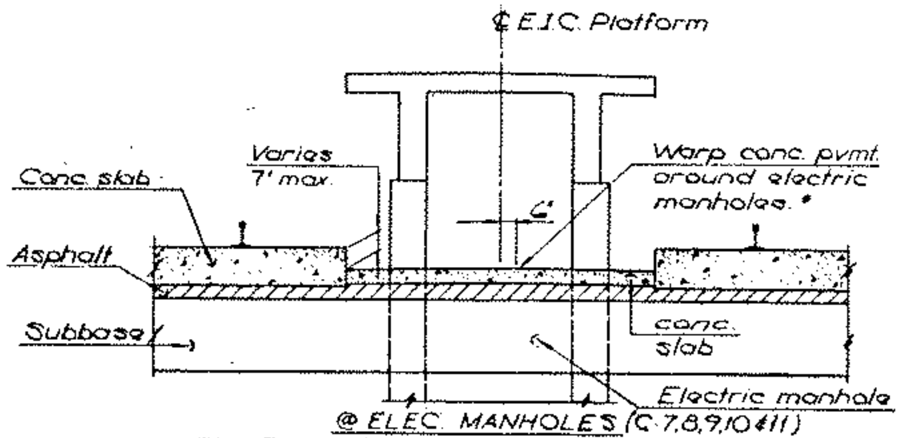
BEGIN PLATFORM TO STA. 17+66.66



STA. 18+61.41 TO 19+75



STA. 19+75 TO END PLATFORM



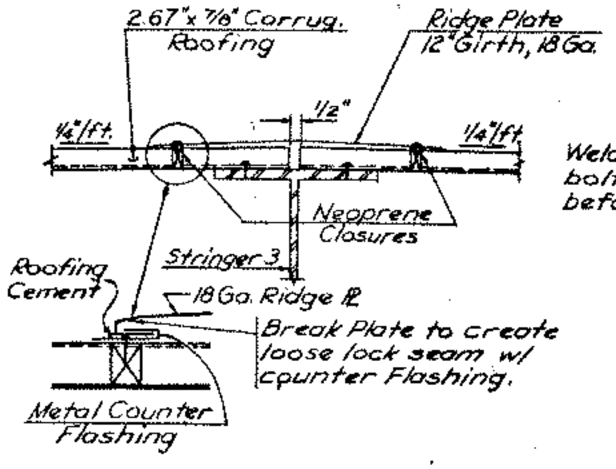
@ ELEC. MANHOLES (C-7,8,9,10 & 11)

* Pvmt. must also be warped around piers 23A & 23, and at footing B-2.

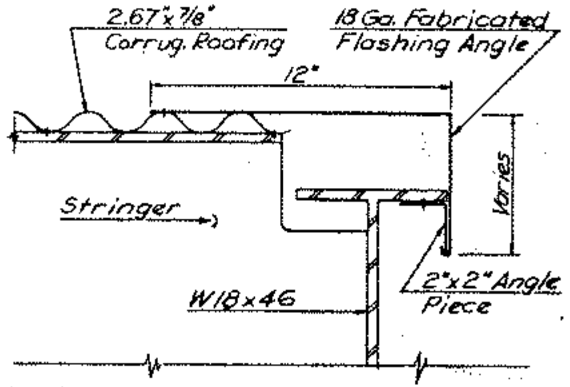
Note:
Typical section for Sta. 17+66.66 to Sta. 18+61.41 is given in 11th Ave. Bridge Plans. Contract No. 1-02-21064-0-0

TYPICAL SECTIONS-DRAINAGE

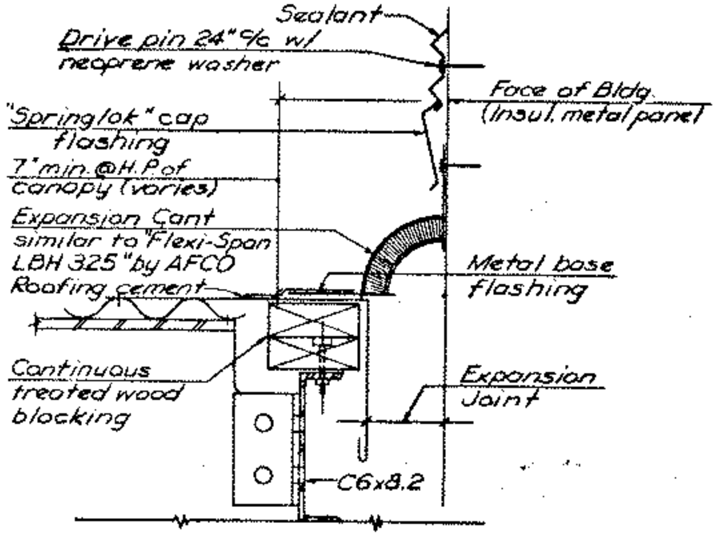
Scale 3/8"=1'-0"



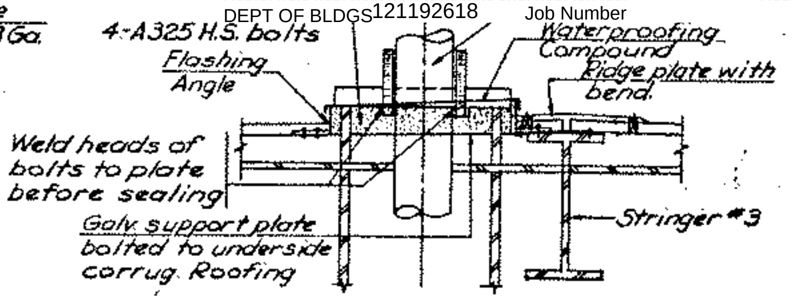
FLASHING DETAIL AT RIDGE PLATE
Scale: 3"=1'-0"

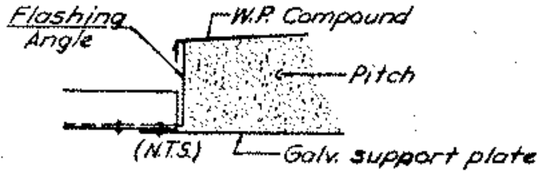


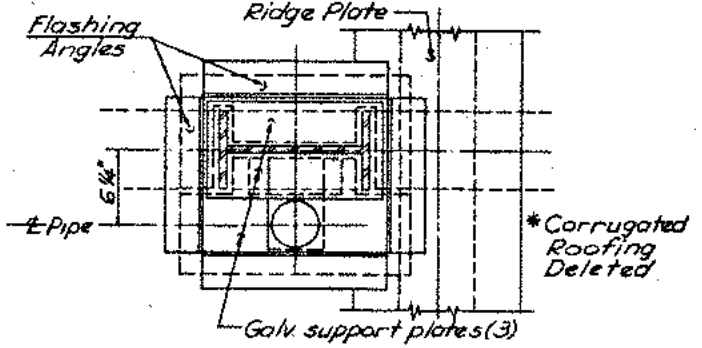
FLASHING AT CANOPY ENDS AT ELEVENTH AVE. & AT PIER 29



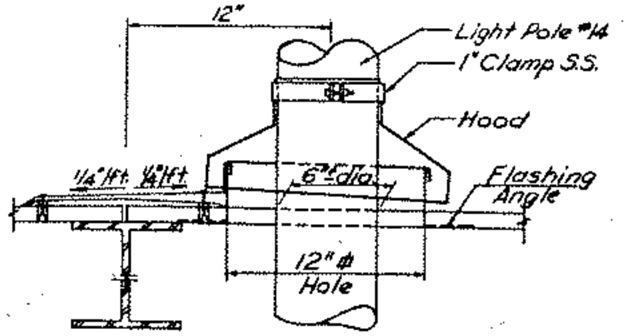
CANOPY END AT (E.I.C. BLDG.)
Scale: 3"=1'-0"



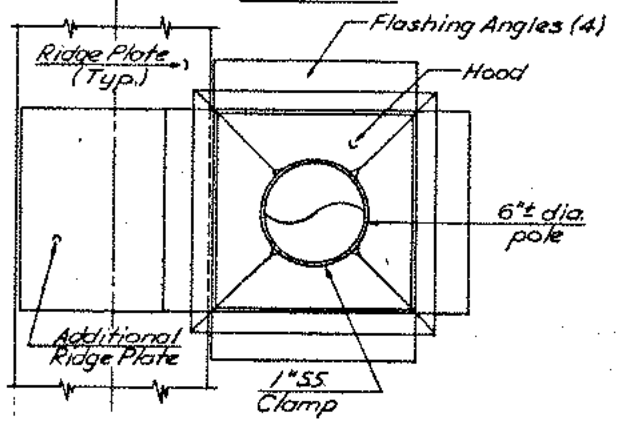




FLASHING DETAIL AT FIRE CONTROL TOWER

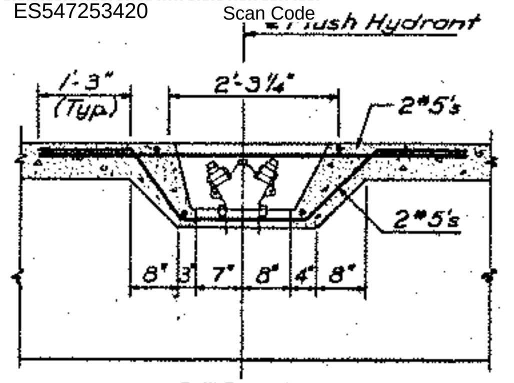


ELEVATION

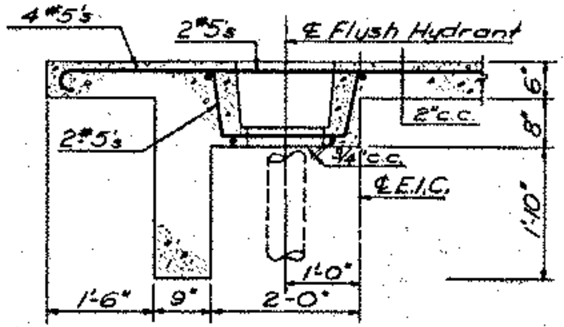


PLAN

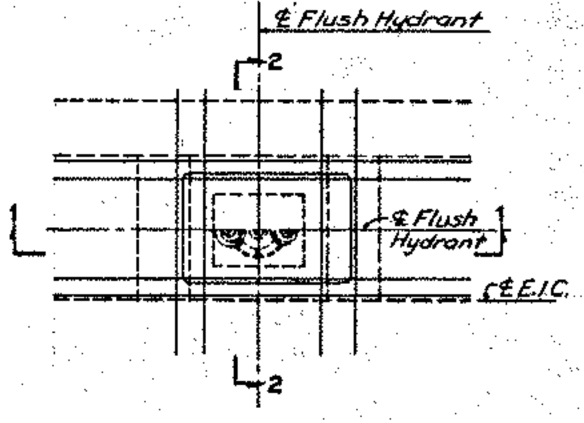
FLASHING DETAIL AT LIGHT POLE
Scale: 1"=6"



SECTION 1-1



SECTION 2-2



PLAN

CONCRETE DETAIL AT FLUSH HYDRANTS
Scale: 3/4"=1'-0"

See Detail 'A' Dwg. C-W55

REV. NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

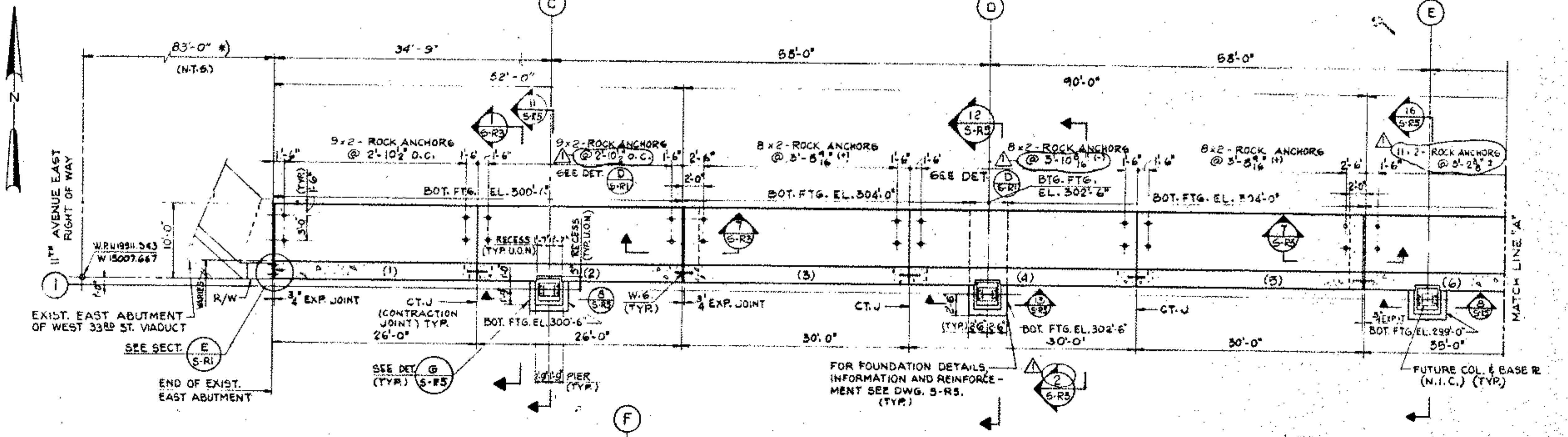
Metropolitan Transportation Authority

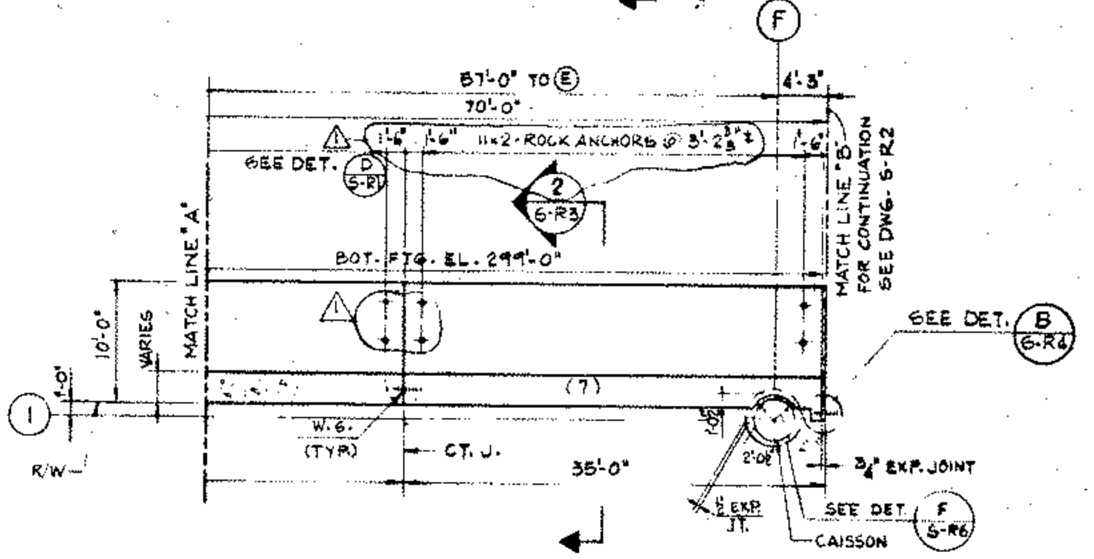
WEST SIDE STORAGE YARD COMPLEX
E.I.C. PLATFORM
MISCELLANEOUS DETAILS

STORAGE YARD

CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. C-EIC 22
SHEET 458 OF 684

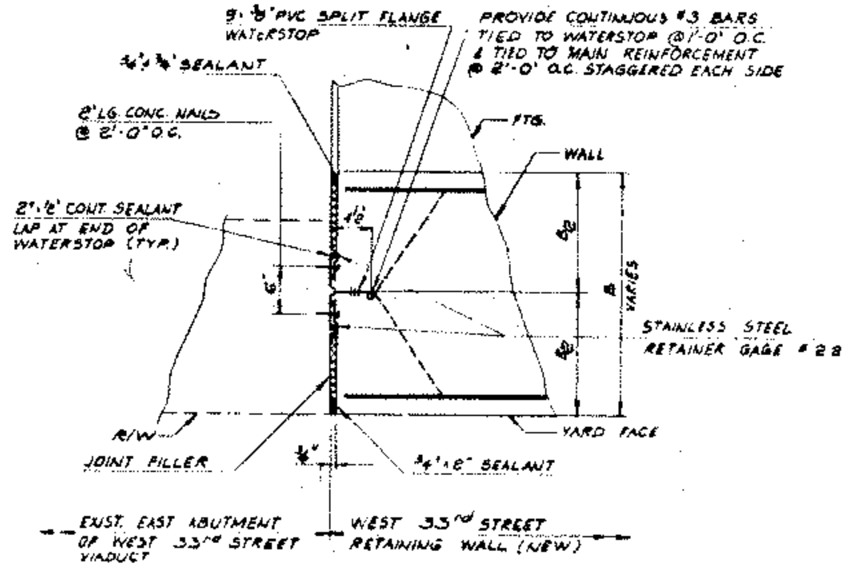
MTA-LIRR Retaining Wall along West 33rd Street and Tenth Avenue



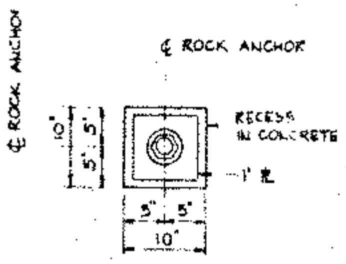


* NOTE: VERIFY IN FIELD THE END OF EXISTING EAST SIDE OF THE ABUTMENT AND NOTIFY THE ENGINEER

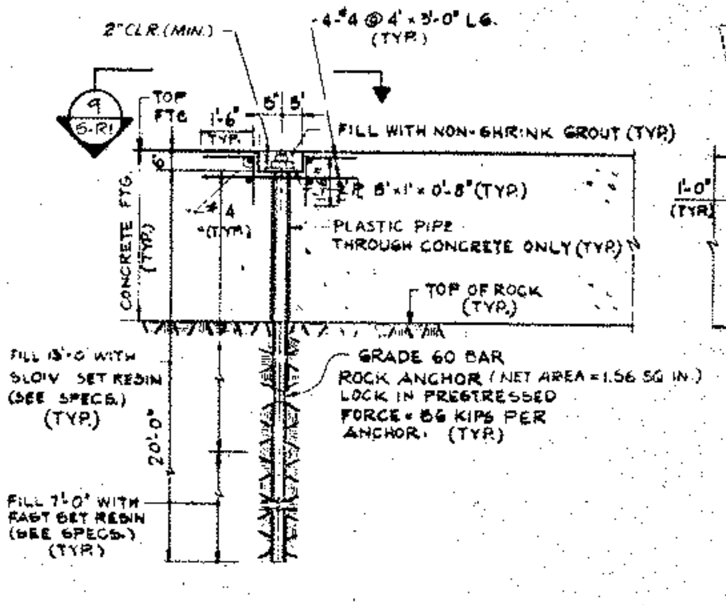
FOUNDATION PLAN
SCALE: ⅛"=1'-0"



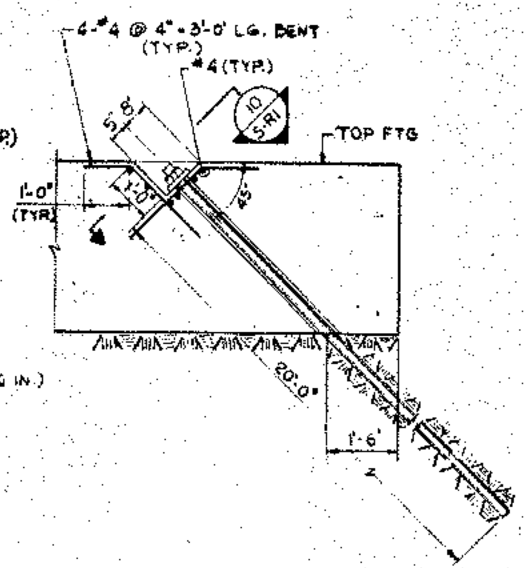
DETAIL E 5-R1
SCALE 1"=1'-0"



SECTION 9 S-R1
SCALE 1"=1'-0"

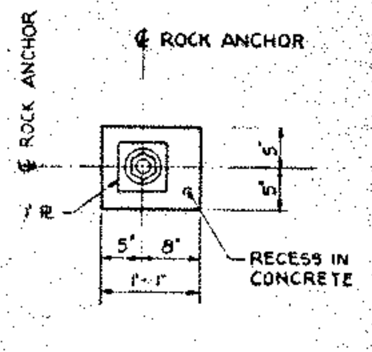


DETAIL D S-R1 S-R2 S-R3



DETAIL D S-R6

TYPICAL ROCK ANCHOR DETAILS
SCALE: ½"=1'-0"
SEE SPECS. SECTION 02285



SECTION 10 S-R1
SCALE: 1"=1'-0"

GENERAL NOTES

FOUNDATION

1. DESIGN ASSUMPTIONS :
   ROCK CAPACITY 40 T.S.F.
2. FOUNDATION SHALL REST ON ROCK.

STRUCTURAL CONCRETE

1. CONCRETE STRENGTH : 4000 P.S.I. AT 28 DAYS.
   WEIGHT : 145 P.C.F.
2. ROD REINFORCEMENT : ASTM A 615 GRADE 60.

GENERAL

1. FOR ROCK ANCHORS SEE SPECIFICATIONS
2. FOR ROCK AND WALL ELEVATIONS SEE DWG. C-RW5, C-RW6 & C-RW7
3. ROCK CONDITION TO BE VERIFIED IN FIELD AND NOTIFIED TO THE ENGINEER.

REV NO	DESCRIPTION	DATE
1	GENERAL REVISIONS	9-17-82

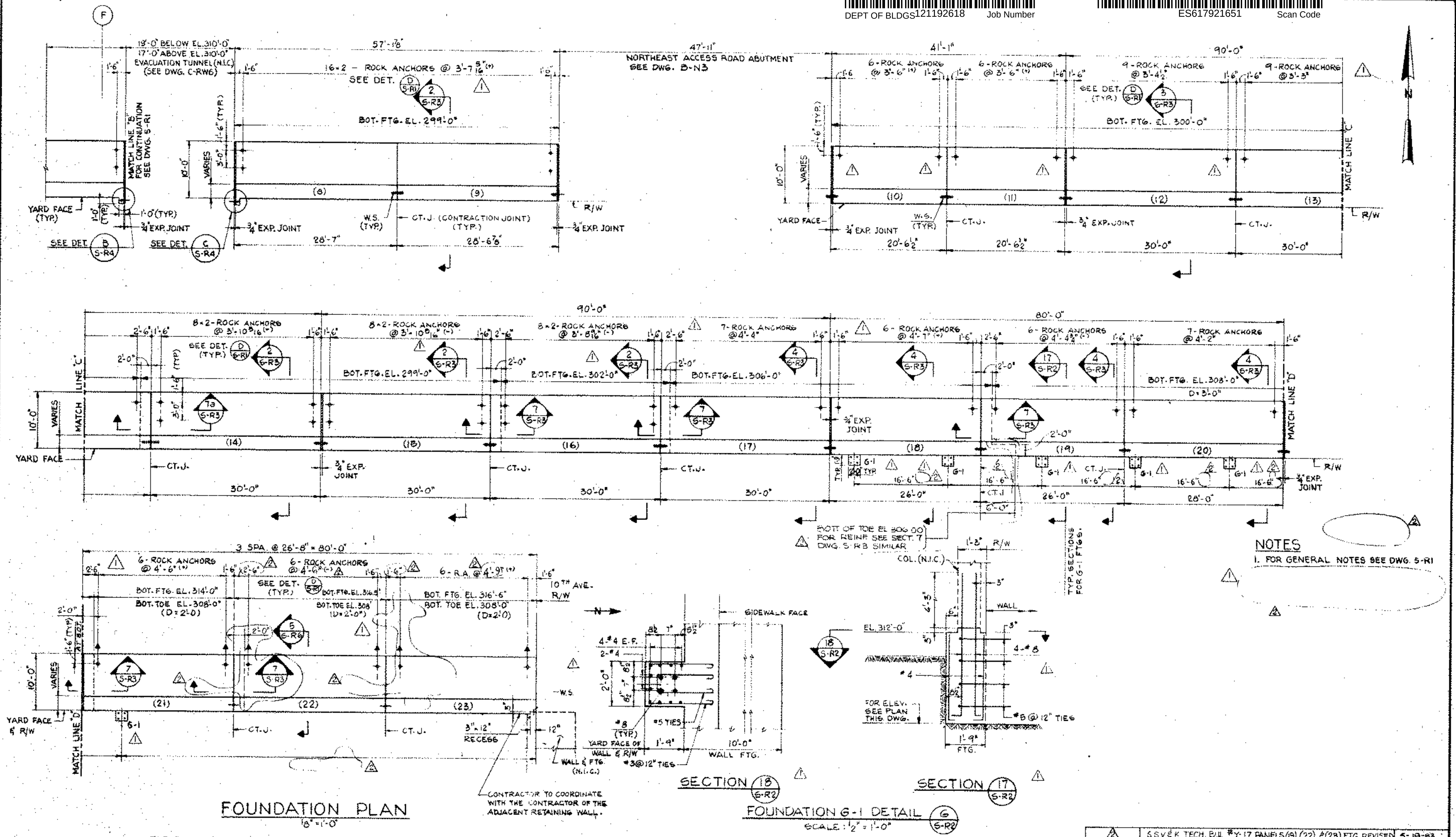
SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
WEST 33RD STREET
RETAINING WALLS (1)
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. S-R1
SHEET 425 OF 684



SECTION 18 S-R2

SECTION 17 S-R2

FOUNDATION G-1 DETAIL 6 S-R2
SCALE: 1/2" = 1'-0"

FOUNDATION PLAN
1/8" = 1'-0"

FOR REINFORCEMENT DETAILS AND OTHER INFORMATION SEE DWG. S-R3
DEPTH OF FOOTINGS = 3'-6" (U.O.N.)

NOTES
1. FOR GENERAL NOTES SEE DWG. S-R1

REV. NO.	DESCRIPTION	DATE
2	SSV&K TECH. BUL #Y-17 PANELS (19), (22) & (23) FTG. REVISED	5-19-83
1	GENERAL REVISIONS	9-17-82

SEELYE STEVENSON VALUE & KNECHT, INC.
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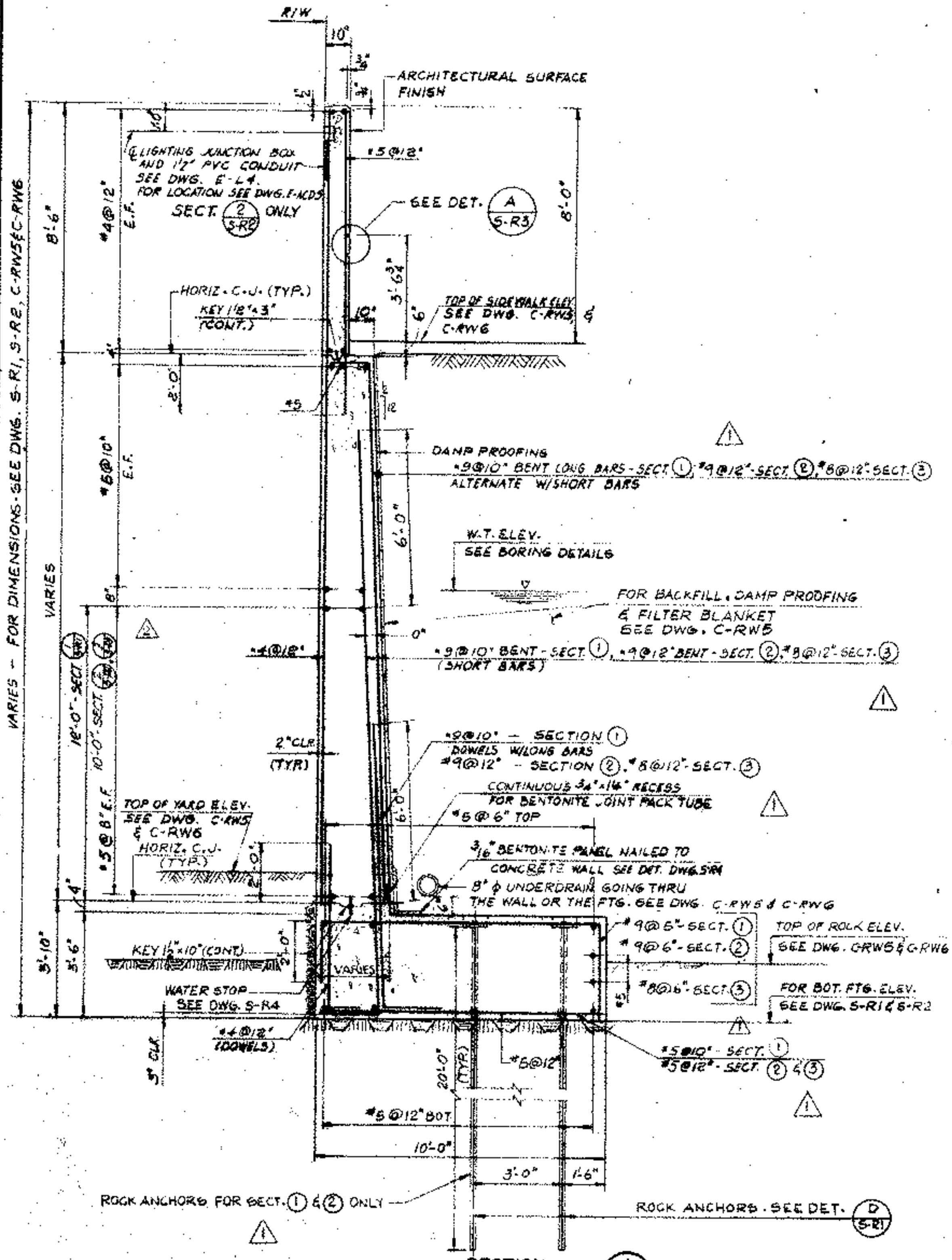
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
WEST 33RD STREET
RETAINING WALLS (2)
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. S-R2
SHEET 426 OF 684



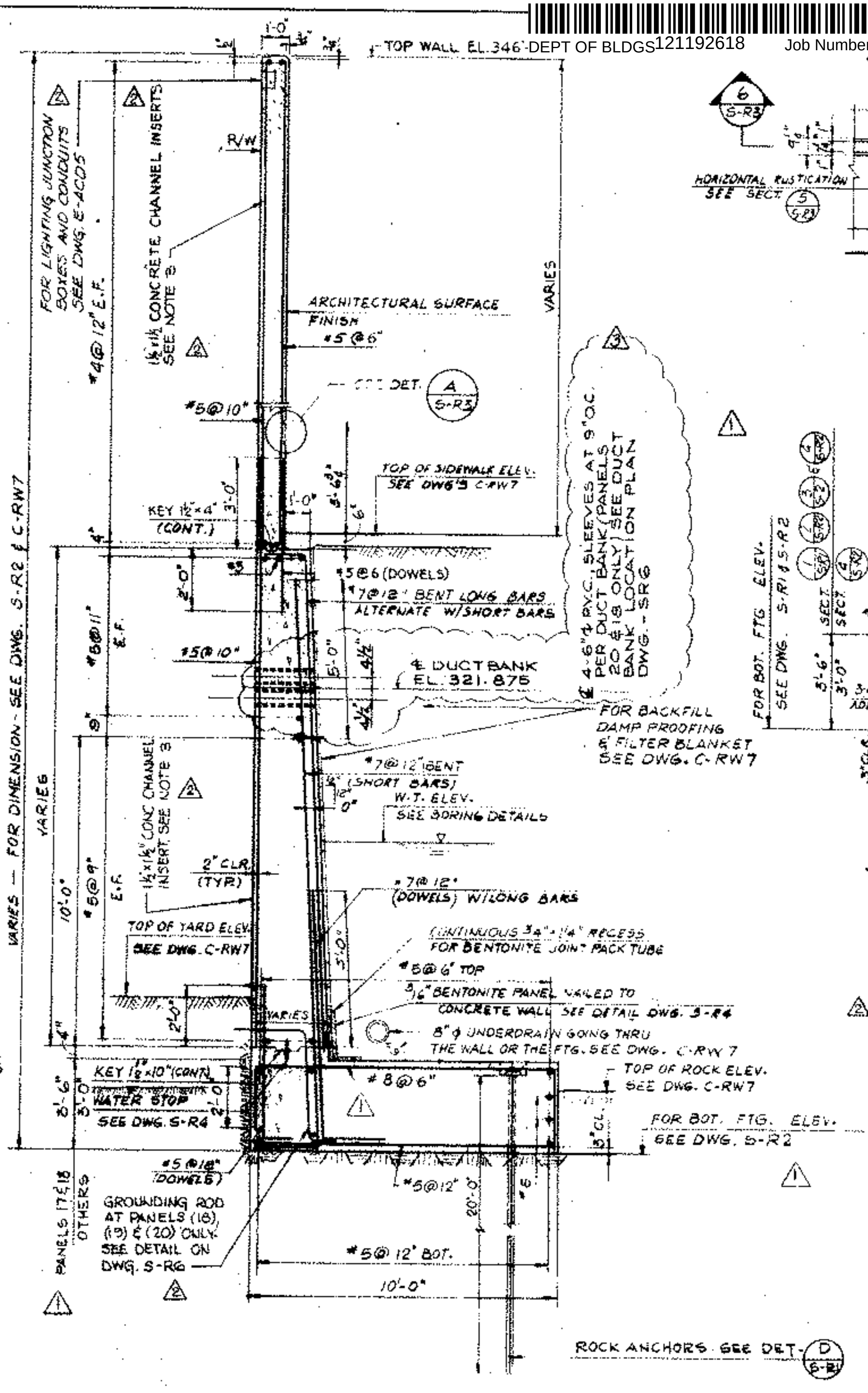
SECTION ① S-R1 AS SHOWN
PANELS (1) & (2)

SECTION ② S-R2 SIMILAR UNLESS OTHERWISE NOTED
PANELS (3) TO (9), (14) TO (16)

SECTION ③ S-R2 SIMILAR UNLESS OTHERWISE NOTED
PANELS (10) TO (13)

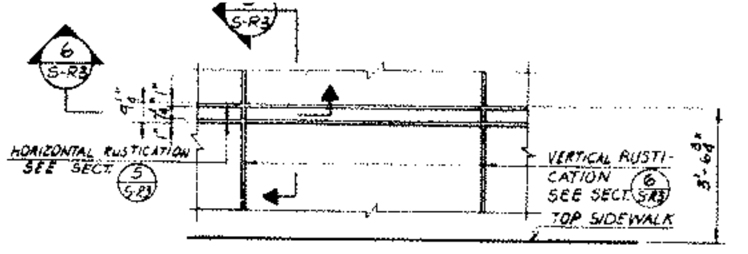
SCALE: ⅜" = 1'-0"

NOTE: FOR WALL SECTIONS AT COLUMNS Ⓒ1 THRU Ⓝ SEE DWG. S-R1



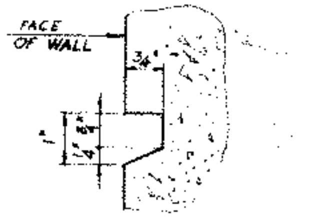
SECTION ④ S-R2
PANELS (17) TO (20)

SCALE 3/8"=1'-0"



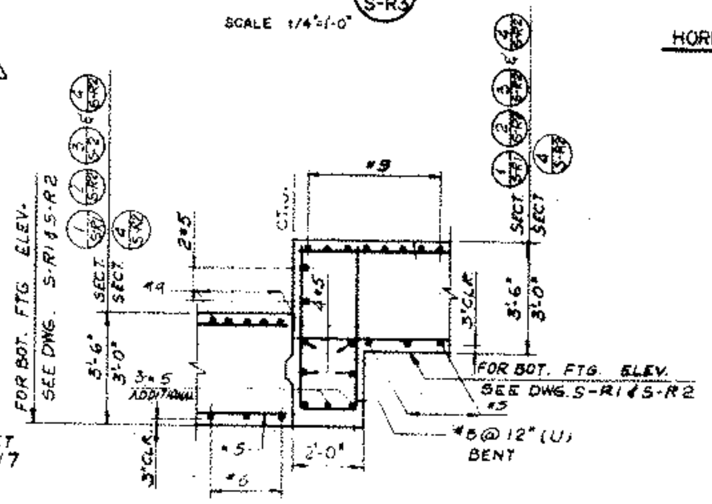
DETAIL A S-R3

SCALE 1/4"=1'-0"



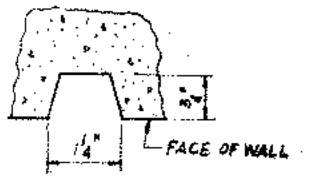
SECTION 5 S-R3
HORIZONTAL RUSTICATION DETAIL

(N.T.S.)



SECTION 7 S-R1 S-R2 AS SHOWN

SECTION 7a S-R2 SIMILAR OPP. HAND



SECTION 6 S-R3
VERTICAL RUSTICATION DETAIL

(N.T.S.)

NOTES

1. FOR GENERAL NOTES SEE DWG. S-R1
2. FOR DETAILS AND INFORMATION NOT SHOWN SEE DWG S-R1, S-R2, C-RW5, C-RW6 & C-RW7
3. FOR LOCATION AND LENGTH OF CHANNEL INSERTS 1½"×1½" 12 GAGE STEEL, SEE REFERENCE DRAWING (142) ACTUAL LOCATIONS TO BE VERIFIED WITH CONTRACTOR FOR MTA CONTRACT 1-02-21546-0-0.

REV NO	DESCRIPTION	DATE
3	S.S.V.&K TECH. BUL. #Y-20 - DUCTBANK REVISION	7-19-83
2	S.S.V.&K TECH. BUL. #Y-17 COORDINATE WITH ELEC. CONTRACT	5-19-83
1	GENERAL REVISIONS	9-17-82

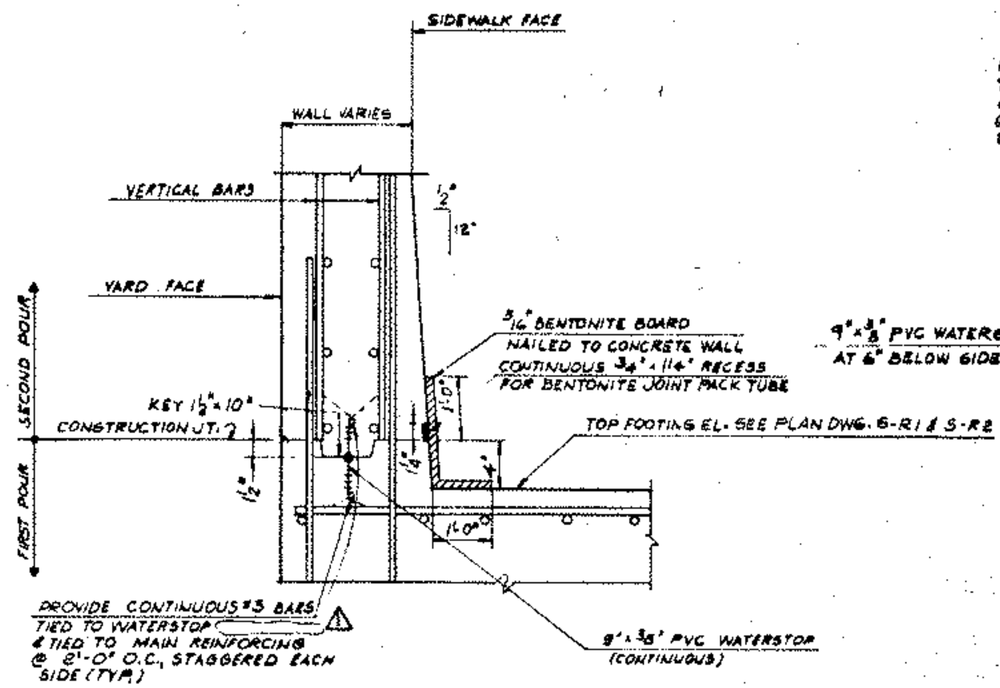
SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

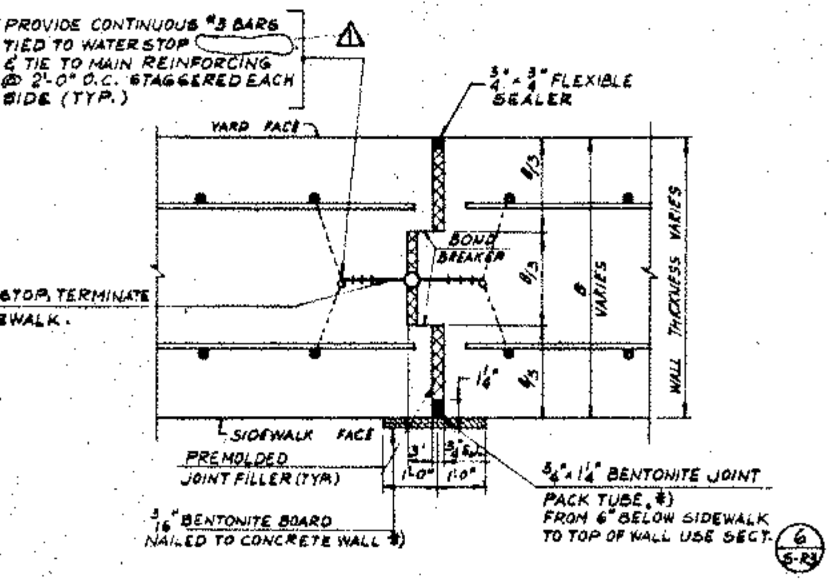
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
WEST 33RD STREET
RETAINING WALLS (3)
STORAGE YARD

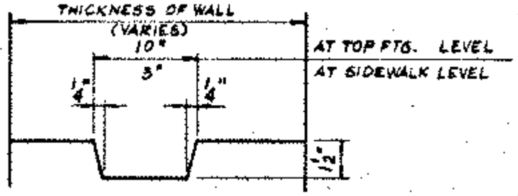
CONTRACT NO 1-02-21154-0-0
DATE AUG 12, 1982
SCALE AS NOTED
DRAWING NO S-R3
SHEET 427 OF 684



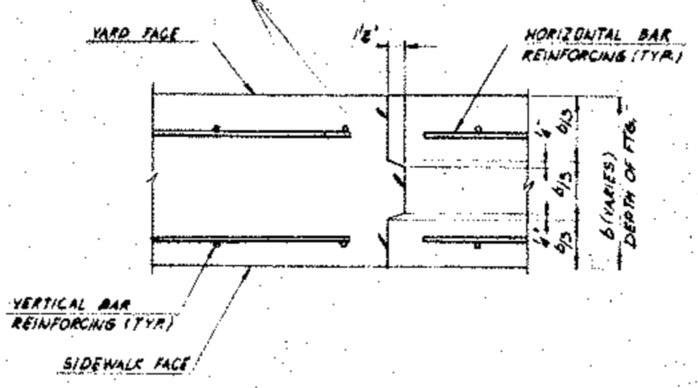
HORIZONTAL CONSTRUCTION JOINT DETAIL
AT TOP OF FOOTING
(N.T.S)



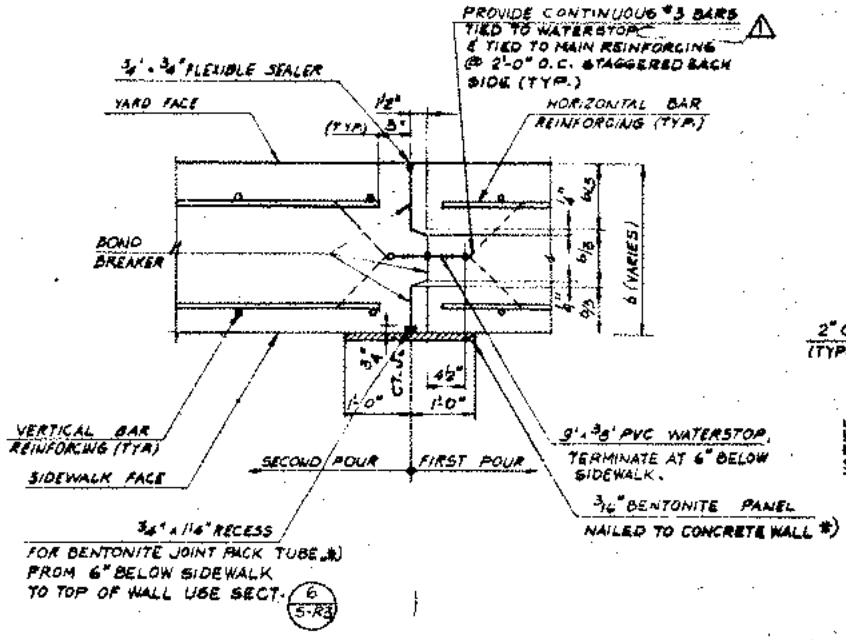
TYPICAL EXPANSION JOINT DETAIL
(N.T.S)



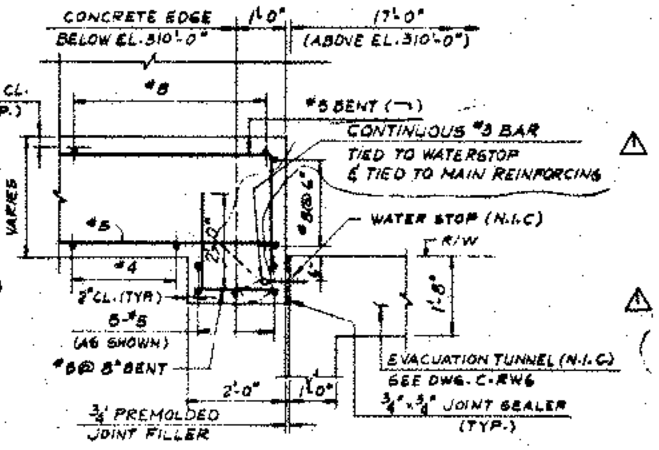
CONSTRUCTION JOINT
KEY DETAIL
(N.T.S.)



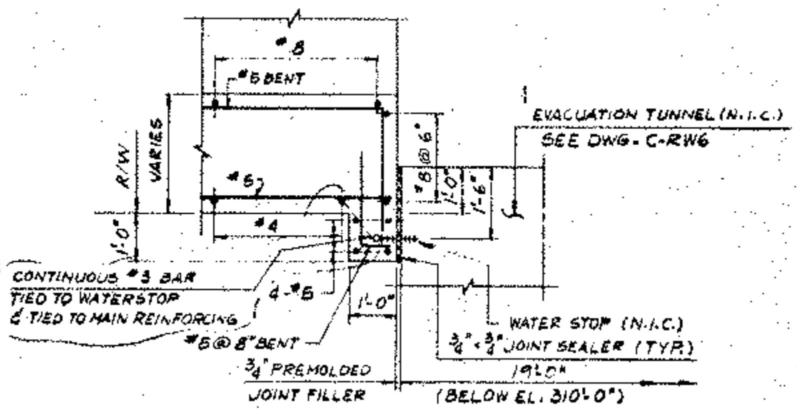
FOOTING VERTICAL CONTRACTION JOINT DETAIL
(N.T.S.)



WALL VERTICAL CONTRACTION JOINT DETAIL
(N.T.S.)



PLAN-EXPANSION JOINT ABOVE EL. 310'-0"



PLAN EXPANSION JOINT BELOW EL. 310'-0"

DETAIL (B / S-R1), S-R2
DETAIL (C / S-R2) SIMILAR-OPP. HAND
SCALE: 1/2" = 1'-0"

NOTES

1) FOR GENERAL NOTES SEE DWG. S-R1

*) BETWEEN HORIZONTAL CONSTRUCTION JOINTS ONLY.

REV NO	DESCRIPTION	DATE
1	GENERAL REVISIONS	9-17-82

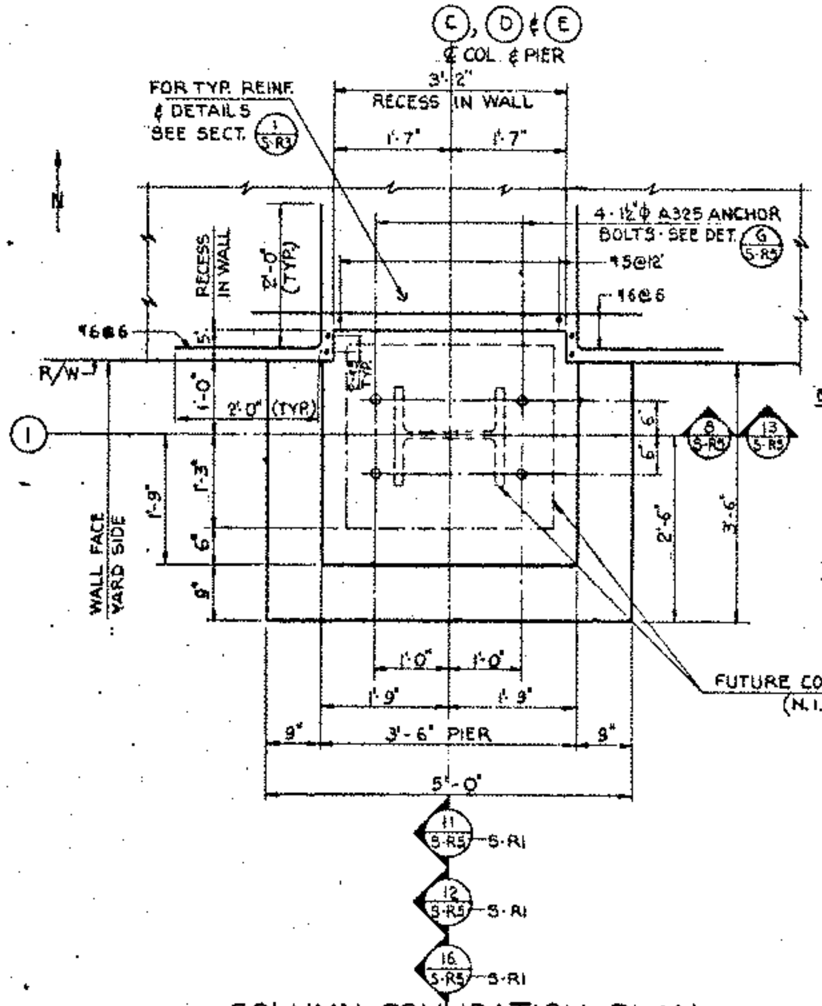
SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

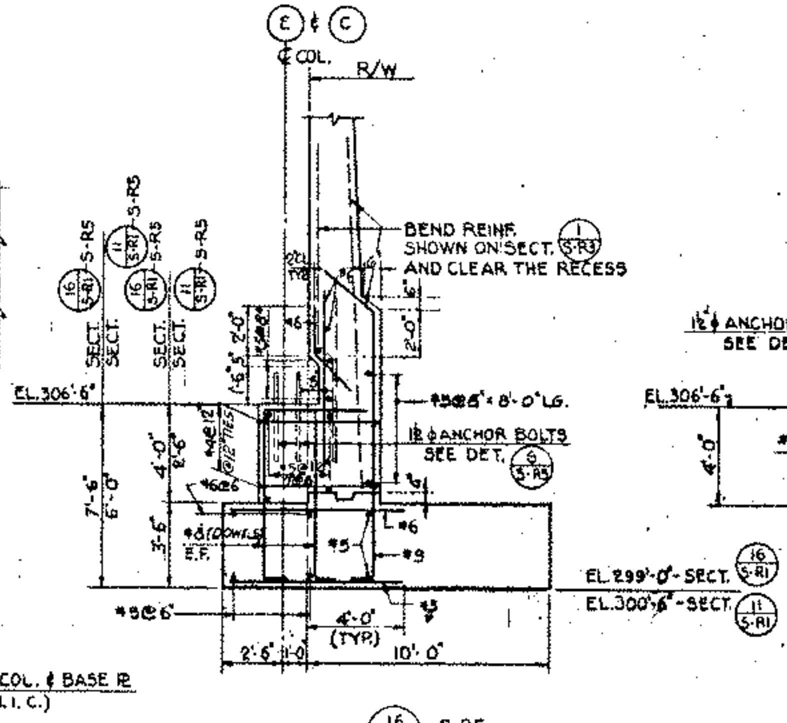
WEST SIDE STORAGE YARD COMPLEX
WEST 33RD STREET
RETAINING WALLS (4)
STORAGE YARD

CONTRACT NO 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO S-R4
SHEET 428 OF 684



COLUMN FOUNDATION-PLAN

ADDITIONAL REINFORCEMENT IN WALL ONLY

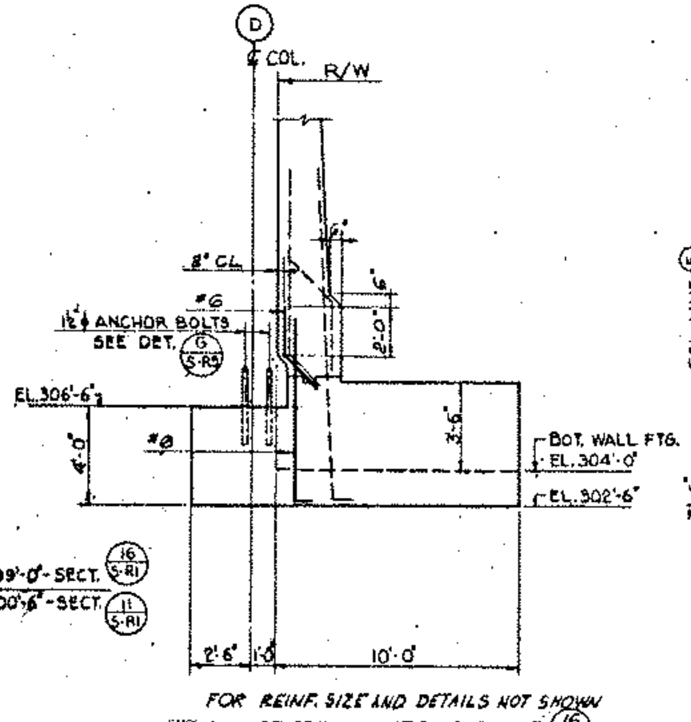


SECTION 16 S-R1 S-R5 AS SHOWN

SECTION 11 S-R1 S-R5 SIMILLAR & AS NOTED

¼"=1'-0"

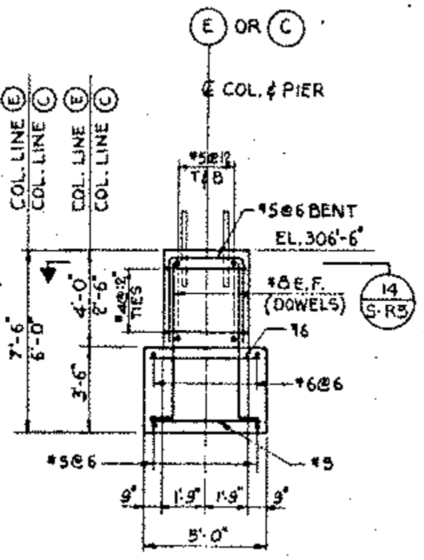
ADD'L. REINF. IN WALL & WALL FTG. ONLY.



FOR REINF. SIZE AND DETAILS NOT SHOWN AND OTHER INFORMATION SEE SECT. 16 S-R5

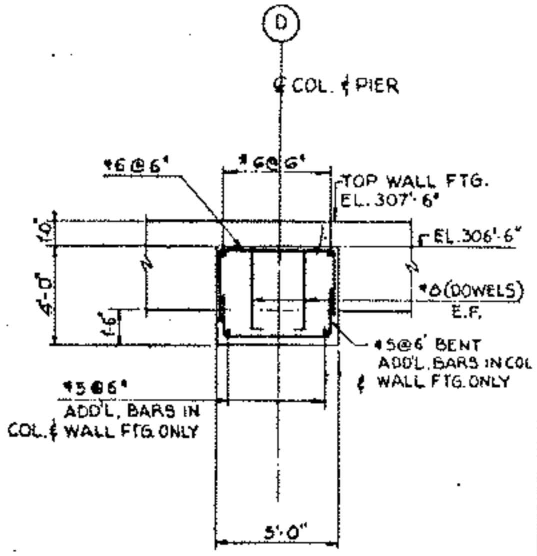
SECTION 12 S-R1 S-R5

¼"=1'-0"



SECTION 8 S-R1 S-R5

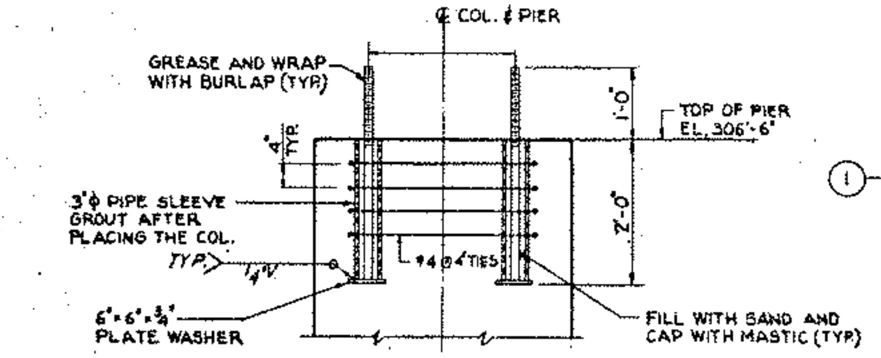
¼"=1'-0"



SECTION 13 S-R1 S-R5

¼"=1'-0"

NOTE
1. FOR GENERAL NOTES SEE DWG. S-R1

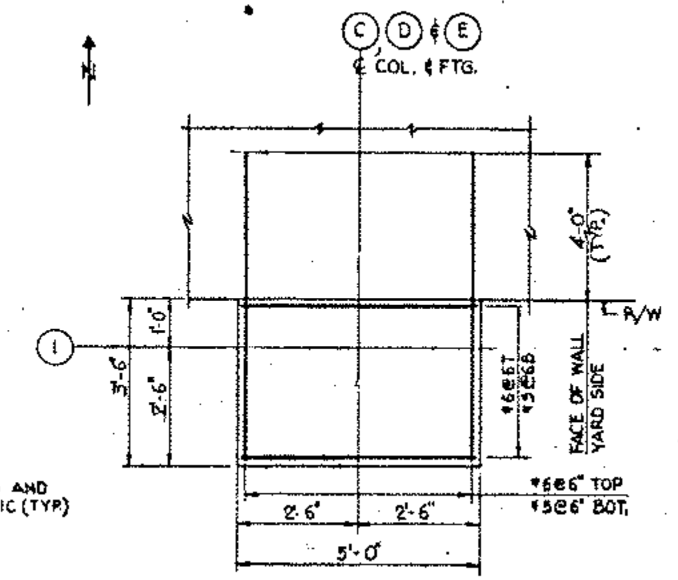


NOTE:
ALL STEEL SHALL BE GALVANIZED

DETAIL G S-R5 S-R1

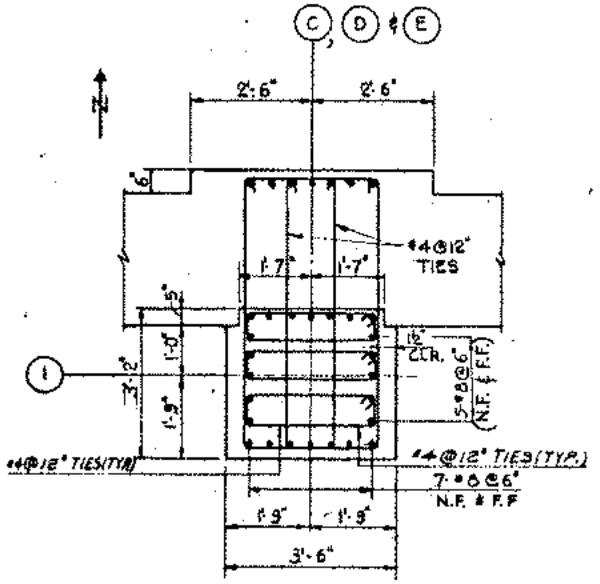
ANCHOR BOLTS DETAIL

¾"=1'-0"



FOOTING REINFORCENT-PLAN

½"=1'-0"



SECTION 14 S-R5

PIER REINFORCEMENT-PLAN

½"=1'-0"

NOTE
CONCRETE SOUTH OF R/W, ANCHOR BOLTS, REBARS & CONCRETE RECESS SHOWN ON THIS DWG. SHALL BE INCLUDED IN BUS GARAGE BID ITEM Nº 2.

REV. NO.	DESCRIPTION	DATE

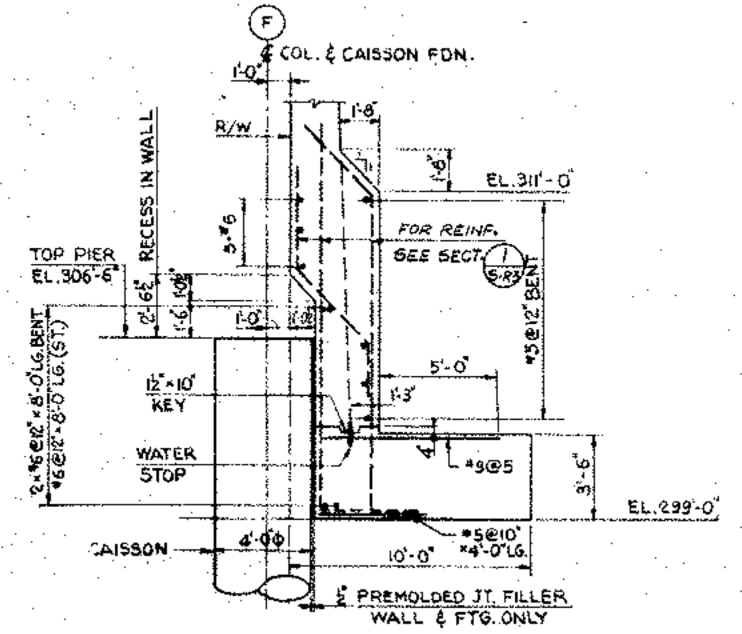
SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
WEST 33RD STREET
RETAINING WALLS (5)
STORAGE YARD

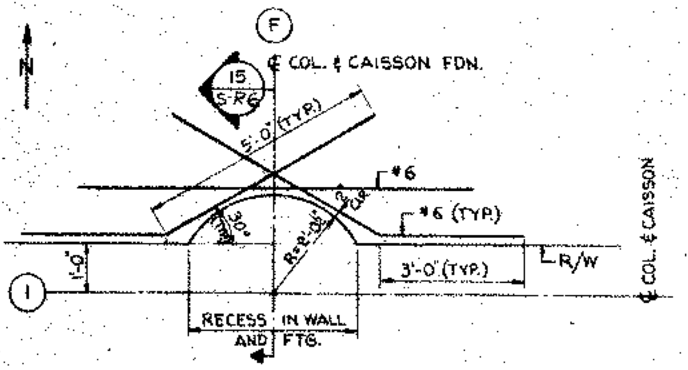
CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. S-R5
SHEET 429 OF 684



SECTION 15/S-R6

(ADDITIONAL BARS ONLY)

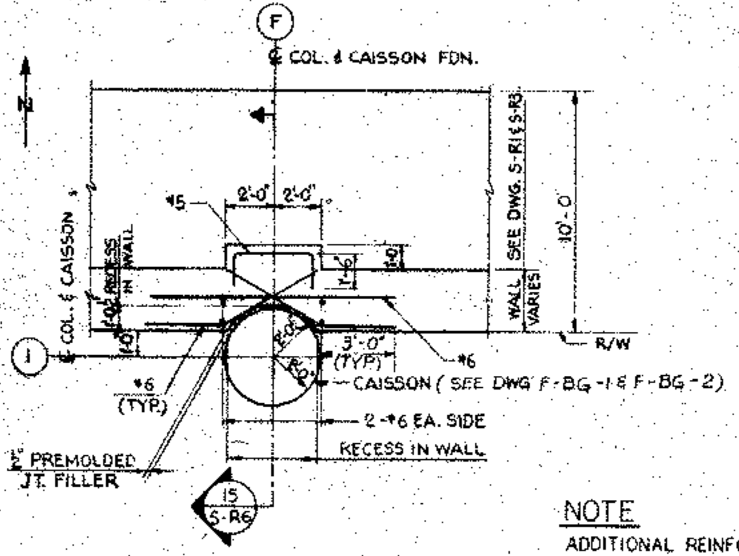
FOR TYPICAL REINFORCEMENT, INFORMATION & DETAILS SEE SECT. 1/S-R3



WALL AND FOOTING-PARTIAL PLAN

½"=1'-0"

(ADDITIONAL REINF. ONLY)



DETAIL F/S-R1

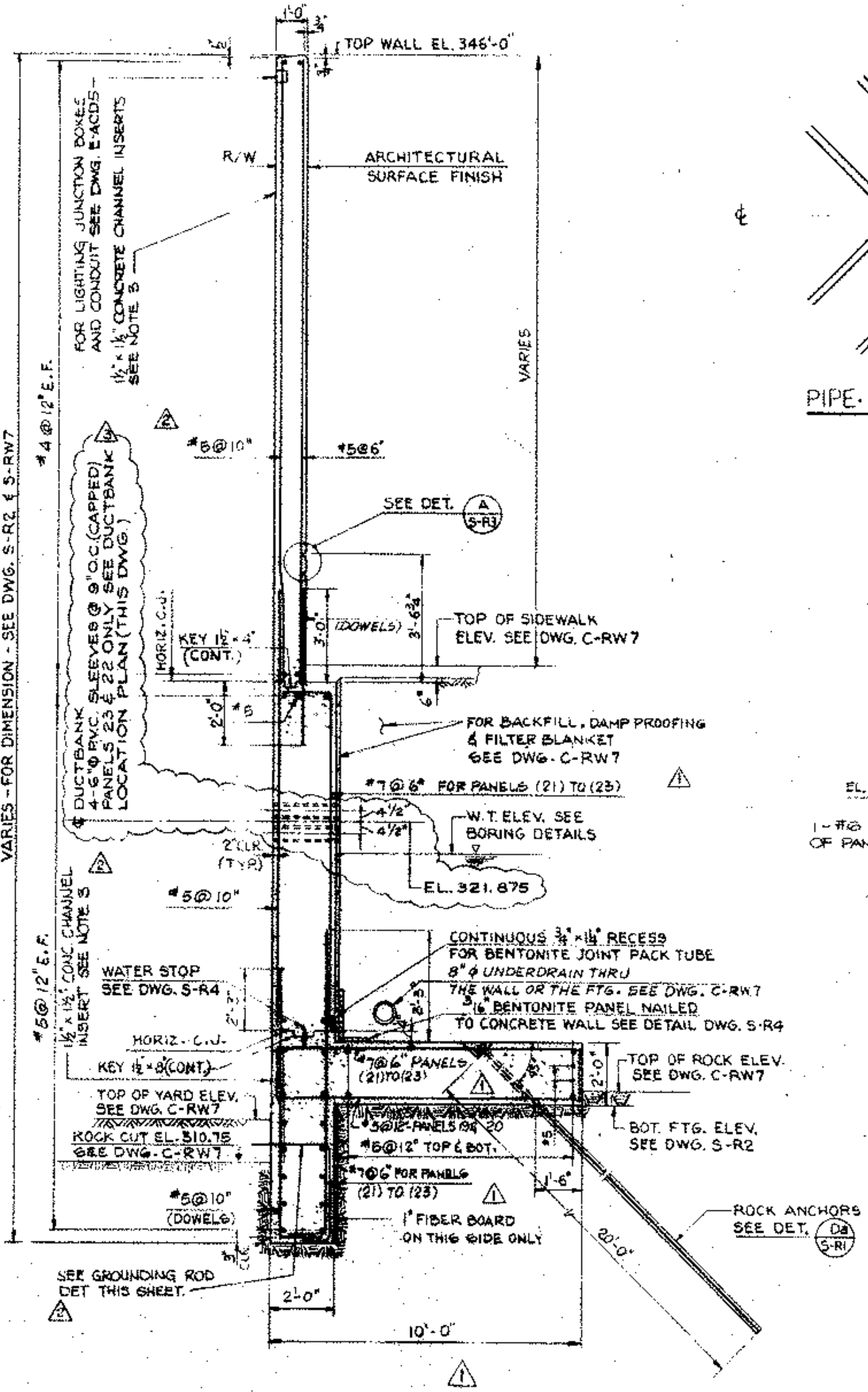
¼"=1'-0" U.O.N.

WALL & FOOTING PLAN

(ADDITIONAL REINF. ONLY)

NOTE

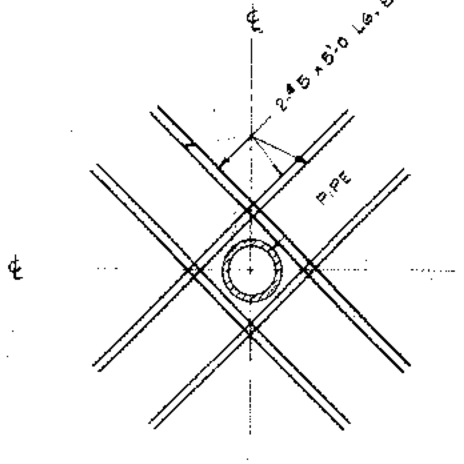
ADDITIONAL REINFORCEMENT, CONCRETE RECESS IN WALL AND FTG. AND ½" JOINT FILLER SHOWN HERE SHALL BE INCLUDED IN BUS GARAGE BID ITEM Nº2.



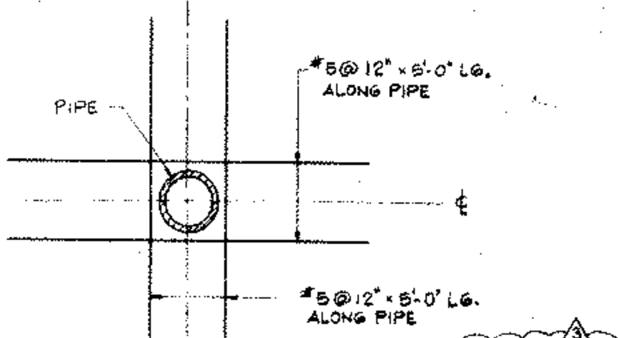
SECTION 5/S-R2

PANELS (21) TO (23)

⅜"=1'-0"



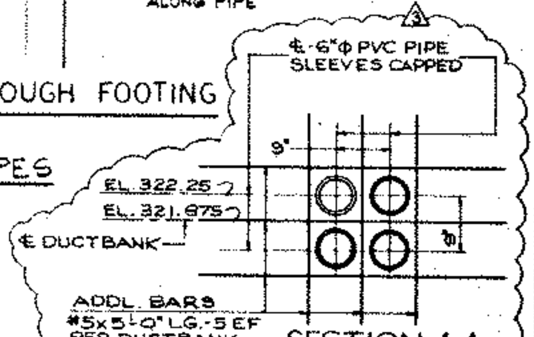
PIPE THROUGH WALL



PIPE THROUGH FOOTING

ADDITIONAL REINF. ADJACENT TO PIPES

SCALE: ¾"=1'-0"

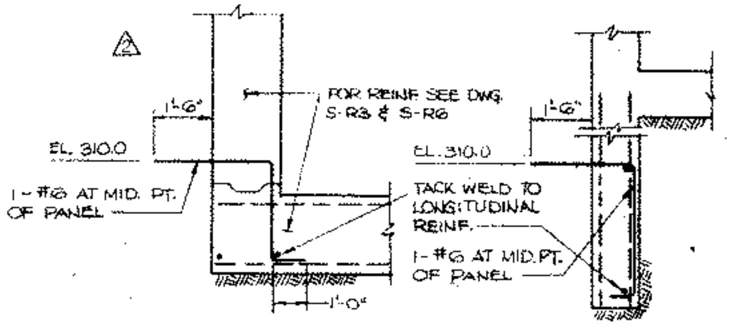


SECTION 1-1

TYPICAL REINFORCING AT DUCTBANKS

NOTE

1. FOR GENERAL NOTES, SEE DWG. S-R1
2. ~~FIVE DUCT BANKS ARE ANTICIPATED. THE EXACT LOCATION OF DUCT BANKS WILL BE FURNISHED TO THE CONTRACTOR DURING CONSTRUCTION.~~
3. FOR LOCATION AND LENGTH OF CHANNEL INSERTS (½"×1½" 12 GAGE STEEL, SEE REFERENCE DRAWING (142). ACTUAL LOCATIONS TO BE VERIFIED WITH CONTRACTOR FOR MTA CONTRACT 1-02-21546-0-0

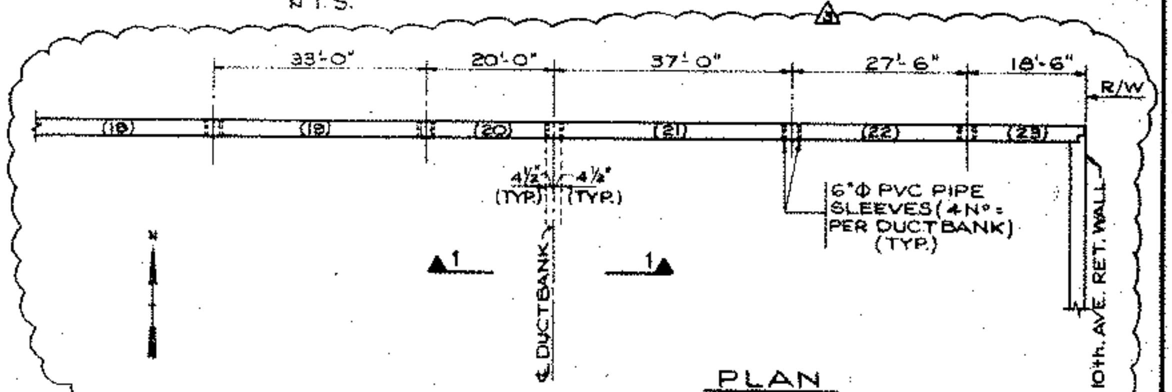


PANELS (18), (19) & (20)

PANELS (21) (22) & (23)

TYP. DET. OF GROUNDING ROD AT MID. POINT OF PANELS (18) THRU (23)

N.T.S.



PLAN DUCT BANK LOCATION

N.T.S.

REV NO	DESCRIPTION	DATE
3	S.S.V.&K. TECH. BUL.#Y-20, DUCT BANK REVISION	7-19-83
2	S.S.V.&K. TECH. BUL.#Y-17, COORDINATE WITH ELEC. CONTRACT	5-19-83
1	GENERAL REVISIONS	9-17-82

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG
ISLAND
RAIL ROAD

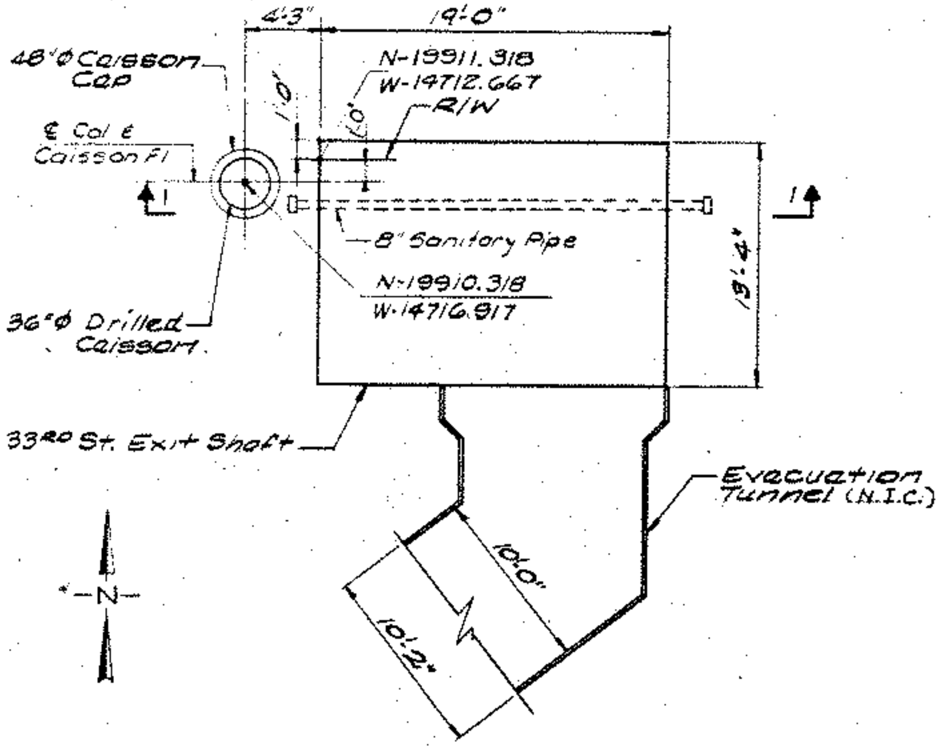
M
Metropolitan
Transportation
Authority

WEST SIDE STORAGE YARD COMPLEX

WEST 33RD STREET
RETAINING WALLS (6)

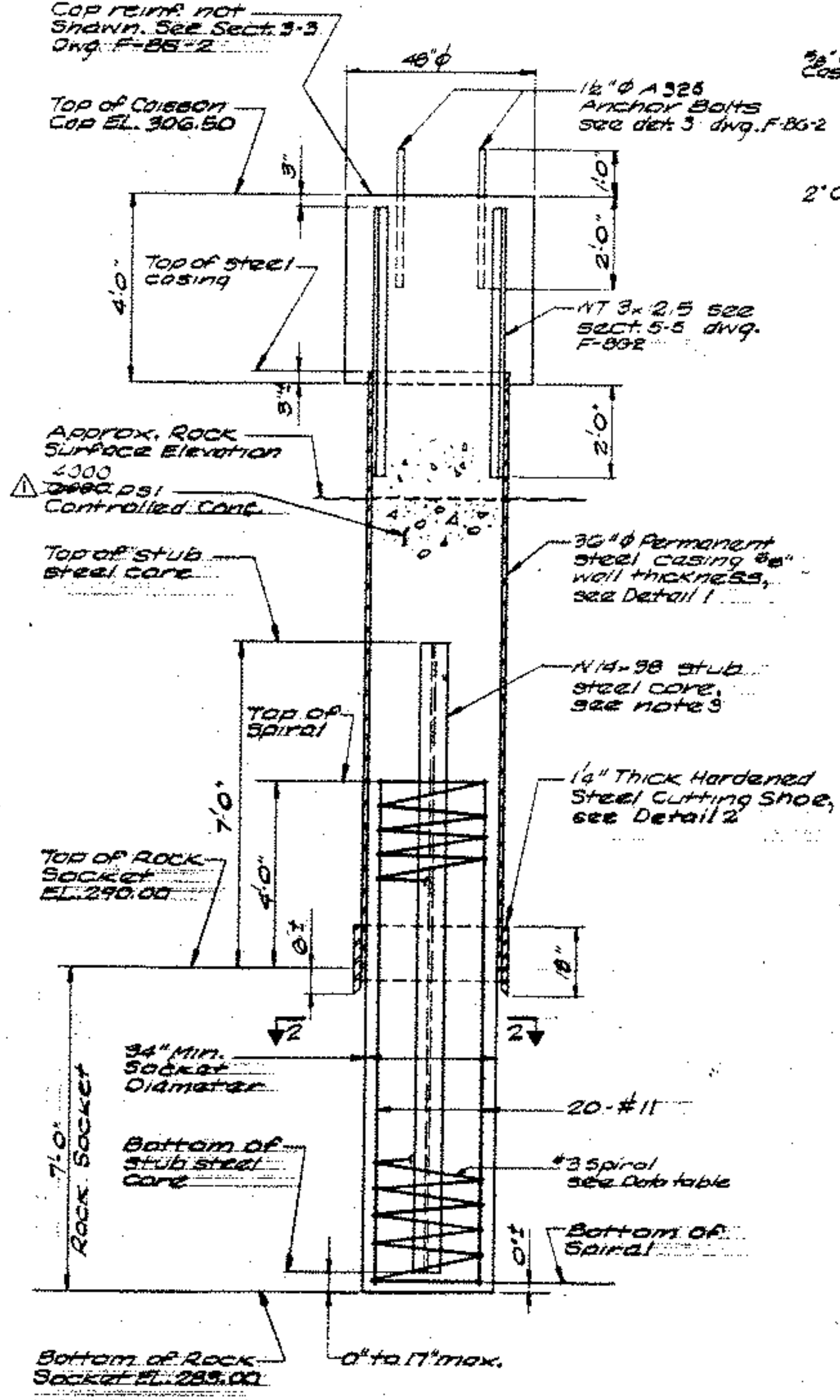
STORAGE YARD

CONTRACT NO. 1-02-21154-0-0
DATE AUG 12, 1982
SCALE AS NOTED
DRAWING NO. S-R6



CAISSON LOCATION PLAN

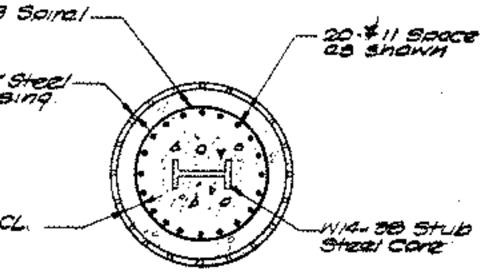
SCALE: 3/16" = 1'-0"



ELEVATION

DRILLED CAISSON F-1

SCALE: 1½" = 1'-0"

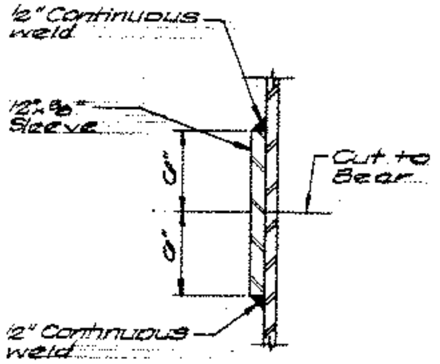


SECTION 2-2

SCALE: 1½" = 1'-0"

DRILLED CAISSON F-1 NOTES:

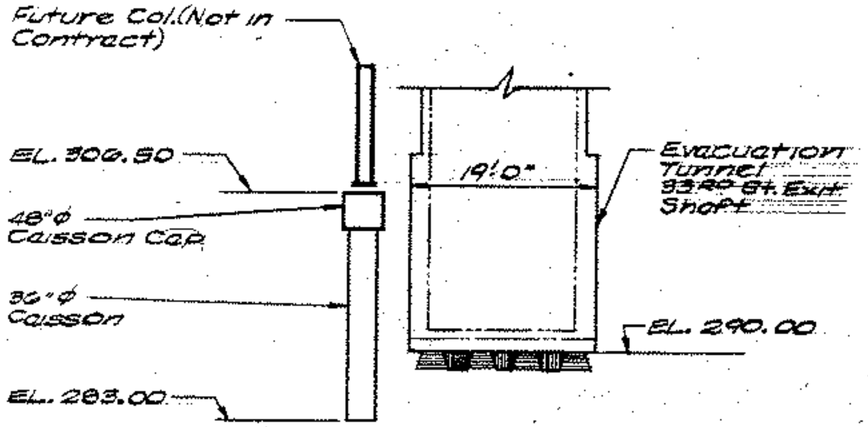
1. For Caisson data, see specifications.
2. The Caisson socket is to be founded in sound rock of 60 T/S.F bearing capacity (class 1-65 rock in N.Y.C. Building Code)
3. The future steel column web and the stub core beam web shall be placed parallel to ℄ of 33RD street.
4. Elevations given are based on Penn. Station datum, on which elevation 300.025 is equal to elevation 0.0 on the borough of Manhattan datum.



DETAIL "1"

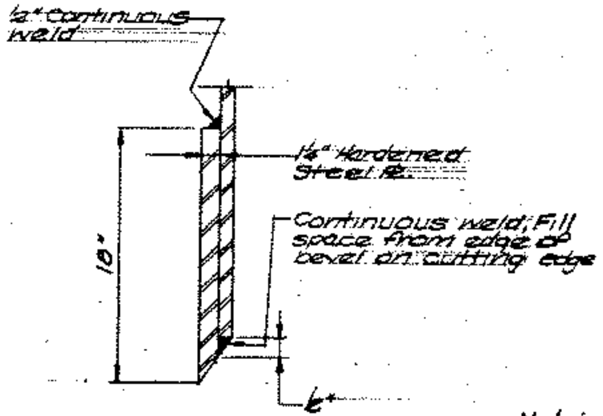
STEEL CASING SPLICE

N.T.S.



SECTION 1-1

SCALE: 1" = 10'



DETAIL "2"

CUTTING EDGE

N.T.S.

Note:
Bus Garage Caisson F-1 is option bid Item

SPIRAL DATA TABLE

SIZE	HEIGHT	PITCH	DIA.
3	11'-0" ±	6"	31½"

REV NO.	DESCRIPTION	DATE
1	Addm. #1: Descriptive Change	9-17-82

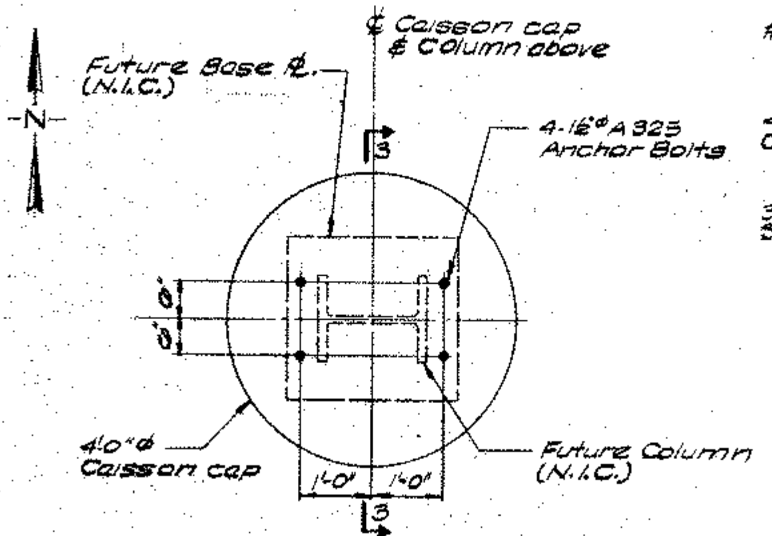
SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
BUS GARAGE CAISSON F-1
LOCATION PLAN & DETAILS
STORAGE YARD

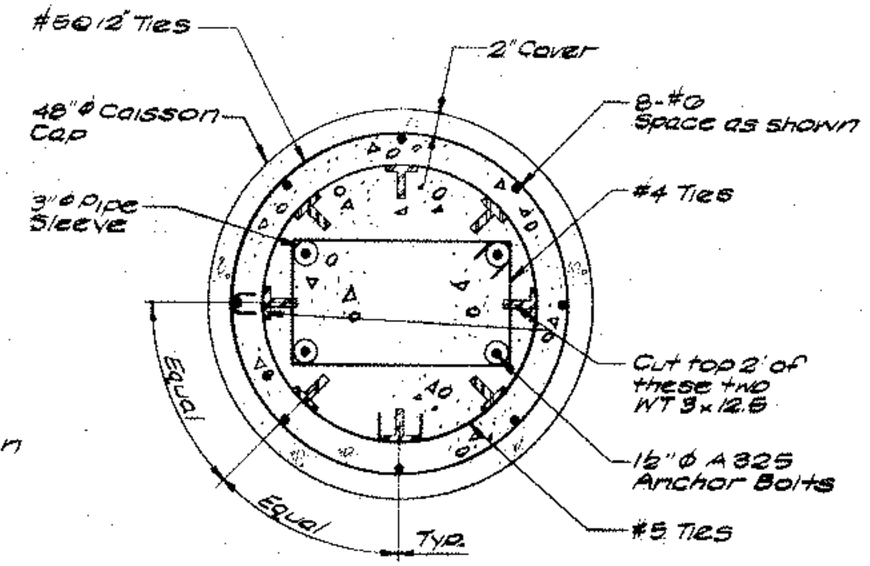
CONTRACT NO. 1-02-21154-0-0
DATE AUG. 12, 1982
SCALE AS NOTED
DRAWING NO. F-BG-1
SHEET 431 OF 684



DETAIL "3"

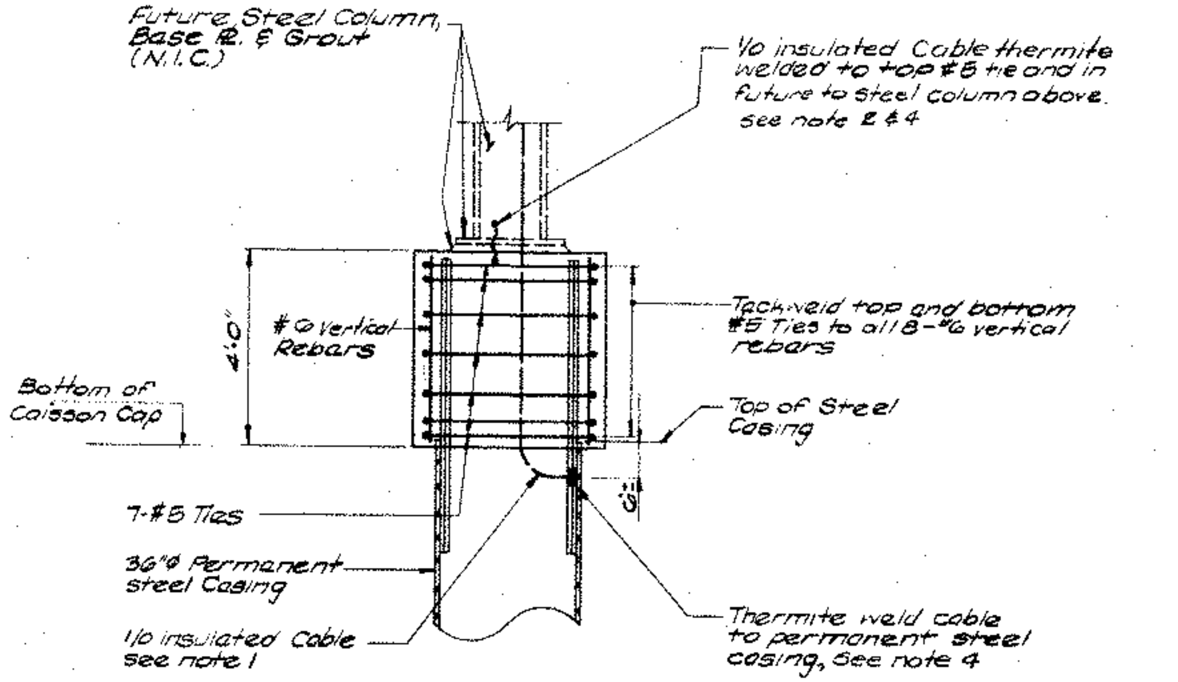
ANCHOR BOLT LOCATION PLAN

SCALE: ¾"=1'-0"



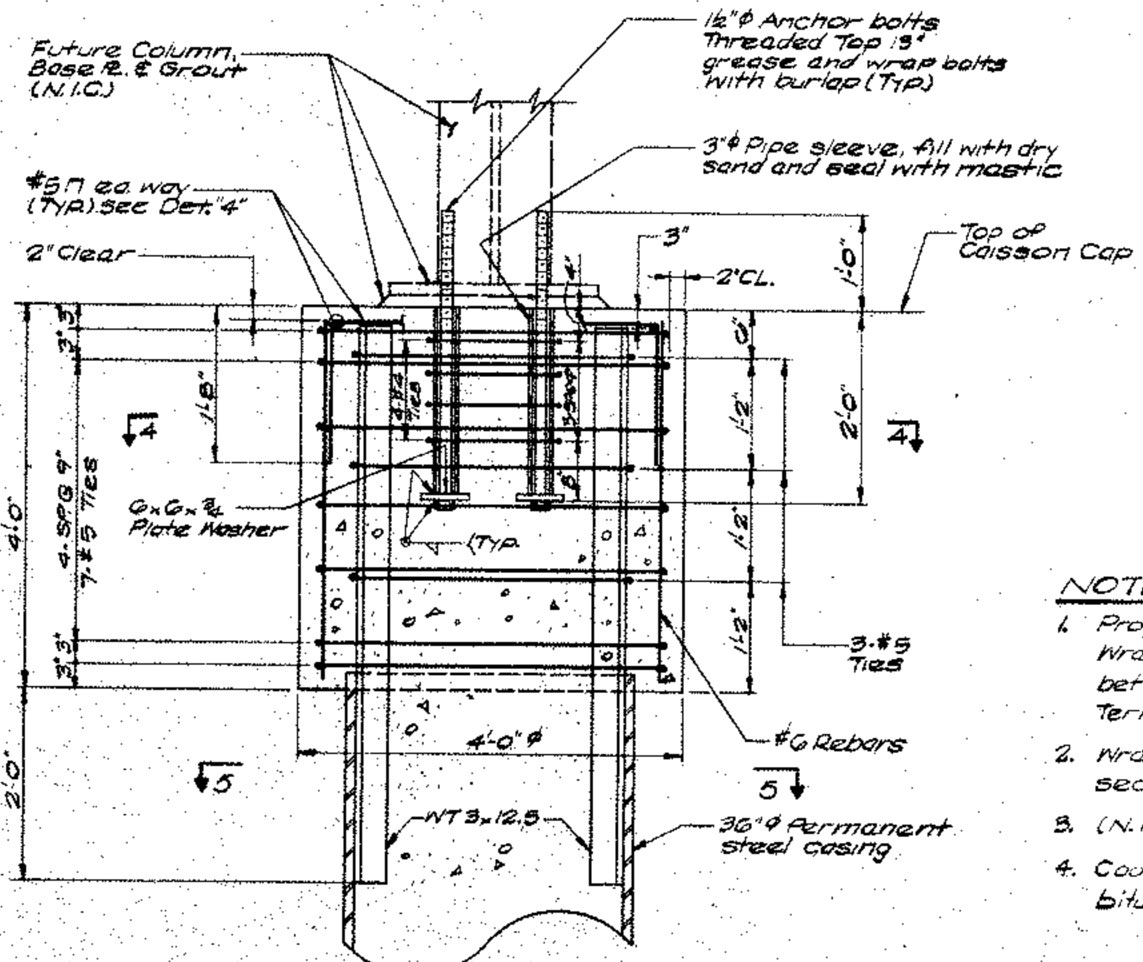
SECTION 4-4

SCALE: 1"=1'-0"



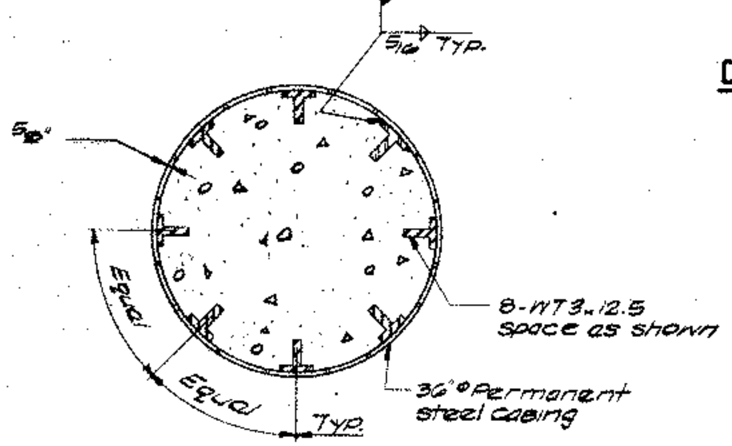
DETAIL FOR CONTROL OF STRAY ELECTRICAL CURRENTS

SCALE: ½"=1'-0"



SECTION 3-3

SCALE: 1"=1'-0"

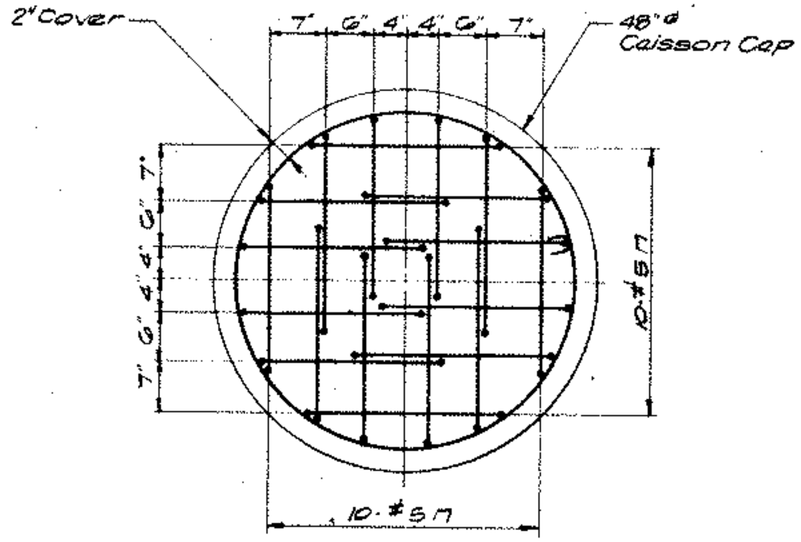


SECTION 5-5

SCALE: 1"=1'-0"

NOTES:

1. Provide approximately 13 FT. of 1/0 insulated cable. Wrap exposed portion in plastic and secure between exposed top 12" of Anchor Bolts. Termination to be done in future (N.I.C.).
2. Wrap exposed portion of cable in plastic and secure to exposed top 12" of Anchor Bolts.
3. (N.I.C.) denotes not in contract.
4. Coat all thermite weld connections with cold applied bitumen.



DETAIL "4"

TOP OF CAISSON CAP REINF. LAYOUT

SCALE: 1"=1'-0"

REV NO	DESCRIPTION	DATE

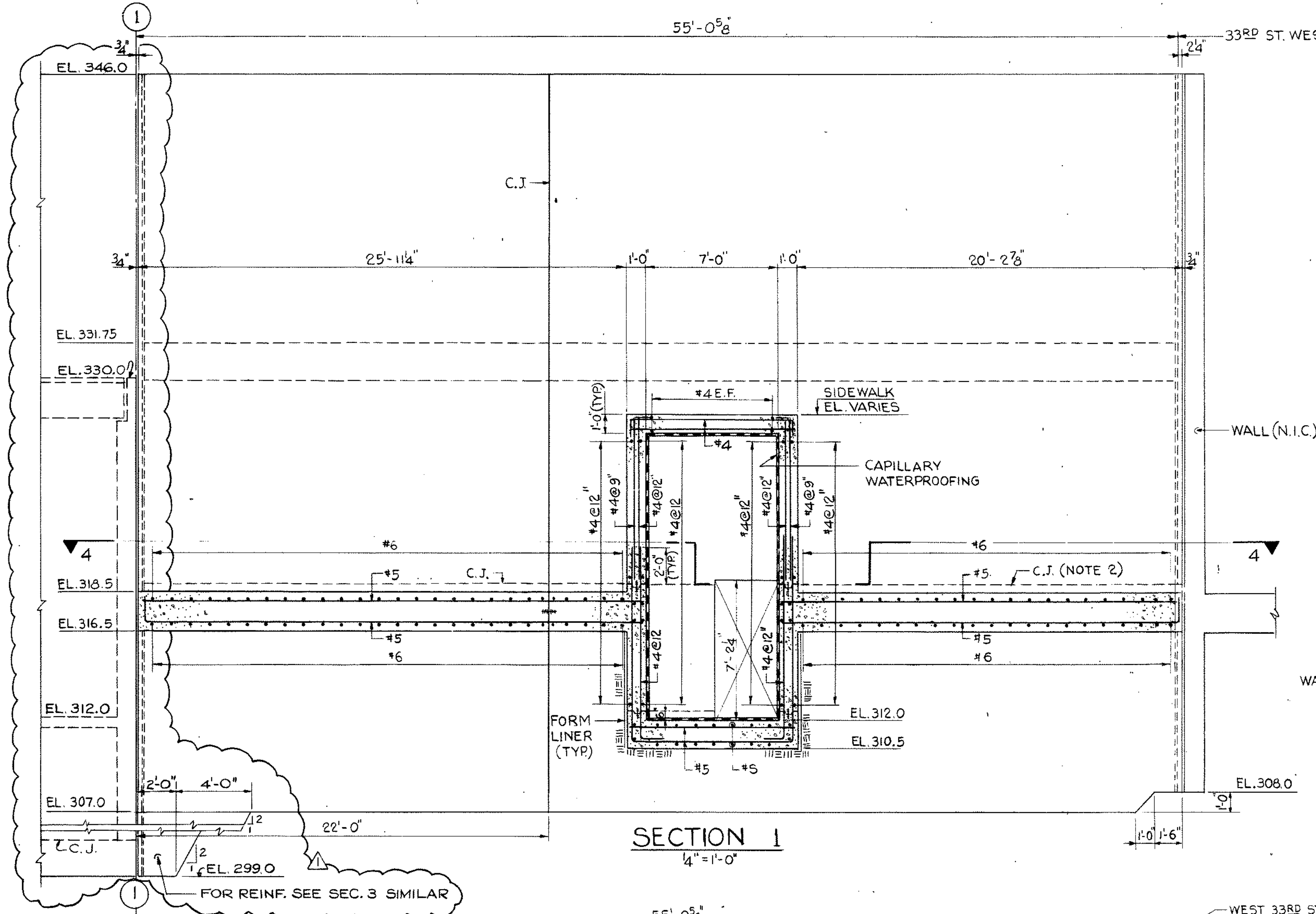
SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

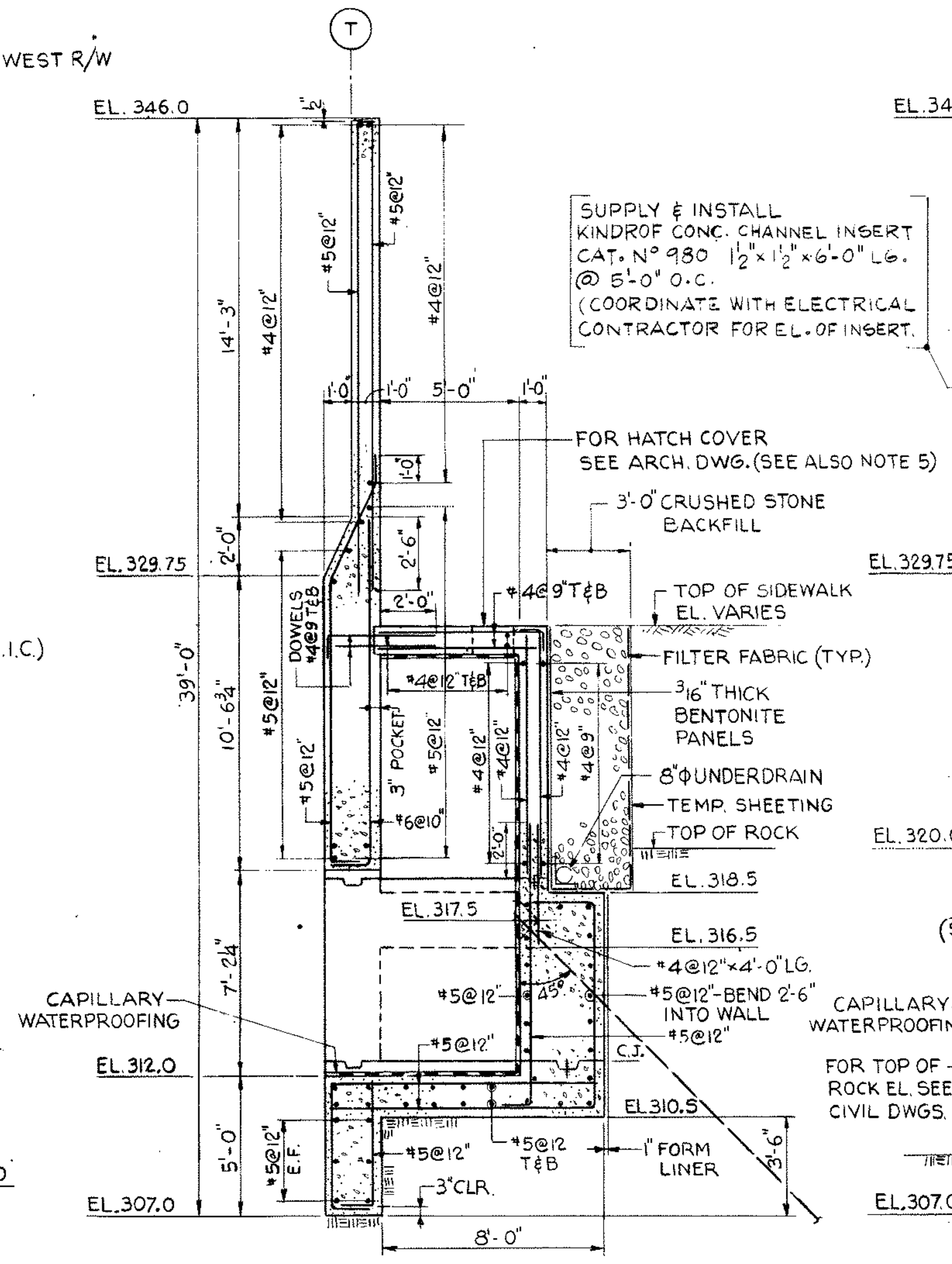
WEST SIDE STORAGE YARD COMPLEX
BUS GARAGE CAISSON F-1
MISCELLANEOUS CAISSON DETAILS
STORAGE YARD

CONTRACT NO. 1-09 21154-0-0
DATE AUG 12, 1982
SCALE AS NOTED
DRAWING NO. F-BG-2



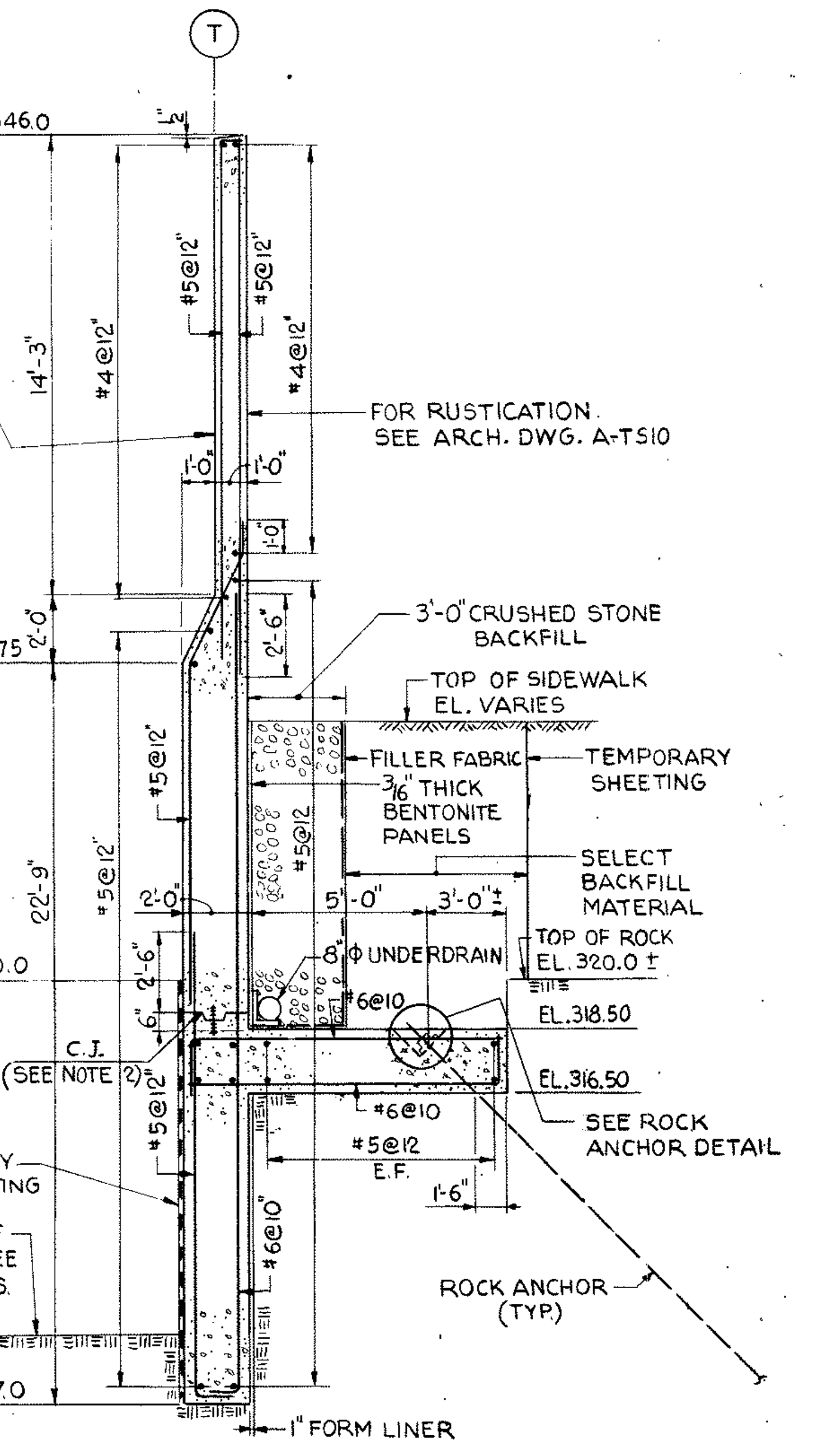
SECTION 1

1/4" = 1'-0"



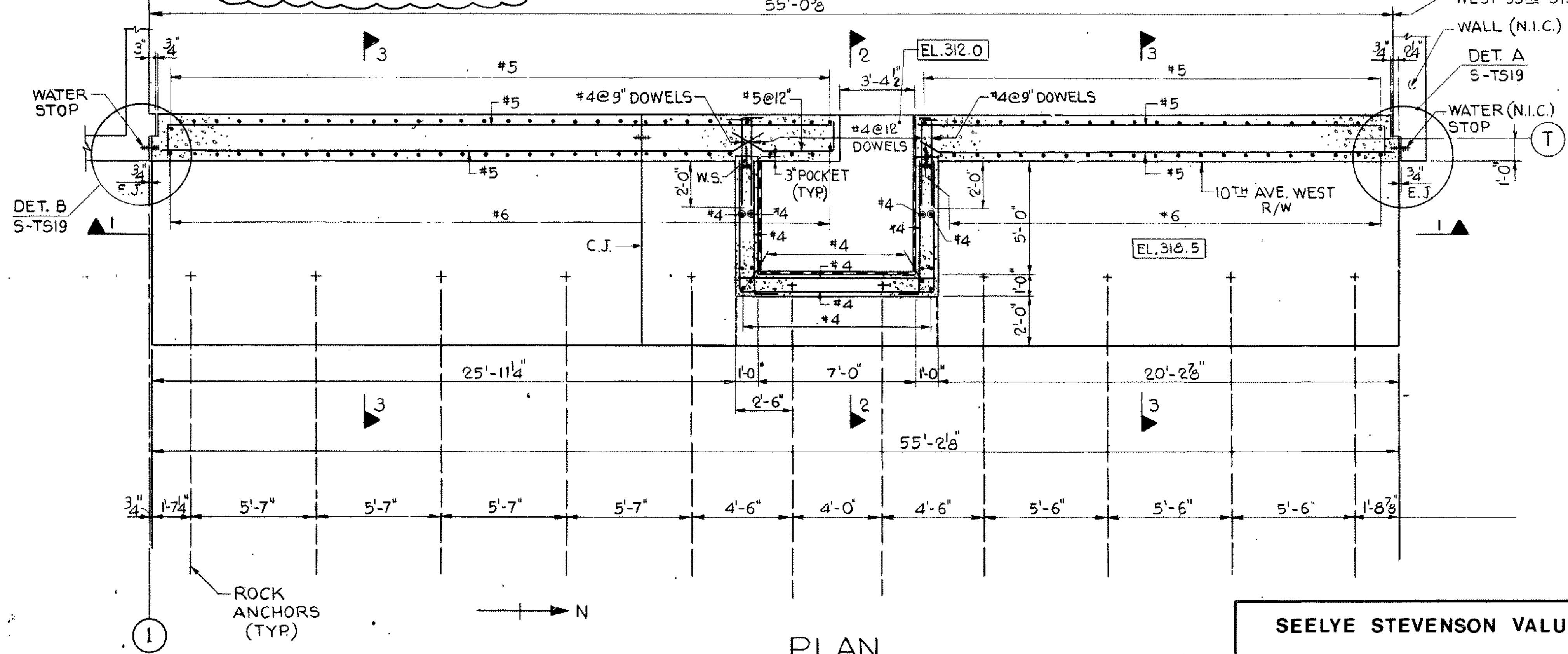
SECTION 2

1/4" = 1'-0"



SECTION 3

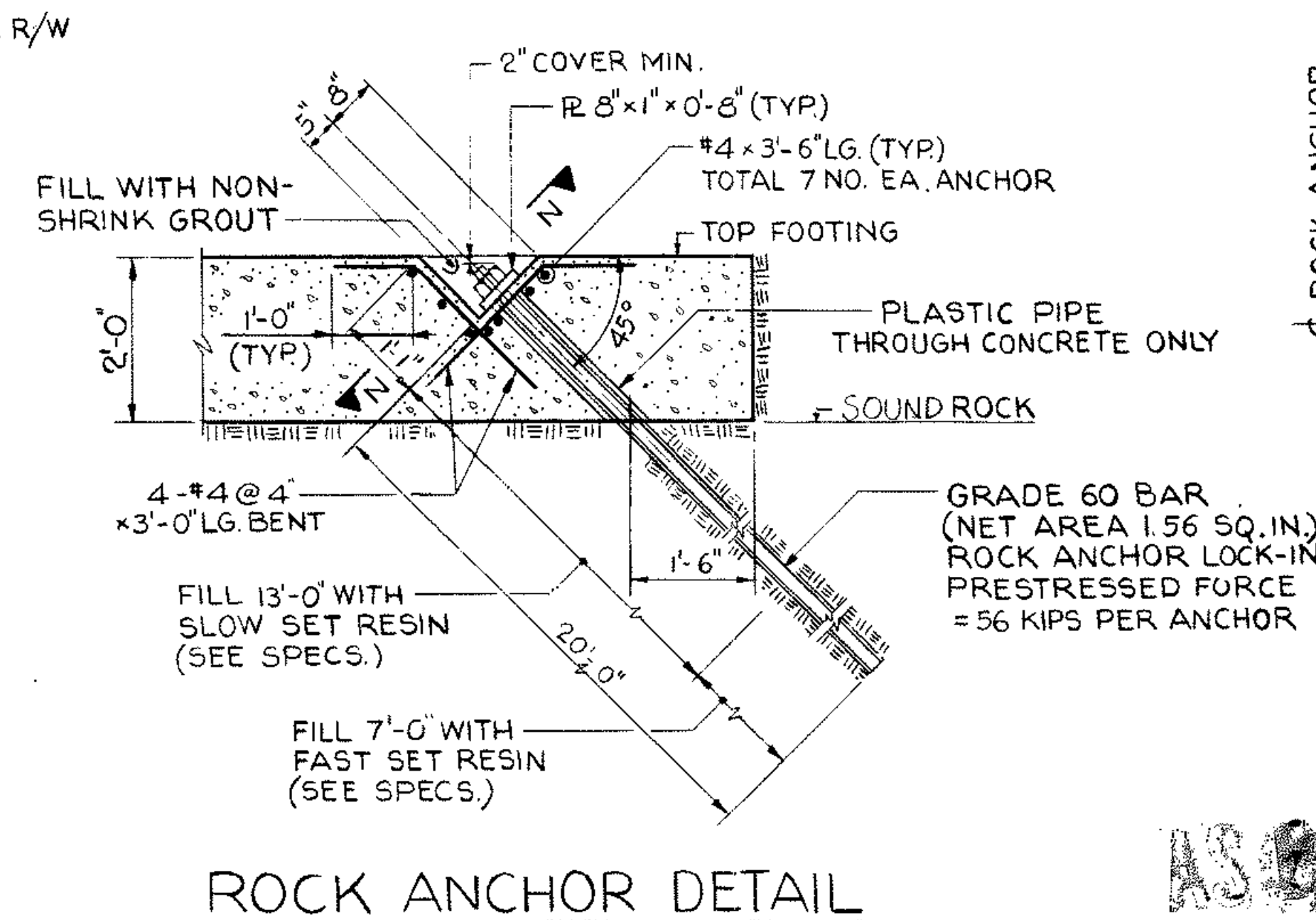
1/4" = 1'-0"



PLAN

SECTION 4

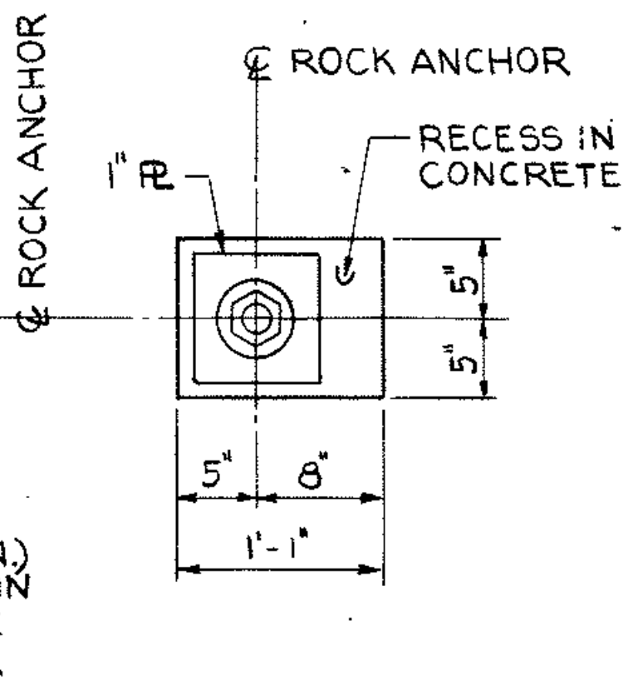
1/4" = 1'-0"



ROCK ANCHOR DETAIL

1/2" = 1'-0"

NOTE: ROCK ANCHOR DETAIL AT WALL SIMILAR



SECTION N

1"=1'-0"

NOTES

1. FOR GENERAL NOTES SEE DWG. S-N1 & S-N2.
2. FOR CONSTRUCTION JOINT DETAILS SEE DWG. S-TS19.
3. FOR LOCATION OF SHAFT AND WALL SEE DWG. S-TS3.
4. FOR DETAIL OF UNDERDRAIN SEE CIVIL DWG. C-TS1
5. FOR ADD'L. REINFORCEMENT AT OPENINGS SEE TYPICAL DETAIL DWG. S-N2
6. CLEAR (CONC. PROTECTION FOR REINF.) = 3"-BOTTOM OF FOOTING AND 2" ELSE WHERE

AS BUILT DRAWING

REV NO	DESCRIPTION	DATE
1	SSVK T.B. #B-3 LOWER TOE OF WALL AT COL ① TO EL 299.0	10-31-83

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

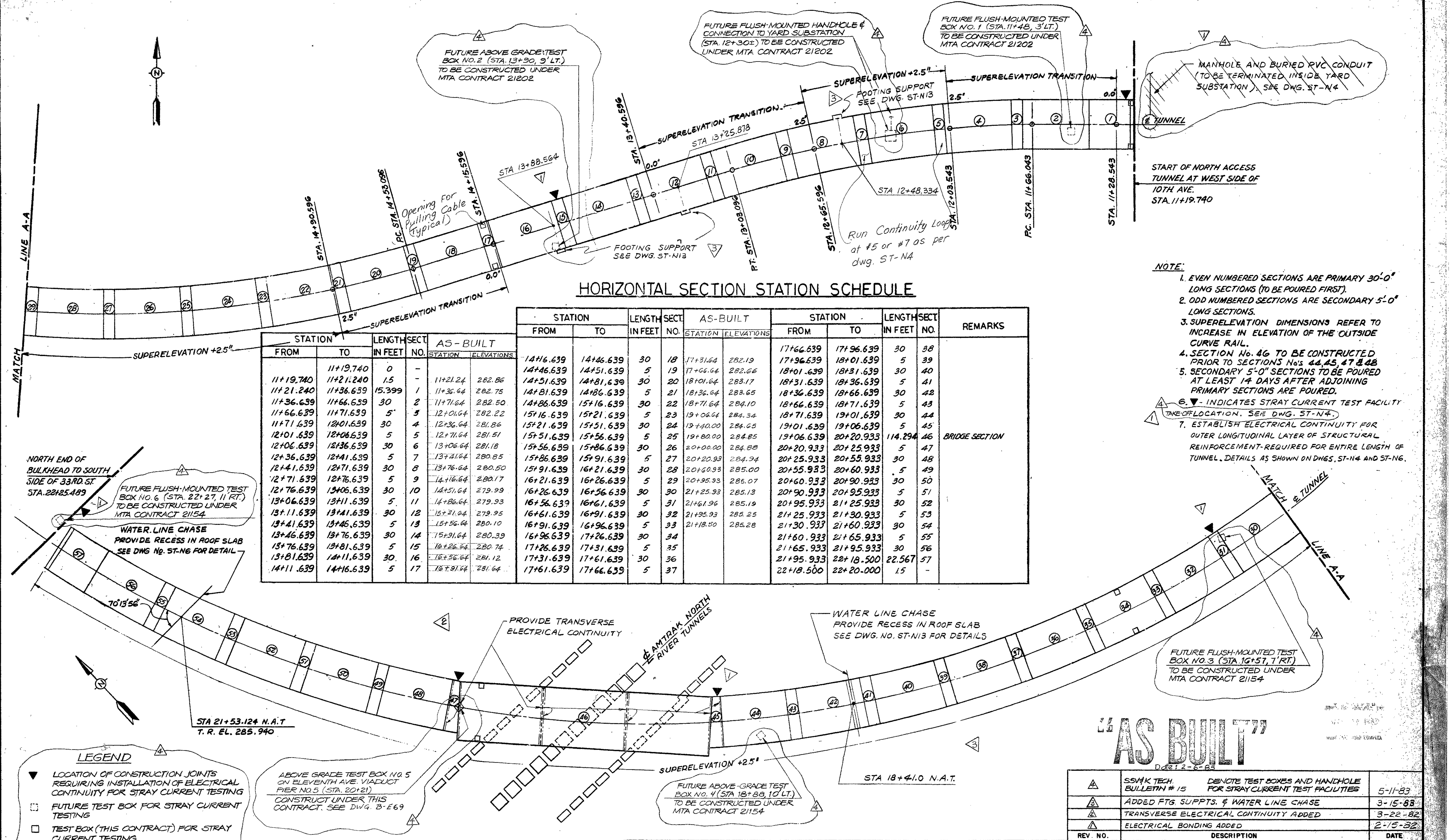
L.I.R.R.
LONG ISLAND RAIL ROAD

Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
TOWER / SUBSTATION BUILDING
ESCAPE SHAFT & RETAINING WALL
BUILDINGS

CONTRACT NO. i-02-21202-0-0
DATE FEB.28, 1983
SCALE AS NOTED
DRAWING NO. S-TS9
SHEET 59 OF 332

Amtrak North Access Tunnel (Empire Line)



HORIZONTAL SECTION STATION SCHEDULE

STATION FROM	STATION TO	LENGTH IN FEET	SECT. NO.	AS-BUILT STATION	AS-BUILT ELEVATIONS	REMARKS
	11+19.740	0	-			
11+19.740	11+21.240	1.5	-	11+21.24	282.86	
11+21.240	11+36.639	15.399	1	11+36.64	282.75	
11+36.639	11+66.639	30	2	11+71.64	282.50	
11+66.639	11+71.639	5	3	12+01.64	282.22	
11+71.639	12+01.639	30	4	12+36.64	281.86	
12+01.639	12+06.639	5	5	12+71.64	281.51	
12+06.639	12+36.639	30	6	13+06.64	281.18	
12+36.639	12+41.639	5	7	13+41.64	280.85	
12+41.639	12+71.639	30	8	13+76.64	280.50	
12+71.639	12+76.639	5	9	14+16.64	280.17	
12+76.639	13+06.639	30	10	14+51.64	279.99	
13+06.639	13+11.639	5	11	14+86.64	279.93	
13+11.639	13+41.639	30	12	15+21.64	279.95	
13+41.639	13+46.639	5	13	15+56.64	280.10	
13+46.639	13+76.639	30	14	15+91.64	280.39	
13+76.639	13+81.639	5	15	16+26.64	280.74	
13+81.639	14+11.639	30	16	16+56.64	281.12	
14+11.639	14+16.639	5	17	16+91.64	281.64	
14+16.639	14+46.639	30	18	17+31.64	282.19	
14+46.639	14+51.639	5	19	17+66.64	282.66	
14+51.639	14+81.639	30	20	18+01.64	283.17	
14+81.639	14+86.639	5	21	18+36.64	283.65	
14+86.639	15+16.639	30	22	18+71.64	284.10	
15+16.639	15+21.639	5	23	19+06.64	284.34	
15+21.639	15+51.639	30	24	19+40.00	284.65	
15+51.639	15+56.639	5	25	19+80.00	284.85	
15+56.639	15+86.639	30	26	20+00.00	284.88	
15+86.639	15+91.639	5	27	20+20.93	284.94	
15+91.639	16+21.639	30	28	20+60.93	285.00	
16+21.639	16+26.639	5	29	20+95.93	285.07	
16+26.639	16+56.639	30	30	21+25.93	285.13	
16+56.639	16+61.639	5	31	21+61.96	285.19	
16+61.639	16+91.639	30	32	21+95.93	285.25	
16+91.639	16+96.639	5	33	21+18.50	285.28	
16+96.639	17+26.639	30	34			
17+26.639	17+31.639	5	35			
17+31.639	17+61.639	30	36			
17+61.639	17+66.639	5	37			
17+66.639	17+96.639	30	38			
17+96.639	18+01.639	5	39			
18+01.639	18+31.639	30	40			
18+31.639	18+36.639	5	41			
18+36.639	18+66.639	30	42			
18+66.639	18+71.639	5	43			
18+71.639	19+01.639	30	44			
19+01.639	19+06.639	5	45			
19+06.639	20+20.933	114.294	46			BRIDGE SECTION
20+20.933	20+25.933	5	47			
20+25.933	20+55.933	30	48			
20+55.933	20+60.933	5	49			
20+60.933	20+90.933	30	50			
20+90.933	20+95.933	5	51			
20+95.933	21+25.933	30	52			
21+25.933	21+30.933	5	53			
21+30.933	21+60.933	30	54			
21+60.933	21+65.933	5	55			
21+65.933	21+95.933	30	56			
21+95.933	22+18.500	22.567	57			
22+18.500	22+20.000	1.5	-			

NOTE:

1. EVEN NUMBERED SECTIONS ARE PRIMARY 30'-0" LONG SECTIONS (TO BE POURED FIRST).
2. ODD NUMBERED SECTIONS ARE SECONDARY 5'-0" LONG SECTIONS.
3. SUPERELEVATION DIMENSIONS REFER TO INCREASE IN ELEVATION OF THE OUTSIDE CURVE RAIL.
4. SECTION No. 46 TO BE CONSTRUCTED PRIOR TO SECTIONS No's 44,45,47 & 48
5. SECONDARY 5'-0" SECTIONS TO BE POURED AT LEAST 14 DAYS AFTER ADJOINING PRIMARY SECTIONS ARE POURED.
6. ▼- INDICATES STRAY CURRENT TEST FACILITY TAKE-OFF LOCATION. SEE DWG. ST-N4.
7. ESTABLISH ELECTRICAL CONTINUITY FOR OUTER LONGITUDINAL LAYER OF STRUCTURAL REINFORCEMENT-REQUIRED FOR ENTIRE LENGTH OF TUNNEL. DETAILS AS SHOWN ON DWGS. ST-N4 AND ST-N6.

LEGEND

- ▼ LOCATION OF CONSTRUCTION JOINTS REQUIRING INSTALLATION OF ELECTRICAL CONTINUITY FOR STRAY CURRENT TESTING
- ⬚ FUTURE TEST BOX FOR STRAY CURRENT TESTING
- □ TEST BOX (THIS CONTRACT) FOR STRAY CURRENT TESTING
- ⬚ FUTURE HANDHOLE FOR DRAINING STRAY CURRENT

"AS BUILT"
Date: 2-6-85

REV. NO.	DESCRIPTION	DATE
4	SSV&K TECH. BULLETIN # 15 DENOTE TEST BOXES AND HANDHOLE FOR STRAY CURRENT TEST FACILITIES	5-11-83
3	ADDED FTG. SUPPTS. & WATER LINE CHASE	3-15-83
2	TRANSVERSE ELECTRICAL CONTINUITY ADDED	3-22-82
1	ELECTRICAL BONDING ADDED	2-15-82

M.R.J. & D. NO.5385N

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

MUESER · RUTLEDGE · JOHNSTON & DESIMONE
CONSULTING ENGINEERS
708 THIRD AVENUE NEW YORK N.Y. 10017

L.I.R.R.
LONG ISLAND RAIL ROAD

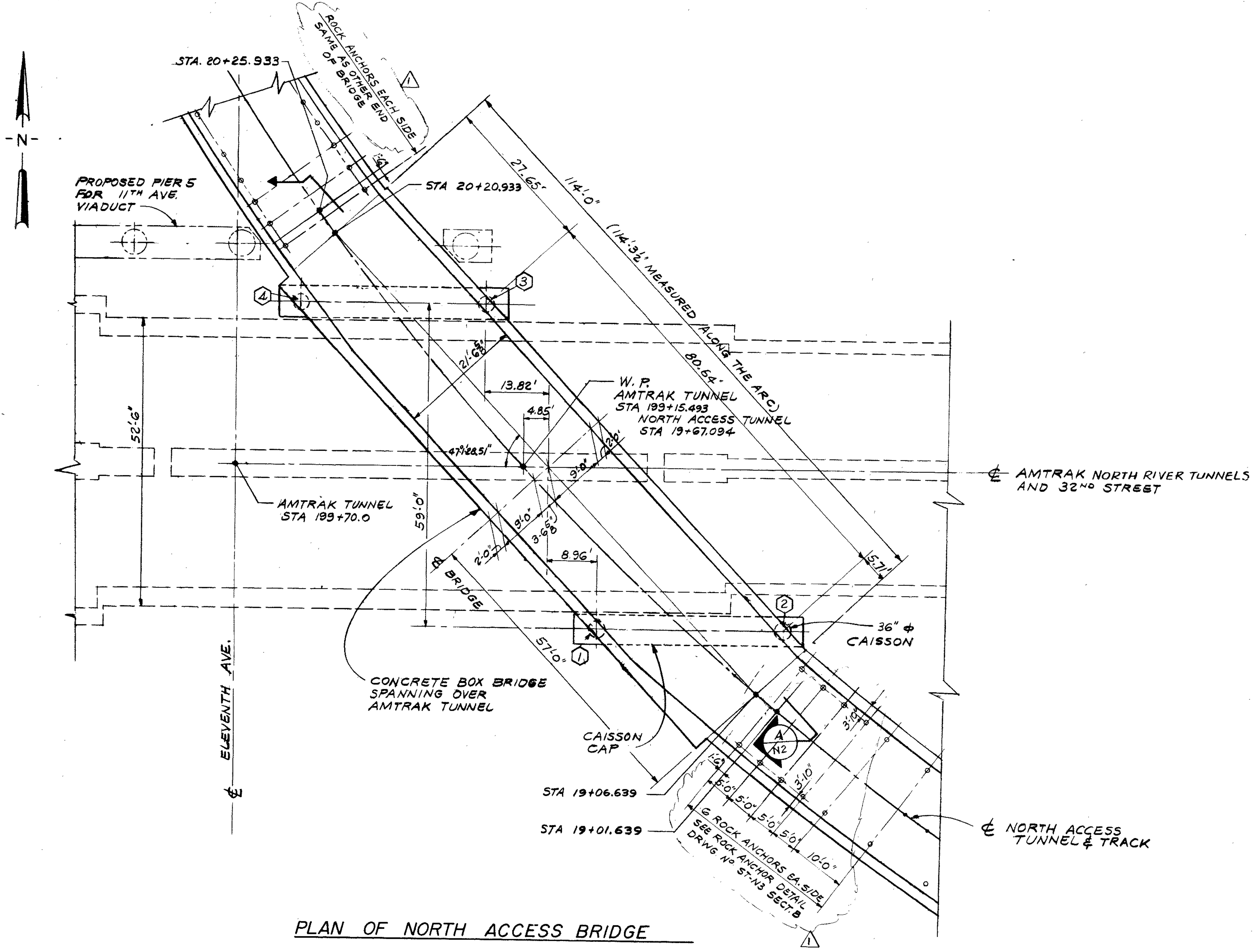
M
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX

NORTH ACCESS TUNNEL
KEY PLAN

NORTH ACCESS TUNNEL

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE 1"= 20'-0"
DRAWING NO. ST-N1a
SHEET 170 OF 187



PLAN OF NORTH ACCESS BRIDGE

⬡ - DENOTES JACK IDENTIFICATION NUMBER

GENERAL NOTES

1. FOR THE HORIZONTAL ALIGNMENT SEE DRAWING NO. CS-4,5,7 & 8
2. FOR THE VERTICAL ALIGNMENT SEE DRAWING NO. T-N1, T-N2 & T-N3
3. CONCRETE STRENGTHS $f'_c = 4{,}000$ PSI TUNNEL SECTION
   $f'_c = 6{,}000$ PSI BRIDGE SECTION
4. REINFORCEMENT $f_y = 60{,}000$ PSI
5. ROOF LOAD ON TUNNEL COOPER E 72.
6. FOR SUGGESTED JACKING PROCEDURES SEE CONTRACT SPECIFICATIONS SECTION 02161.
7. LIVE LOAD WITHIN TUNNEL COOPER E80
8. △1 FOR TYPICAL LAYOUT OF ROCK ANCHORS AT 30' SECTIONS SEE DRAWING NO. ST-N3.

"AS BUILT"
Date: 2-6-85

REV NO.	DESCRIPTION	DATE
△1	REV. ROCK ANCHOR SPACING NEAR BRIDGE	2-15-82

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

MUESER · RUTLEDGE · JOHNSTON & DESIMONE
CONSULTING ENGINEERS
708 THIRD AVENUE NEW YORK, N.Y. 10017

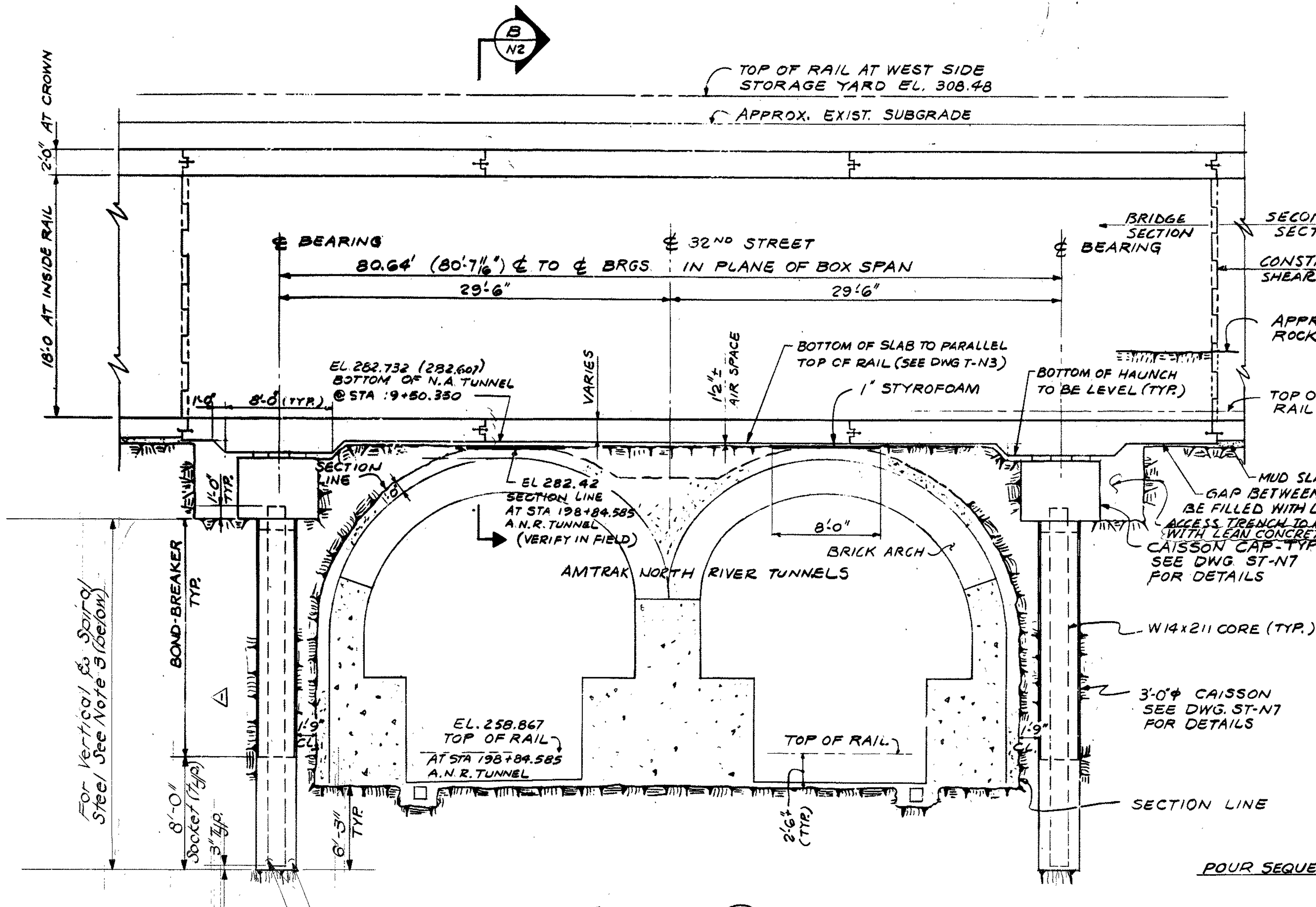
L.I.R.R.
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
PLAN AT AMTRAK TUNNEL
NORTH ACCESS TUNNEL

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE 3/32" = 1'-0"
DRAWING NO. ST-N1
SHEET 171 OF 187

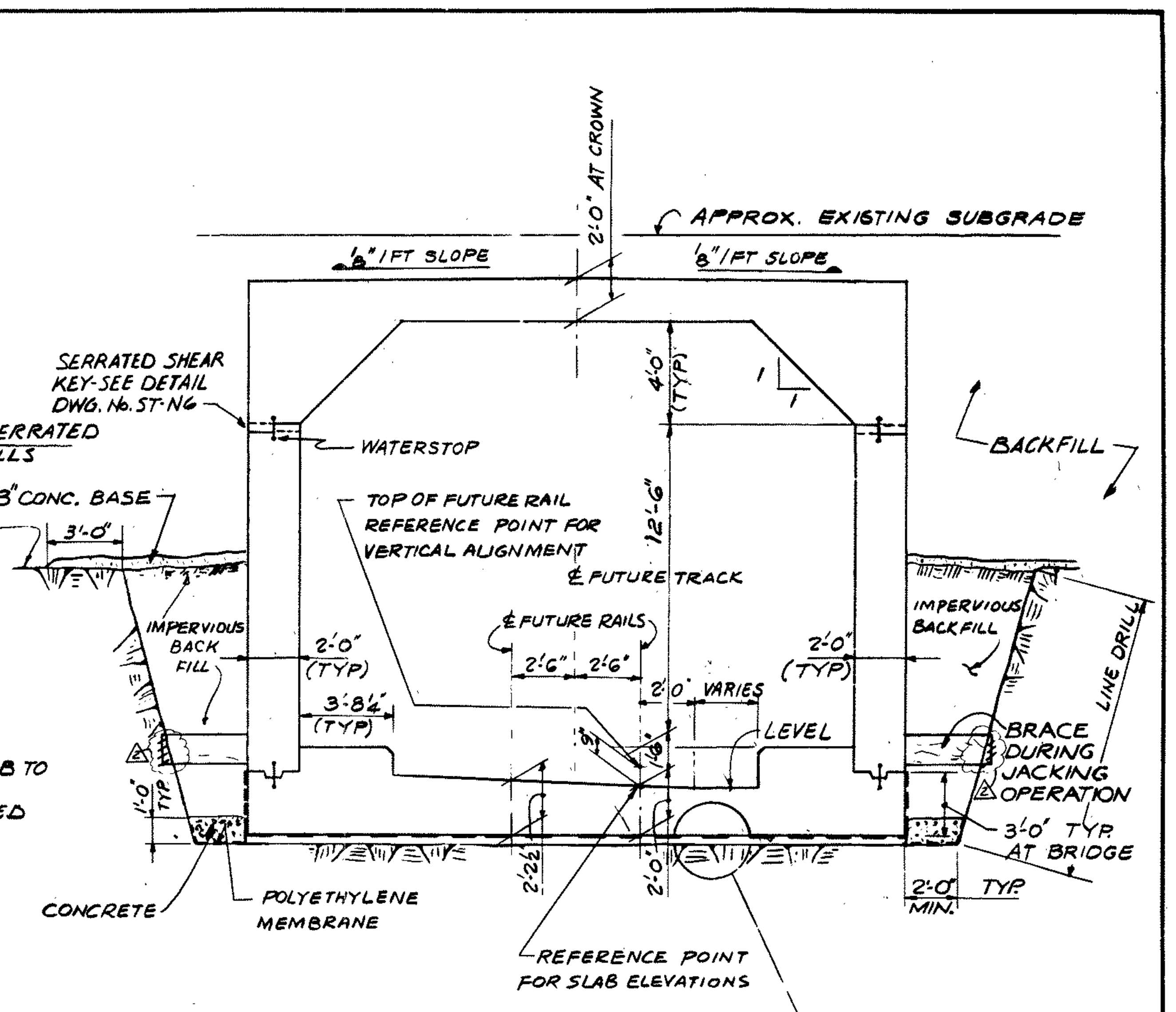
M.R.J&D NO. 5385 N



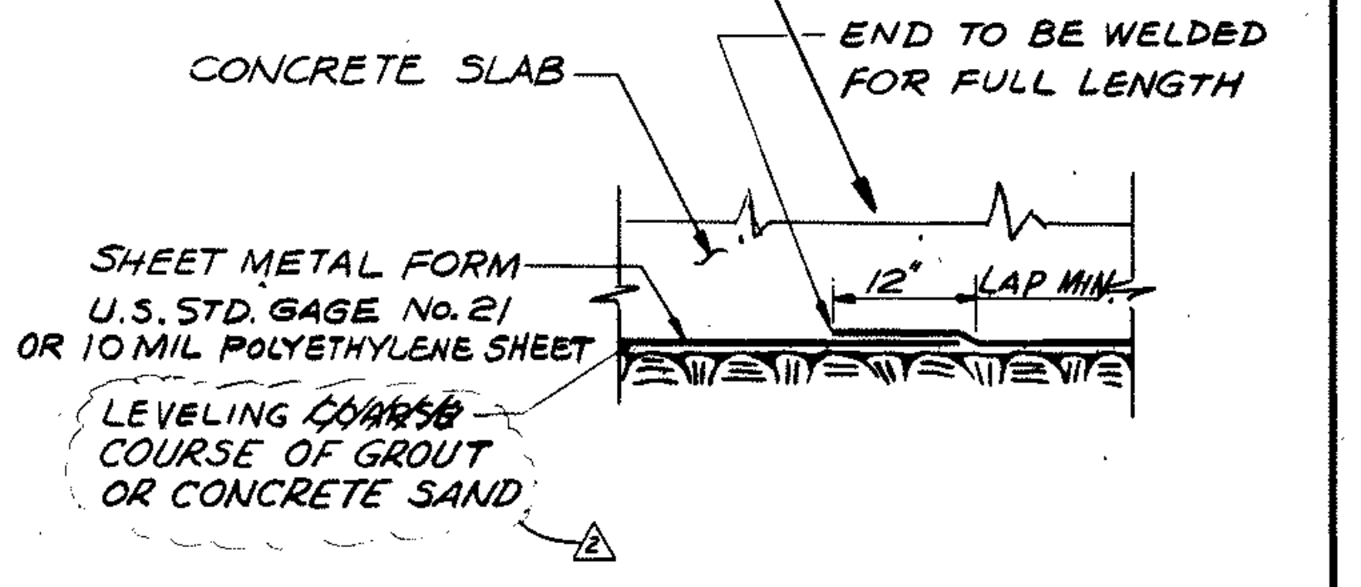
SECTION A
SCALE 3/16" = 1'-0" (N-1)

NOTE

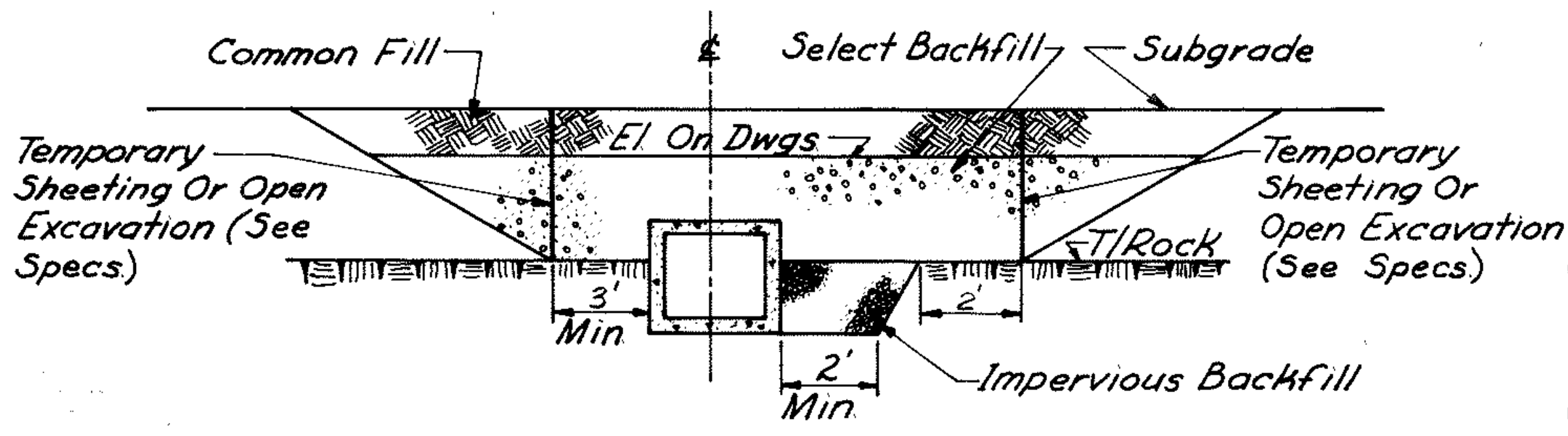
1. FOR SUGGESTED JACKING PROCEDURES SEE SPECIFICATIONS SECTION 02161.
2. ELEVATIONS SHOWN IN PARENTHESIS ( ) DENOTE PRE-JACKING ELEVATIONS. ALL OTHER DENOTE FINAL ELEVATIONS.
3. Use Vertical & Spiral Steel as Shown on Contract Dwg. # ST-N7. See also Dwg. #ST-N2.



SECTION B
SCALE 1/4" = 1'-0" (N-2)



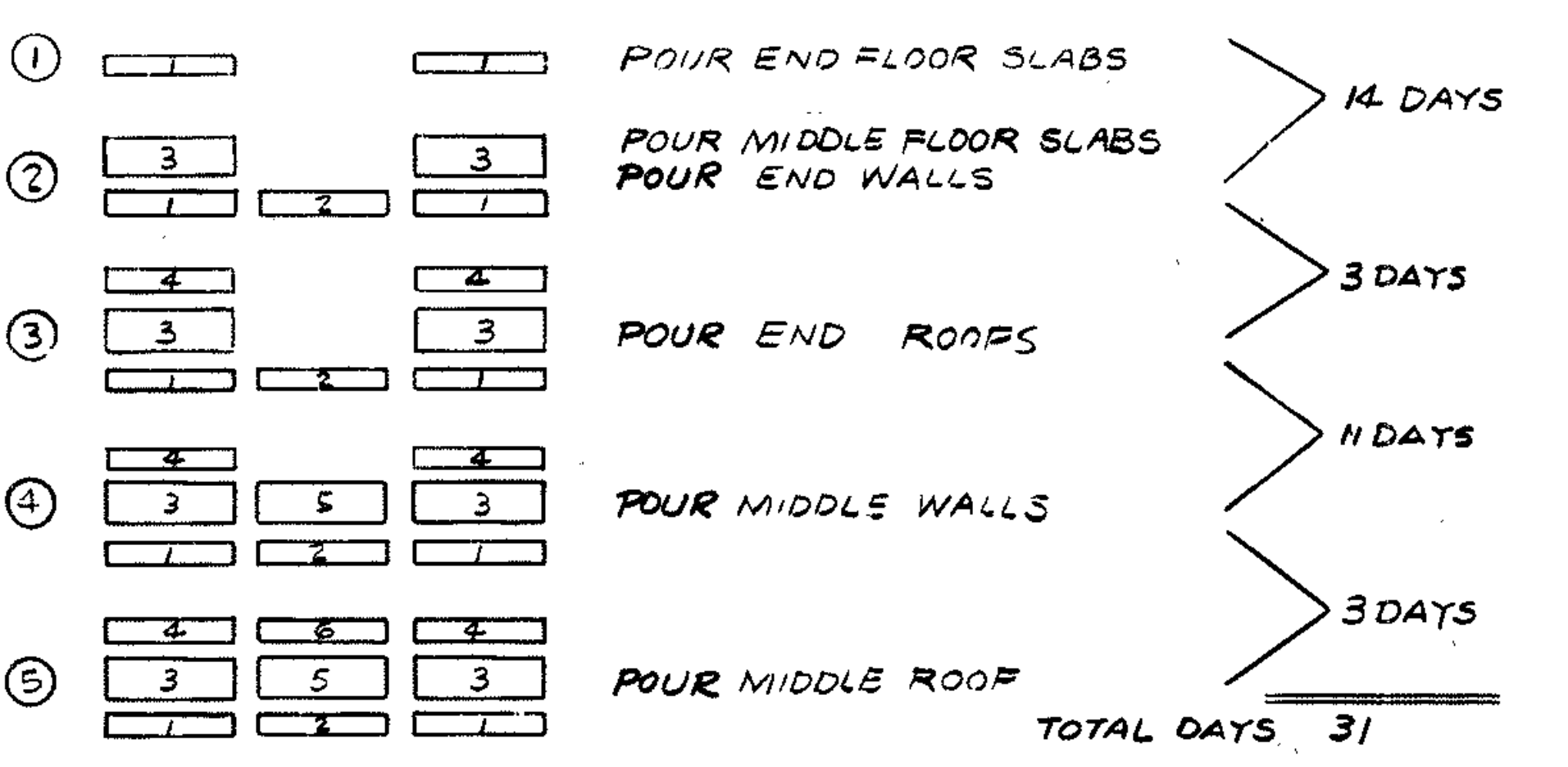
DETAIL BEFORE JACKING
NOT TO SCALE



TYPICAL HALF SECTION **HALF SECTION AT BRIDGE**

EXCAVATION & BACKFILL TYPICAL
NOT TO SCALE

POUR SEQUENCE BRIDGE SECTION



①	POUR END FLOOR SLABS	14 DAYS
②	POUR MIDDLE FLOOR SLABS POUR END WALLS	
③	POUR END ROOFS	3 DAYS
④	POUR MIDDLE WALLS	11 DAYS
⑤	POUR MIDDLE ROOF	3 DAYS

TOTAL DAYS 31

AS BUILT
2-6-85
DATE

REV NO.	DESCRIPTION	DATE
2	ADD DETAIL OF EXCAVATION & BACKFILL TYPICAL	3-22-82
	& MISC CLASSIFICATIONS & REVISIONS	3-22-82
1	POUR SEQUENCE NOTE REVISED	2-15-82

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

MUESER · RUTLEDGE · JOHNSTON & DESIMONE
CONSULTING ENGINEERS
708 THIRD AVENUE NEW YORK, N.Y. 10017

L.I.R.R.
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

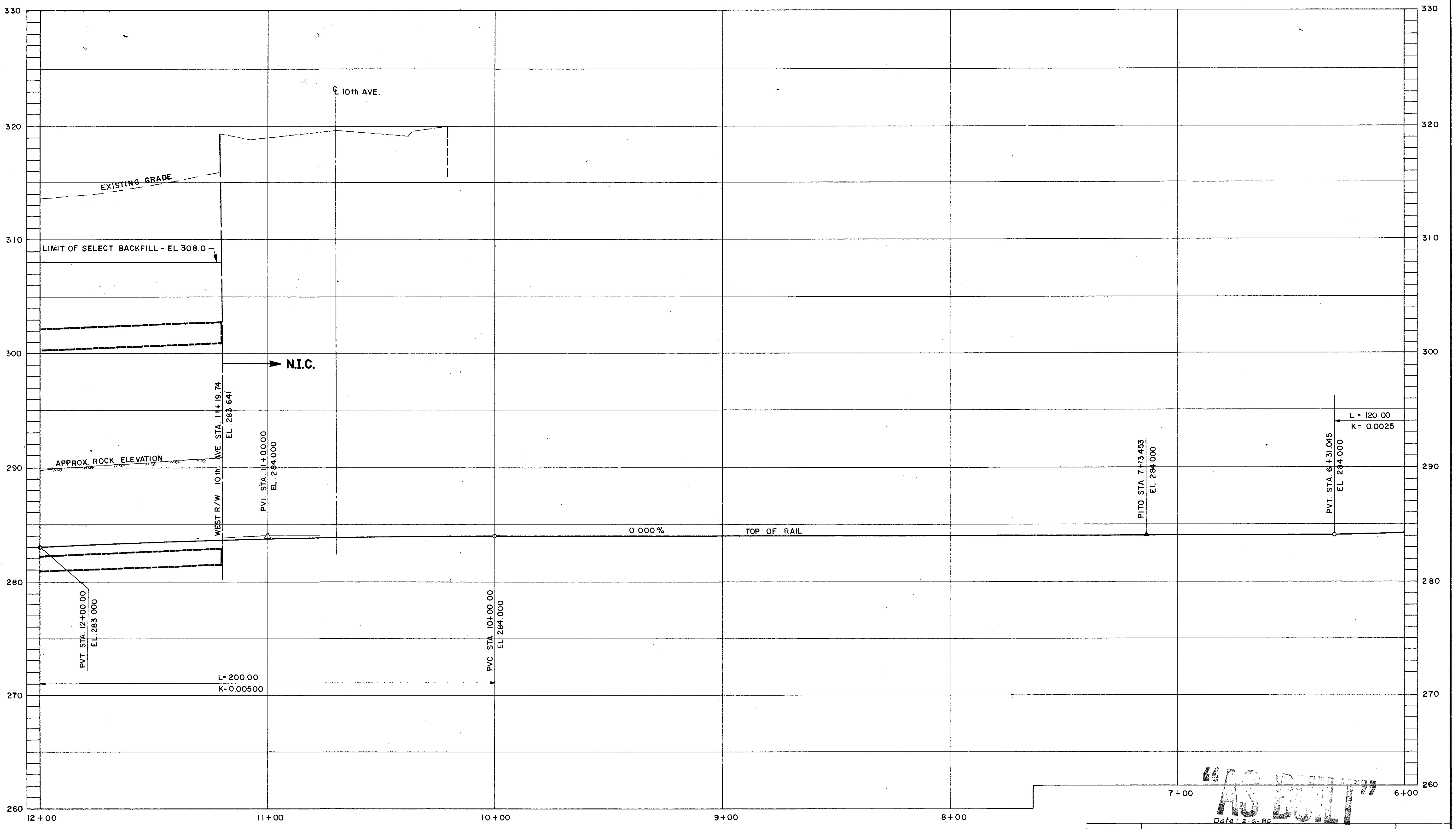
WEST SIDE STORAGE YARD COMPLEX

SECTION SPANNING EXISTING AMTRAK TUNNELS

NORTH ACCESS TUNNEL

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE AS SHOWN
DRAWING NO. ST-N2
SHEET 172 OF 187

M.R.J.&D. NO. 5385 N



"AS BUILT"
Date: 2-6-85

NOTES:

1. ELEVATIONS REFER TO LONG ISLAND RAILROAD DATUM
2. PROFILES REFER TO INSIDE RAIL
3. FOR HORIZONTAL CURVES EQUAL TO 12°-30'-00" USE 2 1/2" SUPERELEVATION OF THE OUTER RAIL WITH A TRANSITION OF 37.50' BEFORE AND 37.50' INTO THE CURVE.

REV. NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG
ISLAND
RAIL ROAD

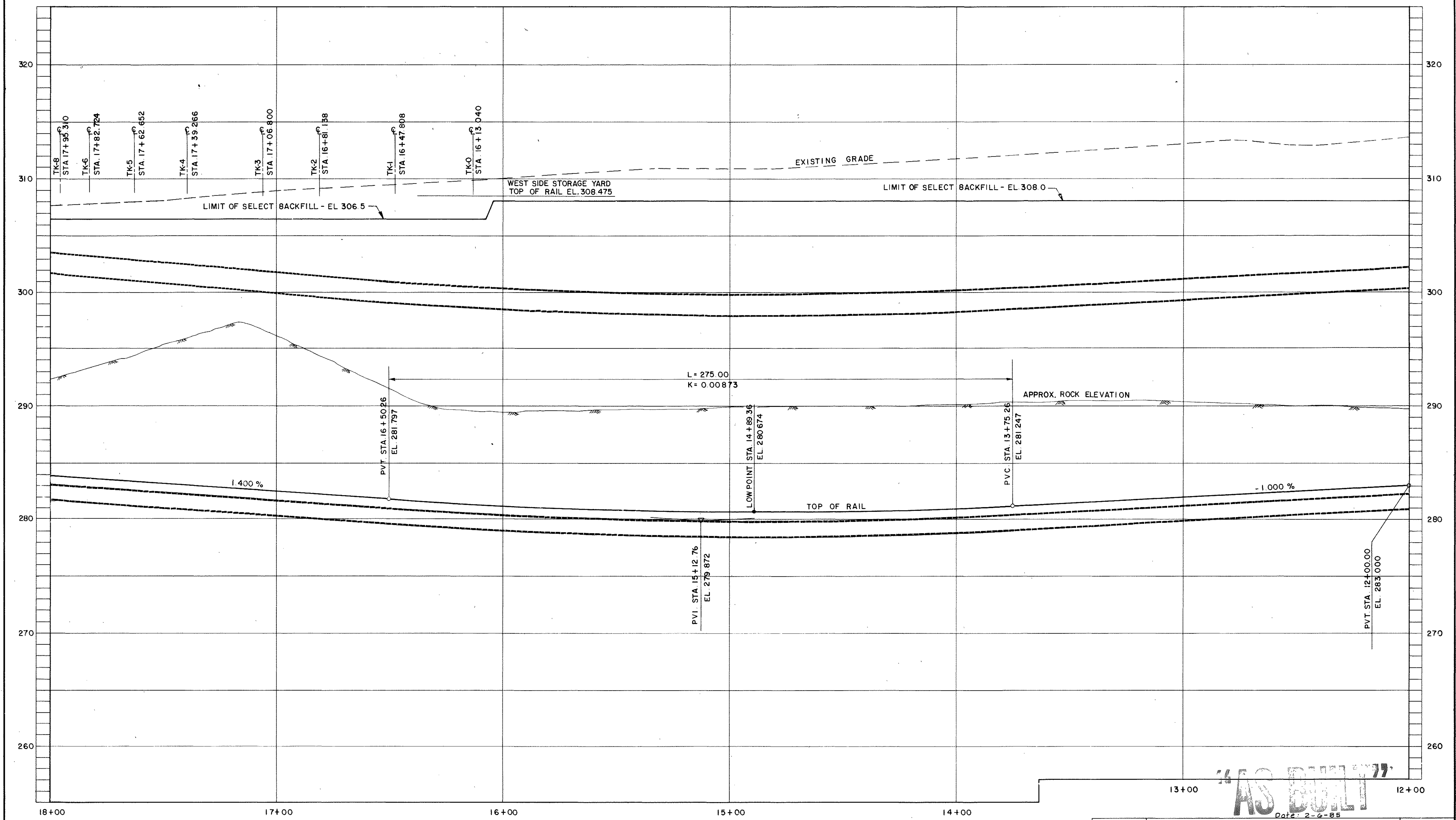
M
Metropolitan
Transportation
Authority

WEST SIDE STORAGE YARD COMPLEX

PROFILE

NORTH ACCESS TUNNEL

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE HORIZ. 1" = 20'
VERT. 1" = 4'
DRAWING NO. T-N1
SHEET 183 OF 187



"AS BUILT"
Date: 2-6-85

FOR NOTES SEE DWG T-N1

REV NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG
ISLAND
RAIL ROAD

M
Metropolitan
Transportation
Authority

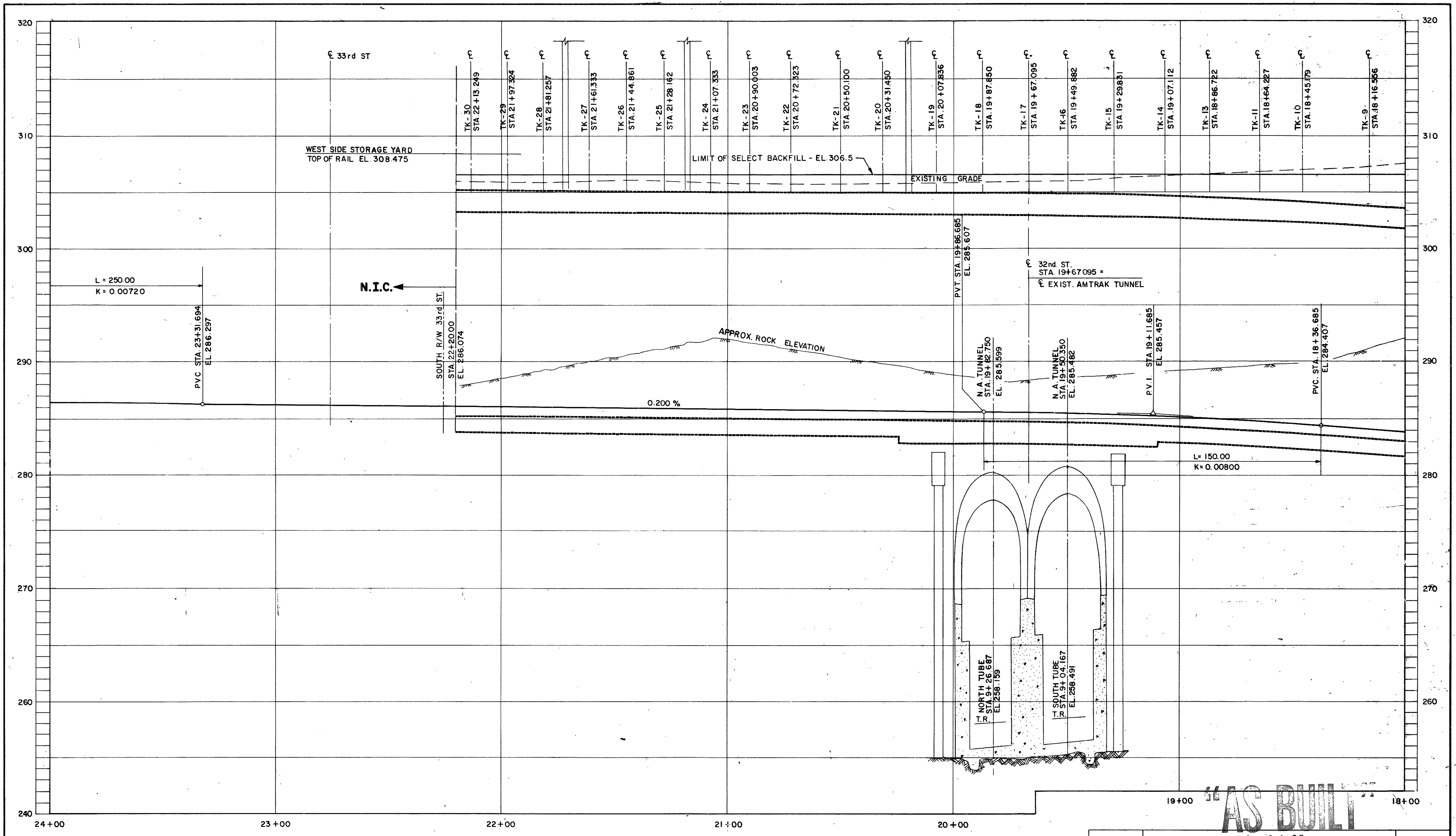
WEST SIDE STORAGE YARD COMPLEX

PROFILE

NORTH ACCESS TUNNEL

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE HORIZ 1" = 20' VERT. 1" = 4'
DRAWING NO. T-N2
SHEET 184 OF 187

12



"AS BUILT"
Date: 2-6-85

FOR NOTES SEE DWG. T-N1

REV. NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG
ISLAND
RAIL ROAD

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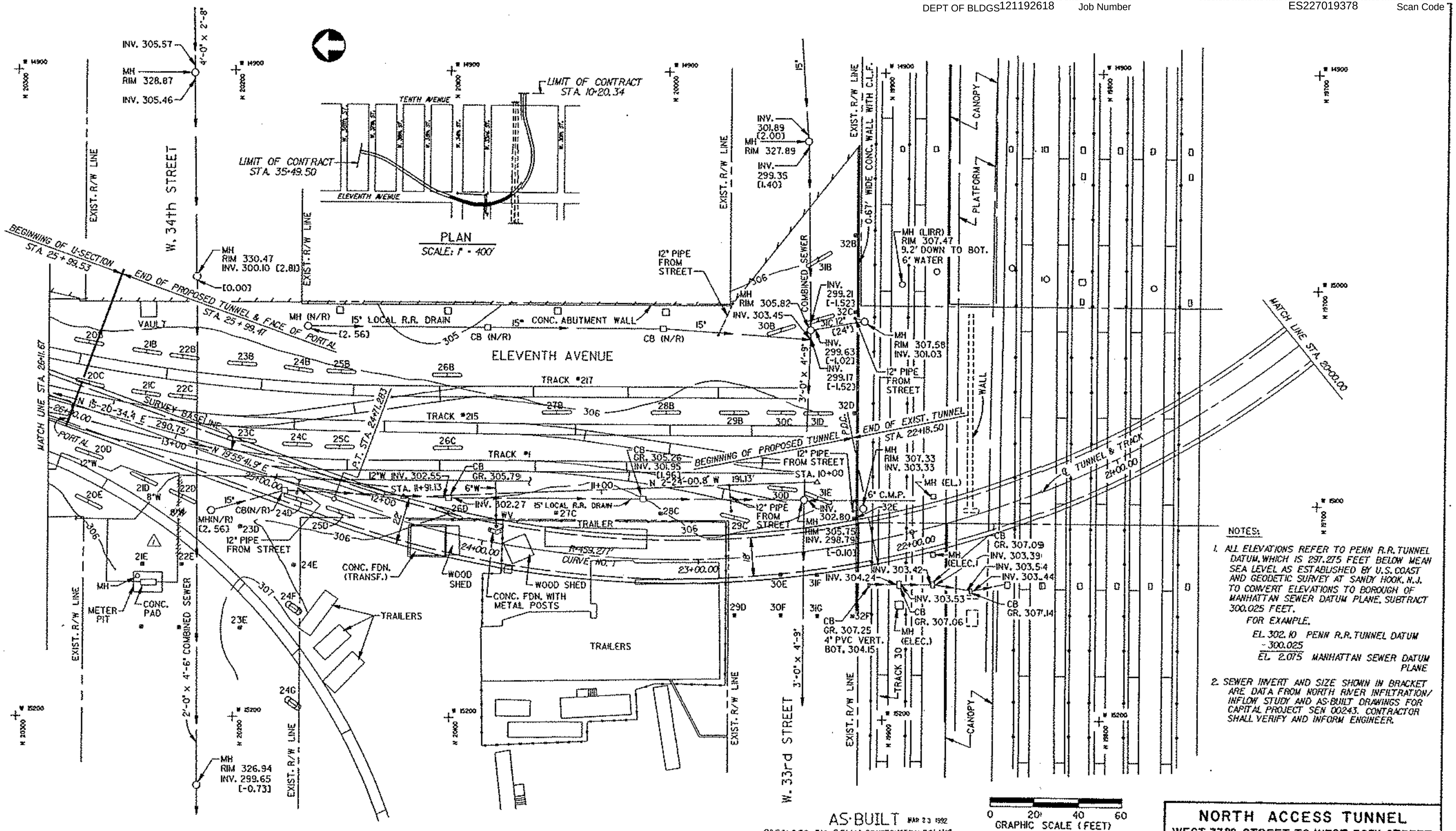
Metropolitan
Transportation
Authority

WEST SIDE STORAGE YARD COMPLEX

PROFILE

NORTH ACCESS TUNNEL

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE HORIZ: 1" = 20'
VERT 1" = 4'
DRAWING NO. T-N3
SHEET 185 OF 187



NOTES:

1. ALL ELEVATIONS REFER TO PENN R.R. TUNNEL DATUM, WHICH IS 297.275 FEET BELOW MEAN SEA LEVEL AS ESTABLISHED BY U.S. COAST AND GEODETIC SURVEY AT SANDY HOOK, N.J. TO CONVERT ELEVATIONS TO BOROUGH OF MANHATTAN SEWER DATUM PLANE, SUBTRACT 300.025 FEET.

   FOR EXAMPLE.

   EL. 302.10 PENN R.R. TUNNEL DATUM
   - 300.025
   EL. 2.075 MANHATTAN SEWER DATUM PLANE

2. SEWER INVERT AND SIZE SHOWN IN BRACKET ARE DATA FROM NORTH RIVER INFILTRATION/INFLOW STUDY AND AS-BUILT DRAWINGS FOR CAPITAL PROJECT SEN 00243. CONTRACTOR SHALL VERIFY AND INFORM ENGINEER.

AS-BUILT MAR 23 1992
PREPARED BY DELMA CONSTRUCTION CO., INC.

Item	Date	By	Approved	Date
AS-BUILT	3-23-92	[illegible]		

Amtrak
Office of the Chief Engineer
National Railroad Passenger Corporation, 30th Street Station, Philadelphia, PA 19104

DESIGNED: V.M.
DRAWN: R.L.B.
CHECKED: S.Y.
IN CHARGE: A.G.
DATE: 7/31/87

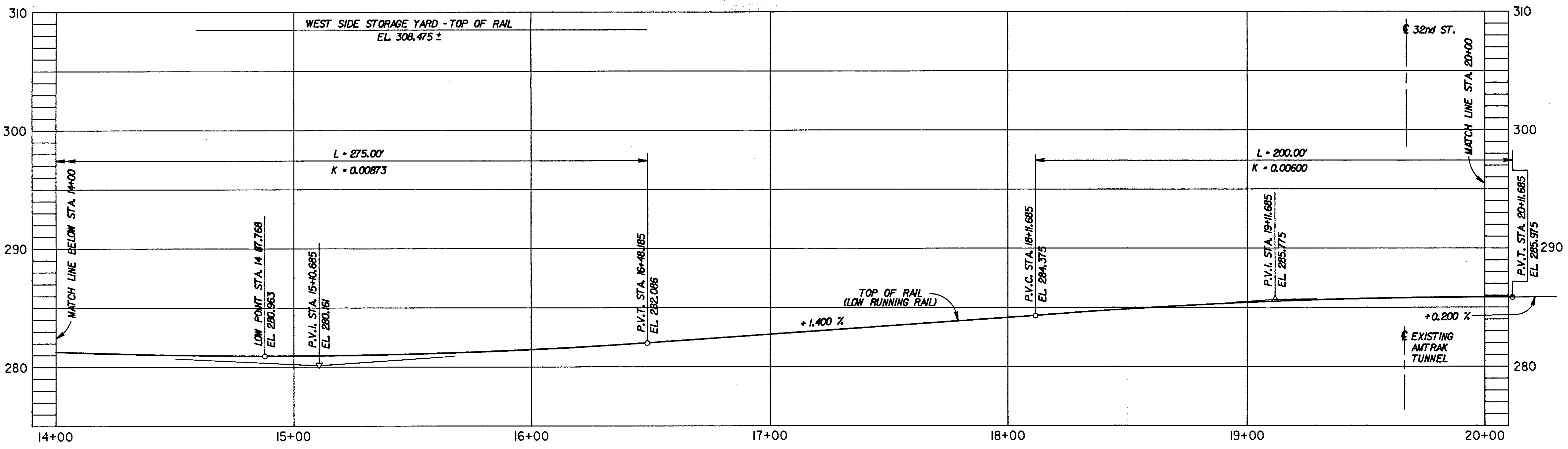
Parsons Brinckerhoff Quade & Douglas, Inc.
Engineers Planners
New York, New York

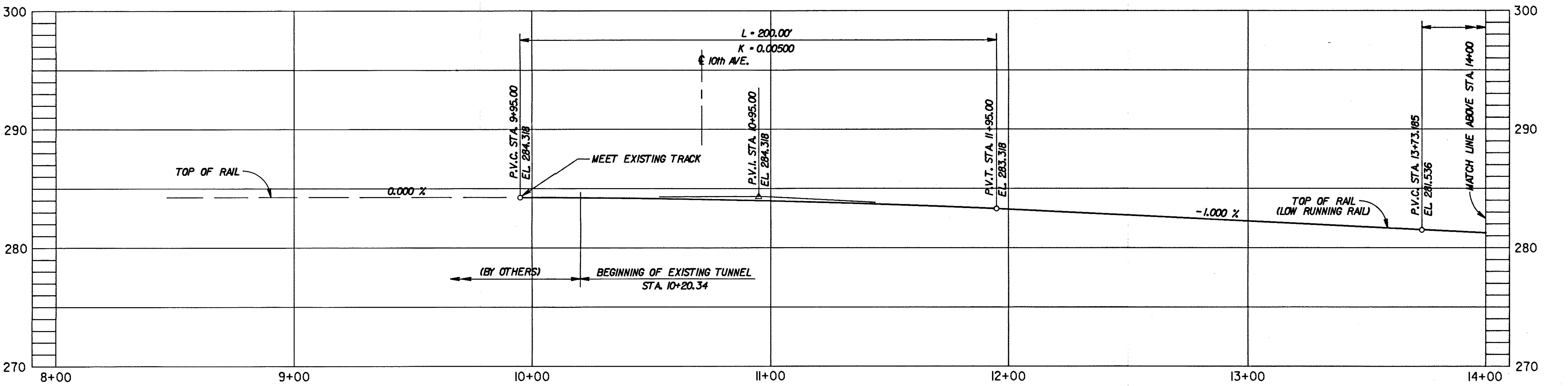
NORTH ACCESS TUNNEL
WEST 33RD. STREET TO WEST 38TH. STREET

SITE PLAN
AND EXISTING CONDITIONS

Project No. E-8715
Drawing No. C7
Sheet No. 007

2162 A 920





AS · BUILT MAR 23 1992

HORIZONTAL
0 20 40 60
GRAPHIC SCALE (FEET)

VERTICAL
0 4 8 12
GRAPHIC SCALE (FEET)

NORTH ACCESS TUNNEL
WEST 33RD. STREET TO WEST 38TH. STREET

o.	Item	Date	By	Approved	Date

Amtrak

Office of the Chief Engineer

National Railroad Passenger Corporation, 30th Street Station, Philadelphia, PA 19104

DESIGNED: V.M.
DRAWN: R.L.B.
CHECKED: S.Y.
IN CHARGE: A.G.
DATE: 7/31/87

#080

**Parsons
Brinckerhoff
Quade &
Douglas, Inc.**

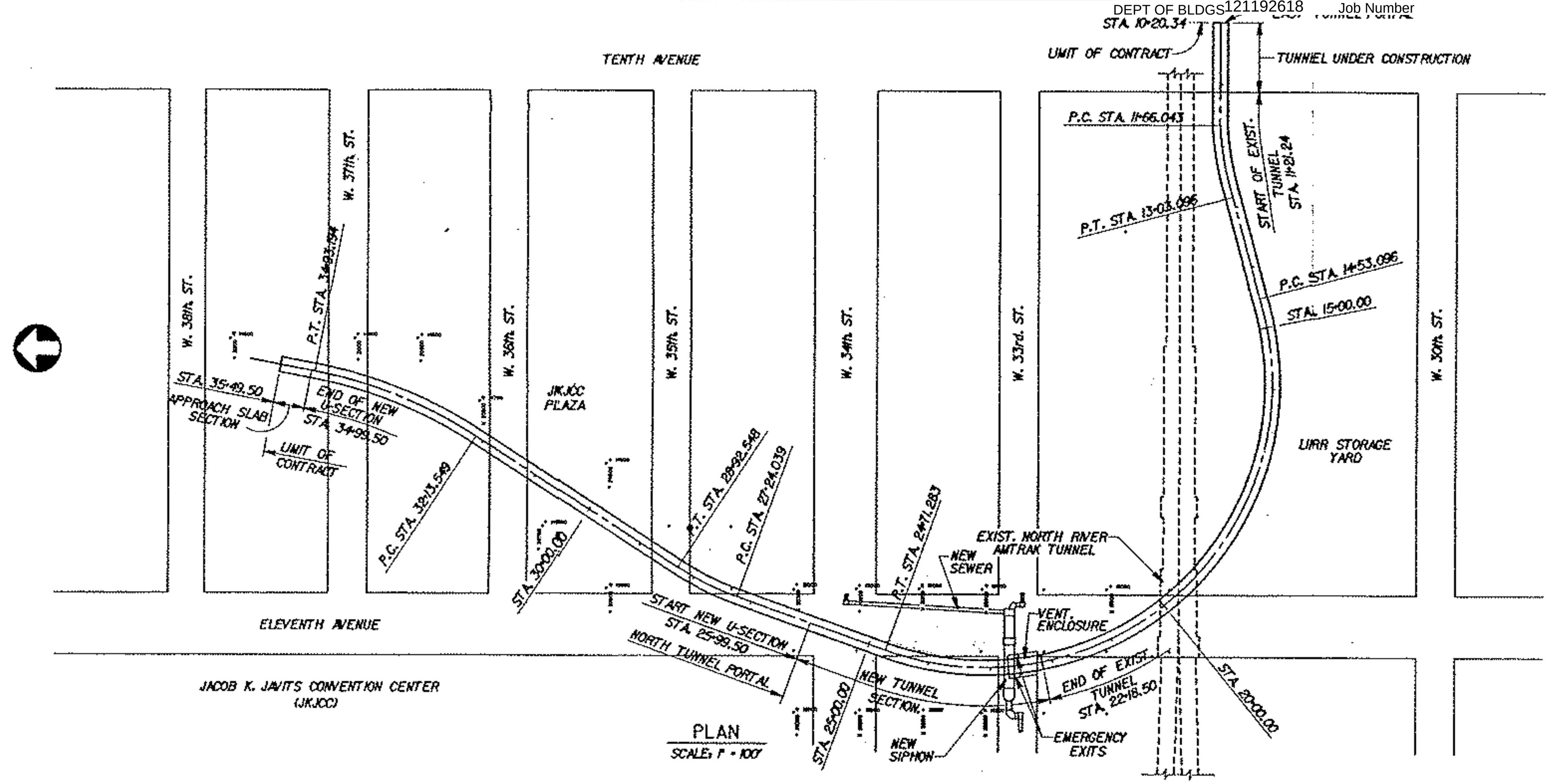
Engineers
Planners

New York, New York

PROFILE
(EXISTING TUNNEL)
STA. 10+20.34 TO STA. 20+00.00

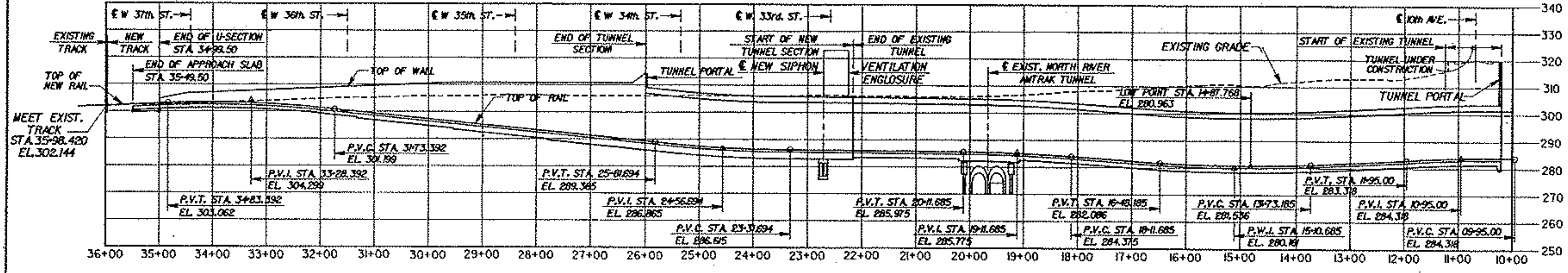
Project No. E-8715
Drawing No. C-15
Sheet No. 015

2162 A 920



PLAN

SCALE: 1" = 100'



PROFILE

SCALE: HORIZ. 1" = 100'
VERT. 1" = 20'

AS · BUILT MAY 23 1992

GRAPHIC SCALES:

1" = 100' 0 100 200 300

1" = 20' 0 20 40 60

No.	Item	Date	By	Approved	Date

Amtrak

Office of the Chief Engineer

National Railroad Passenger Corporation, 30th Street Station, Philadelphia, PA 19104

DESIGNED: JS
DRAWN: RLB
CHECKED: NAM
IN CHARGE: NAM/AG
DATE: 7/31/87

Parsons
Brinckerhoff
Quade &
Douglas, Inc.

Engineers
Planners

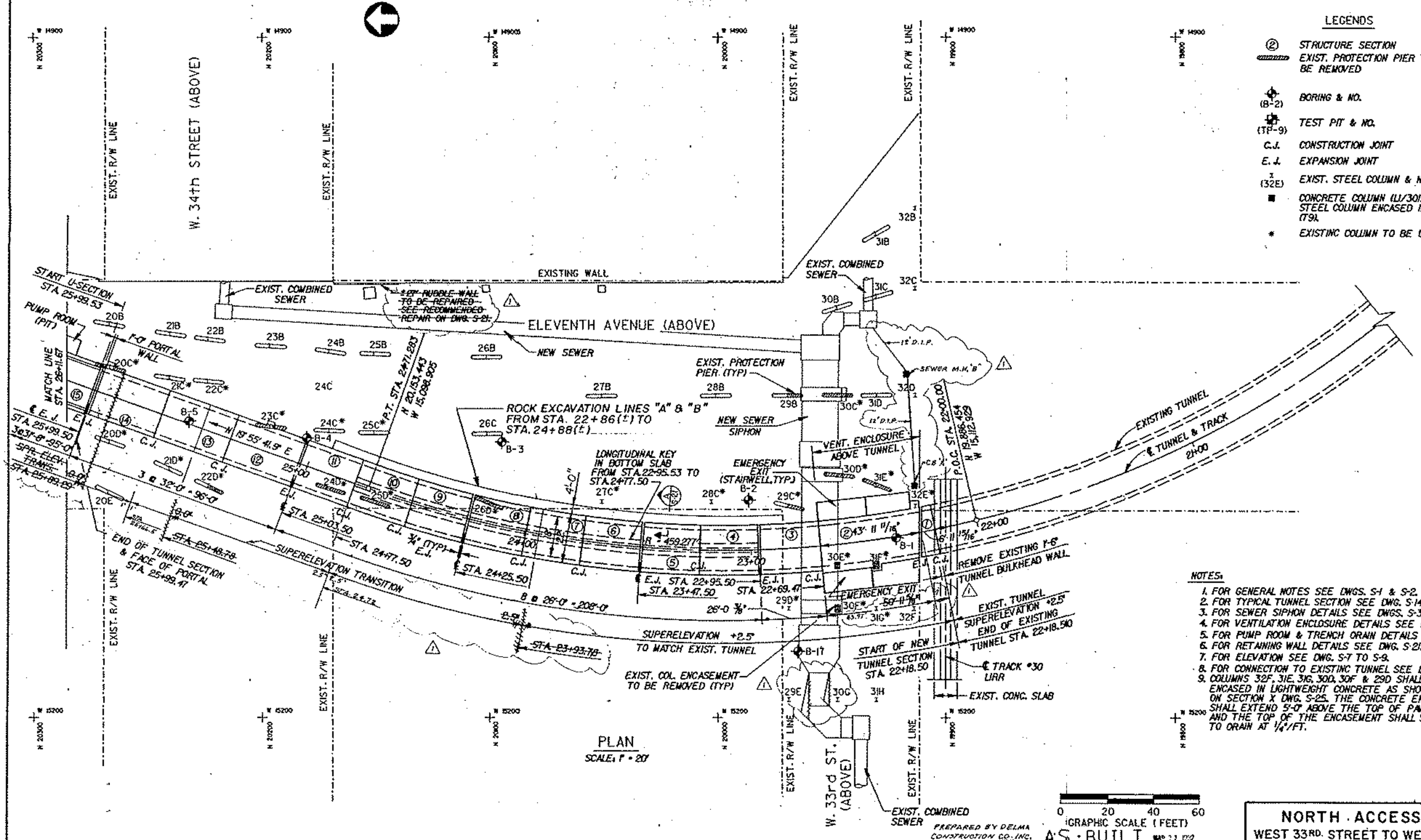
New York, New York

NORTH ACCESS TUNNEL
WEST 33RD. STREET TO WEST 38TH. STREET

GENERAL PLAN & PROFILE

Project No. E-8715
Drawing No. S-3
Sheet No. 036

2162 A 920



PLAN
SCALE: 1" = 20'

0 20 40 60
GRAPHIC SCALE (FEET)

LEGENDS

②	STRUCTURE SECTION
▨	EXIST. PROTECTION PIER TO BE REMOVED
(B-2)	BORING & NO.
(TP-9)	TEST PIT & NO.
C.J.	CONSTRUCTION JOINT
E.J.	EXPANSION JOINT
(32E)	EXIST. STEEL COLUMN & NO.
■	CONCRETE COLUMN (LI/30I) OR STEEL COLUMN ENCASED IN CONCRETE (T9).
*	EXISTINC COLUMN TO BE UNDERPINNED

NOTES:

1. FOR GENERAL NOTES SEE DWGS. S-1 & S-2.
2. FOR TYPICAL TUNNEL SECTION SEE DWG. S-14.
3. FOR SEWER SIPHON DETAILS SEE DWGS. S-32 TO S-36.
4. FOR VENTILATION ENCLOSURE DETAILS SEE DWGS. S-22 TO S-25.
5. FOR PUMP ROOM & TRENCH ORAIN DETAILS SEE DWG. S-26.
6. FOR RETAINING WALL DETAILS SEE DWG. S-21.
7. FOR ELEVATION SEE DWG. S-7 TO S-9.
8. FOR CONNECTION TO EXISTINC TUNNEL SEE DWG. NO. S-19.
9. COLUMNS 32F, 31E, 31G, 30D, 30F & 29D SHALL BE ENCASED IN LIGHTWEIGHT CONCRETE AS SHOWN ON SECTION X DWG. S-25. THE CONCRETE ENCASEMENT SHALL EXTEND 5'-0" ABOVE THE TOP OF PAVEMENT AND THE TOP OF THE ENCASEMENT SHALL SLOPE TO ORAIN AT 1/4"/FT.

PREPARED BY DELMA CONSTRUCTION CO. INC.

AS-BUILT MAR 23 1992

37

No.	Item	Date	By	Approved	Date
1	AS-BUILT	3-23-92	PGP		

Amtrak

Office of the Chief Engineer

National Railroad Passenger Corporation, 30th Street Station, Philadelphia, PA 19104

DESIGNED: W.K.
DRAWN: R.L.B.
CHECKED: P.H.
IN CHARGE: A.G./HAM
DATE: 7/31/87

Parsons Brinckerhoff Quade & Douglas, Inc.
Engineers Planners
New York, New York

NORTH ACCESS TUNNEL
WEST 33RD. STREET TO WEST 38TH. STREET

PROJECT PLAN
PART 1

Project No. E-8715
Drawing No. S-4
Sheet No. 037

2162 A 920

Amtrak North River Tunnels

Z-297

Note:-
Two additional High Tension Conduit Lines laid in North & South Tunnels from High Tension Manholes out to East end of 24'-6" Spans as shown on Dwg No Z 356

PENNSYLVANIA TUNNEL & TERMINAL RAILROAD CO.
North River Division

32ND STREET TUNNELS.

From Station 190+10 to Station 191+80

DRAWING NO. Z 297

Superseding Contract Drawing No. 601 G.

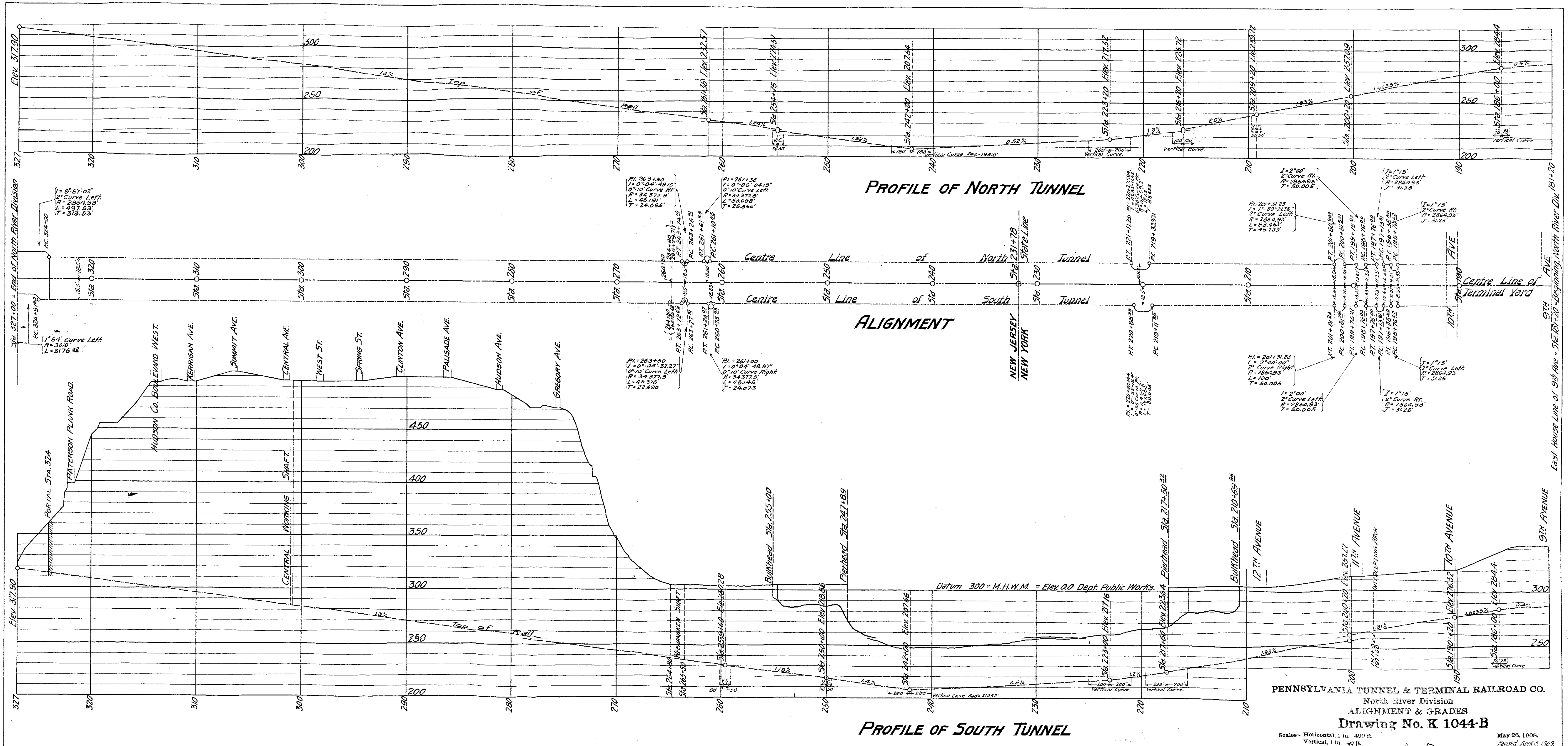
Scale: 3-16 in. = 1 ft.

Dec. 20, 1908.

Charles M. Jacobs
Chief Engineer

Photo Z 121.

Plan of Work as Constructed



PENNSYLVANIA TUNNEL & TERMINAL RAILROAD CO.
North River Division
ALIGNMENT & GRADES
Drawing No. K 1044-B

Scales:- Horizontal, 1 in. 400 ft.
Vertical, 1 in. 40 ft.

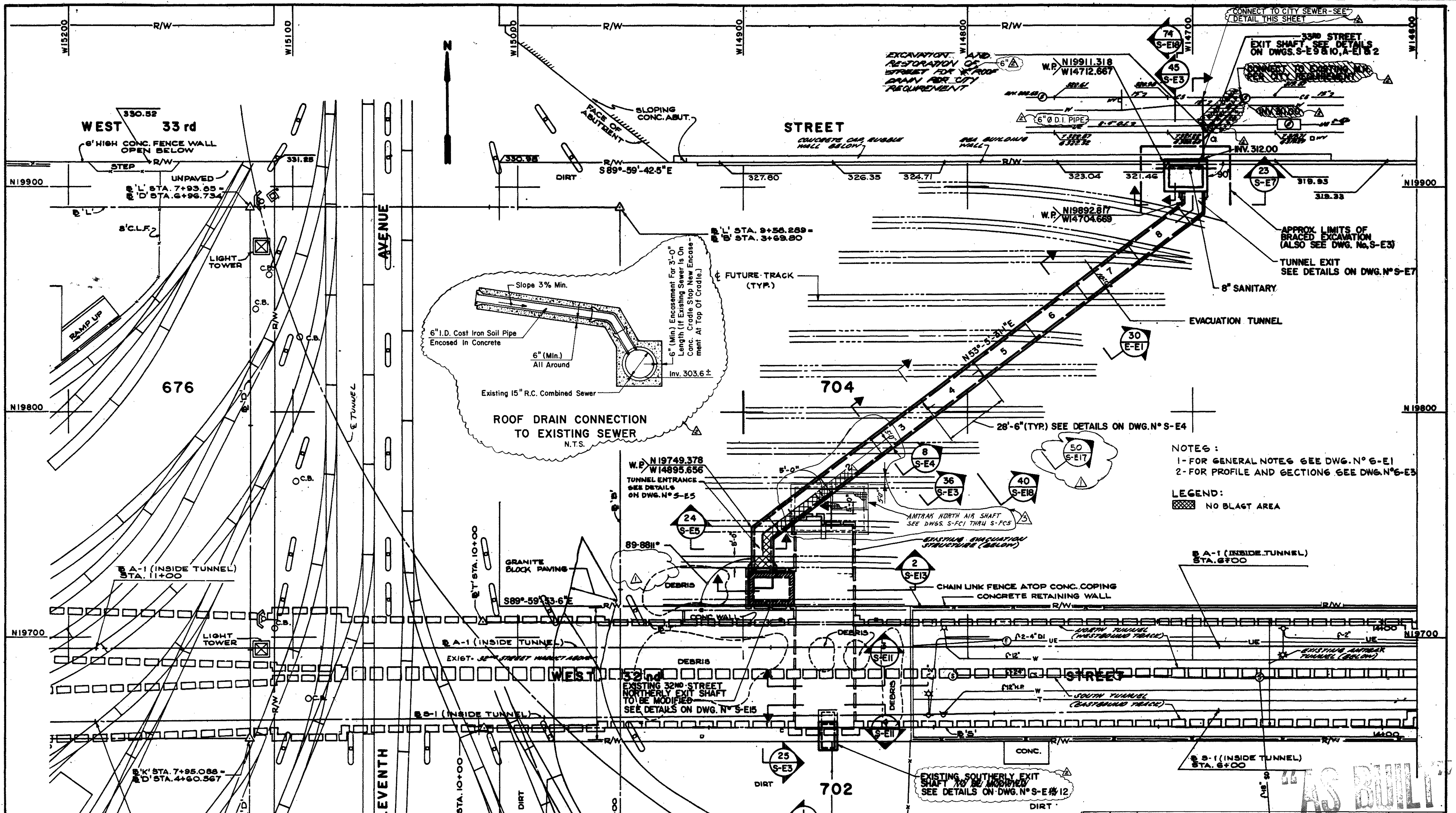
May 26, 1908.
Revised April 5, 1909.
" July 22, 1909.

Charles M. Jacobs
Chief Engineer.

Photo. H. 137.

Plan of Work as Constructed

Amtrak Emergency Evacuation Tunnel (for NRT's)



NOTES:
1- FOR GENERAL NOTES SEE DWG. N° S-E1
2- FOR PROFILE AND SECTIONS SEE DWG. N° S-E3

LEGEND:
▨ NO BLAST AREA

REV. NO.	DESCRIPTION	DATE
3	ADDED AMTRAK NORTH AIRSHAFT S.S.Y.R.-TECH BULL #1	11/10/82
2	REVISE SOUTH EXIT SHAFT NOTE AND	
	REVISED ROOF DRAIN CONNECTION TO CITY SEWER	3/22/82
1	SECTION 50 LOCATION AMENDED	2-15-82

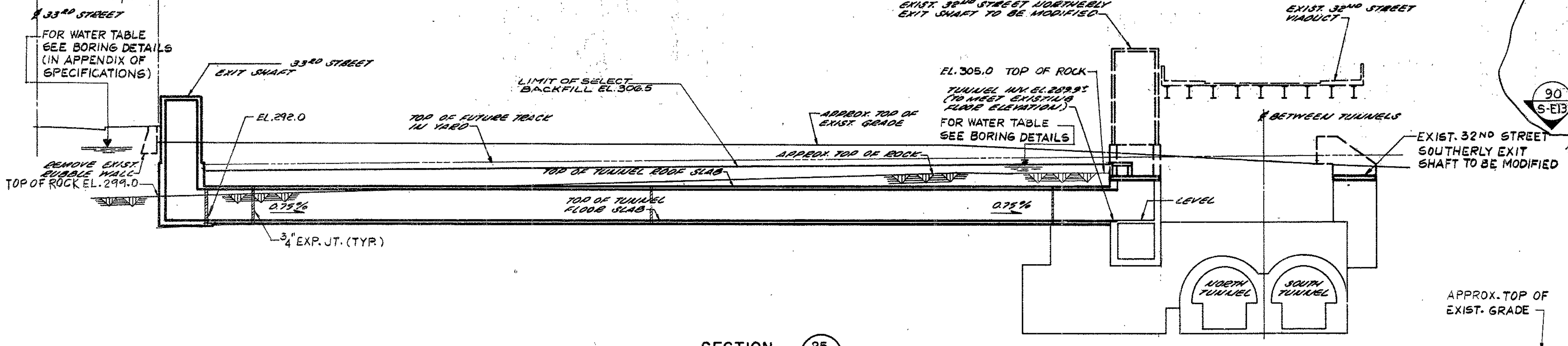
SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
GENERAL PLAN
EVACUATION TUNNEL

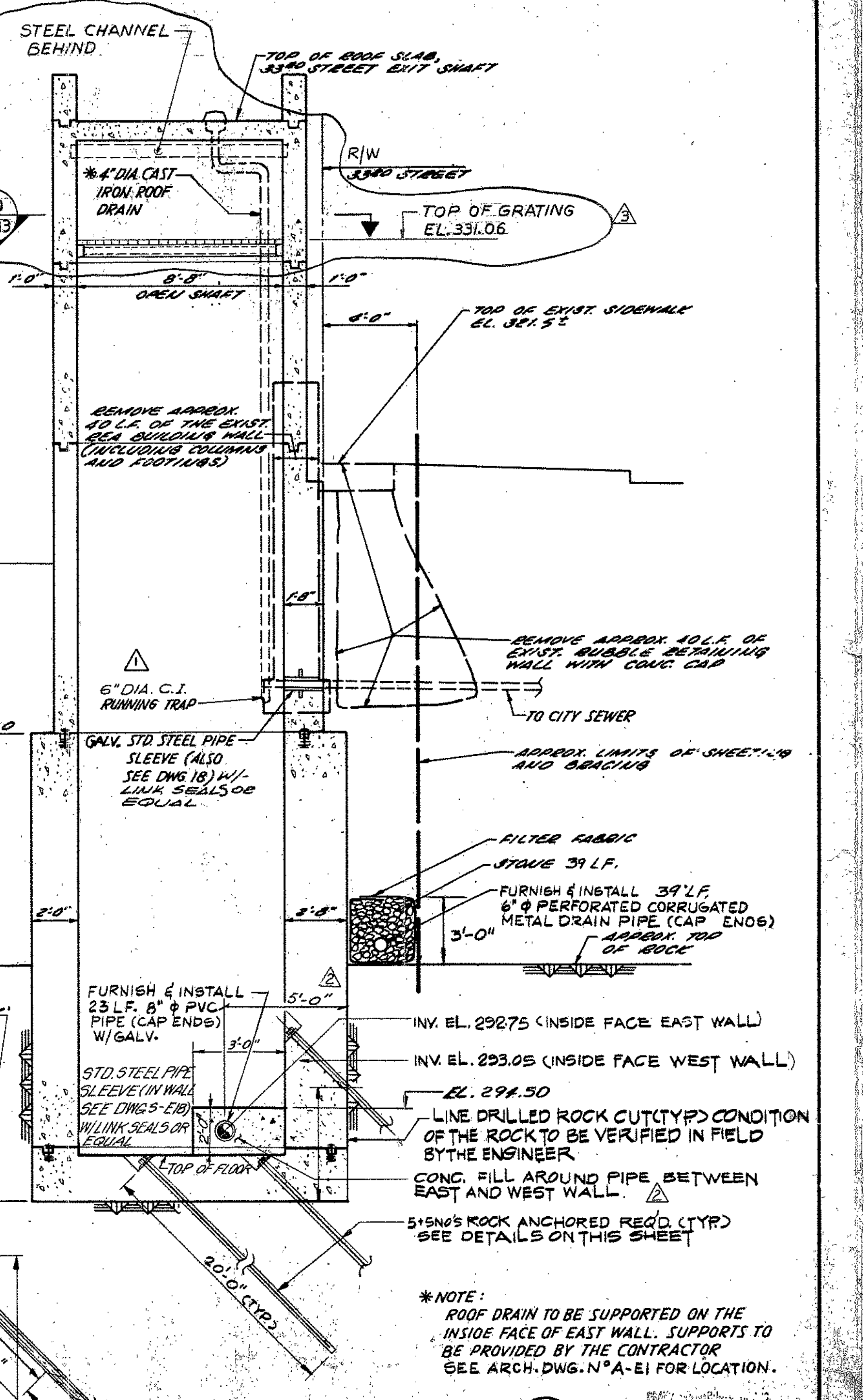
CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE 1" = 20'-0"
DRAWING NO. S-E2
SHEET 150 OF 187



SECTION 25 / S-E2

PROFILE - EVACUATION - TUNNEL

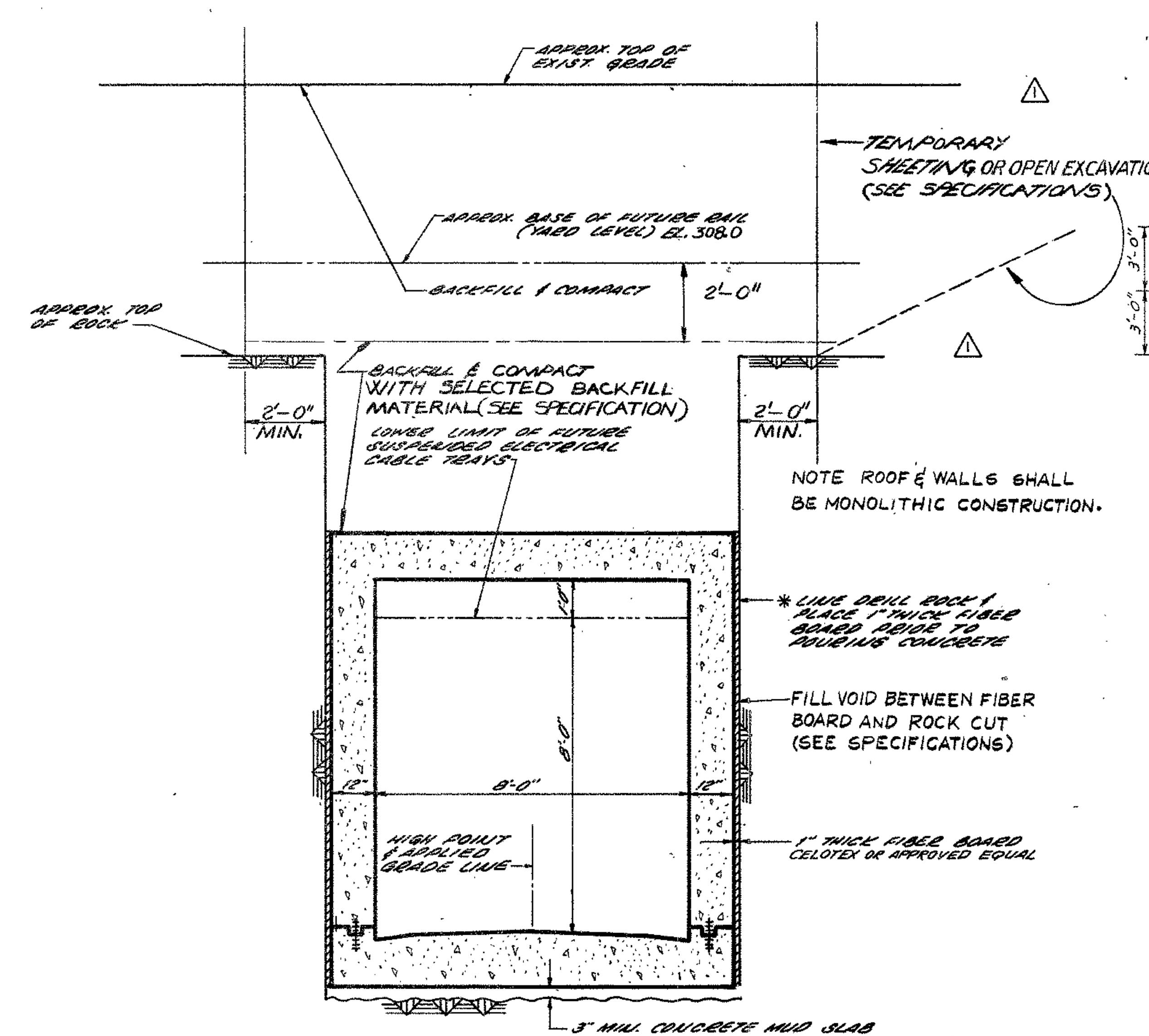
SCALE: 1" = 20'-0"



*NOTE:
ROOF DRAIN TO BE SUPPORTED ON THE INSIDE FACE OF EAST WALL. SUPPORTS TO BE PROVIDED BY THE CONTRACTOR SEE ARCH. DWG. N° A-E1 FOR LOCATION.

33RD STREET EXIT SHAFT SECT. 45 / S-E2

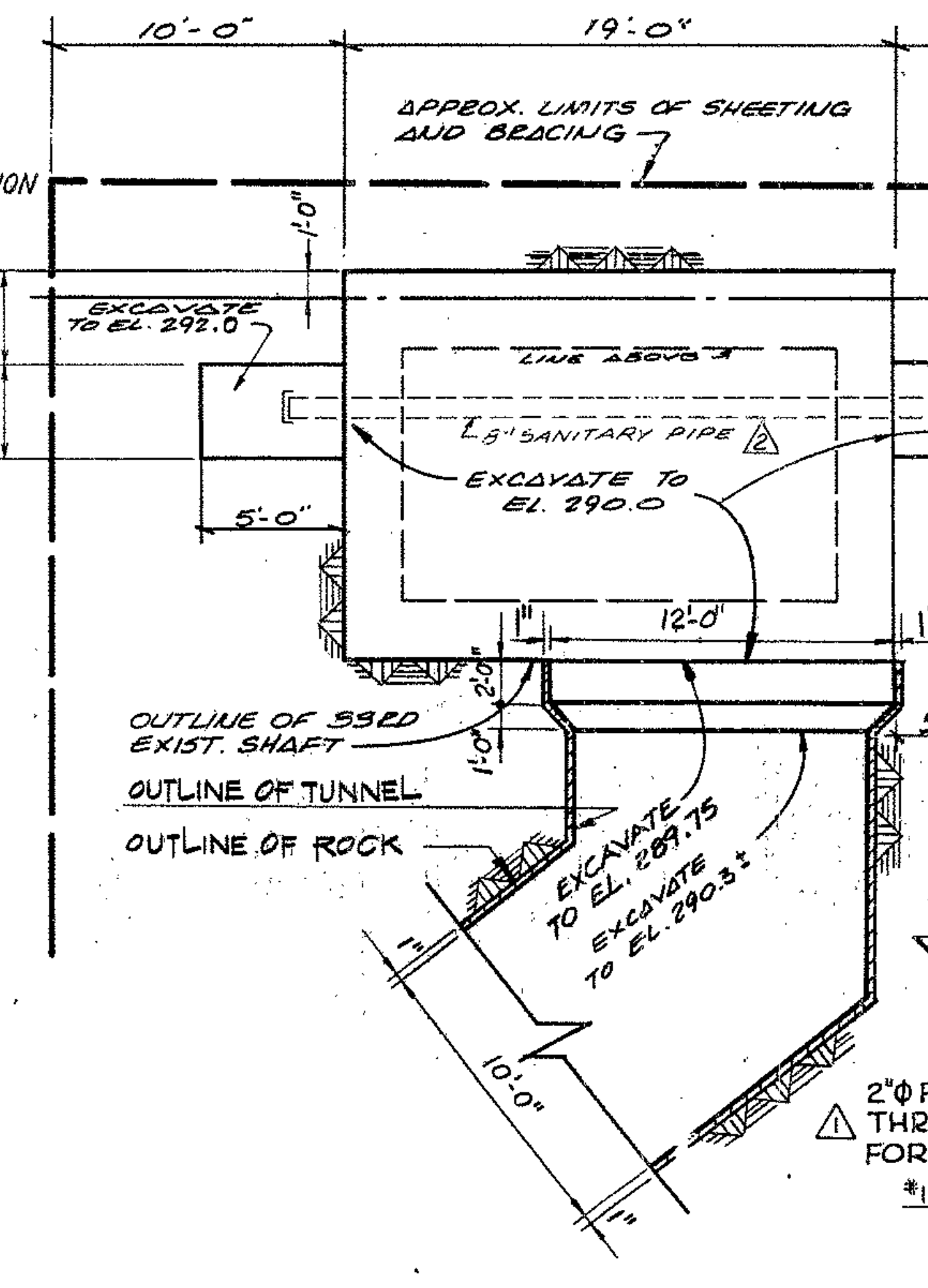
SCALE: 1/4" = 1'-0"



NOTE ROOF & WALLS SHALL BE MONOLITHIC CONSTRUCTION.

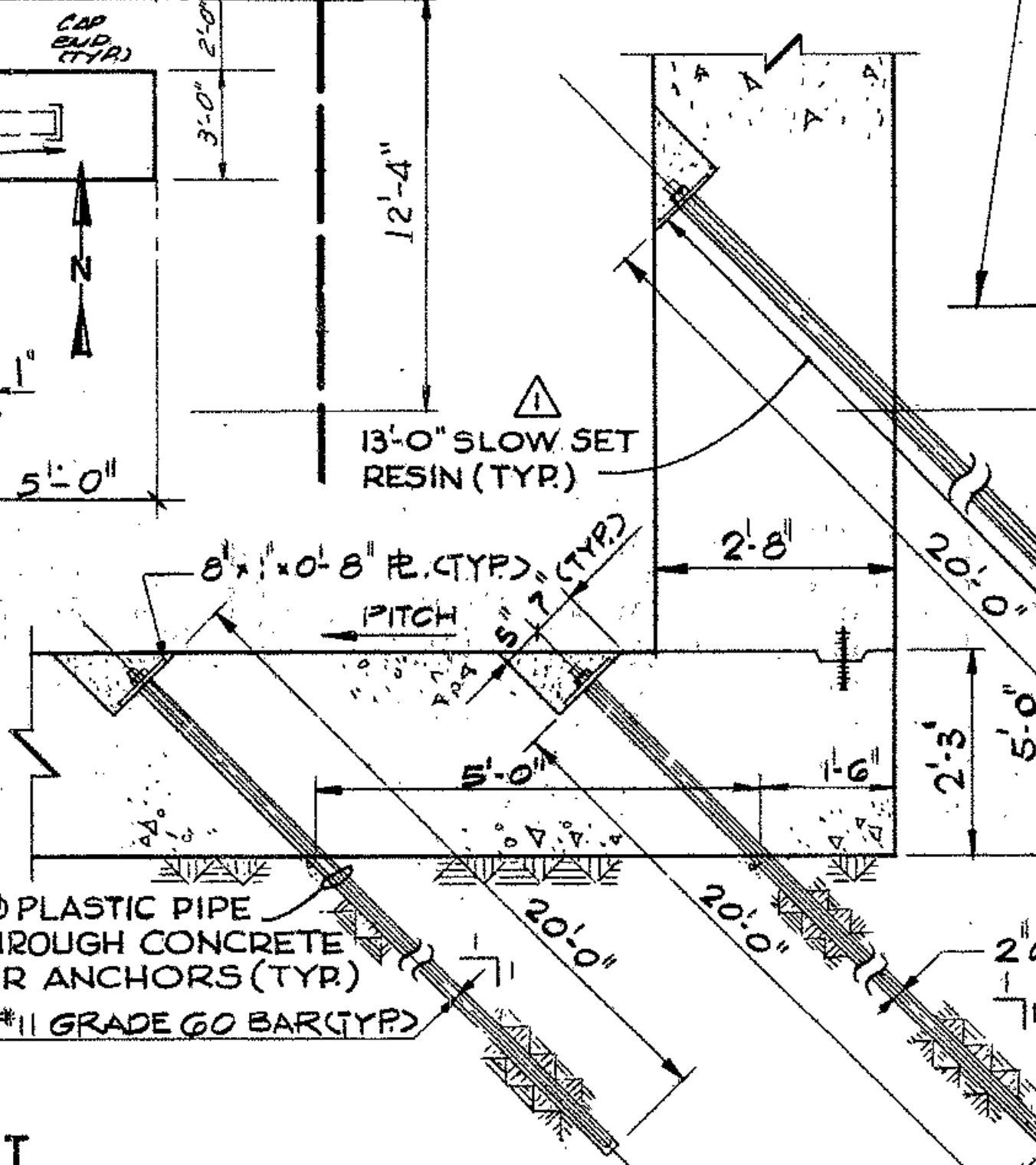
TYPICAL TUNNEL SECTION 36 / S-E2

SCALE: 3/8" = 1'-0"



PLAN - ROCK EXCAVATION AT 33RD STREET EXIT SHAFT

SCALE: 3/16" = 1'-0"



DETAIL OF ROCK ANCHORS

SCALE: 1/2" = 1'-0"

NOTE: SEE SPECIFICATIONS

NOTES:

1. FOR GENERAL PLAN SEE DWG. N°S S-E2
2. FOR GENERAL NOTES SEE DWG. N° S-E1
3. FOR WATERPROOFING, JOINTS & ELECTRICAL BONDING SEE DWG. N°S S-E16, 17 & 18.
4. LINK SEALS FOR 4" CAST IRON PIPE SHALL BE No. LS-300-C10, WITH 6" STD. STEEL PIPE SLEEVE. LINK SEALS FOR 8" PVC PIPE SHALL BE No. LS-300-C19, WITH 10" STD. STEEL PIPE SLEEVE SEE SPECS. SECT. 15040, PAR. 2.01-F

"AS BUILT"

Date: 2-6-85

REV. NO.	DESCRIPTION	DATE
3	SSVK TECH. BULL. #12 GRATING PLATFORM ADDED 33RD ST. EXIT SHAFT	4-4-83
2	REVISE SANITARY SEWER PIPE LOCATION.	9-10-82
1	REVISE EXC. FOR TUNNEL SECTION, CLARIFY DETAIL OF ROCK ANCHORS. RUNNING TRAP SIZE NOTED	3-22-82

SEELYE STEVENSON VALUE & KNECHT, INC.
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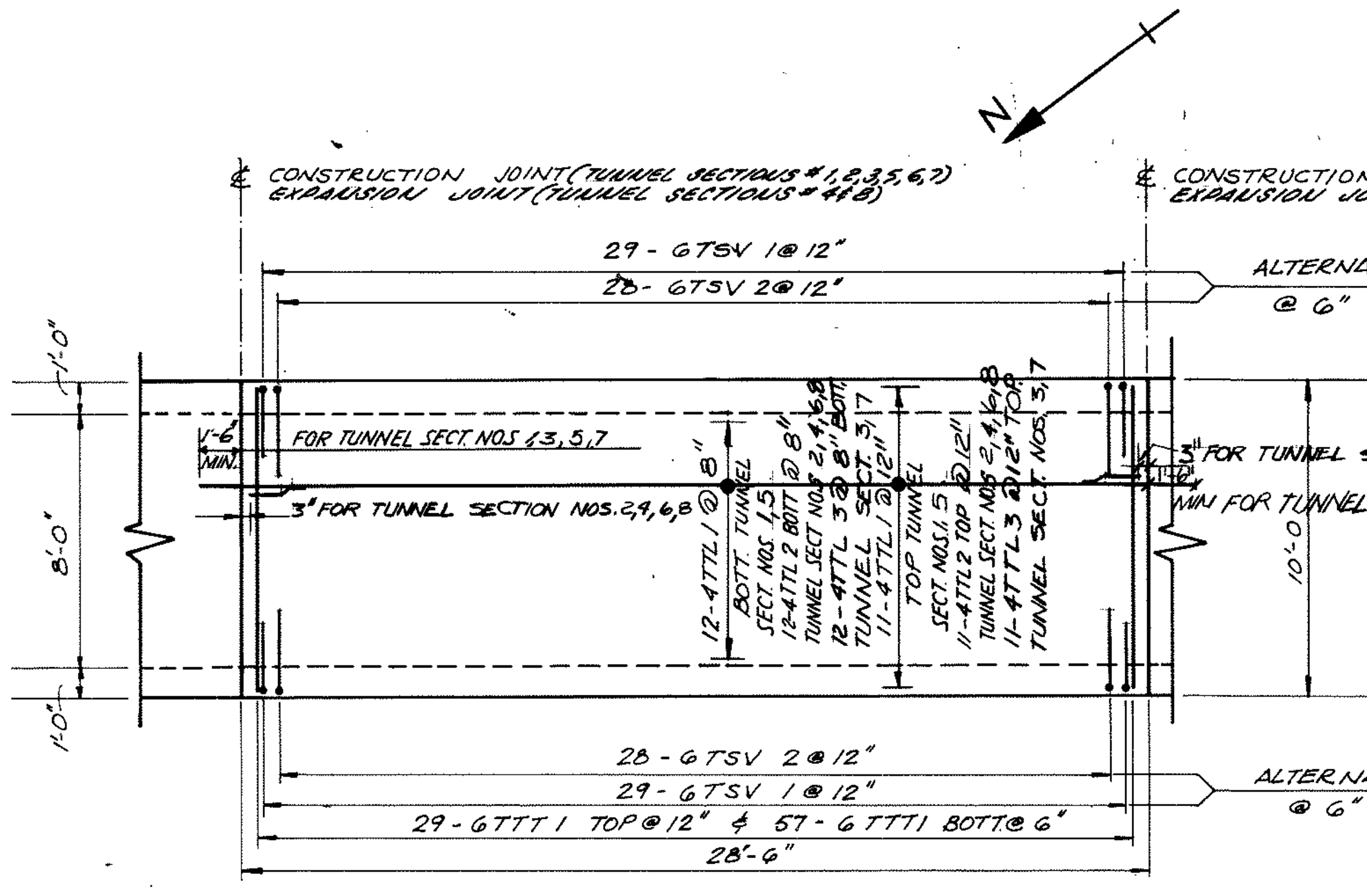
M
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX

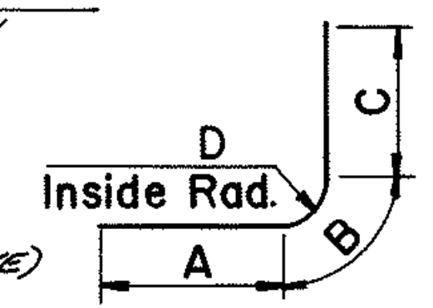
PROFILE AND SECTIONS

EVACUATION TUNNEL

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE NOTED
DRAWING NO. S-E3
SHEET 151 OF 187

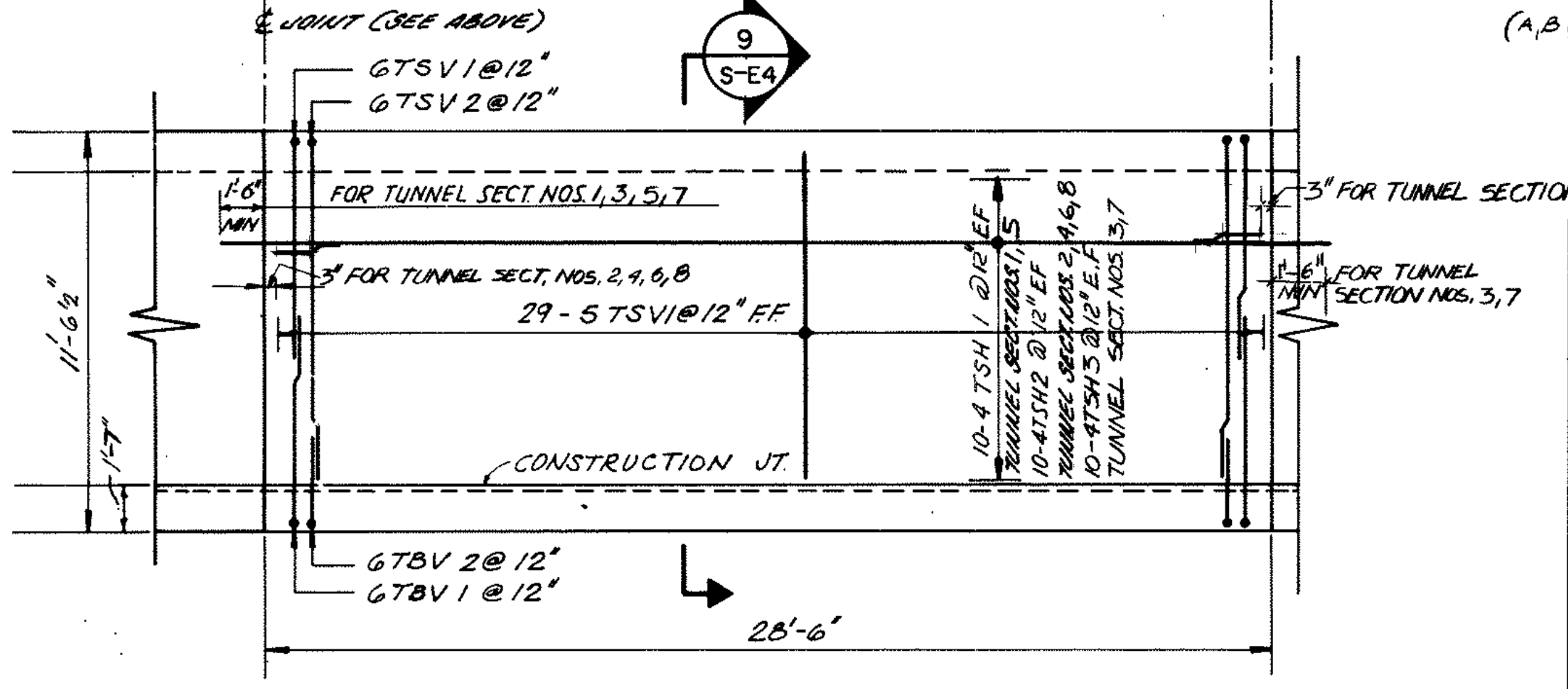


TOP SLAB PLAN

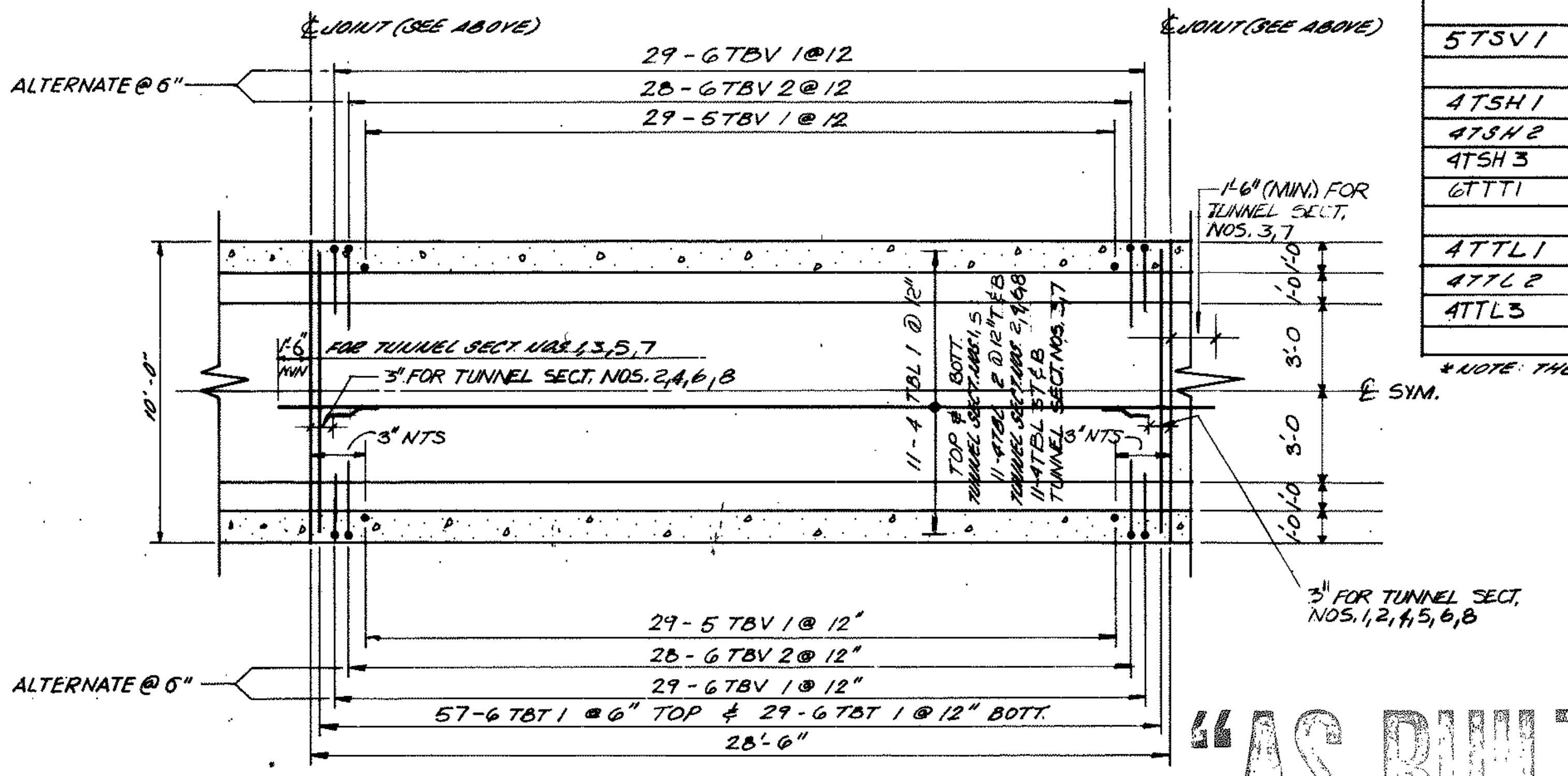


(A,B & C ARE OUTSIDE DIMENSIONS)

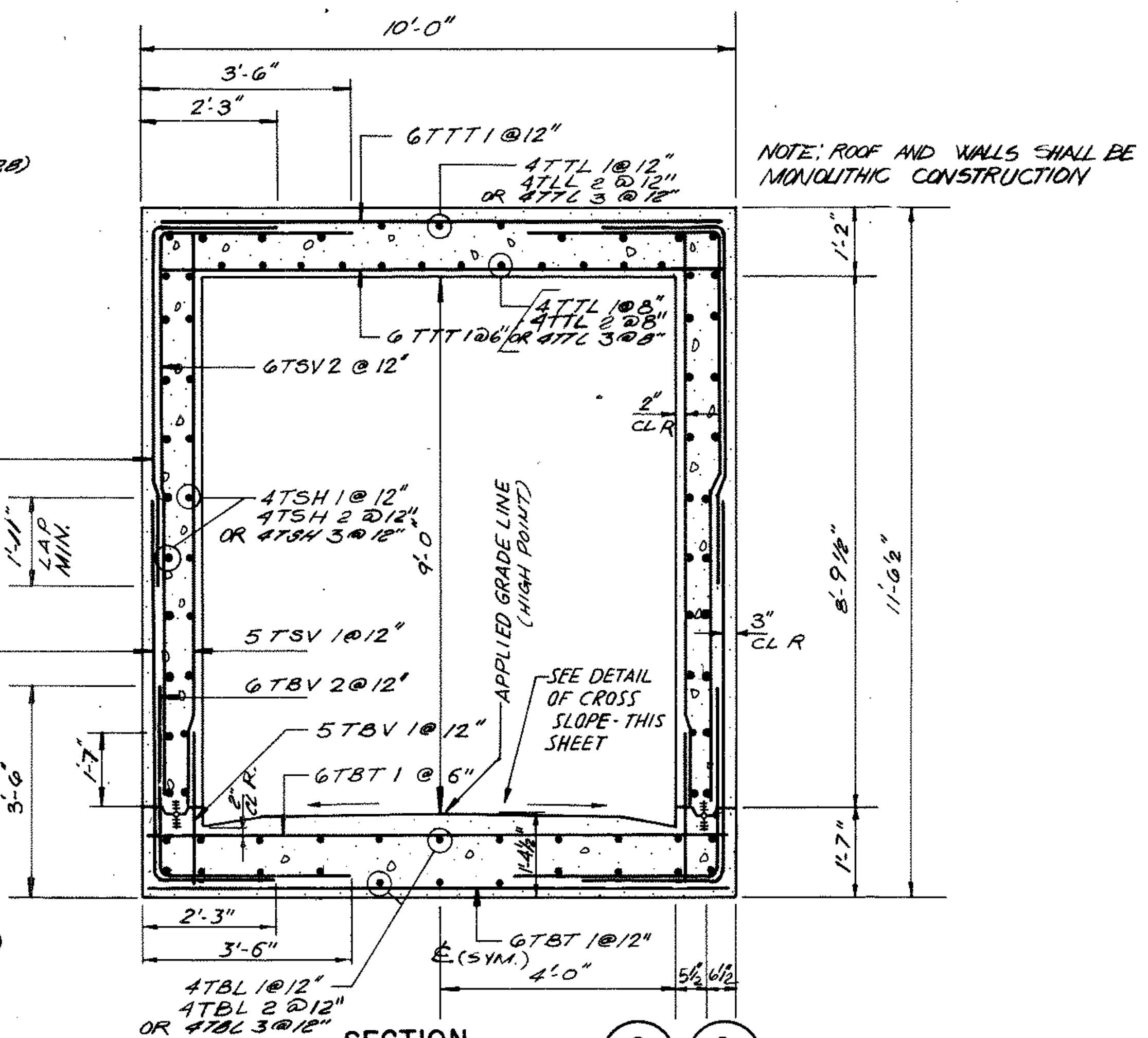
XII



SIDE WALLS ELEVATION

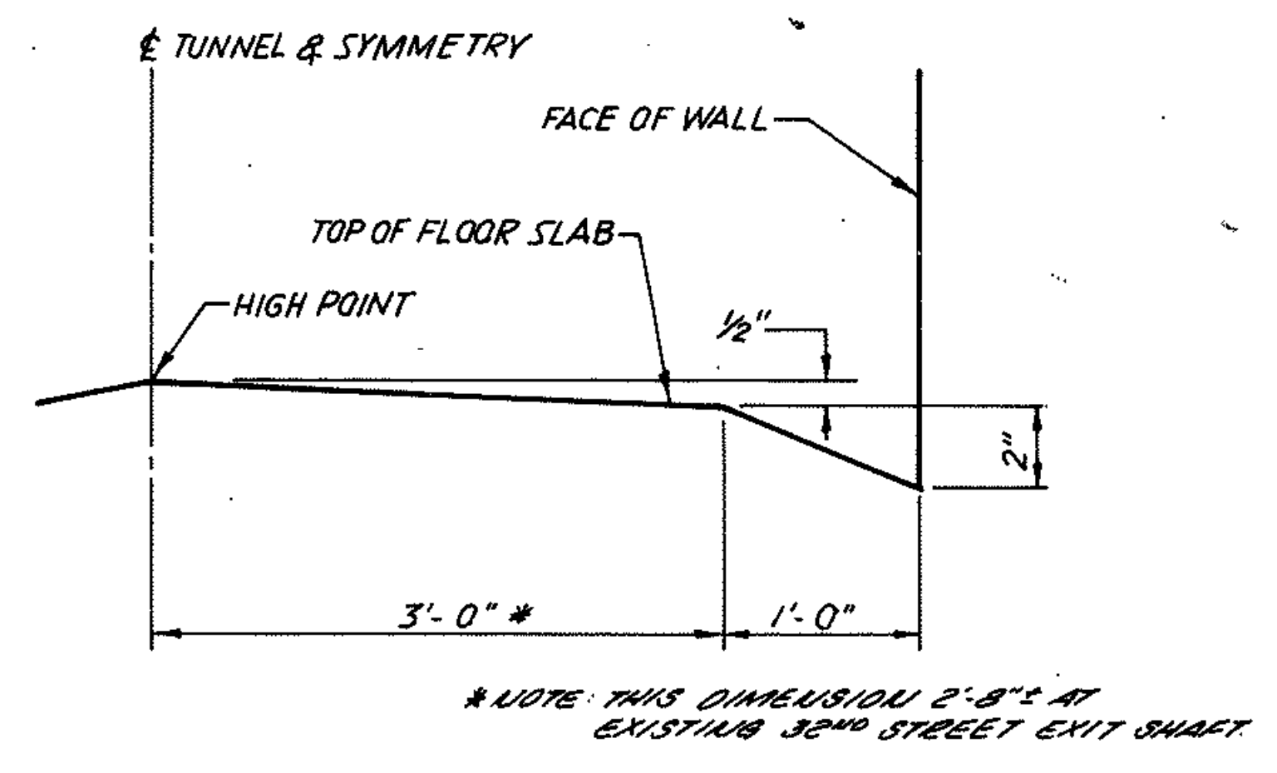


BASE SLAB PLAN



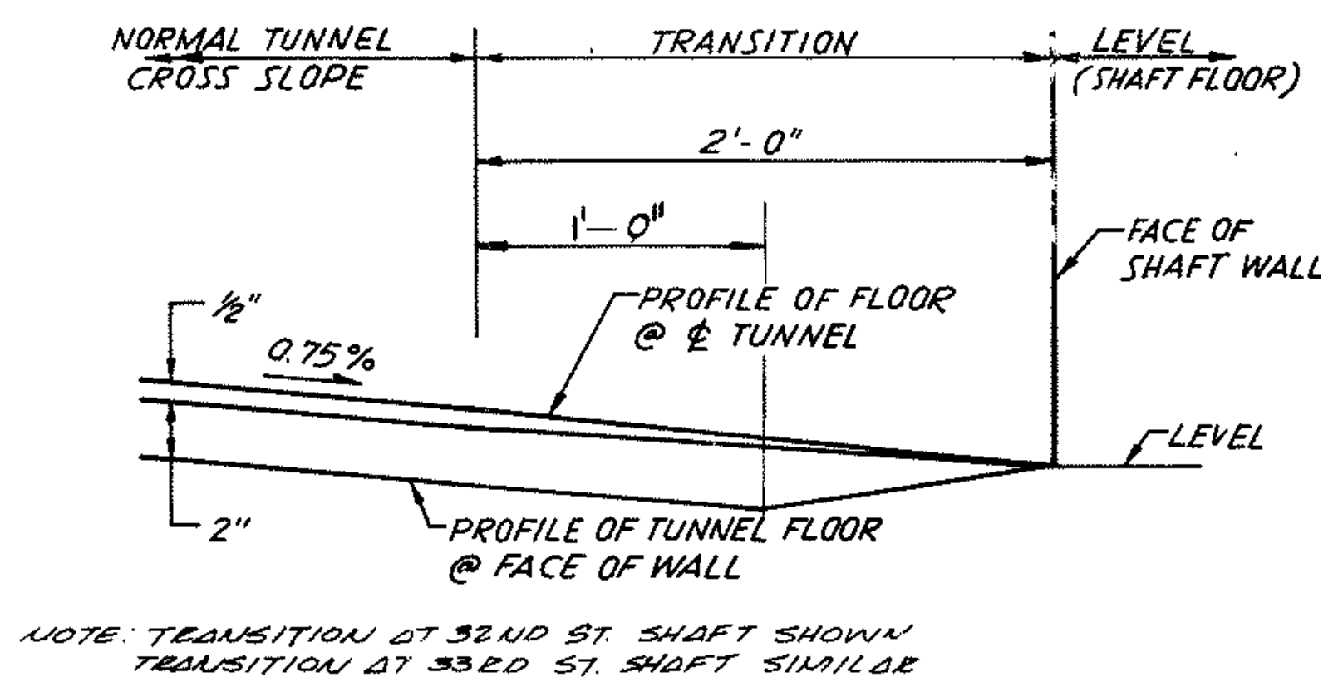
SECTION

SCALE: ½" = 1'-0 (8 / S-E2) (9 / S-E4)



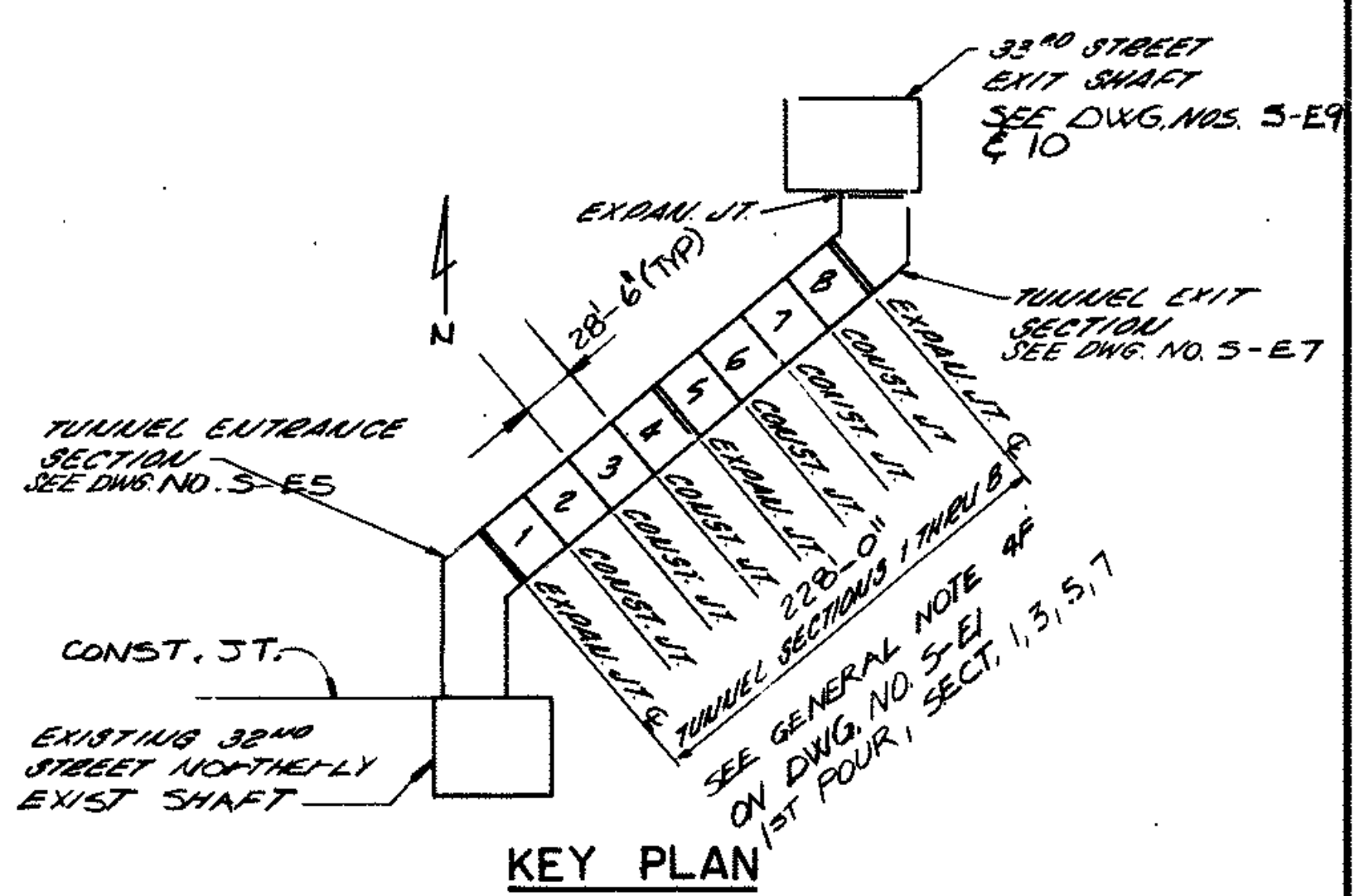
DETAIL - CROSS SLOPE OF TUNNEL FLOOR

NOT TO SCALE



DETAIL
TRANSITION OF CROSS SLOPE OF TUNNEL FLOOR

NOT TO SCALE



KEY PLAN

NOT TO SCALE

MARK	SIZE	LENGTH	*Nº	TYPE	A	B	C	D	E	F	G	H	LOCATION
6TBT1	6	9'-6"	688	Str									TUNNEL BASE SLAB TRANS.
4TBL3	4	31'-6"	44	Str									" " " LONG.
4TBL1	4	29'-9"	44	Str									" " " LONG
4TBL2	4	28'-0"	88	Str									" " " "
6TBV1	6	8'-4½"	464	XII	1'-6¾"	0-8¼"	6'-2"	0-4½"					" " " VERT.
6TBV2	6	6'-3"	448	XII	2'-9¾"	0-8¼"	2'-9¾"	0-4½"					" " " "
5TBV1	5	2'-11"	464	Str									" " " "
6TSV1	6	8'-4½"	464	XII	1'-6¾"	0-8¼"	6'-2"	0-4½"					TUNNEL SIDE WALL "
6TSV2	6	13'-3"	448	XII	2'-9¾"	0-8¼"	9'-8½"	0-4½"					" " " "
5TSV1	5	9'-8½"	464	Str									" " " "
4TSH1	4	29'-9"	80	Str									" " " HORZ.
4TSH2	4	28'-0"	160	Str									" " " "
4TSH3	4	31'-6"	80	Str									" " " "
6TTT1	6	9' 6"	688	Str									TUNNEL TOP SLAB TRANS.
4TTL1	4	29'-9"	46	Str									" " " LONG.
4TTL2	4	28'-0"	92	Str									" " " "
4TTL3	4	31'-6"	46	Str									" " " "

*NOTE: THE QUANTITY GIVEN IS THE TOTAL FOR SECTIONS 1 THRU 8

NOTE:

1. FOR GENERAL NOTES SEE DWG NO. S-E1
2. FOR WATERPROOFING, JOINTS & ELECTRICAL BONDING DETAIL SEE DWG. NOS S-E16, 17 & 18
3. FOR PROFILE AND SECTION SEE DWG. NO S-E3
4. FOR GENERAL PLAN SEE DWG. NO. S-E2

"AS BUILT"
Date: 2-6-85

REV NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

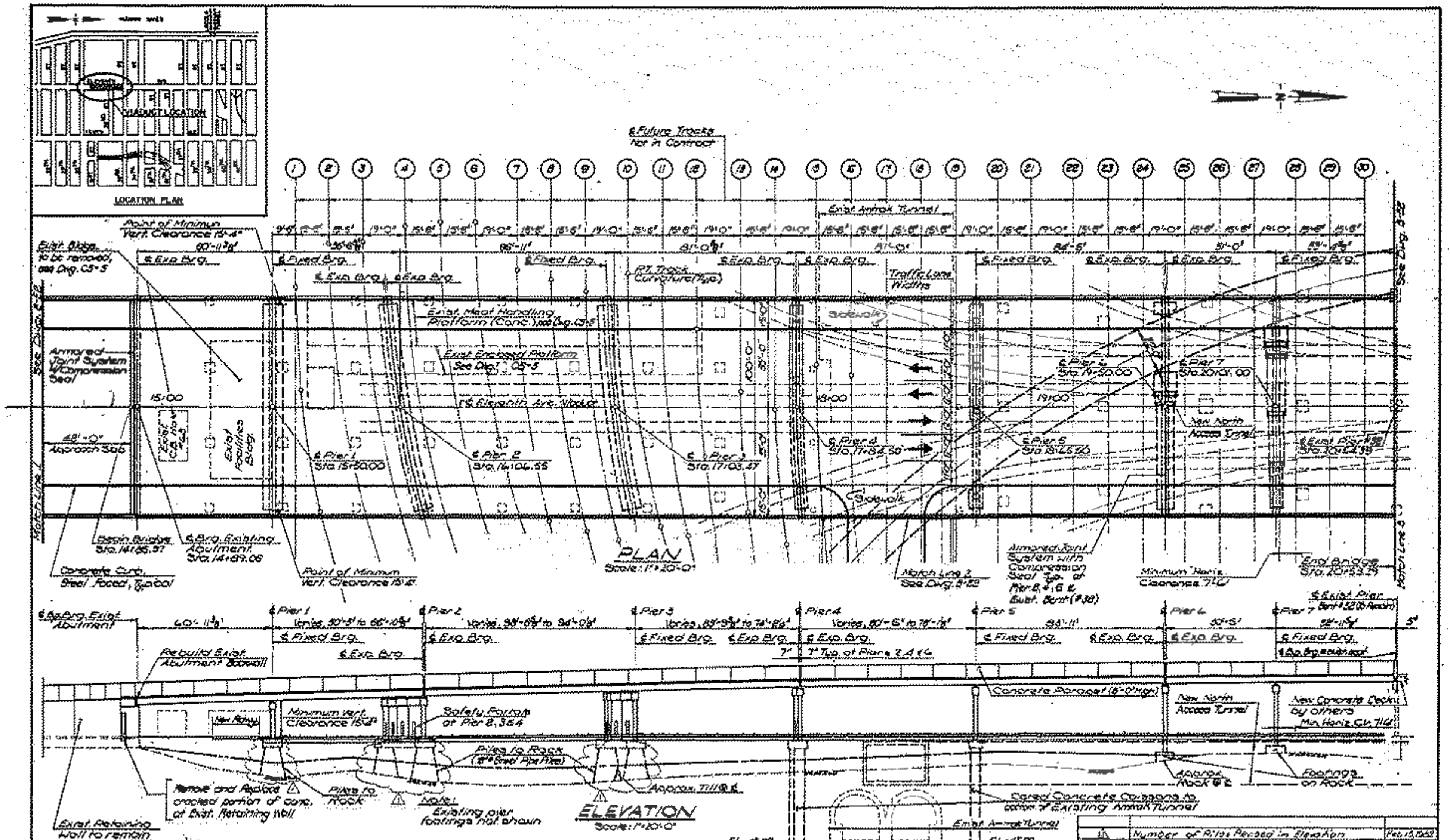
L.I.R.R.
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
TYPICAL EVACUATION TUNNEL SECTION
EVACUATION TUNNEL

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE 1/4" = 1'-0" EXCEPT AS NOTED
DRAWING NO. S-E4
SHEET 152 OF 187

Eleventh Avenue Viaduct



LEGEND

☐	Exist. Pier Footings
----	Exist. Rails
○	Existing Caisson
②	New Track No's

"AS BUILT"

Date - 2 - 6 - 61

Note:
For General Notes and Index of Drawings, see Dwg. B-53
For Profiles, see Dwg. B-54

REV. NO	DESCRIPTION	DATE
1	Number of Piles Revised in Elevation	Feb. 15, 1962

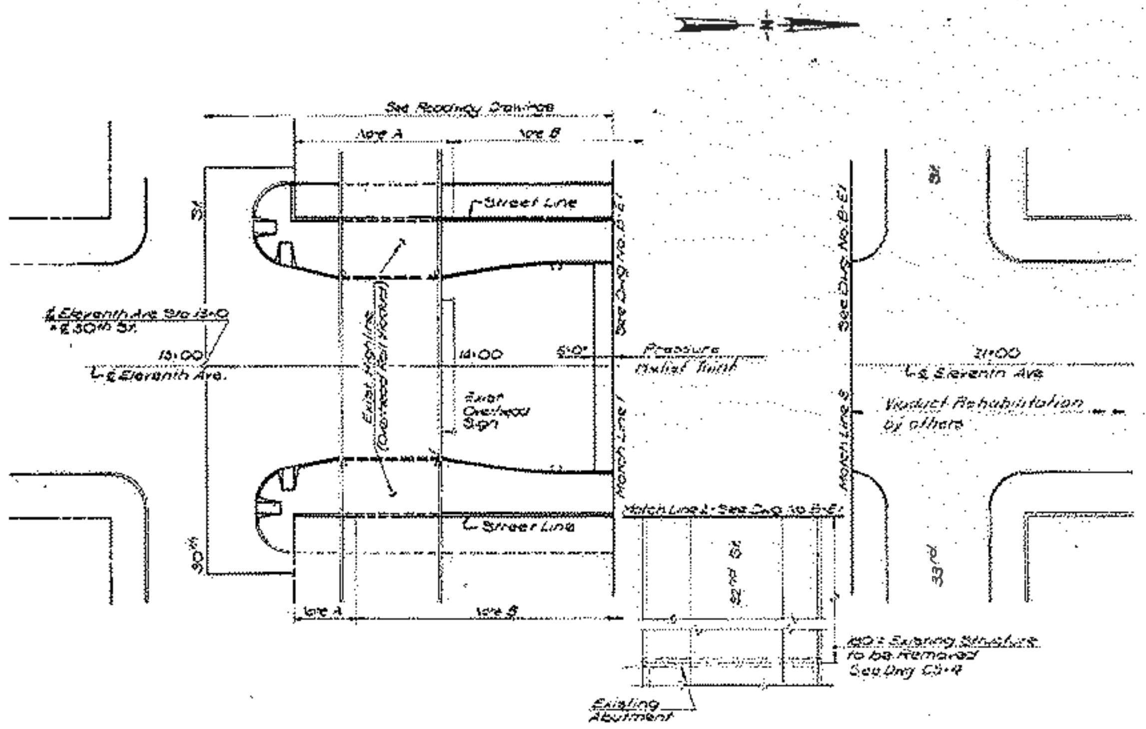
SEELYE STEVENSON VALUE & KNECHT INC.
CONSULTING ENGINEERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAILROAD

Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
GENERAL PLAN - I
11th AVENUE VIADUCT

CONTRACT NO. 1-01-21064-0-0
DATE FEB. 1, 1988
SCALE AS NOTED
DRAWING NO. B-E1
SHEET 82 of 187



MATCH LINES - AT 30TH, 32ND & 33RD STREETS
Scale: 1" = 80'-0"

Note A:
Remove existing chain link fence and concrete base. New 8'-0" parapet and footing.

Note B:
New 8'-0" parapet coneinxd to existing retaining wall.

"AS BUILT"
Date: 2-4-85

REV NO	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT INC.
CONSULTING ENGINEERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAILROAD

Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
GENERAL PLAN — II
11th AVENUE VIADUCT

CONTRACT NO 1-02-21084-0-D
DATE FEB. 1, 1982
SCALE AS NOTED
DRAWING NO B-E2
SHEET 83 OF 187

GENERAL NOTES

DESIGN NOTES

DESIGN SPECIFICATIONS: A.A.S.H.T.O. STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 1977 AND INTERIM SPECIFICATIONS 1978, 1979 AND 1980, AS MODIFIED BY N.Y.S.D.O.T.

LIVE LOAD: HS20-44

MATERIAL AND CONSTRUCTION SPECIFICATIONS: PROJECT SPECIFICATIONS

CONCRETE:	PIERS, EXCEPT CAISSONS	CLASS A
	SUPERSTRUCTURE, INCLUDING SLAB, SIDEWALK, AND PARAPETS AND ALL NEW CONSTRUCTION AT THE EXISTING SOUTH ABUTMENT, INCLUDING THE APPROACH SLAB.	CLASS E
	CAISSONS AT PIER 4 & 5	4000psi

REINFORCING STEEL: DEFORMED REINFORCING BARS SHALL CONFORM TO ASTM A615, GRADE 60. BARS IN TOP OF DECK SLAB AND SIDEWALK SHALL BE EPOXY COATED.

STRUCTURAL STEEL: UNLESS NOTED OTHERWISE ON THE DRAWINGS OR IN THE SPECIFICATIONS, STRUCTURAL STEEL SHALL CONFORM TO ASTM A588 AND SHALL BE PAINTED IN ACCORDANCE WITH THE SPECIFICATIONS.

PILES: 12" STEEL PIPE PILES AT PIER 1, 2 & 3 SHALL BE DRIVEN TO REFUSAL. THE MAXIMUM PILE LOAD IS 80 TONS.

MAXIMUM BEARING PRESSURE ON ROCK

CAISSONS, PIER 4 & 5	52 TONS/SQ.FT.
FOOTINGS, PIER 6 & 7	6 TONS/SQ.FT.

OTHER NOTES

DATUM: ELEVATIONS SHOWN ON 11TH AVE. VIADUCT DRAWINGS ARE MANHATTAN DATUM, UNLESS NOTED TO BE LIRR DATUM. LIRR DATUM EQUALS MANHATTAN DATUM + 300.025'.

STAY-IN-PLACE FORMS: S-I-P FORMS WILL NOT BE ALLOWED FOR THIS STRUCTURE.

EXISTING LIGHTS: EXISTING LIGHT POLES AND FIXTURES SHALL BE REMOVED, STORED AND REINSTALLED BY THE CONTRACTOR.

EXISTING TRAFFIC POLES: EXISTING TRAFFIC POLES, BOXES AND FIXTURES AT 32ND STREET SHALL BE REMOVED AND DELIVERED BY THE CONTRACTOR TO THE N.Y.C. TRAFFIC DEPARTMENT'S SIGNAL WAREHOUSE, 64 METROPOLITAN AVENUE MIDDLE VILLAGE, NEW YORK 11375.
CALL MR J. DELLAVECCHIA AT PHONE NO [illegible] BEFORE DELIVERY.

OTHER NOTES (Cont'd)

MAINTENANCE NOTES: AS PER SECTION 93 OF THE NEW YORK STATE RAILROAD LAW, THE R.R. (LONG ISLAND R.R.) SHALL MAINTAIN AND KEEP IN REPAIR THE FRAMEWORK OF THE BRIDGE, INCLUDING ITS SUPPORTS. THE CITY OF NEW YORK SHALL MAINTAIN AND KEEP IN REPAIR THE ROADWAY, SIDEWALKS AND APPROACHES TO THE BRIDGE.

BONDING: ELECTRICAL BONDING IS REQUIRED FOR THE FOOTINGS OF PIERS 1 THRU 5.
SEE DRAWING B-E68 AND B-E69
△1

"AS BUILT"
Date: 2-6-85

INDEX OF DRAWINGS

B-E 1	GENERAL PLAN - I
B-E 2	GENERAL PLAN - II
B-E 3	GENERAL NOTES & INDEX OF DRAWINGS
B-E 4	PROFILES
B-E 5	EXISTING SOUTH ABUTMENT - PLAN & ELEVATION
B-E 6	EXISTING SOUTH ABUTMENT - EAST WINGWALL
B-E 7	EXISTING SOUTH ABUTMENT - WEST WINGWALL
B-E 8	EXISTING SOUTH ABUTMENT - SECTIONS & DETAILS
B-E 9	EXISTING SOUTH ABUTMENT - REPAIR DETAILS
B-E10	LAYOUT PLAN - PIERS 2, 3 & 4
B-E11	PIER 1 - PLAN & ELEVATION
B-E12	PIER 2 - PLAN & ELEVATION
B-E13	PIER 3 - PLAN & ELEVATION
B-E14	PIER 1, 2 & 3 - FOOTING PLAN
B-E15	PIER 4 - PLAN & FOOTING PLAN
B-E16	PIER 4 - ELEVATION
B-E17	PIER 5 - PLAN & FOOTING PLAN
B-E18	PIER 5 - ELEVATION
B-E19	PIER 6 - PLAN & FOOTING PLAN
B-E20	PIER 6 - ELEVATION
B-E21	PIER 7 - PLAN & FOOTING PLAN
B-E22	PIER 7 - ELEVATION
B-E23	PIER DETAILS
B-E24	PIER DETAILS
B-E25	PIER DETAILS
B-E26	STEEL FRAMING PLAN - SPAN 1 & 2
B-E27	STEEL FRAMING PLAN - SPAN 3 & 4
B-E28	STEEL FRAMING PLAN - SPAN 5 & 6
B-E29	STEEL FRAMING PLAN - SPAN 7 & 8
B-E30	BEAM DETAILS - SPAN 1 THRU 4
B-E31	BEAM DETAILS - SPAN 5 THRU 8
B-E32	SEAT DETAILS AT EXISTING STEEL BENT AT 33RD ST.
B-E33	FIELD SPLICE DETAILS
B-E34	HAUNCH TABLE - SPAN 1 & 2
B-E35	HAUNCH TABLE - SPAN 3 & 4
B-E36	HAUNCH TABLE - SPAN 5 & 6
B-E37	HAUNCH TABLE - SPAN 7 & 8
B-E38	DEFLECTIONS & CAMBERS - SPAN 1 & 2
B-E39	DEFLECTIONS & CAMBERS - SPAN 3 & 4
B-E40	DEFLECTIONS & CAMBERS - SPAN 5 THRU 8
B-E41	DIAPHRAGM DETAILS
B-E42	BEARING DETAILS
B-E43	SLAB PLAN - SPAN 1 & 2
B-E44	SLAB PLAN - SPAN 3 & 4
B-E45	SLAB PLAN - SPAN 5 & 6
B-E46	SLAB PLAN - SPAN 7 & 8
B-E47	DECK CROSS SECTIONS
B-E48	SIDEWALK & PARAPET DETAILS
B-E49	JOINT DETAILS AT PIER 2, 4 & 6
B-E50	JOINT DETAILS AT EXISTING SOUTH ABUTMENT
B-E51	MISCELLANEOUS JOINT DETAILS
B-E52	FIRE COMMUNICATIONS DETAILS
B-E53	FIRE COMMUNICATIONS MANHOLE DETAILS
B-E54	ELECTRICAL CONDUIT DETAILS (CON EDISON)
B-E55	BRIDGE DECK LIGHTING
B-E56	UNDER BRIDGE LIGHTING
B-E57	UNDER BRIDGE LIGHTING
B-E58	NEW APPROACH SLAB AT EXISTING SOUTH ABUTMENT
B-E59	REINFORCING STEEL SCHEDULE - PIER 1 & 2
B-E60	REINFORCING STEEL SCHEDULE - PIER 3
B-E61	REINFORCING STEEL SCHEDULE - PIER 4 & 5
B-E62	REINFORCING STEEL SCHEDULE - PIER 6
B-E63	REINFORCING STEEL SCHEDULE - PIER 7
B-E64	REINFORCING STEEL SCHEDULE - SUPERSTRUCTURE, SPAN 1 & 2
B-E65	REINFORCING STEEL SCHEDULE - SUPERSTRUCTURE, SPAN 3 & 4
B-E66	REINFORCING STEEL SCHEDULE - SUPERSTRUCTURE, SPAN 5 THRU 8
B-E67	REINFORCING STEEL SCHEDULE - EXISTING SOUTH ABUTMENT
B-E68	ELECTRICAL BONDING - PIER 1, 2, & 3
B-E69	ELECTRICAL BONDING - PIER 4 & 5
B-E70	TRAFFIC CONDUIT SYSTEM
B-E71	△1 SCUPPER DETAILS - SPAN 5
B-E72	SCUPPER DETAILS - SPAN 6
B-E73	FIRE ALARM CONDUIT SYSTEM
B-E74	FIRE ALARM CONDUIT SYSTEM
B-E75	MOTORMAN SIGNAL CONDUIT
B-E76	PIER 4,4 & 6 LOUDSPEAKER CONDUIT SYSTEM
B-E77	CHANNEL INSERTS FOR FUTURE CONDUIT
B-E78	TRAFFIC & ELECTRICAL MANHOLE DETAILS
B-E79	STEEL FRAMING AT ELECTRICAL MANHOLES
B-E80	CONDUIT ALIGNMENT AT TRAFFIC MANHOLES

REV. NO.	DESCRIPTION	DATE
1	Bonding Note and Sheet added	Feb.16,2002

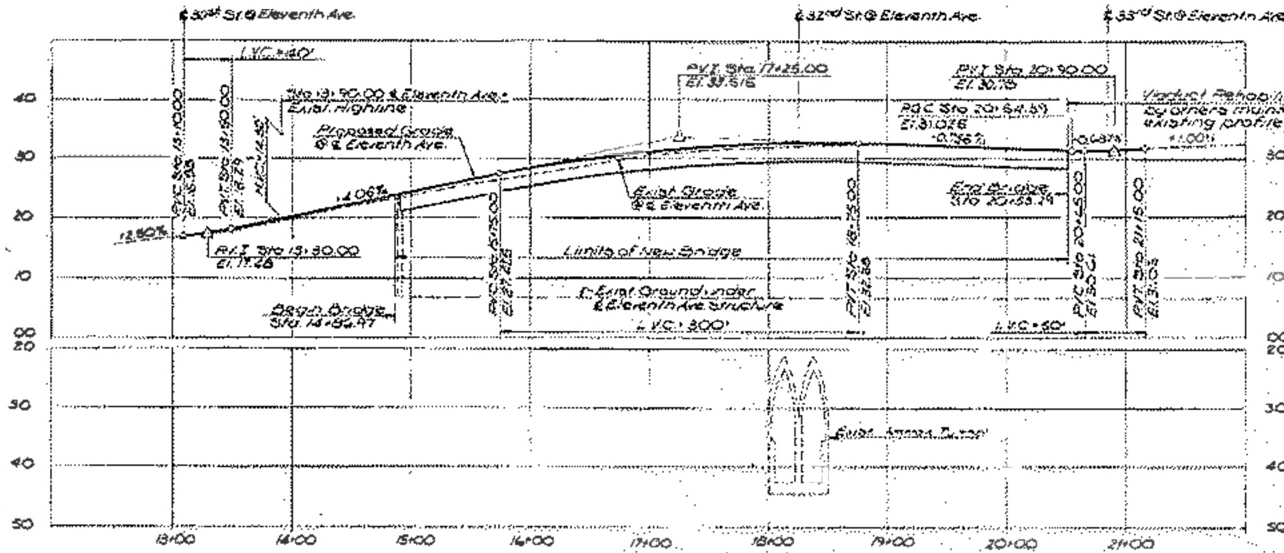
SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

Metropolitan Transportation Authority

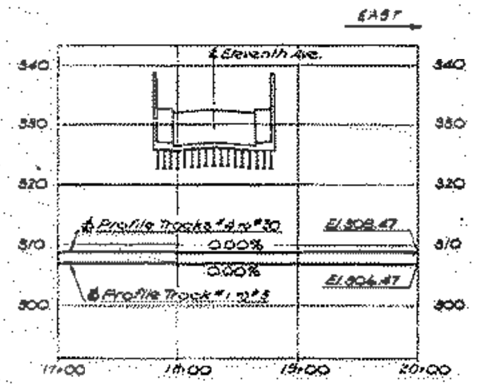
WEST SIDE STORAGE YARD COMPLEX
GENERAL NOTES & INDEX OF DRAWINGS
11th AVENUE VIADUCT

CONTRACT NO. 1-09-2089-0-0
DATE FEB.1,1982
SCALE NO SCALE
DRAWING NO. B-E3
SHEET 84 of 187



PROFILE ELEVENTH AVE.

Scale: Horiz. 1"=50'0"
Vert. 1"=10'-0"



PROFILE YARD TRACKS

Scale: Horiz.: 1"=50'-0"
Vert.: 1"=10'-0"

Street & Bridge Elevations = Manhattan Datum
Yard Elevations = L.I.R.R. Datum
(difference 300.085)

"AS BUILT"
Date: 2-6-85

REV. NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT INC.
CONSULTING ENGINEERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAILROAD

Metropolitan Transportation Authority

WEST SIDE STORAGE YARD

PROFILES

11th AVENUE VIADUCT

CONTRACT NO. 1-06-21064-0-0
DATE FEB. 1, 1988
SCALE AS NOTED
DRAWING NO. B-E 4
SHEET 85 of 187

Notes:

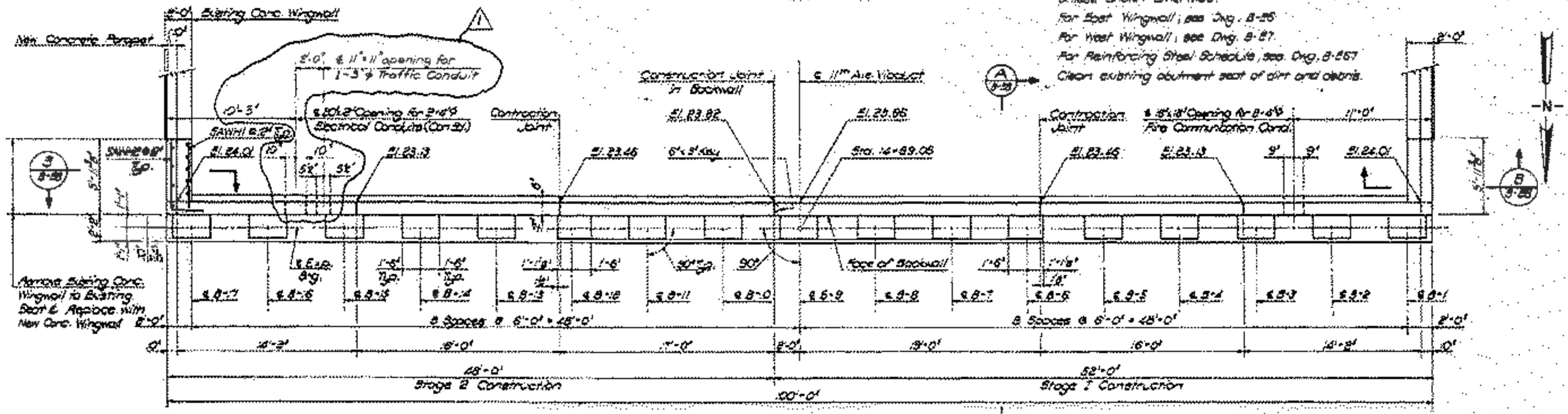
Bevel exposed edges of new construction 1" unless shown otherwise.

For East Wingwall; see Dwg. B-26

For West Wingwall; see Dwg. B-27

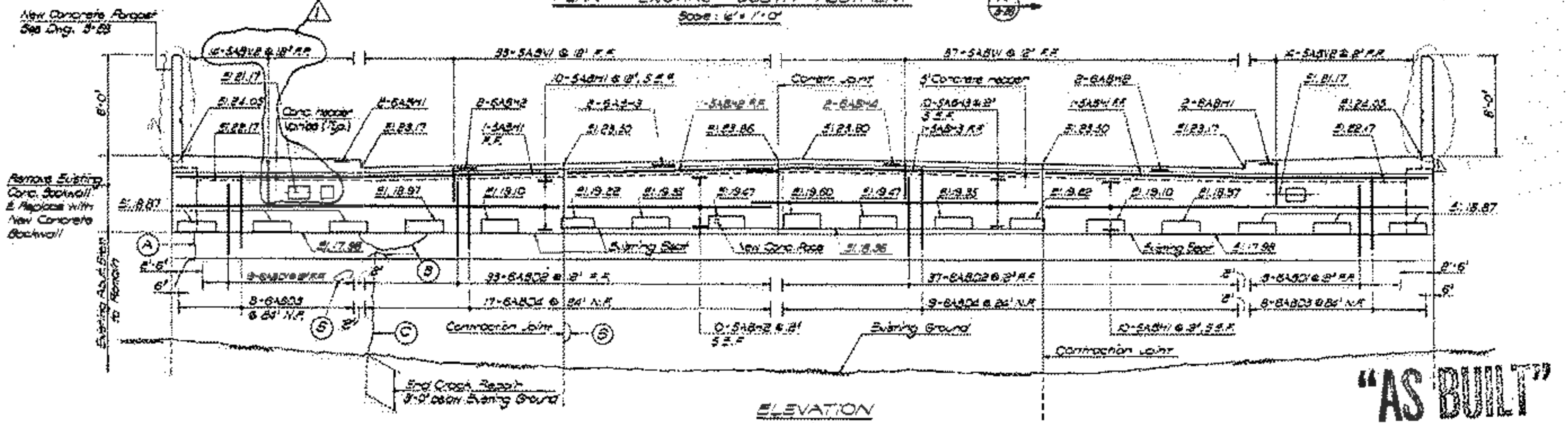
For Reinforcing Steel Schedule, see Dwg. B-E67

Clean existing abutment seat of dirt and debris.



PLAN - EXISTING SOUTH ABUTMENT

Scale: 1/4" = 1'-0"



ELEVATION

Scale: 1/4" = 1'-0"

"AS BUILT"

Date: 3-2-95

Legend:

- Ⓒ Denotes Typical Crack Repair Detail, Dwg. B-29.
- Ⓢ Denotes Typical Concrete Surface Repair Detail, Dwg. B-29.
- Ⓐ Denotes Seat Repair at Corner, Dwg. B-28.
- Ⓢ Denotes Seat Repair, Dwg. B-29.

REV. NO.	DESCRIPTION	DATE
1	Revise Parapet, Backwall opening (Traffic) added	3-22-05

SEELYE STEVENSON VALUE & KNECHT, INC.
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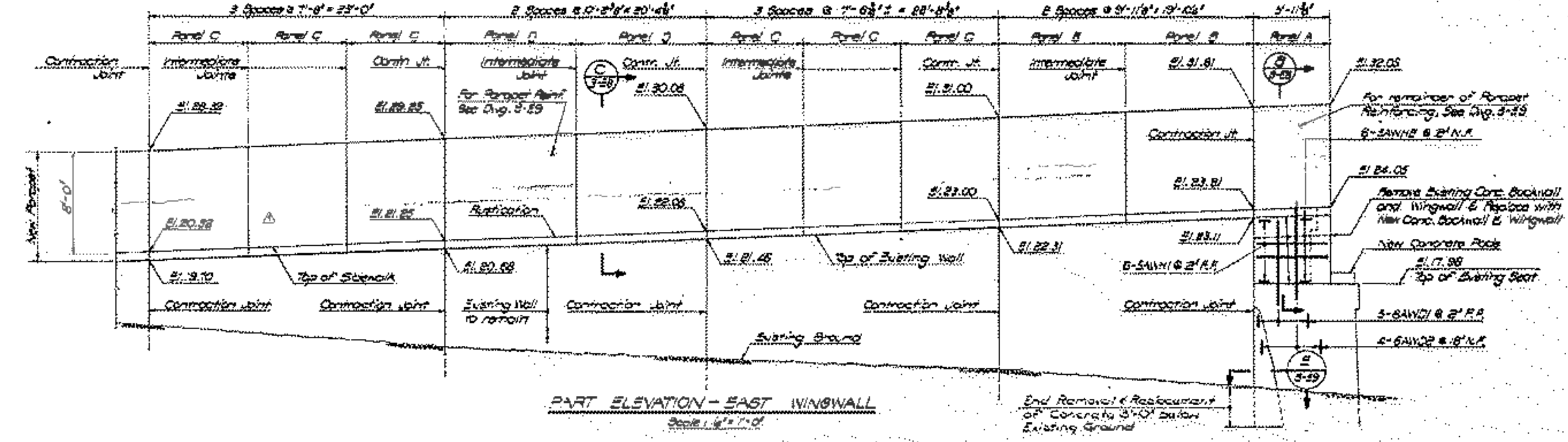
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX

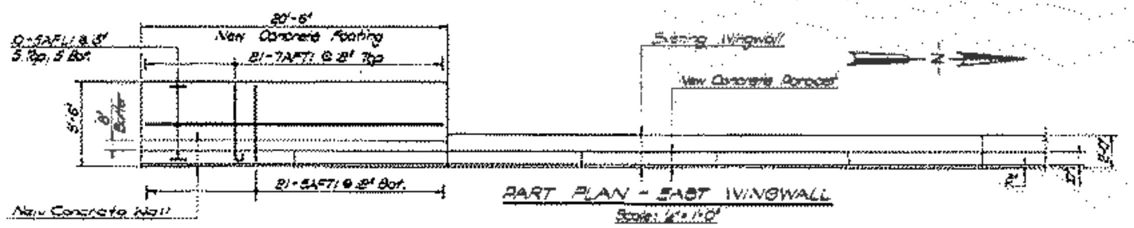
EXISTING SOUTH ABUTMENT
PLAN & ELEVATION

11th AVENUE VIADUCT

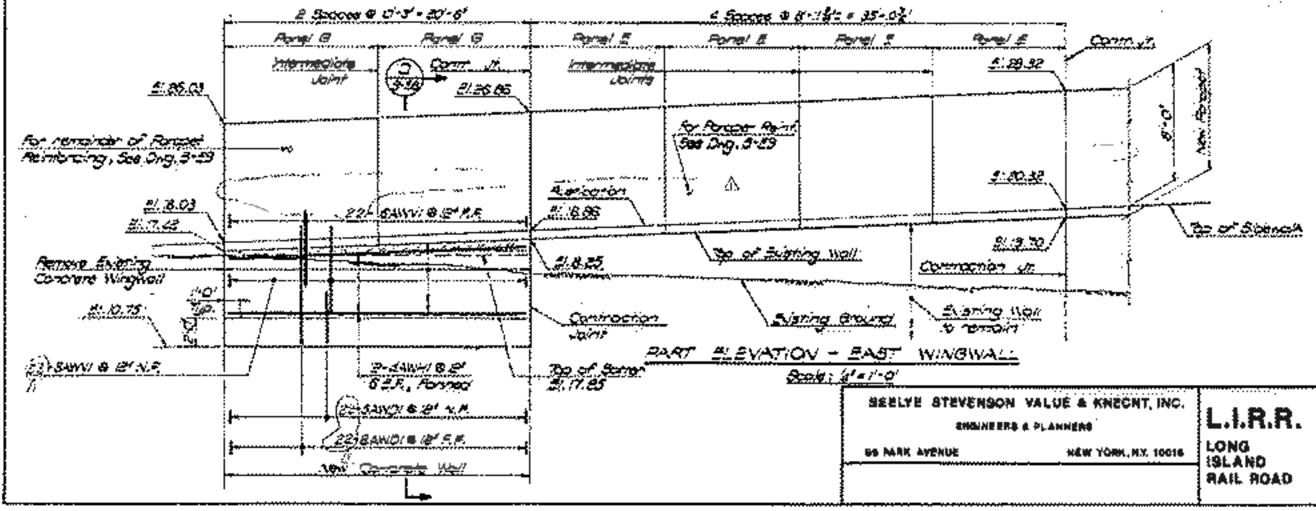
CONTRACT NO. 1-02-11064-0-0
DATE FEB 1, 1992
SCALE 1/4" = 1'-0"
DRAWING NO. B-E5
SHEET 86 OF 187



PART ELEVATION – EAST WINGWALL
Scale: ¼" = 1'-0"



PART PLAN – EAST WINGWALL
Scale: ¼" = 1'-0"



PART ELEVATION – EAST WINGWALL
Scale: ¼" = 1'-0"

“AS BUILT”
Date: 3-6-85

REV. NO.	DESCRIPTION	DATE
1	Horiz. Constr. Joint in Parapet Eliminated	3-22-82

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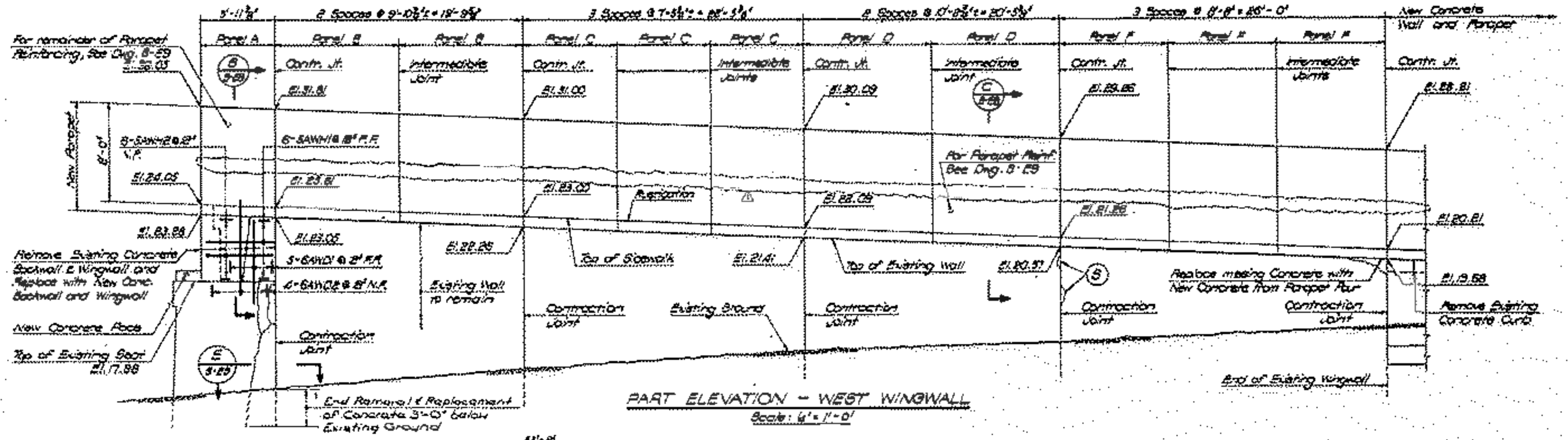
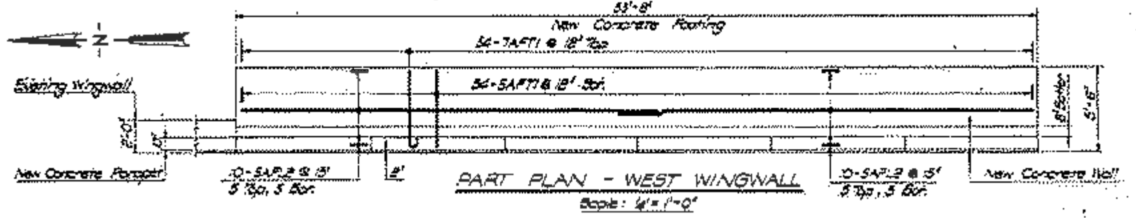
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
EXISTING SOUTH ABUTMENT
EAST WINGWALL
11th AVENUE VIADUCT

CONTRACT NO. 1-02-21064-0-0
DATE FEB 1, 1982
SCALE ¼" = 1'-0"
DRAWING NO. B-E6
SHEET 87 OF 187

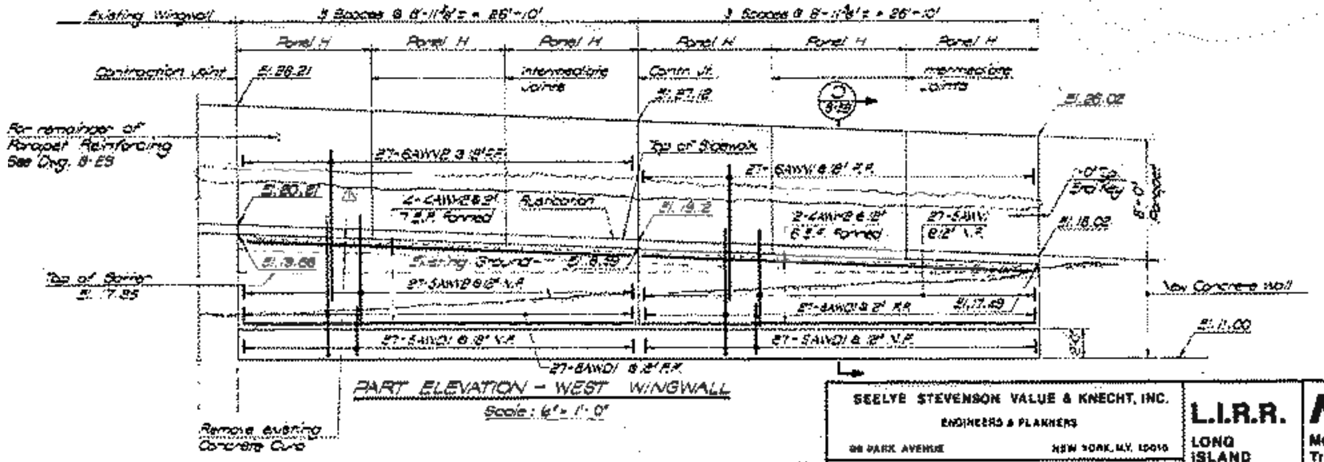


PART ELEVATION – WEST WINGWALL
Scale: ¼" = 1'-0"



PART PLAN – WEST WINGWALL
Scale: ¼" = 1'-0"

Legend:
Ⓢ Denotes Typical Concrete Surface Repair Detail, Dwg. 8-E9.



PART ELEVATION – WEST WINGWALL
Scale: ¼" = 1'-0"

"AS BUILT"
Date: 2-4-86

REV. NO.	DESCRIPTION	DATE
1	Horiz. Construction Joint in Parapet eliminated	3-22-82

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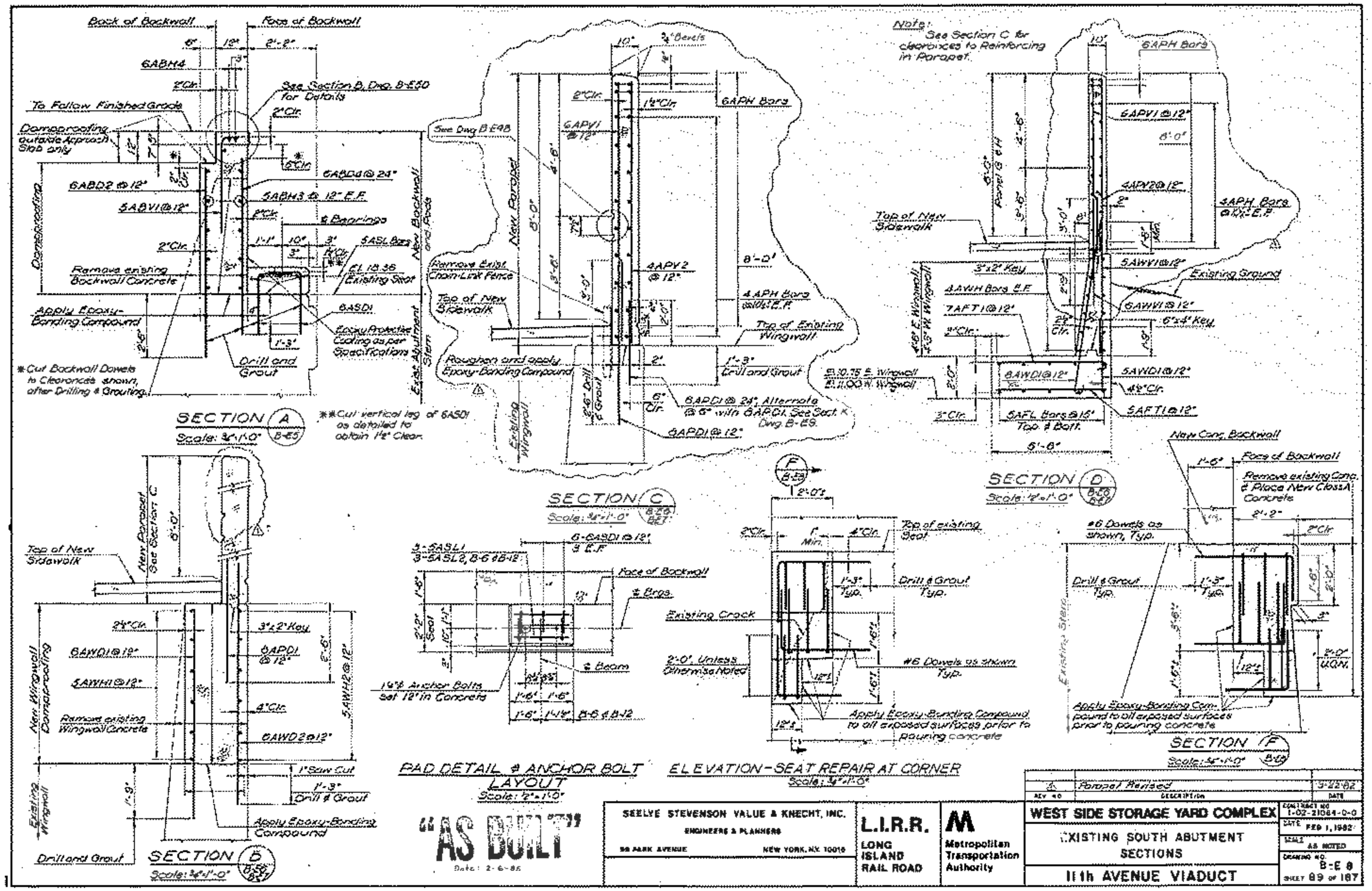
WEST SIDE STORAGE YARD COMPLEX
EXISTING SOUTH ABUTMENT
WEST WINGWALL
11th AVENUE VIADUCT

CONTRACT NO. 1-02-21004-0-0
DATE FEB. 1, 1982
SCALE ¼" = 1'-0"
DRAWING NO. 8 - E7
SHEET 88 OF 187



REV. NO.	DESCRIPTION	DATE
1	Parapet Revised	3-22-82

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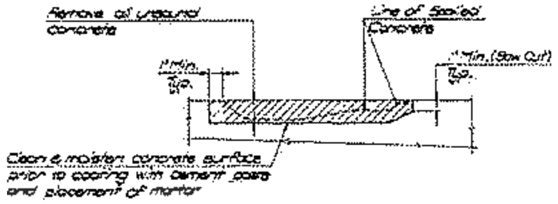
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
EXISTING SOUTH ABUTMENT SECTIONS
11th AVENUE VIADUCT

CONTRACT NO. 1-02-21064-0-0
DATE FEB 1, 1982
SCALE AS NOTED
DRAWING NO. B-E 8
SHEET 89 OF 187

DEPT OF BLDGS 121192618 Job Number

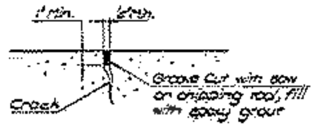
ES265951224 Scan Code



TYPICAL CONCRETE SURFACE REPAIR DETAIL

Not to Scale

PARAPET REINFORCING REQUIRED - ONE PANEL							
Panel	No. of Panels Req'd	Dowels		Verticals		Horizontal	
		8APD1	6APD1	4APV2	6APV1	Top	Intermediate
A	2	6	-	8	6	4-6APH1	18-4APH1
B	4	10	5	10	10	4-6APH2	18-4APH2
C	8	8	4	7	8	4-6APH3	8-4APH3
D	4	11	5	10	11	4-6APH4	18-4APH4
E	4	9	5	9	9	4-6APH5	8-4APH5
F	3	9	4	8	9	4-6APH6	18-4APH6
G	2	-	-	11	11	4-6APH7	18-4APH7
H	6	—	-	9	9	4-6APH8	18-4APH8

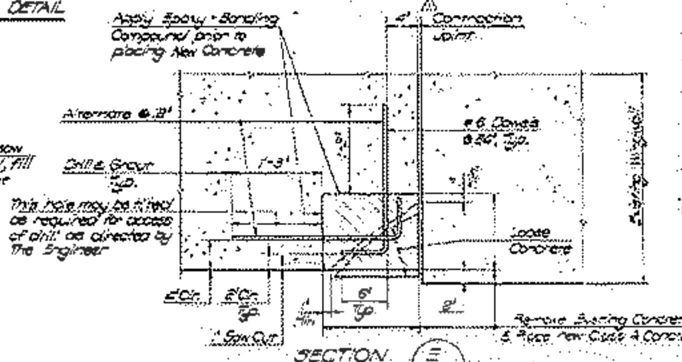


CRACK REPAIR DETAIL

Not to Scale

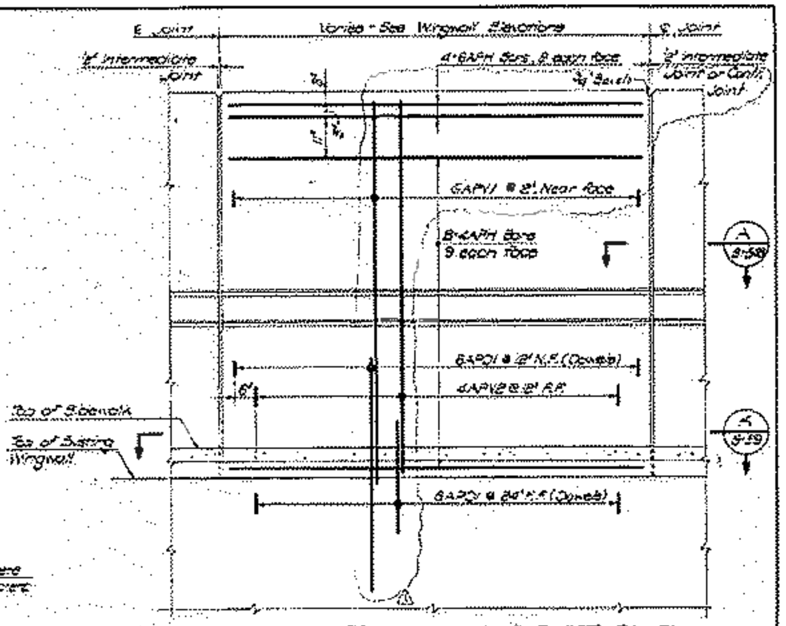
Note:

Use this Detail for cracks 1/8" to 1/4" wide on face of wall. Hair cracks do not require repairs.



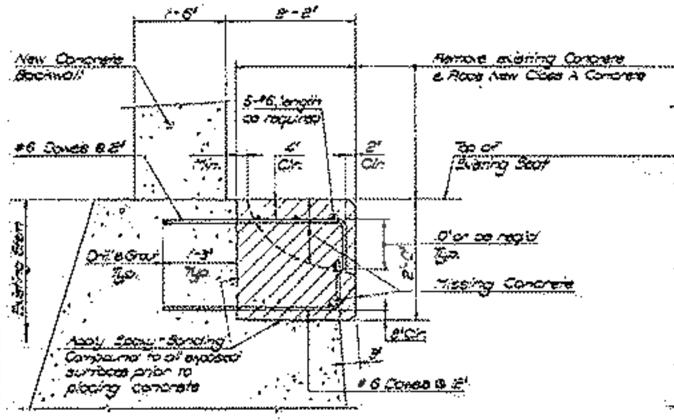
SECTION E 5-56 5-57

Not to Scale



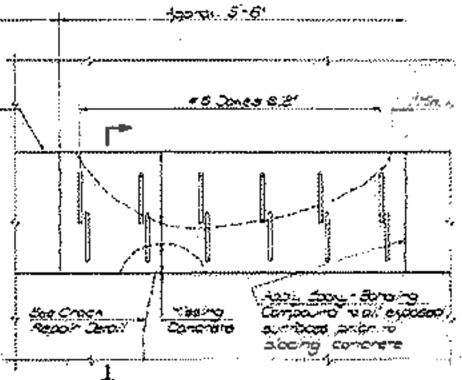
INSIDE ELEVATION - TYPICAL PARAPET PANEL

Scale: 3/4" = 1'-0"



SECTION B 5-59

Scale: 1" = 1'-0"



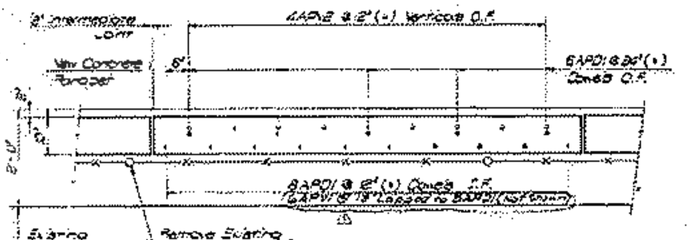
ELEVATION - SEAT REPAIR

Scale: 1" = 1'-0"

Note:

The dowels and other reinforcing bars shown at concrete replacement are not included in the bar schedule.

The exact number and length of bars and dowels will be determined after the deteriorated concrete has been removed.



I.F. - Inside Face

O.F. - Outside Face

SECTION K 5-59

Scale: 3/4" = 1'-0"

"AS BUILT"

Date: 2-6-85

REV. NO.	DESCRIPTION	DATE
1	Parapet Revised	3-22-82

SEELYE STEVENSON VALUE & KNECHT, INC.
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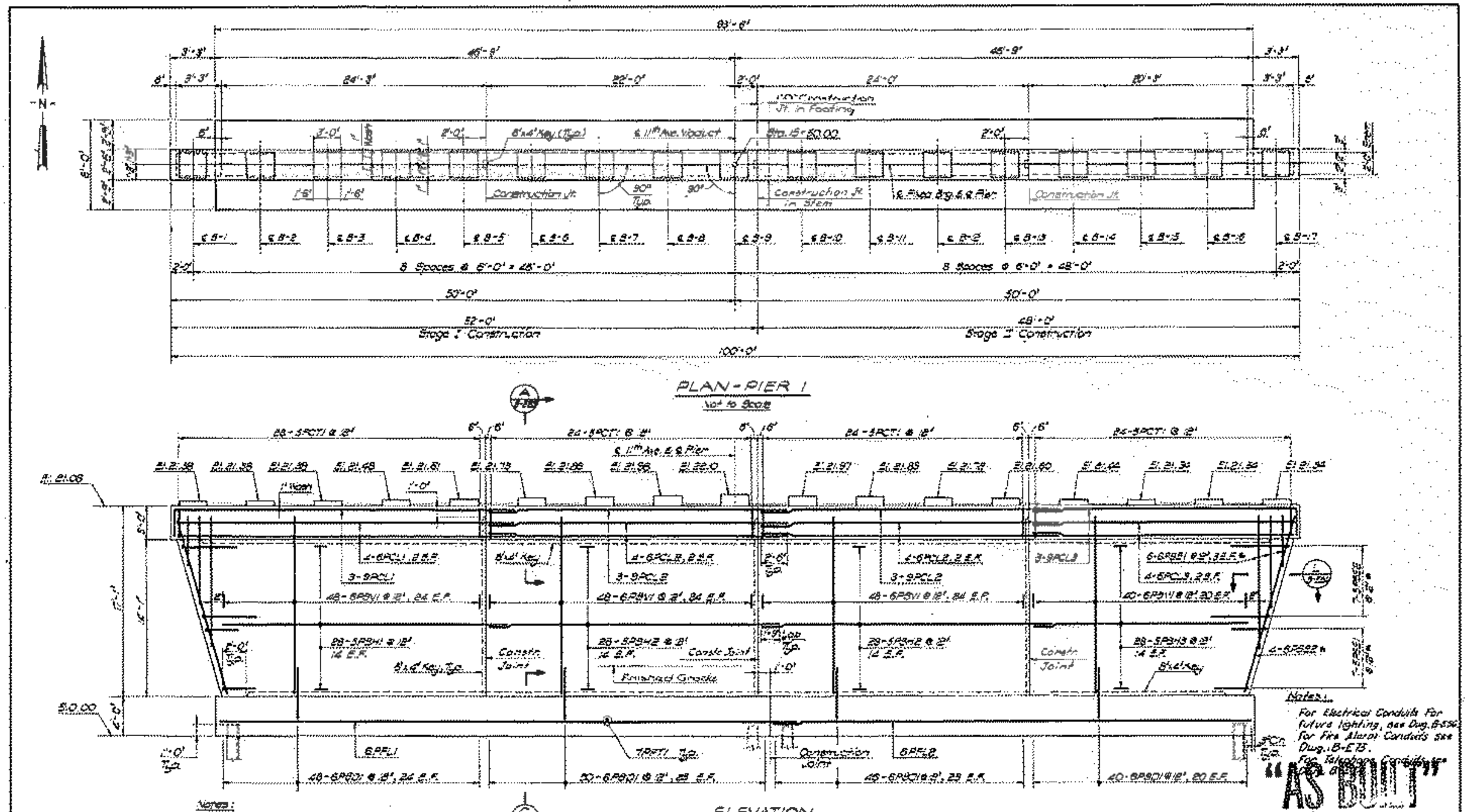
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX

EXISTING SOUTH ABUTMENT
REPAIR DETAILS

11th AVENUE VIADUCT

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE AS NOTED
DRAWING NO. 8-E 9
SHEET 90 of 187



PLAN - PIER I
Not to Scale

ELEVATION
Not to Scale

Notes:
For Electrical Conduits For future lighting, see Dwg. B-556.
For Fire Alarm Conduits see Dwg. B-E75.
For Telephone Conduits see Dwg. ...

"AS BUILT"
Date 12-6-85

Notes:
Bevel all exposed edges 1".
Minimum reinforcing cover to be 2" unless shown otherwise.
For Footing Plan, see Dwg. B-E10.
For Pad Details and Anchor Bolt Layout, see Dwg. B-E84.
For Pile Tip Reinforcing and Pile Note, see Dwg. B-E25.
For Reinforcing Steel Schedule, see Dwg. B-E39.

REV. NO.	DESCRIPTION	DATE

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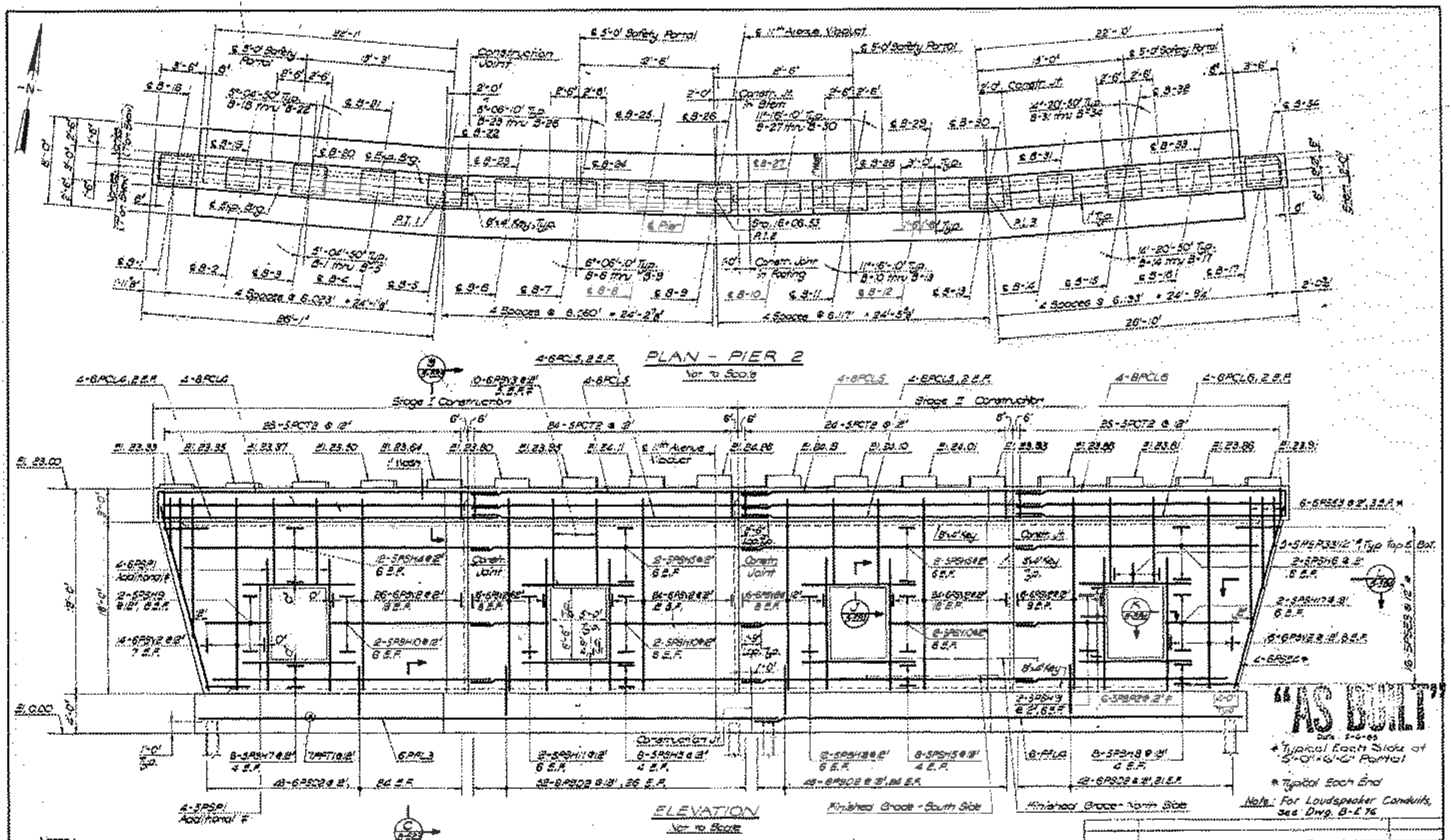
WEST SIDE STORAGE YARD COMPLEX
PLAN & ELEVATION
PIER I
11th AVENUE VIADUCT

CONTRACT NO. 1-02-21064-0-0
DATE FEB 1, 1982
SCALE NOT TO SCALE
DRAWING NO. B-E11
SHEET 92 OF 187



Note: For Loudspeaker Conduits, see Dwg. B-E 76

Notes:
Seal all exposed edges 1".
Minimum reinforcing cover to be 3", unless shown otherwise.
For Footing Plan, see Dwg. B-E14.
For Pad Details and Part Plan or P.I., see Dwg. B-224.
For Anchor Bolt Layout, see Dwg. B-E26.
For Pile Tip Reinforcing and Pile Note, see Dwg. B-E25.
For Reinforcing Steel Schedule, see Dwg. B-E59.

REV. NO	DESCRIPTION	DATE

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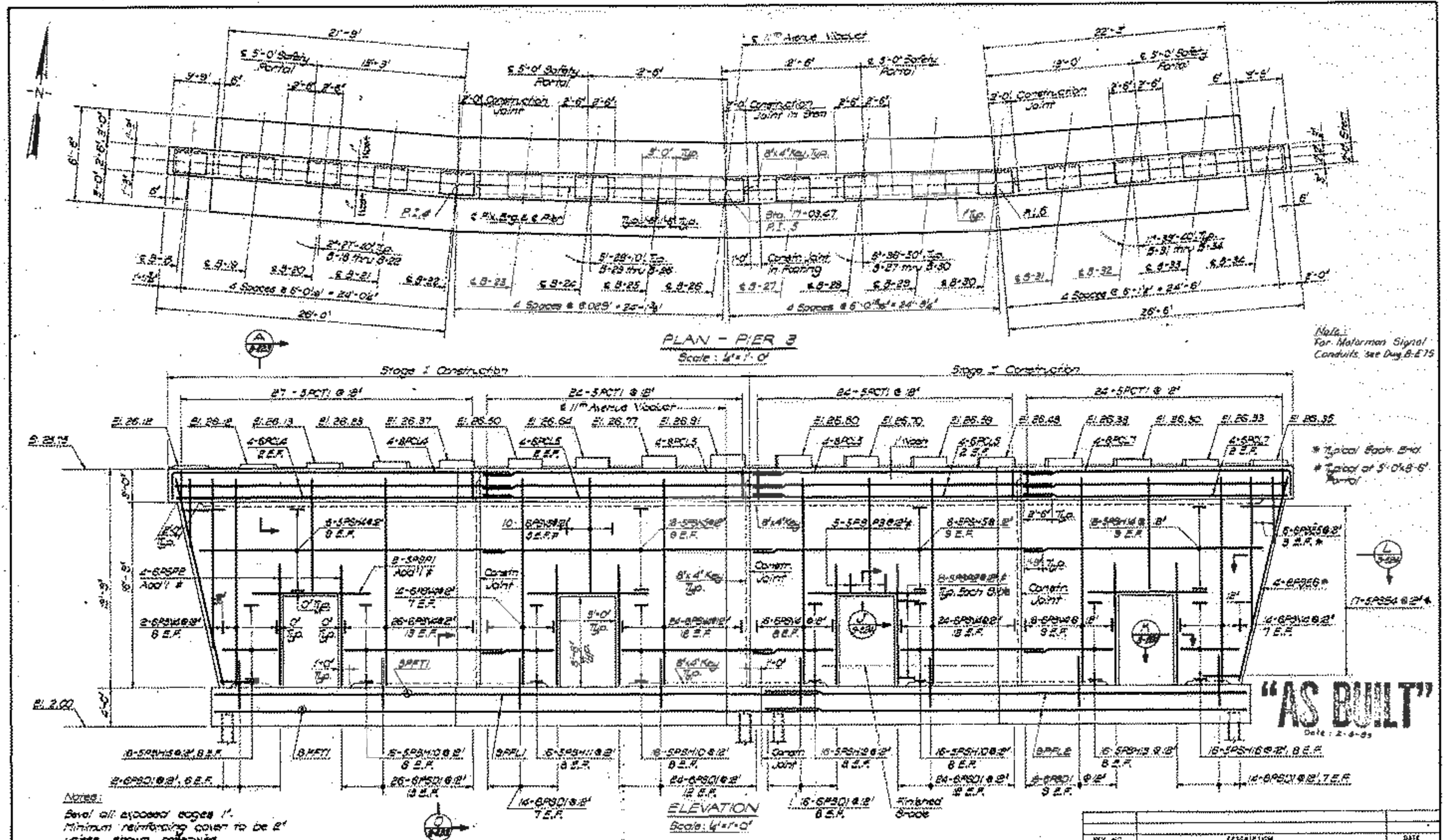
WEST SIDE STORAGE YARD COMPLEX
PLAN & ELEVATION
PIER 2
11th AVENUE VIADUCT

CONTRACT NO. 1-02-21084-0-0
DATE FEB. 1, 1982
SCALE NOT TO SCALE
DRAWING NO. B-E12
SHEET 93 OF 187



Notes:
Bevel all exposed edges 1".
Minimum reinforcing cover to be 2" unless shown otherwise.
For Footing Plan, see Dwg. B-E14.
For Pad Details and Part Plan at P.I., see Dwg. B-E24.
For Anchor Bolt Layout, see Dwg. B-E25.
For Pile Tip Reinforcing and Pile Note, see Dwg. B-E25.
For Reinforcing Steel Schedule, see Dwg. B-E60.

REV. NO.	DESCRIPTION	DATE

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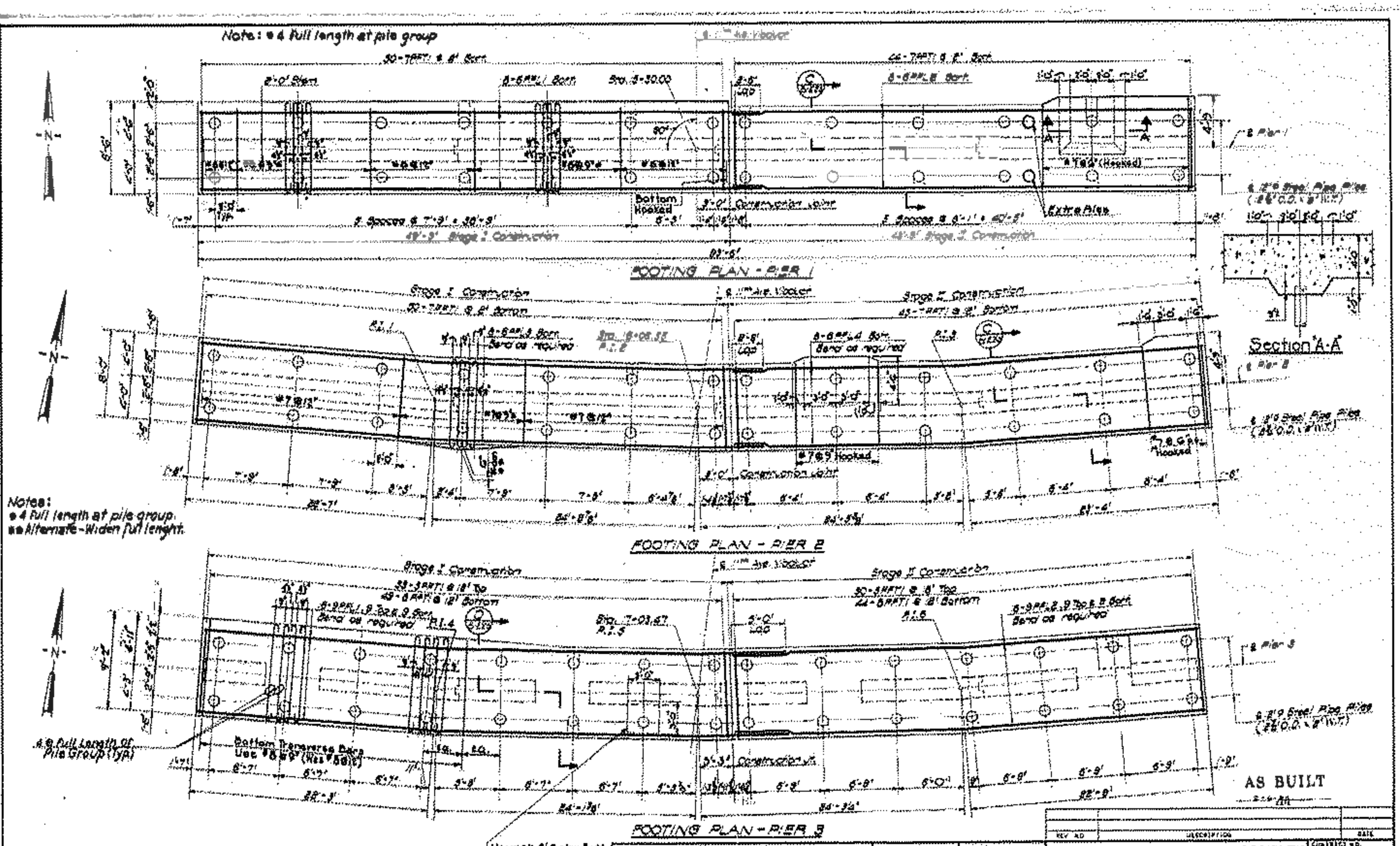
WEST SIDE STORAGE YARD COMPLEX
PLAN & ELEVATION
PIER 3
11th AVENUE VIADUCT

CONTRACT NO. 1-02-21064-0-0
DATE FEB 1, 1982
SCALE 1/4" = 1'-0"
DRAWING NO. B-E13
SHEET 94 OF 187



Note:

For Layout Plan - Pier 2, 3 & 4
See Dwg. No. B-E10

Legend:

○ Denotes battered pile (1:4)

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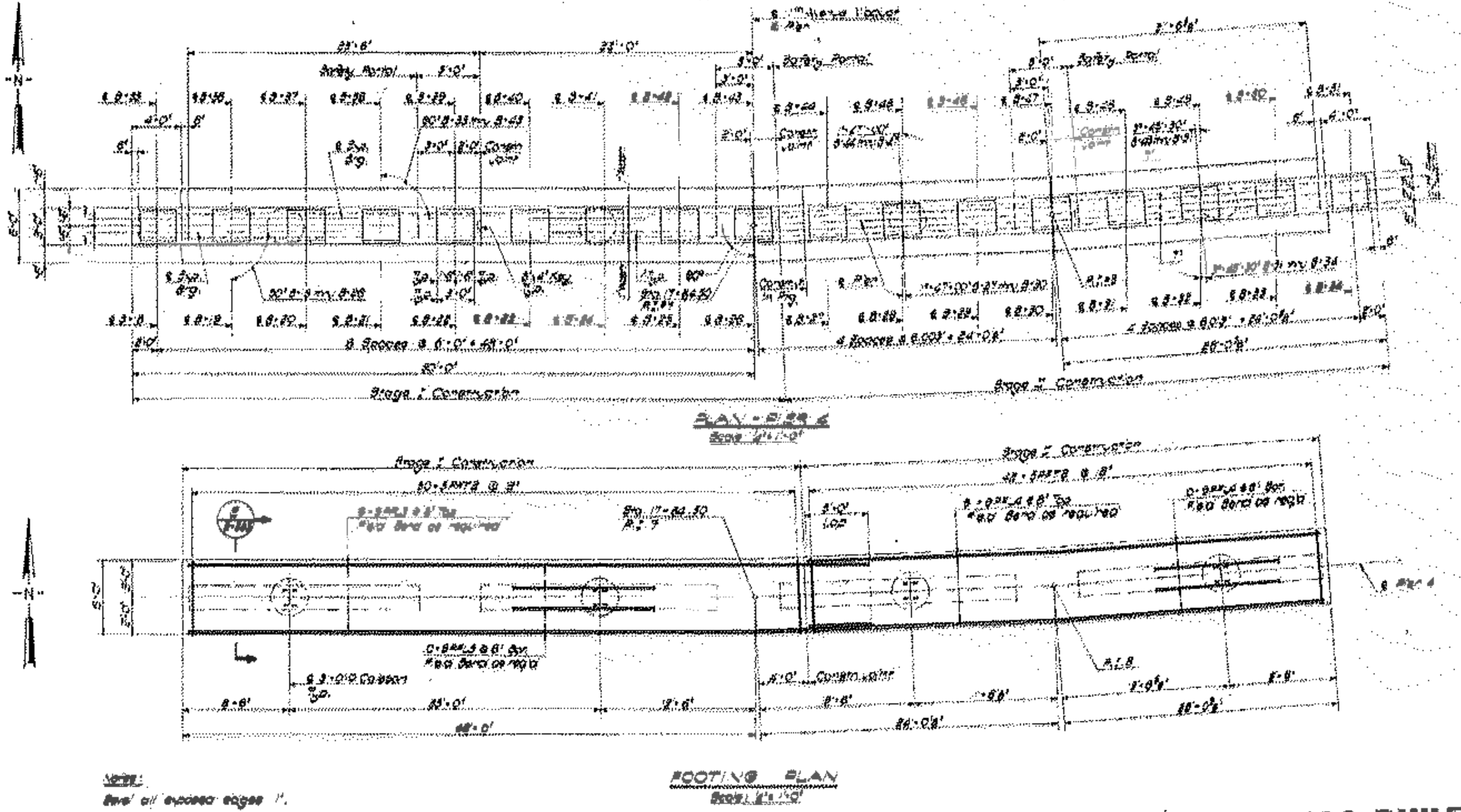
REV. NO.	DESCRIPTION	DATE

WEST SIDE STORAGE YARD COMPLEX
FOOTING PLAN
PIER 1, 2 & 3
11th AVENUE VIADUCT

CONTRACT NO. 3-04-E1004-0-0
DATE FEB. 1, 1988
SCALE NOT TO SCALE
DRAWING NO. B-E14
SHEET 98 of 187

DEPT OF BLDGS 121192618 Job Number

ES365750378 Scan Code



PLAN - EL.23.6

Scale: 1/4"=1'-0"

FOOTING PLAN

Scale: 1/4"=1'-0"

Notes:

Bevel all exposed edges 1".

Minimum reinforcing cover to be 2" unless shown otherwise.

For Elevation, see Dwg. S-216.

For Pad Details and Part Plan of P.E., see Dwg. S-226.

For Anchor Bolt Layout, see Dwg. S-224 & S-225.

For Reinforcing Steel Schedule, see Dwg. S-281.

"AS BUILT"

Date: [illegible]

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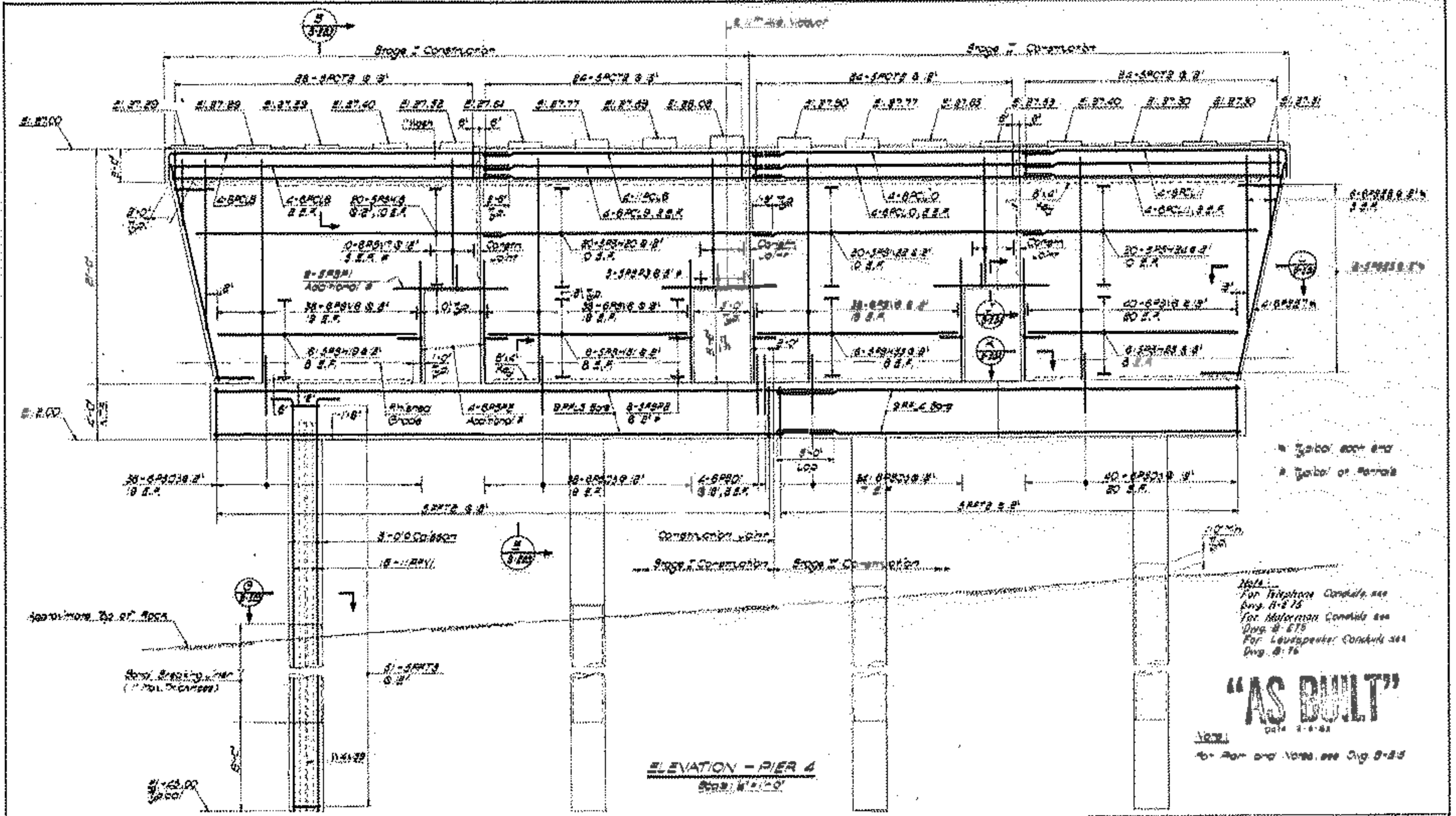
REV. NO. DESCRIPTION DATE

WEST SIDE STORAGE YARD COMPLEX

PLAN & FOOTING PLAN
PIER 4

11th AVENUE VIADUCT

DATE FEB 1, 1982
SCALE 1/4" = 1'-0"
DRAWING NO. S-510
SHEET 95 OF 187



ELEVATION - PIER 4

Scale: ¼" = 1'-0"

Note:
For Telephone Conduits see Dwg. B-E75
For Motorman Conduits see Dwg. B-E75
For Loudspeaker Conduits see Dwg. B-76

"AS BUILT"
Date 2-6-82

Note:
For Plan and Notes, see Dwg. B-E5

REV. NO.	DESCRIPTION	DATE

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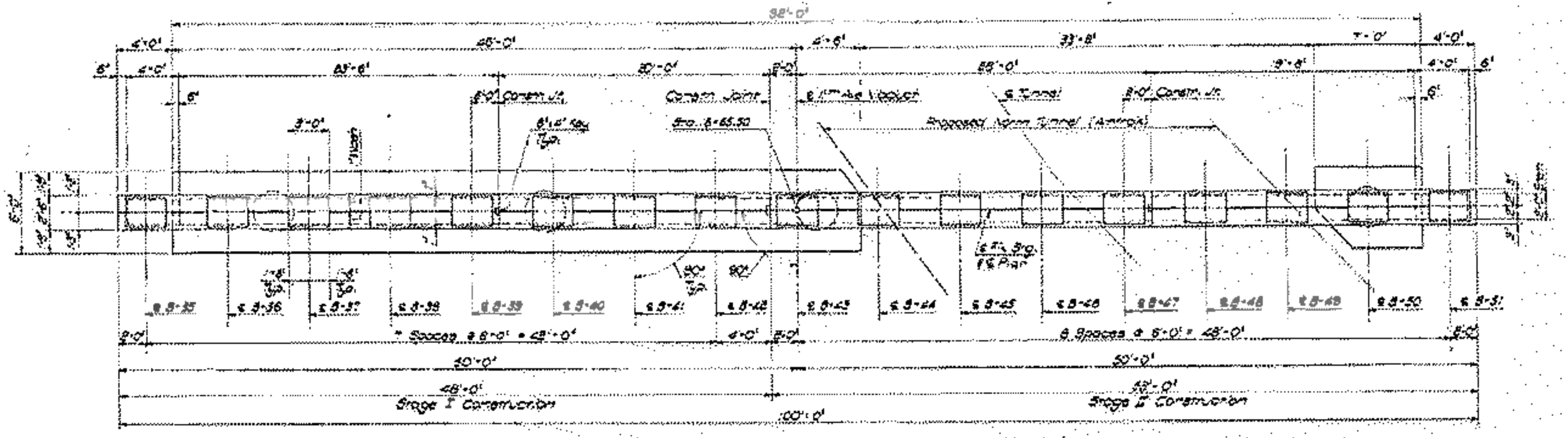
WEST SIDE STORAGE YARD COMPLEX

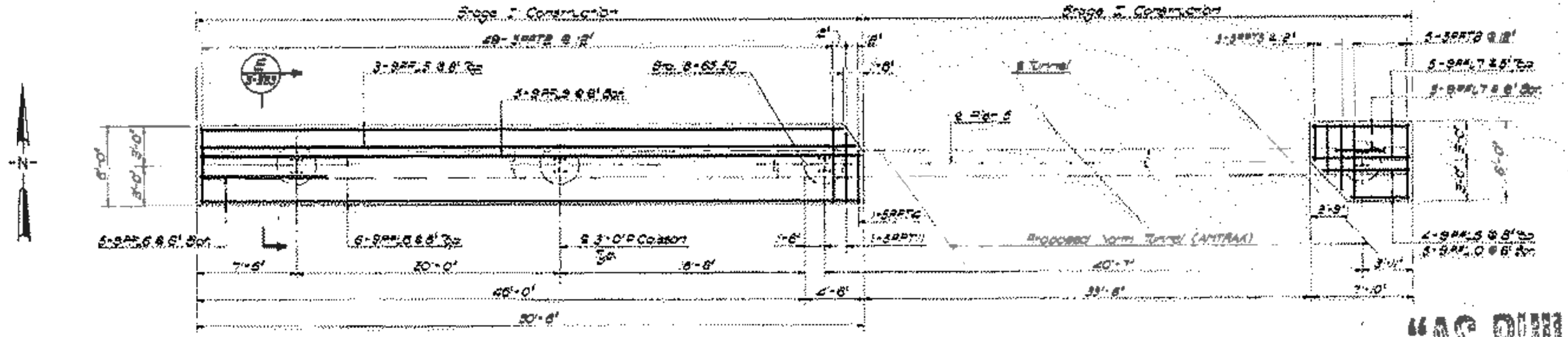
ELEVATION
PIER 4

11th AVENUE VIADUCT

CONTRACT NO. 7-02-21064-0-0
DATE FEB. 1, 1982
SCALE ¼" = 1'-0"
DRAWING NO. B-E16
SHEET 97 OF 197



PLAN - PIER 5
Scale: 1/4" = 1'-0"



FOOTING PLAN
Scale: 1/4" = 1'-0"

"AS BUILT"
Date: 3-6-95

Notes:

Bevel all exposed edges 1".

Minimum reinforcing cover to be 3"
unless otherwise noted.

For Elevation, see Dwg. S-216.

For Pad Details and Anchor Bolt Layout,
see Dwg. S-284.

For Reinforcing Steel Schedule, see Dwg. S-261.

REV. NO.	DESCRIPTION	DATE

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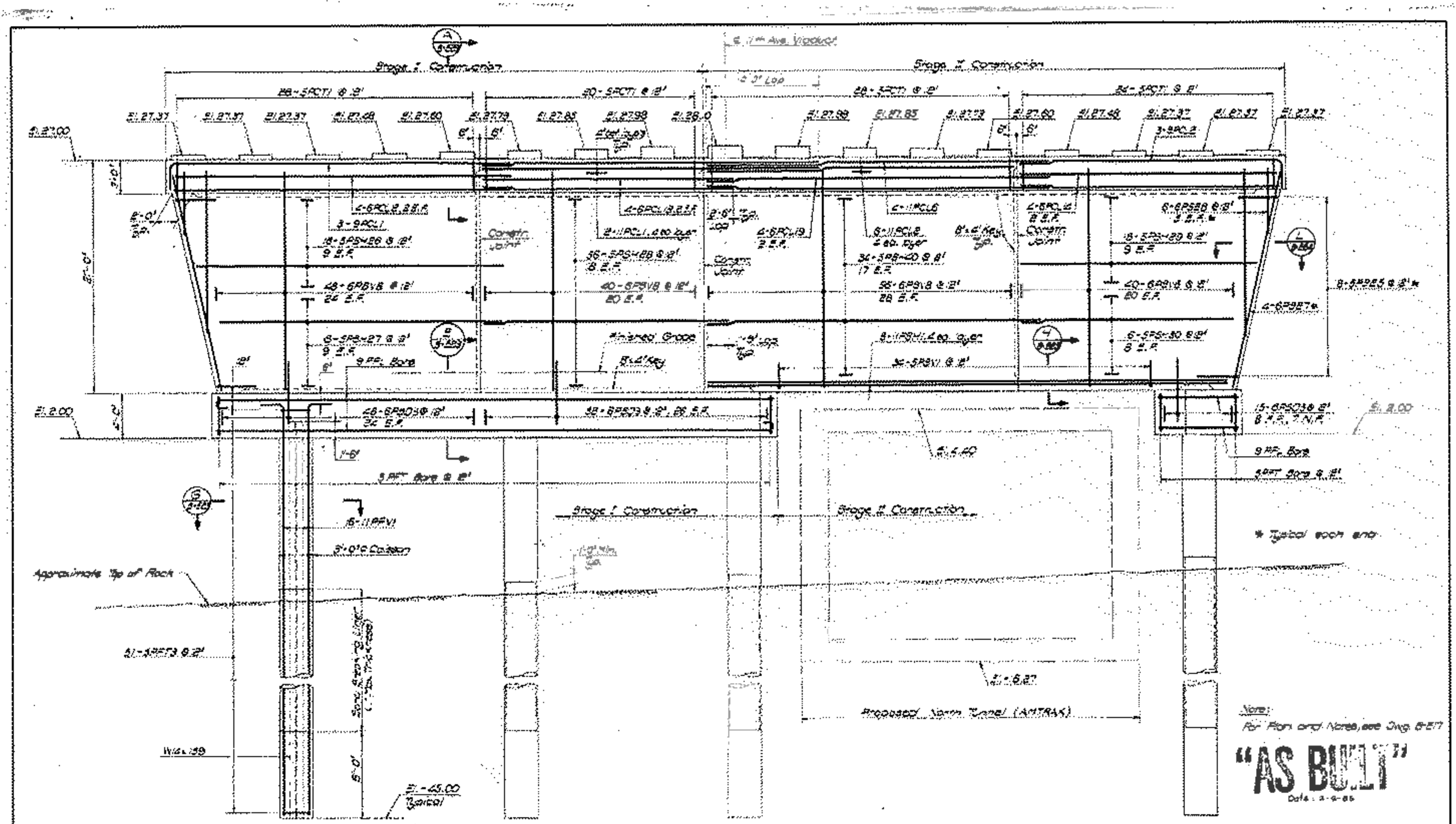
WEST SIDE STORAGE YARD COMPLEX
PLAN & FOOTING PLAN
PIER 5
11th AVENUE VIADUCT

CONTRACT NO. [illegible]
DATE FEB 1, 1988
SCALE 1/4" = 1'-0"
DRAWING NO. S-217
SHEET 98 OF 187

DEPT OF BLDGS121192618 Job Number

ES270876053 Scan Code



ELEVATION - PIER 5

Scale: ¼" = 1'-0"

Note:
For Plan and Notes, see Dwg. B-E17

"AS BUILT"
Date: 3-9-85

REV. NO.	DESCRIPTION	DATE

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WEST SIDE STORAGE YARD COMPLEX

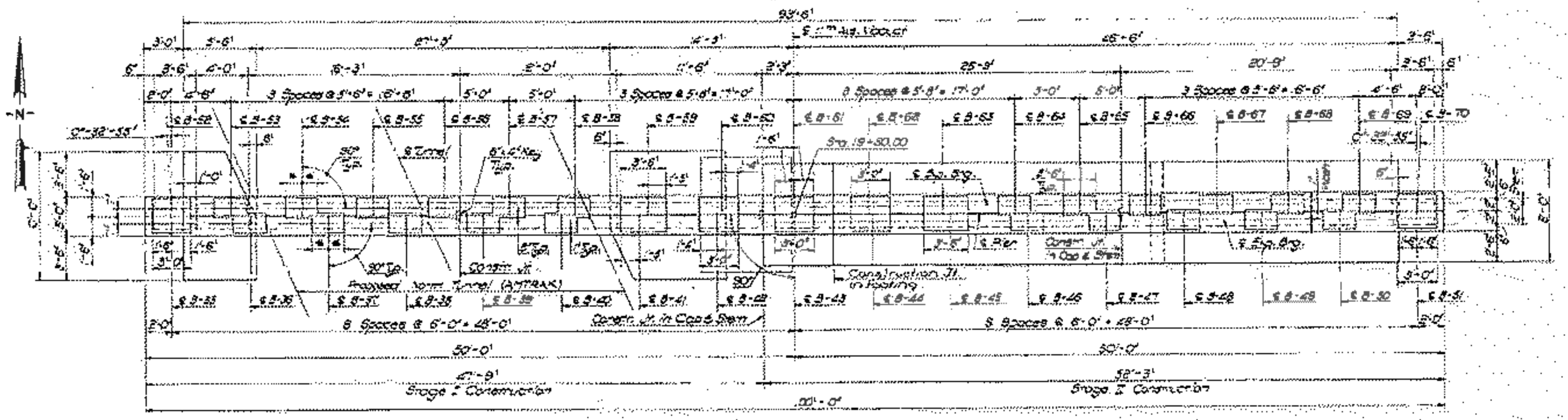
ELEVATION
PIER 5

11th AVENUE VIADUCT

CONTRACT NO. 3-02-23054-0-0
DATE FEB. 1, 1985
SCALE ¼" = 1'-0"
DRAWING NO. B-E18
SHEET 99 OF 187

DEPT OF BLDGS 121192618 Job Number

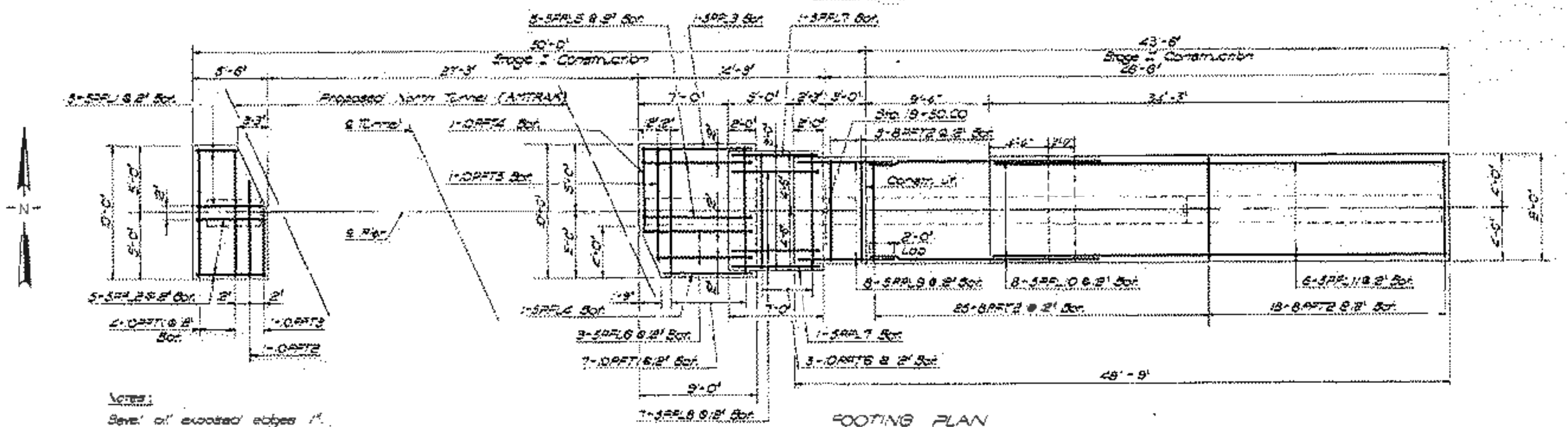
ES571432776 Scan Code



* 1'-3" Typ. Unless otherwise noted.

PLAN - PIER 6

Scale: 1/4" = 1'-0"



FOOTING PLAN

Scale: 1/4" = 1'-0"

Notes:

Bevel all exposed edges 1".

Minimum reinforcing cover to be 2"
unless shown otherwise.

For Elevation, see Dwg. B-E20.

For Pad Details and Anchor Bolt Layout,
see Dwg. B-E24.

For Excavation and Backfill Detail, see Dwg. B-E25.

For Reinforcing Steel Schedule, see B-E62.

AS BUILT

REV. NO.	DESCRIPTION	DATE

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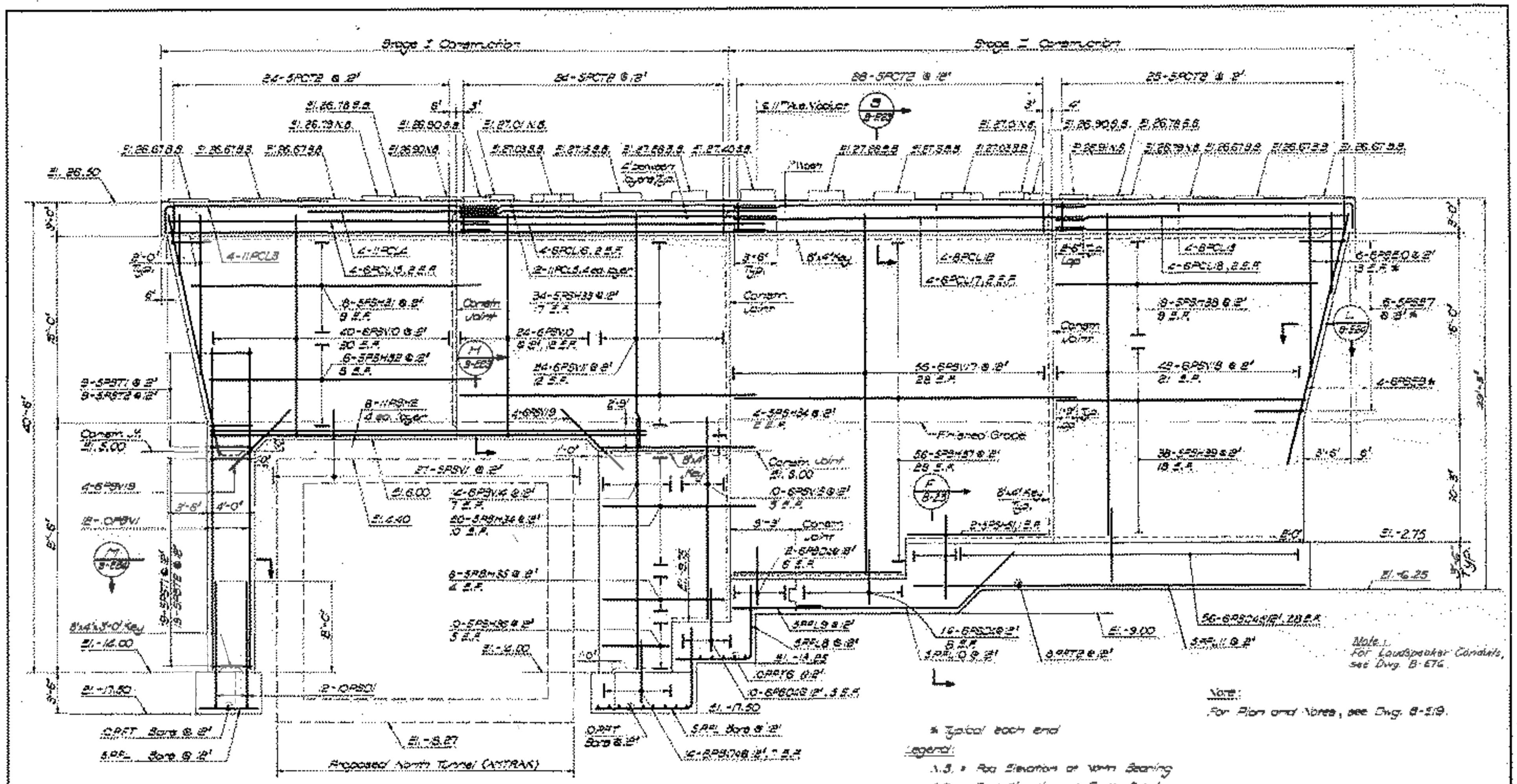
WEST SIDE STORAGE YARD COMPLEX

PLAN & FOOTING PLAN
PIER 6

11th AVENUE VIADUCT

CONTRACT NO [illegible]
DATE FEB 1, 1982
SCALE 1/4" = 1'-0"
DRAWING NO B-E 19
SHEET 100 OF 187



ELEVATION – PIER 6
Not to Scale

Note 1:
For Loudspeaker Conduits, see Dwg. B-E76.

Note:
For Plan and Notes, see Dwg. B-S19.

* Typical each end

Legend:
N.B. = Pad Elevation at North Bearing
S.B. = Pad Elevation at South Bearing
B.B. = Pad Elevation for both North & South Bearings

AS BUILT
2-4-86
DATE

REV. NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
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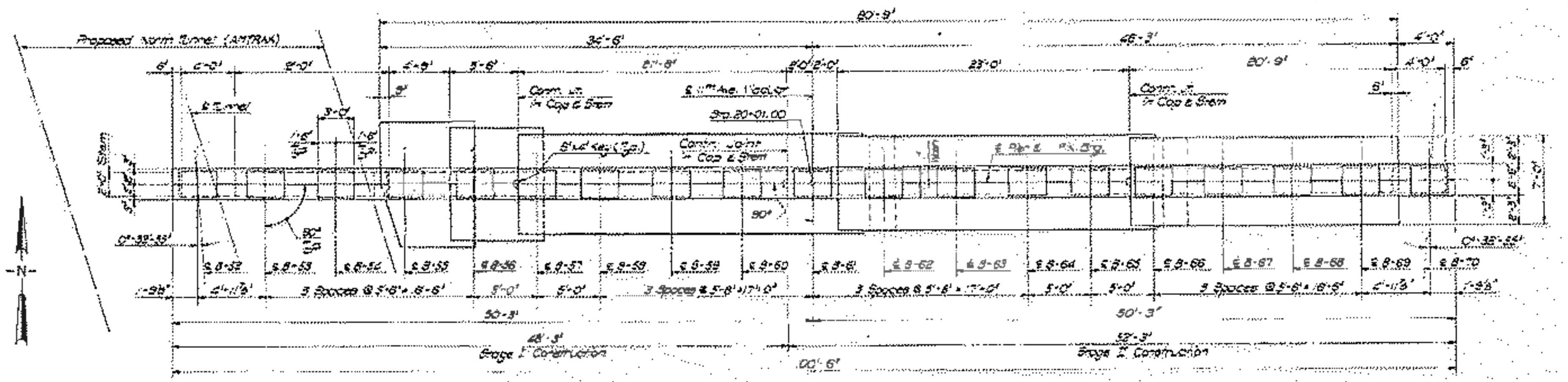
LONG ISLAND RAIL ROAD

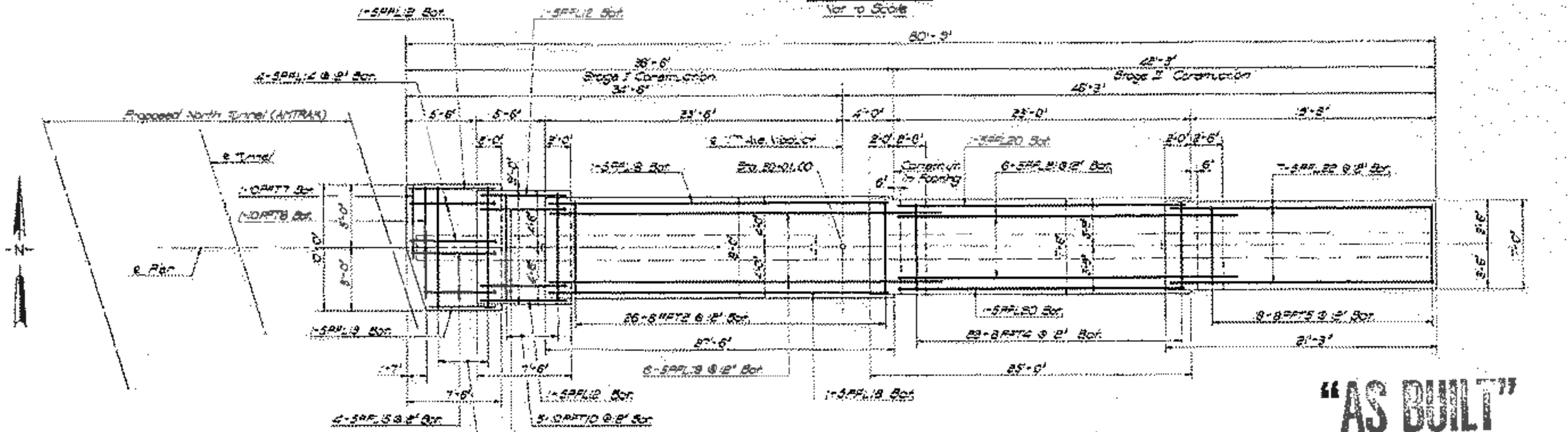
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
ELEVATION
PIER 6
11th AVENUE VIADUCT

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE NOT TO SCALE
DRAWING NO. B-E20
SHEET 101 OF 187



PLAN - PIER 7
Not to Scale



FOOTING PLAN
Not to Scale

"AS BUILT"
Date: 2-4-85

Notes:
Bevel all exposed edges 1".
Minimum reinforcing cover to be 2" unless shown otherwise.
For Elevation, see Dwg. B-E22
For Pad Details and Anchor Bolt Layout, see Dwg. B-E24
For Excavation and Backfill Detail, see Dwg. B-E25
For Reinforcing Steel Schedule, see Dwg. B-E63

REV. NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
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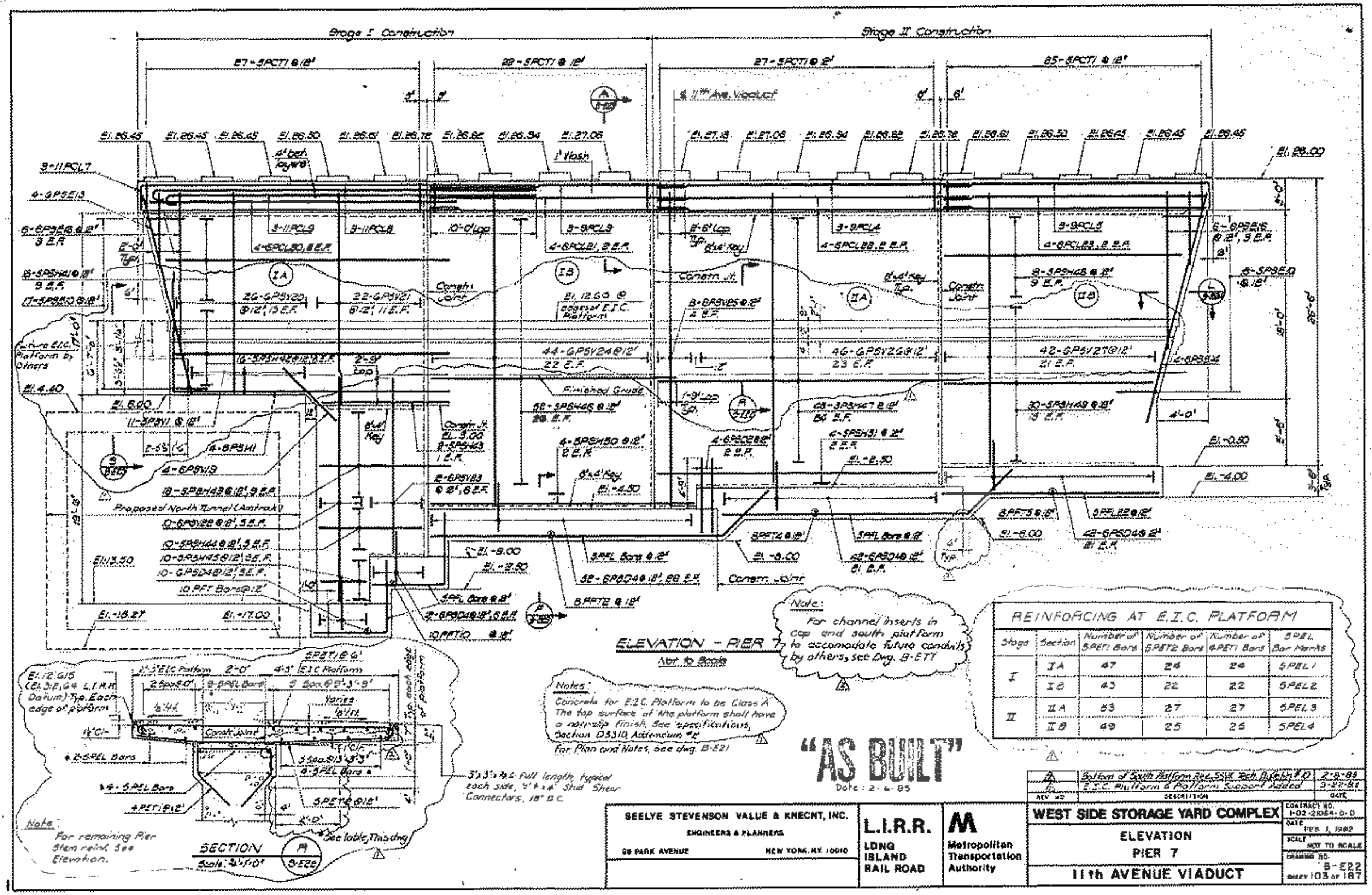
WEST SIDE STORAGE YARD COMPLEX
PLAN & FOOTING PLAN
PIER 7
11th AVENUE VIADUCT

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 1, 1982
SCALE NOT TO SCALE
DRAWING NO. B-E21
SHEET 102 OF 187



Note:
For remaining Pier Stem reinf. See Elevation.

ELEVATION - PIER 7
Not to Scale

Note:
For channel inserts in cap and south platform to accomodate future conduits by others, see Dwg. B-E77

Notes:
Concrete for E.I.C. Platform to be Class A. The top surface of the platform shall have a non-slip finish. See specifications, Section D3310 Addendum #2
For Plan and Notes, see dwg. B-E21

REINFORCING AT E.I.C. PLATFORM					
Stage	Section	Number of 5PET1 Bars	Number of 5PET2 Bars	Number of 4PET1 Bars	5PEL Bar Marks
I	IA	47	24	24	5PEL1
	IB	43	22	22	5PEL2
II	IIA	53	27	27	5PEL3
	IIB	49	25	25	5PEL4

"AS BUILT"
Date: 2-4-85

REV. NO.	DESCRIPTION	DATE
2	Bottom of South Platform Rev. SSVK Tech. Bulletin #10	2-8-83
1	E.I.C. Platform & Platform Support Added	3-22-82

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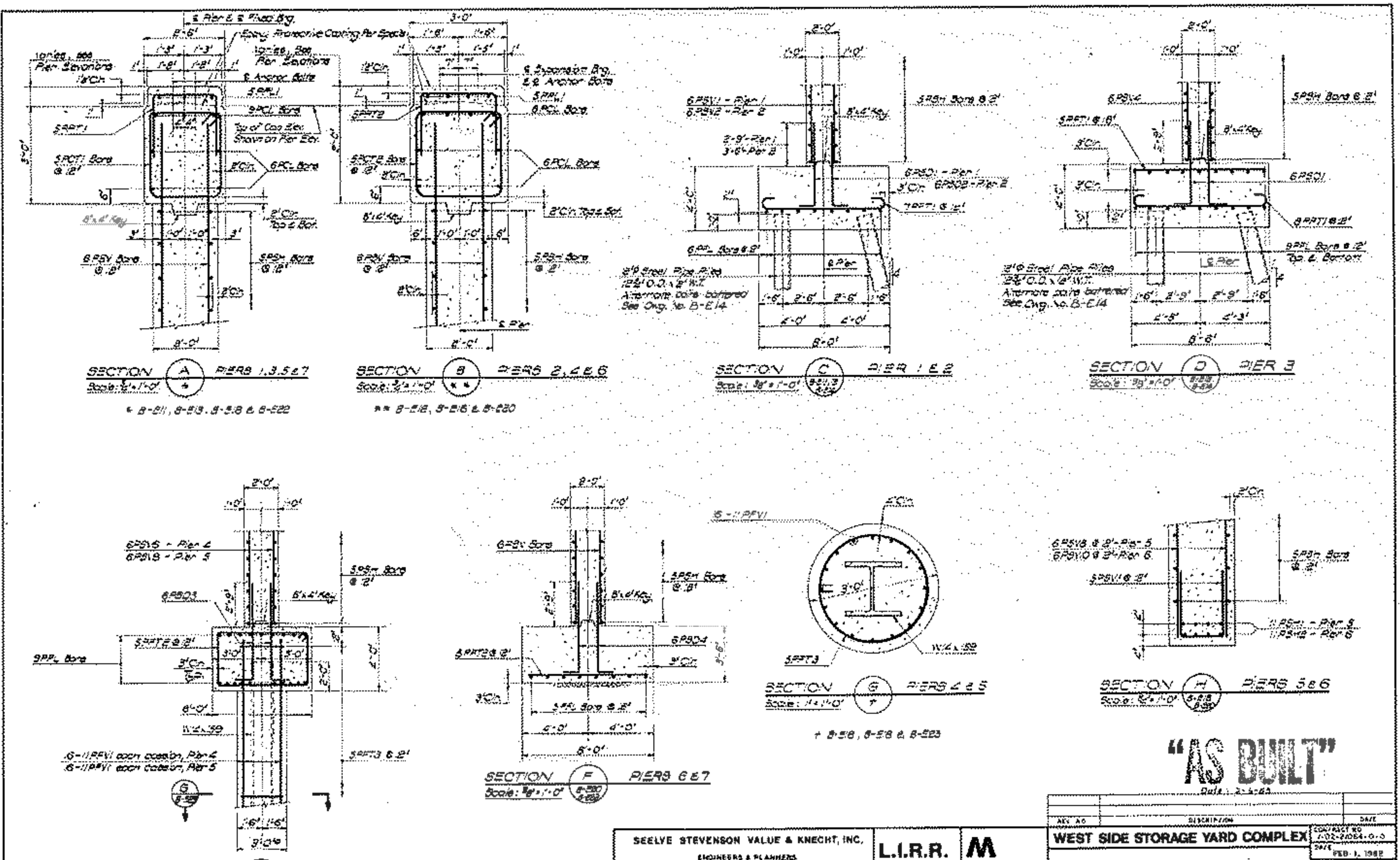
L.I.R.R.
LONG ISLAND RAIL ROAD

Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
ELEVATION
PIER 7
11th AVENUE VIADUCT

CONTRACT NO. 1-02-2064-0-0
DATE FEB. 1, 1982
SCALE NOT TO SCALE
DRAWING NO. B-E22
SHEET 103 OF 187



"AS BUILT"
Date: 2-4-83

REV. NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
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L.I.R.R.
LONG ISLAND RAIL ROAD

Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
PIER DETAILS
11th AVENUE VIADUCT

CONTRACT NO. 7-02-2064-0-0
DATE FEB. 1, 1982
SCALE AS NOTED
DRAWING NO. B-E23
SHEET 104 OF 187

MABSTOA Bus Garage Caissons and Footings

DRILLED CAISSONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: The work of this Section covers requirements for the construction of drilled caissons and related work for the box bridge section of the North Access Tunnel, the Tenth Avenue Bridge, the Eleventh Avenue Viaduct, and the foundations for the future MABSTOA Bus Garage, all as shown on the Drawings.

B. Related Work Described Elsewhere:

1.	Excavation and backfill.	Section 02220
2.	Reinforcing steel.	Section 03201
3.	Cast-in-Place concrete.	Section 03310
4.	Welding	Section 05100

1.02 DEFINITIONS

A. Bond Breaker Shell: A cylindrical shell inserted into the caisson shaft to prevent the concrete from bonding to the rock for a specified length of the shaft.

B. Steel Shell Casing: A steel pipe section used to prevent the soil from caving into the shaft, when installing the caisson from the top of the overburden soil. Where permanent steel casing is indicated on the Drawings, the steel pipe section is a structural member used to increase the*~~bearing~~ capacity of the caisson.

C. Peak Particle Velocity: The maximum of the three-plane velocity components measured at the closest point to the drill from inside the Amtrak North River Tunnels and/or at the closest underpinning column of the West Yard Building underpinning. VELOCITY IS DEFINED AS THE RATE OF [illegible] IN WAVE AMPLITUDE [illegible]

D. Sound Rock: Is rock free from soft seams, clay intrusions or other deleterious formations. Caissons shall bear on Class 1-65 - "Hard Sound Rock" as defined in Table -1-2 of the New York City Building Code.

1.03 SUBMITTALS

A. Submittals shall comply with the provisions of Section 01300.

B. The Contractor shall submit the following:

1. Certified mill test reports for permanent steel casings and for rolled steel shapes used as structural cores.

equipment.

3. Details of pier foundations, if proposed. (See paragraph 1.07 of this Section.)

1.04 QUALITY ASSURANCE

A. The subcontractor performing the work of this Section must be approved by the Engineer. Approval will be based on satisfactory evidence, furnished to the Engineer, of previous successful performance on completed projects having similar conditions to the work required under this Section.

B. Work shall be in accordance with provisions of American Concrete ~~Industry~~ INSTITUTE Standard ACI 336 "Pier Foundations", except where otherwise required in this Section or on the Drawings. △2

1.05 JOB CONDITIONS

A. The structural integrity of the Amtrak North River Tunnel and the underpinning of the West Yard Building shall at all times be preserved.

B. No work shall begin until the requirements for inspection and monitoring of vibrations and change conditions pertaining to the Amtrak Nortn River Tunnels have been established by the Contractor and approved by the Engineer.

C. No equipment or material shall be stored in the area above the existing tunnels. Where equipment must be operated above the existing tunnels, the limitations specified in Section 02220 shall be observed.

D. The Contractor is advised that obstructions may exist that could interfere with the driving of the steel shell casings. The Contractor shall make all necessary preliminary investigations to ascertain the nature of the underlying material.

1.06 PRODUCT STORAGE AND HANDLING

A. Bond breaker shell forms shall be safely stored at the site and protected from damage. They shall be stored on an elevated platform that is at least 4 inches high. The platform shall be long enough to support the length of the longest tube.

B. To protect the forms, they shall be covered (including ends) with a tarpaulin, allowing some circulation of air through the tubes. The tarpaulins shall remain on at all times until the forms are installed.

1.07 HAND DIGGING PIER FOUNDATIONS

A. In lieu of caisson drilling, and subject to the approval of the Engineer, the Contractor may hand dig pier foundations* to the same depth indicated for the caissons. Complete details of pier foundations and the methods of construction shall be submitted to the Engineer for approval. △2

* BY THE METHOD SPECIFIED IN PARAGRAPH [illegible] D OF SECTION 02220

2.01 CONCRETE WORK

A. Concrete work including reinforcing steel shall conform to the requirements of Section 03310, and as specified herein. Grout shall conform to the requirements for concrete grouting material as specified in Section 03010, and as specified herein.

1. Concrete and grout for MABSTOA Bus Garage foundations shall develop a minimum compressive strength of 6,000 psi at 28 days. Concrete and grout for other caissons shall develop a minimum compressive strength of 4,000 psi at 28 days. Slump shall range between 5 inches and 6 inches.

B. Reinforcing steel shall conform to the requirements as specified in Section 03200 for grade 60 steel.

C. Steel for structural core beams and stub core beams shall conform to ASTM A36.

2.02 STEEL SHELL CASING

A. Steel shell casings shall be of the size indicated in the Drawings and of length and thickness as required to prevent soil caving in on the shaft. Permanent steel casings shall be of minimum wall thickness indicated, and shall be in accordance with ASTM A252, Class 2. Casings shall be provided with a hardened steel cutting shoe welded to the bottom of the casing.

2.03 BOND BREAKER SHELL

A. Bond breaker shell forms for caissons shall be of the diameter shown on the Drawings and shall be seamless Sonotube with a protective coating, as manufactured by the Sonoco Products Company, or Authority approved equal. Forms shall be one continuous section for each caisson where required.

B. Forms shall be spirally constructed of laminated plies of fibre. The width of each ply shall not be less than 6 inches. Plies shall be laminated with an adhesive of a type with a proven record of satisfactory service in forms for concrete.

C. The exterior surface shall be uniformly wax impregnated for weather and moisture protection. Interior ply shall allow uniform moisture penetration to prevent unequal expansion of the fibers with consequent dimpling of the concrete surface.

2.04 EQUIPMENT

A. Equipment shall be of adequate type and capacity to install drilled caissons and is subject to the Engineer's approval. The equipment shall be capable of drilling through sound rock, and shall not produce peak particle velocities in excess of those stated in paragraph 3.03 A.2 of this Section.

PART 3

3.01 INSTALLATION OF STEEL SHELL CASINGS

A. Permanent steel shell casings shall be installed at caissons for the MABSTOA Bus Garage foundations. Steel shell casings may be installed at other caissons where the Contractor elects to install the caisson through the earth overburden. Steel shells shall be advanced to and seated into bedrock through the use of pile driving equipment and/or drilling and bailing equipment.

B. Casings shall be installed in one single continuous length for each caisson, where feasible. Splicing of caissons shall be held to a minimum. Where splices are required, they shall be made with an external steel sleeve at least 12 inches long and the same wall thickness as the casing. Ends of the casing at splices shall be square cut, so that the sections will bear on each other. Ends of the sleeve shall be welded to each casing section with a continuous weld of size 1/8 inch less than the sleeve thickness.

C. The Contractor shall, by means of auger drilling or as appropriate remove all loose material from within the shell after it has been installed.

1. Removal of loose material by means of air lifting will not be permitted unless the Contractor can demonstrate safety to all persons and property, as approved by the Engineer.

D. After cleaning the shell casing interior, it shall be redriven to seat securely into the bedrock to form a watertight seal. ✳ △3

1. The integrity of the shell casing shall be maintained throughout installation. Any significant damage to the outside of the caisson, as determined by the Engineer, shall be grounds for removal and replacement with new material at no additional cost to the Authority.

3.02 DRILLING OF ROCK SHAFTS AND SOCKETS

A. Caisson shafts and sockets shall be drilled into rock using equipment which will produce vibrations not greater than the levels specified in paragraph 3.03A.2 of this Section.

B. Each socket bottom shall be approved by the Engineer before concrete is placed therein.

C. The Engineer may direct an increase in socket length if inferior quality rock is encountered within the original socket length or if unsuitable formations are encountered at the bottom of the socket.

✳"Equipment and methods used to seat the caisson into the bedrock shall not result in vibrations greater than the levels specified in paragraph 3.03 A. 2. of this Section".

A. ity. The nce. The seismologist will monitor continuously the vibrations at underpinning columns and within the adjacent Amtrak North River tunnels resulting from the installation of the caissons and drilling operations. Measurements will be taken to determine peak particle velocity, as defined below.

△2 1. Peak particle velocity will be measured during a period when:

"a. Drilling is being undertaken and a train is passing in the tunnel.

b. Drilling is being undertaken and no train is in the tunnel."

△2 "2. The peak particle velocity measured under working conditions shall not exceed 1 inch per second in the Amtrak North River Tunnels, the North Access Tunnel or the Evacuation Tunnel; at the West Yard Building underpinning, the peak particle velocity at underpinning columns shall not exceed 0.5 inch per second."

3. Monitoring equipment will be remote control from outside of the tunnel area.

3.04 INSTALLATION OF BOND BREAKER SHELL

A. Where indicated on the Drawings, bond breaker shell forms shall be installed in drilled caisson shafts to prevent bond between new concrete and the walls of the shaft.

B. The shell form shall to be lowered down into the drilled hole without using force that may damage the shell. It shall be held rigidly in position so that its tip is located at the level shown on the Drawings and remains in position during placement of concrete.

3.05 INSTALLATION OF STEEL CORE OR REINFORCING CAGE

A. The core or cage shall be installed as shown on the Drawings and firmly held in vertical alignment. Steel cores shall be cleaned of loose rust and installed unpainted.

B. Spacers, capable of sliding on the casing and shell, shall be securely attached to the reinforcement or core, and shall be of a design that will not cause damage to the surfaces of the casing and shell.

C. The core or cage shall not be installed until the Engineer has inspected and approved the caisson.

3.06 CONCRETE PLACEMENT

A. The Contractor shall submit for the Engineer's approval his sequence of operations, including the placement of grout, steel reinforcement, steel cores and concrete at each structure. Placement shall not be started until the sequence of operations has been approved by the Engineer.

B. The Contractor shall prepare a clean, dry caisson for inspection of the caisson and placement of concrete.

2. The Contractor shall place a grout seal at the bottom of the steel shell casing if necessary to prevent intrusion of water or undesirable material into the caisson.

C. The Contractor shall furnish all equipment necessary to the Engineer for inspection of the caisson. This shall include, but not be limited to lamps, drop cords, and mirrors.

D. The Contractor shall notify the Engineer and make inspection equipment available a minimum of 24 hours in advance of anticipated concrete or grout placement.

E. The caisson will be reinspected by the Engineer immediately prior to the placement of grout or concrete. If water or debris has intruded into the caisson during the elapsed period it shall be removed and the caisson cleaned before placement of the grout or concrete will be allowed.

F. Dry Caisson Concreting Procedure:

1. Install steel core or cage as required after socket has been completed and pumped out.

2. Place cement grout to depth of 24 inches in socket

3. Grout shall set a minimum of 24 hours before concrete is placed over it.

4. Concrete, of slump as specified, shall be a continuous placement to the limits detailed on the Drawings.

5. Concrete and grout shall be placed so that it completely fills the caisson and in a manner that will preclude separation of the ingredients.

G. Wet Caisson Concreting Procedure:

1. Should the Contractor be unable to restrict inflow of water into the caisson to 4 inches or less per hour the following procedure for placement of grout and concrete shall be followed:

   a. Install steel core or cage as required after socket has been completed, cleaned out and shell is filled with water to ground water level elevation.

   b. Place 1 1/2 inch grout pipe to bottom edge of socket, bottom edge of grout pipe to be cut on a 45° angle.

   c. Pump in grout, through grout pipe until 4 feet above level of cutting edge. Withdraw grout pipe.

   d. Allow grout to set 48 hours.

f. Place 1/2 cu. yd. of grout into caisson.

g. Follow up at once with concrete as specified above using the procedure specified for dry caissons in Paragraph 3.06 F. above, steps 3 and 4.

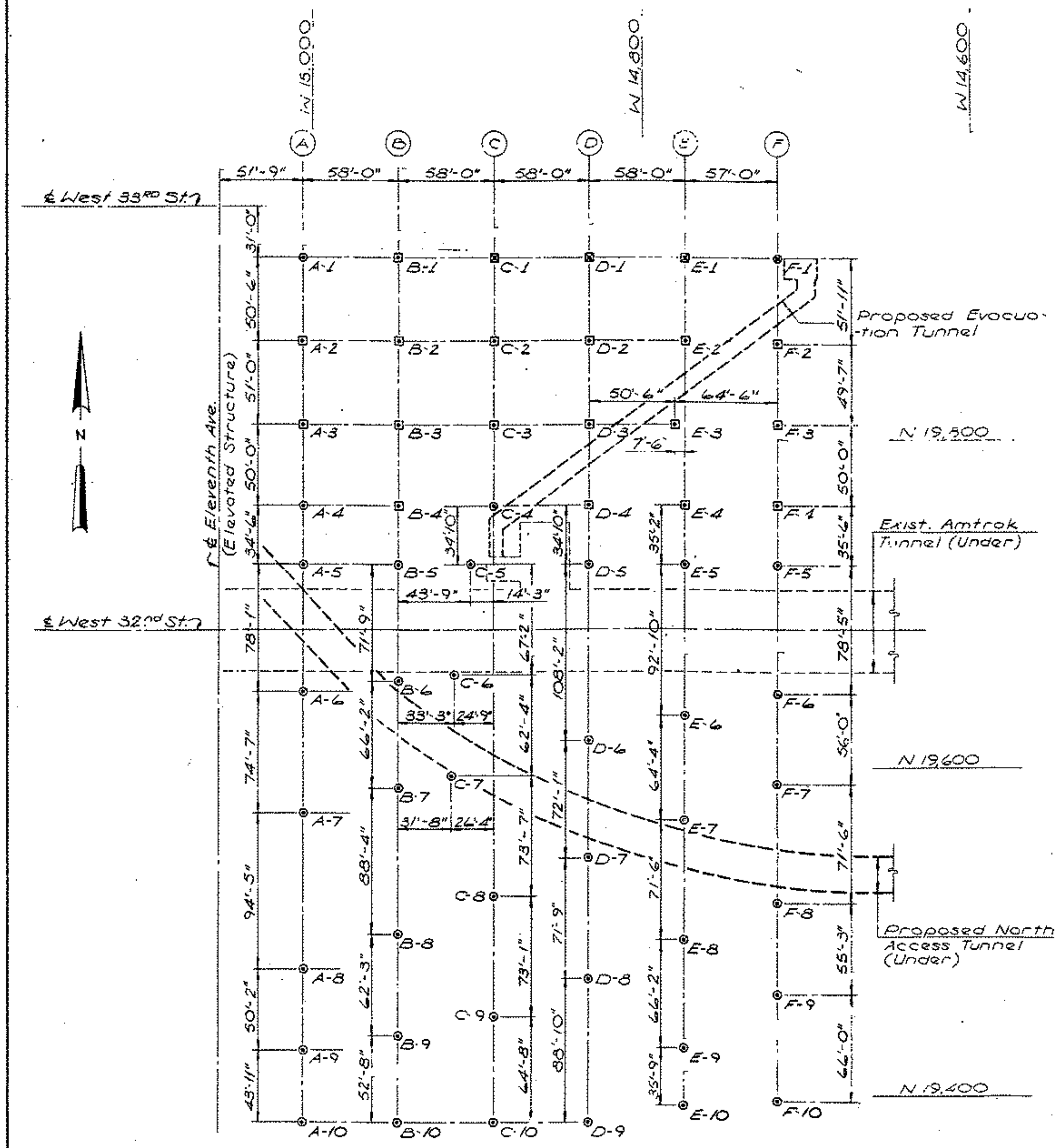
3.07 LOCATION OF CAISSONS

A. Unless otherwise approved, the location of the caissons shall be as shown on the Drawings. Any deviations in the actual locations of the caissons of greater than three inches from the locations as stated on the Drawings, or more than 1 1/2 percent of the length of the caisson out of plumb,* shall be cause for rejection by the Engineer and shall be replaced by the Contractor at no additional cost to the Authority.

B. Where deviations within the specified tolerances occur, caps and cores shall be installed at the design locations shown on the Drawings and not centered on the deviated caisson.

END OF SECTION

△ * "FOR MABSTOA FOUNDATION CASSIONS, OR MORE THAN 5% OF THE LENGTH OF THE CAISSON OUT OF PLUMB FOR [illegible] OTHER CAISSONS



FOUNDATION PLAN

Scale: 1" = 40'-0"

FOUNDATION LAYOUT DATA

Foundation Designation	North Coordinate	West Coordinate	Foundation Designation	North Coordinate	West Coordinate
A-1	19910.343	15005.917	D-1	19910.328	14831.917
A-2	19859.843	15005.921	D-2	19859.828	14831.921
A-3	19808.843	15005.926	D-3	19808.828	14831.926
A-4	19758.843	15005.930	D-4	19758.828	14831.930
A-5	19724.343	15005.933	D-5	19723.995	14831.933
A-6	19646.260	15005.940	D-6	19615.828	14831.942
A-7	19571.676	15005.946	D-7	19543.745	14831.949
A-8	19477.260	15005.954	D-8	19471.995	14831.955
A-9	19427.093	15005.959	D-9	19383.161	14831.962
A-10	19383.176	15005.962	E-1	19910.323	14773.917
B-1	19910.338	14947.917	E-2	19859.823	14773.921
B-2	19859.838	14947.921	E-3	19808.824	14781.426
B-3	19808.838	14947.926	E-4	19758.823	14773.930
B-4	19758.838	14947.930	E-5	19723.656	14773.933
B-5	19724.338	14947.933	E-6	19630.823	14773.941
B-6	19652.588	14947.939	E-7	19566.490	14773.947
B-7	19586.421	14947.945	E-8	19494.990	14773.953
B-8	19498.088	14947.953	E-9	19428.823	14773.958
B-9	19435.838	14947.958	E-10	19393.073	14773.961
B-10	19383.171	14947.962	F-1	19910.318	14716.917
C-1	19910.333	14889.917	F-2	19858.401	14716.922
C-2	19859.833	14889.921	F-3	19808.818	14716.926
C-3	19808.833	14889.926	F-4	19758.818	14716.930
C-4	19758.833	14889.930	F-5	19723.318	14716.933
C-5	19724.001	14904.183	F-6	19644.901	14716.940
C-6	19656.835	14914.689	F-7	19588.901	14716.945
C-7	19594.502	14916.277	F-8	19517.401	14716.951
C-8	19520.916	14889.951	F-9	19462.151	14716.956
C-9	19447.833	14889.957	F-10	19396.151	14716.961
C-10	19383.166	14889.962			

Clearance of Adjacent Caissons and Footings to Tunnels

Foundation Designation	Offset Distance Ft. *	Tunnel
C-5	6.07	Evacuation
C-4	2.62	"
D-3	6.89	"
E-3	8.70	"
F-1	N.I.C.	"
F-2	7.41	"
A-6	9.79	Exist. Amtrak
B-6	5.62	" "
C-6	1.38	" "
A-5	9.46	North Access
B-6	2.47	" "
C-7	1.51	" "
E-7	3.51	" "
		" "

△1

LEGEND

- ⊙ Denotes location of drilled caisson See details
- ⊡ Denotes location of spread footing on rock. See details
- ⊗ Denotes location of drilled caisson. (Not in contract)
- ⊠ Denotes location of spread footing on rock. (Not in contract)

* Offset distance is from the face of the 3'-0" diameter caisson or spread footing to the outside face of the tunnel wall. Only foundations with an offset distance of 10'-0" or less are listed here.

NOTE:
The dimensions for column row 'F' apply to row 'F' only.

"AS BUILT"
Date: 2-6-85

REV NO	DESCRIPTION	DATE
△1	ADD TABLE ON CLEARANCE OF ADJACENT CAISSONS AND FOOTINGS	3-22-82

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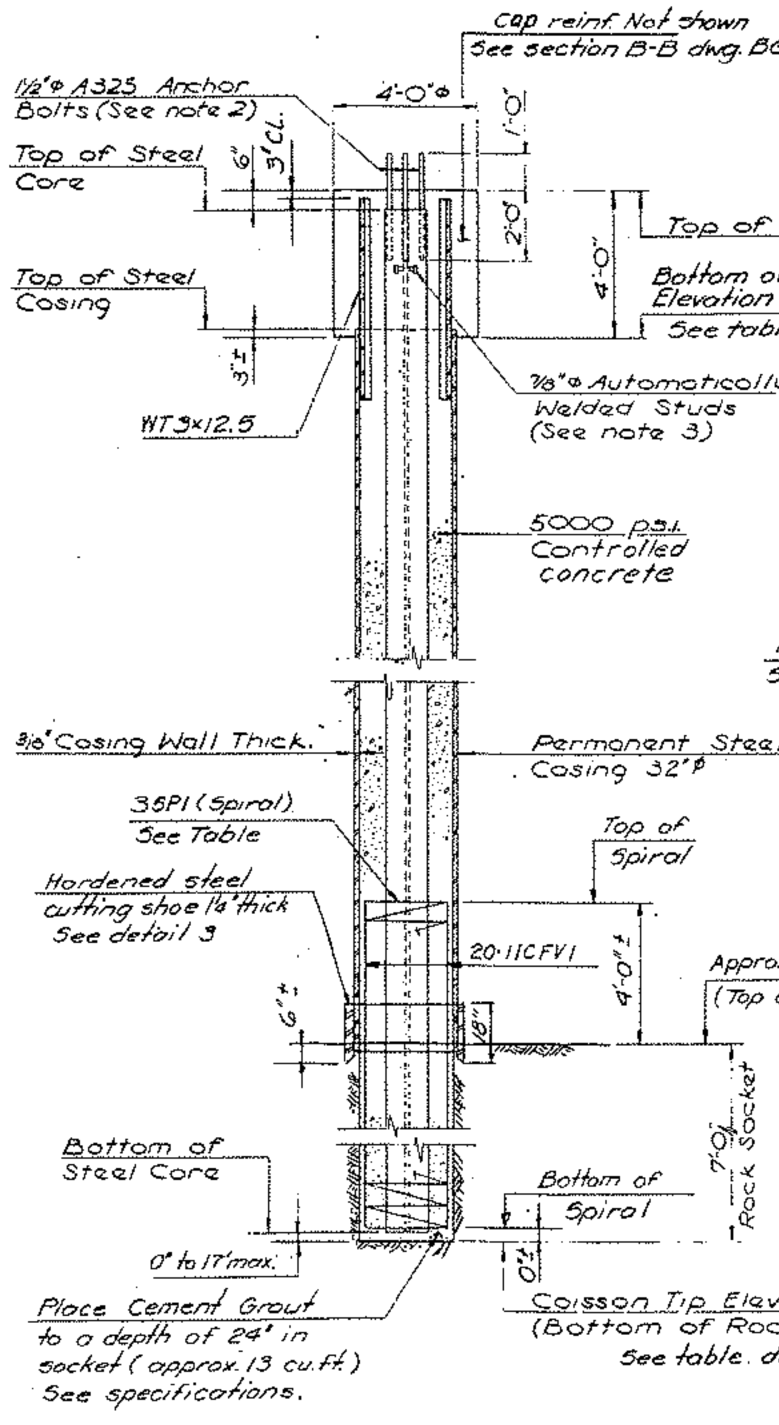
M
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX

FOUNDATION PLAN

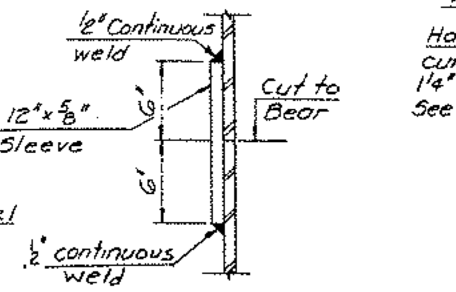
MABSTOA BUS GARAGE FOUNDATIONS

CONTRACT NO. 1-02-21064-0-0
DATE FEB., 15 1982
SCALE 1" = 40'-0"
DRAWING NO. BG-1
SHEET 198 OF 204



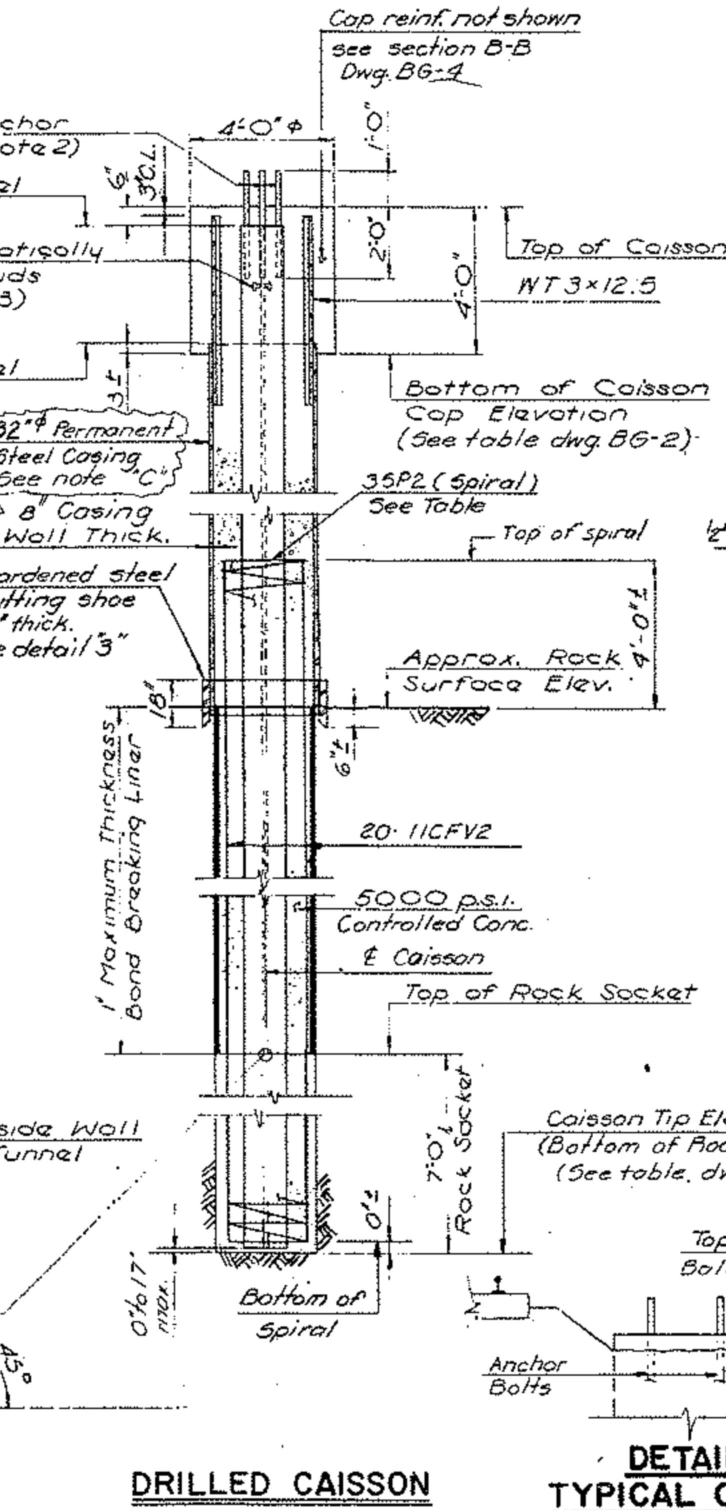
DRILLED CAISSON WITH NO BOND BREAKER

DETAIL (W) (WITH FULL HEIGHT STEEL CORE-AS SHOWN)
DETAIL (X) (WITH STUB STEEL CORE-SEE DETAIL I)
SCALE: ⅜" = 1'-0"



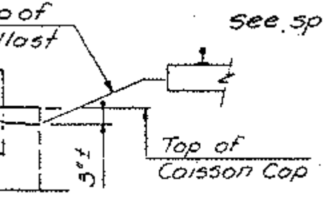
DETAIL "2" STEEL CASING SPLICE

N.T.S.



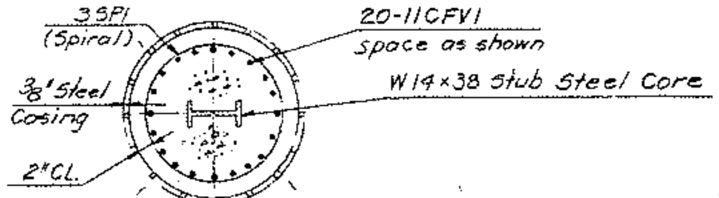
DRILLED CAISSON WITH BOND BREAKER

DETAIL (Y) (WITH FULL HEIGHT STEEL CORE-AS SHOWN)
DETAIL (Z) (WITH STUB STEEL CORE-SEE DETAIL I)
SCALE: ⅜" = 1'-0"



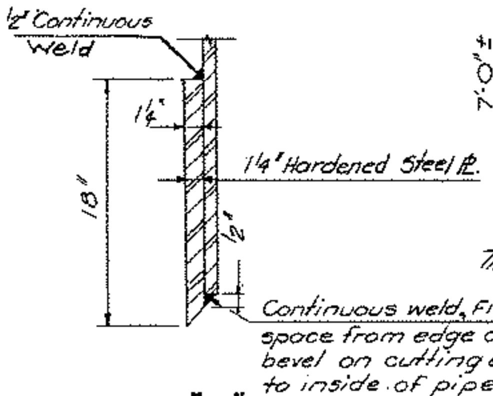
DETAIL "4" TYPICAL CAISSON BETWEEN TRACKS

Scale: ⅜" = 1'-0"



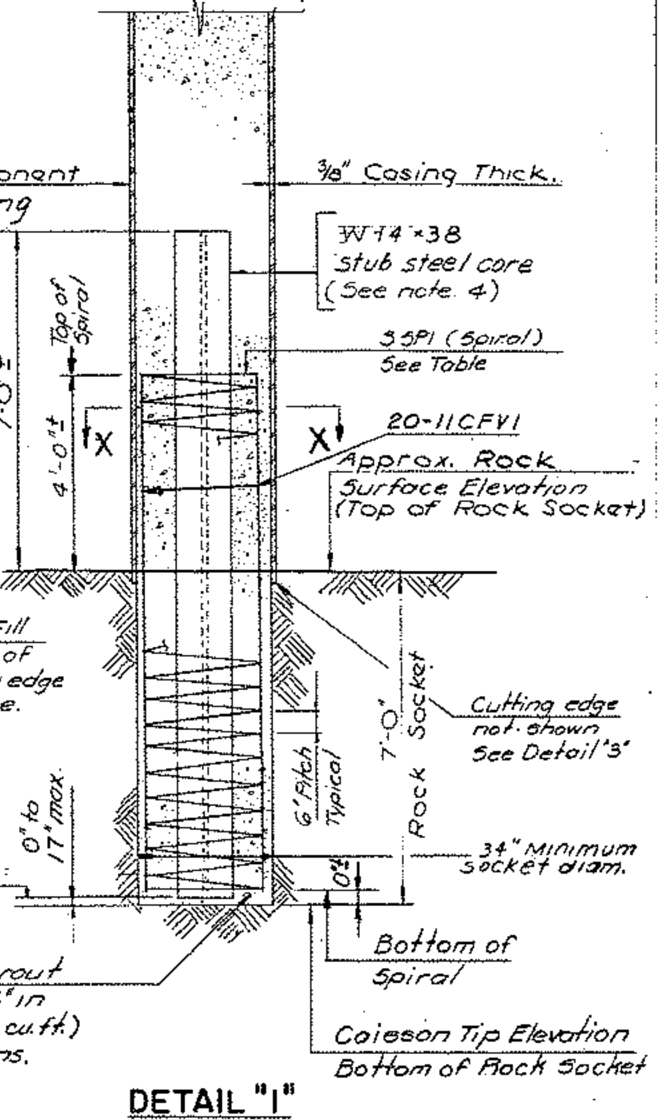
SECTION X-X

Scale: ½" = 1'-0"



DETAIL "3" CUTTING EDGE

N.T.S.



DETAIL "1" ROCK SOCKET WITH STUB STEEL CORE

DETAIL (X) (WITH NO BOND BREAKER-AS SHOWN)
DETAIL (Z) (WITH BOND BREAKER-SIMILAR)
Scale ½" = 1'-0"

NOTES:

1. For Drilled Caisson Data Table See Dwg. No. BG2
2. For Anchor Bolt Details and Locations See Dwg. No. BG-4
3. For Detail of ⅞"φ Automatically Welded Studs See Dwg. No. BG-5
4. W14×38 stub steel core to be used in caissons with no full height steel core.

SPIRAL SCHEDULE					
MARK	SIZE	HEIGHT	NO	PITCH	DIA
3 SP1	4	11'-0"±	24	6"	31½"
3 SP2	4	*VARIES	14	6"	31½"

*VARIES FROM 13'-6"± TO 42'-6"±

Date: 2-6-85
"AS BUILT"

See also, Slattery's Drawings No's 101-104 inclusive.

NOTE "C":
Minimum Height of permanent Steel Casing to be 2'-6". Caissons C-4, D-5 & E-5 may not require the permanent Steel Casing.

REV NO.	DESCRIPTION	DATE
1	Changed Caisson detail designation, Added Note "C"	3-22-82

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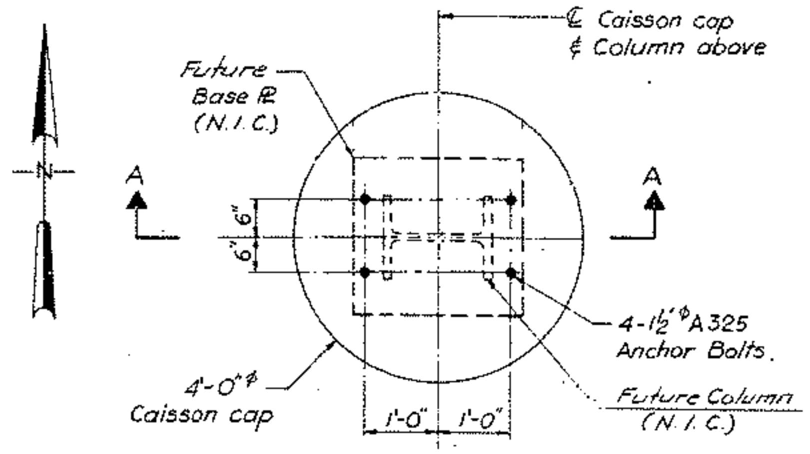
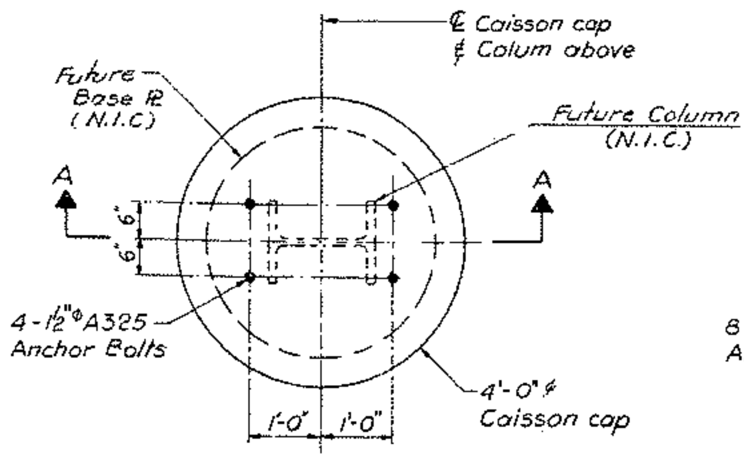
M
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
DRILLED CAISSON DETAILS - 2
MABSTOA BUS GARAGE FOUNDATIONS

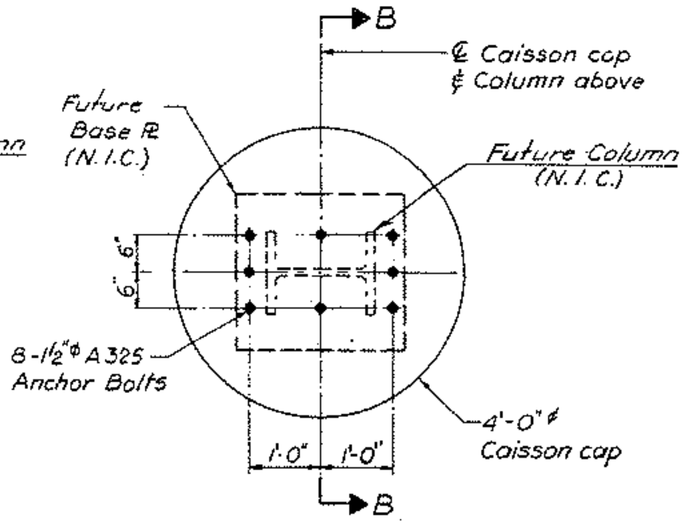
CONTRACT NO. 1-02-21064-0-0
DATE FEB. 15, 1982
SCALE AS NOTED
DRAWING NO. BG-3
SHEET 200 OF 204



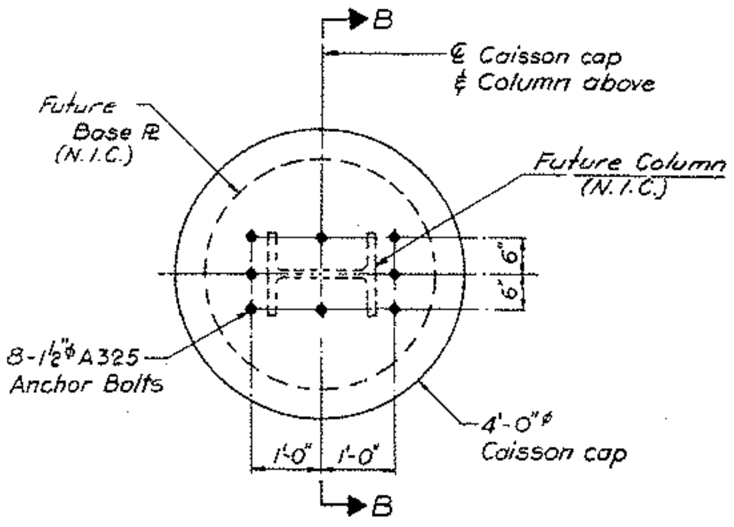
DETAIL B1



DETAIL B2



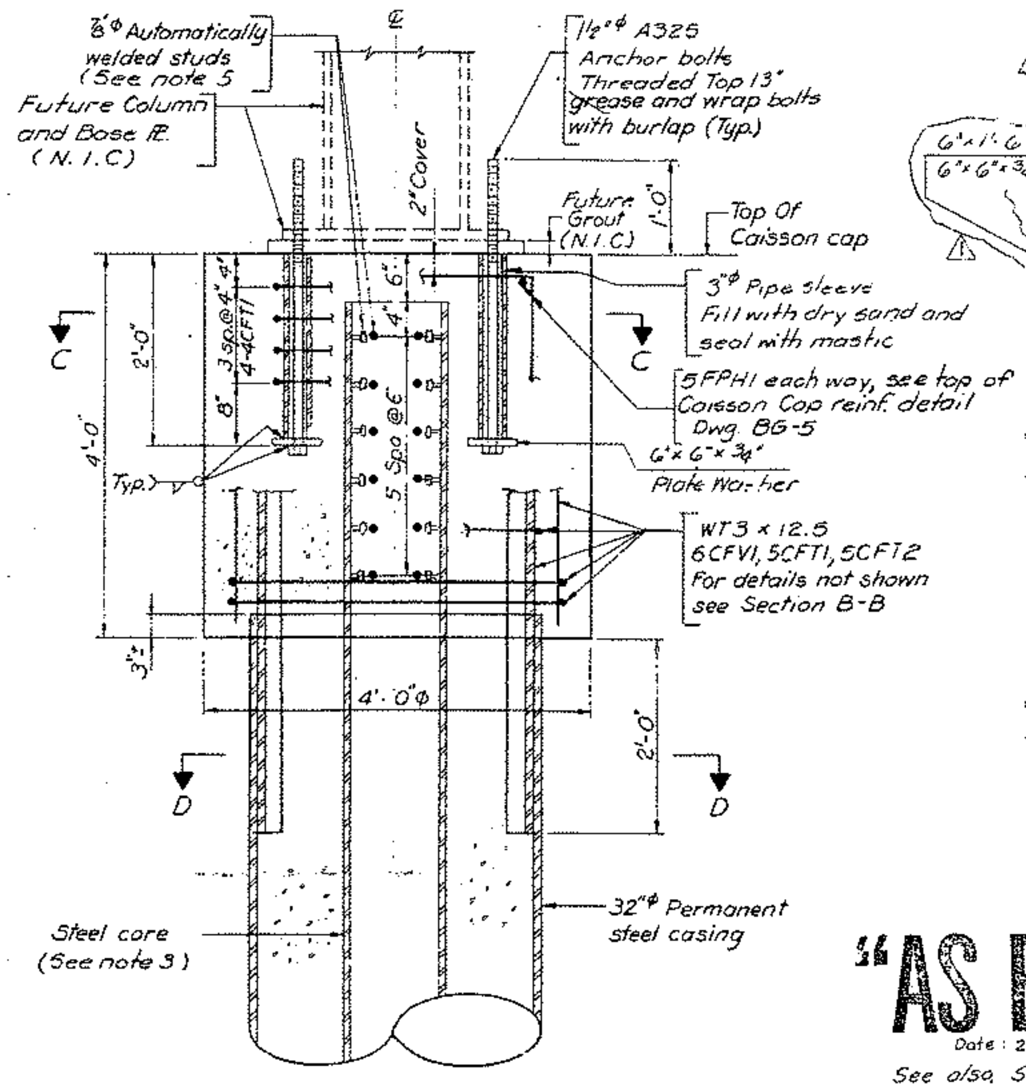
DETAIL B3



DETAIL B4

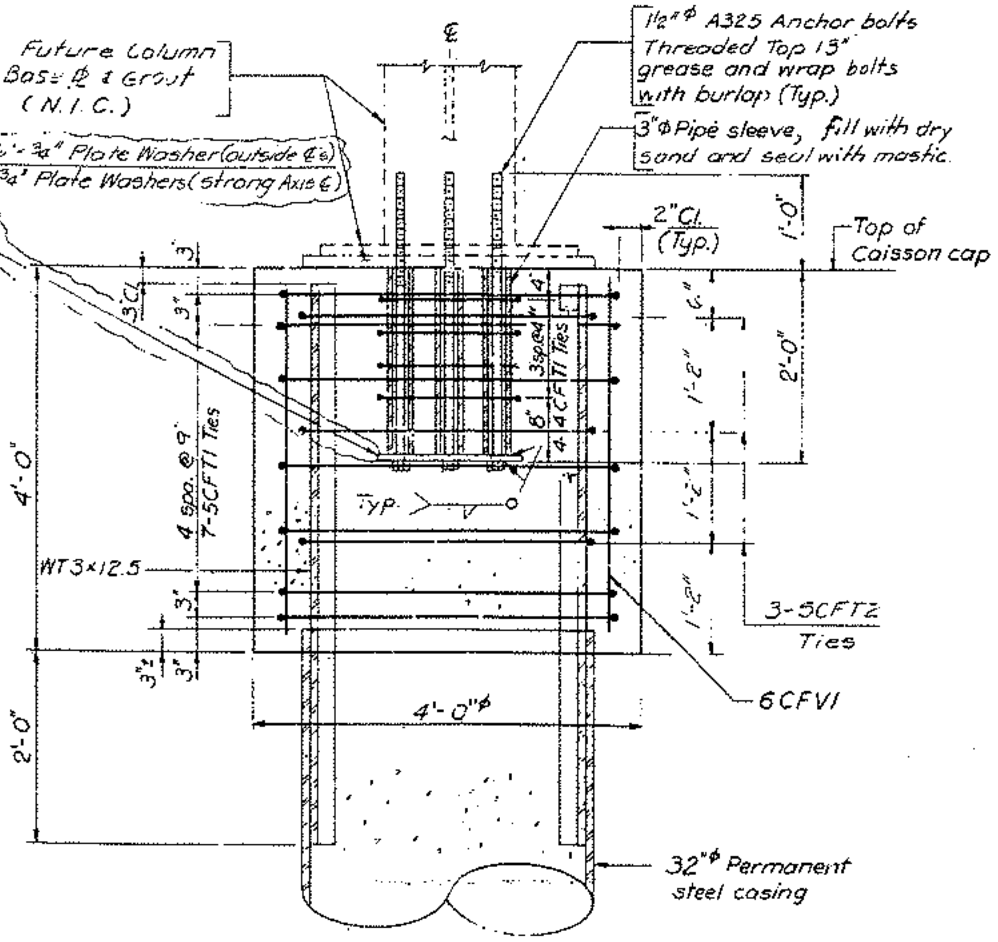
ANCHOR BOLT LOCATION PLAN

Scale: ¾" = 1'-0"



SECTION A-A

Scale: 1" = 1'-0"



SECTION B-B

Scale: 1" = 1'-0'

"AS BUILT"
Date: 2-6-85

See also, Slattery's Drawings No's 101-104 inclusive

NOTES:

1. All anchor bolts, pipe sleeves & plate washers shall be galvanized. Steel for the pipe sleeves shall conform to ASTM A-53 and steel for the plate washers shall conform to ASTM A-36
2. For Section C-C & D-D see dwg No. BG-5
3. Sec. A-A shown with steel core. See table Dwg. No. BG-2 for size of steel core and in which caissons steel core is required.
4. Sec. B-B shown with no steel core. When steel core is required, details for steel core are similar to Section A-A.
5 For details of automatically welded studs see dwg. NO. BG-5
6. For drilled Caisson detail for control of stray electrical currents see dwg. NO BG-5
7. N.I.C. - Denotes not in contract.

ANCHOR BOLT DATA TABLE

ANCHOR BOLT DETAIL	COLUMN NO & CAISSON MARK
B1	A-1, A-5, A-6, A-7 A-9, E-10, F-5, F-6 F-7, F-8, F-9, F-10
B2	B-5, B-6, B-7, B-9 C-5, C-6, C-7, C-9 E-5, E-6, E-8, E-9
B3	A-4, A-8, A-10, B-10 C-4, C-10, D-9
B4	B-8, C-8, D-5 D-6, D-7 D-8, E-7

REV NO.	DESCRIPTION	DATE
1	Rev. Plate Washer dimensions	3-22-82

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

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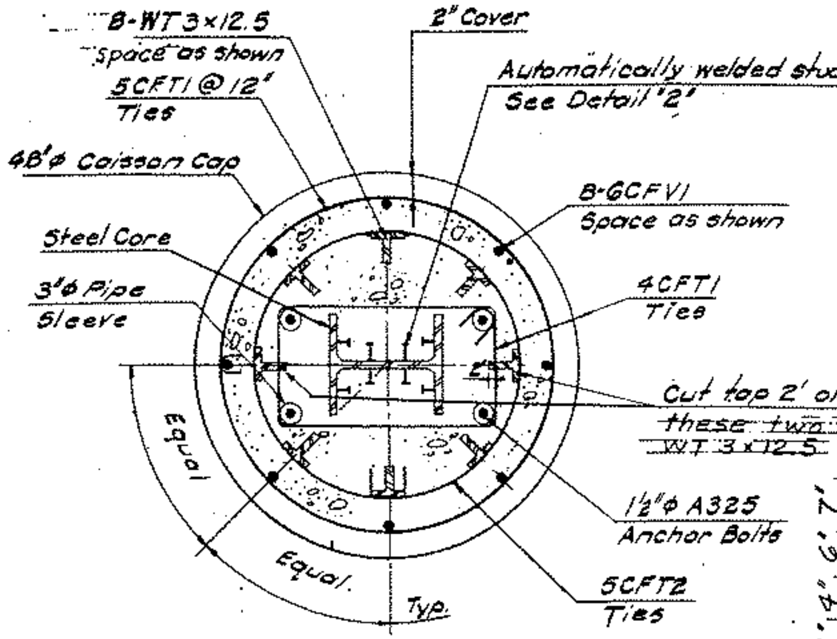
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX

DRILLED CAISSON DETAILS - 3

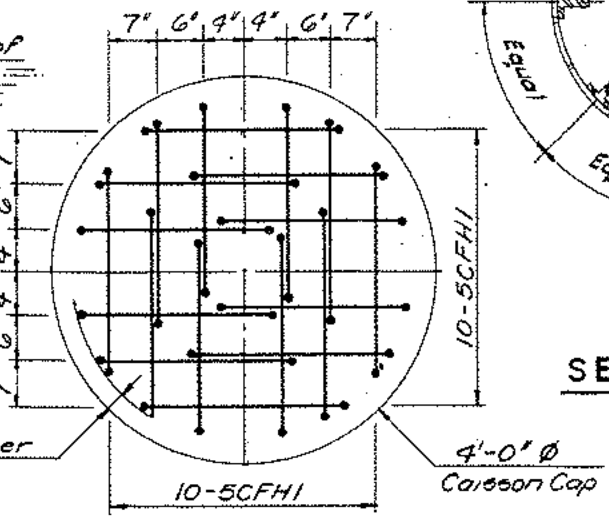
MABSTOA BUS GARAGE FOUNDATIONS

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 15, 1982
SCALE AS NOTED
DRAWING NO. BG-4
SHEET 201 OF 204



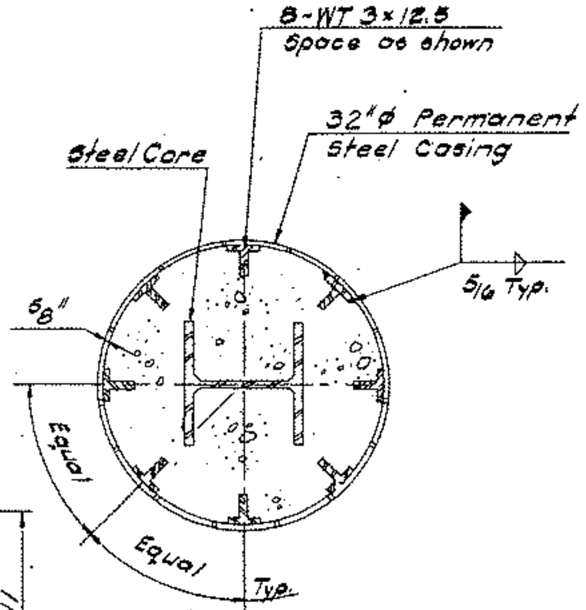
SECTION C-C

Scale: 1"=1'-0"



TOP OF CAISSON CAP REINFORCING DETAIL

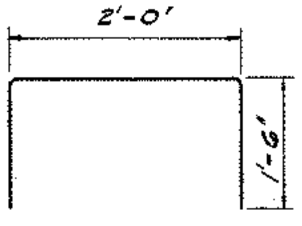
Scale: 1" = 1'-0"



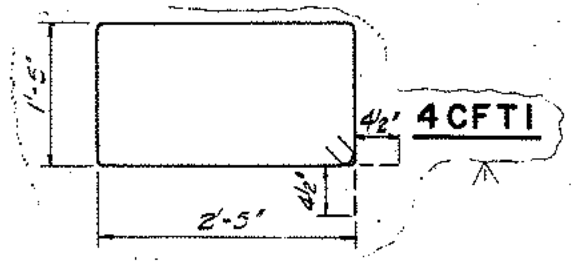
SECTION D-D

Scale: 1"=1'-0"

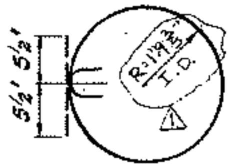
REINFORCING STEEL SCHEDULE				
MARK	NO.	SIZE	LENGTH	TYPE
4CFT1	152	4	⚠ 8'-2"	BENT
5CFT1	266	5	12'-5"	BENT
5CFT2	114	5	10'-4"	BENT
5CFH1	760	5	4'-10"	BENT
6CFV1	304	6	3'-6"	STR
11CFV1	480	11	11'-6"±	STR
11CFV2	280	11	Varies in sets of 20 From 14'-0"± To 42'-6"±	STR



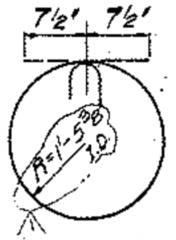
5CFH1



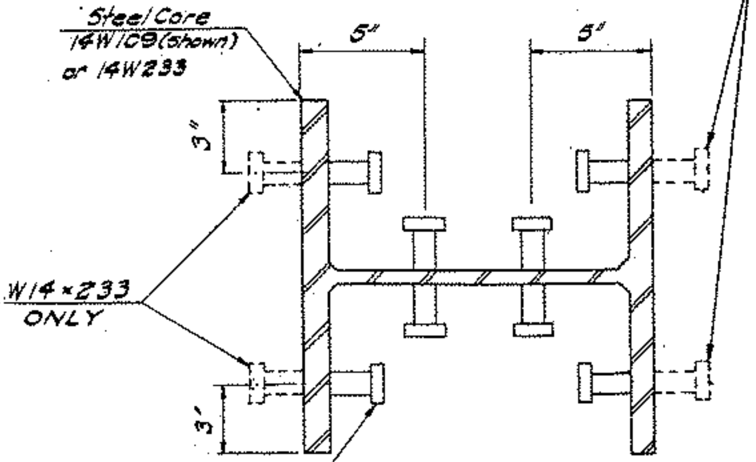
4CFT1



5CFT1



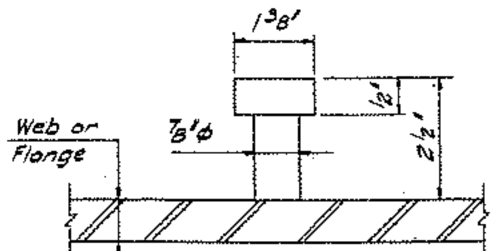
5CFT2



7/8"ϕ Automatically welded studs see detail this dwg.
8 per line (W14×109)
12 per line (W14×233)
By 6 vertical rows.
For spacing of rows see section C-C dwg BG-4

DETAIL "2"

Scale: 3"=1'-0"



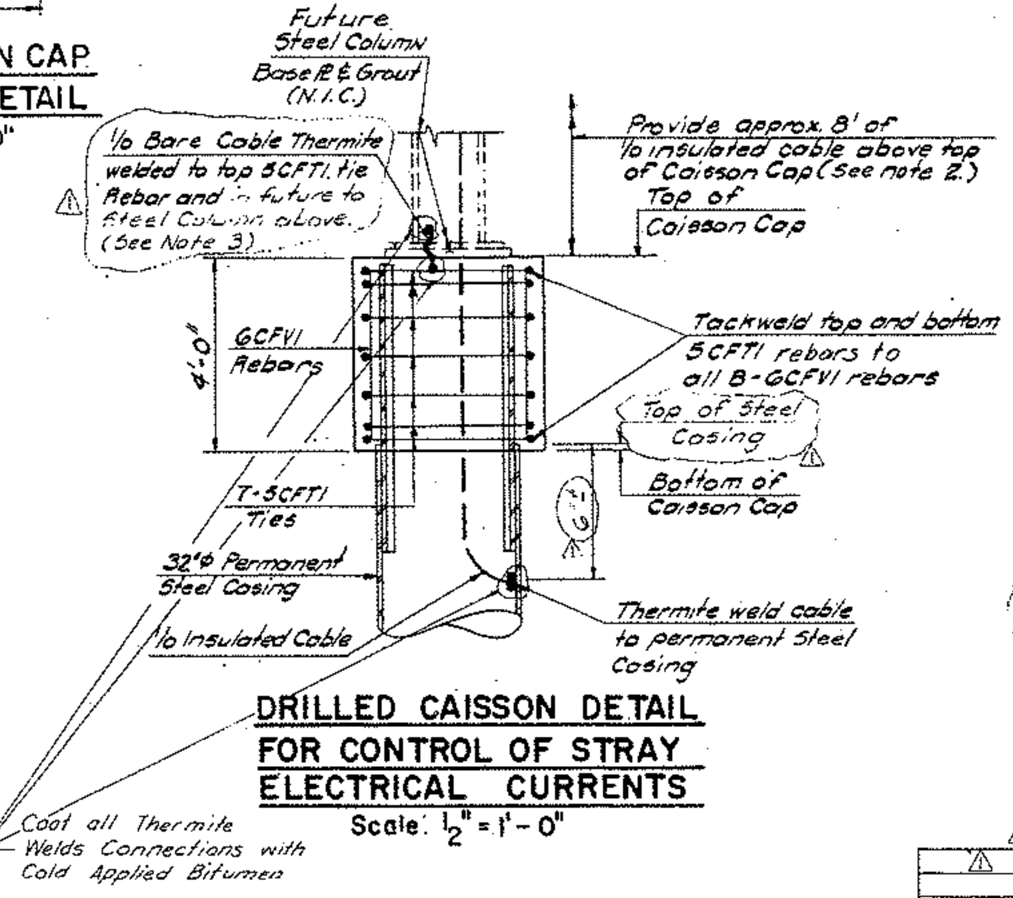
STUD DETAIL

Scale: 6"=1'-0"

48 required each W14×109
72 required each W14×233

"AS BUILT"
Date: 2-6-85

See also, Slattery's Drawing No's. 101 - 104 inclusive



DRILLED CAISSON DETAIL FOR CONTROL OF STRAY ELECTRICAL CURRENTS

Scale: ½"=1'-0"

Notes:

1. For location of Sections C-C & D-D See dwg. NO. BG-4
2. Provide approximately 8' ft. of 1/0 insulated cable above top of Caisson Cap and wrap in plastic and secure between exposed top 12" portion of anchor bolts. Termination to be done in Future. (N.I.C.) ⚠
3. Wrap exposed portion of cable in plastic and secure to anchor bolts above.
4. N.I.C. Denotes Not in Contract.
5. All reinforcing bars dimensions are out to out.

⚠

REV NO.	DESCRIPTION	DATE
⚠	Rev. Caisson det. for control of stray elect. current, Notes & rebars	3-22-82

SEELYE STEVENSON VALUE & KNECHT, INC.
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Metropolitan Transportation Authority

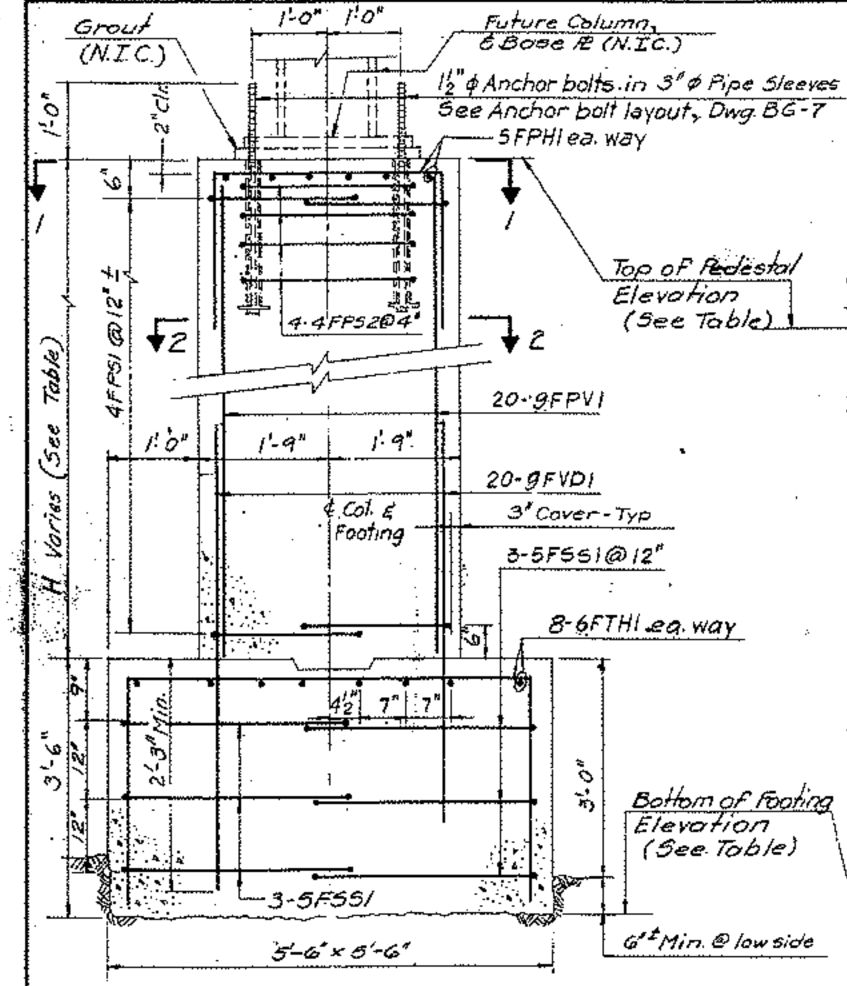
WEST SIDE STORAGE YARD COMPLEX
DRILLED CAISSON DETAILS - 4
MABSTOA BUS GARAGE FOUNDATIONS

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 15, 1982
SCALE AS NOTED
DRAWING NO. BG-5
SHEET 202 OF 204

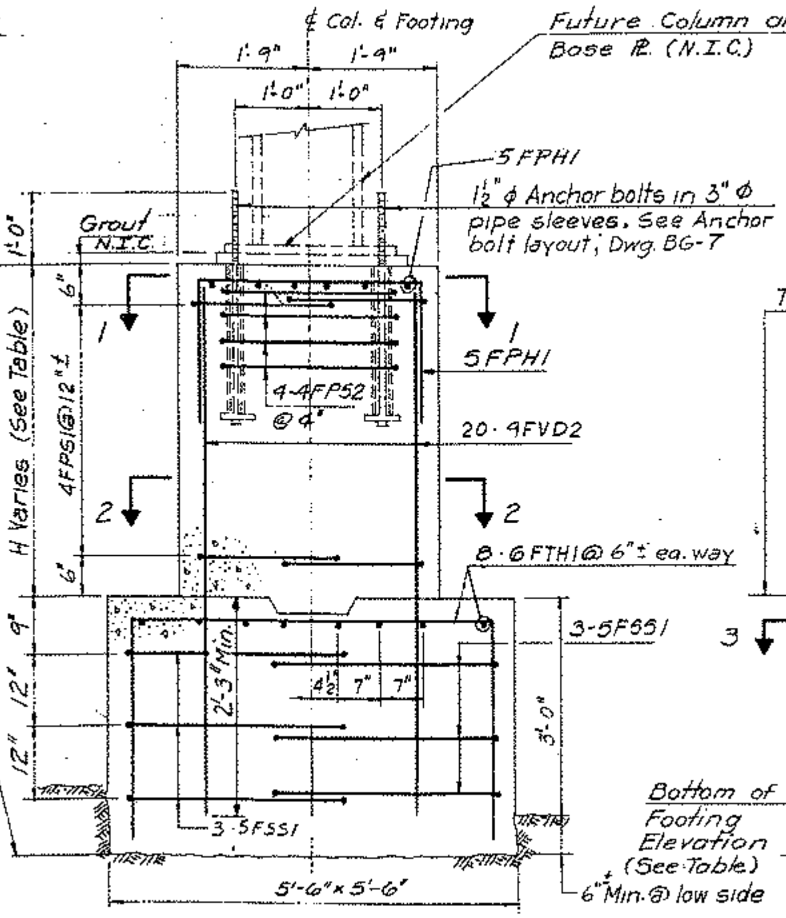
AS-BUILT TOP OF PEDESTAL ELEVATIONS																
B-1	A-2	B-2	C-2	D-2	E-2	F-2	A-3	B-3	C-3	D-3	E-3	F-3	B-4	E-4	F-4	*D-4
306.51	308.52	308.50	308.49	308.49	308.51	306.52	306.53	306.50	306.51	306.51	306.49	306.51	306.50	306.49	306.50	306.50

FOOTING DATA TABLE

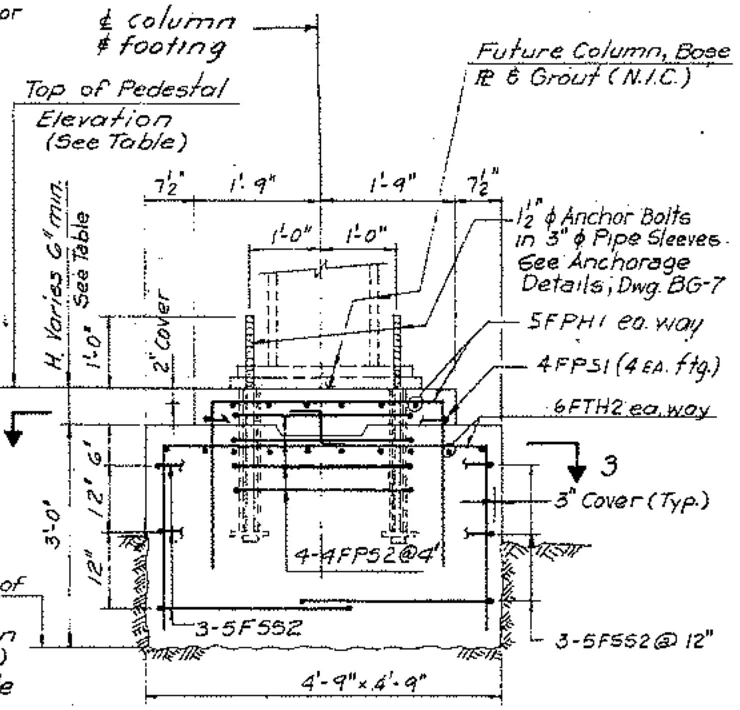
FOOTING MARK	LOAD ON FOOTING (KIPS)	FOOTING TYPE	ANCHORAGE TYPE	APPROX. ROCK SURFACE ELEVATION	BOTTOM OF FOOTING ELEVATION	TOP OF PEDESTAL ELEVATION	HEIGHT OF PEDESTAL H (FT)
B-1	830	B	4	296.0	298.0	306.50	7.50
A-2	1520	A	4	298.0	296.9	308.50	7.50
B-2	1520	A-R	4	302.0	288.5	308.50	3.50
C-2	1520	A	4	305.0	295.15	308.50	1.00
*D-2	1520	B	4	306.0	301.1	308.50	0.50
E-2	1520	B	4	304.0	299.3 300.4	308.50	1.50
F-2	1520	A	4	300.0	292.0 293.4	308.50	5.50
A-3	1520	A	4	295.0	295.2	306.50	9.50
B-3	1520	B	4	300.0	297.3	306.50	3.50
C-3	1520	B-51	4	305.0	298.5	306.50	0.50
D-3	1520	A	4	305.5	295.2	306.50	0.50
E-3	1520	A	4	303.5	289.9 291.3	306.50	0.50
F-3	1520	B	4	300.0	291.6 292.8	306.50	3.50
B-4	1520	B	8	298.0	292.0 294.5	306.50	5.50
E-4	1520	B	8	302.0	290.3 291.4	306.50	1.50
F-4	1520	A	8	300.0	286.8 288.5	306.50	3.50
D-4	1520	B	8	303.0	300.6	306.50	1.00



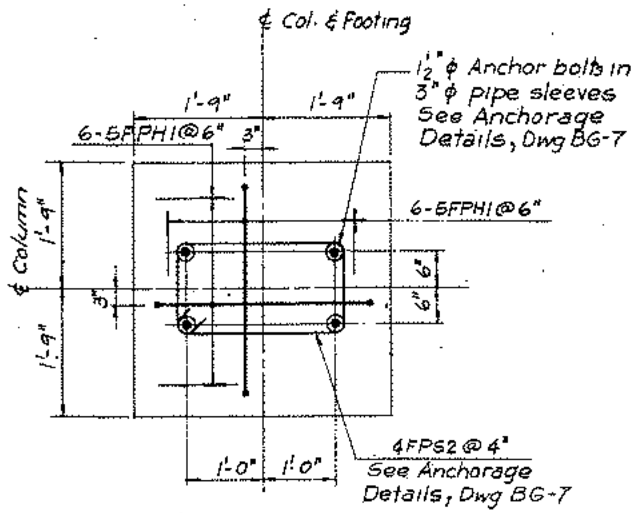
FOOTING TYPE "A"



FOOTING TYPE "B"

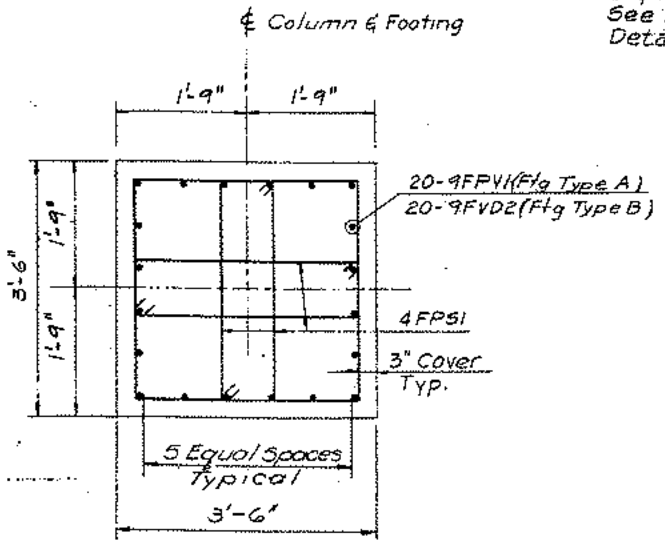


FOOTING TYPE "C"



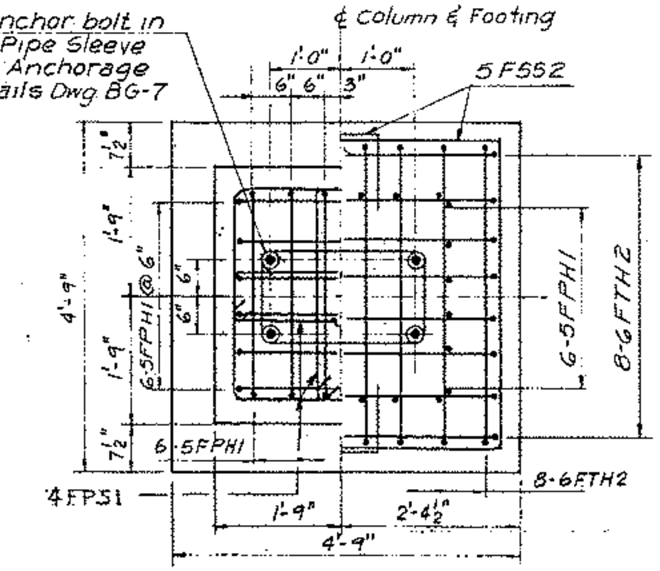
SECTION 1-1

Scale: $\frac{3}{4}$"=1'-0"



SECTION 2-2

Scale: $\frac{3}{4}$"=1'-0"

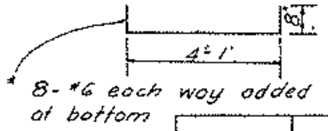


SECTION 3-3

Scale: $\frac{3}{4}$"=1'-0"

NOTES:

1. All footings are to be founded on sound rock of bearing capacity of 120 k.s.f.
2. All concrete for footings shall be 4,000 psi concrete.
3. Deformed Reinforcement Bars shall conform to ASTM A615, Grade 60.
4. Elevation given are based on Penn. Station Datum on which elevation 300.025 is equal to elevation 0.0 on the Borough of Manhattan Datum.
5. N.I.C. Denotes not in Contract.



* 8-#6 each way added at bottom

"AS BUILT"
Date: 2-6-85

REV. NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

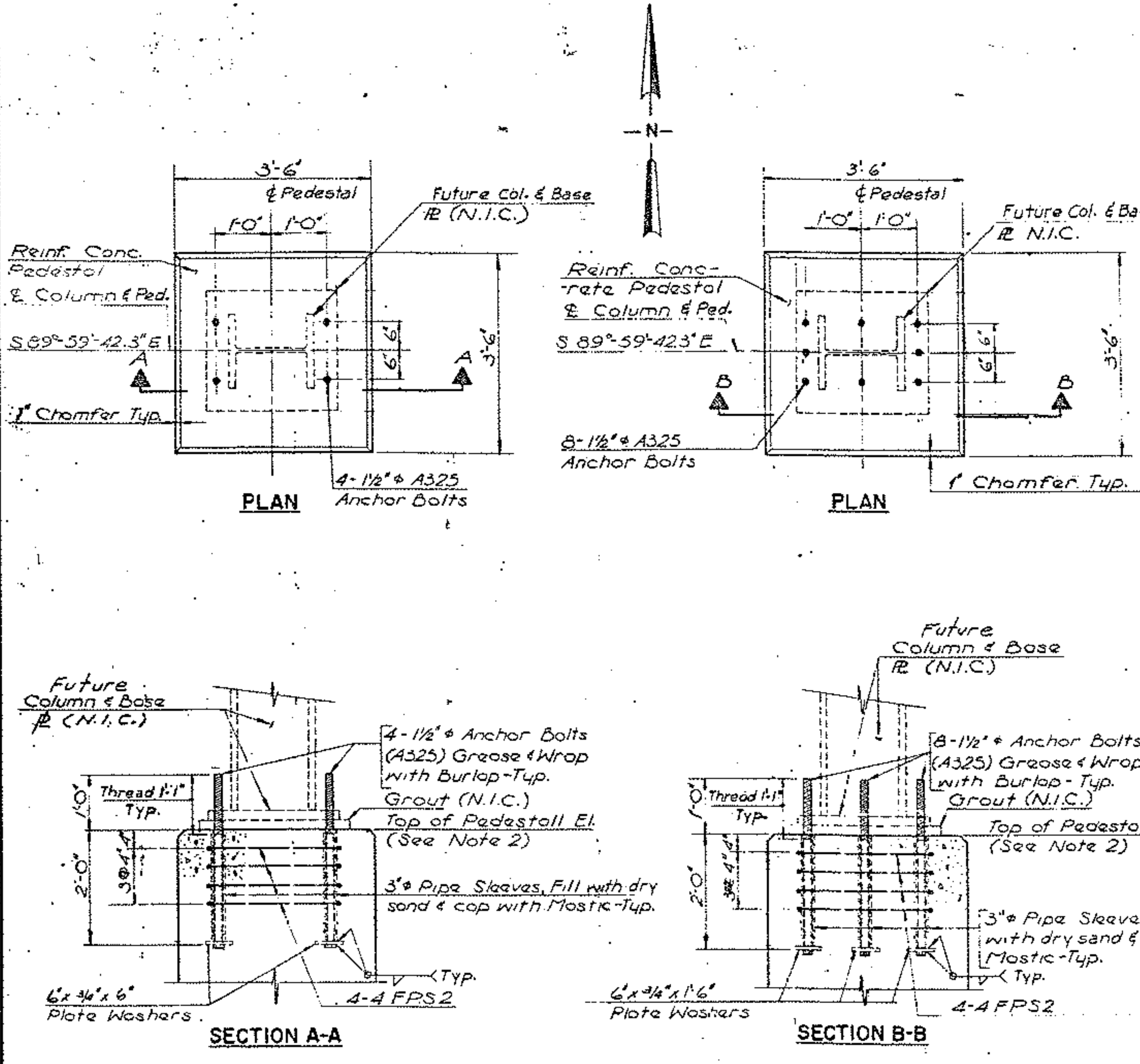
L.I.R.R.
LONG ISLAND RAIL ROAD

Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX
FOOTING DETAILS - I
MABSTOA BUS GARAGE FOUNDATIONS

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 15, 1982
SCALE AS NOTED
DRAWING NO. BG-6
SHEET 203 OF 204

NOTES:
1. N.I.C. Denotes Not in Contract.
2. For Top of pedestal Elevations, see Footing Data Table Dwg. BG-6.
3. All Anchor Bolts, Pipe Sleeves, and Plate Washers shall be galvanized.
4. All Future Column Webs shall be placed parallel to ℄ of 33rd Street.

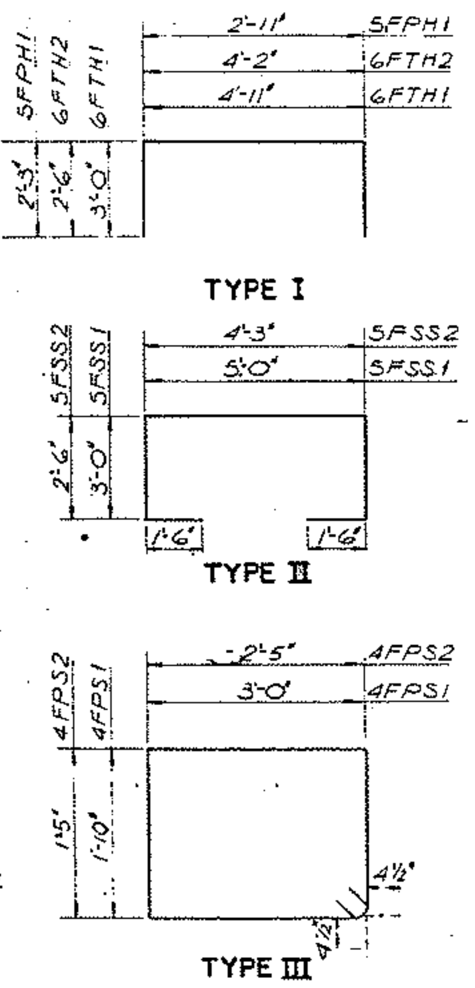


ANCHORAGE TYPE 4

ANCHORAGE TYPE 8

ANCHOR BOLT LAYOUT & DETAILS

SCALE: ¾"=1'-0"



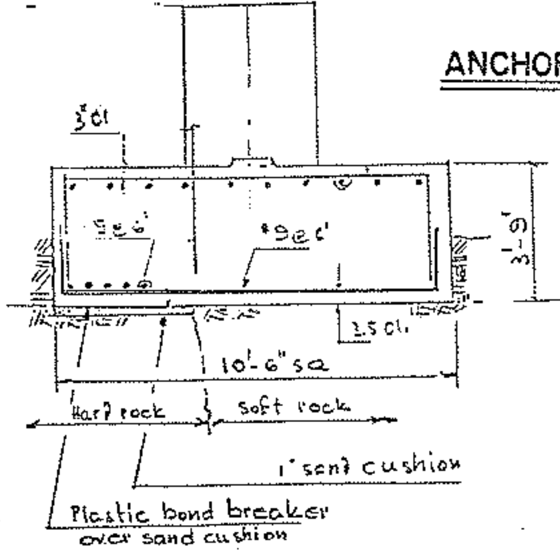
MARK	NO.	SIZE	LENGTH	TYPE	LOCATION
REINFORCING STEEL SCHEDULE - FOOTINGS					
9FVD1	60	9	7'-0"	Str.	Dowel, Ftg. Type A
9FVD2	160	9	8'-6"	Str.	Dowel, Ftg. Type B *
9FPV1	60	9	10'-0"	Str.	Vertical Ped. Type A *
6FTH1	176	6	10'-9"	I	Top of Ftg. Types A & B
6FTH2	96	6	9'-0"	I	Top of Ftg. Type C
5FSS1	66	5	13'-8"	II	Ftg. Ties Types A & B
5FSS2	36	5	11'-11"	II	Ftg. Ties Type C
5FPH1	204	5	7'-3"	I	Top of Pedestal Ftg. Types A,B,& C
4FPS1	248	4	10'-2"	III	Pedestall Ties Ftg. Types A,B,&C
4FPS2	68	4	8'-2"	III	Anchorage Ties Ftg. Types A,B,&C

* Cut in Field as Required

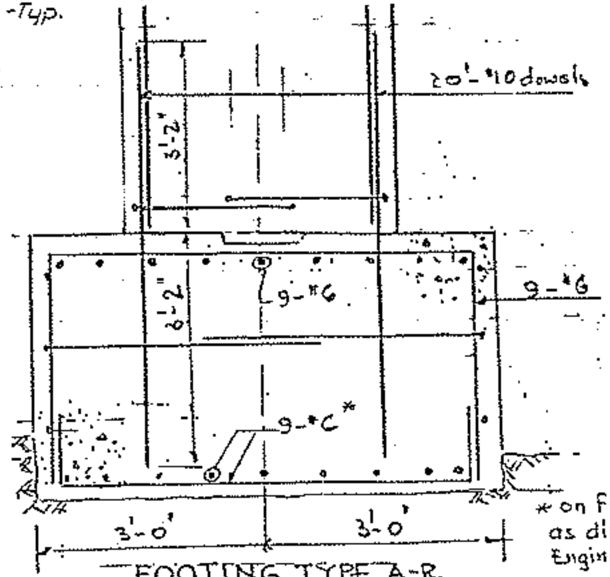
COLUMN FORCE SCHEDULE

COLUMN MARK (SEE NOTE "A")	DEAD LOAD (KIPS)	LIVE LOAD (KIPS)	WIND (E-W)		WIND (N-S)	
			MOM. (FT.K)	SHEAR (KIPS)	MOM. (FT.K)	SHEAR (KIPS)
B-2, B-3, C-2, C-3, E-2, E-3, E-10	720	800	-	-	-	-
A-1, B-1, C-1, D-1, E-1, F-1	430	400	120	10	50	10
A-2, A-3, A-5, D-2, D-3, F-2, F-3, F-5	720	800	-	-	100	10
B-8, C-8, E-7	1250	1150	240	20	-	-
D-7	1250	1150	240	20	150	20
B-5, B-6, B-7, B-9, C-5, C-6, C-7, C-9, E-5, E-6, E-8, E-9	1400	1430	-	-	-	-
D-5, D-6, D-8	1400	1430	-	-	170	20
A-6, A-7, A-9, F-6, F-7, F-8, F-9, F-10	700	720	-	-	90	10
A-10, D-9	530	550	240	20	90	10
B-4, B-10, C-4, C-10, E-4	720	800	240	20	-	-
A-4, A-8, D-4, F-4	720	800	240	20	150	20

NOTE "A":
COLUMN MARK SAME AS CAISSON OR FOOTING MARK.



"AS BUILT"
Date: 2-6-85



FOOTING TYPE A-R

* on Fractured rock as directed by the Engineer

REV NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

L.I.R.R.
LONG ISLAND RAIL ROAD

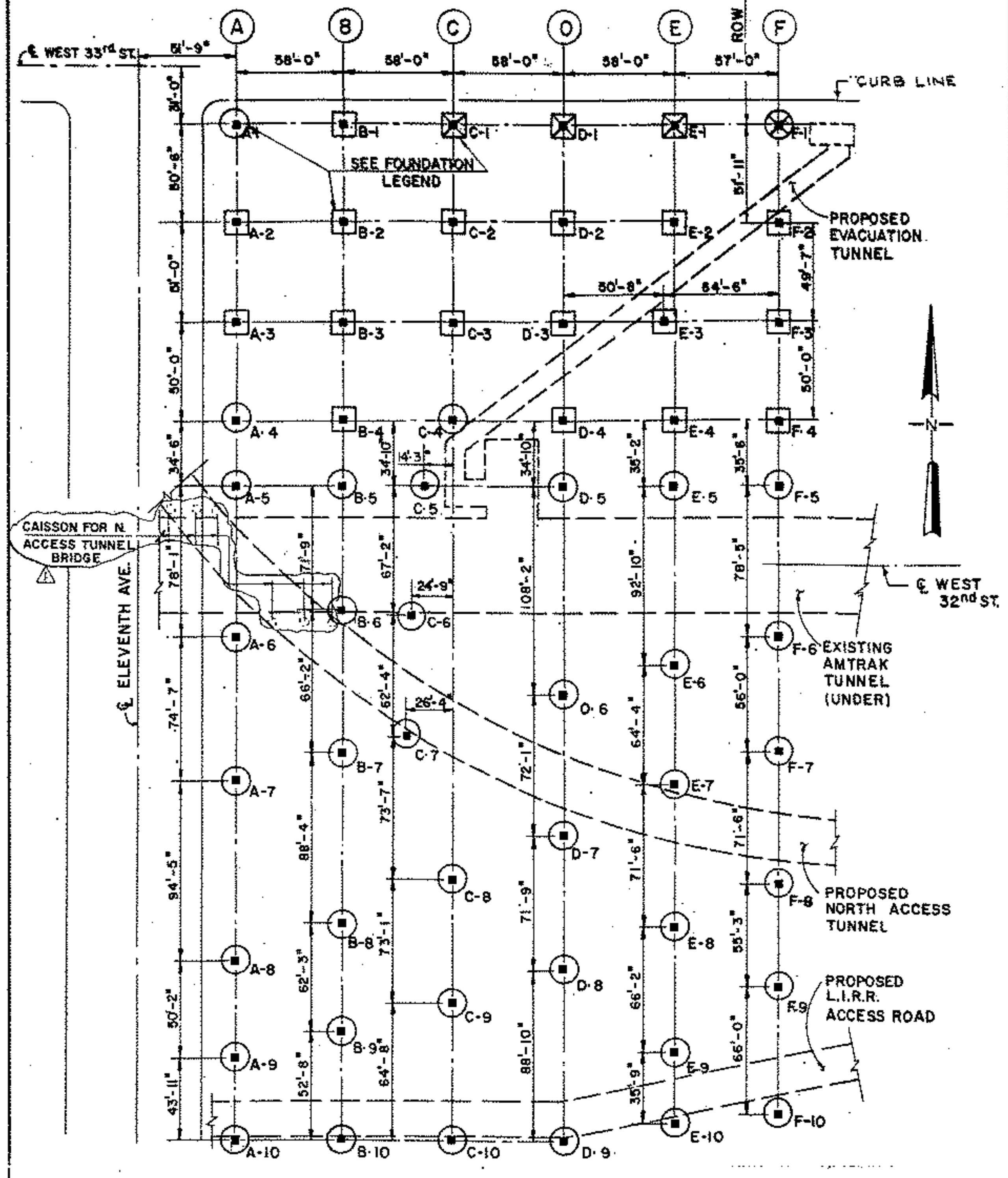
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX

FOOTING DETAILS - II

MABSTOA BUS GARAGE FOUNDATIONS

CONTRACT NO. 1-02-21064-0-0
DATE F [illegible], 1982
SCALE AS NOTED
DRAWING NO. BG-7
SHEET 204 OF 204



FOUNDATION PLAN

Scale: 1" = 40'

AS BUILT
Date: 2-6-85

DRILLED CAISSON DATA TABLE

AS-BUILT

CAISSON MARK	LOAD ON CAISSON (KIPS) See Note "B"	APPLICABLE CAISSON DETAIL See Note "A"	SIZE OF FULL HT STEEL CORE	BOTTOM OF CAISSON CAP ELEVATION	APPROX. ROCK SURFACE ELEVATION	APPROX. TUNNEL INVERT ELEVATION	APPROX. CAISSON TIP ELEVATION	TOP OF CAISSON ELEV.
A-1	830	X	NONE	302.5	290.0	N.A.	283.0	306.50
A-4	1520	X	NONE	302.5	293.0	N.A.	286.0	306.54
A-5	1520	Z	NONE	302.5	290.0	256.8	264.1	306.51
A-6	1420	Z	NONE	302.5	287.0	256.9	261.2	306.48
A-7	1420	X	NONE	302.5	286.5	N.A.	279.5	306.42
A-8	1520	X	NONE	300.5	283.0	N.A.	276.0	304.53
A-9	1420	X	NONE	300.5	282.0	N.A.	275.0	304.61
A-10	1080	X	NONE	300.5	283.5	N.A.	276.5	
B-5	2830	Y	14W233	302.5	295.5	257.9	267.3	306.52
8-6	2830	Y	14W233	302.5	290.5	258.0	258.1	306.41
B-7	2830	W	14W233	302.5	288.5	N.A.	281.5	306.51
B-8	2400	W	14W109	300.7	287.0	N.A.	280.0	304.75
8-9	2830	W	14W233	300.6	286.0	N.A.	279.0	304.66
B-10	1520	X	NONE	300.6	286.5	N.A.	279.5	304.60
C-4*	1520	Z	NONE	302.5	302.5	290.1	283.0	306.49
C-5	2830	Y	14W233	302.5	300.0	258.7	268.1	306.43
C-6	2830	Y	14W233	302.5	293.0	258.6	254.5	306.49
C-7	2830	Y	14W233	302.5	289.0	283.5	276.5	306.47
C-8	2400	W	14W109	301.1	289.0	N.A.	282.0	305.07
C-9	2830	W	14W233	301.1	289.0	N.A.	282.0	305.10
C-10	1520	X	NONE	301.0	290.0	N.A.	283.0	304.92
D-5*	2830	Y	14W233	302.5	301.0	260.1	269.2	306.46
D-6	2830	W	14W233	302.5	295.0	N.A.	288.0	306.47
0-7	2400	W	14W109	301.7	292.0	N.A.	285.0	305.69
D-8	2830	W	14W233	301.7	292.0	N.A.	285.0	305.69
D-9	1080	X	NONE	301.7	290.0	N.A.	283.0	305.65
E-5*	2830	Y	14W233	302.5	301.0	261.2	270.0	306.52
E-6	2830	Y	14W233	302.5	300.0	261.3	283.2	306.56
E-7	2400	Y	14W109	302.2	297.0	281.7	274.5	306.21
E-8	2830	W	14W233	302.3	292.0	N.A.	285.0	306.20
E-9	2830	W	14W233	302.2	289.5	N.A.	282.5	306.20
E-10	1520	X	NONE	302.2	289.5	N.A.	282.5	306.17
F-5	1520	Z	NONE	302.5	300.0	262.3	270.7	306.50
F-6	1420	Z	NONE	302.5	300.0	262.4	270.2	306.54
F-7	1420	X	NONE	302.5	295.0	N.A.	288.0	306.54
F-8	1420	X	NONE	302.5	289.0	N.A.	282.0	306.47
F-9	1420	X	NONE	302.4	289.0	N.A.	282.0	306.35
F-10	1420	X	NONE	302.4	287.5	N.A.	280.5	306.41

⚠ * See Note "C" Dwg, 8G-3

NOTE 'B':

For complete column force schedule see dwg. BG-7

FOUNDATION LEGEND

⊙ Indicates location of drilled Caisson, see details this dwg. and dwg. NO.s BG-3, BG-4 & BG-5

⊗ Indicates location of drilled Caisson not in this contract

▣ Indicates location of Spread Footing on Rock, for details see dwg. NO.s BG-6 & BG-7

☒ Indicates location of Spread Footing on Rock not in this Contract.

DRILLED CAISSON FOUNDATION NOTES

1. For Caisson data, see specifications.
2. The Permanent Steel Casing is being used to increase the bearing capacity of the individual Caisson.
3. Steel for the Permanent Casing shall conform to ASTM, A252 class 2.
4. Steel for the cores and stub beams shall conform to ASTM A36 and shall not be painted.
5. Concrete for Caissons shall be 6000 psi controlled stone concrete.
6. Deformed Reinforcement Bars shall conform to ASTM ⚠ A-615 Grade 60.
7. Welding - See specifications sec. 05100
8. Elevations of top of rock are only approximate, Contractor ⚠ should not rely on these elevations to predict actual elevations at which rock will be encountered.
9. The Caisson sockets are to be founded in sound rock of 60 T/S.F. bearing capacity (Class 1-65 rock in N.Y.C. Building Code).
10. All loads are given in Kips (1^{KIP} = 1000 lbs).
11. The tolerance for placing the casing is not more than 3" from design location. The cap and core shall be placed concentric with design location.
12. Elevations given are based on Penn. Station Datum, on which elevation 300.025 is equal to elevation 0.0 on the ⚠ Borough of Manhattan Datum.
13. All steel column webs and all Caisson steel core webs shall be placed parallel to ℄ of 33rd. Street.

NOTE "A"

For Drilled Caisson details W, X, Y & Z, See dwg. BG-3

Detail W - Drilled Caisson with full height steel core and with no bond breaker.
Detail X - Drilled Caisson with stub steel core and with no bond breaker.
Detail Y - Drilled Caisson with full height steel core and with bond breaker.
Detail Z - Drilled Caisson with stub steel core and with bond breaker. ⚠

REV NO.	DESCRIPTION	DATE
⚠	Changed caisson detail designation, added note 'C' eliminated note under 'Foundation Plan' & revised tip elevation of caissons C-4, C-7 & E-7. Showed caissons for N. Access Tunnel Box Bridge	3-22-82

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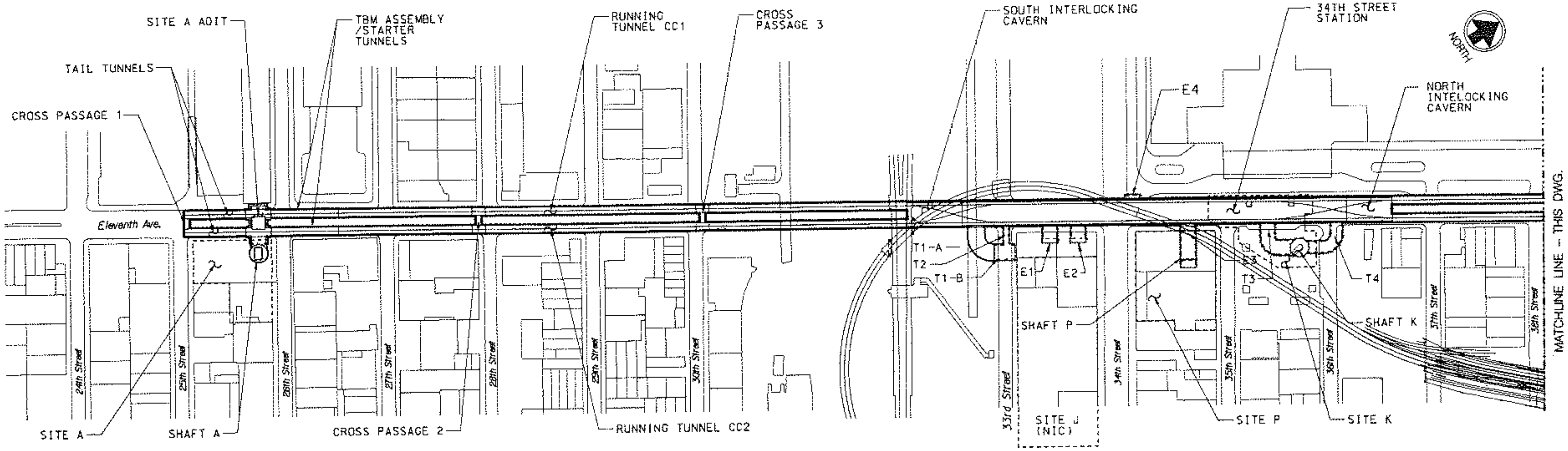
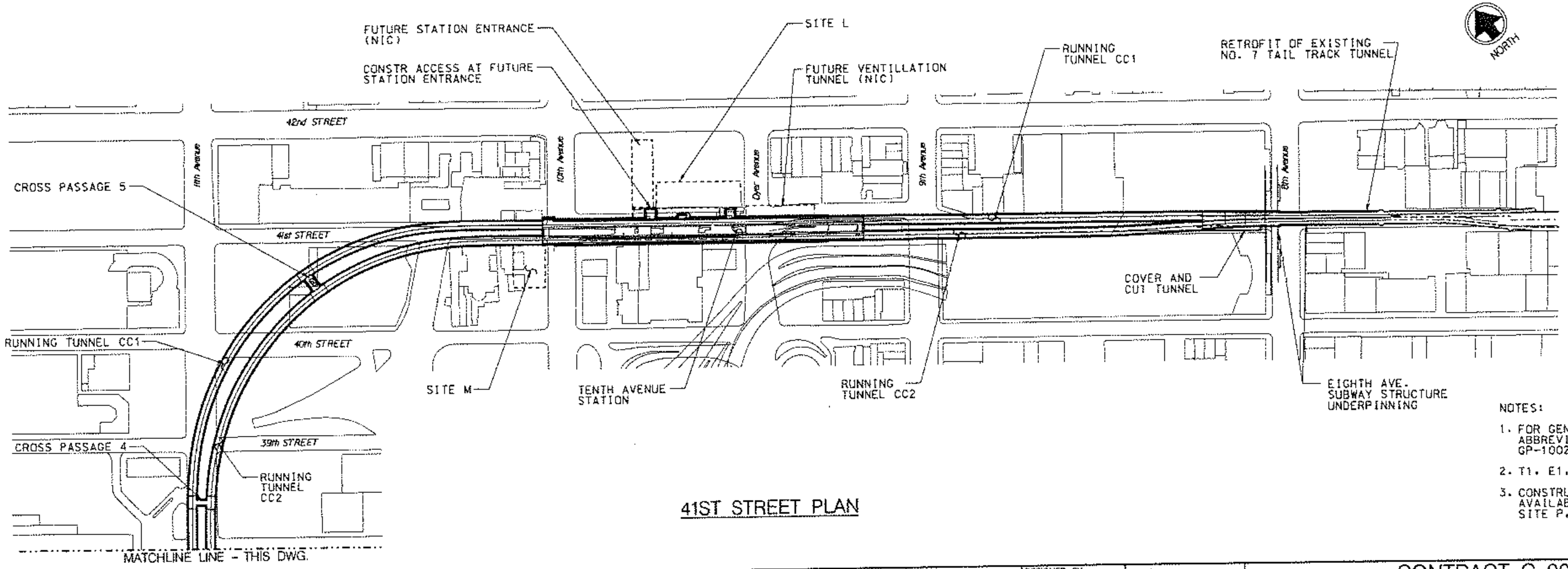
WEST SIDE STORAGE YARD COMPLEX
ORILLED CAISSON OETAILS - I
MABSTOA BUS GARAGE FOUNDATIONS

CONTRACT NO. 1-02-21064-0-0
DATE FEB. 15, 1982
SCALE AS NOTED
DRAWING NO. 8G-2
SHEET 199 OF 204

MTA No. 7 Line Extension



ELEVENTH AVENUE PLAN



41ST STREET PLAN

NOTES:

1. FOR GENERAL NOTES, LEGEND, SYMBOLS AND ABBREVIATIONS, SEE DWG NOS GP-10021 TO GP-10024.
2. T1, E1, (TYP) DENOTES ANCILLARY TUNNELS.
3. CONSTRUCTION STAGING AND LAYDOWN AREAS AVAILABLE TO THE CONTRACTOR INCLUDE: SITE A, SITE P, SITE M AND SITE L.

New York City Transit
Capital Construction

HYDC
Hudson Yards Development Corporation

PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.
ONE PENN PLAZA NEW YORK, NY 10119

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REV	DESCRIPTION	DATE	APPROVED

PETER M. WAHL
No. 069028

DESIGNED BY: K. UPPAL Kuppal
DRAWN BY: D. TARECTECAN D. Tarectecan
CHECKED BY: P. WAHL P. Wahl
APPROVED BY: H. L. BERLINER H. L. Berliner

CONTRACT C-26503
CONSTRUCTION OF RUNNING TUNNELS AND STATION STRUCTURES
NUMBER ⑦ (FLUSHING) LINE EXTENSION, "A" DIVISION (IRT), BOROUGH OF MANHATTAN
KEY PLANS

DATE: JAN 19, 2007
DRAWING No. GP-10031
REVISION:

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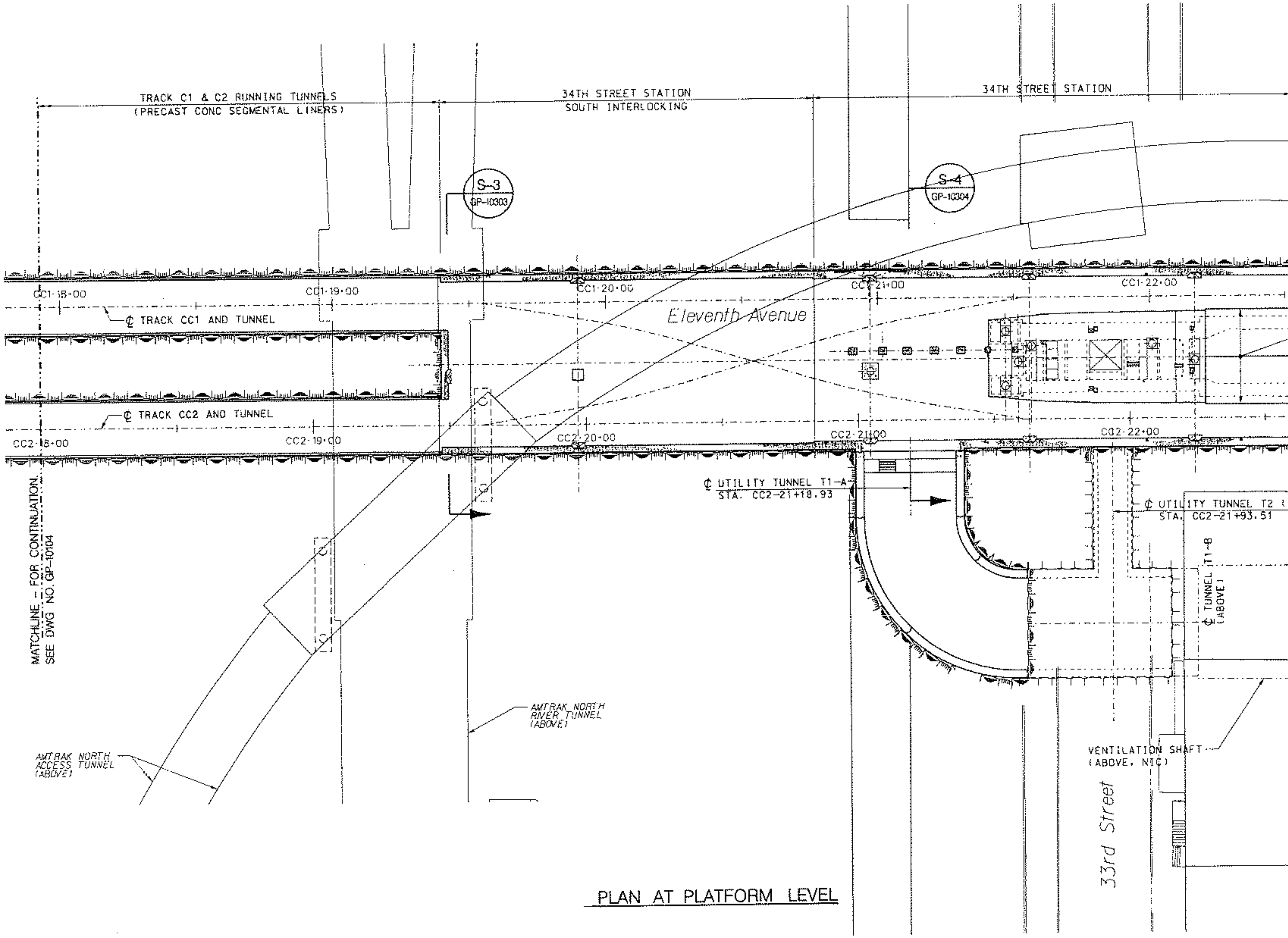


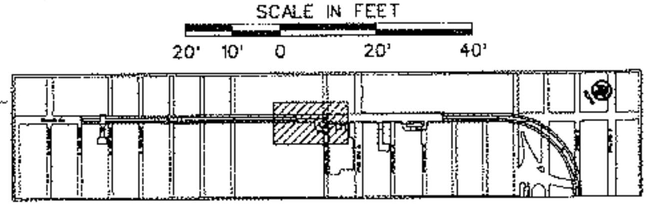
PLAN AT PLATFORM LEVEL

NOTES:

1. FOR NOTES, SEE DWG NO. GP-10101.

SCALE IN FEET

20' 10' 0 20' 40'



ELEVENTH AVENUE KEY PLAN

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Capital Construction

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REV	DESCRIPTION	DATE	APPROVED

PETER M. WAHL No. 069028

DESIGNED BY: K. UPPAL
DRAWN BY: D. TARECTECAN
CHECKED BY: P.WAHL
APPROVED BY: H. L. BERLINER

CONTRACT C-26503
CONSTRUCTION OF RUNNING TUNNELS AND STATION STRUCTURES
NUMBER ⑦ (FLUSHING) LINE EXTENSION, "A" DIVISION (IRT), BOROUGH OF MANHATTAN
GENERAL PLAN
STA. CC2-18+00 TO STA. CC2-22+65
SHEET 5

DATE: JAN 19, 2007
DRAWING No. GP-10105
REVISION:

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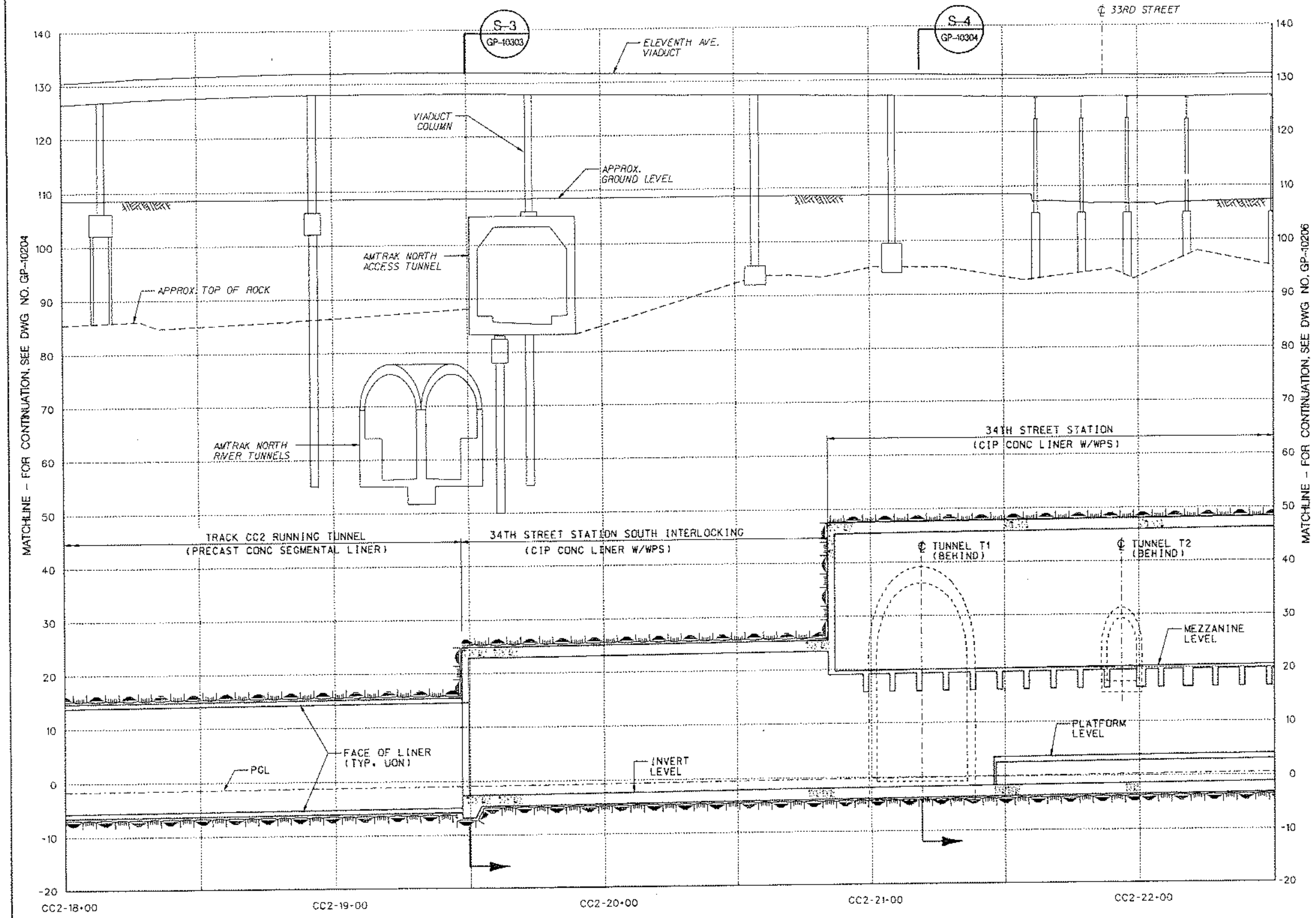

NOTES:

1. FOR NOTES, SEE DWG NO GP-10101.

HORIZ: SCALE IN FEET 20' 10' 0 20' 40'

VERT: SCALE IN FEET 10' 5' 0 10' 20'

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REV	DESCRIPTION	DATE	APPROVED

PETER M. WAHL No. 060028

DESIGNED BY:	K. UPPAL	KUppal
DRAWN BY:	D. TARECTECAN	D. Tarectecan
CHECKED BY:	P. WAHL	P Wahl
APPROVED BY:	H. L. BERLINER	H Berliner

CONTRACT C-26503
CONSTRUCTION OF RUNNING TUNNELS AND STATION STRUCTURES
NUMBER 7 (FLUSHING) LINE EXTENSION, "A" DIVISION (IRT), BOROUGH OF MANHATTAN
GENERAL PROFILE - TRACK CC2
STA. CC2-18+00 TO STA. CC2-22+50
SHEET 5

DATE: JAN 19, 2007
DRAWING No. GP-10205
REVISION:

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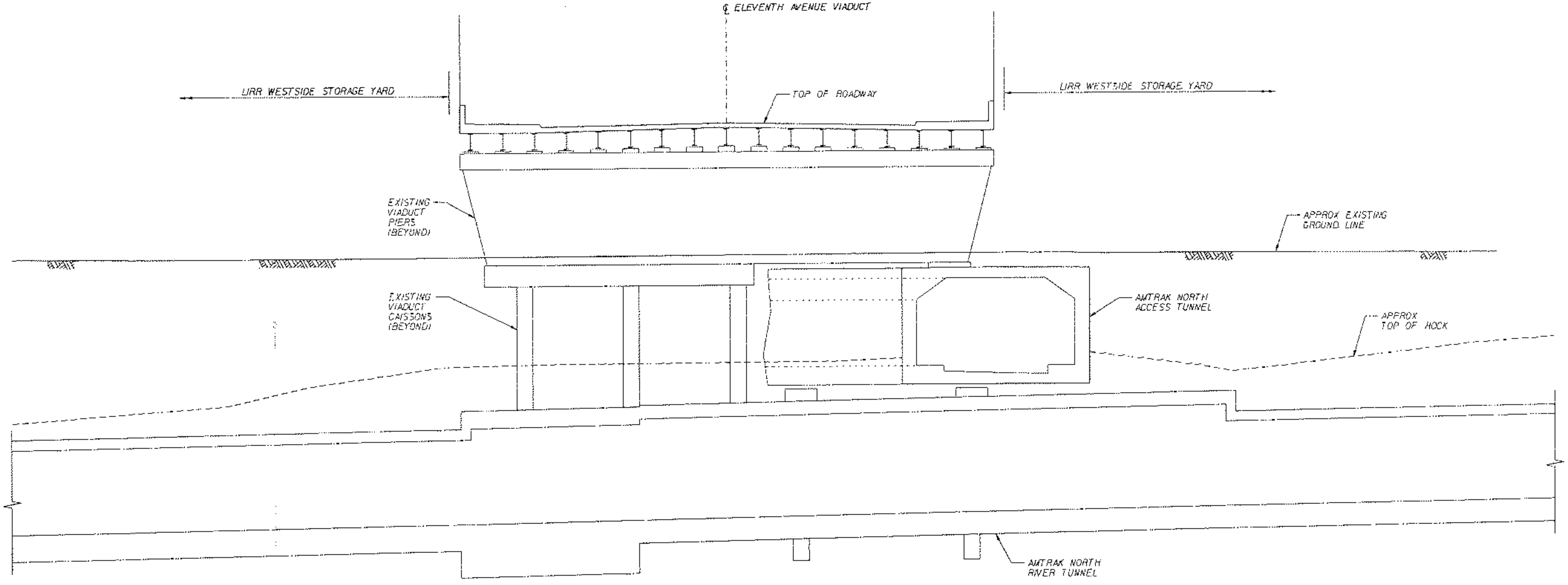

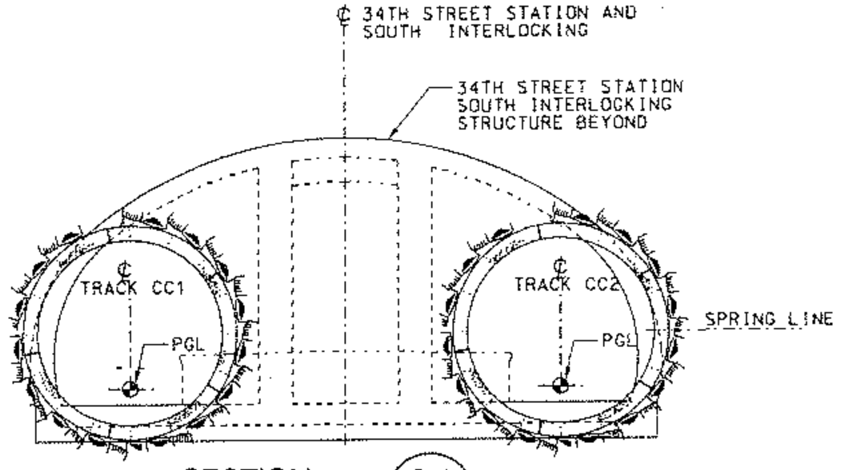

SECTION S-3
GP-10105
GP-10205
GP-10225

NOTES:
1. FOR NOTES SEE DWG NO. GP-10101.

SCALE IN FEET
10' 5' 0 10' 20'

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Capital Construction

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REV	DESCRIPTION	DATE	APPROVED

PETER M. WAHL
No. 069028

DESIGNED BY: K. UPPAL	KUppal
DRAWN BY: J. PADILLA	J. Padilla
CHECKED BY: P. WAHL	P Wahl
APPROVED BY: H. L. BERLINER	H Berliner

CONTRACT C-26503
CONSTRUCTION OF RUNNING TUNNELS AND STATION STRUCTURES
NUMBER ⑦ (FLUSHING) LINE EXTENSION, "A" DIVISION (IRT), BOROUGH OF MANHATTAN
GENERAL TRANSVERSE SECTIONS
SHEET 3

DATE: JAN 19, 2007
DRAWING No. GP-10303
REVISION:

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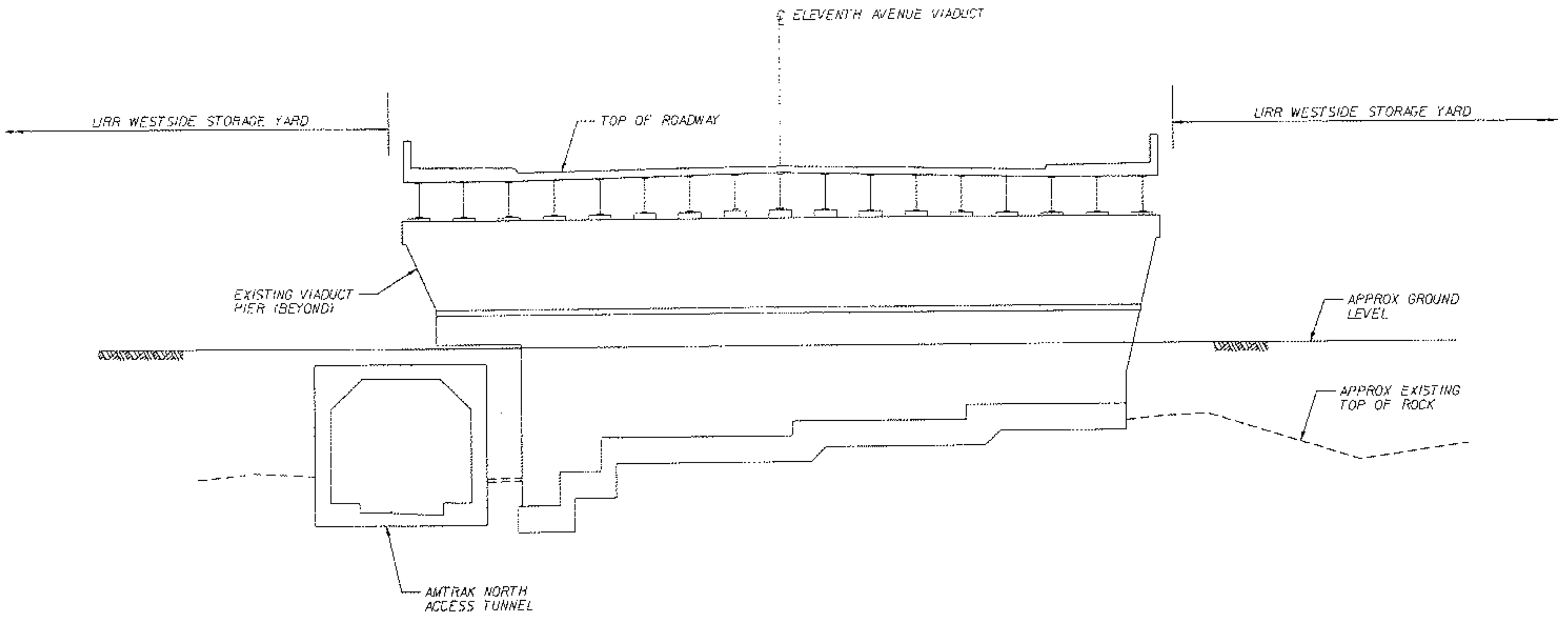

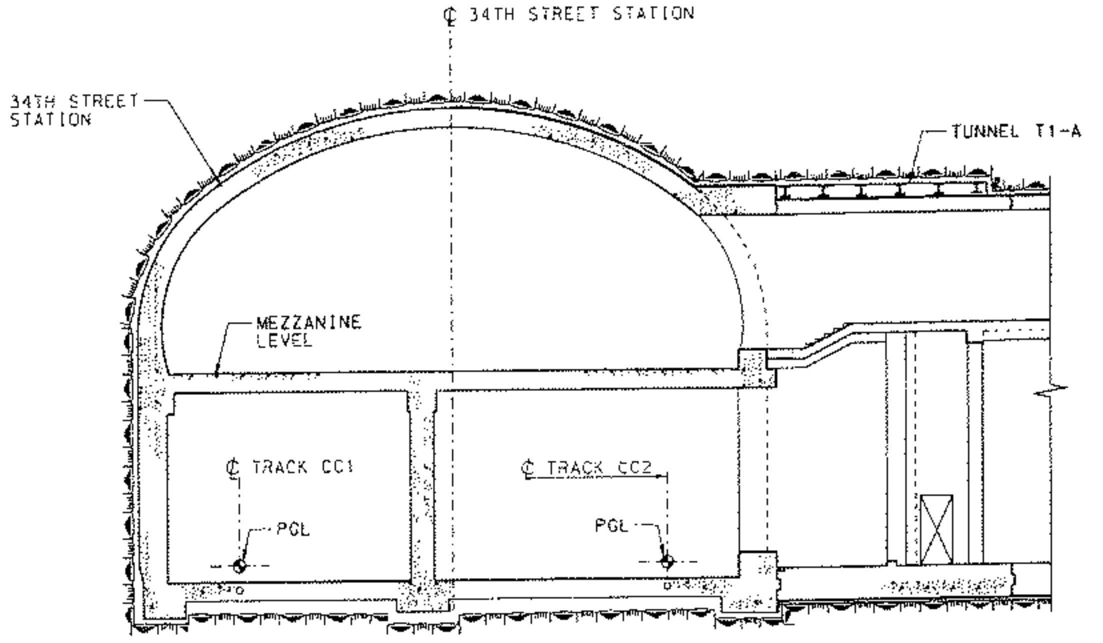

SECTION S-4 GP-10105
GP-10205
GP-10225

NOTES:
1. FOR NOTES, SEE DRAWING GP-10101.

SCALE IN FEET
10' 5' 0 10' 20'

New York City Transit
Capital Construction

HYDC
Hudson Yards Development Corporation

PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.
ONE PENN PLAZA, NEW YORK, NY 10119

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REV	DESCRIPTION	DATE	APPROVED

PETER M. WAHL
No. 069028

DESIGNED BY:
K. UPPAL
DRAWN BY:
J.PADILLA
CHECKED BY:
P. WAHL
APPROVED BY:
H. L. BERLINER

CONTRACT C-26503
CONSTRUCTION OF RUNNING TUNNELS AND STATION STRUCTURES
NUMBER ⑦ (FLUSHING) LINE EXTENSION, "A" DIVISION (IRT), BOROUGH OF MANHATTAN
GENERAL TRANSVERSE SECTIONS
SHEET 4

DATE:
JAN 19, 2007
DRAWING No.
GP-10304
REVISION:

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APPENDIX B
2008 Langan Boring Logs

DEPT OF BLDGS 121192618 Job Number

ES235072652 Scan Code

LANGAN
ENGINEERING & ENVIRONMENTAL SERVICES

Log of Boring **EC-1-1** Sheet 1 of 1

Project: Hudson Yards East Rail Yard (ERY)		Project No.: 170019110	
Location: Manhattan, N.Y.		Elevation and Datum: Approx. 7.7 ft	
Drilling Agency: Aquifer Drilling & Testing, Inc. (ADT)		Date Started: 10/3/08	Date Finished: 10/4/08
Drilling Equipment: High-Rail Mounted Davey Kent DK 50		Completion Depth: 13 ft	Rock Depth: 13 ft.
Size and Type of Bit: 6" I.D. Hollow Stem Auger		Number of Samples: Disturbed 3	Undisturbed N/A; Core N/A
Casing (diameter, material, etc.): N/A	Casing Depth (ft): N/A	Water Level (ft.): First ▽ 9.8	Completion ▼; 24 HR. ▼
Casing Hammer: N/A	Weight (lbs): N/A; Drop (in): N/A	Drilling Foreman: Chris Stratton	
Sampler: 2" O.D. Split spoon			
Sampler Hammer: Slide Hammer	Weight (lbs): 140; Drop (in): 30	Inspecting Engineer: Krishna Jagannathan	

Elev. (ft)	Sample Description	PID Reading (ppm)	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+7.7	Reinforced CONCRETE - 3/4" steel reinforcing bars	0	0 1						Utility clearance, soft dig to 5' depth completed on 9/27-9/28/08
+6.2	f-m GRAVEL, trace sand								
+5.7	Brown m-c SAND, fine gravel, trace silt (dry)	0 0 0	2 3 4						
+2.7	BOULDER	0	5						Environmental sample EC-1-1-4.5-5.0 Boulder obstruction, very hard grinding at 5' to 6' depth
+1.5	Brown f-m SAND, some c-f gravel, trace silt (dry)	0 0	6 7						Sporadic moderate to heavy grinding to 8'
-0.3	Dark gray f-m SAND, some gravel (dry)	0	8	S-1	SS	12	34 13 11 17	24	Occasional cobbles
-1.3	Dark brown silty SAND (moist)	0	9						
-1.6	Fine GRAVEL (moist) ▽								
-2.1	Dark brown micaceous fine SAND, some silt (wet)	0	10						
-2.3	Grayish brown SAND and GRAVEL (wet0			S-2	SS	18	12 23 18 19	41	
-3.3	Brown f-m SAND, trace gravel (wet)	0	11						Environmental sample EC-1-1-11.0-12.0
-4.1	Brown silty fine SAND (wet)	0	12						
-4.3	Brown m-f SAND and silty clay, trace to some fine gravel (wet)			S-3	SS	7.5	22 100/0"	Refusal	
-5.3	End of boring at 13'	0	13						Monitoring well constructed, screen between 2 and 12 ft bgs
			14 15 16 17 18 19 20						

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DEPT OF BLDGS 121192618 Job Number

ES357152658 Scan Code

LANGAN
ENGINEERING & ENVIRONMENTAL SERVICES

Log of Boring **EC-1-2** Sheet 1 of 1

Project: Hudson Yards East Rail Yard (ERY)

Project No.: 170019110

Location: Manhattan, N.Y.

Elevation and Datum: Approx. 7.7 ft

Drilling Agency: Aquifer Drilling & Testing, Inc. (ADT)

Date Started: 10/4/08

Date Finished: 10/4/08

Drilling Equipment: High-Rail Mounted Davey Kent DK 50

Completion Depth: 8.25 ft

Rock Depth: 8.25 ft

Size and Type of Bit: 6" I.D. Hollow Stem Auger

Number of Samples: Disturbed 1 Undisturbed N/A Core N/A

Casing (diameter, material, etc.): N/A

Casing Depth (ft): N/A

Water Level (ft.): First ▽ N/E Completion ▼ 24 HR. ▼

Casing Hammer: N/A Weight (lbs): N/A Drop (in): N/A

Drilling Foreman: Chris Stratton

Sampler: 2" O.D. Split spoon

Inspecting Engineer: Kasey Gibb

Sampler Hammer: Slide Hammer Weight (lbs): 140 Drop (in): 30

MATERIAL SYMBOL	Elev. (ft) +7.7	Sample Description	PID Reading (ppm)	Depth Scale	Sample Data Number	Type	Recov. (ft)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+6.1	Railroad track ballast m-c GRAVEL	0	0 1						Utility clearance, soft dig to 7' depth completed on 9/27-9/28/08
	+3.7	Reinforced CONCRETE, 3/4" steel reinforcing bars	0 0	2 3						
	+3.2	f-m GRAVEL	0	4						
	+1.7	Brown m-c SAND and f-m GRAVEL (dry)	0	5						
	+0.3	Gray black fine SAND and GRAVEL	0 0	6 7	S-1	SS	12	36 41 19 12	60	Environmental sample EC-1-2-6.5-7.0
	-0.6	Brown f-m SAND and CLAY becoming f-m SAND and GRAVEL (dry to moist)	0	8						Auger and split spoon refusal at 8.3' bgs
		End of boring at 8.25'		9 10 11 12 13 14 15 16 17 18 19 20						Shallow bedrock, dry conditions, no monitoring well constructed

DEPT OF BLDGS 121192618 Job Number

ES373546864 Scan Code

LANGAN
ENGINEERING & ENVIRONMENTAL SERVICES

Log of Boring EC-1-6 Sheet 1 of 1

Project Hudson Yards East Rail Yard (ERY)		Project No. 170019110	
Location Manhattan, N.Y.		Elevation and Datum Approx. 7.8 ft	
Drilling Agency Aquifer Drilling & Testing, Inc. (ADT)		Date Started 10/10/08	Date Finished 10/11/08
Drilling Equipment High-Rail Mounted Davey Kent DK 50		Completion Depth 18.7 ft	Rock Depth 18.5 ft
Size and Type of Bit 6" I.D. Hollow Stem Auger		Number of Samples	Disturbed 7 / Undisturbed N/A / Core N/A
Casing (diameter, material, etc.) N/A	Casing Depth (ft) N/A	Water Level (ft.)	First ▽ 13 / Completion ▼ / 24 HR. ▽
Casing Hammer N/A	Weight (lbs) N/A / Drop (in) N/A	Drilling Foreman Chris Stratton	
Sampler 2" O.D. Split spoon		Inspecting Engineer Krishna Jagannathan	
Sampler Hammer Slide Hammer	Weight (lbs) 140 / Drop (in) 30		

MATERIAL SYMBOL	Elev. (ft)	Sample Description	PID Reading (ppm)	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+7.8	Reinforced CONCRETE with 3/4" reinforcing bars		0						Utility clearance, soft dig to 6' on 10/10/08 followed immediately by soil test boring
			0	1						
	+6.3	ASPHALT PAVEMENT								
	+5.8	FILL (dry) Light brown f-m SAND, some f-m gravel, trace silt	0	2						
			0	3						
	+4.3	FILL (dry to moist) Red brown f-m SAND, some f-m gravel, trace to some silt	0	4						Environmental sample EC-1-6-3.5-4.0
			0	5						
	+1.8		0	6						
		GLACIAL TILL (dry to moist) red brown silty fine SAND, trace m-c sand, trace clay	0	7	S-1	SS	16	7 7 12 15	19	
			0	8						
		GLACIAL TILL (dry to moist) Red brown f-m SAND, some silt, trace coarse sand, trace clay	0	9	S-2	SS	23	10 14 11 19	25	
			0	10						
		GLACIAL TILL (moist) Red brown silty fine SAND, trace to some sand, trace clay	0	11	S-3	SS	18	9 10 16 17	26	
			0	12						
		GLACIAL TILL (moist to wet) ▽ Red brown f-m SAND, some silt, trace to some clay, trace coarse sand and fine gravel	0	13	S-4	SS	15	17 18 15 15	33	2" clay layer at 13.5'
	-6.2		0	14						
		GLACIAL TILL Red brown SILT, some fine sand, trace medium sand, trace clay becoming f-m SAND, trace to some silt	0	15	S-5	SS	12	9 9 9 10	18	
			0	16						Environmental sample EC-1-6-16-18
		GLACIAL TILL Red brown f-m SAND, trace to some silt, trace coarse sand, trace clay	0	17	S-6	SS		15 18 17 17	35	
	-10.7		0	18	S-7	SS	8	28 100/3"		Mica schist Auger and split spoon refusal
	-10.9	DECOMPOSED BEDROCK (moist) mottled black and white f-m SAND, trace to some silt End of boring at 18.7'							Refusal	Monitoring well constructed, screen between 8.5 and 18.5 ft
				19						
				20						

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DEPT OF BLDGS 121192618 Job Number

ES876655434 Scan Code

LANGAN
ENGINEERING & ENVIRONMENTAL SERVICES

Log of Boring **EC-1-7** Sheet 1 of 1

Project: Hudson Yards East Rail Yard (ERY)
Project No.: 170019110
Location: Manhattan, N.Y.
Elevation and Datum: Approx. 7.8 ft
Drilling Agency: Aquifer Drilling & Testing, Inc. (ADT)
Date Started: 10/10/08
Date Finished: 10/10/08
Drilling Equipment: High-Rail Mounted Davey Kent DK 50
Completion Depth: 6 ft
Rock Depth: 6 ft
Size and Type of Bit: 6" I.D. Hollow Stem Auger
Number of Samples: Disturbed 2; Undisturbed N/A; Core N/A
Casing (diameter, material, etc.): N/A
Casing Depth (ft): N/A
Water Level (ft.): First ▽ N/E; Completion ▼; 24 HR. ▽
Casing Hammer: N/A
Weight (lbs): N/A
Drop (in): N/A
Drilling Foreman: Chris Stratton
Sampler: 2" O.D. Split spoon
Inspecting Engineer: Krishna Jagannathan
Sampler Hammer: Slide Hammer
Weight (lbs): 140
Drop (in): 30

MATERIAL SYMBOL	Elev. (ft)	Sample Description	PID Reading (ppm)	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+7.8	Railroad track ballast m-c GRAVEL		0						Utility clearance, soft dig to 5' on 10/10/08 followed immediately by soil test boring
	+6.3	Reinforced CONCRETE with steel reinforcing bars	0	1						
	+5.3		0	2						
	+4.8	m-f GRAVEL	0	3						
		FILL (dry to moist) Brown f-m SAND, trace silt, trace to some f-m gravel	0	4						Environmental sample EC-1-7-4.5-5.0
	+2.1		0	5	S-1	SS	6	60 100/3"	Refusal	
	+1.8	Light gray brown GNEISSIC BEDROCK End of boring at 6'	0	6	S-2	SS	0	100/0"	Refusal	Set up high-rail mounted DK-50 rig on boring location. Heavy grinding and rig chatter with auger. Auger and split spoon refusal
				7						
				8						
				9						Shallow bedrock, dry conditions, no monitoring well constructed
				10						
				11						
				12						
				13						
				14						
				15						
				16						
				17						
				18						
				19						
				20						

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APPENDIX C
Historical Borings by Others

P
Br
Quade &
Douglas, Inc.

DEPT OF BLDGS 121192618 Job Number
ES939390038 Scan Code

-6
1 of 2

PROJECT NUMBER:

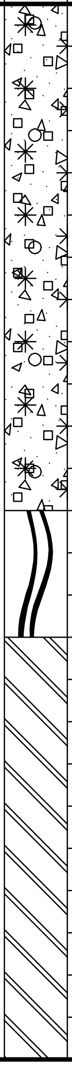
PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Deigert**
INSPECTOR: **C. Burzynski**
DRILLING METHOD: **Rotary Wash**
RIG TYPE: **CME-55**

LOCATION: **Track 21-40' W of 11th Ave**
COORD. N: **214,261.2** E: **983,394.5**
STN. NO.: OFFSET:
SURFACE ELEV.: **108.0+/-**
DATUM:
START DATE: **5/31/05** TIME: **8:30 pm**
FINISH DATE: **6/4/05** TIME: **2:30 pm**

	Casing	Split Spoon	Shelby Tube	Piston	Grab	Core Barrel
Type/Symbol	HW	S ■	U ▯	P ▧	G ☒	C ⊟
I.D.	4"	1.375"	2.938"	2.938"		2"
O.D.	4.5"	2"	3"	3"		3"
Length		24"	24"	24"		
Hammer Wt.	300 lbs	140 lbs	Drill Rod Size		NWJ	
Hammer Fall	24"	30"	I.D. (O.D.)		(2.938")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)



DEPTH (feet)	CASING (Blows/ft) CORING (Min./ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6 / CORING RUN (in.)	6/12 / REC. (in.)	12/18 / REC. %	18/24 / L>4" (in.)	REC. (in.) / RQD %	Depth Elev.	FIELD CLASSIFICATION AND REMARKS
												Concrete cored via thin wall adapter to 1.6 feet Forced Air-Tricone method used to clear utilities to 10 feet
		G	G-1	☒	1.6 - 3.0	-	-	-	-			Brown m-f SAND, little m-f Gravel, moist (SM) (FILL) Dark-gray c-f SAND, some f-Gravel, little Silt & Clay, occasional wood fragments (SM) (FILL)
5												
		G	G-2	☒	3.0 - 10.0	-	-	-	-			
10												
		S	S-1	■	10.0 - 12.0	2	10	20	27	8		(Top 6 inches) Gray c-f SAND, little c-f Gravel, dense (SM) (FILL) (Bottom 2 inches) Gray SILT & CLAY, slightly organic (OH)
15												
		S	S-2	■	15.0 - 17.0	4	2	11	51	20		Gray CLAY & SILT, some f- Sand, little c-f Gravel, slightly organic, stiff. (CL)
20												
		S	S-3	■	20.0 - 22.0	65	20	8	12	6		Gray CLAY & SILT, some m-f Gravel, little f Sand, very stiff (CL)

BORING LOG NO_7NE.GPJ MAINLI~1.GLB 8/23/06

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DEPT OF BLDGS121192618 Job Number

ES832961245 Scan Code

BORING LOG
(continued)

BORING NUMBER FD-6

SHEET 2 of 2

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C. Deigert**

INSPECTOR: **C. Burzynski**

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft) CORING (Min./ft)	SAMPLE				SOIL (Blows/6 in.)						FIELD CLASSIFICATION AND REMARKS
			TYPE	NUMBER	SYMBOL	DEPTH (feet)	0/6 CORING RUN (in.)	6/12 REC. (in.)	12/18 REC. %	18/24 L>4" (in.)	REC. (in.) RQD %	Depth Elev.	
			S	S-4		25.0 - 25.0	100/0	-	-	-	0		No recovery
												29.0	Hard drilling 24.5' to 29'. 3-inch casing advanced to 27'. Roller bit refusal and begin coring rock at 29'.
30													
35													
40													
45													
50													
55													

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-6
1 of 3

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**	LOCATION: **Track 21-40' W of 11th Ave**
LOCATION: **Manhattan**	COORD. **N: 214,261.2** **E: 983,394.5**
CLIENT: **MTA**	STN. NO.: OFFSET:
CONTRACTOR: **Jersey Boring & Drilling**	SURFACE ELEV.: **108.0+/-**
DRILLER: **C. Deigert**	DATUM:
INSPECTOR: **C. Burzynski**	
DRILLING METHOD: **Diamond drilling with double core barrel**	START DATE: **5/31/05** TIME: **8:30 pm**
RIG TYPE: **CME-55**	FINISH DATE: **6/4/05** TIME: **2:30 pm**

CORE BARREL DATA:	NOTES:
TYPE: NX	
CORE SIZE: 2"	
O.D.: 3"	
I.D.: 2"	
CASING SIZE: 4" (4.5")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break
30 35		C-1 29.0 - 37.2	98	100	97	C-1 - 29.0' to 31.5': Dark-gray to black SCHIST c-m grains of biotite, quartz, other black mafic minerals, very close to moderate fracture spacing; slightly weathered, medium strong; foliation defined by wavy contorted schistosity and thin (<0.1") discontinuous quartz bands; foliation dips 75° to 90°; 1"-inch thick intrusions of light-gray, fine grained GRANITE at 29.0' -29.1' and 29.5' - 29.6'; from 31.5' to 37.2': Light-gray GRANITE, f- grains of probable muscovite, quartz and feldspar; close to moderate fracture spacing, lightly weathered, except moderately weathered at 36.9'-37.2', strong, except medium strong at 36.9'-37.2'; light-gray to salmon-pink, c- grained PEGMATITE from 34.0' to 34.7' and 35.3' to 36.1'; contacts with granite steeply dipping; white clay on mica-rich fracture surface at 33.3'; red clay on steep fractures at 36.9'-37.2'.
40 45		C-2 37.2 - 47.2	120	100	84	C-2 - 37.2' to 38.7': Medium-gray GRANITE, f- grains of probable quartz, feldspar, muscovite, in vertical contact with gray to salmon-pink PEGMATITE, with coarse grains of feldspar, quartz, and medium grained garnet; dark-gray biotite SCHIST from 37.2' to 37.4'; very close to moderate fracture spacing; slightly weathered, strong; foliation in schist dips 50°, parallel to contact with granite. 38.7' to 43.0': Dark-gray to black SCHIST, medium to coarse grains of biotite, quartz, muscovite, other mafic minerals; close to moderate fracture spacing; slightly to moderately weathered, medium strong; foliation defined by wavy schistosity dipping 80° to 90°; light-gray PEGMATITE in vertical contact from 41.1' to 46.0'; quartz-PEGMATITE at 39.2'-39.5' has pitted core surface with numerous healed, partly open fractures, most dipping 20°. 43.0' - 45.0' and 45.8'-46.4' Medium-gray GRANITE, as above, except wide fracture spacing. 45.0' - 45.8' and 46.4'-47.2': Dark-gray to black SCHIST, as above except extremely close fracturing at 47.0'-47.2'
50		C-3 47.2 - 57.2	120	100	98	C-3 - 47.2' to 53.4': Dark-gray to black SCHIST c-f grains of biotite, quartz, feldspar, muscovite, other

WEATHERING	STRENGTH	DISCONTINUITY DATA ANGLE (deg)	Jr	Ja	DEPTH (feet)
II	R3	5	2.0	2.0	29
		25	1.5	1.0	29.1
		*60	1.5	1.0	29.2
		*70	1.5	2.0	31.1
II	R4	*75	1.0	2.0	31.5
		5	2.0	1.0	32.1
		5	2.0	1.0	32.3
		5	1.5	1.0	32.8
		70	1.5	4.0	33.3
		5_{MB}	-	-	33.8
		20	1.5	2.0	34.4
		30	1.5	2.0	34.7
		5	3.0	3.0	35.7
II	R3	20	2.0	1.0	36.1
II	R4	5	2.0	2.0	36.4
		70	1.0	4.0	36.9
III/II	R3	80	1.0	4.0	37
		10	1.5	1.0	37.2
		20	1.5	2.0	37.3
		*50	1.0	4.0	37.4
		45	2.0	1.0	37.6
		5_{MB}	-	-	38.8
		5	1.5	1.0	39.1
II	R4	5	1.5	1.0	39.2
		40	1.0	4.0	39.3
		20	1.5	1.0	39.4
		20	2.0	1.0	39.6
		*85	1.0	4.0	39.8
II	R3	75	1.5	1.0	40.3
		45	2.0	1.0	41
II	R3/R4	*75-85	2.0	1.0	42.4
		10	3.0	1.0	42.9
		5_{MB}	-	-	43.4
		30	2.0	1.0	45.3
		5	3.0	1.0	45.8
		20	1.5	1.0	46.3
		*40	1.0	1.0	47.05
		30	1.5	1.0	47.1
		20	1.0	1.0	47.2
		60	1.0	1.0	48.2
II	R4/R5	5	3.0	2.0	48.5

NO. 7 CORING LOG NO_7NE.GPJ MAINLI~1.GLB 8/23/06

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CORING LOG
(continued)

SHEET 2 of 3

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Deigert**
INSPECTOR: **C. Burzynski**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)
55					
60					
		C-4 57.2 - 67.2	120	100	90
65					
70					
		C-5 67.2 - 77.2	120	100	68
75					
80					
		C-6 77.2 - 87.2	120	100	93
85					

DESCRIPTION AND REMARKS
(Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size)

* - Denotes discontinuity along foliation

MB - Denotes mechanical break

black mafic minerals, very close to moderate fracture spacing; slightly weathered, medium strong to strong, rock breaks easily along 1/4-inch thick biotite seams; wavy, contorted foliation defined by schistosity and thin (<0.1") ptygmatically folded quartz bands; foliation dips 40° to 90°. 53.4' - 57.2': Light gray GRANITE, uniform, fine to medium grains of white feldspar, quartz and muscovite; slightly weathered, moderate fracture spacing; strong to very strong; high angle fractures parallel foliation in schist;

C-4 - 57.2' to 61.5': Light-gray GRANITE, as above, except unweathered wide fracture spacing. 61.5' TO 66.7': Light to medium-gray GRANITIC GNEISS, c-f grains of feldspar, quartz, muscovite; moderate fracture spacing, except very closely spaced fractures from 64.1' to 64.6'; slightly weathered, strong; faint foliation defined by indistinct compositional banding dipping 70°; c grained, pink-white PEGMATITES, 1" to 4" thick throughout, parallel to banding; 66.7' to 67.2': Black SCHIST, medium grains of biotite and quartz, very close fracture spacing to crushed; weak to extremely weak, friable; foliation defined by schistosity,
dipping 70°; contact dips 70°.

C-5 - 67.2' to 71.8': Dark-gray to black SCHIST m-f grains of quartz, biotite, other mafic minerals, very close to moderate fracture spacing, except extremely close from 70.15' to 70.4'; foliation defined by, wavy discontinuous quartz bands and irregular schistosity dipping 50° to 90°; fine grained quartz band from 69.2' to 70.15'; dark-gray, sandy clay FAULT GOUGE from 70.2' to 70.3'; 75° healed fracture at 68.1';

71.8' to 77.2': Medium-gray PEGMATITE, medium to coarse grains of quartz, feldspar, muscovite, garnet, black mafic minerals; close to moderate fracture spacing, except very closely spaced from 75.2' to 75.4'; slightly weathered, strong; bands of fine grained gray rock (mostly quartz ?) from 72.1' to 73.1', 73.7' to 74.6' and 75.9' to 76.5', with near vertical, 70° to 90° contacts;
black schist inclusion from 73.9' to 74.3'; healed hairline fractures dipping 60° to 70° and 20° to 30°, with many crisscrossing from 74.5' to 75.3'; core sides bulge at schist inclusion.

C-6 - 77.2' to 87.2': Medium-gray PEGMATITE c-m grains of quartz, feldspar, muscovite, garnet, some epidote (?) along fractures; moderate fracture spacing, except very close spacing from 77.7' to 78.0' and 79.5' to 79.9'; slightly weathered, except moderately weathered from 79.5' to 79.9'; medium strong to strong; banded inclusions of black schist 77.7' -78.0', 79.4'-79.5', 79.8'-77.9' and 80.1'-80.5, with contacts parallel to foliation, dipping 50°; 6" to 12" wide bands of fine grained quartz-muscovite rock in vertical contact with pegmatite.
83.3'-87.2': Dark-gray to black SCHIST m-f grains of quartz, biotite, muscovite; close to wide fracture spacing; slightly weathered, medium strong to strong;

WEATHERING	STRENGTH
I	R4/R5
II	R2/R1
II	R4/R3
II	R0/R2
II	R4
II	R3/R4
III	R3/R4
II	R4

DISCONTINUITY DATA

ANGLE (deg)	Jr	Ja	DEPTH (feet)
5	1.5	2.0	49.1
5	2.0	2.0	49.2
*55	1.5	2.0	51.4
*45_{MB}	-	-	52.2
*50	1.0	1.0	52.4
55	1.5	2.0	53.7
60	1.5	1.0	54.2
20	2.0	1.0	55.9
20_{MB}	-	-	57.2
20	2.0	1.0	57.9
20	2.0	1.0	60.5
5	1.5	1.0	61.6
5	3.0	2.0	62
*70	1.5	2.0	62.1
25	2.0	1.0	62.2
25	3.0	1.0	62.9
5_{MB}	-	-	63.3
35	1.5	3.0	64.1
40	1.5	1.0	64.3
20	1.5	1.0	64.35
20	1.5	1.0	64.5
20	1.5	4.0	66.4
*70	1.0	1.0	66.7
5	1.5	2.0	66.8
30	1.5	2.0	67
*80	1.0	4.0	67.1
10_{MB}	-	-	67.2
*65	1.0	4.0	67.4
*60	1.5	1.0	67.7
5	3.0	1.0	68.35
55	1.5	3.0	68.6
*60	1.5	1.0	68.9
55	1.5	4.0	69
*50	1.0	4.0	69.05
15	1.5	2.0	69.5
20	1.5	2.0	69.7
50	1.0	3.0	69.9
5	1.0	2.0	70
5	1.5	6.0	70.15
5	1.5	4.0	70.4
5	1.5	4.0	70.45
20	2.0	4.0	70.6
40	2.0	1.0	71.4
10	1.5	1.0	71.5
10	3.0	1.0	72
20	3.0	1.0	72.2
55	1.5	1.0	73.2
5	1.5	2.0	73.8
5	1.5	2.0	74.6
30	1.5	2.0	74.9
10	2.0	1.0	75.3
70	2.0	3.0	75.4
*70	2.0	1.0	76
5_{MB}	-	-	77.2
5	1.5	1.0	77.7
5	1.5	3.0	77.9

(continued)

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PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C. Deigert**

INSPECTOR: **C. Burzynski**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH
						foliation defined by wavy, discontinuous quartz bands and faint schistosity; foliation dips 60°to 80°.		
90 95		C-7 87.2 - 97.2	120	100	98	C-7 - Dark-gray to black SCHIST m-f grains of quartz, biotite, other mafic minerals; moderate to wide fracture spacing; slightly weathered to unweathered, strong; foliation defined by faint schistosity and a few thin (<0.1") contorted quartz bands; foliation dips 50° to 70°, bands of fine grained quartz, 1-inch thick, at 92.0' and 92.5' and from 93.5' to 95.2'; bands parallel to foliation; numerous subparallel, healed 60° fractures from 93.5'-95.2', in quartz band.		
100		C-8 97.2 - 102.2	60	100	95	C-8 - Dark-gray to black SCHIST, as above, except closely spaced fractures from 101.2' to 101.8'; f-grained quartz -muscovite band parallel to foliation from 98.4' to 99.7' and 101.8' to 102.2'; becomes more gneissic with depth.	II	R4
105 110		C-9 102.2 - 112.1	119	100	97	C-9 - Medium to dark gray SCHISTOSE GNEISS, medium fine grains of quartz, biotite and other mafic minerals, muscovite; garnets up to 0.1" across; close to moderate fracture spacing; slightly weathered; strong to very strong; foliation defined by contorted bands and nodules of quartz and faint schistosity; foliation dips 60° to 90°; medium to fine grained granitic bands from 104.3' to 107.9' to 110.1'; non-foliated; irregular 1" to 3" quartz xenoliths in black fine grained matrix from 102.5' to 104.0'; with 0.1" garnets and 0.1" to 0.3" nodules of gold metallic mineral at quartz contacts; wavy core sides throughout mafic zones.	II	R4/R5
115		C-10 112.1 - 120.3	98	100	96	C-10 - Medium to dark-gray GNEISS SCHIST, c-f grains of quartz, biotite, muscovite, other mafic minerals; scattered garnet up to 0.2" across; moderate to wide fracture spacing, except very close fracture spacing from 113.3' to 113.7'; unweathered except slightly weathered from 113.3' to 113.7'; strong; indistinct foliation defined by thin (0.1") contorted + folded quartz bands and faint schistosity; foliation dips 60° to 90°; slickensides on polished 70° foliation fracture at 113.4', with thick(>0.1") gray sandy clay GOUGE; poor crack fit; concentration of weathered garnet crystals within 1" of fracture.	I II I	R4 R4 R4
120						E.O.B at 120.3'.		

DISCONTINUITY DATA			
ANGLE (deg)	Jr	Ja	DEPTH (feet)
60	2.0	1.0	78.7
5	2.0	1.0	79.4
30	2.0	3.0	79.5
5	2.0	3.0	79.55
5	2.0	3.0	79.6
5	2	3.0	79.65
*35	1.0	1.0	79.9
*50	1.0	1.0	80.2
5	2.0	2.0	81.8
30	3.0	2.0	81.9
90	2.0	2.0	82.1
10	3.0	1.0	82.2
50	3.0	2.0	82.7
*60	1.0	1.0	83.6
*50	1.5	2.0	85.2
20	2.0	2.0	85.8
50	3.0	2.0	87.2
*65	2.0	1.0	88.3
20	3.0	1.0	90.8
5_{MB}	-	-	91.4
40	1.5	1.0	92
40_{MB}	-	-	92.2
*60	1.5	1.0	92.4
*50	1.5	3.0	92.7
*50	1.5	1.0	93.2
*40	1.0	2.0	94.8
*50	1.0	1.0	95.2
40	3.0	1.0	96.7
30_{MB}	-	-	97.7
*60	1.5	1.0	98.4
*55	1.5	2.0	99.2
*50	1.5	1.0	100.2
*50	1.5	1.0	101.2
5	1.5	1.0	101.4
30	1.0	1.0	101.8
5_{MB}	-	-	102.2
40	1.0	1.0	103.3
5	3.0	1.0	104.5
15	1.5	4.0	106.3
20	2.0	2.0	106.55
5_{MB}	-	-	107.2
50	2.0	1.0	108.2
5_{MB}	-	-	108.7
20	2.0	1.0	109
5	2.0	3.0	109.6
5	1.5	1.0	110.15
*50	1.5	4.0	110.8
*75	1.5	1.0	111
35	2.0	2.0	111.6
80	2.0	1.0	112.3
5	1.5	1.0	112.4
70	0.5	4.0	113.4
*60	1.5	2.0	113.6
25	2.0	1.0	114
5_{MB}	-	-	117.1
10_{MB}	-	-	117.4
30	3.0	1.0	120.2
10	2.0	1.0	120.3

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1 of 1	
PROJECT NUMBER:	

PROJECT: **No 7 Subway line Extension**	LOCATION: **Track 21-200' E of 11th Ave**
LOCATION: **Manhattan**	COORD. N: **214,091.4** E: **983,575.0**
CLIENT: **MTA**	STN. NO.: OFFSET:
CONTRACTOR: **Jersey Boring & Drilling**	SURFACE ELEV.: **108.0+/-**
DRILLER: **C.Cruz/E. Morales**	DATUM:
INSPECTOR: **A. Zabala**	
DRILLING METHOD: **Rotary Wash**	START DATE: **5/31/05** TIME: **8:30 pm**
RIG TYPE: **Acker 45 (High Rail Truck-mounted)**	FINISH DATE: **6/4/05** TIME: **6:00 pm**

	Casing	Split Spoon	Shelby Tube	Denison	Grab	Core Barrel
Type/Symbol	HW	S ■	U ▯	D ☐	G ☒	C ⊟
I.D.	4"	1.375"	2.938"	2.938"		2"
O.D.	4.5"	2"	3"	4.625"		3"
Length		24"	24"	24"		
Hammer Wt.	140 lbs	140 lbs	Drill Rod Size		NWJ	
Hammer Fall	24"	30"	I.D. (O.D.)		(2.938")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)
6/1/05	9:00 am	9.0	10.0	27.0
6/4/05	9:00 am	10.0	10.0	120.0

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft) CORING (Min./ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6 / CORING RUN (in.)	6/12 / REC. (in.)	12/18 / REC. %	18/24 / L>4" (in.)	REC. (in.) / RQD %	Depth Elev.	FIELD CLASSIFICATION AND REMARKS
													AIR TRICONE METHOD 0' TO 1.5'(2" stone (ballast)) 1.5' to 2.5' concrete slab 2.5' to 5.0' c-f Gravel, some c-f Sand.
5			S	1	■	5.0 - 5.3	100/3"				3		Schist fragments and rock fragments at tip Refusal (1-foot boulder)
10			S	2	■	10.0 - 10.3	100/3"				2	10.5	Black Rock fragments / possible boulder. Roller bit refusal and begin coring at 10.5'.
15													
20													

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DEPT OF BLDGS 121192618 Job Number
ES201622960 Scan Code

D-7
SHEET 1 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C.Cruz/E. Morales**
INSPECTOR: **A. Zabala**
DRILLING METHOD: **Diamond drilling with double core barrel**
RIG TYPE: **Acker 45 (High Rail Truck-mounted)**

LOCATION: **Track 21-200' E of 11th Ave**
COORD. N: **214,091.4** E: **983,575.0**
STN. NO.: OFFSET:
SURFACE ELEV.: **108.0+/-**
DATUM:
START DATE: **5/31/05** TIME: **8:30 pm**
FINISH DATE: **6/4/05** TIME: **6:00 pm**

CORE BARREL DATA:	NOTES:
TYPE: NX	
CORE SIZE: 2"	
O.D.: 3"	
I.D.: 2"	
CASING SIZE: 4" (4.5")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)
6/1/05	9:00 am	9.0	10.0	27.0
6/4/05	9:00 am	10.0	10.0	120.0

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)
		C-1 10.5 - 16.1	67	100	70
15					
		C-2 16.1 - 21.0	54	92	82
20					
		C-3 21.0 - 27.0	72	100	100
25					
		C-4 27.0 - 37.0	120	100	83
30					
35					

DESCRIPTION AND REMARKS
(Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size)

* - Denotes discontinuity along foliation

MB - Denotes mechanical break

C-1 - Pink to light gray GRANITE, m-f grains of feldspar, quartz, muscovite and scattered black mafic minerals; medium grained garnets from 12..6' to 13.0', very close to wide fracture spacing, very strong, slightly weathered; fractures have orange iron staining, thin (<0.1") red clay coating at 15.1'; EXCEPT:10.8' to 11.6' Dark gray to black SCHIST, medium grains of biotite, quartz, mafic minerals, close fracture spacing, slightly weathered, close fracture spacing, strong; fractures have pyrite and iron staining, thin (<0.1") clay coating at 11.0', indistinct foliation dips 40° defined by schistosity.

C-2 - 16.1' to 20.1' Light-gray GRANITE m-f grains of feldspar, muscovite, garnet; black mafic minerals, mostly quartz, from 17.5' to 18.5'; close to moderate fracture spacing, slightly weathered, very strong; yellow staining on fractures; coarse grained quartz - feldspar PEGMATITE from 18.4' to 18.7' and from 19.7' to 20.1'.

20.1' to 21.0': Dark-gray to Black SCHIST, m grains of biotite, quartz, other mafic minerals; extremely close fracture spacing, slightly weathered with no iron staining, extremely weak and friable; contorted foliation defined by schistosity and irregular quartz nodules. Loss of Recovery between 20.5' and 21.0'

C-3 - Dark gray to dark-blue-gray SCHIST c-f grains of biotite, quartz, pyrite, other mafic minerals; 0.1-inch nodules of blue mineral (cyanite) wide fracture spacing, unweathered to slightly weathered, strong, faint wavy foliation dips 60° to 90°, defined by indistinct schistosity and contorted bands of quartz; all fractures across foliation; non-parallel core sides throughout the run, with bulging in biotite-rich zones.

C-4 - 27.0' to 29.0': Dark-gray to dark blue-gray SCHIST,as above, with healed, vertical, non-foliation fracture offsetting quartz band by 0.5".

29.0' to 37.0': Medium-gray to yellow-gray GRANITE,m-f grains of feldspar, quartz, muscovite, scattered garnets up to 0.1" across; moderate fracture spacing, slightly weathered with iron staining;

WEATHERING	STRENGTH
II	R5
II	R5
II	R5
I/II	R4
II	R4

DISCONTINUITY DATA

ANGLE (deg)	Jr	Ja	DEPTH (feet)
*40	1.5	1.0	10.8
*40	1.5	4.0	11
*40	1.0	1.0	11.1
*40	1.0	2.0	11.3
*40	1.0	4.0	11.6
*45	1.0	3.0	12.6
0	2.0	2.0	14.8
30	2	2	14.9
30	2	2	15.1
35	1.5	2.0	15.8
0_{MB}	-	-	16.1
30	1.5	1.0	17.5
20	3.0	1.0	18.6
0_{MB}	-	-	19
20	3.0	2.0	19.9
20	2.0	3.0	20.1
*30	2.0	3.0	20.3
*40	-	-	21
0	3.0	1.0	21.2
20	3.0	1.0	23.6
20_{MB}	-	-	24.1
15_{MB}	-	-	24.9
*85	2	1	26.9
0_{MB}	-	-	27
0_{MB}	-	-	27.8
*80	3.0	4.0	28.8
10	2.0	3.0	28.9
30	1.5	2.0	29
80	2	3	31.1
0	1.5	1.0	31.2
80	3.0	2.0	31.5
0	3.0	1.0	32.1
5	2.0	1.0	32.3
10	3.0	3.0	33.6
50	1.5	3.0	33.7

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(continued)

-7

2 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C.Cruz/E. Morales**

INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH
						strong; several subparallel, near vertical healed fractures, partially open, with iron staining, dip from 80 ° to 90 °. EXCEPT: 31.0' to 32.0', 33.5'-34.6', 35.2' - 36.7' White to salmon-pink PEGMATITE, c grains of quartz, feldspar, muscovite, mafic minerals, close to wide fracture fracture spacing, strong; numerous 80 to 90° healed fractures partially open, with iron stained infill.	I/II	R4/R5
40 45		C-5 37.0 - 47.0	120	100	100	C-5 - 37.0' to 46.5': Light gray to salmon-pink GRANITE m-f grains of feldspar, quartz, muscovite, mafic minerals, very wide fracture spacing, unweathered, very wide fracture spacing, faint banding dipping 20°, with fine grained zones; interlayered light-gray to salmon-pink PEGMATITE; 0.5 ft to 1.5 ft thick; coarse grains of feldspar, quartz, muscovite, unweathered, strong.		
						46.5'-47.0': Dark-gray to black SCHIST, m grains of biotite, quartz, mafic minerals, garnet, slightly weathered, strong, indistinct foliation.	II	R4/R5
50		C-6 47.0 - 56.1	109	100	83	C-6 - 47.0' to 48.6': Medium-gray GRANITE m-f grains of quartz, feldspar, mafic minerals; moderate fracture spacing; slightly weathered, very strong. 48.6' to 50.8': Dark-gray to black SCHIST m-f grains of biotite, other mafic minerals, quartz, close to very close fracture spacing, slightly weathered, medium strong, wavy foliation defined by discontinuous schistosity, dipping 20° to 40 °.	II	R4
55						50.8' to 51.9': Dark-gray PEGMATITE, c grains of muscovite, quartz and pink feldspar, with medium grained garnet in dark-gray fine grained matrix; strong, slightly weathered, with wavy core sides. 51.9' to 56.1': Medium-gray GRANITE, as above, with scattered 1/2-inch Pegmatite veins dipping 20°to 40° medium garnet below 55.5'.	II	R5
60 65		C-7 56.1 - 65.8	116	100	97	C-7 - Medium gray to pink GRANITE m-f grains of feldspar, quartz, muscovite, black mafic minerals, sparse medium grained garnet, moderate to very wide fracture spacing, unweathered to slightly weathered, very strong; slight yellow staining on some fractures. Light-gray to pink to yellow PEGMATITES from 60.9' to 62.5', 62.8' to 63.9' coarse grains of feldspar, quartz, mica, garnet. Bottom of the borehole measured with tape at 65.8'.		
70						C-8 - Dark-pink to medium gray GRANITE m-f grains of feldspar, quartz, muscovite, garnet enriched from 66.1' to 68.3' with agglomerations of garnet crystals up to 0.2-inches across from 66.1' to 68.3'; wide to very wide fracture spacing, except very close fracture spacing from 69.1 to 69.2', unweathered to slightly weathered, very strong, faint gneissic banding	II	R5

DISCONTINUITY DATA

ANGLE (deg)	Jr	Ja	DEPTH (feet)
0	2.0	1.0	34.1
20	3.0	2.0	34.8
90	2.0	1.0	34.9
0	3.0	1.0	36.6
80	2.0	1.0	37
0_{MB}	-	-	39
10_{MB}	-	-	40
20	2.0	1.0	42.2
0	1.5	1.0	43.6
35	1.5	4.0	46.5
0_{MB}	-	-	47
0	1.5	1.0	48.5
30	1.5	3.0	48.6
30	1.0	1.0	49.2
30	1.5	1.0	49.4
10	2.0	3.0	49.7
0	2.0	1.0	49.9
20-30	2.0	1.0	50
5	3.0	1.0	50.1
35	1.5	4.0	50.8
0_{MB}	-	-	51.9
20	1.5	1.0	53.3
30	1.5	1.0	53.4
0_{MB}	-	-	54.4
0_{MB}	-	-	55.1
0_{MB}	-	-	55.5
0_{MB}	-	-	55.8
0	3.0	1.0	56.1
10	2.0	1.0	58
30	2.0	1.0	59.7
30_{MB}	-	-	61
20	1.5	1.0	62
20	1.5	1.0	63
45	3.0	1.0	63.3
30	1.5	1.0	65
0_{MB}		-	65.8
10	3.0	1.0	66.9
0	1.5	1.0	69.1
10	1.5	1.0	69.2

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DEPT OF BLDGS 121192618 Job Number

ES163725774 Scan Code

CORING LOG
(continued)

BORING NUMBER FD-7

3 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C.Cruz/E. Morales**

INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA			
									ANGLE (deg)	Jr	Ja	DEPTH (feet)
		C-8 65.8 - 75.6	118	100	99	dips 50° to 90°; Light-gray to salmon-pink PEGMATITE from 70.3' to 70.9' and 74.7' to 75.4', with c grains of feldspar, quartz, mica, mafic minerals and medium grained garnet.	II	R5	15	2.0	1.0	70.5
									0	3.0	1.0	70.7
									0_{MB}	-	-	71.3
									0	2.0	1.0	72.1
									10	1.5	1.0	73.5
75									40	1.5	1.0	74.9
		C-9 75.6 - 85.1	100	88	86	C-9 - Light to medium gray GRANITE m-f grains of white and pink feldspar, quartz, muscovite, biotite, garnet with agglomerations of garnet crystals up to 0.2" across; very close to wide fracture spacing, several near-vertical healed hairline fractures, with iron stained infill, unweathered to slightly weathered, , very strong; light-gray to salmon-pink PEGMATITE, coarse grained at 77.7' - 78.0' and 81.3' - 82.0'. Borehole depth measured with tape at 85.1'.	II/I	R5	0	3.0	1.0	75.6
									80	1.5	4.0	76.3
									80	1.5	2.0	76.8
									0	2.0	1.0	77.1
									80	1.5	2.0	77.4
									80	1.5	1.0	78.8
									5	2.0	1.0	79.2
80									15	1.5	1.0	80.5
									20	2.0	1.0	80.6
									10	3.0	1.0	82
									15	2.0	1.0	83.6
									10	2.0	1.0	83.65
85									10	1.5	1.0	84.7
									30	1.5	1.0	84.9
		C-10 85.1 - 92.1	84	100	96	C-10- Medium-gray to pink GRANITE m-f grains of feldspar, quartz, muscovite, black mafic minerals, garnet up to 0.2" across; with additional medium grained garnets from 86.4' to 87.3', moderate to wide fracture spacing, unweathered to slightly weathered, very strong; pink, coarse grained PEGMATITES below 87.9', 2" to 6" thick.	I/II	R5	10	1.5	2.0	85.1
									30	3.0	1.0	85.9
									25	3.0	1.0	87.3
									10	2.0	1.0	88.7
									10_{MB}	-	-	89.5
90									$0\text{-}20_{MB}$	-	-	90
									10	1.5	1.0	90.3
									10	1.5	1.0	91.2
									0_{MB}	-	-	91.4
									0_{MB}	-	-	91.6
		C-11 92.1 - 102.1	120	100	97	C-11- Medium-gray to light-gray GRANITE, m-f grains of feldspar, quartz, muscovite, sparse black mafic minerals; sparse garnets up to 0.1" across; unweathered, except slightly weathered near fractures; very close to wide fracture spacing, very strong; below 99.2' numerous tightly healed fractures, dipping 85°, spaced 1/4" to 3/4" apart, parallel to 85° fractures.	I/II	R5	0	1.5	1.0	92.1
									0	2.0	1.0	93.9
95									20	2.0	1.0	94.1
									10_{MB}	-	-	94.9
									0	3.0	1.0	96.2
									70	3.0	2.0	96.3
									0	2.0	1.0	97.3
									0	2.0	1.0	97.4
100									85	2.0	3.0	99.4
									5_{MB}	-	-	99.8
									80	1.5	2.0	100.7
									80	1.5	2.0	101
						C-12 - Medium-gray to pink GRANITE, m-f grains of feldspar, quartz, muscovite, sparse garnet, except notable medium grained garnet at 104.6' - 105.1' and 105.8' - 106.5'; moderate to wide fracture spacing, except for for very closely spaced 10° to 30°	I/II	R5/R4	40_{MB}	-	-	102
105												

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DEPT OF BLDGS 121192618 Job Number

ES635885296 Scan Code

(continued)

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4 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C.Cruz/E. Morales**

INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA			
									ANGLE (deg)	Jr	Ja	DEPTH (feet)
		C-12 102.1 - 110.3	98	100	92	fractures at 109.2' - 109.5'; unweathered except slightly weathered at low angle fractures; very strong, except pegmatites strong; light-gray to salmon-pink, coarse grained PEGMATITES, 1" to 12" thick, tightly healed fractures dipping 20° from 100.6' to 109.8', with quartz infilling, parallel to fractures.			0	2.0	1.0	107
									45	2.0	1.0	107.6
									20_{MB}	-	-	108
									30	1.5	2.0	109.2
110									25	1.5	1.0	109.3
		C-13 110.3 - 120.0	114	98	96	C-13 - Medium-gray to pink GRANITE, m-f grains of feldspar, quartz, muscovite, notable medium grained garnet at 111.6'-111.9' and 117.8'-118.8'; wide fracture spacing, except for closely spaced 20° to 30 ° fractures at 119.9'-120.0'; very strong, except strong at pegmatites; white to salmon-pink PEGMATITE, coarse grains of feldspar, quartz, muscovite, biotite, at 112.4'-115.0', 115.3' - 117.7' and 119.8'-20.0'; granite-pegmatite contacts intact , dip 60° to 80 °.	I/II	R5/R4	10	1.5	1.0	109.4
									30	1.5	1.0	109.5
									0_{MB}	-	-	110
									20	3.0	1.0	110.1
									45	3.0	1.0	110.3
									25_{MB}	-	-	110.31
									20	1.5	1.0	111.25
									15_{MB}	-	-	113.55
115									5	3.0	1.0	113.65
									30	3.0	1.0	115.4
									15_{MB}	-	-	117.05
120						E.O.B at 120.0'.			20	2.0	3.0	119.9
									30	2.0	2.0	120
125												
130												
135												
140												

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BORING LOG

BORING NUMBER FD-08w
1 of 1

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Cruz**
INSPECTOR: **A. Zabala**
DRILLING METHOD: **Rotary Wash**
RIG TYPE: **CME 75**

LOCATION: **W 33rd St. & 11th Ave (NE)**
COORD. N: **214,347.1** E: **983,672.2**
STN. NO.: OFFSET:
SURFACE ELEV.: **128.6 feet**
DATUM:
START DATE: **10/11/04** TIME: **7:30 am**
FINISH DATE: **10/14/04** TIME: **3:00 pm**

	Casing	Split Spoon	Shelby Tube	Piston	Grab	Core Barrel
Type/Symbol	HW	S ■	U ▯	P ⧅	G ⊠	C ▤
I.D.	4"	1.375"	2.938"	2.938"		2"
O.D.	4.5"	2"	3"	3"		3"
Length		24"	24"	24"		
Hammer Wt.	300 lbs	140 lbs	Drill Rod Size		NWJ	
Hammer Fall	24"	30"	I.D. (O.D.)		(2.938")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft) CORING (Min./ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6 CORING RUN (in.)	6/12 REC. (in.)	12/18 REC. %	18/24 L>4" (in.)	REC. (in.) RQD %	Depth Elev.	FIELD CLASSIFICATION AND REMARKS
						0.0 - 6.0		Hand		Auger			0' to 6' Hand Auger 0' to 0.5': Concrete (Sidewalk) 0.5' to 2.0': Gray brown c-f GRAVEL, some c-f Sand 2.0' to 4.0': Brown m-f GRAVEL, and c-f Sand 4.0' to 5.0': Boulder 5.0' to 6.0': C-f SAND, little c-f Gravel(FILL)
5													
			S	1	■	6.0 - 8.0	3	4	3	3	1		Brown c-f Sand, little Silt, loose, moist (SM)
			S	2	■	8.0 - 10.0	8	1	WOH	WOH	4		Gray m-f GRAVEL, and cf Sand, little Silt, very loose, moist (SM) (FILL).
10													
			S	3	■	10.0 - 12.0	7	1	3	8	8		Grayish brown c-f Gravel , some c-f Sand, trace Silt, loose (GP) (FILL)
													Gray wash, rig chatter to 15 ft.
15													
			S	4	■	15.0 - 17.0	25	25	13	20	16		Grayish brown c-f SAND, little m-f Gravel, little Silt, dense, wet (SM)
													Drove casing to 19.0 ft, gray wash.
20													
			S	5	■	20.0 - 21.7	11	10	8	100/2"	10		Brownish gray c-f SAND, and Silt, trace m-f Gravel, little Silt, medium dense, wet (SM) Rock fragment in spoon tip.
												24.0	Roller bit refusal and begin coring at 24 ft

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CORING LOG

-08w
1 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**	LOCATION: **W 33rd St. & 11th Ave (NE)**
LOCATION: **Manhattan**	COORD. **N: 214,347.1 E: 983,672.2**
CLIENT: **MTA**	STN. NO.: OFFSET:
CONTRACTOR: **Jersey Boring & Drilling**	SURFACE ELEV.: **128.6 feet**
DRILLER: **C. Cruz**	DATUM:
INSPECTOR: **A. Zabala**	
DRILLING METHOD: **Diamond drilling with double core barrel**	START DATE: **10/11/04** TIME: **7:30 am**
RIG TYPE: **CME 75**	FINISH DATE: **10/14/04** TIME: **3:00 pm**

CORE BARREL DATA:	NOTES:
TYPE: NX	
CORE SIZE: 2"	
O.D.: 3"	
I.D.: 2"	
CASING SIZE: 4" (4.5")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH
25		C-1 24.0 - 28.7	56	99	87	24.0' - 27.2' Medium gray to dark pink GRANITE; f-m grains of quartz feldspar, muscovite, mafic minerals; close fracture, spacing, slightly weathered; strong; non-foliated; slighty iron staining on fracture surfaces.	II	R4
						27.2' - 28.7': Light gray PEGMATITE; coarse grains of quartz, white feldspar, muscovite and scattered mafic minerals; close to very closely fractured; slightly weathered except moderately weathered from 27.2' - 27.9'; medium strong to strong.	II	R3/R4 R3/R4
30		C-2 28.7 - 33.9	62	100	48	28.7' - 29.3': Light gray PEGMATITE, as above.		
35						29.3' - 23.9': Dark pink to medium gray GRANITE, f-c grains of quartz, white and pink feldspar, muscovite; sparse mafic minerals; close to moderate fracture spacing, except very close from 32.4' to 33.2'; slightly weathered; strong; many healed hairline fractures, dipping ~20 degrees and near vertical; a few irregular, think (<0.1") bands of muscovite.	I/II	R4/R5
40		C-3 33.9 - 41.1	86	100	93	Medium gray to dark pink GRANITE; f-c grains of quartz, white and pink feldspar, muscovite, black mafic minerals; moderate to wide fracture spacing, except two very closely spaced fractures at 36.5' and 38.9'; unweathered to slightly weathered; strong to very strong; iron staining in two closely fractured zones along quartz band; quartz bands 0.5" and 1" wide at 36.5' and 37.2' dipping 55 degrees.		
45		C-4 41.1 - 51.1	114	95	88	41.1' - 50.1': Medium gray GRANITE; f-m grains of quartz, white feldspar, and muscovite; close to moderate fracture spacing; slightly weathered; strong to very strong; slightly weathered; strong to very strong; slight iron staining on zone fractures; seam of soft biotite ~ 0.5 " wide at 42.7', dipping 55 degrees.	II	R4/R5
						50.1' - 51.1': Black to light gray SCHIST; m-c grains of predominantly biotite, with quartz, and white and pink feldspar; very close fracture spacing; moderately weathered; weak; contorted schistosity and banding dip ~ 50 degrees.		

DISCONTINUITY DATA

ANGLE (deg)	Jr	Ja	DEPTH (feet)
20	2.0	1.0	24.25
80	2.0	2.0	24.3
0-10$_{MB}$	-	-	24.6
25	1.5	1.0	25.2
20	2.0	1.0	25.6
30	1.5	1.0	26.2
20	1.5	2.0	26.5
70	3.0	2.0	27.2
30	2.0	1.0	28.1
25	2.0	1.0	28.2
0$_{MB}$	-	-	28.7
75-90	2.0	2.0	29
20	3.0	2.0	29.4
20	3.0	2.0	29.5
60	1.5	2.0	29.7
20	3.0	1.0	30
25	1.5	1.0	30.8
20	2.0	2.0	31.1
30	1.5	1.0	31.5
30	2.0	1.0	31.7
30	2.0	2.0	32.3
30	2.0	3.0	32.6
20	1.5	2.0	32.8
20	1.5	2.0	33
20	3.0	1.0	33.2
20	3.0	1.0	34.6
70	1.5	2.0	36.1
25	1.5	1.0	36.5
30	1.5	1.0	36.55
30$_{MB}$	-	-	37.2
10$_{MB}$	-	-	37.4
10$_{MB}$	-	-	37.6
15	1.5	1.0	38.9
20	1.5	3.0	38.95
0-40$_{MB}$	-	-	41.1
0-5$_{MB}$	-	-	42.2
55	1.0	4.0	42.7
30	2.0	1.0	42.9
35	1.5	2.0	43.4
25	2.0	1.0	44.4
25	2.0	1.0	44.9

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DEPT OF BLDGS 121192618 Job Number

ES486173639 Scan Code

(continued)

D-08w

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PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C. Cruz**

INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA ANGLE (deg)	Jr	Ja	DEPTH (feet)
50						Non-recovery from 50.6' to 51.1'. Loss of drilling fluid throughout core run.	II	R2	25 0_{MB} 30	1.5 - 1.5	1.0 - 1.0	46 46.1 46.8
55 60		C-5 51.1 - 61.0	118	99	95	51.1' to 51.5': Black and gray SCHIST; c-grains of biotite and quartz; close to extremely close fracture spacing; moderately weathered; weak; contorted schistosity dip ~ 40 degrees. 51.5' to 61.0': Medium gray to dark pink GRANITE; f-m grains of quartz, white and pink feldspar, muscovite, black mafic minerals, sparse m-grained garnet; wide fracture spacing; slightly weathered to unweathered; strong to very strong; includes bands of c. grained, pink and gray pegmatite, ~ 1" to 2" wide, dipping 60 degrees to 80 degrees; a few healed hairline fractures dipping ~ 20 degrees and near vertical.	III I/II	R2 R4/R5	30_{MB} 25_{MB} 30 60 75 45 20_{MB} 35 10 0 20_{MB}	2.0 - 2.0 3.0 3.0 2.0 - 2.0 3.0 3.0 -	1.0 - 1.0 3.0 3.0 2.0 - 2.0 1.0 3.0 -	48.3 49.3 49.5 50.1 51.1 51.9 52.6 52.7 55.1 56.2 59
65 70		C-6 61.0 - 70.8	118	100	100	Medium gray to dark pink GRANITE; as above, except with vertical band of c. grained pegmatite extending from 62.0' to 65.8'; a few seams of mica, ~ 0.25" thick, dip ~ 80 degrees.	I/II	R4/R5	15_{MB} 10_{MB} 30 30 5 35_{MB} 25_{MB} 20 5_{MB} 10 10 20_{MB}	- - 3.0 3.0 2.0 - - 3.0 2.0 2.0 3.0 -	- - 1.0 2.0 1.0 - - - 1.0 1.0 2.0 -	60.9 61 61.9 63.7 64.1 65.5 65.8 65.9 66.2 66.9 67.5 68.7
75 80		C-7 70.8 - 81.0	115	94	69	70.8' to 72.0' and 73.4' to 80.8': Medium gray to dark pink GRANITE; f-c grains of quartz, feldspar, muscovite; biotite, and sparse m. grained garnet; close to moderate fracture spacing; slightly weathered; strong scattered bands of mica, ~ 0.25" thick, and pegmatite, ~ 1" thick, dip ~ 75 degrees to 85 degrees; slight staining and sandy coatings on some fractures above 72.0'. 72.0' to 73.4': Orange-brown to medium gray GRANITE; c-m grains of quartz, feldspar, biotite, muscovite; moderately weathered; very close fracture spacing; weak wavy; orange iron staining, especially on fracture surfaces; also sand on many fracture surfaces; faint, near-vertical banding. Possible loss of recovery from 72.7' to 73.2'. Re-drill marks on core stem from 80.5' to 80.8'. Loss of circulation throughout run.	II III	R4 R2	50_{MB} 80 20 65 15 55 20 90 65 20 20 15_{MB} 30 30 10 40_{MB}	- 2.0 3.0 3.0 2.0 3.0 2.0 2.0 1.5 2.0 3.0 - 3.0 2.0 2.0 -	- 3.0 3.0 3.0 3.0 3.0 3.0 3.0 1.0 1.0 1.0 - 1.0 2.0 1.0 -	70.8 71.5 72.1 72.2 72.3 72.4 72.6 73.3 73.5 74.1 75.3 75.8 76.5 77.3 78.5 79.6
						Medium gray to yellow gray GRANITE; c-f grains of quartz , white feldspar, muscovite, black mafic minerals; moderate to wide fracture spacing, except	II	R4	20_{MB} 25_{MB} $0\text{-}20_{MB}$ $0\text{-}30_{MB}$ 10	- - - - 3.0	- - - - 1.0	80 80.3 80.5 80.8 82

CORING LOG
(continued)

-08w
3 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C. Cruz**

INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA			
									ANGLE (deg)	Jr	Ja	DEPTH (feet)
85		C-8 81.0 - 90.0	108	100	83	very close at 82.3' to 82.4' and 88.2' to 88.3'; slightly weathered; strong; some fractures iron stained, with thin sandy coatings; long, big-angle fracture at 86.2' has orange and yellow staining, and sandy surface. Loss of circulation throughout run.			0 30 15_{MB} 10_{MB} 20_{MB} 85 $0\text{-}5_{MB}$ 25 30 30	2.0 2.0 - - - 2.0 - 1.5 2.0 2.0	1.0 1.0 - - - 3.0 - 2.0 3.0 3.0	82.3 82.4 82.7 83.8 85.5 86.2 86.9 87.8 88.2 88.3
90 95		C-9 90.0 - 96.0	72	100	47	Core is overdrilled from 93.0' to 96.0'. RQD is 34"/36" for first 3 ft. of run. RQD is not applicable for last 4 ft. of run. Medium gray to yellow-gray GRANITE; f-c grains of quartz, feldspar muscovite, black mafic minerals; close to moderate fracture spacing (93.0'-96.0'); slightly weathered; strong; some yellow-orange iron staining on core and on fracture surfaces.	II		25 30 10 20 30 15 25 0_{MB}	2.0 2.0 3.0 2.0 1.5 1.5 2.0 -	2.0 2.0 2.0 1.0 2.0 2.0 2.0 -	89.4 89.8 90 91.1 91.7 91.9 92.4 93
100 105		C-10 96.0 - 105.1	109	100	99	From 93.0' to 96.0' rig chatter. Re-drilled corestones from 93.0' to 96.0'. Loss of circulation throughout core run. Dark pink to medium gray GRANITE; f-m grains of quartz, feldspar, muscovite, biotite; dark pink color due in part to many m-grained garnets; with additional larger garnets up to 0.2" across; moderate to wide fracture spacing, except extremely coarse fracture spacing from 101.8' to 101.9'; unweathered to slightly weathered; strong to very strong; a few bands of pegmatite, 0.25" to 1" thick, dipping 60 to 70 degrees; iron staining on fractures at 99.6' and 101.8'. Loss of circulation throughout core run.	I/II	R4/R5	0_{MB} 0 $0\text{-}10_{MB}$ 30 0_{MB} 30 30	- 3.0 - 1.5 - 2.0 2.0	- 1.0 - 1.0 - 2.0 3.0	96 97.5 99.1 99.6 100.2 101.8 101.9
		C-11 105.1 - 109.7	55	100	100	Dark pink to medium gray GRANITE, m-f grains of quartz, feldspar, muscovite, biotite; m. grained garnet gives rock dark pink color; moderate to wide fracture spacing; unweathered to slightly weathered; very strong; yellow staining on fracture at 108.7' and some on core surface.	I/II	R5	$20\text{-}30_{MB}$ 30 5_{MB} 2.0	- - - 2.0	- - - 1.0	105.1 106 107.9 108.7
110 115		C-12 109.7 - 119.6	119	100	99	Dark pink to medium gray GRANITE, as above, except wide fracture spacing throughout and unweathered, except for slight weathering at 113.4' - 113.6'	I	R5	45 0_{MB} 10_{MB} 20 20 20_{MB} 10_{MB} 0 0 15_{MB} 50	3.0 - - 3.0 2.0 - - 2.0 2.0 - -	2.0 - - 1.0 1.0 - - 1.0 1.0 - -	109.7 110.2 111.5 112.8 113.5 113.9 114.5 114.8 114.85 115.1 116.4

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(continued)

-08w
4 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Cruz**
INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA			
									ANGLE (deg)	Jr	Ja	DEPTH (feet)
120		C-13 119.6 - 124.4	58	100	100	Medium gray to dark pink GRANITE; f-c grains of quartz, feldspar, muscovite, black mafic minerals; some zones enriched in m. grained garnets; moderate to wide fracture spacing; unweathered; very strong; near-vertical pegmatite band at 120.6' is ~ 1" wide.	I	R5	$0\text{-}5_{MB}$ 0-40 $0\text{-}5_{MB}$ 20_{MB} $0\text{-}5_{MB}$ $0\text{-}5_{MB}$	- 1.5 - - - -	- 2.0 - - - -	119.2 119.6 120.1 121.1 122.4 123.6
125		C-14 124.4 - 126.8	29	100	100	Medium gray GRANITE; f-c grains of quartz, feldspar muscovite, biotite; sparse m. grained garnet and a few additional garnets up to 0.2" across; moderate fracture spacing; unweathered; very strong; near vertical quartz-feldspar-biotite pegmatite, ~ 1" wide, from 125.0' - 126.0'. Loud noise during drilling.	I	R5	20_{MB} 35_{MB} $0\text{-}30_{MB}$ $0\text{-}30_{MB}$ 0_{MB} $0\text{-}15_{MB}$	- - - - - -	- - - - - -	124.4 124.9 125.5 125.7 126.3 126.8
130						E.O.B at 126.8'.						
135												
140												
145												
150												

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DEPT OF BLDGS121192618 Job Number

ES229287353 Scan Code

D-09

1 of 1

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Cruz**
INSPECTOR: **A. Zabala**
DRILLING METHOD: **Rotary Wash**
RIG TYPE: **CME 75**

LOCATION: **140' of 11th on 33rd St (N)**
COORD. N: **214,297.4** E: **983,762.4**
STN. NO.: OFFSET:
SURFACE ELEV.: **125.3 feet**
DATUM:
START DATE: **10/7/04** TIME: **7:00 am**
FINISH DATE: **10/11/04** TIME: **2:30 pm**

	Casing	Split Spoon	Shelby Tube	Piston	Grab	Core Barrel
Type/Symbol	HW	S ■	U ▯	P ⧅	G ☒	C ⊟
I.D.	4"	1.375"	2.938"	2.938"		2"
O.D.	4.5"	2"	3"	3"		3"
Length		24"	24"	24"		
Hammer Wt.	300 lbs	140 lbs	Drill Rod Size		NWJ	
Hammer Fall	24"	30"	I.D. (O.D.)		(2.938")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft) CORING (Min./ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6 / CORING RUN (in.)	6/12 / REC. (in.)	12/18 / REC. %	18/24 / L>4" (in.)	REC. (in.) / RQD %	Depth Elev.	FIELD CLASSIFICATION AND REMARKS
						0.0 - 6.0		Hand		Auger			Hand Augered from 0' to 6' 0' to .5' Concrete (sidewalk) 0.5' to 2.0' Gray c-f GRAVEL, and c-f Sand, trace Silt, occasional brick fragment. 2.0' to 4.5' Brown gray c-f SAND, some m-f Gravel, trace Silt, trace brick fragment (FILL). 4.5' to 6.0' Brown c-f SAND, little c-f Gravel, trace Silt (FILL).
5													
			S	1	■	6.0 - 8.0	1	WOH	1	18	0		No Recovery
			S	2	■	8.0 - 10.0	5	10	8	4	4		Brown c-f SAND, some Silt, trace f Gravel, trace concrete fragments, medium dense (SM). (FILL)
10													
			S	3	■	10.0 - 12.0	3	10	6	8	5		Brown-black c-f SAND,little Silt, little f Gravel, medium dense, occasional concrete fragments (FILL).
15													
			S	4	■	15.0 - 17.0	21	9	9	14	10		S-4A: Dark brown-black c-f GRAVEL, some c-f Sand, trace Silt, medium dense, micaceous (FILL) S-4B: Brown Silty CLAY, some m-f Sand, trace f-Gravel, very stiff, wet, mica Schist in tip of spoon (FILL)
												18.0	
20													Roller bit refusal and begin coring at 18'.

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DEPT OF BLDGS 121192618 Job Number

ES688153648 Scan Code

D-09

1 of 3

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Cruz**
INSPECTOR: **A. Zabala**
DRILLING METHOD: **Diamond drilling with double core barrel**
RIG TYPE: **CME 75**

LOCATION: **140' of 11th on 33rd St (N)**
COORD. N: **214,297.4** E: **983,762.4**
STN. NO.: OFFSET:
SURFACE ELEV.: **125.3 feet**
DATUM:
START DATE: **10/7/04** TIME: **7:00 am**
FINISH DATE: **10/11/04** TIME: **2:30 pm**

CORE BARREL DATA:	NOTES:
TYPE: NX	
CORE SIZE: 2"	
O.D.: 3"	
I.D.: 2"	
CASING SIZE: 4" (4.5")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH
20		C-1 18.0 - 22.7	56	100	74	Light gray to light brown GRANITE, f-c grains of quartz, feldspar and other mafic minerals, scattered garnets up to 0.1" across, close to moderate fracture spacing, slightly weathered, medium strong to strong, c- grained Pegmatite band ~ 1" wide, near vertical, from ~118.4' to 119.4' most fractures iron stained, thin clay (<0.1") and silt coating on 80° fracture at 21.7'.	II	R3/R4
25		C-2 22.7 - 30.0	77	88	76	Light gray to orange brown GRANITE, f-c grains of quartz, feldspar and other mafic minerals, scattered garnets up to 0.2" across, close to moderate fracture spacing except two very closely spaced fractures at 23.8' and 23.9', slightly weathered except moderate from 23.7' to 23.9', strong; bands of c- grained Pegmatite 0.5" to 3.0" wide; most fractures iron stained. Vertical fracture from 22.7' to 23.4'.	III II	R4 R4
30 35		C-3 30.0 - 40.0	120	100	90	From 30.0' to 36.8' Light gray to pink PEGMATITE, c- grains of quartz, white and pink feldspar, biotite and other mafic minerals, close to moderate fracture spacing, slightly weathered, strong, many healed hairline fractures most of which are near vertical; many fractures iron stained. From 36.8' to 40.0' Medium gray GRANITE, f-m grains of quartz, feldspar. mafic minerals and scattered garnet up to 0.1" across, close to moderate fracture spacing, slightly weathered, strong, garnet enriched from 37.5' to 36.0, heavy iron staining with closer fracturing from 38.9' to 39.2'.	II	R4
40		C-4 40.0 - 45.0	60	100	100	Medium gray to dark pink GRANITE GNEISS, f-m grains of quartz, feldspar, biotite, other mafic minerals and m- grained garnet throughout, wide fracture spacing, unweathered, very strong, very faint indistinct banding is nearly vertical.	I	R5

DISCONTINUITY DATA

ANGLE (deg)	Jr	Ja	DEPTH (feet)
30	2.0	2.0	18.2
3.0	1.5	2.0	18.3
5-10	3.0	2.0	18.4
10-20	3.0	2.0	18.5
5-20	3.0	2.0	19.2
10-30	3.0	1.0	19.4
80	1.5	4.0	21.7
80	1.5	3.0	22.3
85	1.5	3.0	23.2
0-5	3.0	3.0	23.8
30	3.0	3.0	23.9
5-10	3.0	2.0	24.2
10	2.0	2.0	25.8
15-20	2.0	2.0	27.1
10_{MB}	-	-	27.5
30	3.0	1.0	28.1
10	3.0	1.0	28.5
5	3.0	2.0	29.1
20	2.0	2.0	30.6
5-10	3.0	1.0	31.1
5-10	1.5	2.0	31.6
5-10	3.0	2.0	31.8
5	3.0	2.0	32.2
20	3.0	1.0	32.6
5-10	3.0	1.0	32.9
20	3.0	2.0	33.6
40	3.0	3.0	33.7
20	3.0	1.0	34.8
5-10	3.0	1.0	35.1
75	2.0	1.0	35.3
10-20	3.0	1.0	36.4
45	2.0	1.0	37
40_{MB}	-	-	37.7
25_{MB}	-	-	38.3
50	2.0	3.0	38.8
30	2.0	3.0	38.9
60	2.0	3.0	39.4
50	3.0	3.0	39.8

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DEPT OF BLDGS 121192618 Job Number

ES623755075 Scan Code

(continued)

-09

2 of 3

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C. Cruz**

INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA			
									ANGLE (deg)	Jr	Ja	DEPTH (feet)
45		C-5 45.0 - 53.3	100	100	92	Medium gray to dark pink GRANITE GNEISS, f-m grains of quartz, feldspar, biotite, sparse m- grained garnets, moderate to wide fracture spacing except extremely close spacing from 51.5' to 51.6', slightly weathered, strong to very strong, very faint discontinuous banding is near vertical. Oxidation on joint surfaces at 48.1', 49.0' and 51.9'.	II	R4/R5	20_{MB}	-	-	45
									20	2.0	2.0	45.3
									10	2.0	2.0	47.7
									10	2.0	2.0	48.6
									60	2.0	3.0	49
50									$0\text{-}5_{MB}$	-	-	49.7
									30	3.0	1.0	50.2
									10	2.0	1.0	51.5
									10	2.0	2.0	51.55
									10	2.0	2.0	51.6
		C-6 53.3 - 63.5	122	100	84	From 53.3' to 55.0' GRANITE GNEISS, as above.	II	R4/R5	20	2.0	2.0	51.9
									25	2.0	2.0	52.6
55									25_{MB}	-	-	53.3
						From 55.0' to 55.8' Light gray to yellow brown PEGMATITE, c- grains of quartz, feldspar, biotite and other mafic minerals, closely fractured, moderately weathered, medium strong, heavy iron staining, rock is ~50% amphibole from 55.7' to 55.8'.	III	R3	30	2.0	1.0	53.6
									10-20	2.0	1.0	53.8
									0-5	2.0	2.0	54.6
						From 55.8' to 63.5' Light to medium gray GRANITE, f-m grains of quartz, feldspar, biotite, sparse m-grained garnet, moderate to wide fracture spacing, slightly weathered, very strong, healed hairline fractures dip ~ 20° to 40°.	II	R5	0-10	2.0	2.0	54.9
									30	2.0	3.0	55.1
									25	1.0	3.0	55.3
									*40	1.5	3.0	55.4
									20	3.0	1.0	55.5
60									45	2.0	2.0	55.6
									0-5	2.0	3.0	55.7
									0-10	2.0	3.0	55.8
									5_{MB}	-	-	56.2
									*80	1.5	3.0	56.8
									50	2.0	3.0	56.9
		C-7 63.5 - 70.0	62	79	46	From 63.5' to 63.9' GRANITE, as above. From 63.9' to 68.0' Black to dark gray SCHIST, m-c grains of black biotite, quartz, feldspar and amphibolite, close to moderate fracture spacing, slightly weathered, medium strong, foliation defined by thin (<0.1") contorted quartz bands and faint alignment of platy minerals, foliation dips ~50o to 80o, rock is ~ 50% black mafic minerals and 50% quartz/feldspar, thin (<0.1") light green clay coatings on some 30o to 40o fractures, c- grained Pegmatite from 66.8' to 67.4' with vertical contact.	II	R5	5_{MB}	-	-	58.3
									5_{MB}	-	-	58.6
65									30	3.0	1.0	59.8
									15	3.0	1.0	60.7
							II	R3	20	3.0	1.0	62.2
									20	1.5	2.0	62.9
									0-5	1.5	2.0	63.5
									40	2.0	3.0	63.9
									20	2.0	2.0	64.4
									50	1.0	4.0	64.6
70									40	1.0	4.0	64.9
		C-8 70.0 - 79.5	108	95	87	From 68.0' to 70.0' Light gray PEGMATITE, c- grains of quartz, feldspar, biotite and garnet, closely fractured, slightly weathered, strong. Slightly weathered, moderately to slightly fractured, close fracture Possible loss of recovery at 69.6', 64.8', 66.2', 66.5' and 67.9' to 68.1'.	II	R4	10	2.0	2.0	65.5
									20	1.5	2.0	65.8
									30	1.5	4.0	66
									40	1.0	4.0	66.3
									50	1.0	4.0	66.5
									30	3.0	1.0	66.9
									30	1.5	2.0	67
75									40	2.0	4.0	67.4
						From 70.0' to 79.3 Light gray to pink PEGMATITE, c- grains of quartz, white and pink feldspar, muscovite, biotite, m- grained grained garnet, close to moderate fracture spacing, slightly weathered, strong, schistose zone from 73.2' to 73.25'.	II	R3	10	1.5	3.0	67.8
									10	2.0	3.0	67.9
									20	3.0	3.0	68
									30	3.0	3.0	68.1
									20	3.0	1.0	68.6

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CORING LOG
(continued)

BORING NUMBER FD-09
SHEET 3 of 3
PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Cruz**
INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH
80						From 73.25' to 79.5' Black to dark gray SCHIST, c-f grains of biotite, quartz, feldspar and amphibole, close to very close fracture spacing, slightly weathered, medium strong, foliation defined by pronounced schistosity and irregular bands of quartz 0.2" to 2.0" thick, foliation dips ~30° to 40°, some foliation fractures have thick (<0.1") coatings of light green clay, many fractures along biotite layers are very smooth.	II	R4
85		C-9 79.5 - 89.5	120	100	94	From 79.5' to 85.2' Dark gray to black SCHIST, as above, with m- grained, light gray Aplite from 81.2' to 82.5, pyrite at 83.3'.		
						From 85.2' to 89.5' Light gray to pink PEGMATITE m-c grains of quartz, pink and white feldspar, biotite and other mafic minerals, sparse m- grained garnet, moderate fracture spacing, unweathered to slightly weathered, strong, scattered zones of schistose biotite 0.2" to 0.8" thick, dipping 20° to 30°.	I/II	R4
90		C-10 89.5 - 99.0	114	100	93	From 89.5' to 96.4': Light gray to pink PEGMATITE, c- grains of quartz, feldspar, muscovite, biotite and garnet up to 0.1" across, close to moderate fracture spacing, unweathered to slightly weathered, strong, scattered seams of schistose biotite ~0.2" thick dipping ~ 30°.	II	R4
95						From 96.4' to 99.0' Medium gray to dark pink GRANITE, f-c grains of quartz, feldspar, muscovite, black mafic minerals and some zones of garnet enrichment with garnets up to 0.1" across, moderate to wide fracture spacing, unweathered, very strong, two quartz bands 0.25" thick dip 80° at 96.7' and 97.7', scattered pegmatite bands up to 1.0" thick. Core rate increase from 10 min/foot to 20 min/foot.	I	R5
100 105 110						E.O.B at 99'.		

DISCONTINUITY DATA			
ANGLE (deg)	Jr	Ja	DEPTH (feet)
30	1.5	1.0	70.7
0-5	2.0	1.0	70.8
20	30	1.0	71.4
10	3.0	1.0	72.6
30	1.5	3.0	73.2
20	1.5	3.0	74.5
*30	1.5	2.0	75.2
*30	1.0	4.0	75.6
*30	1.0	4.0	75.9
*40	1.5	4.0	76.5
*40	1.5	4.0	76.7
*40	1.5	4.0	77.1
*40	1.5	4.0	77.6
*30	1.5	2.0	78.1
50	3.0	1.0	78.2
*30	2.0	2.0	78.5
*30	1.5	2.0	78.7
*30	1.5	4.0	78.8
80	3.0	2.0	79
*25	1.5	2	79.7
*30	1.5	4.0	80.4
30	1.5	4.0	80.7
35	3.0	1.0	82.3
*40	1.5	1.0	82.7
*25	2.0	1.0	83.1
10	3.0	2.0	83.3
20	2.0	1.0	84.1
0	2.0	1.0	84.4
$0\text{-}10_{MB}$	-	-	84.6
5	1.5	1.0	85.1
10	2.0	1.0	85.3
20	3.0	1.0	86.5
25	2.0	2.0	88
30	1.5	4.0	88.8
45	2.0	3.0	89.1
30	2.0	1.0	89.5
40	2.0	1.0	90.9
10	3.0	1.0	91.1
30	2.0	2.0	91.5
0	3.0	2.0	91.7
45	3.0	2.0	91.8
50	1.0	4.0	92.7
20_{MB}	-	-	94.5
50	2.0	4.0	95
75	1.5	1.0	95.3
30	3.0	1.0	96.1
0_{MB}	-	-	99

NO. 7 CORING LOG NO_7NE.GPJ MAINLI~1.GLB 8/21/06

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DEPT OF BLDGS 121192618 Job Number

ES688076008 Scan Code

BORING LOG

-402

1 of 1

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C. Cruz**
INSPECTOR: **A. Zabala**

DRILLING METHOD: **Rotary Wash**
RIG TYPE: **Acker 45**

LOCATION: **Track 26 under 11th Ave**
COORD. N: **214,296.4** E: **983,505.3**
STN. NO.: OFFSET:
SURFACE ELEV.: **107.8 feet**
DATUM:

START DATE: **12/6/05** TIME: **7:00 pm**
FINISH DATE: **12/12/05** TIME: **2:00 am**

	Casing	Split Spoon	Shelby Tube	Piston	Grab	Core Barrel
Type/Symbol	HW	S ■	U ▯	P ⧅	G ☒	C ⊟
I.D.	4"	1.375"	2.938"	2.938"		2"
O.D.	4.5"	2"	3"	3"		3"
Length		24"	24"	24"		
Hammer Wt.	300 lbs	140 lbs	Drill Rod Size		NWJ	
Hammer Fall	24"	30"	I.D. (O.D.)		(2.938")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)
12/7/05	12:00 am	5.5	16.0	70.6
12/8/05	10:00 pm	6.0	16.0	120.0
12/9/05	8:30 pm	5.6	16.0	125.7

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft) CORING (Min./ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6 / CORING RUN (in.)	6/12 / REC. (in.)	12/18 / REC. %	18/24 / L>4" (in.)	REC. (in.) / RQD %	Depth Elev.	FIELD CLASSIFICATION AND REMARKS
													18" - Concrete Slab Air-Tricone from 1.5' to 10 feet; Brown c-f SAND, some Silt, trace f-Gravel (observed in cuttings)
5													
10			S	1	■	10.0 - 12.0	7	7	4	6	14		Brown m-f SAND, some Silt, medium dense, wet (SM)
15			S	2	■	15.0 - 15.3	100/3"				3	15.5	Brown m-f SAND, some Silt, little c-f Gravel, very dense, wet (SM) -weathered rock fragments (Pegmatite) at tip of the spoon Roller bit refusal and begin coring at 15'.
20													

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-402
1 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Cruz**
INSPECTOR: **A. Zabala**
DRILLING METHOD: **Diamond drilling with double core barrel**
RIG TYPE: **Acker 45**

LOCATION: **Track 26 under 11th Ave**
COORD. **N: 214,296.4** **E: 983,505.3**
STN. NO.: OFFSET:
SURFACE ELEV.: **107.8 feet**
DATUM:
START DATE: **12/6/05** TIME: **7:00 pm**
FINISH DATE: **12/12/05** TIME: **2:00 am**

CORE BARREL DATA:	NOTES:
TYPE: NX	
CORE SIZE: 2"	
O.D.: 3"	
I.D.: 2"	
CASING SIZE: 4" (4.5")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)
12/7/05	12:00 am	5.5	16.0	70.6
12/8/05	10:00 pm	6.0	16.0	120.0
12/9/05	8:30 pm	5.6	16.0	125.7

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH
		C-1 15.5 - 20.0	54	100	85	C-1: Light gray to tan GRANITE; m-f grains of quartz, feldspar, muscovite, and sparse mafic minerals; moderate to wide fracture spacing, except very close spacing from 15.5' to 15.8'; slightly weathered; strong; brick-red hematite on vertical fractures; weathered pieces of schist and quartz; 17.0' - 18.5' : Gray to salmon-pink PEGMATITE; coarse grained; contacts intact, gradational.	II	R4
20 25		C-2 20.0 - 29.9	119	100	100	C-2: Light gray to medium gray GRANITE; m grains of quartz, feldspar, muscovite, sparse medium grained garnet; moderate to wide fracture spacing; slightly weathered; strong to very strong; very faint gneissic compositional banding dips ~60° Except: 22.3' - 22.5' and 27.9' - 29.4': dark gray SCHIST; fine to medium grains of biotite, quartz, feldspar, muscovite; close to very close fracture spacing; slightly weathered; medium strong; distinct schistosity dips 60° to 70°; all fractures have orange iron staining; 29.4' - 29.9': light gray PEGMATITE band; coarse grained; contact intact and parallel to schistosity; lower contact with granite is near vertical.	II	R4/R5
30 35		C-3 29.9 - 38.1	98	100	100	C-3: 29.9' - 33.5': Light gray to medium gray GRANITE; m-f grains of quartz, feldspar, and sparse mafic minerals; coarse grained pegmatite band from 29.9' to 30.5', in vertical contact with granite; moderate fracture spacing; slightly weathered; strong; except: 30.6' - 30.7', 31.6' - 33.1', and 33.4' - 33.5': Dark gray SCHIST; fine to medium grains of quartz, biotite, feldspar, muscovite; close to moderate fracture spacing; slightly weathered; strong; faint schistosity dips 45° to 55°; 33.5' - 36.9' Medium gray, almost pure QUARTZ; very coarse grained; 1/2-inch band of mafic minerals at 34.4' dipping 45°, with irregular patches of yellow metallic mineral (gold?) at quartz contact; unweathered to slightly weathered; 36.9' - 38.1': Light to medium GRANITE; as above; 1/4-inch band	II	R4
40		C-4 38.1 - 40.3	26	100	100		I/II	R4/R5

DISCONTINUITY DATA

ANGLE (deg)	Jr	Ja	DEPTH (feet)
0_{MB}	-	-	15.8
0	1.5	1	16.2
85	1.5	2.0	16.5
45	1.5	1.0	16.7
80	2.0	2.0	17
0_{MB}	-	-	20
0	1.5	1.0	20.1
0	1.5	1.0	22.2
60	1.5	2.0	22.3
55	2.0	1.0	23.5
0_{MB}	-	-	24
15_{MB}	-	-	24.5
0_{MB}	-	-	24.9
0_{MB}	-	-	25.1
0	2.0	1.0	25.4
30	1.5	1.0	27.7
*85	1.0	2.0	28.1
*60	1.5	3.0	28.3
*65	1.5	2.0	29
30_{MB}	-	-	29.9
*45	1.0	2.0	30.7
$*50_{MB}$	1.0	1.0	32
45	1.0	1.0	32.3
35	2.0	1.0	33.4
0_{MB}	-	-	33.9
0_{MB}	-	-	34.9
20	1.5	1.0	35.6
40	2.0	1.0	36
20	1.5	2.0	36.8
15	1.0	1.0	37.4
0	2.0	1.0	38
10_{MB}	-	-	38.1
15	2.0	1.0	38.7
30_{MB}	-	-	39.3

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(continued)

FD-402
2 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C. Cruz**

INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA ANGLE (deg)	Jr	Ja	DEPTH (feet)
45 50		C-5 40.3 - 50.5	122	100	98	of schist dipping 20° at quartz-granite contact. C-4: Light gray GRANITE m-f grains of quartz, feldspar, muscovite, and scattered medium to coarse grained garnets; moderate fracture spacing; unweathered to slightly weathered; strong to very strong; pegmatite from 39.5' to 40.1'; pure, medium gray quartz from 40.1' to 40.3'; contact dips 50° C-5: 40.3' - 40.5': Medium gray Quartz, coarse grained; 40.5' - 46.1': Light gray GRANITE; c-f grains of quartz, feldspar, muscovite, and scattered medium grained garnets; irregular PEGMATITES, 1/2-inch to 3-inch thick throughout; moderate to wide fracture spacing; unweathered to slightly weathered; strong to very strong; faint banding dips 40° to 60°. 46.1' - 50.0': Dark gray to black SCHIST; fine to coarse grains of biotite, quartz, feldspar and muscovite; moderate fracture spacing; slightly weathered; medium strong to strong; foliation defined by wavy, contorted schistosity dipping 40° to 90°; band of pure quartz, ~1-inch thick, dips 80° from 49.3' to 50.0'; 50.0' - 50.3': Light gray PEGMATITE, coarse grained; 50.3' - 50.5': Dark gray SCHIST, as above	I/II II I/II	R4/R5 R3/R4 R4	0_{MB} 10_{MB} 60_{MB} 0_{MB} 0_{MB} 80 40 30 *60 10	- - 3.0 - 1.5 2.0 2.0 3.0 1.0 2.0	- - 1.0 - 1.0 2.0 1.0 3.0 4.0 1.0	39.8 40.3 44.2 44.5 44.8 45.2 46.8 48.6 49.3 49.4
55 60		C-6 50.5 - 60.6	121	100	100	C-6: 50.5' - 51.9': Light gray to salmon-pink PEGMATITE; c grains of white and pink feldspar, quartz, muscovite; moderate fracture spacing; slightly weathered; strong; in vertical contact with: light gray GRANITE, fine to medium grains of quartz, feldspar and muscovite; healed hairline fractures along contact; 51.9' - 60.6': Dark gray to black SCHIST; m-f grains of quartz, biotite, feldspar, muscovite, hornblende; moderate to wide fracture spacing; unweathered to slightly weathered; strong; indistinct, crenulated schistosity dips 60° to 90°; near-vertical bands of pegmatite from 52.3' to 52.9' and 59.2' to 59.7'; contorted, 1/2-inch thick quartz bands throughout.	II	R4	25_{MB} *40 *65 *70 10_{MB} 35 20_{MB} 40_{MB} 15_{MB} 20	- 1.5 2.0 1.0 - 2.0 - - - 3.0	- 1.0 1.0 1.0 - 2.0 - - - 1.0	50.2 50.5 51.9 53 54.2 54.9 57.2 58.4 59.2 59.7
65 70		C-7 60.6 - 70.6	120	100	100	C-7: Dark gray SCHIST; fine to medium grains of quartz, biotite, muscovite, feldspar; wide fracture spacing; unweathered to slightly weathered; medium strong to strong; crenulated schistosity is near-vertical, except at pegmatite contacts; many jagged mechanical breaks across foliation; pegmatite bands from 65.6' - 66.3' and 67.0' - 67.6'.	I/II	R3/R4	20 20_{MB} 35 30 30_{MB} *50 *60 15_{MB} 0_{MB} 25_{MB} 25_{MB}	2.0 - 3.0 2.0 - 2.0 2.0 - - - -	1.0 - 1.0 1.0 - 2.0 1.0 - - - -	60.1 60.6 62.4 63.9 64.4 65.8 67.7 68.4 68.8 69 69.8
75						C-8: Dark gray SCHIST, as above, except strong throughout; few scattered healed hairline fractures dipping 20° to 30°; no pegmatite; core sides slightly wavy.	I	R4	40_{MB} 10 0_{MB}	- 3.0 -	- 1.0 -	70.6 71.3 72.5

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CORING LOG
(continued)

BORING NUMBER FD-402
3 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Cruz**
INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH
80		C-8 70.6 - 80.6	120	100	100			
85 90		C-9 80.6 - 90.7	121	100	100	C-9: Dark gray SCHIST; m-f grains of quartz, biotite, muscovite, feldspar; moderate to wide fracture spacing; unweathered to slightly weathered; strong; indistinct, crenulated schistosity dips 80° to 90°; core sides slightly wavy.	I/II	R4
95 100		C-10 90.7 - 100.5	118	100	90	C-10 - 90.7' - 94.5': Dark gray to black SCHIST; m-f grains of biotite, feldspar, muscovite, black mafic minerals; moderate to wide fracture spacing; unweathered to slightly weathered; strong; schistosity is crenulated, dips 75° to 90°, except at contacts; increased hornblende content below 92.6'; 1/2-inch wide contorted bands of quartz-feldspar at 92.2' - 92.6'; contacts intact dipping 45° to 75°, subparallel to foliation; core sides slightly bulging from 92.6' to 94.5'; 94.5' - 96.0': Medium gray GRANITE; c-f grains of quartz, feldspar, muscovite and garnet; slightly weathered; moderate fracture spacing; strong; core is pitted where large muscovite flakes are weathered out; many irregular healed hairline fractures. 96.0'-96.5': Dark gray to black SCHIST, as above. 96.5' - 99.3': Medium gray, pure QUARTZ; slightly weathered; close fracture spacing; strong; thin (<0.1") coatings of white soft mineral (calcite?) on most fracture surfaces; most fractures dip 25°, with some open and partly open, near-vertical fractures; 99.3' - 100.5': Medium grained GRANITE-PEGMATITE; coarse grains of quartz, and white and pink feldspars in fine to medium grained matrix of muscovite and some garnet; moderate fracture spacing; slightly weathered; strong; faint, near-vertical compositional banding.	I	R4
105 110		C-11 100.5 - 110.0	114	100	100	C-11 - 100.5' - 103.8': Medium gray GRANITE-PEGMATITE; c grains of quartz, feldspar, in fine to medium grained matrix of muscovite and other minerals; coarser grained below 102.0'; moderate fracture spacing; slightly weathered; with some pitting on core surface from 100.5' to	II	R3/R4

DISCONTINUITY DATA

ANGLE (deg)	Jr	Ja	DEPTH (feet)
0_{MB}	-	-	75.8
15_{MB}	-	-	76.9
30	3.0	1.0	79.5
25	2.0	1.0	80.6
*80	1.5	2.0	80.9
20	2.0	1.0	81
45	2.0	1.0	81.8
30_{MB}	-	-	82.3
*80	1.5	2.0	84.6
20_{MB}	-	-	86.7
10	2.0	2.0	87.2
0_{MB}	-	-	87.5
0_{MB}	-	-	90.7
50	2.0	1.0	90.8
*40	2.0	1.0	92.7
20_{MB}	-	-	94.5
30	2.0	1.0	95.1
0_{MB}	-	-	95.6
20	2.0	1.0	95.8
*45	1.5	3.0	96.5
80	2.0	1.0	96.8
25	2.0	1.0	96.9
25	2.0	1.0	97.2
10	2.0	1.0	97.5
15	2.0	1.0	97.7
80	2.0	2.0	97.9
10	1.5	1.0	98.2
10	2.0	1.0	98.4
10	1.5	1.0	98.8
40	2.0	2.0	100.3
40	3.0	2.0	100.5
*40	1.0	1.0	101.7
30	3.0	2.0	103.8
0_{MB}	-	-	104.8
15_{MB}	-	-	105
40_{MB}	-	-	105.3
45	3.0	1.0	106

(continued)

BORING NUMBER FD-402
SHEET 4 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Cruz**
INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA ANGLE (deg)	Jr	Ja	DEPTH (feet)
		C-12 110.0 - 120.0	120	100	100	102.8'; medium strong to strong; black biotite-hornblende Schist in near-vertical contact from 101.9' - 102.8', with contorted schistosity along contacts; schistosity dips 40° to 90°; 103.8' - 110.0': Dark gray to black SCHIST; m-f grains of quartz, muscovite, and feldspar; moderate to wide fracture spacing; unweathered to slightly weathered; strong; indistinct, crenulated foliation dips 80° to 90°.	I/II	R4	10_{MB}	-	-	110
									*85	1.5	2.0	110.4
									45	2.0	2.0	110.6
									10_{MB}	-	-	113
									10_{MB}	-	-	113.4
									40	1.5	1.0	114
115									0_{MB}	-	-	114.9
						C-12 - 110.0' - 117.0': Dark gray to black SCHIST; fine to medium grains of biotite, muscovite, quartz, feldspar, hornblende; moderate to wide fracture spacing; unweathered to slightly weathered; strong; crenulated to wavy schistosity dips 75° to 90°; many jagged, low angle mechanical breaks; slightly bulging core of core sides from 114.0' to 117.0'; 117.0' - 120.0': Light gray to white GRANITE; fine to medium grains of quartz, white feldspar, and muscovite; few scattered medium grained garnets; wide fracture spacing; unweathered to slightly weathered; very strong; upper and lower contacts are sharp, but intact, dipping 40°.			20_{MB}	-	-	116
							I/II	R5	10	2.0	1.0	117
120									40	1.5	1.0	119.6
		C-13 120.0 - 125.7	68	100	99		I/II	R4	20	2.0	1.0	120
									40	3.0	2.0	120.3
									40	2.0	2.0	120.4
125						C-13 - 120.0' - 123.3': Dark gray SCHIST; m-f grains of quartz, biotite, muscovite, feldspar, hornblende; sparse garnet; wide fracture spacing, except for two very close fractures at 120.3'; unweathered, except slightly weathered from 120.0' to 120.5'; strong; crenulated schistosity dips 80° to 90°; 123.3' - 125.7': Light gray to white GRANITE; m-f grains of quartz, feldspar, muscovite; wide fracture spacing; unweathered to slightly weathered; very strong; upper contact with schist is sharp and intact, dipping ~80°, subparallel to foliation in schist; E.O.B at 125.7'.			0	1.5	2.0	124.2
									0_{MB}	-	-	124.9
									0_{MB}	-	-	125.4
									0_{MB}	-	-	125.7
130												
135												
140												
145												

NO. 7 CORING LOG NO_7NE.GPJ MAINLI~1.GLB 8/23/06

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Douglas, Inc.

DEPT OF BLDGS 121192618 Job Number

ES859520470 Scan Code

BORING LOG

D-405

1 of 1

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Deigert**
INSPECTOR: **N. Shah**
DRILLING METHOD: **Rotary Wash**
RIG TYPE: **CME-55**

LOCATION: **Track 20 under 11th Ave**
COORD. N: **214,174.3** E: **983,518.9**
STN. NO.: OFFSET:
SURFACE ELEV.: **107.8 feet**
DATUM:
START DATE: **11/28/05** TIME: **6:00 pm**
FINISH DATE: **12/2/05** TIME: **6:00 am**

	Casing	Split Spoon	Shelby Tube	Piston	Grab	Core Barrel
Type/Symbol	HW	S ■	U ▯	P ⧅	G ☒	C ⊟
I.D.	4"	1.375"	2.938"	2.938"		2"
O.D.	4.5"	2"	3"	3"		3"
Length		24"	24"	24"		
Hammer Wt.	300 lbs	140 lbs	Drill Rod Size		NWJ	
Hammer Fall	24"	30"	I.D. (O.D.)		(2.938")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft) CORING (Min./ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6 / CORING RUN (in.)	6/12 / REC. (in.)	12/18 / REC. %	18/24 / L>4" (in.)	REC. (in.) / RQD %	Depth Elev.	FIELD CLASSIFICATION AND REMARKS
													0.0'-1.5' - Concrete Slab - Advanced through via 6-inch single barrel thin wall coring adapter. 1.5' - 10.0': Advanced through soil-overburden via Air-Tricone method to bypass the utilities (up to 10 feet, as required);
5													Dark brown c-f SAND, some Silt, little f-Gravel, moist (became wet at 8 feet) (SM) (based on observations in cuttings)
10			S	1	■	10.0 - 12.0	6	5	5	4	2		Dark brown to black c-f SAND, some Silt, little f-Gravel, wet, loose (SM)
15			S	2	■	15.0 - 15.8	23	100/3			6		Dark brown m-f SAND, some Silt, trace f-Gravel, wet, very dense(SM) (Decomposed micaceous rock fragment at tip of spoon)
20												19.8	Roller bit refusal and begin coring at 19.8'.

BORING LOG NO_7NE.GPJ MAINLI~1.GLB 8/23/06

Boring No. **FD-405** Sheet **1** of **1**

P
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-405

1 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C. Deigert**
INSPECTOR: **N. Shah**

DRILLING METHOD: **Diamond drilling with double core barrel**
RIG TYPE: **CME-55**

LOCATION: **Track 20 under 11th Ave**
COORD. **N: 214,174.3** **E: 983,518.9**
STN. NO.: OFFSET:
SURFACE ELEV.: **107.8 feet**
DATUM:

START DATE: **11/28/05** TIME: **6:00 pm**
FINISH DATE: **12/2/05** TIME: **6:00 am**

CORE BARREL DATA:	**NOTES:**
TYPE: NX	
CORE SIZE: 2"	
O.D.: 3"	
I.D.: 2"	
CASING SIZE: 4" (4.5")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA ANGLE (deg)	Jr	Ja	DEPTH (feet)
		C-1 19.8 - 23.2	41	100	93	C-1: Dark gray to tan SCHIST m-f grains of biotite, quartz, muscovite, feldspar; close to moderate fracture spacing; slightly weathered; medium strong; foliation defined by wavy schistosity dipping 70° to 80°; soft mica on foliation fractures.	II	R3	*70 45 15	2.0 2.0 3.0	3.0 2.0 2.0	20.4 21.6 21.7
25 30		C-2 23.2 - 31.2	90	94	75	C-2, 23.2' - 31.2': Medium to dark gray SCHIST m-f grains of quartz, biotite, feldspar, muscovite; garnets up to 0.2-inch across from 23.2' to 25.2'; close to moderate fracture spacing, except very close spacing from 23.2' to 24.0'; slightly weathered; medium strong to strong; foliation defined by wavy schistosity dipping 60° to 80°; 1/2-inch thick pegmatites at 26.7' and 28.6'; many fractures are iron stained; 30.8' - 31.2': Medium gray PEGMATITE c-m grains of quartz, feldspar, mafic minerals; contact with overlying schist is along foliation fracture; possible recovery loss at 23.2' to 23.8'.	II	R3/R4	20 10 20 90 30 45 45 20 *60 20 15 *70 *70 *70	3.0 3.0 2.0 1.0 3.0 2.0 2.0 3.0 2.0 2.0 3.0 1.5 1.5 2.0	2.0 2.0 2.0 4.0 2.0 2.0 1.0 3.0 2.0 2.0 2.0 3.0 1.0 1.0	23 23.2 23.8 23.9 24.1 24.5 25.3 26.2 26.6 27.3 27.5 28.1 29.3 29.7
35 40		C-3 31.2 - 41.2	120	100	89	C-3: Dark gray SCHIST: fine to coarse grains of quartz, feldspar, biotite, muscovite, scattered medium to coarse garnets; very close to wide fracture spacing; slightly weathered; medium strong to strong; wavy schistosity dips 30° to 80°; Medium gray to dark pink PEGMATITE from 31.2' to 32.1'; contacts dip 30°, subparallel to foliation; light gray GRANITE from 32.5' to 34.3' and 34.5' to 35.9', with PEGMATITE; contacts dip 30° to 70°, intact; subparallel to foliation.	II	R3/R4	35 40 30 10 *60 10_{MB} 30 *45 30 30 20 30 30 *65 30 20	3.0 1.5 1.5 2.0 1.0 - 2.0 1.5 1.0 2.0 3.0 2.0 3.0 1.5 1.5 1.0	1.0 1.0 2.0 1.0 3.0 - 3.0 2.0 1.0 1.0 1.0 2.0 2.0 2.0 1.0 2.0	30.2 30.3 30.5 30.7 30.8 31.2 31.6 32 32.4 32.5 33.3 33.5 33.6 34.3 34.6 35.9
						C-4: Dark gray SCHIST c-f grains of quartz, feldspar, biotite, and muscovite; many garnets, up to 0.3-inch across; close to moderate fracture spacing; slightly weathered, except moderately weathered from 45.4' to 45.8'; medium strong to strong, except weak from 45.4' to 46.5'; distinct wavy schistosity	II	R3/R4	30_{MB} 30 55 30_{MB} 45_{MB} 40	- 3.0 3.0 - - 3.0	- 1.0 1.0 - - 1.0	36.1 36.2 37.6 39.5 41.2 42.2

DEPT OF BLDGS 121192618 Job Number

ES817977342 Scan Code

CORING LOG
(continued)

BORING NUMBER FD-405

SHEET 2 of 4

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **C. Deigert**

INSPECTOR: **N. Shah**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA ANGLE (deg)	Jr	Ja	DEPTH (feet)
50		C-4 41.2 - 51.1	119	100	76	dips 60° to 90°bands of pure quartz from 49.4' to 50.2', with 30° upper contact and 70° lower contact; single near-vertical, wavy foliation fracture extends from 43.1' to 45.6', with clay and soft mica on fracture surface; continuous, slow water loss observed throughout the core run.	III II	R2 R3/R4	70 *80 *90 20 *75 *60 *60 15 25_{MB} *30	1.0 1.0 1.0 1.0 1.5 1.5 2.0 1.5 - 1.0	4.0 3.0 4.0 4.0 2.0 4.0 2.0 2.0 - 2.0	43.1 44 44.5 45.2 45.4 45.6 46 47 48.1 49.4
55 60		C-5 51.1 - 60.8	116	100	100	C-5: Dark gray to dark blue gray SCHIST m-f grains of quartz, biotite, muscovite and feldspar; many garnets, up to 0.2-inch across; close to wide fracture spacing; slightly weathered; strong; wavy schistosity dips 70° to 90°; all fractures are across foliation; continuous, small water loss observed throughout the core run; depth of the borehole confirmed via measuring tape at 60.8'.	II	R4	10 *70 45_{MB} 40 40 35_{MB} 40 40_{MB}	2.0 1.0 - 2.0 2.0 - 2.0 -	1.0 2.0 - 1.0 1.0 - 1.0 -	50.1 50.2 51.1 53.4 53.9 54.4 55.9 56.3
65 70		C-6 60.8 - 71.2	125	100	96	C-6: Dark gray SCHIST c-f grains of quartz, muscovite, biotite, feldspar; many garnets up to 0.2-inch across; wide fracture spacing; unweathered to slightly weathered; strong; crenulated schistosity dips 70° to 90°; 1/2-inch thick quartz bands, near-vertical, between 63.3' and 64.3'; schistosity is contorted around quartz bands; slightly wavy core sides from 63.3' to ~65.0'; rock is muscovite-rich with spangly appearance; at the bottom of the rock core was jammed in core barrel; had to hammer hard to take it out; bottom of the borehole confirmed via measuring tape at 72.1';	I/II	R4	15_{MB} 40_{MB} 30_{MB} 60 10	- - - 3.0 2.0	- - - 1.0 2.0	60.8 63.4 65.8 67.6 69.2
75		C-7 71.2 - 81.2	120	100	100	C-7: Dark gray SCHIST c-f grains of quartz, muscovite, biotite, feldspar, and scattered garnets up to 0.3-inch across; wide fracture spacing; unweathered to slightly weathered; strong; crenulated schistosity dips 60° to 90°, except where contorted around quartz nodules and large garnets; slightly wavy core sides; rock is muscovite-rich, with spangly appearance; medium to fine grained below 80.1'.	I/II	R4	*80 60 45 *70 $15\text{-}20_{MB}$ *60 30 60_{MB} 40_{MB} 35_{MB}	2.0 2.0 2.0 1.5 - 2.0 3.0 - - -	2.0 2.0 2.0 2.0 - 2.0 1.0 - - -	70.8 70.9 71 71.2 72.45 73.9 74.4 75.4 76.1 78.8

DEPT OF BLDGS 121192618 Job Number
ES614826821 Scan Code

CORING LOG
(continued)

BORING NUMBER FD-405
SHEET 3 of 4
PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Deigert**
INSPECTOR: **N. Shah**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA ANGLE (deg)	DISCONTINUITY DATA Jr	DISCONTINUITY DATA Ja	DISCONTINUITY DATA DEPTH (feet)
									30_{MB}	-	-	80.2
85 90		C-8 81.2 - 91.2	120	100	100	C-8: Dark gray to medium gray SCHIST m-f grains of quartz, muscovite, feldspar, biotite, and garnets, up to 0.1-inch across; wide fracture spacing; unweathered; strong; crenulated schistosity dips 70° to 90°, contorted in places; irregular bands of granite , ~ 1-inch thick are near-vertical at 87.7' and 94.5'; wavy core sides throughout; all mechanical breaks are across foliation and jagged.	I	R4	25_{MB} 10_{MB} 40_{MB} 35_{MB} 20_{MB} 25_{MB} 10_{MB} 15_{MB} 15_{MB} 20_{MB} 25_{MB} 15_{MB} 40_{MB}	- - - - - - - - - - - - -	- - - - - - - - - - - - -	81.2 81.8 84.1 84.8 85 85.9 86.2 86.6 88.4 88.5 89.3 89.5 90
95		C-9 91.2 - 96.5	64	100	100	C-9: Dark gray SCHIST m-f grains of quartz, biotite, feldspar, muscovite; scattered garnets, up to 0.1-inch across; moderate to wide fracture spacing; unweathered to slightly weathered; strong; wavy schistosity dips 65° to 80°; irregular contorted quartz bands 1/4-inch thick; near-vertical bands of light gray GRANITE from 93.8' to 94.7', contact intact, with sub parallel foliation; core sides very slightly wavy; pyrite coating on 65° foliation fracture at 93.1'.	I/II	R4	20_{MB} *65 20_{MB}	- 1.0 -	- 2.0 -	91.2 93.1 94.85
100 105		C-10 96.5 - 106.0	105	92	79	C-10: 96.5' to 98.8': Dark gray SCHIST m-f grains of quartz, biotite, muscovite, feldspar, hornblende, and garnets up to 0.1-inch across; moderate fracture spacing, with numerous near-horizontal mechanical breaks; slightly weathered; strong; wavy contorted schistosity is near-vertical; near-vertical band of light gray GRANITE from 96.9' to 97.5'; 98.8' - 101.1': Black SCHIST c-m grains of biotite, hornblende, quartz, feldspar and yellow metallic flaky mineral (pyrite?) on fracture surfaces and throughout; very closely fractured, with some over coring; slightly weathered; strong; very dense; near-vertical schistosity; probable non-recovery zone from 99.8' to 100.8'; 101.0' - 103.9: Dark gray SCHIST m-f grains of biotite, quartz, muscovite, hornblende and garnets up to 0.1-inch across; wide facture spacing; unweathered; strong; foliation defined by indistinct schistosity and contorted 1/4-inch bands of quartz, both dipping 80° to 90°; core sides are parallel; 103.9 - 106.0': Dark gray to black SCHIST c-m grains of hornblende, biotite, muscovite, quartz, and many scattered 0.1-inch feldspar phenocrystals; moderate fracture spacing; slightly weathered; strong; very dense; faint foliation dips 80° to 90°; a few contorted bands of quartz, near-vertical and 1/4-inch to 1/2-inch thick; wavy, bulging core sides; -drilling was hard; core barrel jammed at ~ 100 feet; rock core catcher was not catching	II II I/II	R4 R4 R5	30_{MB} 10_{MB} $5\text{-}10_{MB}$ $10\text{-}15_{MB}$ 15 10_{MB} 20 25 25 80 40 10 50 0_{MB} 20_{MB} 15 15_{MB} 15_{MB} $10\text{-}15_{MB}$	- - - - 3.0 - 3.0 2.0 2.0 1.0 2.0 2.0 2.0 - - 1.5 - - -	- - - - 1.0 - 1.0 2.0 2.0 2.0 2.0 1.0 2.0 - - 1.0 - - -	96.5 97 97.6 98 98.2 98.5 98.8 98.9 98.95 99.4 99.8 100.1 100.9 101 101.2 104.1 104.3 105.4 106
110		C-11 106.0 - 116.1	121	100	97				20 10_{MB} 30 30	3.0 - 2.0 2.0	1.0 - 2.0 2.0	108.4 110.2 110.9 111.1

NO. 7 CORING LOG NO_7NE.GPJ MAINLI~1.GLB 8/23/06

CORING LOG
(continued)

BORING NUMBER FD-405
SHEET 4 of 4
PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **C. Deigert**
INSPECTOR: **N. Shah**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH
						cored rock; redrilled cored-rock observed between 99.0' and 100.0'. C-11, 106.0' - 109.1': Dark gray to black SCHIST; as above, except with scattered medium grained garnets and greater number of quartz bands; 109.1' to 116.1' - Dark gray SCHIST; fine to medium grains of quartz, biotite, muscovite, and feldspar; wide fracture spacing, except for two pairs of closely spaced fractures at 110.9' and 115.8'; unweathered to slightly weathered; very strong; foliation defined by indistinct near-vertical schistosity; - bottom of the core run jammed inside the core barrel; had to hammer hard to take it out.	I/II	R4/R5
120		C-12 116.1 - 126.1	120	100	100	C-12: Dark gray SCHIST m-f grains of quartz, biotite, muscovite, feldspar; moderate to wide fracture spacing; unweathered to slightly weathered; strong to very strong; indistinct foliation dipping 75° to 90°; 122.8' to 123.3' - black SCHIST c-m grains of hornblende, quartz, biotite, with white, 0.1-inch phenocrystals; 123.3' - 123.6': Light gray quartz-feldspar near-vertical band; wavy core sides from 123.3' to 123.6'; - Rock-core was jammed inside core barrel; had to hammer hard to pull it out; - A lot of mechanical breaks between 125.1' and 125.25 due to hammering; E.O.B at 126.1'.		
125								
130								
135								
140								
145								

DISCONTINUITY DATA

ANGLE (deg)	Jr	Ja	DEPTH (feet)
35_{MB}	-	-	114.8
80	2.0	1.0	115.8
40	2.0	1.0	115.9
30_{MB}	-	-	116.1
20_{MB}	-	-	117.6
$25\text{-}30_{MB}$	-	-	119
5-10	2.0	1.0	119.9
10	2.0	1.0	120.5
10	2.0	1.0	121.1
10	2.0	1.0	123.8
30_{MB}	-	-	124.6
50	2.0	1.0	125.1
40_{MB}	-	-	125.15
$*75_{MB}$	-	-	125.2
40_{MB}	-	-	125.25
0_{MB}	-	-	126.1

NO. 7 CORING LOG NO_7NE.GPJ MAINLI~1.GLB 8/23/06

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BORING LOG

-23
1 of 1

PROJECT NUMBER:

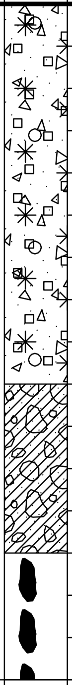
PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **D. Keith**
INSPECTOR: **A. Zabala**
DRILLING METHOD: **Rotary Wash**
RIG TYPE: **CME 55 (High Rail)**

LOCATION: **LIRR-Trk 26-11th Ave (40'E)**
COORD. N: **214,249.0** E: **983,592.0**
STN. NO.: OFFSET:
SURFACE ELEV.: **108.0 feet**
DATUM:
START DATE: **8/26/03** TIME: **11:30 am**
FINISH DATE: **9/9/03** TIME: **4:00 pm**

	Casing	Split Spoon	Shelby Tube	Piston	Grab	Core Barrel
Type/Symbol	HW	S ■	U ▯	P ◺	G ☒	C ⊟
I.D.	4"	1.375"	2.938"	2.938"		2"
O.D.	4.5"	2"	3"	3"		3"
Length		24"	24"	24"		
Hammer Wt.	300 lbs	140 lbs	Drill Rod Size		NWJ	
Hammer Fall	24"	30"	I.D. (O.D.)		(2.938")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)
9/8/03	9:00 am	20.0	17.0	138.5



DEPTH (feet)	CASING (Blows/ft) CORING (Min./ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL 0/6 / CORING RUN (in.)	SOIL 6/12 / CORING REC. (in.)	SOIL 12/18 / CORING REC. %	SOIL 18/24 / CORING L>4" (in.)	SOIL REC. (in.) / CORING RQD %	Depth Elev.	FIELD CLASSIFICATION AND REMARKS
					0.0 - 6.0		Hand		Auger			Hand Augered Material: 0' to 1.1' - Concrete 1.1' to 1.5' - Asphalt 1.5' to 2' - Coarse Gravel 2' to 4' - Light brown m-f SAND, some Silt 4' to 6' - Brown/reddish m-f SAND
5		S	1	■	6.0 - 8.0	10	23	29	25	24		A. (top 14") Brown m-f SAND, little Silt, moist, dense (SP) B. (bottom 10") Brown/goldish m-f SAND, trace Silt, dense (Pyrite) (SP)
10		C	1	⊟	10.0 - 12.6	31	31	100				White/reddish Granitic GNEISS (boulder)
		S	2	■	13.0 - 14.0	32	100/6"	-	-	12		Brown c-f SAND, little Silt, little m-f decomposed Pegmatite, moist, very dense
15		S	3	■	15.0 - 15.8	40	100/3"	-	-	5	16.0	White and brown m-f decomposed rock, some c-f Sand, little f- Gravel, very dense Roller bit refusal and begin coring at 16.'
20												

Boring No. **PE-23** Sheet **1** of **1**

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DEPT OF BLDGS 121192618 Job Number

ES740427494 Scan Code

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1 of 5

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **D. Keith**
INSPECTOR: **A. Zabala**
DRILLING METHOD: **Diamond drilling with double core barrel**
RIG TYPE: **CME 55 (High Rail)**

LOCATION: **LIRR-Trk 26-11th Ave (40'E)**
COORD. **N: 214,249.0** **E: 983,592.0**
STN. NO.: OFFSET:
SURFACE ELEV.: **108.0 feet**
DATUM:
START DATE: **8/26/03** TIME: **11:30 am**
FINISH DATE: **9/9/03** TIME: **4:00 pm**

CORE BARREL DATA:	**NOTES:**
TYPE: NX	
CORE SIZE: 2"	
O.D.: 3"	
I.D.: 2"	
CASING SIZE: 4" (4.5")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)
9/8/03	9:00 am	20.0	17.0	138.5

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA			
									ANGLE (deg)	Jr	Ja	DEPTH (feet)
		C-2 16.0 - 24.3	100	100	96	Pink/light gray Granitic GNEISS, slightly weathered, sound, wide fracture spacing, very strong rock, m-f grained -Scattered Garnets up to 3/8" -Foliation faint, dips 70°	II	R5	10 0 10_{MB} 10_{MB}	1.5 1.5 - -	1 1 - -	16.2 16.4 16.6 18
20						19.7' to 24.3' - Pink/light gray PEGMATITE, c-grained, slightly weathered, wide fracture spacing, strong, some iron staining 23' to 36.5'	II	R4	5_{MB} 5_{MB} 15 20 20 0	- - 1.5 1.5 1.5 2.0	- - 1.0 1 2.0 2.0	20 20.6 21.4 21.5 22.9 23.3
25 30		C-3a 24.3 - 33.1	106	100	100	24.3' to 25.3' - Pink/light gray PEGMATITE, unweathered to slightly weathered, sound, wide fracture spacing, very strong rock, c- grained 25.3' to 33.1' - Pink/light gray Granitic GNEISS, c-f grained, wide fracture spacing, unweathered, very strong, foliation dips 70° -Pegmatite 1" wide at 29.7', 30.2', 30.7'	I/II I	R5 R5	20 0_{MB} 0_{MB} 20 0_{MB} 0_{MB}	1.0 - - 1.5 - -	1.0 - - 1.0 - -	24.3 25.25 27.7 30.1 30.9 32.6
		C-3b 33.1 - 33.9	10	100	100	C-3 continued - Gray/pink Granitic GNEISS, unweathered, strong rock - rock recovered from top of C-4 core run	I	R5	20_{MB}	-	-	33.1
35		C-4 33.9 - 38.6	56	100	100	Gray/pink Granitic GNEISS, unweathered, very strong rock, medium to fine grained -Faint banding dips 70-80°	I	R5	0_{MB} 0_{MB} 0_{MB}	- - -	- - -	33.9 37.3 37.9
40						Gray/pink Granitic GNEISS, slightly weathered, medium to fine grained, few brown Garnet aggregate present Except: 41' to 47.7' - unweathered	II	R4	0_{MB} 5 5	- 1.5 1.5	- 1.0 3.0	38.6 39.2 39.6

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(continued)

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PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **D. Keith**

INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA			
									ANGLE (deg)	Jr	Ja	DEPTH (feet)
45		C-5 38.6 - 48.0	113	100	95	44.1' to 44.4', 45' to 45.4', and 46.1' to 46.4' - Pink PEGMATITE -46.1' to 46.4' contact with Gneiss near vertical -Drill locked up after first 0.6 ft, core stuck in barrel, pulled rock and continued drilling -Lost entire tub of drilling fluid, rig chatter when drilling continued -No rock wall contact at 39.2', 39.6', and 40.8' -Break along Quartz vein with sand particles at 40.5' -Frequent staining on joint walls 39' to 41' (yellow and red)	I	R4	20 0 0 30_{MB}	1.5 1.5 1.5 -	2 3.0 3.0 -	40.5 40.8 41 42.8
50 55		C-6 48.0 - 58.0	120	100	98	Light gray Granitic GNEISS, very strong rock, slightly weathered to unweathered, medium to fine grained, foliation dip 75-80° -Rock is light red Garnet rich or Hematite stained -51.4' to 51.7', 52.1' to 52.6', and 54.2' to 54.5' - m-grained Garnets constitute 10% of rock -57.1' to 58' - 1/8" wide bands of Garnet parallel to foliation, spaced approx. 2" apart -Lost entire tub of drilling fluid three times Note: Depth of 48' was measured using drill rods (tape was sticking to side of boring wall and could not be used)	II	R5	0 0 20 0 5 5 5 0_{MB} 30 5 10 10_{MB} 0_{MB} 10_{MB} 0_{MB}	1.5 1.5 1.5 1.5 1.5 1.5 1.5 - 1.5 1.5 1.5 - - - -	3.0 2.0 2.0 2.0 1 2.0 2 - 3.0 3.0 1.0 - - - -	47.7 47.8 48 49.7 50.4 50.6 51 51.1 51.8 53.1 55.1 55.8 55.9 56.4 56.6
60 65		C-7 58.0 - 66.5	102	100	99	Pink/gray Granitic GNEISS, slightly weathered, sound, wide fracture spacing, very strong rock, c-m grained -58.2' to 59.8' and 65.2' to 65.5' - Pink/white PEGMATITE, coarse to very coarse grained -Lost two tubs of water	II	R5	20 20_{MB} $-_{MB}$ 10 20 15 5 10_{MB} 0_{MB} 20_{MB}	1.5 - - 1.5 1.5 1.5 1.5 - - -	1.0 - - 1 1 1 1.0 - - -	57.1 57.4 58 60.1 60.2 61.1 61.4 62 63.3 65.2
70		C-8 66.5 - 70.2	44	100	100	Pink/gray Granitic GNEISS, unweathered, sound, wide fracture spacing, very strong rock, c-f grained, foliation dips 50-60° -Garnets up to 3/4" -Scattered Pegmatite 1" wide parallel to foliation -Stopped drilling at 70.2' due to need for new coring bit	I	R5	0 0 10 5_{MB} 5_{MB} 5_{MB}	1.0 1.0 1.0 - - -	1.0 1.0 1.0 - - -	66.5 66.6 66.8 67.2 68.9 69.5
75		C-9 70.2 - 80.4	122	100	100	Pink/gray Granitic GNEISS, slightly weathered to unweathered, sound, very wide fracture spacing, very strong rock, m-f grained, foliation dips 50° -White/pink Pegmatite, 1" to 2" wide, at 75.5', 76.1', 76.9', and 77.8' parallel to foliation -Quartz enriched 78.5' to 80.4' -Lost two tubs of water	I/II	R5	0_{MB} 0_{MB} 10_{MB}	- - -	- - -	70.2 71.3 72.3

P
B
Quade &
Douglas, Inc.

DEPT OF BLDGS 121192618 Job Number

ES180854848 Scan Code

(continued)

-23

3 of 5

PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **D. Keith**

INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA ANGLE (deg)	Jr	Ja	DEPTH (feet)
									10 0_{MB} 0	1.5 - 1.5	1.0 - 1	76.3 76.9 77.7
80 85		C-10 80.4 - 89.8	113	100	100	Pink/light gray Granitic GNEISS, unweathered, sound, very wide fracture spacing, very strong rock, m-f grained, foliation dips 40-50° -Scattered Garnets to 3/8" -Pink/white, m-c grained PEGMATITE from 80.4' to 80.9', 82.5' to 85.6', and 87.5' to 88' -Loss of water	I	R5	0_{MB} 0 0_{MB} 0_{MB} 40_{MB}	- 1.5 - - -	- 1.0 - - -	80.4 80.5 83.9 85.4 86.1
90 95		C-11 89.8 - 99.9	121	100	100	Light gray Granitic GNEISS, as above Except: 92' to 92.4' - Black SCHIST, foliation 40 degrees -Contacts concordant with Gneiss foliation -Pink/white PEGMATITE from 92.6' to 94', 95.5' to 96.2', 97.5' to 97.6', and 99' to 99.6'	I	R5	0_{MB} 0_{MB} 30 10_{MB} 0_{MB} 0_{MB} 20 10_{MB} 10_{MB} 15	- - 1.5 - - - 1.5 - - 1.5	- - 3.0 - - - 1.0 - - 2.0	89.8 91.3 92.1 92.8 93.5 94.7 96.6 96.9 97.9 98.8
100 105		C-12 99.9 - 106.1	74	100	100	Pink/light gray Granitic GNEISS, unweathered, sound, very wide fracture spacing, very strong rock, c-f grained, foliation dips 50° -Pink/white PEGMATITE from 101.8' to 102.1'. 102.8' to 103.1', and 104.2' to 104.3'	I	R5	5_{MB} 15_{MB} 0_{MB} 10_{MB} 25_{MB} 0_{MB} 0_{MB} 0_{MB}	- - - - - - - -	- - - - - - - -	99.6 99.9 100.1 100.7 101.9 102.9 104.4 105.3
		C-13 106.1 - 109.2	37	100	100	Pink/gray Granitic GNEISS, unweathered, sound, wide fracture spacing, very strong rock, m-f grained Except: 107' to 108.5' - Black SCHIST, foliation 50 degrees, contacts contorted -Rig blocked up -Bit shoe broke off	I	R5	5_{MB} 30_{MB}	- -	- -	106.1 108.6
110						Pink/gray Granitic GNEISS, unweathered, sound, very wide fracture spacing, very strong rock, m-f	I	R5	0_{MB} 0_{MB} 0_{MB}	- - -	- - -	108.7 109.1 109.2

PROJECT: **No 7 Subway line Extension**
LOCATION: **Manhattan**
CLIENT: **MTA**
CONTRACTOR: **Jersey Boring & Drilling**
DRILLER: **D. Keith**
INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA ANGLE (deg)	Jr	Ja	DEPTH (feet)
		C-14 109.2 - 114.7	66	100	100	grained, foliation dips 40-60° (faint banding) Except: 111' to 111.3' - Pink/gray PEGMATITE -Roller bit before coring this run due to problem with bit in previous run			30MB 20 25MB 20MB	- 1.5 - -	- 1.0 - -	109.6 110.5 112.8 114.2
115 120		C-15 114.7 - 124.0	112	100	100	114.7' to 121.6' - Pink/gray Granitic GNEISS, unweathered, sound, very wide fracture spacing, very strong rock, m-f grained, foliation dips 60-70° -1/8" thick Mica seam dipping 70°at 120.7' -30° fracture at 122.6' cuts across foliation 121.6' to 124' - Dark gray to black, Biotite-amphibole SCHIST, slightly weathered, wide fracture spacing, strong rock, c-f grained, wavy foliation dips 60° -Friable at upper contact with Gneiss	I II	R5 R4	25MB 15MB 0 0MB 0 30	- - 1.5 - 1.5 1.5	- - 2.0 - 4 4.0	114.7 116.5 118.3 119 121.6 122.6
125 130		C-16 124.0 - 134.1	121	100	93	Dark gray to black Biotite-amphibole SCHIST, slightly weathered, sound, wide to moderate fracture spacing, medium strong to strong, foliation is wavy (crenulated in places) and dips 60-80° -Irregular xenoliths of light gray Gneiss and pink Pegmatite, 2" to 6" across, with healed contacts, some parallel to schistosity 128.5' to 134.1' - Light gray Granitic GNEISS, slightly weathered, sound, close to wide fracture spacing, strong to very strong rock, f-c grained, faint banding dips 60° -Near vertical Mica seam, 1/2" wide, 130.5' to 131.2' -Mica-chlorite seam, approx. 1/2" wide, at 133.1', dips 70° -Broken up rock from 133.7' to 134', angular fragments, extremely close fracture spacing	I Ii	R3/R4 R4/R5	15 20 10MB 30 20MB 25 0 25MB 10MB 20 60	1.5 1.5 - 1.5 - 1.5 1.5 - - 1.5 1.5	1.0 4.0 - 3.0 - 1.0 1.0 - - 2 4.0	124 124.6 126.5 127.7 128.9 129.4 129.9 131.3 131.8 132.8 133.1
135		C-17 134.1 - 138.5	53	100	68	Pink/gray Granitic GNEISS, slightly weathered, sound, moderate to wide fracture spacing, very strong rock, c- grained -2 long vertical fractures: (1) 136.5' to 137' (2) 137.2' to 138' -5" wide band of pink Pegmatite 134.3' to 134.7' -1/8" wide band of Garnet, dipping 60°, from 135.8' to 136.5'	II II	R5 R4	70-30 60 40-30MB 25 20 80 25MB	1.0 4 - 1.5 1.5 1.5 -	1.0 1 - 1.0 1.0 1 -	133.7 134 134.1 135.8 136.2 136.7 137
140		C-18 138.5 - 140.6	25	100	100	136.7' to 138.5' - White/gray/pink PEGMATITE, coarse to very coarse grained, moderate to extremely close fracture spacing, slightly weathered, strong, Quartz rich	III	R3	80 20 80 20	1.5 1.5 1.5 1.5	1 1.0 1.0 1.0	137.6 138.5 138.6 138.7
145		C-19 140.6 - 145.2	55	100	96	Pink/gray PEGMATITE, moderately weathered, close fracture spacing, medium strong rock, c- grained Pink/gray PEGMATITE, slightly weathered, moderate fracture spacing, strong rock, c- grained Except: 143.7' to 144.9' - Light gray Granitic GNEISS, m-f grained	II	R5	5 25 25MB 25MB 20 15MB 10MB 10MB 15	1.5 1.5 - - 1.5 - - - 1.5	1.0 1.0 - - 1.0 - - - 1.0	139 139.6 140.4 140.6 140.9 141.3 141.5 141.7 141.9

P
Br
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(continued)

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PROJECT NUMBER:

PROJECT: **No 7 Subway line Extension**

LOCATION: **Manhattan**

CLIENT: **MTA**

CONTRACTOR: **Jersey Boring & Drilling**

DRILLER: **D. Keith**

INSPECTOR: **A. Zabala**

DEPTH (feet)	CORING RATE (ft/min)	CORE RUN NO. AND DEPTH (ft)	RECOVERY (in)	RECOVERY (%)	RQD (%)	DESCRIPTION AND REMARKS (Lithology, Structure, Weathering, Continuity, Strength, Color, Grain Size) * - Denotes discontinuity along foliation MB - Denotes mechanical break	WEATHERING	STRENGTH	DISCONTINUITY DATA			
									ANGLE (deg)	Jr	Ja	DEPTH (feet)
						-Mica seam at 142.3'			20	1.5	2.0	142.1
						-144.9' to 145.2' - Concrete with piece of tie rod			0	1.5	1	142.2
						E.O.B. at 145.2'.			10_{MB}	-	-	142.8
									0_{MB}	-	-	143.4
									35	1.5	1.0	144.3
									5	1.5	2	144.9
150												
155												
160												
165												
170												
175												
180												

PB Team
2 Broadway
New York, NY 10004

BORING LOG

BORING NUMBER: SB-HE-03
SHEET NUMBER: 1 of 1
PROJECT NUMBER: JG-2140

PROJECT: No. 7 Subway Line Extension
LOCATION: Manhattan, New York
CLIENT: MTA
CONTRACTOR: Jersey Boring & Drilling

DRILLER: D. Kieth
INSPECTOR: J. Reigart

DRILLING METHOD: Hand/ Hollow Stem Auger
RIG TYPE: CME-55

LOCATION: Caemmerer Yard - East
COORD. N: N/A E: N/A
STN. NO.: **OFFSET:**
SURFACE ELEVATION: N/A
DATUM:
DEPTH TO ROCK: 14 ft
START DATE: 10/6/2004 **TIME:**
FINISH DATE: 10/6/2004 **TIME:**

	Casing	Split Spoon	Shelby Tube	Piston	Grab	Core Barrel
Type/Symbol	HW	S	U	P	G	C
I.D.		1.375"	2.938"			2"
O.D.		2"	3"			3"
Length		24"	24"			
Hammer Wt.		140 lbs	Drill Rod Size		NWJ	
Hammer Fall		30"	I.D. (O.D.)			

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)
10/6/2004		N/A		14

Note: WOH = Weight of Hammer

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft) CORING (Min./ft)	SAMPLE TYPE	SAMPLE SYMBOL	SAMPLE NUMBER	SAMPLE DEPTH (feet)	SOIL (Blows / 6in) 0/6 CORING RUN (in.)	6/12 REC. (in.)	12/18 REC. %	18/24 L>4" (in.)	REC (in.) RQD %	PID (ppm)	FIELD CLASSIFICATION AND REMARKS
0	⁙												Dusky brown coarse SAND.
	☰												Concrete
	⁙												Light brown coarse to fine SAND, some Gravel .
	⁙		G	☒	1	2.0-4.0							
5	⁙			☒	2	4.0-6.0							
	⁙												Light brown coarse to fine SAND, some Gravel, trace Silt.
	⁙		S	■		5.5-7.5	10	14	13	12	1.25		
	⁙												Light brown coarse to medium SAND, some Silt, trace Gravel .
	⁙		S	■		7.5-9.5	8	10	6	5	1		Light brown coarse to medium SAND, some Silt, trace Gravel .
10	⁙												
	⁙		S	■		11.5-13.5	7	10	8	100/2"			Bedrock
						End of Boring at 14 ft							
15													

Boring No. SB-HE-03 SHEET 1 of 1

BORING LOGS - MG SERIES - MABSTOA GARAGE AREA

MUESER, RUTLEOGE, JOHNSTON & OESIMONE
WOOOWARO–CLYOE CONSULTANTS, INC.

SHEET 1 of 2
BORING NO. MG-801
FILE NO. 4840

BORING LOG

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: + 16.1
COORDINATES: N 191932.3 E 1999628.3
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 03/26/82
INSPECTOR: B. Mukherjee (MRJD)
DATE COMP.: 03/29/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: J. Bowen
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 43.0 FT.; DIA. 3 IN. FROM 0.0 TO 45.0 FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 3 3/4, 2 15/16 IN
SAMPLING EQUIPMENT. (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U–SAMPLER: DIA. IN.; TYPE
CORE BIT Diamond, BX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 45.0 FT. DEPTH TO COMP. 60.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
03/29/82	0800	42.0	43.0	7.5		After weekend
03/29/82	1345	60.0	43.0	14.5		After 20 minutes of completion of drilling
03/29/82	1405	60.0	43.0	11.9		
03/29/82	1430	40.0	0.0	11.5		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0800	–					*	0	*Concrete
	2	1D	0.7	10-10	Brown f-c sand, sm silt, trace	0.3 Loose to medium compact, brn f-c sand & gravel, some silt, trace cinders (Fill)		
	16		2.7	11-4	Cinders (Fill)(SM)			
	16							
	25							
	39	2D	5.0	5-10	Graveland some decomposed mica		5	
	43		7.0	11-35	schist, silt (Fill) (GM)			
	29							
	26							
	21							
	15	3D	10.0	6-2	Red-brown silty fine sand		10	
	13		12.0	1-2	(Fill)(SM)			
Cloudy, Rain	11							
	30							
	52							
	29	4D	15.0	12-12	Top: Yellow-brown m-f sand, sm		15	
	31		17.0	9-10	silt (Fill)(SM)	16.0 Medium compact, brn & red-brn f-m sand, sm silt, tr clay, gravel, mica		
	37				Bot: Brown silty fine sand, tr			
	41				gravel (SM)			
	53							
03/28/82	42	5D	20.0	12-11	Brown f-m sand, tr mica (SP)		20	
	46		22.0	10-11				
	48							
	43							
	45							
	30	6D	25.0	10-9	Brown fine sand, some silt, tr		25	
	40		27.0	10-15	m-c sand, gvl, mica (SM)			
	50							
	62							
	58						30	

BORING NO. MG-801

SHEET 2 of 2
WOOOWARO–CLYOE CONSULTANTS, INC.
BORING NO. MG-801

BORING LOG

FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Same as above	49	7D	30.0	7-9	Red-brown silty fine sand, sm	same as above	30	
	54		32.0	12-12	mica, trace clay layers (SM)			
	63							
	70							
	75							
	57	8D	35.0	8-8	Red-brown silty fine sand, tr		35	
	66		37.0'	9-14	mica (SM)			
	75							
	89							
	84							
	132	9D	40.0	14-29	Red-brown gravelly c-f sand,	40.0 9D Very Compact	40	
1500	104		42.0	37-23	some silt (SM)			
0700	250							**44.0'-45.0' Drilled
	**							
						43.5 ***		***Dec. rock. 43.5'-45.0'
		1C	45.0	Rec= 94%	Light gray mica schist, trace	45.0 Light gray mica schist cljtd -jtd UnWExJts	45	Decomposed mica
			50.0	RQD= 60%	quartz inclusions, cljtd,			schist was
					UnWExJts			observed in
								cuttings.
03/29/82 Sunny		2C	50.0	Rec= 98%	Do 1C		50	
			55.0	RQD= 66%				
		3C	55.0	Rec= 86%	Light gray mica schist, jtd,		55	
			60.0	RQD= 78%	UnWExJts			
1430						60.0	60	
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-801

MUESER, RUTLEDGE, JOHNSTON & OESIMONE
WOOOWARO–CLYOE CONSULTANTS, INC.
BORING LOG

SHEET 1 of 3
BORING NO. MG-802P
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +13.6
COORDINATES: N 191930.5 E 1999414.1
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 03/30/82
INSPECTOR: B. Mukherjee (MRJD)
DATE COMP.: 03/31/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: C. Soto
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 3 IN. FROM 0.0 TO 39.5 FT.; DIA. IN. FROM TO FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 2 15/16 IN
SAMPLING EQUIPMENT, (TYPE & SIZE)
D-SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U-SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, BX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☑ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U-TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 39.5 FT. DEPTH TO COMP. 63.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
03/31/82	0830	63.0	34.0	8.9		Overnight
04/01/82	1300	20.0	20.0	9.0		Inside Piezometer

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0800	1					*	0	*Sidewalk Concrete
	11	1D	1.0	8-14	Dark brn f-m sand, sm silt, tr gvl, cinders (Fill) (SM)	0.3		W = Water content in %
	19		3.0	20-10		Loose brown silty fine to medium sand, sm silt, tr gvl, cndrs (Fill)		
	23							
	16							
	5	2D	5.0	4-2	Brn silty f-m sand, tr cinders, gravel (Fill) (SM)		5	
Sunny	4		7.0	3-2				
	12							
	11							
	8							
	7	3D	10.0	6-5	Brn silty f-m sand, tr gvl (Fill) (SM)		10	Recovered in second attempt.
03/30/82	6		12.0	3-1				
	7							
	8							
	8							
	12	4D	15.0	4-2	Brn silty f-m sand, tr gvl (Fill) (SM)		15	
	10		17.0	2-8				
	20							
	29							
	28							
	21	5D	20.0	3-4	Brown silt, trace fine sand (ML)	20.0	20	W = 18
	29		22.0	5-7		Loose brn silt, tr fine sand		
	32							
	36							
	40							
	36	6D	25.0	3-5	Do 5D (ML)		25	W = 38
	35		27.0	6-7				
	47							
	54							
	55						30	

WOOOWARO–CLYOE CONSULTANTS, INC.
BORING LOG

2 of 3
BORING NO. MG-802P
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
	34	*7D	30.0	5-6	Brown m-f sand, tr coarse sand, silt (SP)	Med cpt,brown m-f sand, sm silt, mica trace coarse sand	30	*Sample probably wash
	43		32.0	7-8				
	51							
	60							
	72							
	45	8D	35.0	3-6	Brown m-f sand, sm silt, mica (SM)		35	
	41		37.0	9-11				
	57							
	92							
	150/6"							
		1C	40.0	Rec=96%	Light gray mica schist & qtz veins, broken UnWExJts	40.0	40	Jnts mostly parallel to foliation.
			45.0	RQD=30%		Lt gray quartz garnet mica sch broken, UnWExJts to HiW		
Sunny								
		2C	45.0	Rec=88%	Light gray qtz garnet mica schist, broken, UnWExJts to HiW		45	
			47.0	RQD=14%				
03/30/82								
		3C	50.0	Rec=60%	Do 2C		50	
			55.0	RQD= 0%				
		4C	55.0	Rec=46%	Light gray mica schist, bkn HiW to SlW		55	Decomposed rock washed out.
			57.6	RQD= 0%		56.9		Between 56.9'-60.0'
						4C		
		5C	60.0	Rec=73%	White and light gray micaceous quartzite & mica schist, bkn, UnWExJts	60.0	60	Core barrel blocked at 63.0'
			63.0	RQD=16%		5C		
1530								
						63.0		
							65	
							70	
							75	
							80	
							85	

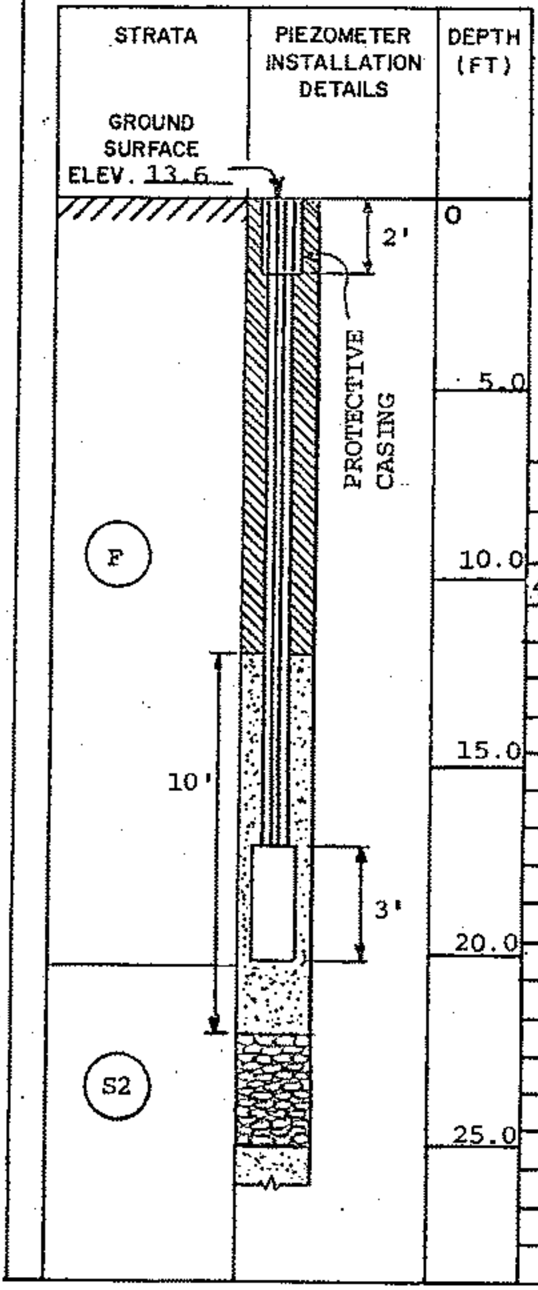
SHEET 3 OF 3
FILE NO. 4840
SUBCODE SMBST

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

PIEZOMETER RECORD

PROJECT WEST SIDE HIGHWAY-CONTRACT 5
PIEZOMETER NO. MG-802P
LOCATION MABSTOA GARAGE
PIEZOMETER LOCATION 10th AVE & W 30th STREET
DATE OF INSTALLATION 3-30-82
☐ SEE SKETCH ON BACK
RES. ENG. B. Mukherjee



PIEZOMETER TYPE DOUBLE TUBE POROUS PLASTIC

INTAKE POINT

depth to bottom, ft = 20.0
depth to top, ft = 17.0
length, ft = 3' = L
diameter, in = 1.5, ft = 0.125 = 2R

STANDPIPE/RISER (DOUBLE TUBE)

elevation of rim, ft = 13.6
diameter, in = 3/8, ft = 0.031 = 2r

READING TIME		DEPTH - RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
4-1-82	1300	9.0	4.0	1/2" Rainfall on 3-31-82

░ Sand ▦ Bentonite
△ Gravel ▨ Grout

GROUND SURFACE ELEV. 13.6

PIEZOMETER NO. MG-802p

SHEET 1 of 2
BORING NO. MG-803
FILE NO. 4840

WOODWARD-CLYDE CONSULTANTS, INC.

BORING LOG

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: + 14.1
COORDINATES: N 192031.4 E 1999465.7
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 03/25/82
INSPECTOR: Y.K. Chan (MRJD)
DATE COMP.: 03/26/82
CONTRACTOR: Warren George, Inc.
DRILLER: B. Nicolosi
HELPER: W. Myrick
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 24.0 FT.; DIA. 3 IN. FROM 0.0 TO 45.0 FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 4 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D-SAMPLER: Split Spoon, 2" O.D.
DRILL ROD NW
U-SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 360 AVG. FALL 18-24 IN.
NO. OF U-TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 44.0 FT. DEPTH TO COMP. 72.8 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
03/26/82	0800	50.0	45.0	9.3		Overnight. Rain in the morning
03/26/82	1313	72.8	45.0	9.8		At completion of boring
03/26/82	1353	72.8	0.0	7.3		40 Minutes after completion of boring

DAILY PROGRESS	CASING BLOWS	SAMPLE			SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
		NO.	DEPTH	BLOWS/6"				
0830	***					*	0	*Asphalt
		1D	1.0	5-6	Dk brn f-c sand, sm silt, tr	0.3		***Drilled
			3.0	4-30	gvl, brk, cinders (Fill)(SM)	Loose brn f-c sand, sm silt, tr gravel, brick, cinders (Fill)		W = Water content in %
	5							
	12							
	9	NR	5.0	1-2			5	
	8		7.0	2-3				
	10	2D	7.0	2-2	Dk brn f-c sand, sm silt, tr gvl			
	8		9.0	4-7	(Fill)(SM)			
	14							
	16	3D	10.0	4-1	Brown silty fine to medium sand		10	
	11		12.0	1-4	(Fill)(SM)			
	13							
	16							
	19							
Cloudy	21	4D	15.0	17-23	Brown fine to coarse sand,		15	
	34		17.0	19-31	some silt, gravel (SM)			
	58							
	54					18.0		
	29					Compact brn silt, sm to trace fine sand Layers		
	33	5D	20.0	31-11	Red-brown silt, trace fine sand		20	W = 26
	46		22.0	9-11	(ML)			
03/25/82	49							
	44							
	D							
	R	NR	25.0	16-12			25	
	I		27.0	15-16				
	L	6D	27.0	9-13	Red-brn silt, sm fine sand			W = 26
	L		29.0	14-23	layers (ML)			
	E						30	

BORING NO. MG-803

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WDDDWARO–CLYOE CDNSULTANTS, INC.
BORING LOG

SHEET 2 of 2
BORING NO. MG-803
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Sunny 03/25/82	DRILLED	7D	30.0	6-10	Top: Red-brn silt, sm fine sand layers (ML)	****	30	****7D Top:
			32.0	15-16	Bot: Red-brn m-f sand, some silt (SM)	30.8 Med cpt red-brown f-c sand, some silt, trace gravel		
		8D	35.0	7-11	Red-brown silt, some fine to medium sand (ML)		35	W = 26
			37.0	14-15				
		9D	40.0	21-16	Red-brown f-c sand, some gravel silt (SM)		40	
			42.0	13-20				
		1C	45.0	Rec=77%	Gray mica schist, trace pegmatite, bkn, HiW to UnWExJts	45.0 Gray mica schist, tr quartzite veins, bkn, HiW to UnWExJts	45	
			50.0	RQD=25%				
1530								
0800		2C	50.0	Rec=82%	Gray mica schist, trace quartzite veins, bkn, HiW to UnWExJts		50	
			55.0	RQD=26%				
Cloudy, Occa. Rain 03/26/82		3C	55.0	Rec=86%	Top: Do 2C		55	
			60.0	RQD=43%	Bot: White micaceous quartzite, jointed, UnWExJts	57.9 White mic quartzite to granitic gneiss,tr mica schist pkts,cljtd,UnWExJts to SlW		
		4C	60.0	Rec=90%	White micaceous quartzite, tr mica schist, cljtd, UnWExJts to SlW		60	
			65.0	RQD=52%				
		5C	65.0	Rec=80%	White micaceous quartzite to granitic gneiss, tr mica schist pkts,cljtd, UnW to SlW		65	Core barrel blocked off at 65.0'.
			67.8	RQD=28%				
		6C	67.8	Rec=90%	Do 5C, UnWExJts			
			72.8	RQD=45%			70	
1313						72.8		
							75	
							80	
							85	

BORING NO. MG-803

WDDDWARD–CLYOE CONSULTANTS, INC.
BDRING LOG

SHEET 1 of 2
BORING NO. MG-804
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: + 12.5
COORDINATES: N 192012.9 E 1999268.0
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 04/12/82
INSPECTOR: Y.K. Chan (MRJD)
DATE COMP.: 04/12/82
CONTRACTOR: Warren George, Inc.
DRILLER: V. Gandolfo
HELPER: J. Loconte
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☒ CME-75
CASING: DIA. 3 IN. FROM 0.0 TO 30.5 FT.; DIA. IN. FROM TO FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 2 15/16 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD N
U–SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 30.3 FT. DEPTH TO COMP. 40.5 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/12/82	1516	40.5	30.5	13.8		At Completion
04/12/82	1645	40.5	0.0	9.2		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0900	2					*	0	* Concrete
	8	1D	0.5	10-8	Dark brown m-f sand, sm silt,tr gravel, cinders (Fill)(SM)	0.5 Medium compact to loose brown c-f sand, sm silt, tr gravel, cinders, clay (Fill)		
	13		2.5	6-7				
	13							
	9							
	10	2D	5.0	3-8	Do 1D (Fill)(SM)		5	
	20		7.0	13-10				
	16							
	12							
	10							
Sunny 04/12/82	4	**3D	10.0	3-1	Brown c-f sand, tr silt, gravel (Fill) (SP-SM)		10	** Washed sample
	5		12.0	1-2				
	10							
	7							
	10							
	18	4D	15.0	6-11	Brown medium to fine sand, sm silt, tr clay (Fill)(SM)		15	
	23		17.0	13-13				
	31							
	37					18.0 Med cpt,brn silty fine sand		
	44							
	33	5D	20.0	11-10	Brown silty fine sand, tr m-c sand, gravel, mica (SM)		20	Attempted twice for 6" recovery
	37		22.0	15-15				
	40							
	49							
	47							
	40	6D	25.0	13-8	Red-brown silty m-f sand, tr gravel, and clay (SM-SC)	25.0 6D Med Cpt.	25	
	45		27.0	10-7				
	45							
	57							
	61						30	

BORING NO. MG-804

MUESER, RUTLEOGE, JOHNSTON & OESIMONE
WOOOWARO–CLYOE CONSULTANTS, INC.

BORING LOG

SHEET 2 of 2
BORING NO. MG-804
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
same as above		7D	30.0	100/4"	Red-brown silt, sm fine sand, and rock fgmts (ML)	7D	30	
			30.3			30.3		
		1C	30.5	Rec=96%	Gray garnet mica schist, cljtd UnWExJts			
			35.5	RQD=52%				
		2C	35.5	Rec=100%	Gray garnet mica schist, trace quartz inclusions, jtd to Mdjt, UnWExJts	2C	35	
			40.5	RQD=82%				
1530						40.5	40	
							45	
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							80	

BORING NO. MG-804

WOODWARO–CLYOE CONSULTANTS, INC.

BORING LOG

SHEET 1 of 2
BORING NO. MG-805
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +12.0
COORDINATES: N 192111.7 E 1999322.6
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 03/23/82
INSPECTOR: B. Mukherjee (MRJD)
DATE COMP.: 03/24/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: J. Bowen
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 30.0 FT.; DIA. 3 IN. FROM 0.0 TO 32.0 FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 3 3/4 IN.
SAMPLING EQUIPMENT. (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD
U–SAMPLER: DIA. IN.; TYPE
CORE BIT Diamond, BX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES -- NO. OF VANE TESTS -- DEPTH TO ROCK 32.3 FT. DEPTH TO COMP. 52.3 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
03/24/82	0730	42.3	32.0	8.0		Overnight
03/24/82	1130	52.3	30.0	7.5		While withdrawing 3" casing
03/24/82	1140	52.3	25.0	7.8		" " " " "
03/24/82	1145	52.3	10.0	8.0		" " " " "
03/24/82	1200	-	0.0	8.4		After withdrawing all 3" casing

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0700	-					*	0	*Asphalt
	31					0.5 Med cpt, cndrs, c-f sand (Fill)		
	35	1D	2.3	12-10	Dark gray c-f sand, sm silt, cinders (Fill)(SM)			W = Water content in %
	79		4.3	7-25				
	50							
	17	2D	5.0	22-7	Gray silty fine sand, tr gvl, silt (Fill)(SM)	5.0 Loose gray m-f sand trace gravel (Fill)	5	
	24		7.0	3-3				
	19							
	7							
	5							
	8	3D	10.0	2-3	Gray medium to fine sand, sm silt, tr gravel (Fill)(SM)		10	
	9		12.0	2-4				
	10							
	15							
	24							
Tuesday	29	4D	15.0	12-10	Red-brn silt, sm fine sand, tr gravel (ML)	15.0 Med cpt red-brn, silt sm fine sand, tr mica, gravel	15	W = 18
	36		17.0	9-8				
	44							
	46							
	53							
03/24/82	50	5D	20.0	9-12	Red-brown silt, sm fine sand, tr mica, gravel (ML)		20	
	76		22.0	16-16				△ 25.0'-29.0'Drilled ahead of casing.
	124							
	134							
	137							
	△83	*6D	25.0	10-16	Do 5D (ML)		25	*Recovered 6D in second attempt. W = 26
	75		27.0	17-20				
	263					27.0 ***		***Hard drilling at 27.0'. Possible till.
	95							
	79						30	

BORING NO. MG - 805

MUESER, RUTLEDGE, JDHNSTDN & DESIMDNE
WDDDWARD–CLYDE CONSULTANTS, INC.

BDRING LDG

SHEET 2 of 2
BORING NO. MG-805
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
	****	NR	30.0	52/1"			30	****Drilled
	↓		30.1			*		*Hard drilling. Possible till.
		7D	32.0	100/4"	Gray micaceous f-m sand, trace silt (Decomposed rock) (SP)	30.2		
			32.3			7D 32.3		
Sunny 03/23/82		1C	32.3	Rec=84%	Top: Gry mica schist, tr qtz veins, cljtd. SlW	1C Top		
			37.3	RQD=48%			35	**Buff white micaceous quartzite, jtd to cljtd, UnWExJtd
					Bot:Buff white quartzite, jtd, UnW	**		
		2C	37.3	Rec=90%	Top: Buff white micaceous quartzite, cljtd, UnW	38.3		
			42.3	RQD=36%	Bot: Gry mica schist, bkn SlW		40	
1530						Gray mica schist, bkn to jointed, SlW to UnWExJts		
0700		3C	42.3	Rec=90%	Gray mica schist, cljtd to jtd UnWExJts			
			47.3	RQD=70%			45	
Sunny 03/24/82		4C	47.3	Rec=98%	Gray mica schist, jtd to cljtd, UnWExJts			
			52.3	RQD=78%			50	
1200						52.3		
							55	
							60	
							65	
							70	
							75	
							80	
							85	

WOOOWARD–CLYOE CONSULTANTS, INC.

BORING LOG

SHEET 1 of 2
BORING NO. MG-806
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +12.0
COOROINATES: N 192163.2 E 1999353.2
OATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 03/24/82
INSPECTOR: B. Mukherjee (MRJD)
DATE COMP.: 03/25/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: J. Bowen
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 27.3 FT.; DIA. 3 IN. FROM 30.0 TO FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 3 3/4 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BX
U–SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, BX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 29.0 FT. DEPTH TO COMP. 40.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONOITIONS OF OBSERVATION
03/25/82	0730	17.0	15.0	2.0		
03/25/82	1330	40.0	27.3	8.0		At completion of drilling
03/25/82	1340	40.0	15.0	5.5		
03/25/82	1350	–	0.0	6.2		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
1300	–					*	0	*Concrete
	27	1D	1.0	8-12	Gray-brn silty f-m sand, cndrs	0.5		W = Water content in %
	32		3.0	11-13	(Fill) (SM)	Loose to med cpt, gry to gry-brn f-c sand, cinders (Fill)		
	24							
	18							
Sunny 03/24/82	B	2D	5.0	3-3	Gray f-c sand, sm silt, dec		5	
	39		7.0	9-17	mica schist (Fill)(SM)			
	35							
	32							
	29							
	24	3D	10.0	1-2	Gry-brn m-f sand,sm silt, tr		10	
	33		12.0	7-4	organic, bricks, cndrs, shells			
	49				(Fill)(SM)			
	55							
	51					13.5		
	*34	4D	15.0	3-3	Red-brn silt, sm fine sand, tr		15	*15.0'-25.0' drilled ahead of casing.
1500	31		17.0	4-6	gravel (ML)			W = 21
0700	26					Med compact red-brown fine sand and silt		
	24							
	24							
	24	5D	20.0	7-9	Red-brown silty fine sand		20	
Sunny 03/25/82	21		22.0	10-12	(SM)			
	24							
	26							
	27							
	29	6D	25.0	9-11	Gray-brown silt, trace fine		25	Till at spoon tip in sample 6D
	65		27.0	12-12	sand, gravel (ML)	26.0		
	60/4"					6D		
	*							*Drilled
	↓					** 29.0	30	1C Top **

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.
BORING LOG

SHEET 2 of 2
BORING NO. MG-806
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Sunny 03/25/82		1C	30.0	Rec=96%	Top: Light gray mica schist, cljtd,UnWExJts Bot: White micaceous quartzite, cljtd, UnWExJts	1C Top	30	
			35.0	RQD=70%		33.5		
		2C	35.0	Rec=100%	Top: White micaceous quartzite, & granitic gneiss,jtd,UnWExJts Bot: Gray mica schist, jointed, UnWExJts	2C Top	35	
			40.0	RQD=90%				
1330						39.2*	40	*2C, Bottom
						40.0		
							45	
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-806

WOODWARD–CLYOE CONSULTANTS, INC.
BORING LOG

SHEET 1 of 2
BORING NO. MG-807
FILE NO. 4840

PROJECT WEST SIDE HIGHWAY
OOT. CONTR. NO.: D 250002
ELEVATION: +11.5
COORDINATES: N 192101.8 E 1999110.6
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 03/30/82
INSPECTOR: Y.K. Chan (MRJD)
DATE COMP.: 03/31/B2
CONTRACTOR: Warren George, Inc.
DRILLER: J. Farrell
HELPER: G. McCartar
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☒ CME-75
CASING: DIA. 4 IN. FROM 0.0 TO 26.3 FT.; OIA. IN. FROM TO FT.
DRILLING MUD UTILIZED: MUO TYPE
ROTARY BIT DIA. 3 7/8 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROO NW
U–SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 26.3 FT. DEPTH TO COMP. 36.5 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	OEPTH TO WATER	ELEVATION OF TIDE	CONOITIONS OF OBSERVATION
03/31/82	0730	26.3	26.3	4.5		Overnight at start of drilling
03/31/82	0940	36.5	26.3	6.2		At completion
03/31/82	1010	36.5	0	8.2		30 minutes after completion

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
1100	–					* 0.3	0	*Concrete
	7	1D	1.0	8-10	Brown f-m sand, sm silt tr gvl brick, cindrs, (Fill)(SM)	Loose to medium cpt brown f-c sand, sm silt, tr gravel, brick cinders (Fill)		
	12		3.0	7-8				
	13							
	4							
	8	2D	5.0	3-3	Brown f-c sand, sm silt, tr gravel (Fill)(SM)		5	
	14		7.0	2-7				
	15							
	13							
	3							
Sunny 03/30/82	4	NR	10.0	1-2/18"			10	
	10		12.0					
	15	3D	12.0	4-3	Brown c-f sand, tr silt, gvl (Fill) (SP-SM)			
	17		14.0	9-7				
	4							
	9	NR	15.0	3-4			15	
	11		17.0	3-3				
	18	4D	17.0	9-8	Top: Brn silty f-m sand, tr gvl (Fill) (SM) Bot: Red-brn silty f sa,tr mica (SM)			
	25		19.0	13-18		18.0		
	29					Red-brn f-c sand sm silt, trace gravel		
	40	5D	20.0	7-9	Red-brn silty f-c sand, tr gvl (SM)		20	
	73		22.0	17-26				
	165							
	*68							*24.0'-26.0' Drilled ahead of casing.
1530	42							
0700	30	6D	25.0	23-20	Red-brown m-f sand, sm silt,tr gvl, c sand (SM)		25	
			26.3	100/4"				
Same as below		1C	26.3	Rec=98%	Gray garnet mica schist, cljtd to bkn, UnWExJts	26.3		
			31.5	RQD=64%		1C		
							30	

BORING NO. MG-807

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 2 of 2
BORING NO. MG-807
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
03/31/82 Cloudy, Rain 1100		2C	31.5	Rec=98%	Gray garnet mica schist, sm white granite pegmatite, jtd, UnWExJts	2C	30	
			36.5	RQD=82%			35	
						36.5	40	
							45	
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-807

WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 1 of 2
BORING NO. MG-808
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +10.1
COORDINATES: N 192191.2 E 1999178.9
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 03/19/82
INSPECTOR: Y.K. Chan (MRJD)
DATE COMP.: 03/22/82
CONTRACTOR: Warren George, Inc.
DRILLER: B. Nicolosi
HELPER: W. Myrick
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 35.0 FT.; DIA. IN. FROM TO FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 4 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE): D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD NW
U–SAMPLER: DIA. IN.; TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 24 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 34.5 FT. DEPTH TO COMP. 58.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
03/22/82	0745	31.5	29.0	8.0		Over the weekend
03/22/82	1300	58.0	35.0	6.0		At completion. Rods still in hole.
03/22.82	1336	58.0	0.0	5.3		36 min. after completion

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
1100	–					0* Loose to med cpt brn to dk brn silty f-c sand, sm bricks, cinders (Fill)	0	*Asphalt
	25	1D	1.0	11-13	Black c-f sand, sm cndrs, silt, trace gravel (Fill)(SM)			Roller bit to 1.0' ahead of casing
	29		3.0	11-11				
	21							
	4							
	14	2D	5.0	4-3	Brick and wood, some m-f sand, cinders (Fill)(SP)		5	W = Water content in %
	9		7.0	21-20				
	14							Lost water at 7.0'
	10							
	6							
	25	3D	10.0	10-5	Dark brn silty m-f sand, sm dec rock, tr coarse sand, wood (Fill)(SM)		10	
	25		12.0	8-4				
	27							
	20					13.0 Med cpt red-brn silt, tr fine sand, mica		
	20							
Cloudy	27	4D	15.0	5-6	Red-brn silt, tr fine sand, mica (ML)		15	W = 30
	35		17.0	6-11				
	66							
	95							
	50							
03/19/82	46	5D	20.0	8-11	Top: Do 4D (ML) Bot: Red-brn f sand, sm silt, tr mica (SM)		20	W = 26
	65		22.0	12-17		20.2 Med cpt brn f-c sand, sm silt, tr gravel		
	70							
	55							
	53							
	46	6D	25.0	8-11	Top: Do 5D, bottom (SM) Bot: Red-brn silty f-c sand, sm gravel (SM)		25	W = 17
	38		27.0	16-20				
	17							
	18							
1530	37						30	

BORING NO. MG-808

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 2 of 2
BORING NO. MG 808
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0700	34	7D	30.0	30-45	Brn c-f sand, sm gvl, tr mica, silt (SP-SM)	7D		
	45		31.5	100/5"				
	44							
	74							
	85							
Sunny & Windy		1C	35.0	Rec=82%	Gray garnet mica schist, tr qtz inclusions, cljtd to bkn, UnWExJts to SlW	34.5 Light gray garnet mica schist, tr quartz veins, cljtd to jtd, UnWExJts	35	
			39.5	RQD=26%				
		2C	39.5	Rec=100%	Gray garnet mica schist, tr qtz inclusions, cljtd to bkn, UnWExJts		40	
			43.0	RQD=42%				
		3C	43.0	Rec=96%	Light gray garnet mica schist tr qtz veins, cljtd, UnWExJts			
			48.0	RQD=64%			45	
03/22/82		4C	48.0	Rec=100%	Light gray qtz garnet mica schist, tr qtz veins, cljtd, UnWExJts			Drilling rod bend while drilling at 46.0'. Rod was changed at 50.6'.
			53.0	RQD=54%			50	
		5C	53.0	Rec=94%	Light gray garnet mica schist, jtd, UnWExJts			
			58.0	RQD=80%			55	
1330						58.0		
							60	
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-808

WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 1 of 2
BORING NO. MG-809
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +10.2
COORDINATES: N 192243.0 E 1999210.9
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 03/22/82
INSPECTOR: Y.K. Chan (MRJD)
DATE COMP.: 03/24/82
CONTRACTOR: Warren George, Inc.
DRILLER: B. Nicolosi
HELPER: W. Myrick
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 40.0 FT.; DIA. 3 IN. FROM 0.0 TO 52.0 FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 4 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD NW
U–SAMPLER: DIA. IN.; TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18-24 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 40.0 FT. DEPTH TO COMP. 61.2 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
03/23/82	0730	10.0	9.0	5.2		Overnight
03/24/82	1417	61.2	40.0	8.2		At completion 3" casing completely pulled out

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
1400	–					*	0	*Concrete
	14	1D	1.0	11-24	Brn-blk m-f sand, sm silt,cndrs, tr brick (Fill)(SM)	0.7 Cpt to loose brn-blk m-f sand, sm silt, cndr, gvl, tr brick, boulders, concrete (Fill)		W = Water content in %
03/22/82 Windy & Sunny	20		3.0	20-23				W = 15
	14							
	6							
	10	2D	5.0	5-4	Brn m-f sand & brick, tr silt, gvl (Fill) (SP)		5	
	9		7.0	4-5				
	7							
	22							
1530	7							
0700	81	3D	10.0	7 1/2"	Brn m-f sand, sm silt, gvl, tr brick (Fill) (SM)		10	Boulders or concrete encountered from 10.2' to 11.5'
	160		10.2					
	114	4D	12.0	5-7	Brn silt, tr mica, fine sand (ML)	11.5 Med cpt silty f-m sand, tr gvl, mica		
	106		14.0	13-16				
	71							
	70	5D	15.0	14-9	Brn silty f-m sand, tr gvl, mica (SM)		15	W = 17
	108		17.0	12-7				
	111							
	98							
	75							
03/23/82 Sunny	45	NR	20.0	12-12		20.0 Cpt red-brn silty fine to medium sand	20	
	45		22.0	11-14				
	61	6D	22.0	10-8	Red-brn silty f-m sand (SM)			
	72		24.0	9-9				
	42							
	38	*NR	25.0	7-8			25	Attempted sample twice. No recovery. Red-brn material in wash water.
	46	*	27.0	8-13				
	58	NR	27.0	1-3				
	62		29.0	8-7				
	53						30	

BORING NO. MG-809

MUESER, RUTLEOGE, JOHNSTON & OESIMONE
WOOOWARD–CLYOE CONSULTANTS, INC.
BORING LOG

SHEET 2 of 2
BORING NO. MG-809
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE OEPTH	SAMPLE BLOWS/6"	SAMPLE OESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Sunny 03/25/82	77	7D	30.0	14-17	Brown c-f sand, sm silt, gvl (SM)	Cpt light brn c-f sand, tr to sm silt gravel	30	
	81		32.0	32-35				
	100							
	90							
	*14							34.0'-40.0' Casing drilled ahead
	24	8D	35.0	42-17	Light brown c-f sand, tr silt, gravel (SP)		35	
	31		37.0	14-63				
	91							
	62							
	46							
		1C	40.0	Rec=90%	Top:Light gray garnet mica schist, cljtd, SlW	40.0 1C TOP	40	
			45.0	RQD=68%	Bot: White granitic gneiss,jtd UnWExJts	42.5 Wht granitic gns jtd to cljtd UnWExJts		Core barrel blocked off by sand recirculating in drilling fluid.
1530								
0700		2C	45.0	Rec=97%	White granitic gneiss, cljtd, UnWExJts		45	
			48.5	RQD=60%				
Sunny 03/24/82		3C	48.5	Rec=80%	Top:Green-gry mica schist, bkn, HiW	48.5 3C TOP		3" casing telescoped inside 4" casing to 52.0' to seal off HiW rock 48.5' - 50.0'.
			53.5	RQD=36%	Bot: Gry mica schist, tr qtz veins & wthd pegmatite, cljtd to bkn, UnWExJts to HiW	Gry mica schist & pegmatite, tr qtz veins jtd to bkn, UnWExJts	50	
		4C	53.5	Rec=100%	Gry garnet mica schist, tr qtz pkts, cljtd,UnWExJts			
			56.2	RQD=78%			55	
		5C	56.2	Rec=100%	Gray mica schist and white granitic pegmatite, jtd, UnWExJts.			
			61.2	RQD=74%				
1530							60	
						61.2		
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-809

WOOOWARO–CLYOE CONSULTANTS, INC.
BORING LOG

SHEET 1 of 2
BORING NO. MG-813
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
OOT. CONTR. NO.: D 250002
ELEVATION: +9.3
COORDINATES: N 192265.1 E 1999064.0
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 03/18/82
INSPECTOR: B. Mukherjee (MRJD)
DATE COMP.: 03/19/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: J. Bowen
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTEO ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 13.5 FT.; DIA. IN. FROM TO FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 3 3/4,2 5/16 IN
SAMPLING EQUIPMENT, (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U–SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, BX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 14.0 FT. DEPTH TO COMP. 41.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
03/19/82	1400	41.0	13.5	4.0		At completion of rock coring
03/19/82	1415	41.0	5.0	4.7		
03/19/82	1420	–	0.0	4.5		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
1145	10	1D	0.5	19-20	Gray c-f sand, sm gravel, silt, cinders (Fill)(SM)	0.3*	0	* Asphalt
	43		2.5	18-14		Cpt to loose gray,brn c-f sand, sm gvl, silt, tr cinders (Fill)		
	46							
	51							
	45							
	25	2D	5.0	9-7	Gray & brn c-f sand, sm gvl, silt (Fill)(SM)		5	
Sunny 03/18/82	31		7.0	11-11				
	24							
	32							
	23							
	18	3D	10.0	13-5	Gray-brown m-f sand, sm gravel, silt (Fill)(SM)		10	**Decomposed rock
	15		12.0	4-2				Decomposed mica schist in cuttings at 13.5'
	20							
	23/6"					13.5		
		1C	14.0	Rec=98%	Light gray mica schist, broken to cljtd, UnWExJts	**		
			19.0	RQD=34%		Gray garnet mica schist, sm quartzite, cljtd, UnWExJts	15	
1530		2C	19.0	Rec=65%	Gray garnet mica schist, tr qtz pkts,bkn,UnWExJts to MdW			
0700			21.0	RQD= 0%			20	Run #3 change to new drilling bit Soil filling at 23.0' wash water color brown. Core barrel blocked in run #2.
Sunny 03/19/82		3C	21.0	Rec=84%	Gray garnet mica schist, some micaceous quartzite, cljtd, UnWExJts			
			26.0	RQD=38%				
		4C	26.0	Rec=100%	Gray garnet mica schist, tr quartz inclusions, jtd, UnWExJts		25	
			31.0	RQD=90%				
							30	

BORING NO. MG-813

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOOOWARD–CLYOE CONSULTANTS, INC.
BORING LOG

SHEET 2 of 2
BORING NO. MG-813
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Sunny 03/19/82		5C	31.0	Rec=100%	Gray garnet mica schist, jtd UnW	Gray garnet mica sch, sm to tr quartzite, cljtd, UnWExJts	30	
			36.0	RQD=85%				
							35	
		6C	36.0	Rec=100%	Gray garnet mica schist, tr quartz inclusions, Mdjtd, cljtd, UnW			
			41.0	RQD=80%				
							40	
1530						41.0		
							45	
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							85	

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOOOWARO–CLYOE CONSULTANTS, INC.
BORING LOG

SHEET 1 of 1
BORING NO. MG-B14
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY DOT. CONTR. NO.: D 250002 ELEVATION: +9.0
COORDINATES: N 192299.9 E 1999067.7 DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage DATE STARTED: 03/29/82
INSPECTOR: Y.K. Chan (MRJD) DATE COMP.: 03/29/82
CONTRACTOR: Warren George, Inc.
DRILLER: B. Nicolosi HELPER: W. Myrik
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4.0 IN. FROM 0.0 TO 18.0 FT.; DIA. IN. FROM TO FT.
DRILLING MUD UTILIZED: MUD TYPE ROTARY BIT DIA. IN.
SAMPLING EQUIPMENT. (TYPE & SIZE) D–SAMPLER: Split Spoon, 2" O.D. DRILL ROD NW
U–SAMPLER: DIA. IN.; TYPE
CORE BIT Diamond, NX CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 18.0 FT. DEPTH TO COMP. 29.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
03/29/82	1345	29.0	18.0	3.6		At completion
03/29/82	1415	29.0	0	5.2		30 minutes after completion

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0700	–					*		*Concrete
	13	1D	1.0	10-15	Dark brown fine to coarse sand, some silt, gravel, cinders (Fill) (SM)	0.8 Med cpt to cpt dk brn f-c sand, tr-sm silt,gvl, brick mica shells (Fill)		
	44		3.0	43-69				
	22							
	6							
	8	2D	5.0	3-3	Dark brown fine to medium sand, some silt, trace brick, mica (Fill) (SM)		5	
	19		7.0	8-10				
	49							
	48							
	17							
	33	NR	10.0	9-6			10	
Sunny	31		12.0	6-6				
	18	3D	12.0	1-2	Dark brown fine to coarse sand, trace silt, gravel, shells (Fill) (SP-SM)			
	23		14.0	18-14				
	21							
	30	4D	15.0	14-13	Top: Brown mic silty f-m sand ** (SM)		15	**Decomposed rock (Fill)
03/29/82	40		17.0	14-15		16.0 4D Bot.		
	61				Bot: Red-brn silty f sand (SM)			
						18.0 Wht quartzite & grt gneiss, tr gry mica schist, jtd,UnWExJts		
		1C	19.0	Rec=92%	White quartzite & granite gneiss, cljtd,UnWExJts			
			24.0	RQD=66%			20	
		2C	24.0	Rec=100%	White quartzite & granitic gneiss, tr gray mica schist, jtd, UnWExJts			
			29.0	RQD=78%			25	
1415						29.0	30	

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 1 of 2
BORING NO. MG-819
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +16.3
COORDINATES: N 192230.6 E 1998879.2
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 04/01/82
INSPECTOR: B. Mukherjee (MRJD)
DATE COMP.: 04/01/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: C. Soto
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 34.5 FT.; DIA. IN. FROM TO FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 3 3/4 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U–SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 33.0 FT. DEPTH TO COMP. 47.2 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/01/82	1400	47.2	34.5	11.7		At completion of rock drilling.
04/01/82	1410	47.2	29.5	12.9		
04/01/82	1420	-	0.0	12.9		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0715	–					*	0	*Concrete
	5	1D	1.5	4-3	Dk gray c-f sand, sm gvl, cndrs silt (Fill)(SM)	0.7		W = Water content in %
	9		3.5	5-4		Loose to med cpt brn c-f sand, sm silt, tr-sm gvl, trace brick (Fill)		
	8							
	11							
	13	2D	5.0	3-5	Do 1D, tr brick (Fill)(SM)		5	
	14		7.0	3-3				
	34							
	25							
	12							
	4	NR	10.0	6-4			10	
	6		12.0	4-4				
	8	3D	12.0	3-2	Brn silty m-f sand, trace gvl (Fill)(SM)			
	7		14.0	2-2				
Sunny	25							
	10	4D	15.0	6-3	Brn f-c sand, sm silt, tr gvl (Fill)(SM)		15	
	6		17.0	1-1				
	5							
	4							
	20							
04/01/82	27	5D	20.0	17-13	Top: Do 4D (Fill)(SM)		20	
	19		22.0	7-5	Bot: Lt brn m-f sand, sm silt (SM)	21.0		
	17					Med cpt,brn m-f sa,sm silt tr org silt (Fill)		
	13							
	12							
	22	6D	25.0	11-13	Brown m-f sand, sm organic silt, trace gravel (SM)		25	26.0'-27.0' Organic silt, mixture.
	22		27.0	2-3				
	24					27.0 ***		***Med cpt red-brn silt, sm fine sand
	25							
	24						30	

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 2 of 2
BORING NO. MG-819
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
	44	7D	30.0	3-10	Top:Red-brn silt, sm mic fine sand (ML)	7D Top	30	W = 24 (Top)
	46		32.0	7-11	Bot: Lt gray micaceous f-m sand (SP)	31.5*		*Decomposed mica schist
	131							
	125							34.5
	125/6"							
Sunny		1C	34.5	Rec=100%	Lt gray garnite mica schist, tr quartz inclusions, mdjtd, UnWIncJts	Lt gry grt mica schist, sm qtz veins, tr qtz inclusions, mdjtd to jtd, UnWIncJts to UnWExJts	35	
			39.5	RQD=92%				
04/01/82		2C	39.5	Rec=100%	Light gray mica schist, sm quartz veins, jtd, UnWExJts		40	Core barrel blocked in run 2C.
			43.5	RQD=80%				
		3C	43.5	Rec=100%	Do 1C		45	
			47.2	RQD=100%				
1500						47.2		
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							85	

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 1 of 2
BORING NO. MG-820
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +9.1
COORDINATES: N 192373.6 E 1999022.8
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 03/16/82
INSPECTOR: B. Mukherjee (MRJD)
DATE COMP.: 03/18/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: J. Bowen
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 10.0 FT.; DIA. 3 IN. FROM 0.0 TO 23.2 FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 3 3/4 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U–SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 23.5 FT. DEPTH TO COMP. 33.7 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
03/18/82	0730	22.0	20.0	4.1		Overnight. Drill rods in hole.
03/18/82	1030	33.7	23.2	9.0		At completion of rock coring.
03/18/82	1045	33.7	10.0	6.9		After 3" dia casing completely withdrawn
03/18/82	1100	–	0.0	6.5		After all casing completely withdrawn.

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
03/16/82 Cloudy 1300	–							
	18	1D	1.5	3-10	Gray c-f sand, sm cndrs,gvl, brk, silt (Fill) (SM)	* 0.3	0	*Asphalt
	23		3.2	12-62/3"				
	64							
1500	12							
0700	43	2D	5.0	7-20	Gray gvl, sm c-f sand, tr silt (Fill)(GP)	Med cpt to v cpt, gry gvl, sm c-f sand, tr silt, cndrs, wood, bricks, (Fill)	5	
	77		6.0					
	69							
	83							
	95							
03/17/82 Light Rain	DRILLED	3D	10.0	46-76	Pieces of gravel, trace coarse to fine sand (Fill)(GP)		10	Drilled ahead of casing 15.0'-23.0'. Wash water color red-brown at 18.0' Telescoped 3" casing in 4" casing at 10.0'.
			12.0	29-18				
	14	4D	15.0	15-38	Pieces of wood (Fill)		15	
	26		17.0	18-25				
	20							
	28							
	60					18.0		
	44	5D	20.0	53-41	Top: Red-brn m-f sand,sm gvl silt (SM)	V cpt,red-brn to brn c-f sand, sm gvl silt	20	
1300	49		22.0	48-81				
0700	107				Bot: Brn gravelly f-c sand,tr silt (SP-SM)			Piece of diabase gravel in wash at 23.0'.
	45/2"							
03/18/82 Sunny		1C	23.7	Rec=96%	Top: Lt gry garnet mica schist cljtd, UnWExJts	23.5	25	
			28.7	RQD=80%				
					Bot: Lt gry garnet mica schist blky,UnW	1C Top cljtd-blky UnWExJts		
		2C	28.7	Rec=100%	Lt gry garnet mica schist, mdjtd, UnWExJts			
			33.7	RQD=88%			30	

WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 2 of 2
BORING NO. MG-820
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Same as Above 1100						1C Bottom cljtd to blky UnWExJts	30	
						33.7	35	
							40	
							45	
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							85	

MUESER, RUTLEOGE, JOHNSTON & OESIMONE
WOOOWARO–CLYOE CONSULTANTS, INC.
BORING LOG

SHEET 1 of 2
BORING NO. MG-829
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY	DOT. CONTR. NO.: D 250002		ELEVATION: + 9.2
COORDINATES: N 192227.9	E 1999114.6		DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage			DATE STARTED: 04/08/82
INSPECTOR: Y. K. Chan (MRJD)			DATE COMP.: 04/09/92
CONTRACTOR: Warren George, Inc.			
DRILLER: J. Farrell		HELPER: G. McCartar	

TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐

CASING: DIA. 4 IN. FROM 0.0 TO 5.0 FT.; DIA. 3 IN. FROM 0.0 TO 22.5 FT.

DRILLING MUD UTILIZED: MUD TYPE Quick - Gel ROTARY BIT DIA. 3 7/8 IN.

SAMPLING EQUIPMENT. (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D. DRILL ROD NW
U–SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, NX CORE BARREL Double Barrel

FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐

SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.

CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.

NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 20.5 FT. DEPTH TO COMP. 33.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/09/82	0730	17.0	5.0	3.1		Over night. Drilling mud in hole.
04/09/82	1040	33.0	5.0	5.1		At completion. Water in hole.

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
1300	–					*	0	* Asphalt
	10	1D	1.0	6-6	Dark brown f-c sand, sm cinders, silt, tr gravel (Fill)(SM)	0.8		W = Water content in %
	14		3.0	7-7		Med cpt to loose dk brn f-c sand, sm cndrs, tr brick, gvl (Fill)		
	15							
	18							
Sunny	LOWERED 3" DIA	2D	5.0	10-16	Dark brn m-f sand, sm silt, tr brick, gravel (Fill) (SM)		5	
			7.0	8-5				
04/08/82		NR	10.0	7-6			10	
			12.0	3-2				
		3D	12.0	3-3	Top: Dk brn m-f sand, sm silt, tr gravel (Fill)(SM)			
			14.0	3-6	Bot: Brn clayey silt, tr fine sand, mica (ML)	13.9		
		4D	15.0	4-9		Med-Stiff red-brn cl si, sm m-f sand	15	
1530			17.0	8-11	Red-brown clayey silt, sm m-f sand layers (ML)			W = 19
0700						18.0		
						5D Top		
		5D	20.0	10-100/4"	Top: Red-brn f-c sand, sm silt, tr gravel (SM)		20	5D Bottom is decomposed rock.
Cloudy			20.8		Bot: Gry mic silty f-m sand, tr rock fragments (SM)	20.5		
						5D Bot		
		1C	23.0	Rec=96%	Top: White granite pegmatite, jtd, UnW	23.0		
04/09/82			28.0	RQD=80%	Bot: Lt gry mica schist, tr qtz veins, jtd, UnWExJts	1C	25	
							30	

BORING NO. MG-829

WOOOWARO–CLYOE CONSULTANTS, INC.
BORING LOG

SHEET 2 of 2
BORING NO. MG-829
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Same as above		2C	28.0	Rec=97%	Lt gry mica schist, tr quartzite veins, jtd, UnWExJts		30	
			33.0	RQD=80%		2C		
						33.0		
							35	
							40	
							45	
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-829

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 1 of 2
BORING NO. MG-830
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250008
ELEVATION: + 11.1
COORDINATES: N 192151.5 E 1999020.8
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 04/12/82
INSPECTOR: B. Mukherjee (MRJD) / Y. K. Chan (MRJD)
DATE COMP.: 04/13/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: C. Soto
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 26.5 FT.; DIA. IN. FROM TO FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 3 3/4 IN.
SAMPLING EQUIPMENT. (TYPE & SIZE)
D-SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U-SAMPLER: DIA. IN.; TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U-TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 26.5 FT. DEPTH TO COMP. 37.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/13/82	1036	37.0	26.5	5.5		At completion
04/13/82	1048	37.0	15.0	8.6		
04/13/82	1058	37.0	0.0	8.8		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
1400	2	1D	0.5	5-8	Brown silty f-m sand, tr gravel	*	0	* Concrete
	10		2.5	5-6	(Fill)(SM)	0.4		W = Water
	12					Loose brown silty fine to medium sand, tr gravel, glass (Fill)		content in %
04/12/82 Partly Sunny	15							
	26							
	10	2D	5.0	3-4	Do 1D, tr glass (Fill)(SM)		5	
	36		7.0	3-10				
	8							
	4							
	3							
	16	3D	10.0	11-6	Brown f-c sand, sm silt, tr gvl		10	
	28		12.0	10-7	(Fill)(SM)			
	37							
	15							
	10							
	3	4W	15.0	10-5	Brown c-f sand, tr silt		15	
1530	5		17.0	3-3	(Fill)(SP)			
0700	17					17.7		
Cloudy	24					5D,		
	26					Med		
	38	5D	20.0	8-12	Top: Med dk gry org silty clay,		20	
	35		22.0	12-11	sm fine sand, tr sls, gvl (OH)	20.5		
	44				Bot:Brn silt,sm f sand, tr mica	6D		
04/13/82	55				(ML)	Loose		
	61							
	56	6D	25.0	3-4	Brown silt, sm fine sand, tr	26.0	25	W = 28 (Top)
			26.5	5-100/0"	gravel, clay, mica (ML)	**		
		1C	27.0	Rec=98%	White granitic gneiss cljtd,SlW,	26.5		**Decomposed rock
			32.0	RQD=76%	to gray mica schist, tr qtz	1C		
					inclusions, jtd, UnWExjts		30	

BORING NO. MG-830

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 2 of 2
BORING NO. MG-830
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
							30	
Same as above		2C	32.0	Rec=100%	Gray mica schist, some quartz			
			37.0	RQD=88%	veins, jtd, UnWExJts	2C		
							35	
1200								
						37.0		
							40	
							45	
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-830

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.
BORING LOG

SHEET 1 of 2
BORING NO. MG-831
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +10.8
COORDINATES: N 192313.3 E 1998985.3
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 04/09/82
INSPECTOR: Y.K. Chan (MRJD)
DATE COMP.: 04/12/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Farrell
HELPER: G McCartar
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 5.0 FT.; DIA. 3 IN. FROM 0.0 TO 33.5 FT.
DRILLING MUD UTILIZED: MUD TYPE Quick-Gel
ROTARY BIT DIA. 3 7/8 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD NW
U–SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 33.0 FT. DEPTH TO COMP. 44.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/12/82	0800	27.0	5.0	5.8		Over weekend. Drilling mud in hole
04/12/82	1410	44.0	5.0	11.5		At completion Water in hole
04/12/82	1445	44.0	0.0	7.5		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
1215		1D	0.5	12-11	Dark brown f-c sand, sm silt, gravel, cinders (Fill) (SM)	0.* Med cpt to loose dark brn f-c sand, sm silt, tr gvl, cndrs, decomposed wood (Fill)	0	*Concrete W = Water content in %
	4		2.5	6-4				
	8							
	7							
	6							
	LOWERED	2D	5.0	4-3	Gray-brown f-m sand, sm silt, tr decomposed wood (Fill) (SM)		5	
			7.0	3-3				
Snow		3D	10.0	7-1	Gray-brown f-m sand, sm silt, tr gravel (Fill) (SM)		10	
			12.0	12-15				
04/09/82		4D	15.0	4-4	Top: Do 3D (Fill) (SM) Bot: Soft black organic silty clay, tr fine sand (OH)		15	4D Bot: W = 58
			17.0	4-2		16.5 4D Bottom		
		NR	20.0	7-14		20.0 Cpt red-brn f-c sand, sm silt, gravel	20	
			22.0	17-23				
		5D	22.0	29-29	Brown silty f-m sand, tr gravel (SM)			
			24.0	38-44				
		6D	25.0	28-36	Red-brown f-c sand, sm silt, gravel (SM)		25	
			27.0	32-41				
							30	

BORING NO. MG-831

SHEET 2 of 2
BORING NO. MG-831

WOODWARD–CLYDE CONSULTANTS, INC.
BORING LOG

FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Sunny		7D	30.0	24-36	Brown f-c sand, sm silt, gravel (SM)	7D V cpt	30	
			32.0	62-37		33.0		
						*		*Decomposed rock
04/12/82		1C	34.0	Rec=98%	Light gray-white micaceous quartzite blocky, UnW	34.0 Lt gry mica schist quartzite mass, UnW	35	Core barrel was blocked at 35.5.
			39.0	RQD=98%				
		2C	39.0	Rec=100%	Do 1C		40	
			44.0	RQD=96%				
1530						44.0	45	
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-831

MUESER, RUTLEOGE, JOHNSTDN & OESIMDNE
WODDWARO–CLYDE CONSULTANTS, INC.

BDRING LOG

SHEET 1 of 2
BORING NO. MG-832
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +15.2
COORDINATES: N 191987.5 E 1999546.6
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 04/14/82
INSPECTOR: Y.K. Chan (MRJD)
DATE COMP.: 04/15/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: C. Soto
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 15.0 FT.; DIA. 3 IN. FROM 0.0 TO 48.5 FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 3 3/4, 2 7/8 IN
SAMPLING EQUIPMENT. (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U–SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 46.0 FT. DEPTH TO COMP. 59.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/15/82	0725	59.0	48.5	11.1		Overnight
04/15/82	0810	59.0	15.0	13.0		
04/15/82	0820	59.0	0.0	10.0		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0700	–	1D	0.8	20-20	Dark brown silty fine to medium sand, tr gravel (Fill)(SM)	* 0.8	0	*Asphalt
	36		2.8	19-12		Med cpt to cpt, brn silty f-m sand, sm gravel, tr mica (Fill)		
	49							
	80							
	150							
	45	2D	5.0	14-11	Gray gravelly mic fine to medium sand (Fill)(SP)		5	
	86		7.0	20-20				
	79							
	59							
	28							
	10	3D	10.0	9-1	Brown silty fine to medium sand, trace mica (Fill)(SM)		10	
Sunny	6		12.0	2-1				
	8					12.5		
	14							
	21							
04/14/82	LOWERED	4D	15.0	5-9	Brown silty medium to fine sand (SM)	Med cpt brown c-f sand, sm silt, trace gravel	15	Note: Drilled ahead of the casing. 15.0'-45.0'.
			17.0	12-16				
		5D	20.0	9-12	Brown coarse to fine sand, sm silt, tr gravel (SM)		20	
			22.0	13-12				
		6D	25.0	7-8	Brown coarse to fine sand, tr silt, gravel (SP-SM)		25	**Medium compact brown silt, tr fine sand.
			27.0	10-9				
						28.0 **	30	

BORING NO. MG-832

WDDOWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 2 of 2
BORING NO. MG-832
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
		7D	30.0	3-6	Brown silt, trace fine to medium sand (ML)	Med cpt brown silt, trace fine sand	30	
			32.0	7-7				
		8D	35.0	5-7	Do 7D (ML)		35	
			37.0	8-15				
		9D	40.0	4-11	Red-brown m-f sand, sm silt,tr gravel (SM)	40.0	40	
			42.0	15-16		Medium compact 9D		
Sunny	38	10D	45.5	10-14	Brown mic m-f sand, sm silt (SM)		45	Sample 10D is Decomposed rock.
	55		47.5	19-28		46.0		
	55					Dec Rock		
	150/6"							
		1C	49.0	Rec=98%	Light gray garnet mica schist, trace quartz veins, jtd,UnWExJts	49		
04/14/82			54.0	RQD=88%		Lt gry,jtd-blky garnet,mica schist, tr qtz veins,UnWExJts	50	
		2C	54.0	Rec=100%	Do 1C, blocky, UnWExJts			
			59.0	RQD=100%			55	
1530						59.0	60	
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-832

MUESER, RUTLEOGE, JOHNSTON & DESIMDNE
WOODWARD–CLYOE CONSULTANTS, INC.

BDRING LOG

SHEET 1 of 2
BORING NO. MG-833U
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +13.2
COORDINATES: N 192068.9 E 1999398.6
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 04/19/82
INSPECTOR: Y.K. Chan (MRJD)
DATE COMP.: 04/21/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: C. Soto
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 25.5 FT.; DIA. 3 IN. FROM 0.0 TO 35.0 FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 3 3/4, 2 15/16 IN
SAMPLING EQUIPMENT, (TYPE & SIZE)
O–SAMPLER: Split Spoon, 2" & 3" O.D.
DRILL ROO BW
U–SAMPLER: DIA. 3 IN.; TYPE Osterberg & Shelby
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES 4 NO. OF VANE TESTS – DEPTH TO ROCK 35.5 FT. DEPTH TO COMP. 45.5 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/20/82	0800	18.5	18.5	4.0		Overnight
04/21/82	0705	35.0	25.5	2.0		Overnight
04/21/82	0906	45.5	18.5	10.7		At completion of hole 3" casing withdrawn
04/21/82	0915	45.5	12.0	10.5		
04/21/82	0925	45.5	0.0	7.1		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
1040	–	1D	0.5	12-10	Black c-f cinders, sm sand, silt (Fill) (SM)	* 0.3	0	*Asphalt W = Water content in %
	10		2.5	6-7		Medium compact to loose, black to gray fine to coarse sand, some silt, trace roots, peat (Fill)		
	21							
	15							
	16							
	26	2D	5.0	7-5	Gray fine to medium sand, some silt (Fill)(SM)		5	
	11		7.0	3-3				
	10							
Sunny	12							
	17							
	19	3D	10.0	3-2	Top: Gry org si f sand (Fill)(SM)		10	
	16		12.0	2-3	Bot: Gry peat,tr f sand (PT)			
04/19/82	21	4U	12.0	P=24"	Top: Gry f-c sa,sm si (Fill)(SM)			Sample No. 4U
	26		14.0	R=24"	Bot:Gry f-c sa,sm si,tr rts(Fill)(SM)			void in tube.
	25	5U	14.0	P=24"	Top Gry-brn m-f sa,sm si,tr gvl (Fill)(SM)			Sample moved
	24		16.0	R=19"		15.0	15	inside the tube.
	23	6U	16.0	P=6"	Bot:Brn f-c sa, sm si (SM)	*		*Med cpt brn to
	27		16.5	R=6"	Brn c-f sa, sm silt (SM)	16.5		red-brn c-f sa,
	28	7D	16.5	3-7	Top: Red-brn silt f-c sand, tr cl gvl (SM-SC)	Cpt to v cpt red-brn silt, tr clay, gravel fine to medium & fine sand layers		sm silt,tr cl,gvl
1530	25		18.5	9-9				16.5'-18.5' First
0700	23	8U	18.5	P-24"	Bot: Red-brn silt, tr cl (ML)		20	attempt was made
	38		20.5	R=19"	Red-brn silt, tr clay (ML)			
Sunny	*23	9UD	20.5	P=24"	Red silt, tr f sand,mica (ML)			without any re-
	*27		22.5	R=5"				covery. Second
	31	10UD	22.5	P=24"	Do 9UD, tr gravel (ML)			attempt was made
04/20/82	40		24.5	R=4"			25	by 3"dia spoon
	46	11UD	24.5	P=24"	Red-brn silt, tr cl, gvl, f-m sand layers (ML)			8U W = 25
	25/6"		26.5	R=2"				Sample 9UD thru
		12UD	26.5	P=24"	Do 11UD (ML)			12UD-3" dia. split
	▼		28.5	R=3"			30	spoon sampler driven 18"after

Note: Sample identification typed out of scale because of space restriction.

BORING NO. MG-833U

WOODWARD–CLYDE CONSULTANTS, INC.

BDRING LOG

SHEET 2 of 2
BORING NO. MG-833U
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Same as above	D	13D	28.5	10-14	Red-brn silt, tr gvl, c-f sand layers (ML)	Same as above	30	attempting each
	E		30.5	34-40				undisturbed sample.
	R	Δ14D	30.5	29-46	Red-brn silt, tr fine sand layers, gvl (ML)			to recover
	E		32.5	34-37				sufficient amount
	W							of material.
1530	O					35.0 **	35	Blows per 6" for
0700	L	1C	35.5	Rec=90%	Light gray garnet mica schist, sm quarztite,jtd, UnWExJts	35.5		each sample are
			40.5	RQD=80%				as follows:
								9UD=31,31,40
04/21/82 Cloudy						1C	40	10UD=17,17,23
								11UD= 9,24,31
		2C	40.5	Rec=100%	Light gray mica schist, tr quartzite, quartz veins, mdjtd, UnWExJts	&		12UD=18,25,33
			45.5	RQD=100%				
								*21.0'-25.0'
						2C	45	casing drilled ahead
1000						45.5		
								Δ Used 3" dia split spoon
							50	**Decomposed rock Strata reflected in wash water.
							55	
							60	
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-833U

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 1 of 2
BORING NO. MG-834
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
COORDINATES: N 192147.3 E 1999254.6
ELEVATION: +11.2
BORING LOCATION: MTA Yard, MABSTOA Garage
DATUM: Manhattan
INSPECTOR: Y.K. Chan (MRJD)
DATE STARTED: 04/15/82
CONTRACTOR: Warren George, Inc
DATE COMP.: 04/16/82
DRILLER: J. Stevenson
HELPER: C. Soto
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 22.0 FT.; DIA. 3 IN. FROM 0.0 TO 23.0 FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA 3 3/4 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U–SAMPLER: DIA. IN.; TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES -- NO. OF VANE TESTS - DEPTH TO ROCK 21.8 FT. DEPTH TO COMP. 33.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/16/82	0727	22.0	22.0	7.3		Overnight
04/16/82	1000	33.0	23.0	7.0		At completion
04/16/82	1030	33.0	15.0	6.6		
04/16/82	1046	33.0	0.0	5.0		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0900	10	1D	0.3	19-17	Black fine to coarse sand, sm silt, cinders (Fill)(SM)	0.3* Med cpt to loose, blk &brn m-f sand, sm cndrs, silt, tr brick, mica (Fill)	0	*Aphalt.
	33		2.3	11-11				
	23							
	19							
	15							
	5	2D	5.0	2-1	Brown m-f sand, sm silt, tr brick, cinders (Fill)(SM)		5	
	19		7.0	1-10				
	37							
Sunny	21							
	20							
	184	3D	10.0	90-13	Gray-brown m-f sand, sm silt, tr mica, gravel (Fill)(SM)		10	Cobbles encountered from 10.0'-10.5'
	36		12.0	9-8				
	36							
	41							
	55					14.0		
04/15/82	*28	4D	15.0	6-11	Red-brown micaceous silty fine sand (SM)	Medium compact 4D	15	*15.0'-20.0' Casing drilled ahead
	17		17.0	10-10				
	20							
	21							
	17							
	126	5D	20.0	10-11	Brown c-f sand, sm silt, gravel (SM)		20	20.0'-20.5' Washed ahead with roller bit.
1500	93		21.8	59-100/3"		21.0 Dec Rock		
0700 Sunny								
		1C	23.0	Rec=94%	White micaceous quartzite, mdjtd, UnWIncJts	23.0		
			28.0	RQD=92%				
04/16/82						1C	25	
							30	

WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 2 of 2
BORING NO. MG-834
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Same as above 1100		2C	28.0	Rec=100%	White micaceious quartzite & dark gray mica schist, jtd, UnWExJts	Same as above	30	
			33.0	RQD=80%		33.0		
							35	
							40	
							45	
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							85	

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.
BORING LOG

SHEET 1 of 2
BORING NO. MG-835
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +8.4
COORDINATES: N 192399.1 E 199911.0
DATUM: Manhattan
BORING LOCATION: MTA Yard Ramp
DATE STARTED: 04/16/82
INSPECTOR: Y.K. Chan (MRJD)
DATE COMP.: 04/19/82
CONTRACTOR: Warren George, Inc.
DRILLER: John Stevenson
HELPER: Cecil Soto
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 24.0 FT.; DIA. IN. FROM TO FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 3/3/4 IN.
SAMPLING EQUIPMENT (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U–SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 24.5 FT. DEPTH TO COMP. 34.5 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/19/82	0705	24.5	24.0	2.0		~~Over weekend at start of drilling.~~
04/19/82	0836	34.5	20.0	6.0		At completion
04/19/82	0848	34.5	10.0	4.9		
04/19/82	0900	34.5	0.0	3.2		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
1130	113	1D	0.5	15-15	Dark gray m-f sand, sm silt	*	0	*Aphalt
	26		2.5	10-22	trace gravel (Fill) (SM)	0.5		
	45							
	50							
	52							
	27	2D	5.0	6-8	Brown f-m sand, sm silt, trace		5	
	25		7.0	6-4	cinders (Fill) (SM)			
	23							
	25							
	38							
Sunny	35	3D	10.0	5-3	Dark brown c-f sand, tr silt,	Med cpt dark brn f-c sand some silt, tr gravel cinders (Fill)	10	
	50		12.0	9-12	cinders (Fill) (SP-SM)			
	45							Red-brown color of washed at 14.0'
	48							
	56					14.0		
	42 *	NR	15.0	8-9			15	
04/16/82	46 *		17.0	10-9				
	47 *	4D	17.0	2-9	Red-brown silty fine to medium			
	46 *		19.0	10-8	sand (SM)			* Washed ahead
	42 *							
	49 *	5D	20.0	7-12	Red-brown fine to coarse sand,	Med cpt red-brn c-f sand, sm silt tr gravel	20	
	43 *		22.0	12-14	some silt, tr gravel (SM)			
	66 *							
1530	58/4"*					22.5 **		
0700		1C	24.5	Rec=98%	Gray mica schist, some granitic			**Decomposed rock Decomposed mica schist in cuttings between 22.5'-24.5'.
			29.5	RQD=64%	gneiss, cljtd to jtd, UnWExJts	24.5	25	
04/19/82 Sunny						1C	30	

BORING NO. MG-835

WOODWARD–CLYDE CONSULTANTS, INC.
BORING LOG

SHEET 2 of 2
BORING NO. MG-835
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
04/19/82 Sunny		2C	29.5	Rec=100%	White to gray granitic gneiss,		30	
			34.5	RQD=84%	some mica schist, jtd, UnWExJts	2C		
0930						34.5	35	
							40	
							45	
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-835

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.
BORING LOG

SHEET 1 of 2
BORING NO. MG-824
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +5.7
COORDINATES: N 192491.8 E 1998852.4
DATUM: Manhattan
BORING LOCATION: MTA Yard, Ramps
DATE STARTED: 04/07/82
INSPECTOR: Y.K. Chan (MRJD)
DATE COMP.: 04/08/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Farrell
HELPER: G. Mccartar
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 5.0 FT.; DIA. 3 IN. FROM 0.0 TO 29.5 FT.
DRILLING MUD UTILIZED: MUD TYPE Quick-Gel
ROTARY BIT DIA. 3 7/8 IN.
SAMPLING EQUIPMENT (TYPE & SIZE):
D-SAMPLER: Split Spoon, 2" O.D.
DRILL ROD NW
U-SAMPLER: DIA. IN.; TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U-TUBES - NO. OF VANE TESTS - DEPTH TO ROCK 27.7 FT. DEPTH TO COMP. 39.5 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/08/82	0730	20.0	5.0	0.0		Overnight - mud in hole.
04/08/82	1120	39.5	29.5	5.0		At completion. Water in hole.

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
1300	10	1D	0.0	6-8	Dark brown f-c sandy gravel, some silt, trace glass (Fill) (GM)	Med cpt dk brn, f-c sand & gvl, sm silt, tr brick, glass (Fill)	0	W = Water content in %
	15		2.0	9-8				
	17							
	31							
	17							
04/07/82 Sunny, Windy	LOWERED						5	
		NR	5.5	6-8				
			7.5	5-6				
		2D	7.5	9-9	Dark brown f-c sand, sm silt, trace brick (Fill) (SM)			
			9.5	16-13				
		NR	10.0	3-3			10	
			12.0	3-4		12.0		
		3D	12.0	5-3	Black organic clayey m-f sand (Fill)(SC)	Loose 3D (Fill)		
			14.0	4-6				
		4D	15.0	1-1	Medium dark gray organic silty clay, tr fine sand, decomposed wood (OH)	15.0	15	W = 72
1530			17.0	1-1		4D, trace vegetation		
0700								
Sunny		5D	20.0	1/12"	Do 4D, trace vegetation (OH)		20	W = 57
			22.0	2-2				
						24.0		
04/08/82		6D	25.0	6-5	Red-brn silty f-m sand, sm silty clay layers, tr gravel, mica (SM)	6D Med cpt	25	
			27.0	5-6		27.5		Decomposed rock fgmts, in wash at 27.5'.
						Dec. Rock	30	

BORING NO. MG-B24

WOODWARD–CLYDE CONSULTANTS, INC.
BORING LOG

SHEET 2 of 2
BORING NO. MG-824
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Sunny		1C	29.5	Rec=98%	Green to light gray hornblende mica schist, tr quartz veins & mica schist, jtd, UnWExJts.	1C	30	
			34.5	RQD=84%				
04/08/82		2C	34.5	Rec=96%	Light gray mica schist, trace quartz inclusions, mdjtd, UnWExJts	34.5	35	
			39.5	RQD=84%		2C		
1200						39.5	40	
							45	
							50	
							55	
							60	
							65	
							70	
							75	
							80	
							85	

BORING NO. MG-824

MUESER, RUTLEOGE, JOHNSTON & DESIMONE
WOOOWARO–CLYOE CONSULTANTS, INC.

BORING LOG

SHEET 1 of 2
BORING NO. MG-825
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +6.2
COORDINATES: N 192600.2 E 1998598.9
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 04/02/82
INSPECTOR: B. Mukherjee
DATE COMP.: 04/05/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: C. Soto
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 35.0 FT.; DIA. 3 IN. FROM 0.0 TO 49.5 FT.
DRILLING MUD UTILIZED: MUD TYPE Zeogel
ROTARY BIT DIA. 3 3/4, 2 15/16 IN
SAMPLING EQUIPMENT, (TYPE & SIZE)
D-SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U-SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, BX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES –– NO. OF VANE TESTS – DEPTH TO ROCK 49.5 FT. DEPTH TO COMP. 68.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/05/82	0715	60.0	49.5	3.0		Over weekend
04/05/82	1430	68.0	49.5	4.9		At completion of rock coring
04/05/82	1440	68.0	35.0	9.0		
04/05/82	1500	68.0	20.0	4.5		
04/05/82	1510	–	0.0	5.2		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0700	–	1D	0.5	12-12	Dk gry c-f cinders, sm silt (Fill)(SM)	*	0	*Asphalt
	16		2.5	8-9		0.3		W = Water content in %
	14					Loose to compact, dark gray fine to coarse sand, some cinders, silt, trace gravel, rock fragments. (Fill)		
	31							
	32							
	14	2D	5.0	7-4	Dk gray c-f cinders, some organic silt (Fill)(SM)		5	
	11		7.0	4-5				
	14							
	13							
	18							
	11	3D	10.0	2-1	Gray fine sand, sm organic silt (Fill)(SM)		10	
	16		12.0	1-2				Lost all drilling water at 12.0'.
	82							
	87							
Sunny	45							
	2B	4D	15.0	12-11	Dk gray c-f sand, sm silt, gvl (Fill)(SM)		15	
	30		17.0	30-32				
	62							
04/02/82	45							
	46							
	30	NR	20.0	15-21			20	
	56		22.0	6-3				
	42	5D	22.0	5-12	Gry mic silty f-c sand, some rock fragments (Fill)(SM)			
	44		24.0	17-20				
	48							
	26	6D	25.0	14-19	Gray mic f-c sand, sm silt (Fill)(SM)		25	
	51		27.0	3-21				
	113							
	276							
	82						30	

BORING NO. MG-825

WOOOWARO–CLYOE CONSULTANTS, INC.

BORING LOG

SHEET 2 of 2
BORING NO. MG-825
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
	46	7D	30.0	WR/12"	Top: Soft blk org silty clay, tr mica (OH)	*	30*	*7D Top
	30		32.0	4-4		31.0		Top: W = 52
	39				Bot: Med gry org silty clay, sm shells, fine sand (OH)	Med gry org silty clay, some shells, trace fine sand, fine sand partings, vegetation		Bot: W =55
	36							
	39							
		8D	35.0	1-1	Medium gray organic silty clay, some shells, trace fine sand (OH)		35	W = 4B
	M		37.0	2-2				
	U							
	D							
	U	9D	40.0	1/12"	Med gry org silty clay, tr fine sand partings, veg (OH)		40	W = 53
	S		42.0	2-2				
	E							
	D							
Sunny								
		10D	45.0	WH-1	Top: Do 9D (OH)		45	Top: W = 34
			47.0	1-2	Bot: Gray f-m sand, sm organic silt, trace peat, shells (SM)	46.0		
						10D Bottom		
		1C	50.0	Rec=94%	Lt gry to white granitic pegmatite, cljtd, UnW to SlW		50	
			55.0	RQD=46%		49.5		
04/02/82						Light gray to white granitic pegmatite, trace quartzite, jtd, UnW to SlW		
		2C	55.0	Rec=98%	Do 1C		55	New diamond bit at 55.0'.
			60.0	RQD=26%				
1530 0700								
		3C	60.0	Rec=93%	Do 2C, trace quartzite		60	Core barrel blocked at 63.0'
			63.0	RQD=50%				
04/05/82								
		4C	63.0	Rec=98%	Lt gray to white quartzite and granitic gneiss, jtd, UnW			
Sunny			68.0	RQD=84%			65	
1530								
						68.0		
							70	
							75	
							80	
							85	

BORING NO. MG-B25

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 1 of 2
BORING NO. MG-826
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
COORDINATES: N 192690.5 E 1998436.2
ELEVATION: +5.7
BORING LOCATION: MTA Yard, MABSTOA Garage
DATUM: Manhattan
INSPECTOR: Y. K. Chan
DATE STARTED: 04/01/82
CONTRACTOR: Warren George, Inc.
DATE COMP.: 04/02/82
DRILLER: J. Farrell
HELPER: G. McCartar
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 11.0 FT.; DIA. 3 IN. FROM 0.0 TO 71.0 FT.
DRILLING MUD UTILIZED: MUD TYPE Quick Gel
ROTARY BIT DIA. 3 7/8 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D-SAMPLER: Split Spoon, 2" O.D.
DRILL ROD NW
U-SAMPLER: DIA. IN.; TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U-TUBES -- NO. OF VANE TESTS --- DEPTH TO ROCK 69.0 FT. DEPTH TO COMP. 82.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/02/82	0710	82.0	71.0	6.2		Overnight
04/02/82	0815	82.0	0.0	6.9		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0700	-	1D	1.0 3.0	23-16 14-11	Gray c-f sand, sm gravel, trace silt (Fill)(SP)	* 0.3 Loose to compact gry to blk f-c sand, sm silt, tr gvl, sls, dec wood (Fill)	0	*Asphalt W = Water content in %
		2D	5.0 7.0	6-8 7-7	Gray silty fine to medium sand (Fill)(SM)		5	
Sunny		**NR	10.0 12.0	7-5 3-3			10	**Tried for sample twice. No recovery.
		3D	12.0 14.0	3-3 13-17	Black c-f sand, sm silt, tr gravel (Fill)(SM)			
04/01/82		4D	15.0 17.0	3-3 3-3	Blk f-c sand, sm silt, tr gvl decomposed wood, sls(Fill) (SM)		15	
		5D	20.0 22.0	6-3 3-4	Gray-brn clayey fine to medium sand, trace gravel (Fill)(SC)		20	Color of mud was black at 23.0'.
						23.0		
		6D	25.0 27.0	2-2 3-3	Soft black organic silty clay, trace fine sand (OH)	6D	25	W = 72 *Soft-med,dk gry org silty clay, tr f sa, f sa seams,sls, veg.
						28.0 *	30	

WOODWARD–CLYDE CONSULTANTS, INC.

BORING LOG

SHEET 2 of 2
BORING NO. MG-826
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
	M U D	7D	30.0 32.0	WH/12" 2-3	Soft dark gray organic silty clay, tr fine sand seams (OH)	Soft to medium dark gray organic silty clay, tr fine sand seams, shells, vegetation.	30	W = 69
	U S E D	8D	35.0 37.0	WH-1 1-2	Do 7D, trace shells, veg (OH)		35	W = 46
		9D	40.0 42.0	1/12" WH/12"	Do 8D (OH)		40	W = 52
		10D	45.0 47.0	2-2 2-2	Do 8D (OH)		45	W = 52
		11D	50.0 52.0	1-2 2-3	Medium dark gray organic silty clay, trace fine sand (OH)		50	W = 57
		12D	55.0 57.0	WR/24"	Do 11D, some fine sand, trace shells (OH)		55	W = 35
04/01/82		13D	60.0 62.0	WH/12" 3-3	Medium dark gray organic silty clay, tr fine sand, shells, veg (OH)		60	W = 41
		14D	65.0 67.0	WH/18" 3	Medium dark gray organic silty clay, tr fine sand, veg (OH)		65	W = 33
						69.0 *	70	Telescoped 3" casing inside 4" casing to 72.0' *Possible decomposed rock
		1C	72.0 77.0	Rec=98% RQD=88%	Top: Gray garnet mica schist, jtd, UnWExJts Bot: White quartzite, mdjtd. UnW.	72.0 Gry grt mica schist to wht quartzite, jtd to mdjtd,UnWExJts	75	Mica schist is very micaceous.
		2C	77.0 82.0	Rec=98% RQD=96%	Top: White quartzite, mdjtd, UnW Bottom: Gray garnet mica schist, mdjtd, UnWExJts		80	
1530						82.0	85	

MUESER, RUTLEDGE, JOHNSTON & OESIMONE
WODOWARO–CLYDE CDNSULTANTS, INC.

SHEET 1 of 3
BORING NO. MG-827
FILE NO. 4840

BDRING LOG

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +5.5
COORDINATES: N 192663.3 E 1998186.4
DATUM: Manhattan
BORING LOCATION: MTA Yard, Ramps
DATE STARTED: 04/07/82
INSPECTOR: B. Mukherjee (MRJD)
DATE COMP.: 04/09/82
CONTRACTOR: Warren George, Inc.
DRILLER: J Stevenson
HELPER: C. Soto
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 40.0 FT.; DIA. 3 IN. FROM 0.0 TO 115.3 FT.
DRILLING MUD UTILIZED: MUO TYPE
ROTARY BIT DIA. 3 3/4 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D–SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U–SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED OURING CORING: MECHANICAL ☐ HYDRAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U–TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 115.3 FT. DEPTH TO COMP. 135.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	OEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONOITIONS OF OBSERVATION
04/08/82	0730	62.0	40.0	4.6		Overnight
04/09/82	0715	115.3	115.3	6.0		
04/09/82	1430	135.0	115.3	2.0		At completion at rock coring
04/12/82	0730	–	15.0	5.7		Over the weekend
04/12/82	0800	–	0.0	5.0		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	OEPTH (FT)	REMARKS
0830	—	1D	0.75	32-19	Brown cinders, sm c-f sand, silt, tr gravel (Fill) (SM)	* 0.2 Medium compact to loose gray-brown silty fine to coarse sand, trace gravel, cinders, brick, mica (Fill)	-0	*Asphalt W = Water content in %
	28		2.75	10-30				
	48							
	37							
	56							
	31	2D	5.0	9-16	Gry-brn silty f-m sand, tr gvl cndrs, brick, mica (Fill) (SM)		5	
	27		7.0	9-10				
	34							
04/07/82 Partly Cloudy, Cold	21							
	13							
	29	3D	10.0	11-17	Top: 18" Do 2D (Fill) (SM) Bot: 6" Red-brn silt, sm fine sand (Fill) (ML)		10	
	25		12.0	12-8				
	38							
	29							
	17							
	15	4D	15.0	1-3	Dark gray c-f sand, sm gravel, silt, tr cndrs, mica (Fill)(SM)		15	
	15		17.0	3-5				
	16							
	18							
	16							
	*19	5D	20.0	WR-13	Med black organic silty clay, tr fine sand, wood, bricks (OH)	20.0 5D Medium	20	W = 58 *20.0'-25.0' drilled ahead of casing.
	18		22.0	9-6				
	12							
	26							
	27							
	28	6D	25.0	30-19	Gray-brn mic silty f-m sand, sm rock fragments (SM)	25.0 6D Med compact (Fill)	25	6D rock fgmts are decomposed mica schist. (Fill)
	43		27.0	12-13				
	80							
	69							
	90						30	

SHEET 2 of 3
BORING NO. MG-827
FILE NO. 4840

WOOOWARD–CLYOE CONSULTANTS, INC.

BORING LDG

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
	44	NR	30.0	100/4"		Same as above	30	
	22		30.3					
	32							
	34							
	35							
	* 42	7D	35.0	10-14	Stiff black organic clay, trace vegetation (OH)	35.0 Stiff blk org clay	35	W = 64 *35.0'-40.0' drilled ahead of casing.
	26		37.0	8-9				
	26							
	25							
	25							
04/07/82 Partly Cloudy, Cold		8D	40.0	1-1	Medium gray organic silty clay, trace shells (OH)	40.0 Medium gray organic silty clay, trace fine sand partings, shells	40	W = 69
			42.0	2-4				
	LOWERED 3"DIA							
		9D	45.0	1-1	Medium gray organic silty clay, trace shells (OH)		45	W = 53
			47.0	1-1				
		10D	50.0	1-1	Do 9D, some fine sand (OH)		50	W = 47
			52.0	1-1				
		11D	55.0	1-1	Medium gray organic silty clay, trace shells (OH)		55	W = 47
			57.0	2-2				
		12D	60.0	2-2	Do 11D (OH)		60	W = 53
1530			62.0	3-4				
0700								
		13D	65.0	1-WH	Medium gray organic silty clay, tr shells, fine sand partings (OH)		65	W = 57
			67.0	WH-1				
		14D	70.0	WH-1	Do 13D (OH)		70	W = 34
			72.0	1-2				
04/08/82 Sunny								
		15D	75.0	1-1	Do 13D (OH)		75	W = 50
			77.0	2-2				
		16D	80.0	2-3	Do 13D (OH)		80	W = 39
			82.0	4-2				
							85	

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD-CLYDE CONSULTANTS, INC.
BORING LOG

SHEET 3 of 3
BORING NO. MG-827
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
Sunny 04/08/82		17D	85.0	2-2	Medium gray organic silty clay, some fine sand (OH)	Medium gray organic silty clay, tr to sm fine sand, tr fine sand partings, peat	85	W = 59
			87.0	6-5				
		18D	90.0	WH-6	Medium gray organic silty clay, trace fine sand partings (OH)		90	W = 39
			92.0	3-2				
		19D	95.0	WH-1	Medium gray organic silty clay, some fine sand (OH)		95	W = 40
			97.0	5-9				
		20D	100.0	WR-2	Medium gray organic silty clay, trace fine sand partings, peat (OH)		100	W = 45
			102.0	2-11				
		21D	105.0	5-11	Medium gray organic silt, sm fine sand and clay (OL)		105	W = 32
			107.0	16-16				
		22D	110.0	2-5	Stiff gray organic clay, some peat, trace decomposed wood (OH)		110	W = 52 W = 73 (Peat portion of the sample)
			112.0	7-10				
1500								
0700		23D	115.0	100/4"	Light gray micaceous f-m sand, tr c sand, silt (SP)*	115.0 Dec Rock	115	* Decomposed mica schist.
			115.3					
		1C	116.0	Rec=88%	Light gray garnet mica schist, broken, SlW to HiW			
			121.0	RQD=12%		118.0 Lt gry mica schist & grt mica schist, mic quartzite, tr qtz veins, bkn to mdjt, UnWExJts		
Cloudy, 04/09/82		2C	121.0	Rec=82%	Light gray garnet mica schist, trace quartz veins, cljtd, UnWExJts.		120	Run #2C Core barrel blocked.
			125.0	RQD=25%				
		3C	125.0	Rec=92%	Top: Light gray mica schist, tr quartz veins, broken, UnWExJts Bot: White mic quartzite, cljtd UnWExJts		125	
			130.0	RQD=30%				
		4C	130.0	Rec=100%	Light gray mica schist & mic quartzite, mdjtd, UnWExJts		130	
			135.0	RQD=88%				
1430						135.0	135	
							140	

BORING NO. MG-827

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD-CLYDE CONSULTANTS, INC.
BORING LOG

SHEET 1 of 2
BORING NO. MG-827P
FILE NO. 4840

PROJECT: WEST SIDE HIGHWAY
DOT. CONTR. NO.: D 250002
ELEVATION: +5.5
COORDINATES: N 192674 E 1998158
DATUM: Manhattan
BORING LOCATION: MTA Yard, MABSTOA Garage
DATE STARTED: 04/12/82
INSPECTOR: B. Mukherjee (MRJD)
DATE COMP.: 04/12/82
CONTRACTOR: Warren George, Inc.
DRILLER: J. Stevenson
HELPER: C. Soto
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: DIA. 4 IN. FROM 0.0 TO 20.0 FT.; DIA. IN. FROM TO FT.
DRILLING MUD UTILIZED: MUD TYPE
ROTARY BIT DIA. 3 3/4 IN.
SAMPLING EQUIPMENT, (TYPE & SIZE)
D-SAMPLER: Split Spoon, 2" O.D.
DRILL ROD BW
U-SAMPLER: DIA. IN.: TYPE
CORE BIT
CORE BARREL
FEED DURING CORING: MECHANICAL ☐ HYDRAULIC ☐ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U-TUBES – NO. OF VANE TESTS – DEPTH TO ROCK – FT. DEPTH TO COMP. – FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/12/82	1000	20.0	20.0	2.0		
04/12/82	1300	15.5	15.0	3.9		Inside piezometer

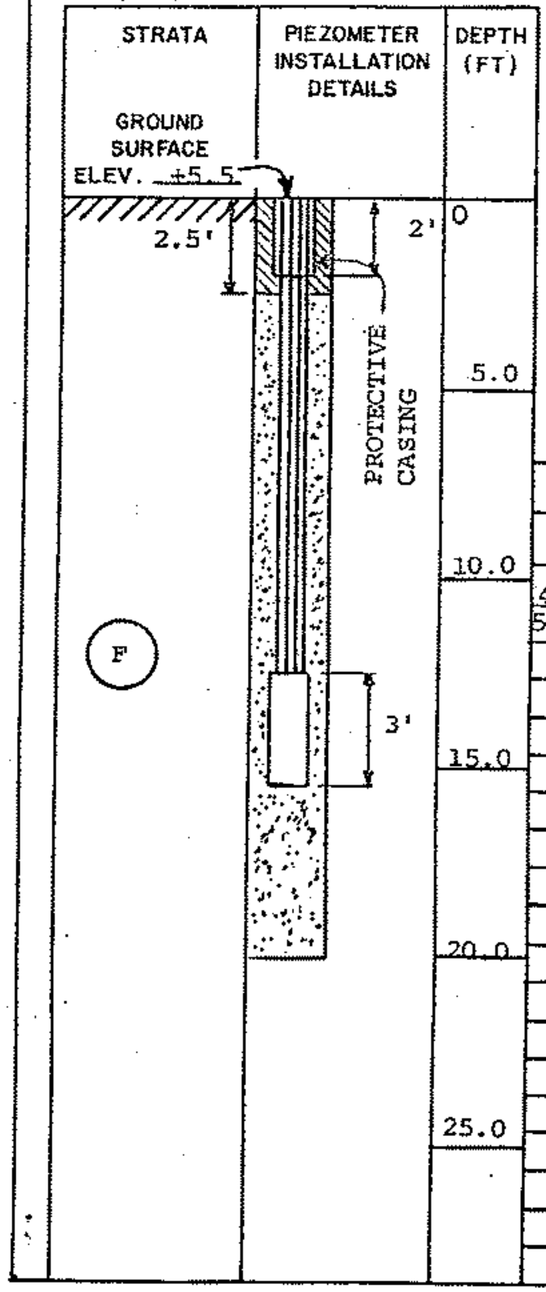
DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0700	13					(Fill)	0	
	18							
	16							
	34							
	12							
Partly Sunny 04/12/82	20						5	
	110							
	88							
	19							
	10							
	25						10	
	20							
	20							
	18							
	12							
	11	1D	15.0	3-3	Gray-brown medium to fine sand, trace gravel (Fill)(SP)		15	
	11		17.0	4-5				
	13							
	12							
1300	12							
						20.0	20	
							25	
							30	

SHEET 2 OF 2
FILE NO. 4840
SUBCODE SMBST

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
CONSULTING ENGINEERS

PIEZOMETER RECORD

PROJECT WEST SIDE HIGHWAY - CONTRACT 5
PIEZOMETER NO. MG-827 P
LOCATION MABSTOA GARAGE
PIEZOMETER LOCATION 12th AVE & W 30th STREET
DATE OF INSTALLATION 4-12-82
☐ SEE SKETCH ON BACK
RES. ENG. B. Mukherjee



PIEZOMETER TYPE DOUBLE TUBE POROUS PLASTIC

INTAKE POINT

depth to bottom, ft = 15.5
depth to top, ft = 12.5
length, ft = 3' = L
diometer, In = 1.5, ft = 0.125 = 2R

STANDPIPE/RISER (DOUBLE TUBE)

elevotion of rim, ft = +5.5
diometer, in = 3/8, ft = 0.031 = 2r

READING TIME		DEPTH - RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
4-12-82	1300	3.9	1.6	High Tide 1220
5-10-82	1503	4.7	0.8	High Tide 1115

⛶ Sond ▨ Bentonite
△ Grovel ▧ Grout

GROUND SURFACE ELEV. +5.5

PIEZOMETER NO. MG-827P

SHEET 1 of 3
BORING NO. MG-828
FILE NO. 4840

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOOOWARO–CLYDE CONSULTANTS, INC.
BORING LOG

PROJECT: WEST SIDE HIGHWAY
OOT. CONTR. NO.: D 250002
ELEVATION: +5.3
COORDINATES: N 192784.1 E 1998289.0
DATUM: Manhattan
BORING LOCATION: MTA Yard, Ramp
DATE STARTED: 04/02/82
INSPECTOR: Y. K. Chan (MRJD)
DATE COMP.: 04/07/82
CONTRACTOR: Warren George, Inc.
DRILLER: J Farrell
HELPER: Mr. G. McCartar
TYPE OF RIG: TRUCK ☒ SKID ☐ BARGE MOUNTED ☐ TRIPOD ☐ OTHER ☐
CASING: OIA. 4 IN. FROM 0.0 TO 10.0 FT.; OIA. 3 IN. FROM 0.0 TO 105.0 FT.
DRILLING MUO UTILIZED: MUD TYPE Quick Gel
ROTARY BIT DIA. 3 7/8 IN.
SAMPLING EOUIPMENT, (TYPE & SIZE)
D-SAMPLER: Split Spoon, 2" O.D.
DRILL ROD NW
U-SAMPLER: DIA. IN.: TYPE
CORE BIT Diamond, NX
CORE BARREL Double Barrel
FEED DURING CORING: MECHANICAL ☐ HYORAULIC ☒ OTHER ☐
SAMPLER HAMMER: WEIGHT (LBS) 140 AVG. FALL 30 IN.
CASING HAMMER: WEIGHT (LBS) 300 AVG. FALL 18 IN.
NO. OF U-TUBES – NO. OF VANE TESTS – DEPTH TO ROCK 103.0 FT. DEPTH TO COMP. 115.0 FT.

WATER LEVEL OBSERVATIONS

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	ELEVATION OF TIDE	CONDITIONS OF OBSERVATION
04/05/82	0750	57.0	10.0	4.4		Over weekend with drilling mud inside the hole
04/07/82	0800	105.0	105.0	4.5		At start of drilling w/water inside the hole
04/07/82	1045	115.0	10.0	4.5		

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
0830	-					* 0.3	0	*Asphalt
	21	1D	0.5	10-8	Dark gray c-f sand, sm cinders, silt, tr gvl (Fill)(SM)	Medium compact dark gray to brown coarse to fine sand, some cinders, gravel, trace silt (Fill)		W = Water content in %
	17		2.5	6-5				
	22							
	13							
	21	2D	5.0	22-17	Black c-f sandy gravel, trace silt (Fill)(GP)		5	
	30		7.0	6-13				
	26							
	30							
	28							
04/02/82 Sunny, Windy		3D	10.0	17-13	Dark brown c-f sand, some cinders, trace gvl (Fill)(SP)		10	
			12.0	9-5				
		**NR	15.0	5-3			15	**Attempted sample twice. No recovery. Sample 4D is probably wash.
			17.0	1-3				
		4D	17.0	5-5	Black c-f sand, sm cndrs, tr silt, gvl (Fill)(SP)			
			19.0	8-9				
		5D	20.0	4-1	Black c-f sand, sm cndrs, tr organic silty clay, gravel (Fill)(SP)		20	
			22.0	2-4				
						23.0 Med blk org siltyclay, tr fsa, wood, veg		
		6D	25.0	2-1	Medium black organic silty clay, trace fine sand, veg, wood (OH)		25	W = 71
			27.0	1-2				
							30	

BORING NO. MG-828

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
WOODWARD–CLYDE CONSULTANTS, INC.
BORING LOG

SHEET 2 of 3
BORING NO. MG 828
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
04/02/82 Sunny		7D	30.0	1-WH	Med dark gray organic silty clay, tr fine sand, sls (OH)	Medium dark gray organic silty clay, trace fine sand, fine sand partings, shells	30	W = 62
			32.0	2-2				
		8D	35.0	1-WH	Do 7D, trace veg. (OH)		35	W = 69
			37.0	1-2				
		9D	40.0	5-4	Do 7D (OH)		40	
			42.0	1-1				
		10D	45.0	1-WH	Do 7D, tr fine sand partings (OH)		45	W = 53
			47.0	3-4				
		11D	50.0	1-WH	Do 7D, tr fine sand partings (OH)		50	W = 54
			52.0	5-4				
1500		12D	55.0	WR - WH	Do 7D, tr fine sand partings (OH)		55	W = 53
0700			57.0	2-4				
04/05/82 Sunny, Windy		13D	60.0	2-3	Do 7D, tr fine sand partings (OH)		60	
			62.0	5-7				
		NR	65.0	9-7			65	
			67.0	7-10				
		14D	67.0	7-2	Med dk org silty clay, sm fine sand, tr sls, gvl, veg (OH)			W = 36
			69.0	5-4				
		15D	70.0	WR/24"	Med dk gray org silty clay, tr fine sand, sls (OH)		70	W = 39
			72.0					
		16D	75.0	WR/24"	Do 15D, tr fine sand partings (OH)		75	W = 34
			77.0					
		17D	80.0	WR - 1	Med dk gray org silty clay, tr m-f sand, fine sand partings, shells (OH)		80	W = 41
			82.0	6-9			85	

BORING NO. MG-828

DEPT OF BLDGS 121192618 Job Number ES155545600 Scan Code

WOODWARD–CLYDE CONSULTANTS, INC.
BORING LOG

3 of 3
BORING NO. MG-828
FILE NO. 4840

DAILY PROGRESS	CASING BLOWS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH (FT)	REMARKS
04/05/82 Sunny, Windy		NR	85.0	5-12		Med dk gry org si cl, sm m-f sa tr shells	85	
			87.0	11-14				
		18D	87.0	9-6	Med dark gray organic silty clay, sm m-f sand, tr shells (OH)			
			89.0	11-14				
		19D	90.0	WR - 6	Med dark gray organic silty clay, some m-f sandy silt lyrs (OH)		90	W = 43
			92.0	6-9		93.0		
		20D	95.0	11-18	Dark gray silty fine to medium sand, tr mica (SM)	Cpt dk gry si f-m sa tr mica	95	3" dia casing was placed inside hole.
			97.0	22-25		99.0		
		21D	100.0	2-6	Stiff dark gray organic silty clay, tr f-m sand, veg (OH)	21D	100	W = 53
1530			102.0	8-11		103.0		
0700						*		
04/07/82 Windy		1C	105.0	Rec=100%	Light gray garnet mica schist, jtd, UnWExJts	105.0 Light gry garnet mica schist, jtd UnWExJts	105	*Possible decomposed rock.
			110.0	RQD=84%				
		2C	110.0	Rec=96%	Do 1C		110	Highly micaceous rock.
1130			115.0	RQD=80%		115.0	115	
							120	
							125	
							130	
							135	
							140	

BORING NO. MG-828

Metropolitan Transportation Authority
10th Avenue Bridge, 11th Avenue Viaduct,
Evacuation Tunnel, North Access Tunnel,
Catenary Removal, Mabstoa Bus Garage
Foundations at the
West Side Storage Yard Complex
Contract No. 1-02-21064-0-0
Stick Logs

LEGEND

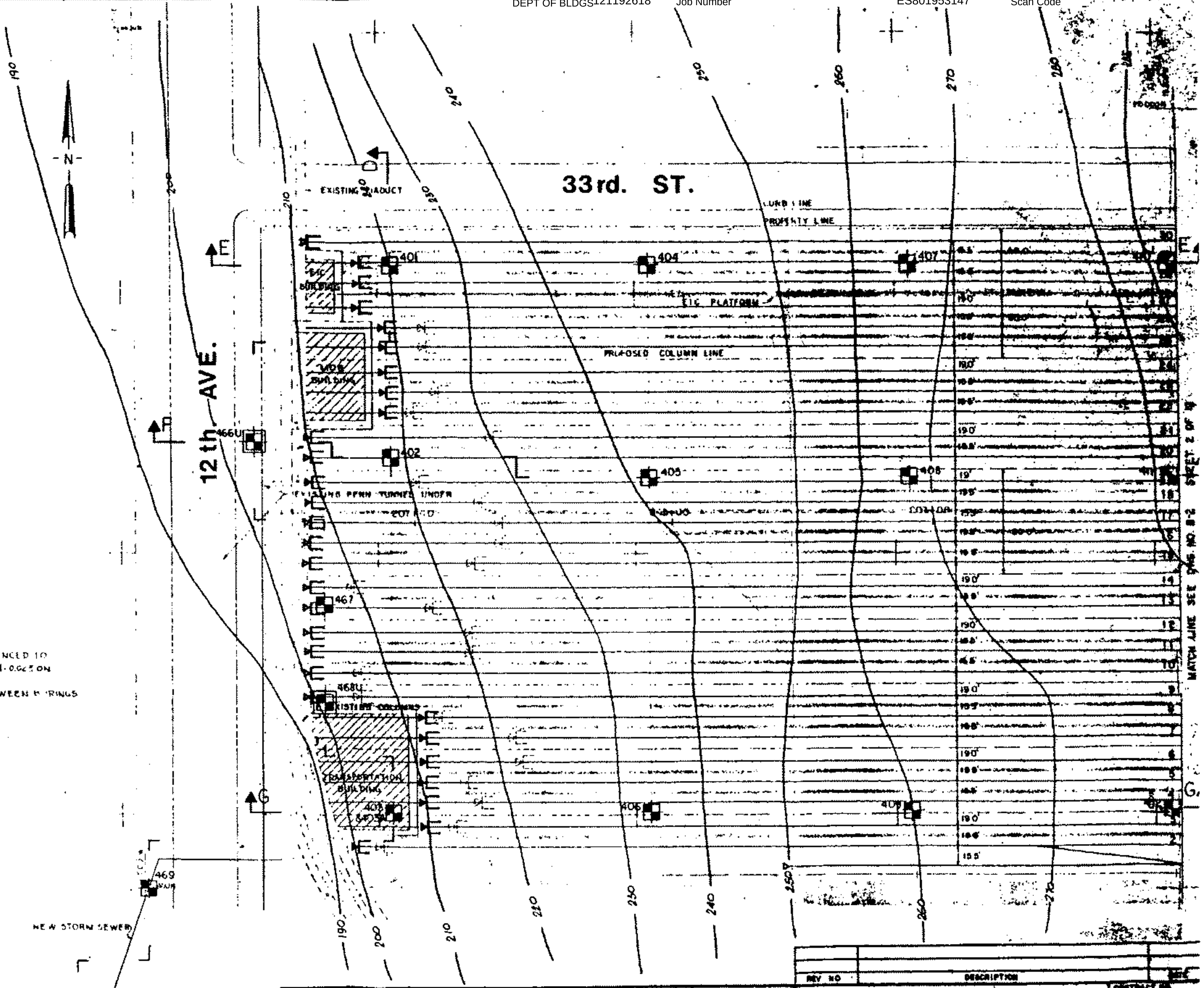
▬	CARTWAY 4' WIDE
■	CARTWAY 8' WIDE
	PLATFORM
	ROADWAY
	ENDS OF TRAINS AT MIN. DISTANCE FROM CLEARANCE POINT
12	ENDS OF TRAINS AT STANDARD DESIGN POSITION WITH NUMBER OF CARS
▨	BUILDING LIMITS
12800 N 10000 E	ARBITRARY COORDINATE SYSTEM
16000 W 13400 N	NEW YORK CITY COORDINATE SYSTEM (BPM)

BORING LEGEND

300 SERIES	DRY SAMPLE BORING MADE IN 1980
	UNDISTURBED SAMPLE BORING MADE IN 1980
400 SERIES	DRY SAMPLE BORING MADE IN 1981
	UNDISTURBED SAMPLE BORING MADE IN 1981

NOTES

1. CONTOURS REPRESENT ELEVATION OF TOP OF ROCK REFERENCED TO L.I.R.R. DATUM, ON WHICH ELEVATION 500 = ELEVATION 0.025 ON BOROUGH OF MANHATTAN DATUM
2. CONTOURS SHOWN ARE NECESSARY INTERPOLATIONS BETWEEN BORINGS
3. BORINGS 463 AND 465 WERE DELETED



GRAPHIC SCALE

0' 20' 40' 80' 120'

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

MUESER·RUTLEDGE·JOHNSTON & DESIMONE
CONSULTING ENGINEERS

L.I.R.R.
LONG
ISLAND
RAIL ROAD

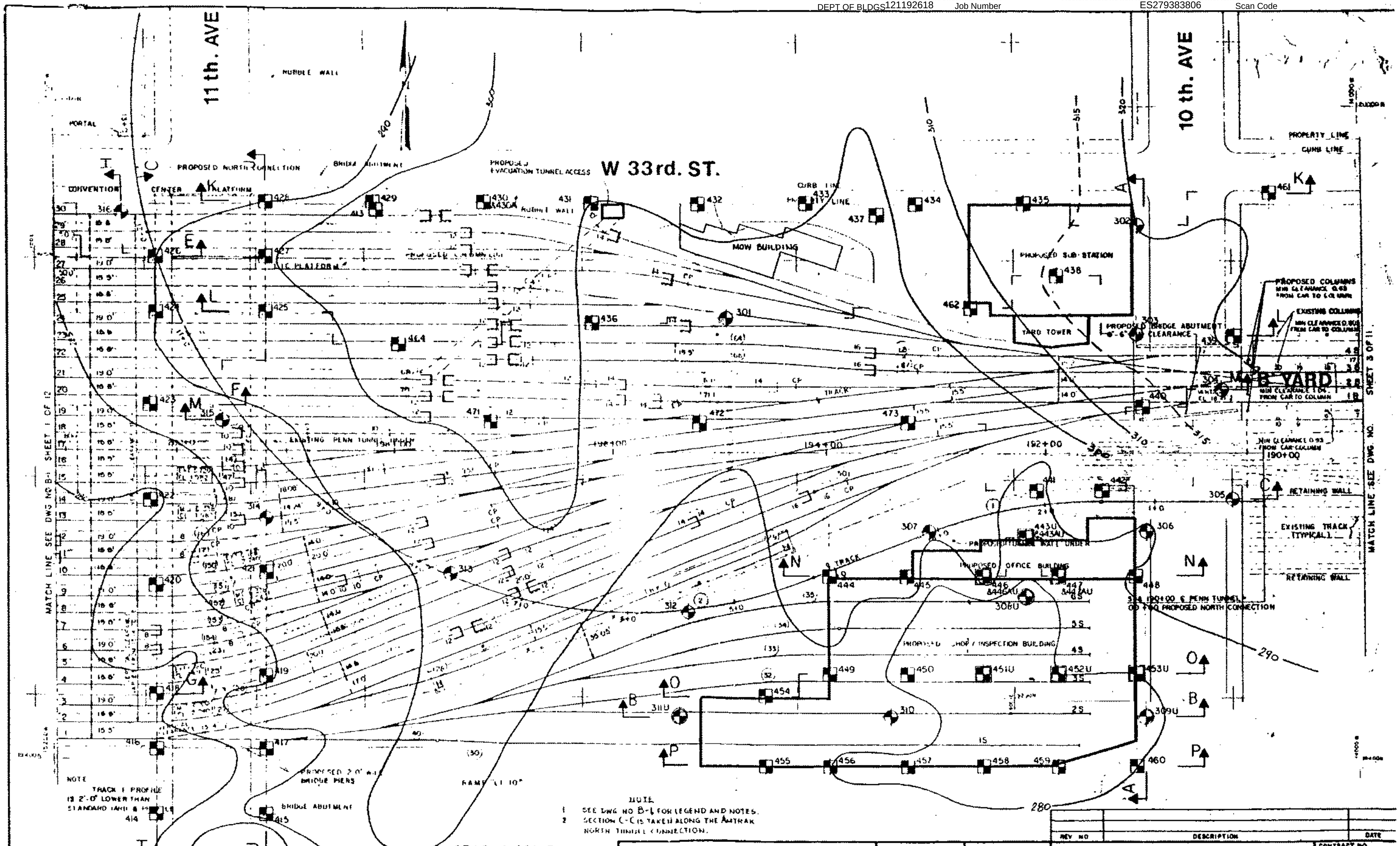
Metropolitan
Transportation
Authority

REV NO	DESCRIPTION	DATE

WEST SIDE STORAGE YARD COMPLEX

BORING LOCATION PLAN
& CONTOURS OF TOP OF ROCK

CONTRACT NO. 5385
DATE JULY 10, 1981
SCALE 1" = 40'
DRAWING NO. B-1
SHEET 1 OF 12



NOTE
1 SEE DWG NO B-1 FOR LEGEND AND NOTES.
2 SECTION C-C IS TAKEN ALONG THE AMTRAK NORTH TUNNEL CONNECTION.

REV NO	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016
MUESER·RUTLEDGE·JOHNSTON & DESIMONE
CONSULTING ENGINEERS

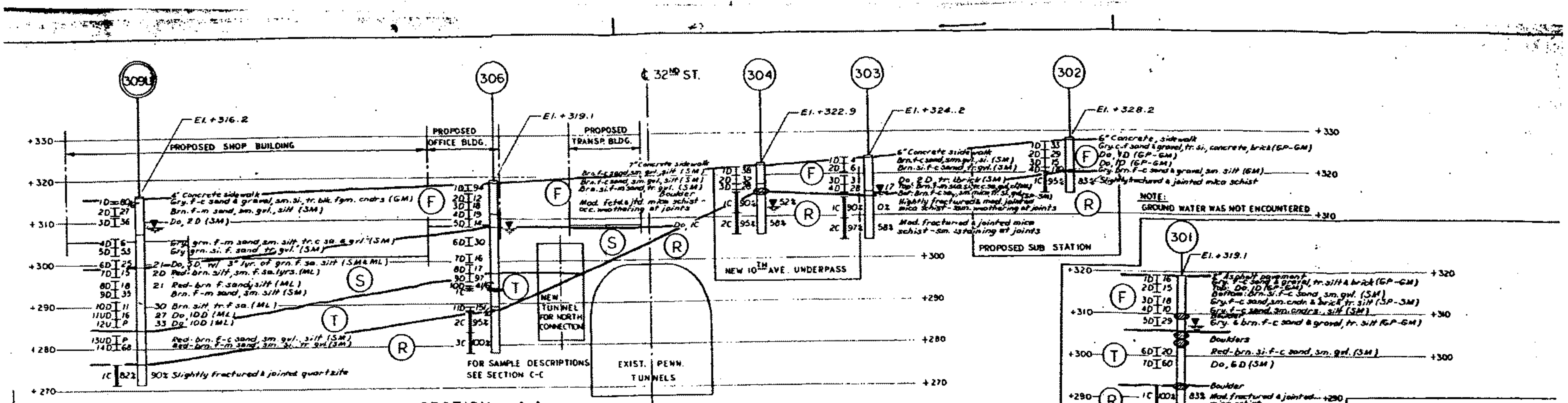
L.I.R.R.
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

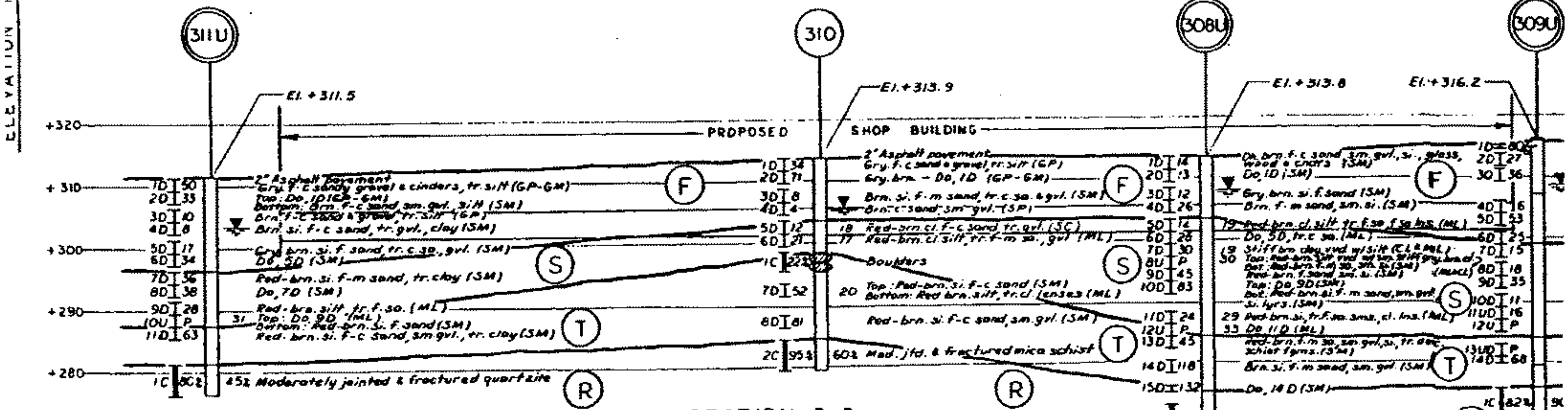
WEST SIDE STORAGE YARD COMPLEX

BORING LOCATION PLAN
& CONTOURS OF TOP OF ROCK

CONTRACT NO. 5585
DATE JULY 16, 1981
SCALE 1" = 40'
DRAWING NO. B-2



SECTION A-A



SECTION B-B

NOTE: BORING 308U PROJECTED TO SECTION

FOR SAMPLE DESCRIPTIONS SEE SECTION A-A

ABBREVIATIONS FOR SOIL SAMPLE DESCRIPTIONS

Word	Abbrev.	Word	Abbrev.	Word	Abbrev.
And	- &	Fine to medium	- f-m	Seams	- sms
Black	- blk	Fragment	- fgmt	Silt or silty	- si
Brown	- brn	Fractured	- fctd	Some	- sm
Bottom	- bot	Gray	- gry	Slightly	- sl
Cinder	- cndr	Green	- grn	Trace	- tr
Clay or clayey	- cl	Gravel or gravely	- gvl	Varved	- vvd
Coarse	- c	Jointed	- jtd	With	- w/
Coarse to fine	- c-f	Layer	- lyr	Relatively	- rel
Dark	- dk	Light	- lt		
Decomposed	- dec	Lenses	- lns		
Ditto	- do	Moderately	- mod		
Fine	- f	Occasional	- occ		

GENERAL STRATA DESCRIPTIONS

Ⓕ - Fill: Loose to compact gray-brown fine to coarse sand and gravel, some silt with cinders, brick and concrete.

Ⓢ - Sand & Silt: Medium compact to compact red-brown silt or clayey silt with layers of silty fine sand to silty fine to coarse sand, some gravel.

Ⓣ - Glacial Till: Very compact red-brown silty fine to coarse sand, some gravel with boulders.

SAMPLE CONSTITUENT PERCENTAGES

Trace — Less than 11 %

Some — 11 % to 30 %

BORING LEGEND

A - Number, type and location of boring.

○ Dry sample boring, made in 1980.

◯ Undisturbed sample boring, made in 1980.

EL - Elevation of ground surface.

B - Number and type of sample.

D - Dry sample taken with 2" O.D. split spoon.

U - Undisturbed sample taken with 3" O.D. piston type sampler.

UD - Undisturbed sample extruded in field and placed in the jar due to poor recovery.

I - Location and length of sample attempt.

N - Standard Penetration Resistance - Number of blows from 140 lb. hammer free falling 30" required to drive 2" O.D. split spoon sampler one foot unless a specific penetration is indicated.

P - Pressed or pushed sample.

▨ Boulder.

E - Average natural water content of sample in percent of dry weight.

▽ Ground water level observed in land borings (immediately after completion of boring).

C - Rock or boulder core.

I - Length of core run.

F - Length of core recovered expressed as a percent of the length of core run.

R - Rock quality designation - length of recovered core consisting of pieces 4" or more in length expressed as a percent of the length of core run.

Letters shown in parenthesis after the soil sample description represent the Unified Soil Classification Symbol.

GENERAL NOTES

1. Borings were made by Warren George, Inc between May 5 & 22, 1980 under the contin. inspection of Mueser, Rutledge, Johnston & De Simone.
2. Classifications shown were made by Mu Rutledge, Johnston & De Simone and may agree with the drillers' classifications,
3. Stratifications shown are necessary inter lations between borings and may or may n represent actual subsurface condition
4. Elevations refer to LIRR datum, which Elevation 300 is equal to Elevati on the Borough of Manhattan datum.
5. Locations and ground surface elevations borings were determined by Seelye, Ste Value & Knecht, Inc.

GRAPHIC SCALE

0' 20' 40' 60'

HORIZONTAL

VERTICAL

METROPOLITAN TRANSPORTATION AUTH
west side storage ya

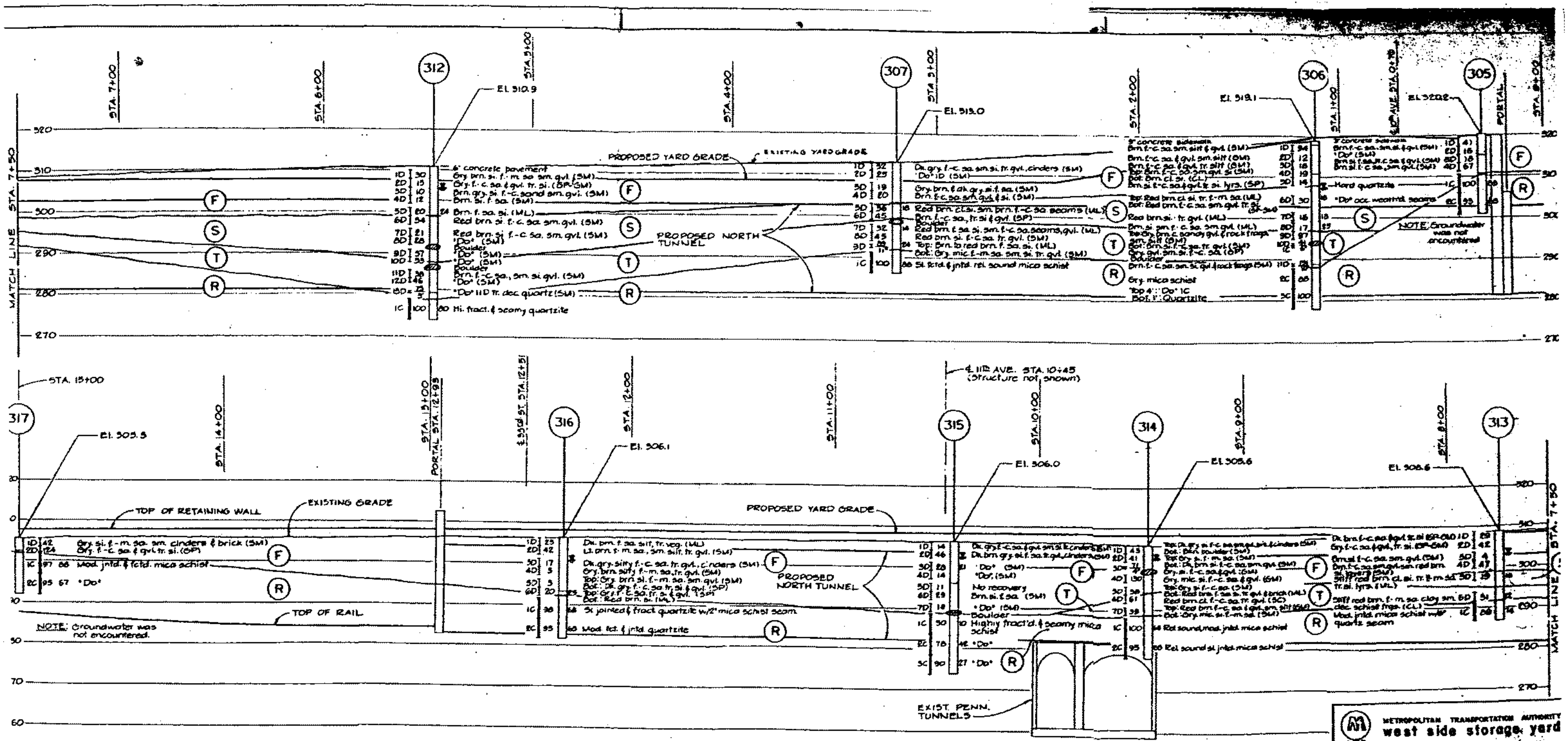
SEELYE STEVENSON VALUE & KNECHT
NEW YORK, N.Y.

MUESER · RUTLEDGE · JOHNSTON & DESIM
CONSULTING ENGINEERS
435 MADISON AVE., NEW YORK N. Y. 10017

SCALE GRAPHIC	DRAWN BY SSS	DATE 6-10-80	5
	CHECKED BY JFO	DATE 6-11-80	

GEOLOGIC SECTIONS A-A & B-B

G



SECTION C-C

GENERAL STRATA DESCRIPTIONS

Ⓕ - Fill: Loose to compact grey-brown fine to coarse sand and gravel, some silt with cinders, brick and concrete.

Ⓢ - Sand & Silt: Medium compact to compact red-brown silt or clayey silt with layers of silty fine sand to silty fine to coarse sand, some gravel.

Ⓣ - Glacial Till: Very compact red-brown silty fine to coarse sand, some gravel with boulders.

Ⓡ - Bedrock: Moderately jointed and fractured

NOTE: For Boring Legend, General Notes and Soil Sample Abbreviations see Drawing No. 65-1.
Tunnel and existing structure profiles were taken from SSV & K's Drawing titled North-Connection Plan.

GRAPHIC SCALE
HORIZONTAL 0 20' 40' 60'

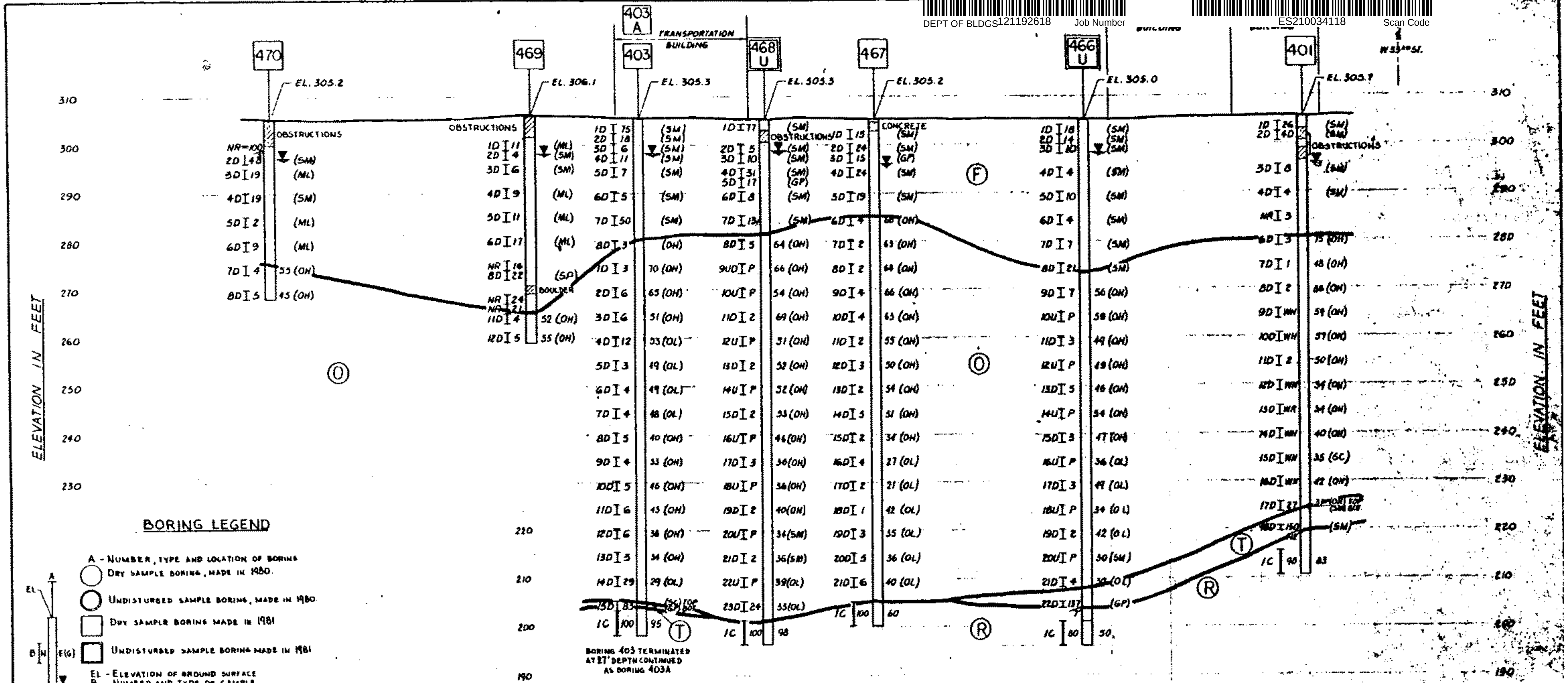
METROPOLITAN TRANSPORTATION AUTHORITY
west side storage yard

SEELYE STEVENSON VALUE & KNECHT INC.
NEW YORK, N.Y.

MUESER · RUTLEDGE · JOHNSTON & DESMOND
CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK N.Y. 10017

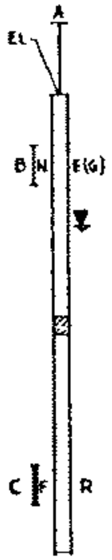
SCALE GRAPHIC	DRAWN BY J V	DATE 6-11-80
	CHECKED BY J F Q	DATE 6-11-80

GEOLOGIC SECTION C-C



SECTION D-D

BORING LEGEND



A - NUMBER, TYPE AND LOCATION OF BORING

○ DRY SAMPLE BORING, MADE IN 1980.

◯ UNDISTURBED SAMPLE BORING, MADE IN 1980.

☐ DRY SAMPLE BORING MADE IN 1981

▣ UNDISTURBED SAMPLE BORING MADE IN 1981

EL - ELEVATION OF GROUND SURFACE
B - NUMBER AND TYPE OF SAMPLE
- D - DRY SAMPLE TAKEN WITH 2" O.D SPLIT SPOON
- U - UNDISTURBED SAMPLE TAKEN WITH 3" O.D PISTON TYPE SAMPLER.
- UD - UNDISTURBED SAMPLE EXTRUDED IN FIELD AND PLACED IN JAR DUE TO POOR RECOVERY.
- NR - NO RECOVERY

I - LOCATION AND LENGTH OF SAMPLE
N - STANDARD PENETRATION RESISTANCE - NUMBER OF BLOWS FROM 140LB. HAMMER FREE FALLING 30" REQUIRED TO DRIVE 2" O.D. SPLIT SPOON SAMPLER ONE FOOT UNLESS A SPECIFIC PENETRATION IS INDICATED
- P - PRESSED OR PUSHED SAMPLE
- WR - SAMPLER ADVANCED UNDER WEIGHT OF RODS
- WH - SAMPLER ADVANCED UNDER WEIGHT OF RODS AND HAMMER

▨ BOULDER OR OBSTRUCTION
E - AVERAGE NATURAL WATER CONTENT OF SAMPLE IN PERCENT OF DRY WEIGHT.
▼ GROUND WATER LEVEL OBSERVED IN LAND BORINGS. (IMMEDIATELY AFTER COMPLETION OF BORING)
C - ROCK CORE
Ⅱ - LENGTH OF CORE RUN.
F - LENGTH OF CORE RECOVERED EXPRESSED AS A PERCENT OF THE LENGTH OF CORE RUN
R - ROCK QUALITY DESIGNATION - LENGTH OF RECOVERED CORE CONSISTING OF PIECES 4" OR MORE IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF CORE RUN
G - UNIFIED SOIL CLASSIFICATION SYMBOL.

GENERAL NOTES

1. 400 SERIES BORINGS WERE MADE BY WARREN GEORGE, INC BETWEEN APRIL 13 AND JUNE 5, 1981 UNDER THE CONTINUOUS INSPECTION OF MUESER, RUTLEDGE, JOHNSTON AND DE SIMONE
2. 300 SERIES BORINGS WERE MADE BY WARREN GEORGE, INC BETWEEN MAY 5 AND 22, 1980 UNDER THE CONTINUOUS INSPECTION OF MUESER, RUTLEDGE, JOHNSTON AND DE SIMONE.
3. CLASSIFICATIONS SHOWN WERE MADE BY MUESER, RUTLEDGE, JOHNSTON AND DE SIMONE AND MAY NOT AGREE WITH THE DRILLERS' CLASSIFICATIONS.
4. STRATIFICATIONS SHOWN ARE NECESSARY INTERPOLATIONS BETWEEN BORINGS AND MAY OR MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS
5. ELEVATIONS REFER TO L.I.R.R. DATUM, ON WHICH ELEVATION 300 IS EQUAL TO ELEVATION -0.025 ON THE BOROUGH OF MANHATTAN DATUM.
6. LOCATIONS AND GROUND SURFACE ELEVATIONS OF BORINGS WERE DETERMINED BY SEELYE, STEVENSON, VALUE AND KNECHT, INC.

GENERAL STRATA DESCRIPTIONS

Ⓕ - FILL: LOOSE TO COMPACT GRAY-BROWN FINE TO COARSE SAND AND GRAVEL, SOME SILT WITH CINDERS, BRICK AND CONCRETE.

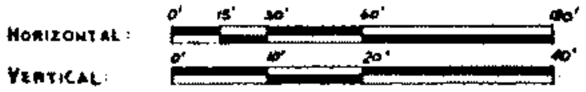
Ⓞ - ORGANIC: SOFT TO MEDIUM DARK GRAY ORGANIC SILTY CLAY TO CLAYEY SILT WITH FINE SAND SEAMS.

Ⓢ - SAND AND SILT: MEDIUM COMPACT TO COMPACT RED-BROWN SILT OR CLAYEY SILT WITH LAYERS OF SILTY FINE SAND TO SILTY FINE TO COARSE SAND, SOME GRAVEL.

Ⓣ - GLACIAL TILL: VERY COMPACT RED-BROWN SILTY FINE TO COARSE SAND, SOME GRAVEL WITH BOULDERS.

Ⓡ - BEDROCK: MODERATELY JOINTED AND FRACTURED MICA SCHIST WITH QUARTZITE SEAMS.

GRAPHIC SCALES



SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

MUESER-RUTLEDGE-JOHNSTON & DESIMONE
CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK, N.Y. 10017

L.I.R.R.
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

REV. NO.	DESCRIPTION	DATE

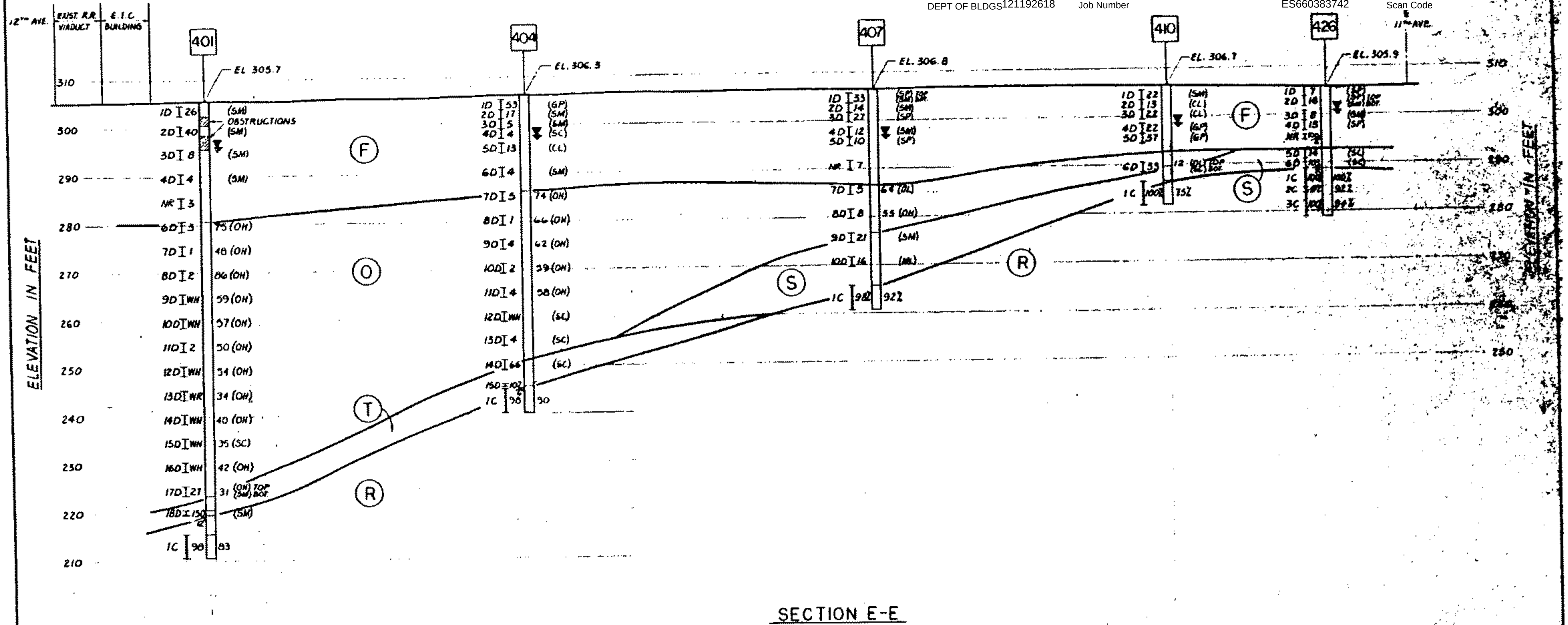
WEST SIDE STORAGE YARD COMPLEX

GEOLOGIC SECTION D-D

CONTRACT NO. 5385
DATE JULY, 16, 1981
SCALE GRAPHIC
DRAWING NO. GS-3
SHEET [illegible]

DEPT OF BLDGS 121192618 Job Number

ES660383742 Scan Code



SECTION E-E

GENERAL STRATA DESCRIPTIONS

Ⓕ – FILL: LOOSE TO COMPACT GRAY - BROWN FINE TO COARSE SAND AND GRAVEL, SOME SILT WITH CINDERS, BRICK AND CONCRETE.

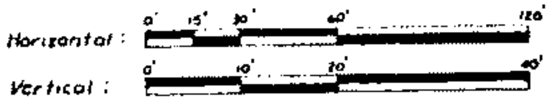
Ⓞ – ORGANIC: SOFT TO MEDIUM DARK GRAY ORGANIC SILTY CLAY TO CLAYEY SILT WITH FINE SAND SEAMS.

Ⓢ – SAND AND SILT: MEDIUM COMPACT TO COMPACT RED - BROWN SILT OR CLAYEY SILT WITH LAYERS OF SILTY FINE SAND TO SILTY FINE TO COARSE SAND, SOME GRAVEL.

Ⓣ – GLACIAL TILL: VERY COMPACT RED-BROWN SILTY FINE TO COARSE SAND, SOME GRAVEL WITH BOULDERS.

Ⓡ – BEDROCK: MODERATELY JOINTED AND FRACTURED MICA SCHIST WITH QUARTZITE SEAMS.

GRAPHIC SCALES



SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

MUESER - RUTLEDGE - JOHNSTON & DESIMONE
CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK, N.Y. 10017

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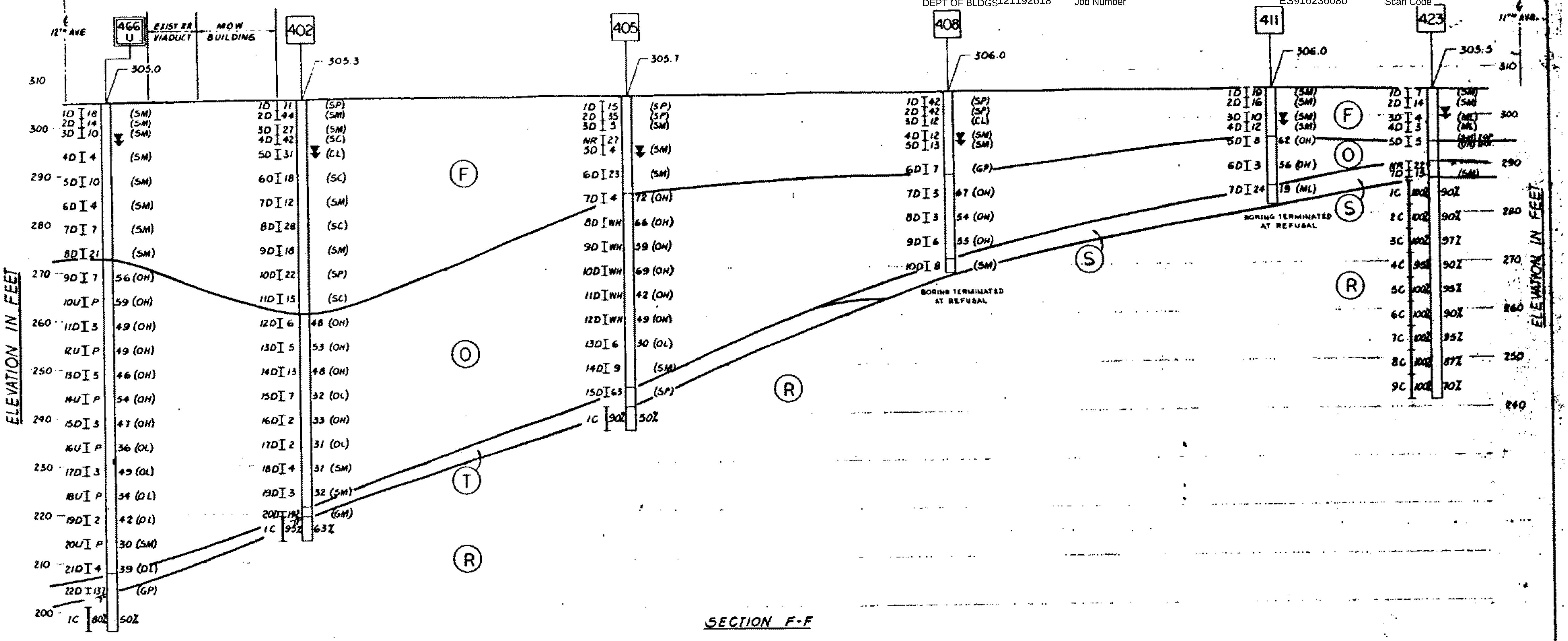
Authority

REV. NO.	DESCRIPTION	DATE

WEST SIDE STORAGE YARD COMPLEX

GEOLOGIC SECTION E-E

CONTRACT NO. 5305
DATE JULY 16, 198
SCALE GRAPHIC
DRAWING NO. GS-4
SHEET 6



SECTION F-F

GENERAL STRATA DESCRIPTIONS

- (F) – FILL: LOOSE TO COMPACT GRAY - BROWN FINE TO COARSE SAND AND GRAVEL, SOME SILT WITH CINDERS, BRICK AND CONCRETE.
- (O) – ORGANIC: SOFT TO MEDIUM DARK GRAY ORGANIC SILTY CLAY TO CLAYEY SILT WITH FINE SAND SEAMS.
- (S) – SAND AND SILT: MEDIUM COMPACT TO COMPACT RED-BROWN SILT OR CLAYEY SILT WITH LAYERS OF SILTY FINE SAND TO SILTY FINE TO COARSE SAND, SOME GRAVEL.
- (T) – GLACIAL TILL: VERY COMPACT RED-BROWN SILTY FINE TO COARSE SAND, SOME GRAVEL WITH BOULDERS.
- (R) – BEDROCK: MODERATELY JOINTED AND FRACTURED MICA SCHIST WITH QUARTZITE SEAMS.

GRAPHIC SCALES

RECORD SET

REV NO	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

MUESER-RUTLEDGE-JOHNSTON & DESIMONE
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK. N.Y. 10017

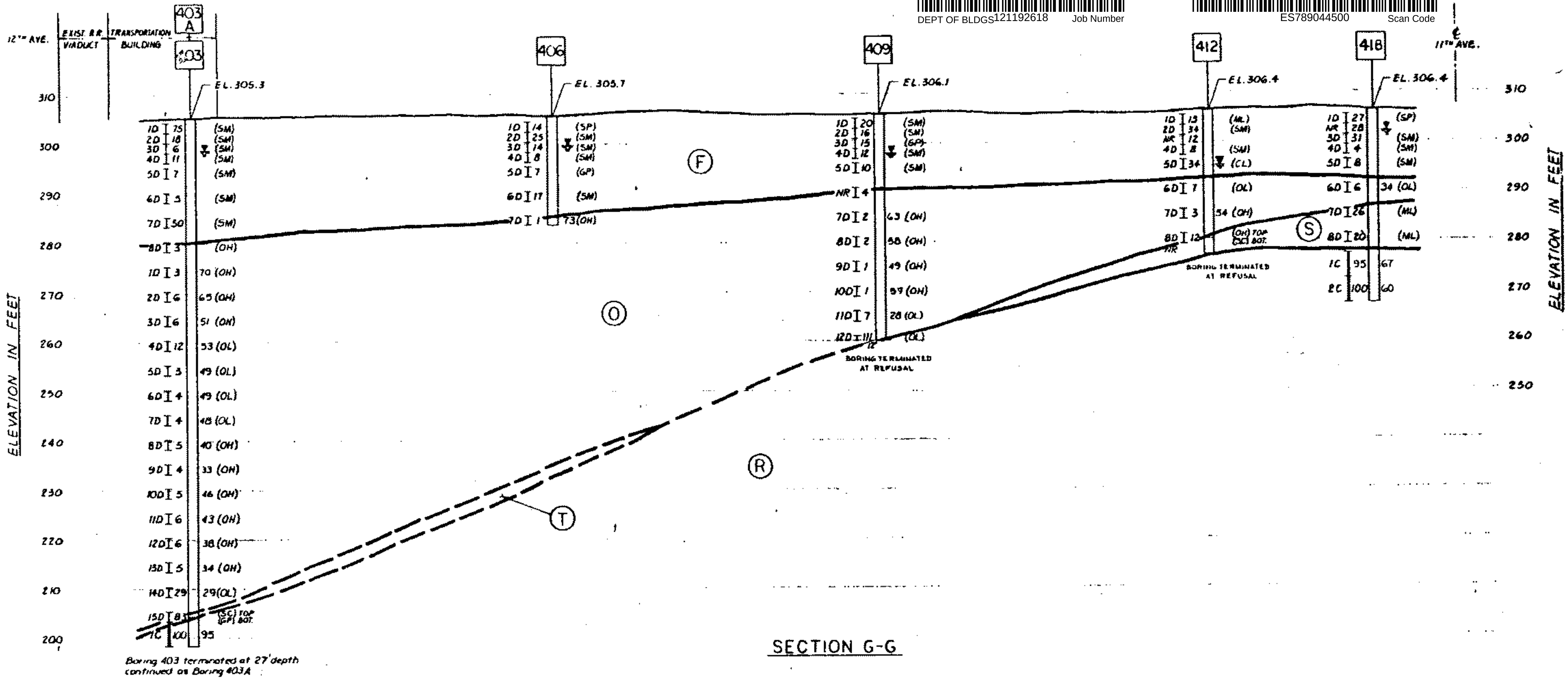
L.I.R.R.
LONG ISLAND RAIL ROAD

Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX

GEOLOGIC SECTION F-F

CONTRACT NO. 5385
DATE JULY, 16, 1981
SCALE GRAPHIC
DRAWING NO. GS-5
SHEET 7 OF 12



SECTION G-G

GENERAL STRATA DESCRIPTIONS

Ⓕ	– FILL: LOOSE TO COMPACT GRAY-BROWN FINE TO COARSE SAND AND GRAVEL, SOME SILT WITH CINDERS, BRICK AND CONCRETE.
Ⓞ	– ORGANIC: SOFT TO MEDIUM DARK GRAY ORGANIC SILTY CLAY TO CLAYEY SILT WITH FINE SAND SEAMS.
Ⓢ	– SAND AND SILT: MEDIUM COMPACT TO COMPACT RED-BROWN SILT OR CLAYEY SILT WITH LAYERS OF SILTY FINE SAND TO SILTY FINE TO COARSE SAND, SOME GRAVEL.
Ⓣ	– GLACIAL TILL: VERY COMPACT RED-BROWN SILTY FINE TO COARSE SAND, SOME GRAVEL WITH BOULDERS.
Ⓡ	– BEDROCK: MODERATELY JOINTED AND FRACTURED MICA SCHIST WITH QUARTZITE SEAMS.

GRAPHIC SCALES

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

MUESER·RUTLEDGE·JOHNSTON & DESIMONE
CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK, N.Y. 10017

L.I.R.R.
LONG
ISLAND
RAIL ROAD

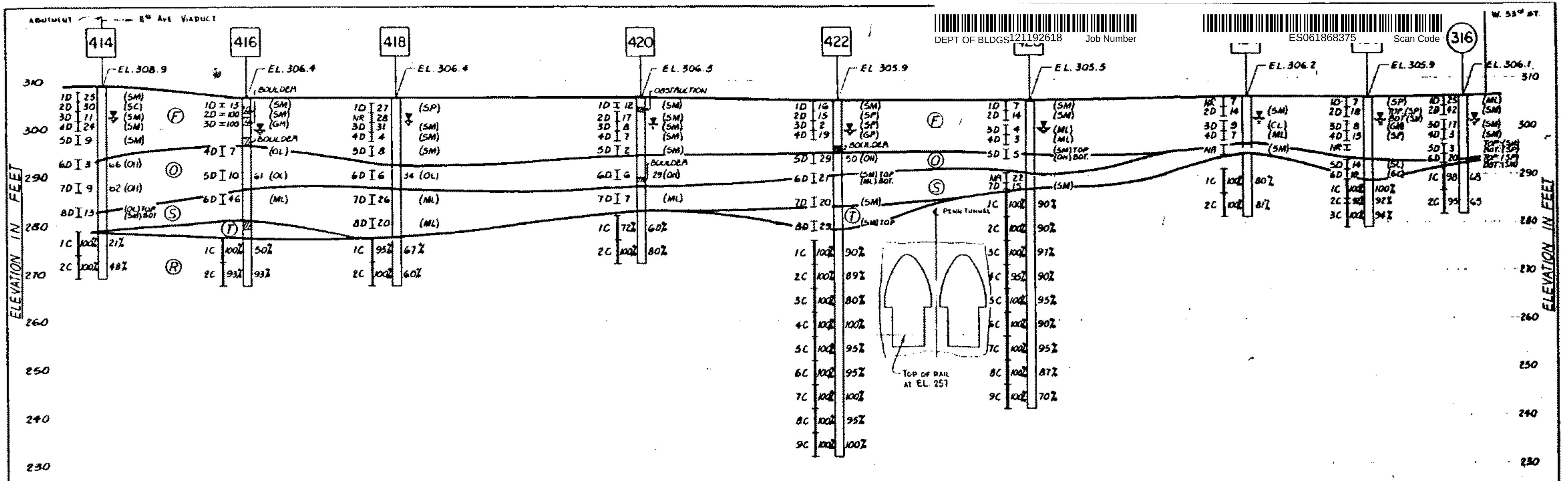
M
Metropolitan
Transportation
Authority

REV NO	DESCRIPTION	DATE

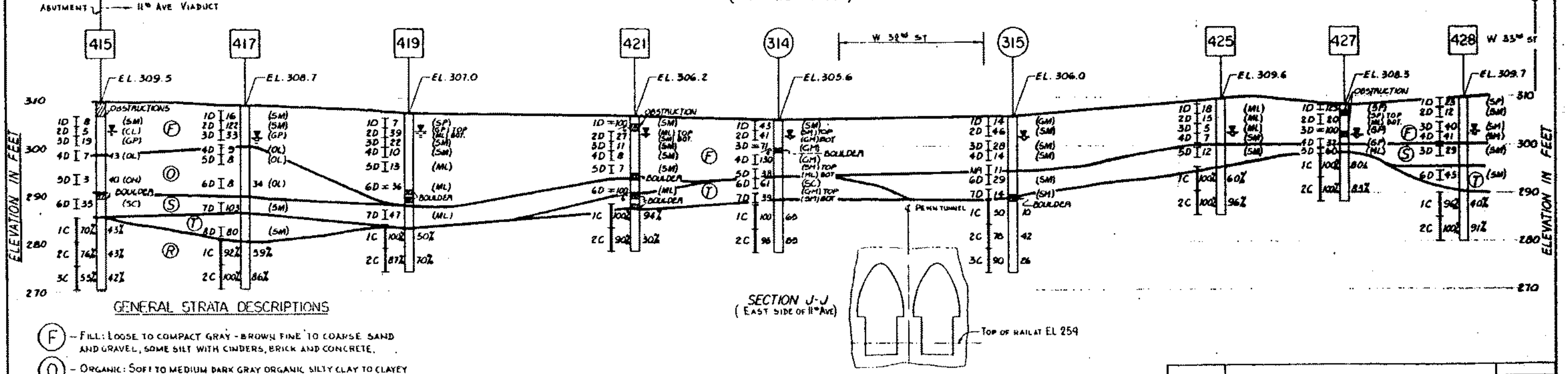
WEST SIDE STORAGE YARD COMPLEX

GEOLOGIC SECTION G-G

CONTRACT NO 5385
DATE JULY, 16, 1981
SCALE GRAPHIC
DRAWING NO. GS-6
SHEET 8 OF 12



SECTION H-H
(WEST SIDE OF 11th AVE)



SECTION J-J
(EAST SIDE OF 11th AVE)

GENERAL STRATA DESCRIPTIONS

- Ⓕ – FILL: LOOSE TO COMPACT GRAY-BROWN FINE TO COARSE SAND AND GRAVEL, SOME SILT WITH CINDERS, BRICK AND CONCRETE.
- Ⓞ – ORGANIC: SOFT TO MEDIUM DARK GRAY ORGANIC SILTY CLAY TO CLAYEY SILT WITH FINE SAND SEAMS.
- Ⓢ – SAND AND SILT: MEDIUM COMPACT TO COMPACT RED-BROWN SILT OR CLAYEY SILT WITH LAYERS OF SILTY FINE SAND TO SILTY FINE TO COARSE SAND, SOME GRAVEL.
- Ⓣ – GLACIAL TILL: VERY COMPACT RED-BROWN SILTY FINE TO COARSE SAND, SOME GRAVEL WITH BOULDERS.
- Ⓡ – BEDROCK: MODERATELY JOINTED AND FRACTURED MICA SCHIST WITH QUARTZITE SEAMS.

HORIZONTAL 0' 20' 40'
VERTICAL 0' 10' 20'

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

MUESER-RUTLEDGE-JOHNSTON & DESIMONE
CONSULTING ENGINEERS
415 MADISON AVE, NEW YORK, N.Y 10017

L.I.R.R.
LONG
ISLAND
RAIL ROAD

M
Metropolitan
Transportation
Authority

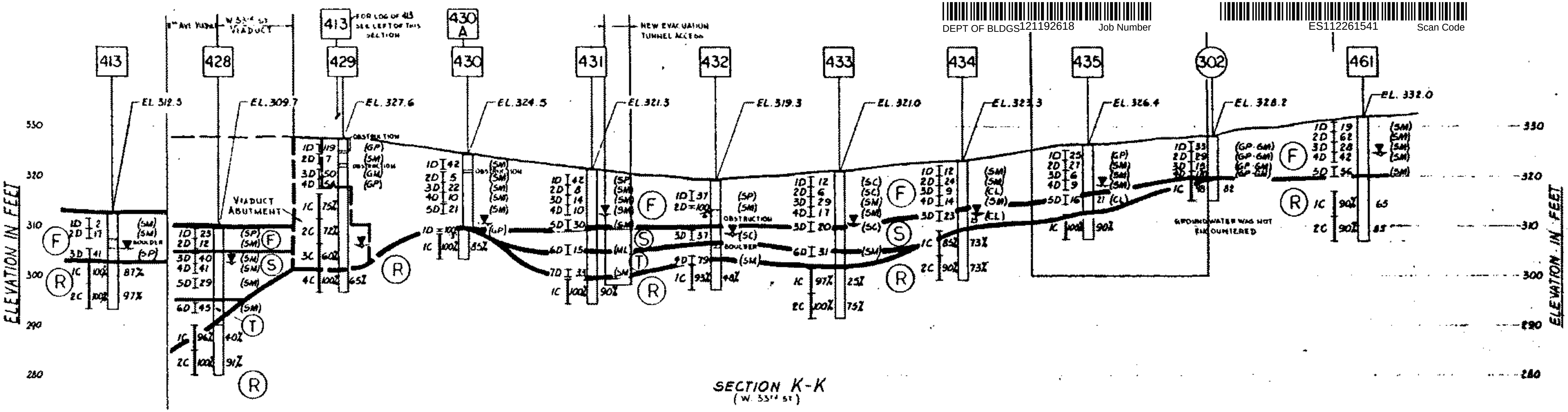
REV NO	DESCRIPTION	DATE

WEST SIDE STORAGE YARD COMPLEX

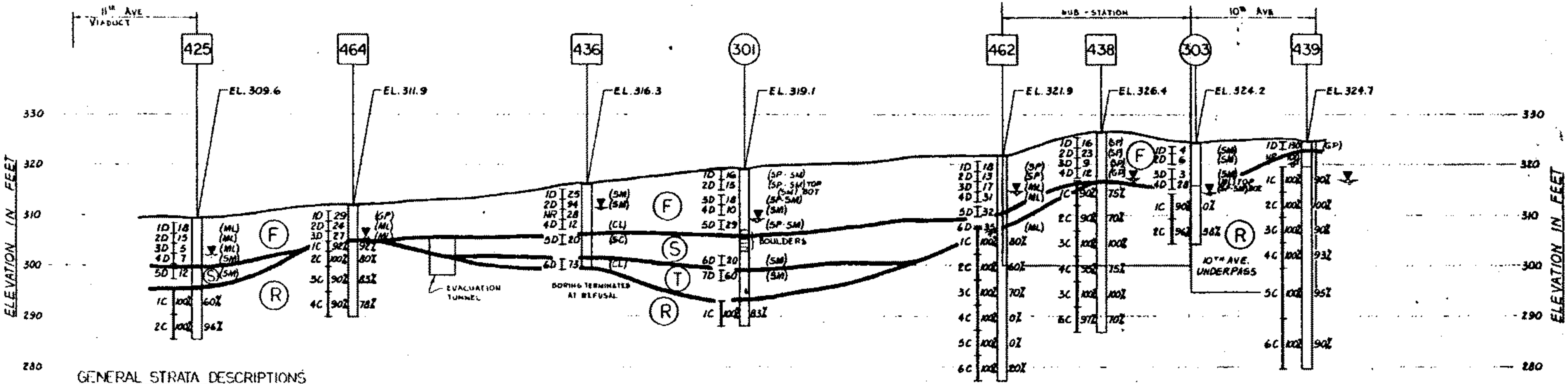
11TH AVENUE VIADUCT
SUBSURFACE PROFILES

GEOLOGIC SECTION H-H & J-J

CONTRACT NO 5385
DATE JULY, 16, 1981
SCALE GRAPHIC
DRAWING NO GS-7
SHEET 9 of 12



SECTION K-K
(W. 33rd ST)



SECTION L-L

GENERAL STRATA DESCRIPTIONS

Ⓕ - FILL: LOOSE TO COMPACT GRAY-BROWN FINE TO COARSE SAND AND GRAVEL, SOME SILT WITH CINDERS, BRICK AND CONCRETE.

Ⓞ - ORGANIC: SOFT TO MEDIUM DARK GRAY ORGANIC SILTY CLAY TO CLAYEY SILT WITH FINE SAND SEAMS.

Ⓢ - SAND AND SILT: MEDIUM COMPACT TO COMPACT RED-BROWN SILT OR CLAYEY SILT WITH LAYERS OF SILTY FINE SAND TO SILTY FINE TO COARSE SAND, SOME GRAVEL.

Ⓣ - GLACIAL TILL: VERY COMPACT RED-BROWN SILTY FINE TO COARSE SAND, SOME GRAVEL WITH BOULDERS.

Ⓡ - BEDROCK: MODERATELY JOINTED AND FRACTURED MICA SCHIST WITH QUARTZITE SEAMS.

GRAPHIC SCALES

HORIZONTAL: 0' 20' 40' 80' 100'

VERTICAL: 0' 10' 20' 40'

REV NO	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

MUESER-RUTLEDGE-JOHNSTON & DESIMONE
CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK, N.Y. 10017

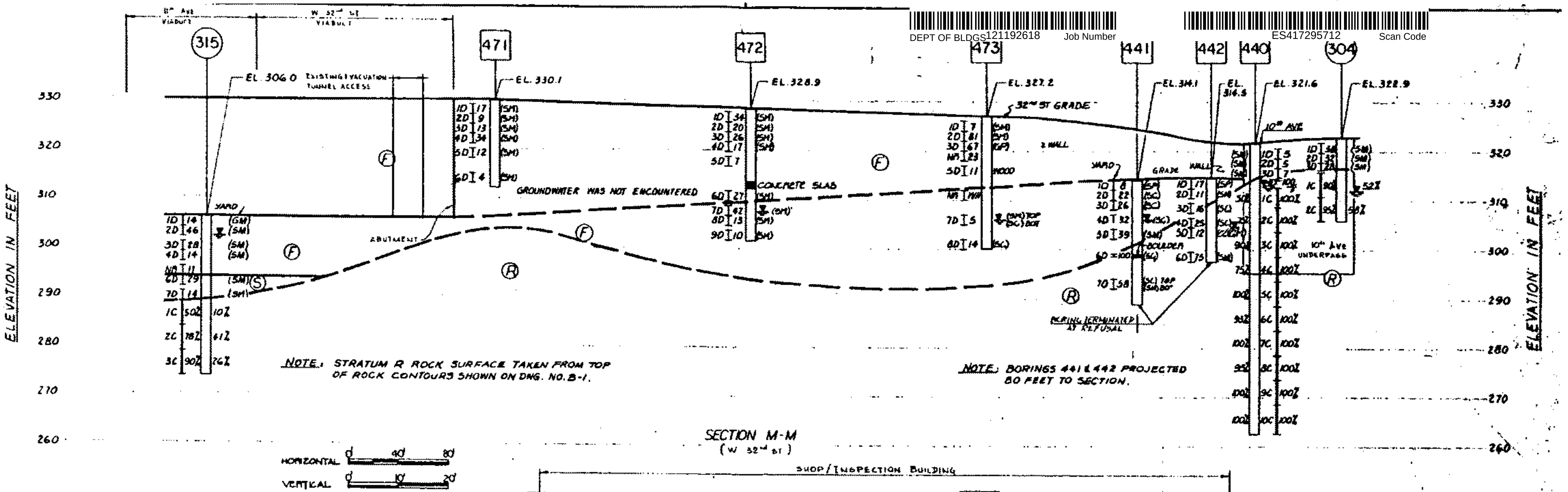
L.I.R.R.
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

WEST SIDE STORAGE YARD COMPLEX

GEOLOGIC SECTION K-K & L-L

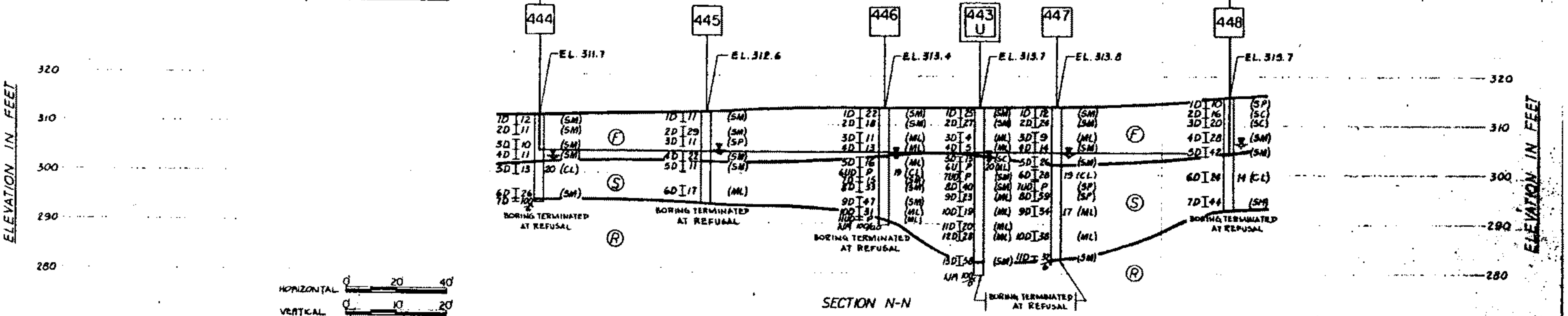
CONTRACT NO 5385
DATE JULY 16, 1981
SCALE GRAPHIC
DRAWING NO GS-8
SHEET 10 OF 12



NOTE: STRATUM R ROCK SURFACE TAKEN FROM TOP OF ROCK CONTOURS SHOWN ON DWG. NO. B-1.

NOTE: BORINGS 441 & 442 PROJECTED 80 FEET TO SECTION.

SECTION M-M
(W 32nd ST)



SECTION N-N

GENERAL STRATA DESCRIPTIONS

Ⓕ – FILL: LOOSE TO COMPACT GRAY-BROWN FINE TO COARSE SAND AND GRAVEL, SOME SILT WITH CINDERS, BRICK AND CONCRETE.

Ⓞ – ORGANIC: SOFT TO MEDIUM DARK GRAY ORGANIC SILTY CLAY TO CLAYEY SILT WITH FINE SAND SEAMS.

Ⓢ – SAND AND SILT: MEDIUM COMPACT TO COMPACT RED-BROWN SILT OR CLAYEY SILT WITH LAYERS OF SILTY FINE SAND TO SILTY FINE TO COARSE SAND, SOME GRAVEL.

Ⓣ – GLACIAL TILL: VERY COMPACT RED-BROWN SILTY FINE TO COARSE SAND, SOME GRAVEL WITH BOULDERS.

Ⓡ – BEDROCK: MODERATELY JOINTED AND FRACTURED MICA SCHIST WITH QUARTZITE SEAMS.

REV NO	DESCRIPTION	DATE
1	REVISED ROCK SURFACE-SECTION M-M	1-19-81

SEELYE STEVENSON VALUE & KNECHT, INC.
ENGINEERS & PLANNERS
99 PARK AVENUE NEW YORK, N.Y. 10016

MUESER-RUTLEDGE-JOHNSTON & DESIMONE
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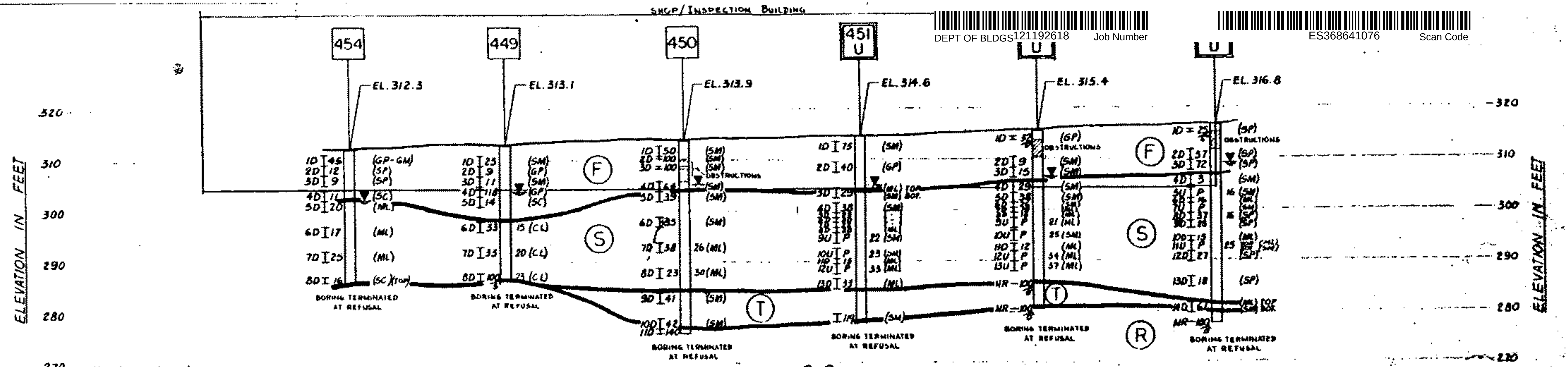
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

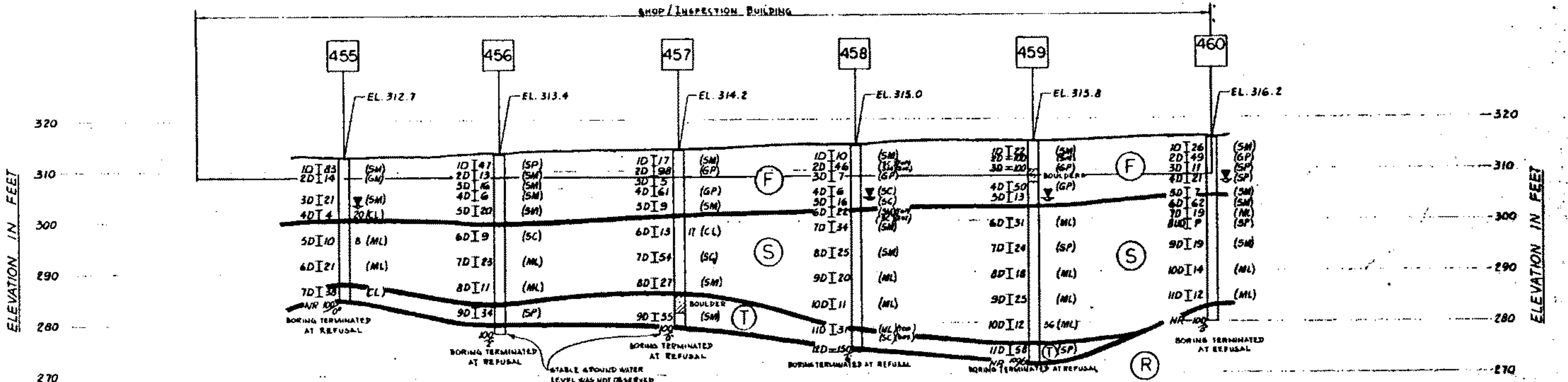
WEST SIDE STORAGE YARD COMPLEX

GEOLOGIC SECTION M-M & N-N

CONTRACT NO. 5385
DATE JULY 16, 1981
SCALE GRAPHIC
DRAWING NO. GS-9
SHEET 11 OF 12



SECTION O-O



SECTION P-P

GENERAL STRATA DESCRIPTIONS

- Ⓕ – FILL: LOOSE TO COMPACT GRAY - BROWN FINE TO COARSE SAND AND GRAVEL, SOME SILT WITH CINDERS, BRICK AND CONCRETE.
- Ⓞ – ORGANIC: SOFT TO MEDIUM DARK GRAY ORGANIC SILTY CLAY TO CLAYEY SILT WITH FINE SAND SEAMS.
- Ⓢ – SAND AND SILT: MEDIUM COMPACT TO COMPACT RED · BROWN SILT OR CLAYEY SILT WITH LAYERS OF SILTY FINE SAND TO SILTY FINE TO COARSE SAND, SOME GRAVEL.
- Ⓣ – GLACIAL TILL: VERY COMPACT RED · BROWN SILTY FINE TO COARSE SAND, SOME GRAVEL WITH BOULDERS.
- Ⓡ – BEDROCK: MODERATELY JOINTED AND FRACTURED MICA SCHIST WITH QUARTZITE SEAMS.

GRAPHIC SCALES

REV. NO.	DESCRIPTION	DATE

SEELYE STEVENSON VALUE & KNECHT, INC.
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L.I.R.R.
LONG ISLAND RAIL ROAD

M
Metropolitan Transportation Authority

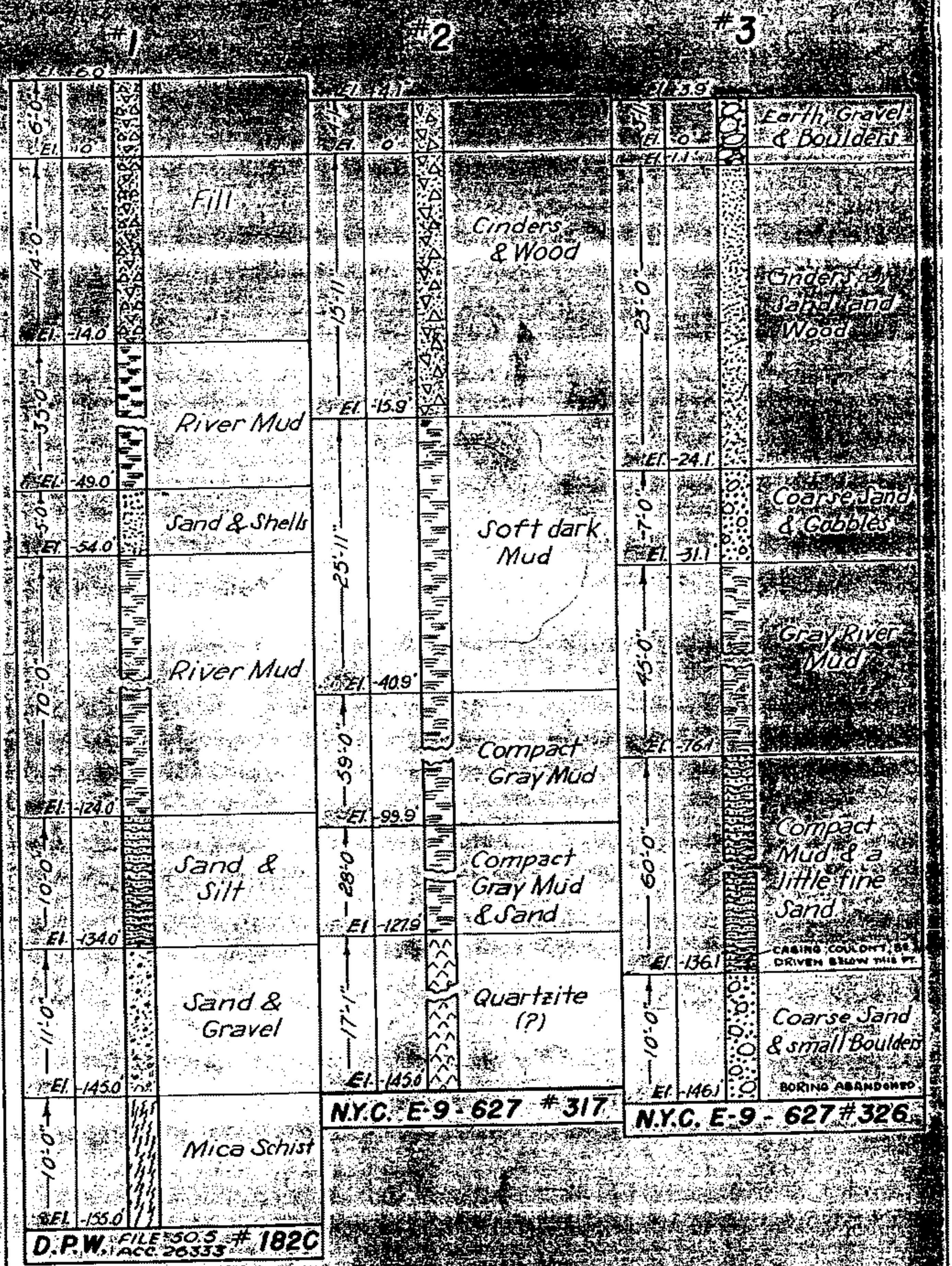
WEST SIDE STORAGE YARD COMPLEX

GEOLOGIC SECTION O-O & P-P

CONTRACT NO. [illegible]
DATE JULY 16, 1981
SCALE GRAPHIC
DRAWING NO. 66-10
SHEET [illegible] OF [illegible]

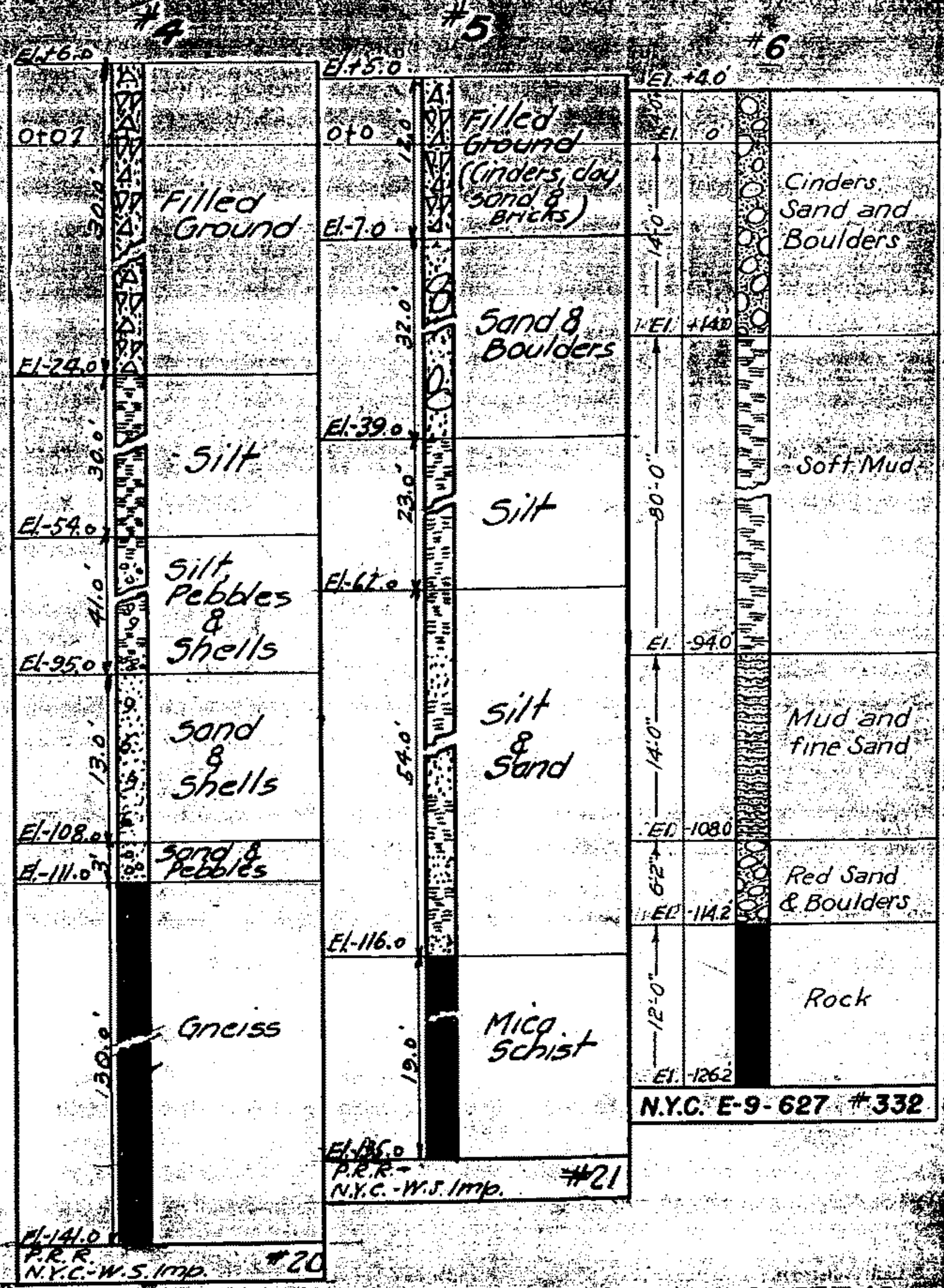
New York City
Department of Design and Construction

Borings Per Location Plan
Volume 2, Sheet 10



ROCK DATA

VOL. 2 SHEET 10



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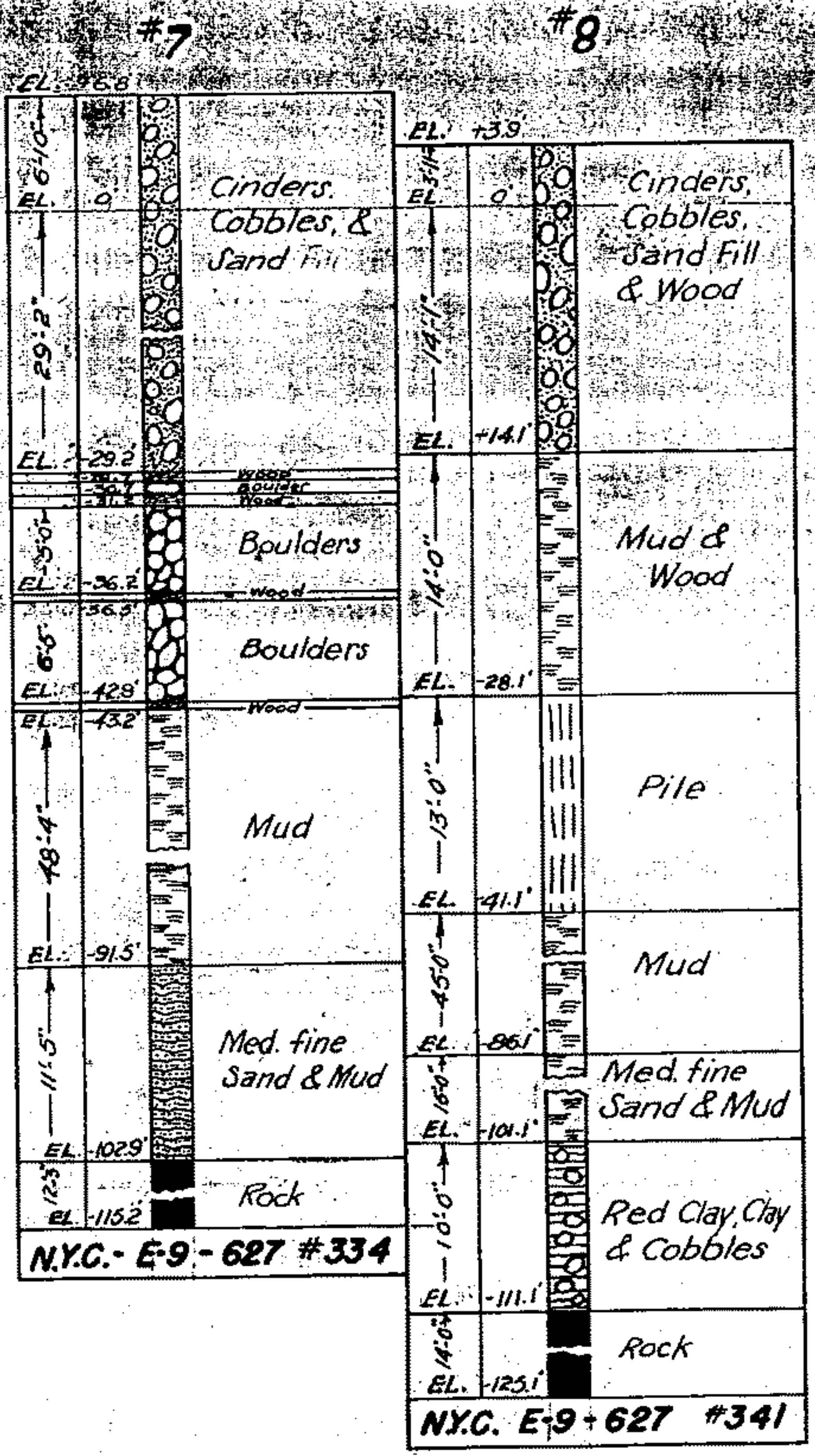

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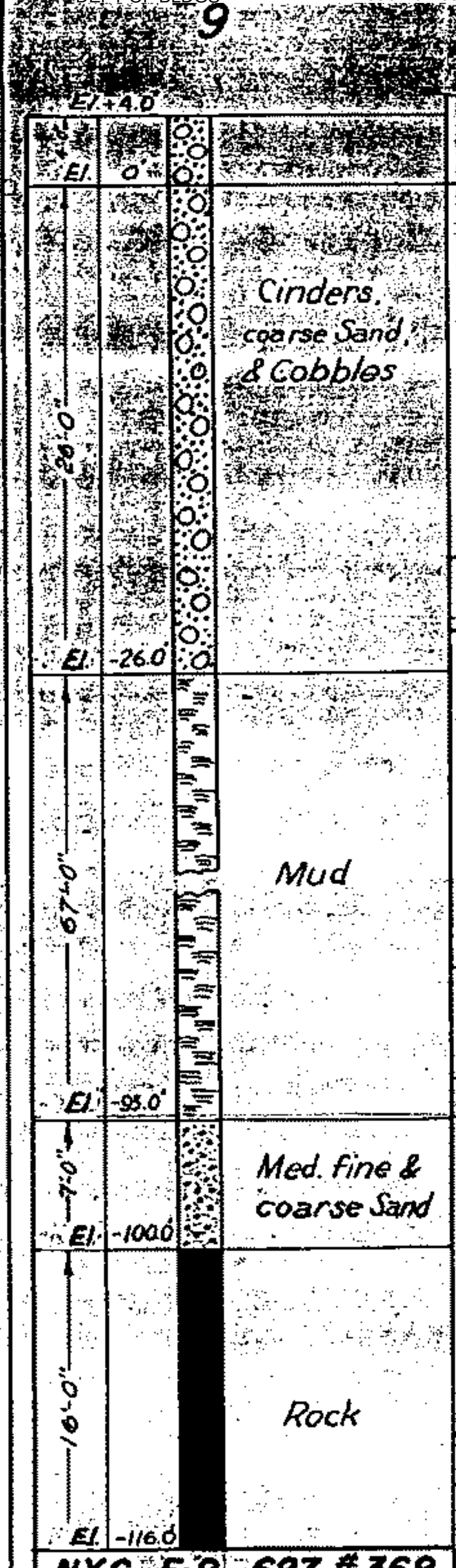

N.Y.C. E-9 - 627 #369

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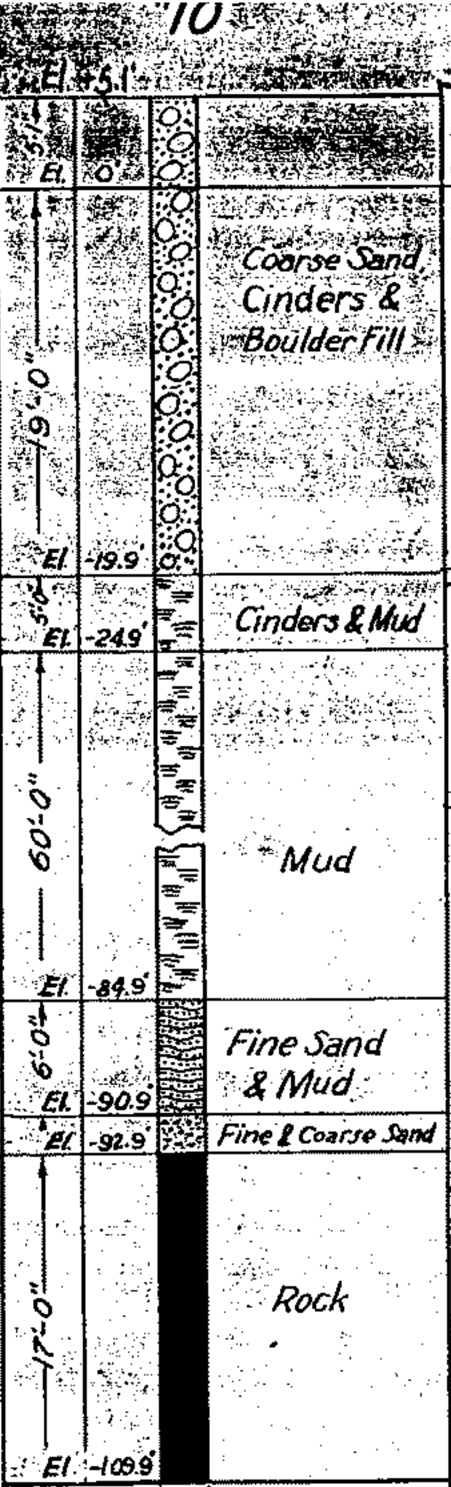

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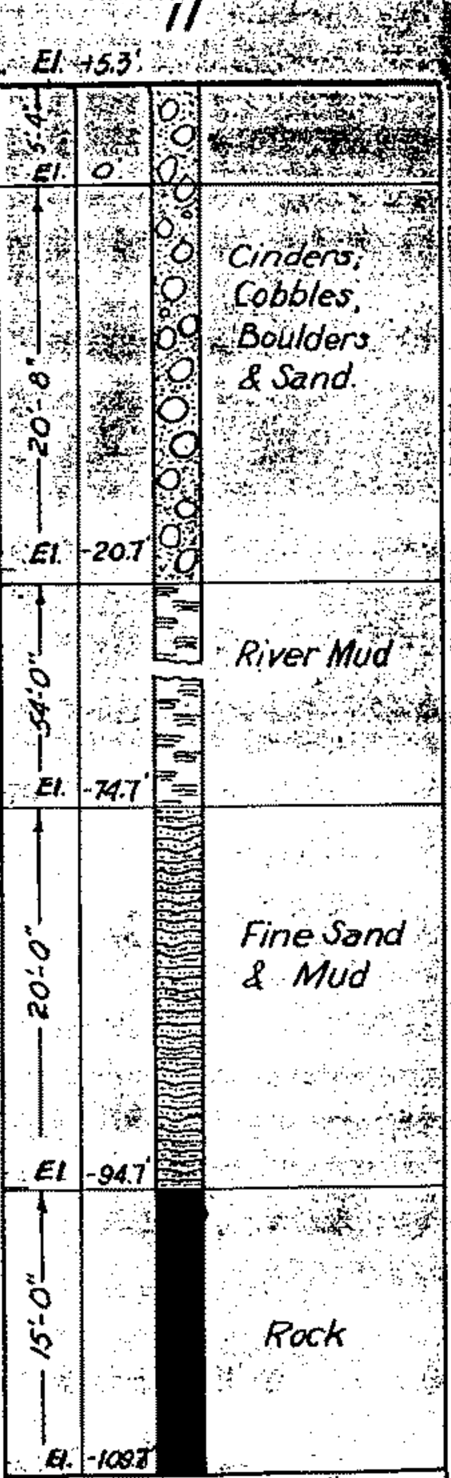

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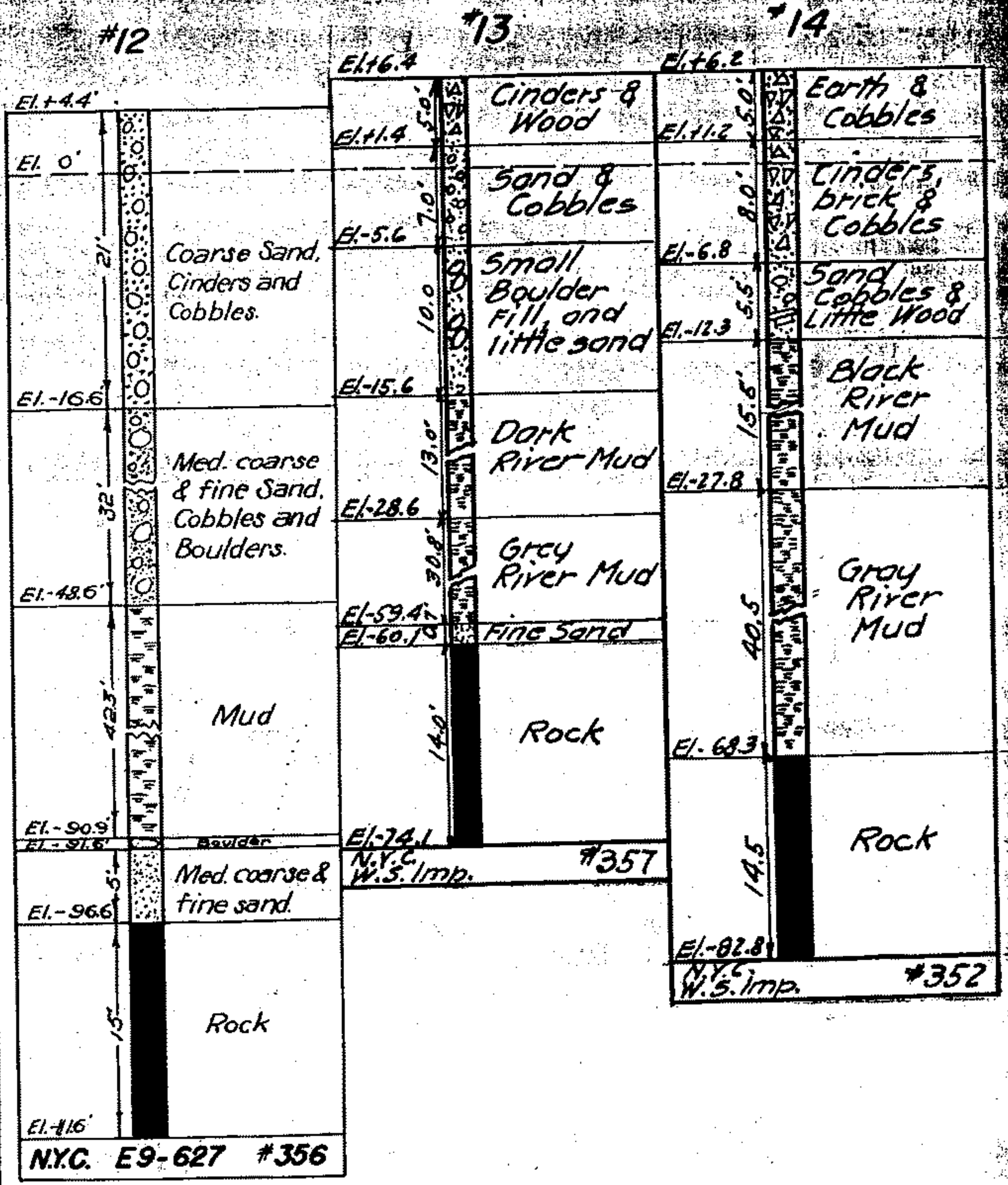

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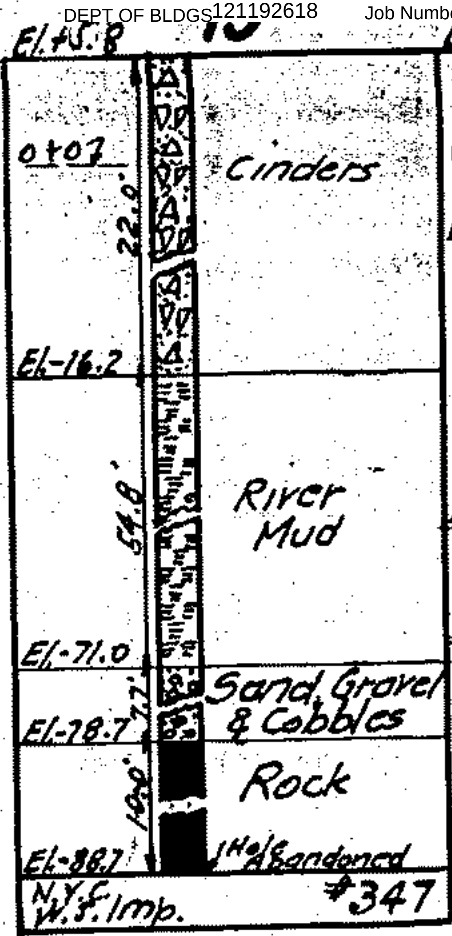

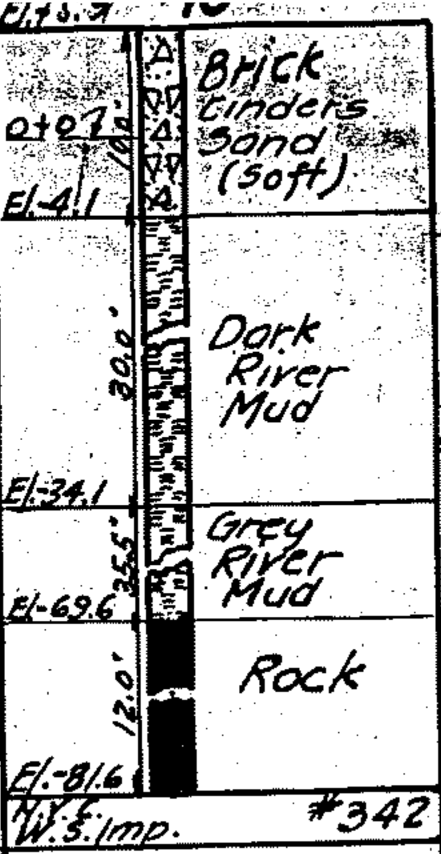

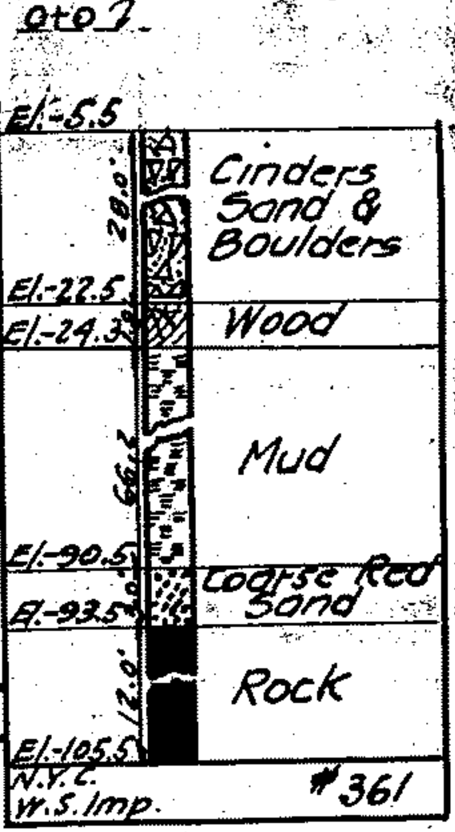

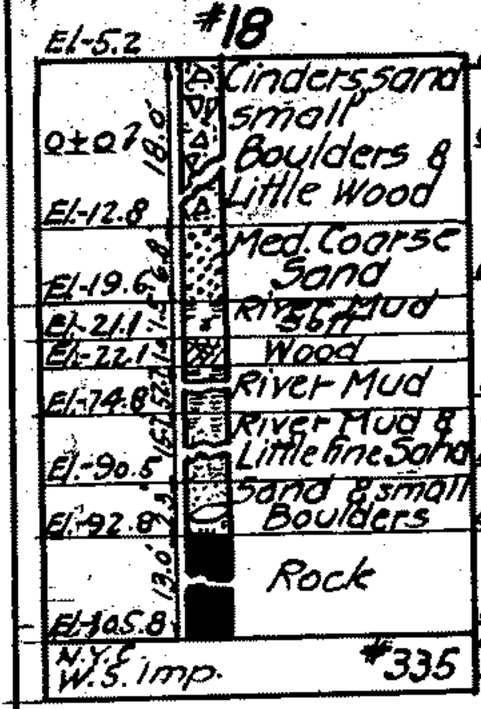

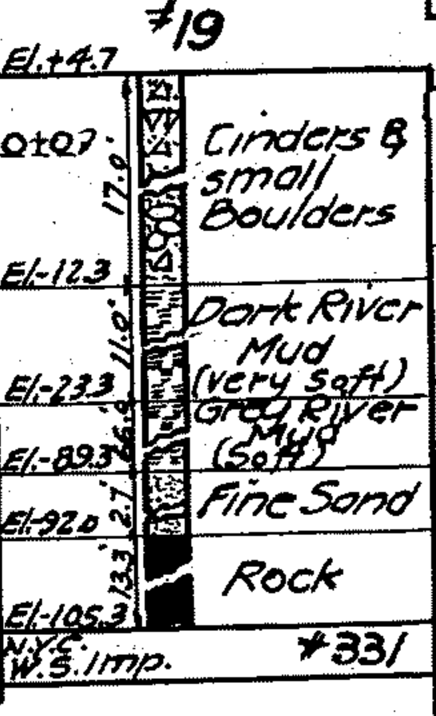

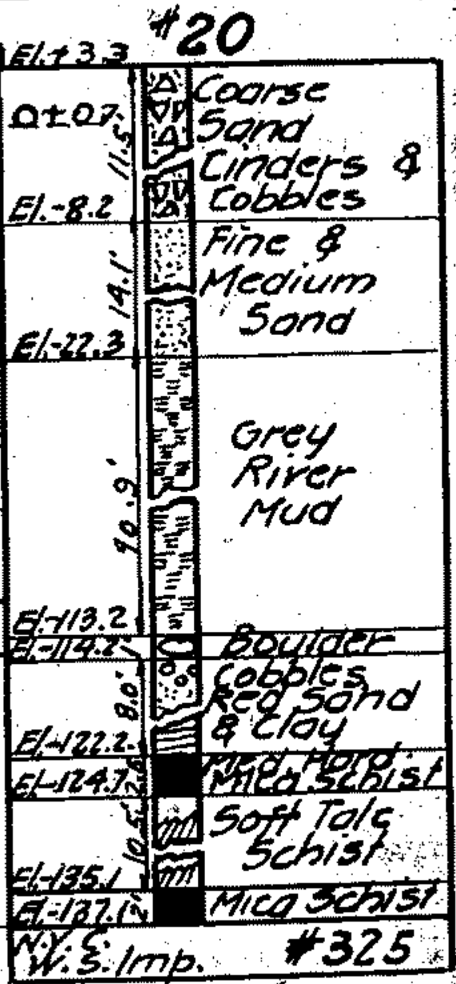

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VOL. 2 SH. 10

Ch. B 11-19-34

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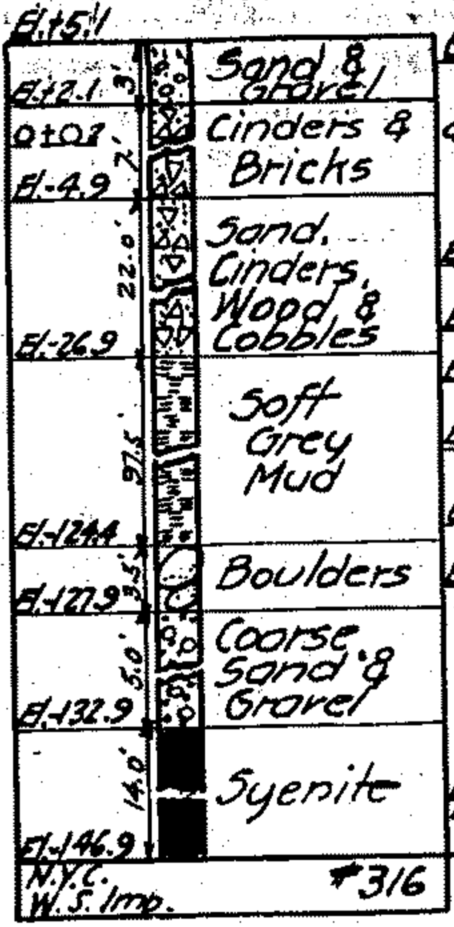

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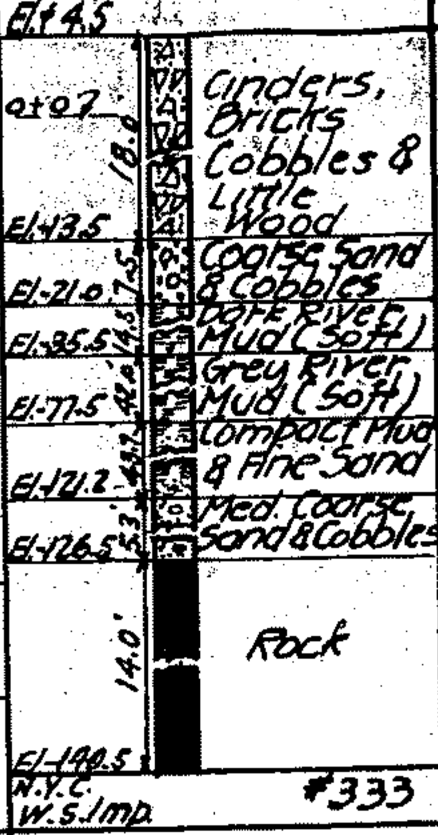

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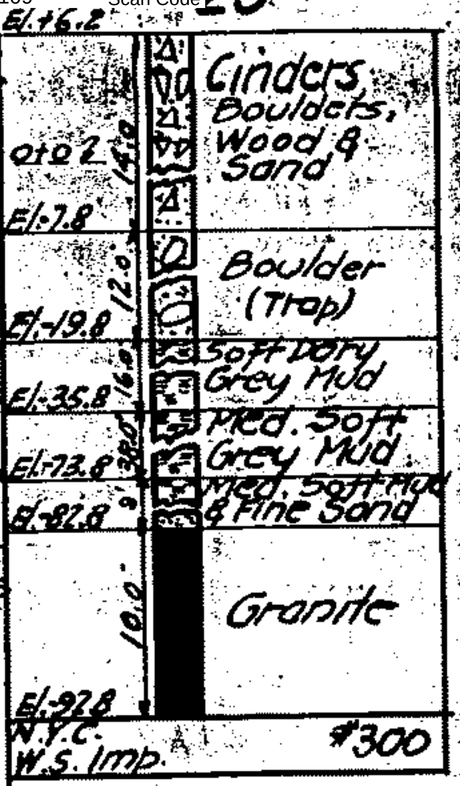

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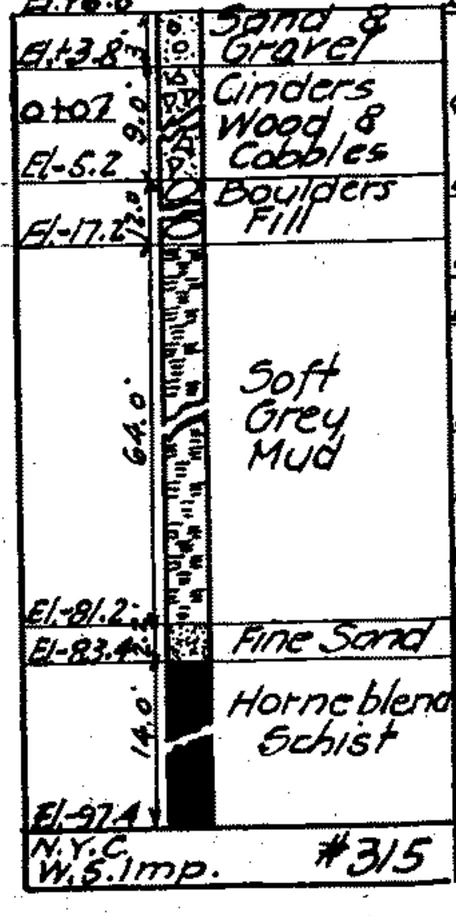

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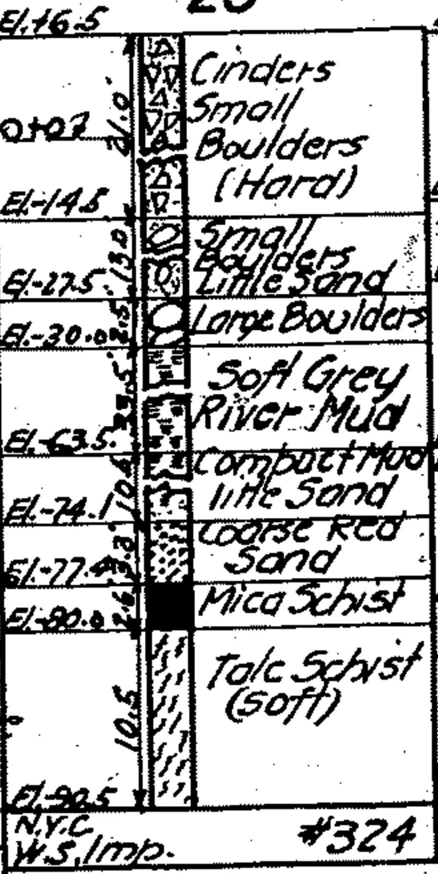

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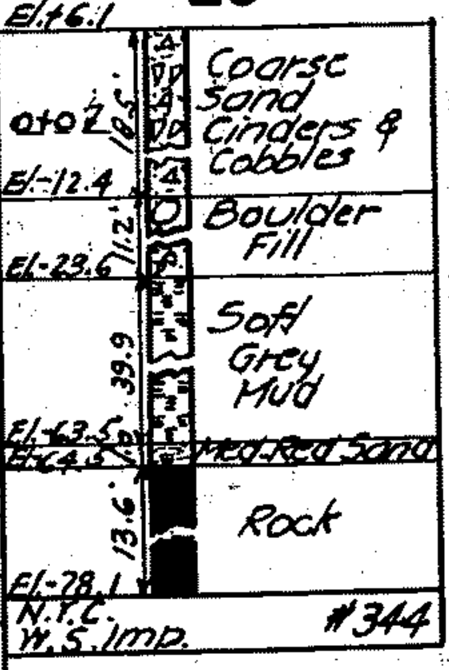

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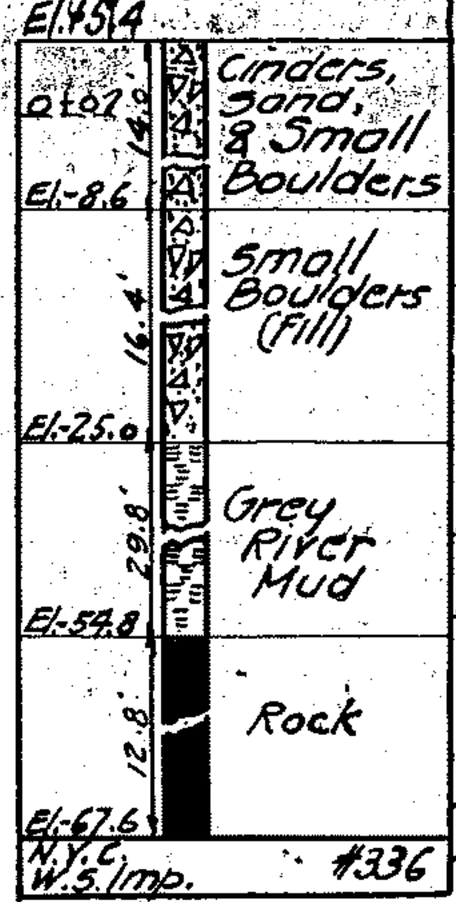
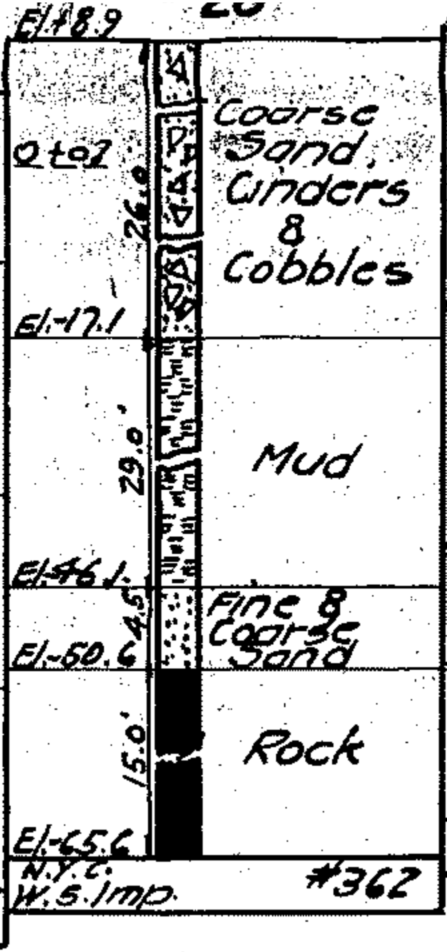
VOL. 2 SH. 10





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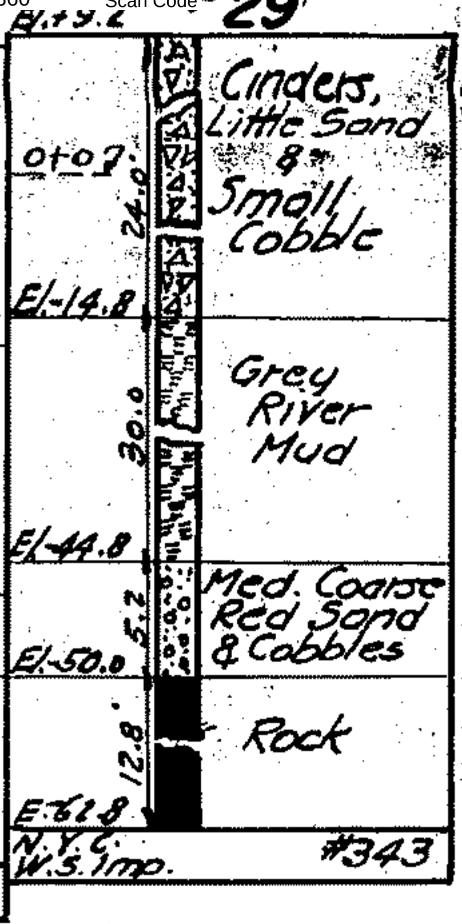

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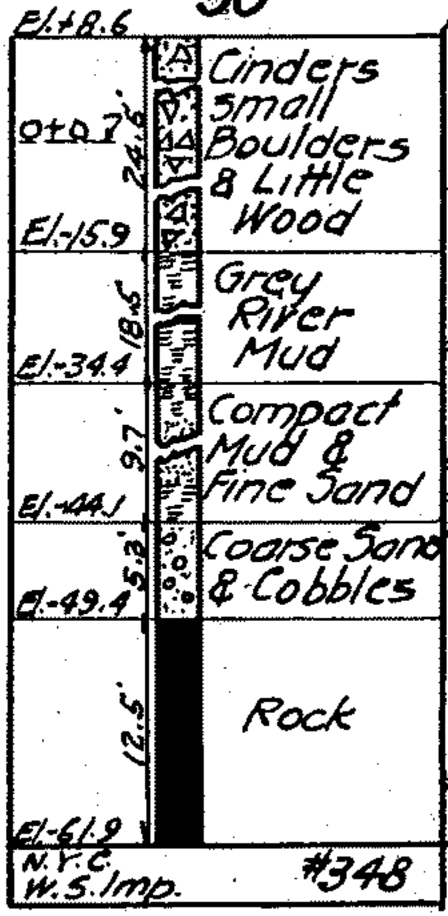

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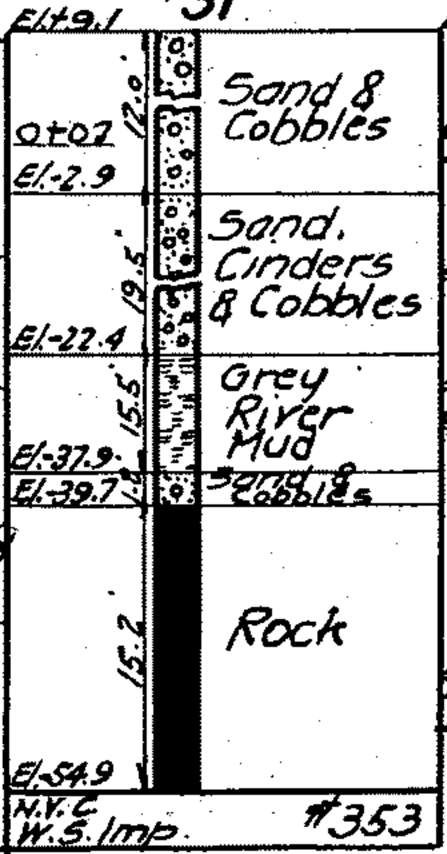

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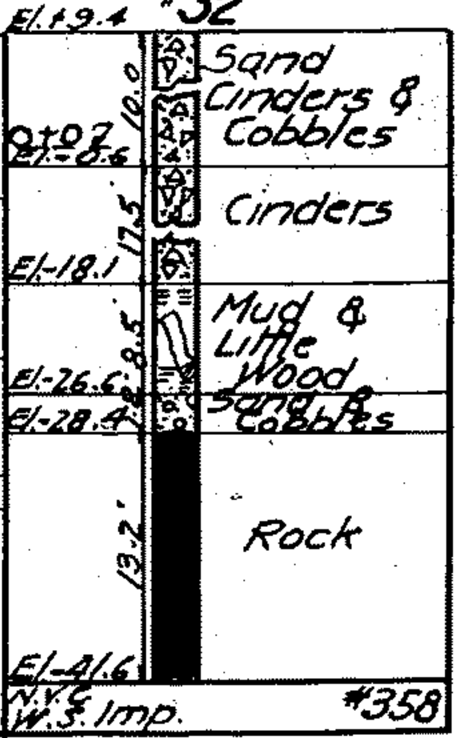

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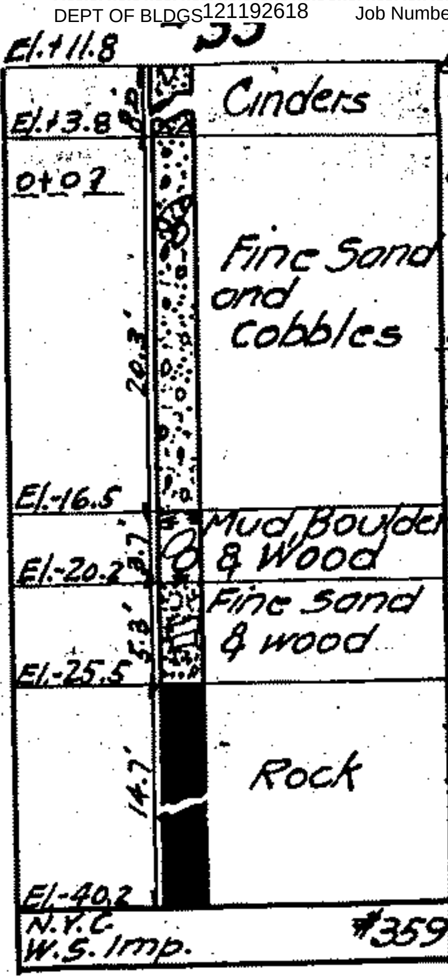
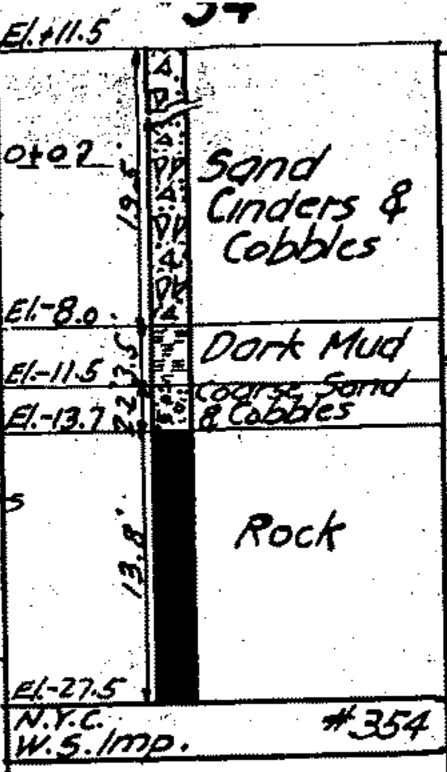
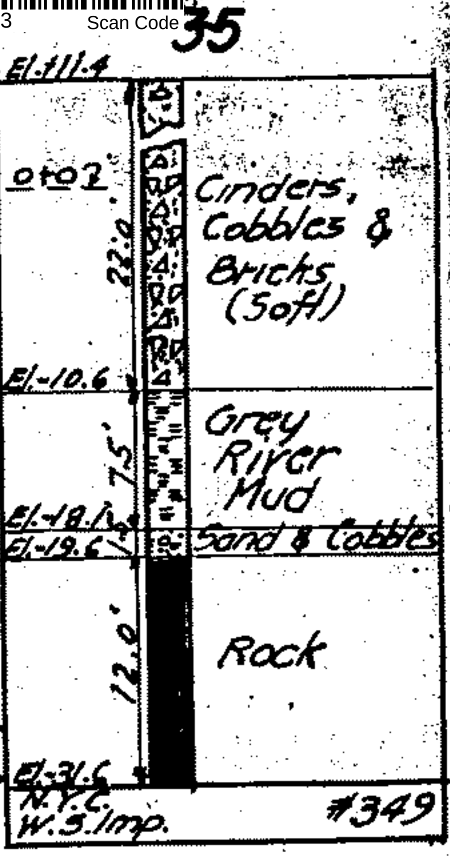
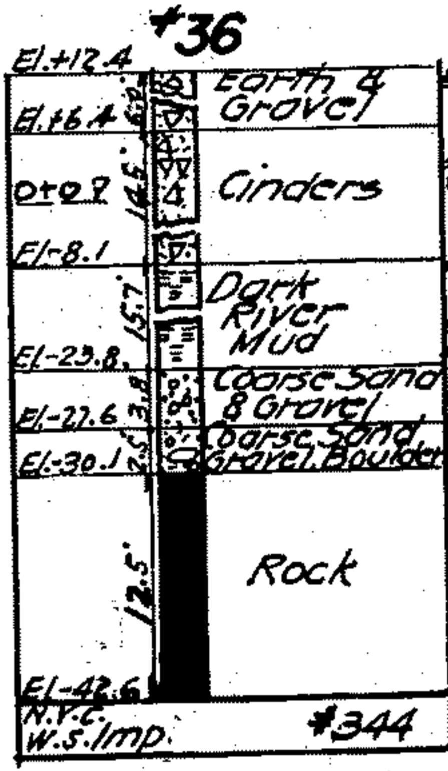
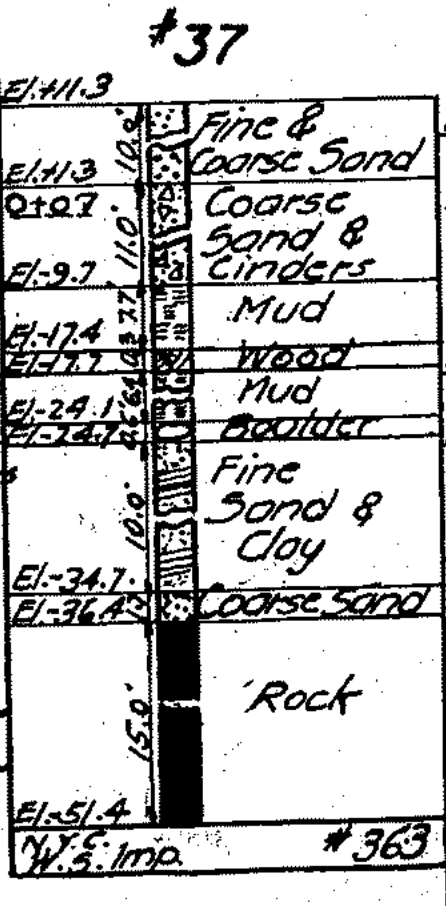
VOL. 2 SH. 10

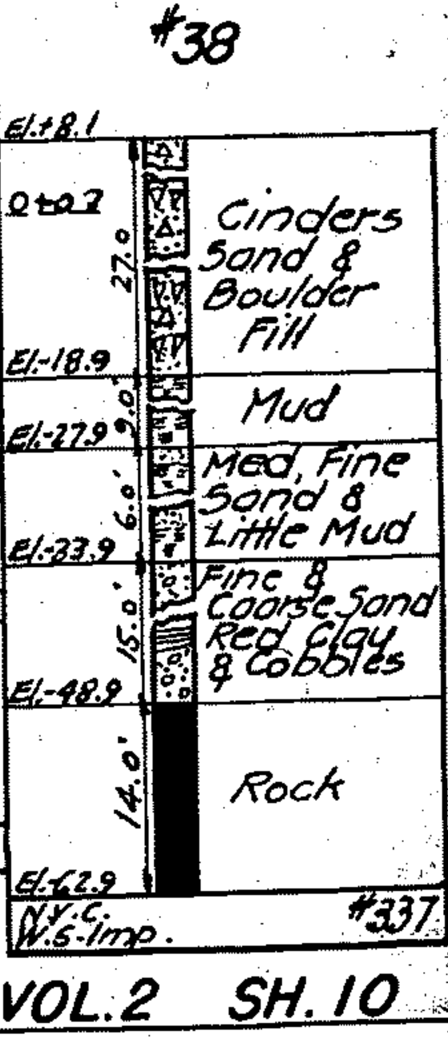












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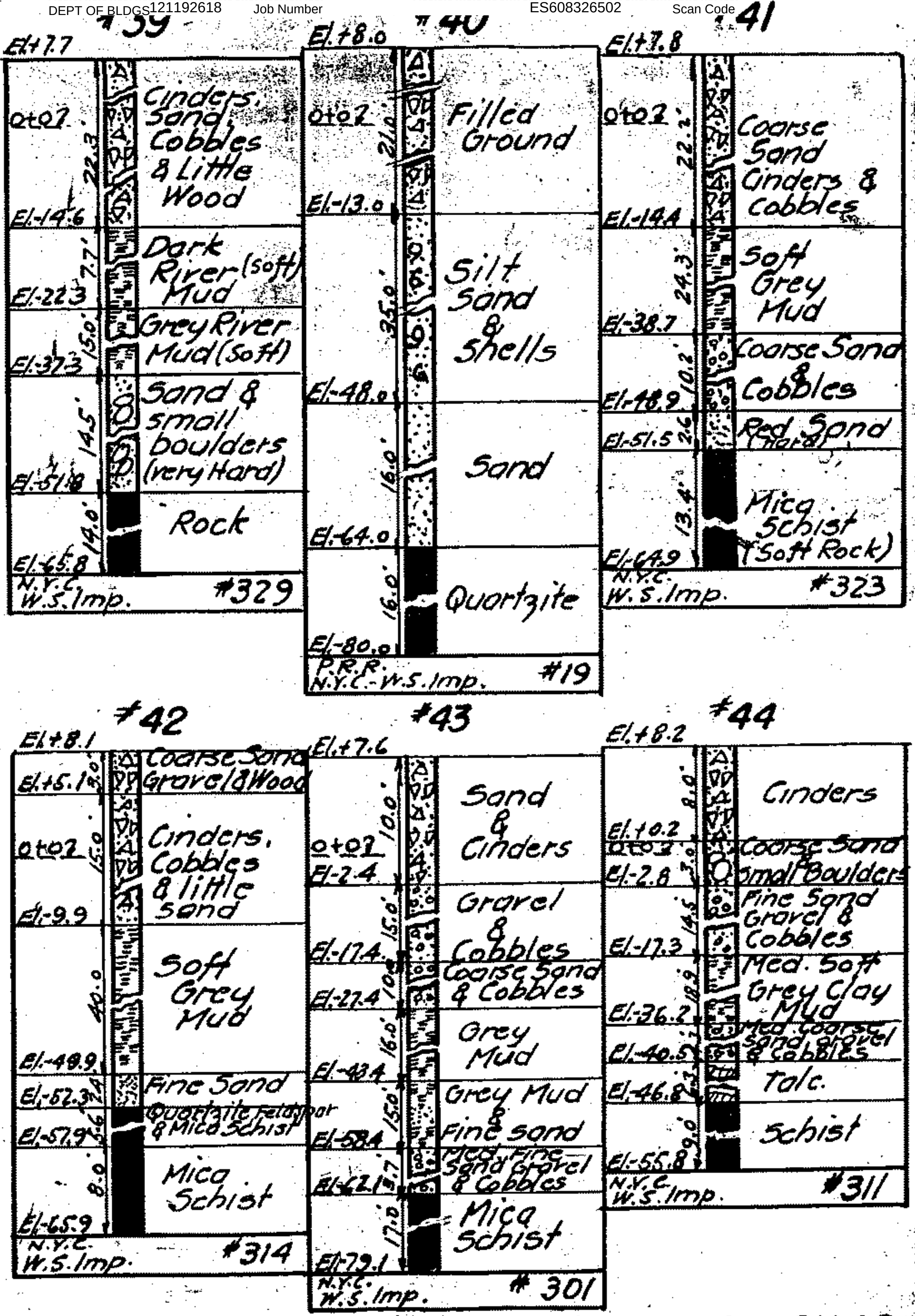
VOL.2 SH.10



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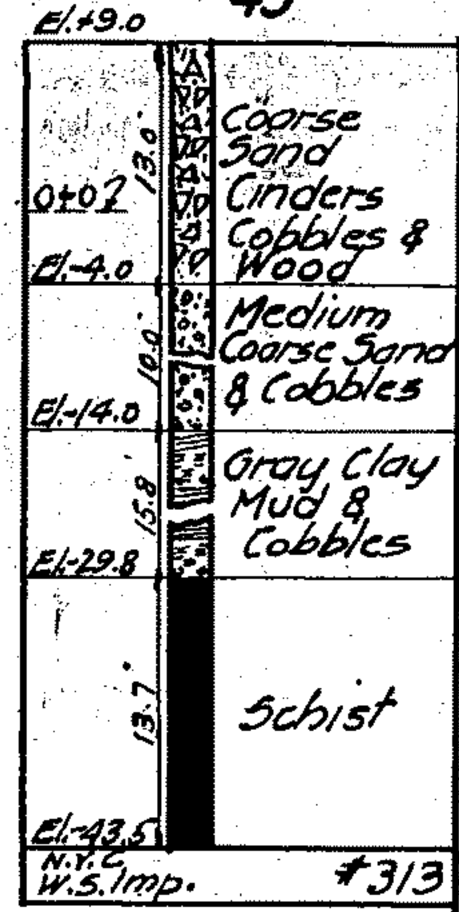

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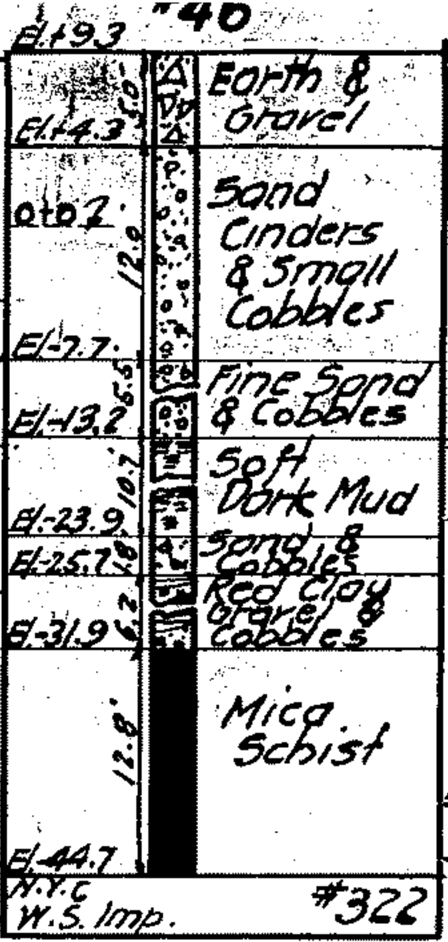

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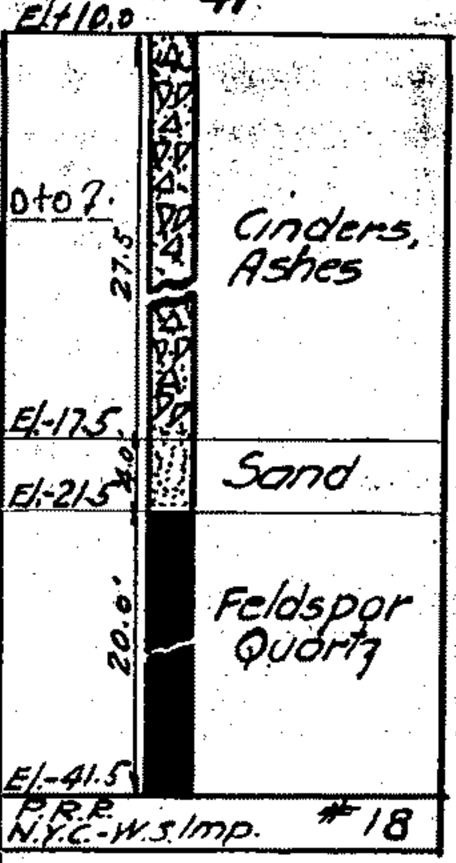

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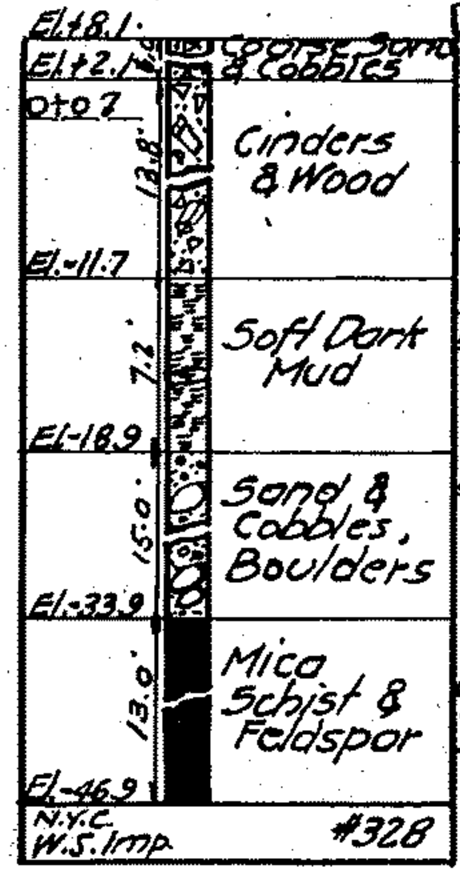

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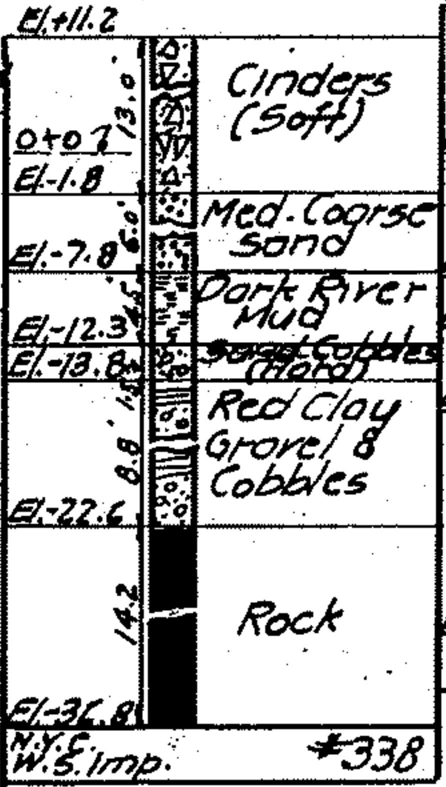

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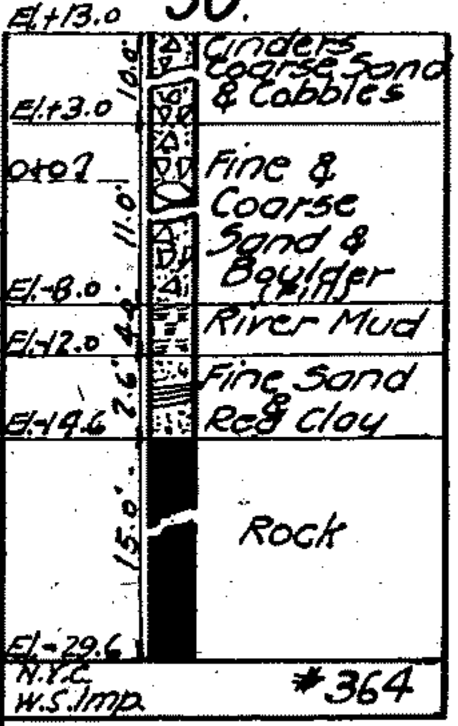

ROCK DATA

VOL.2 SH.10

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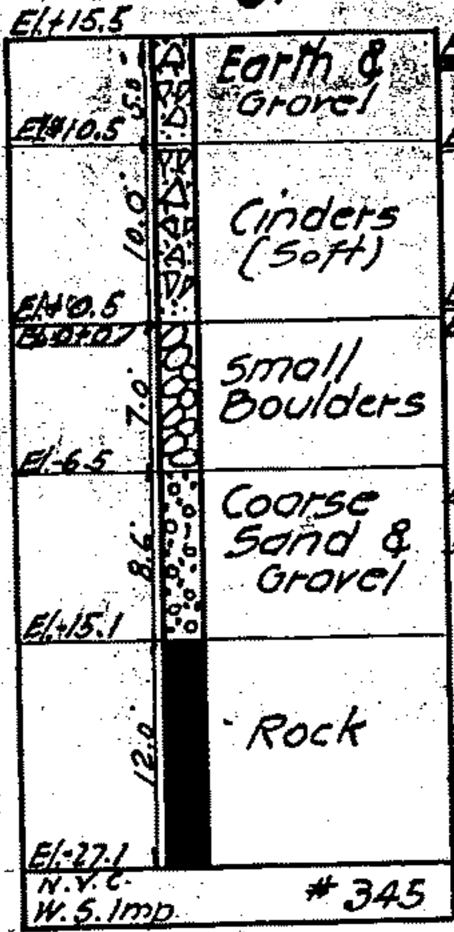

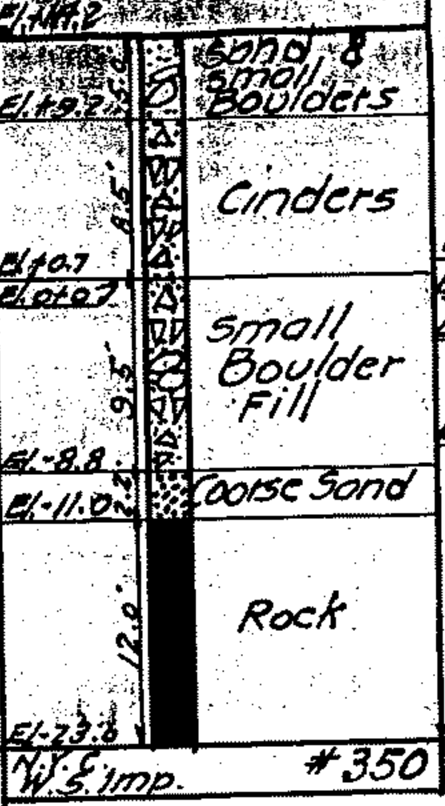

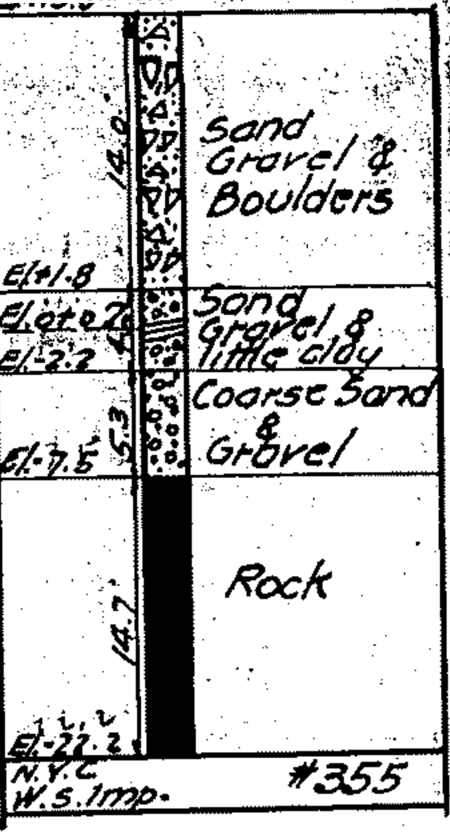

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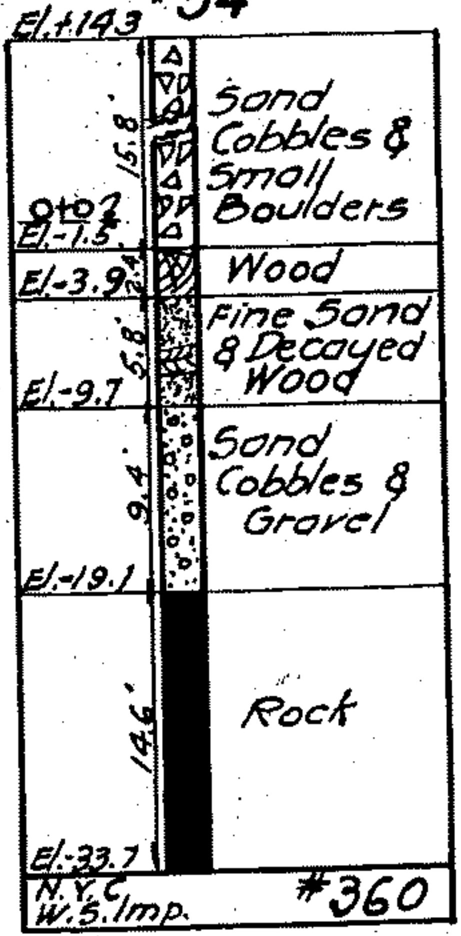

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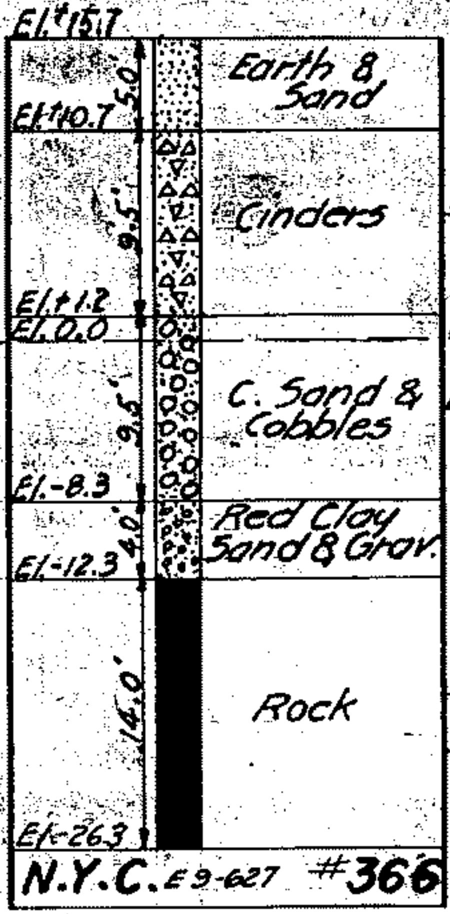
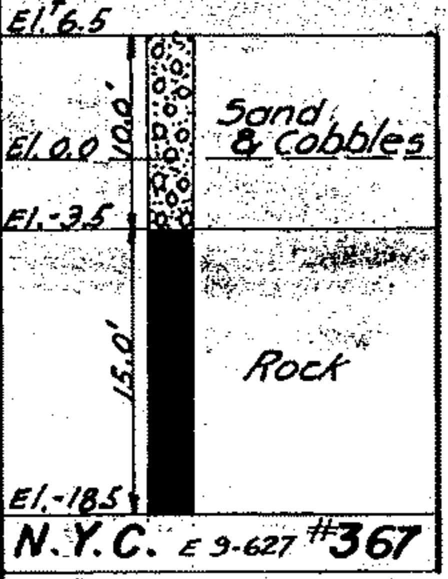
VOL. 2 SH. 10

Ch. B

#55 #56





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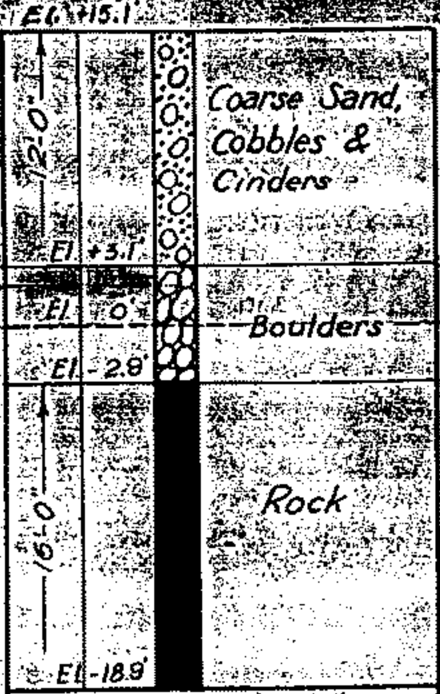

N.Y.C. E-9·627 #365

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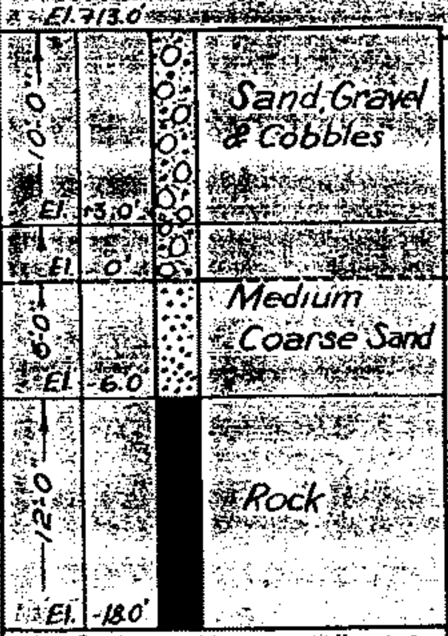

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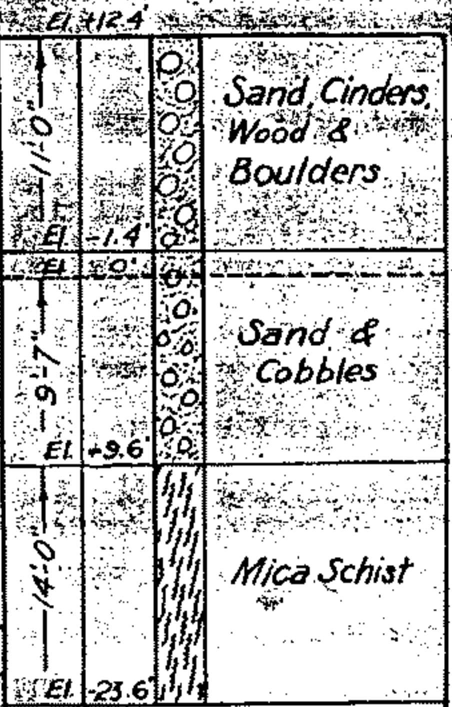

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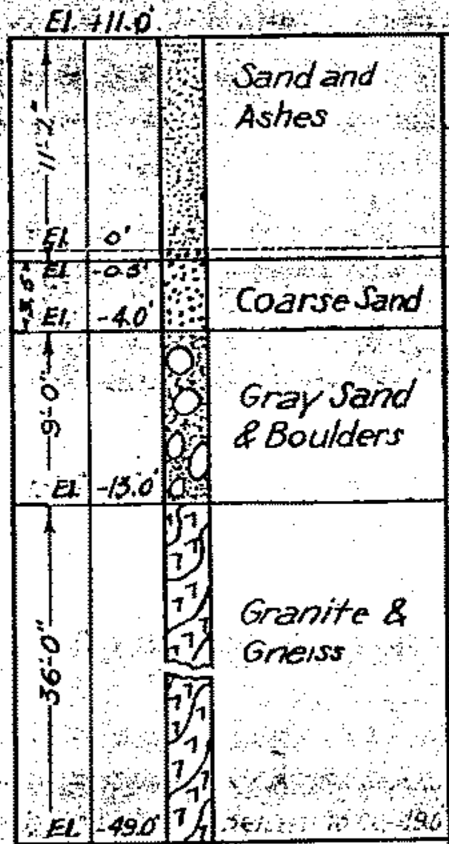

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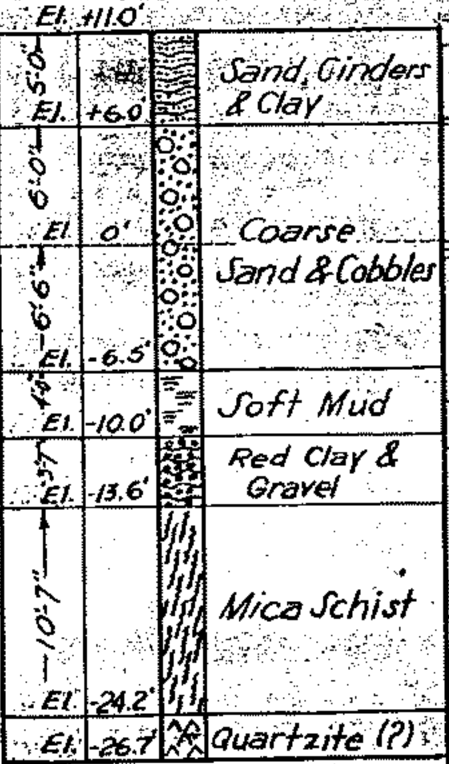

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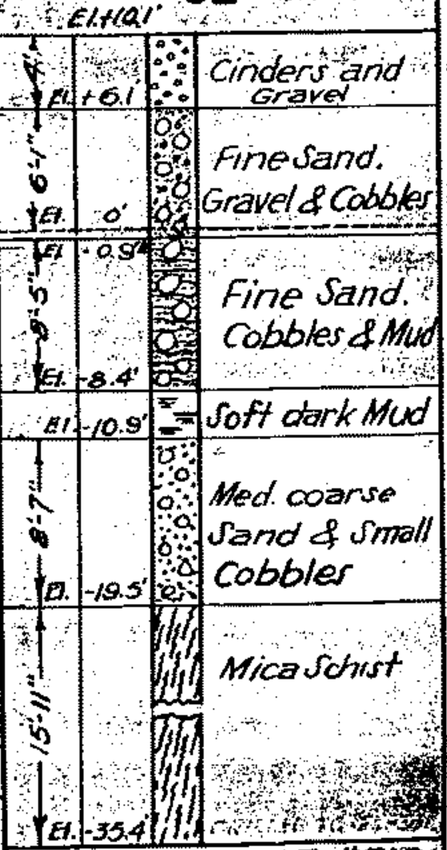

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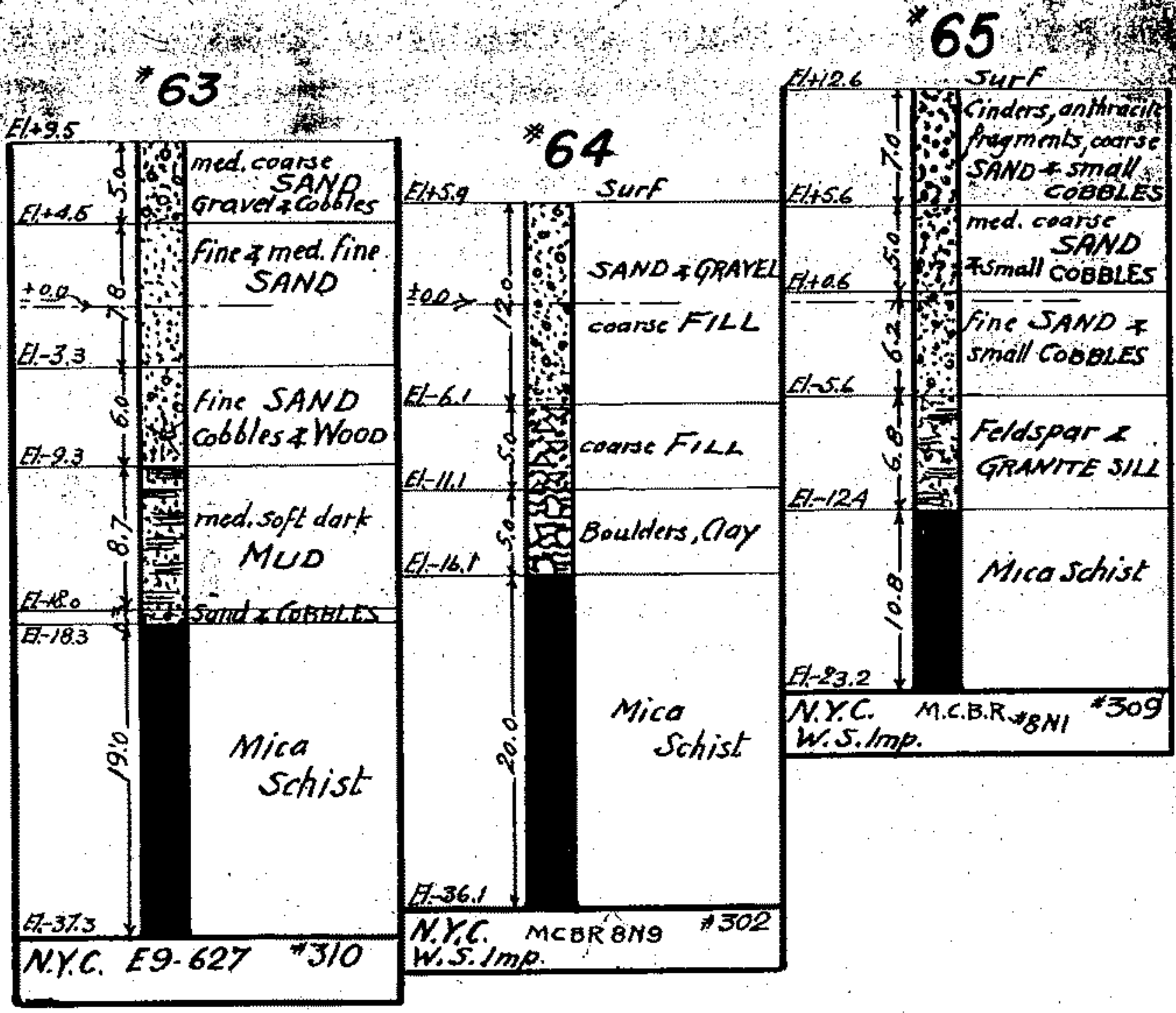
VOL.2 SHEET 10



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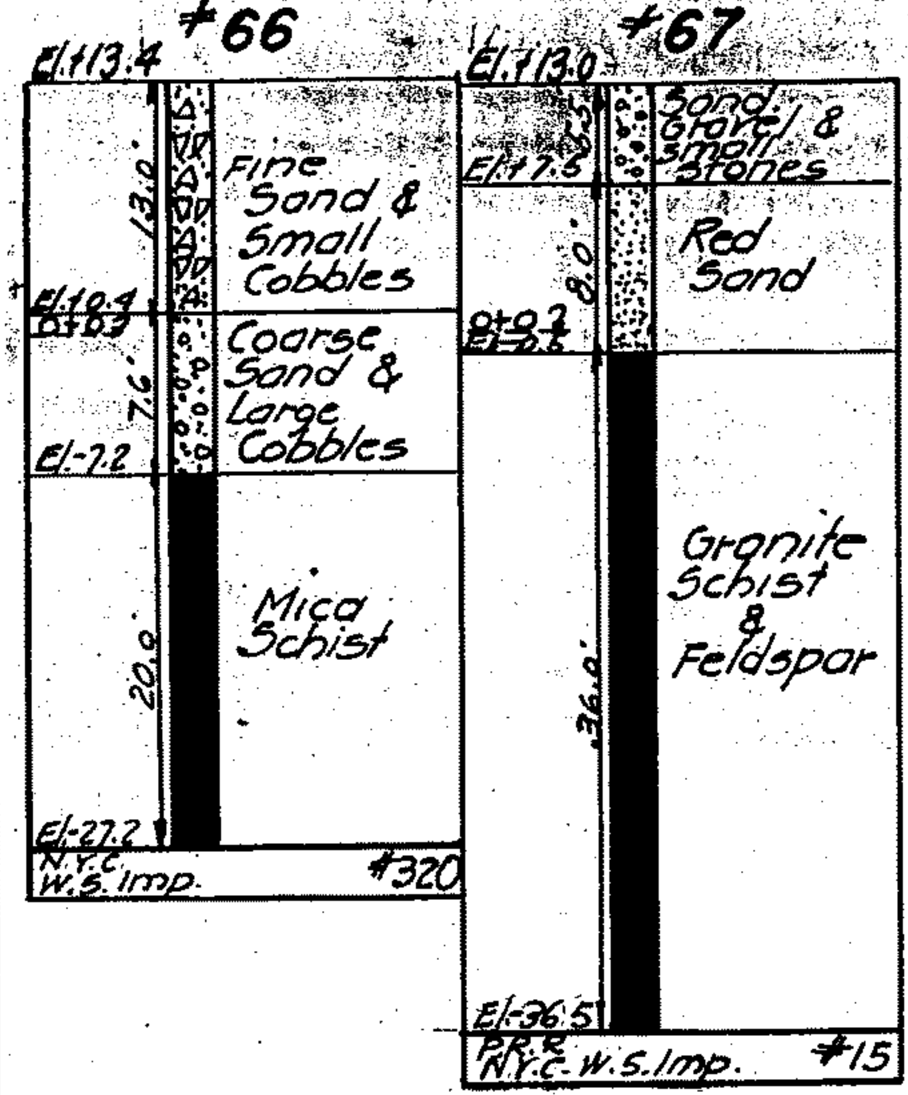

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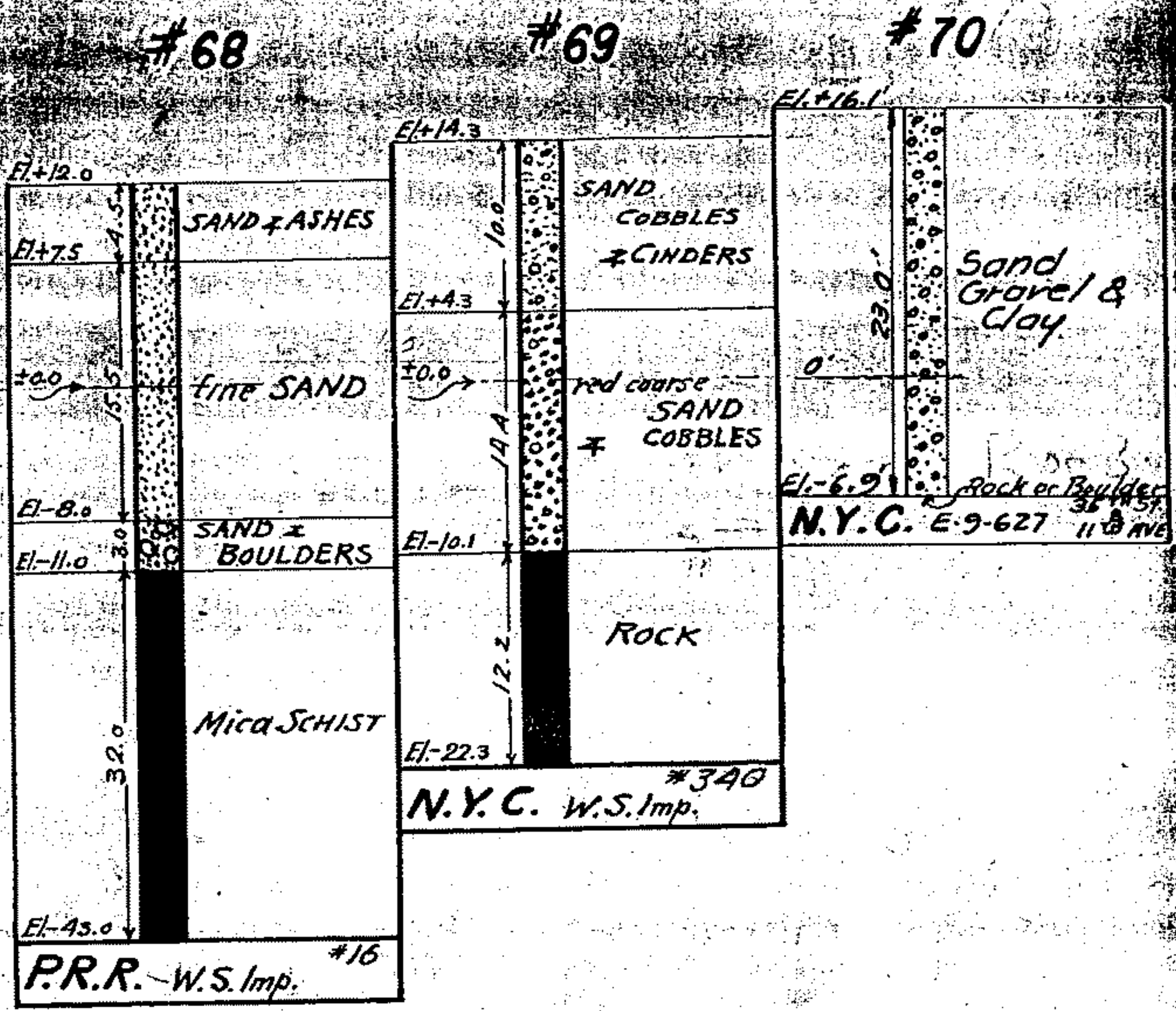

ROCK DATA

VOL. 2 SH: 10

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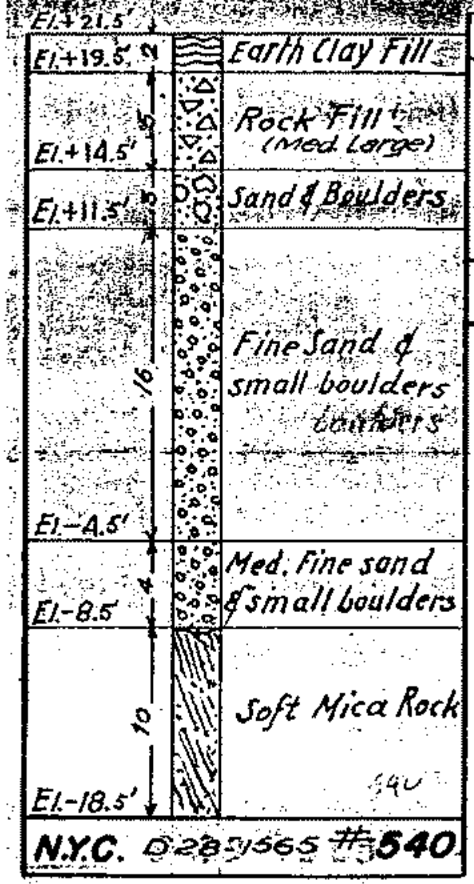

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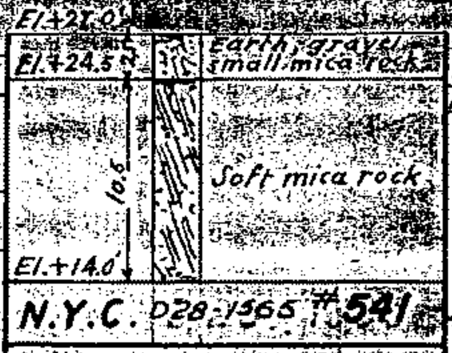

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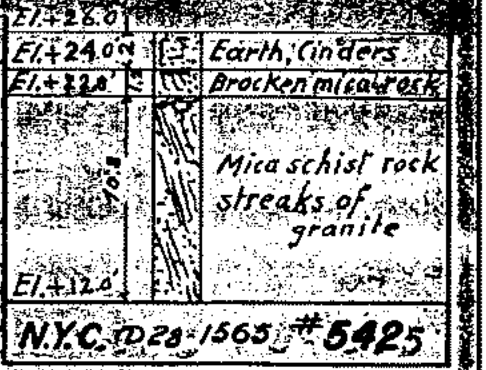

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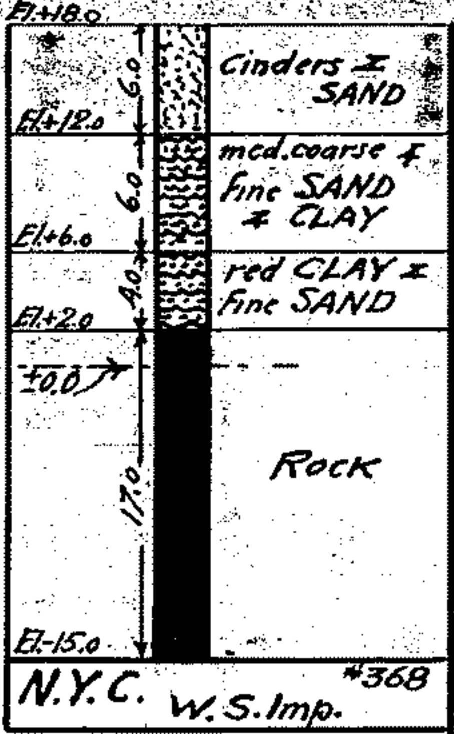

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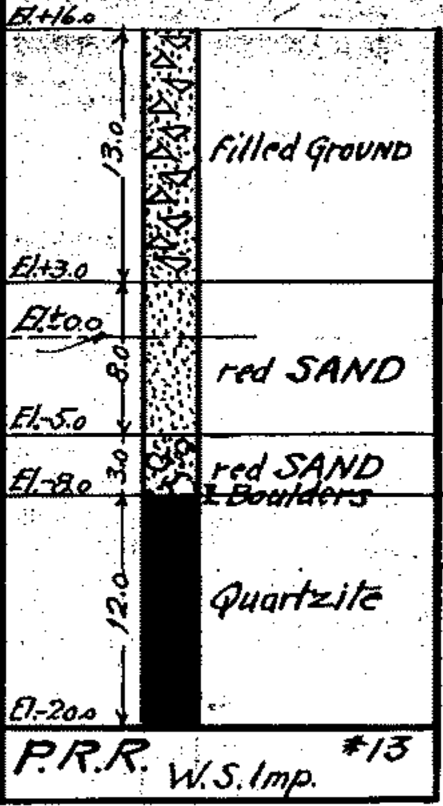

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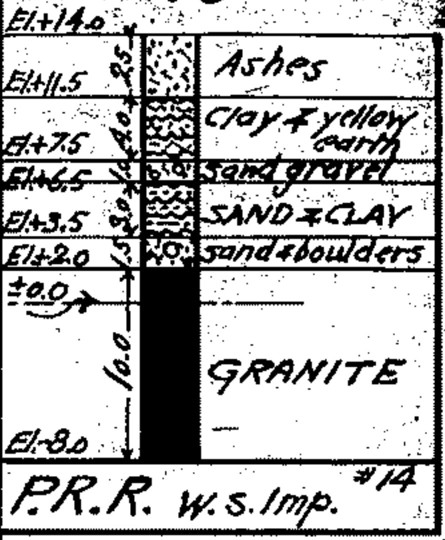

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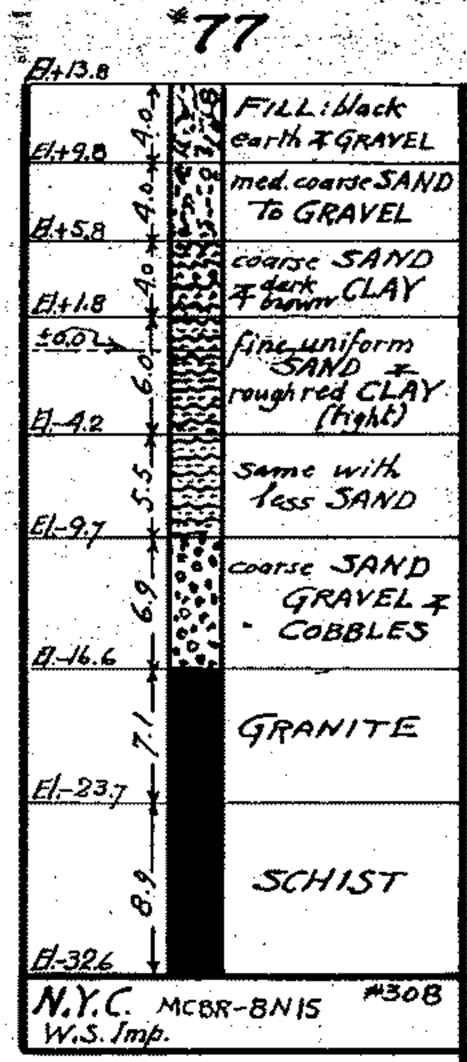

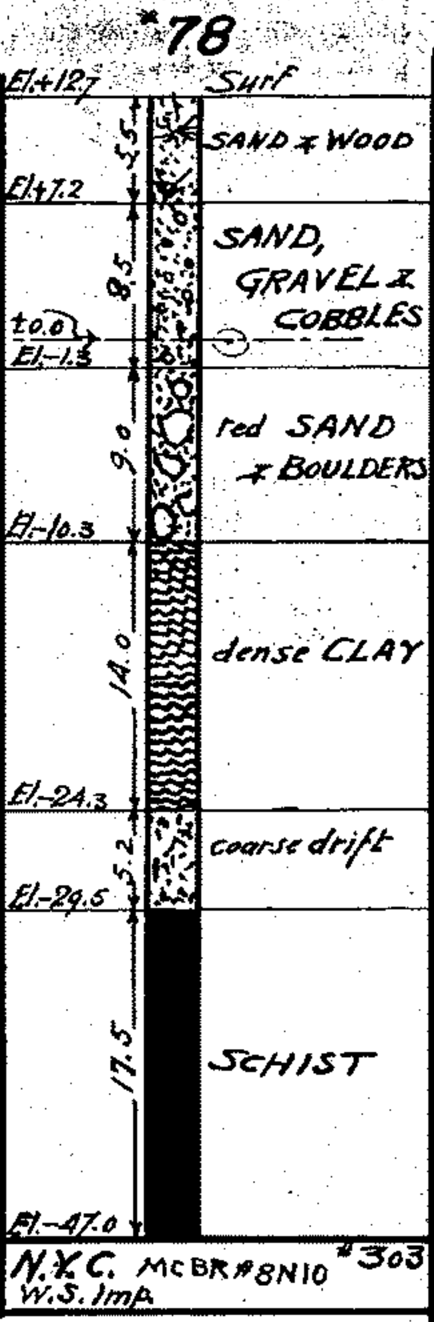

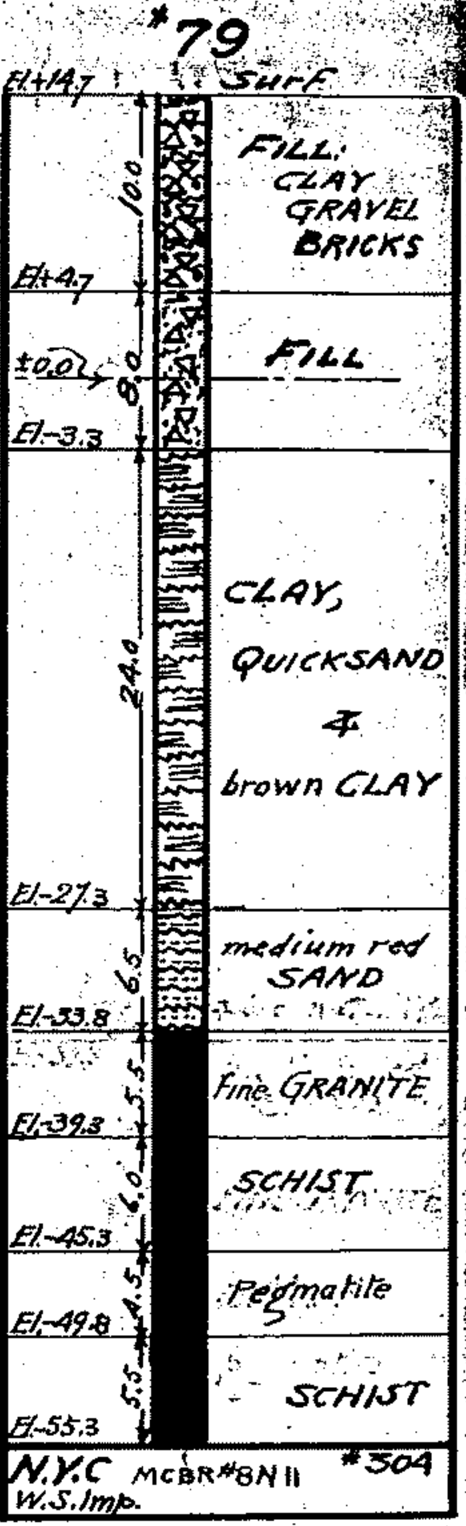

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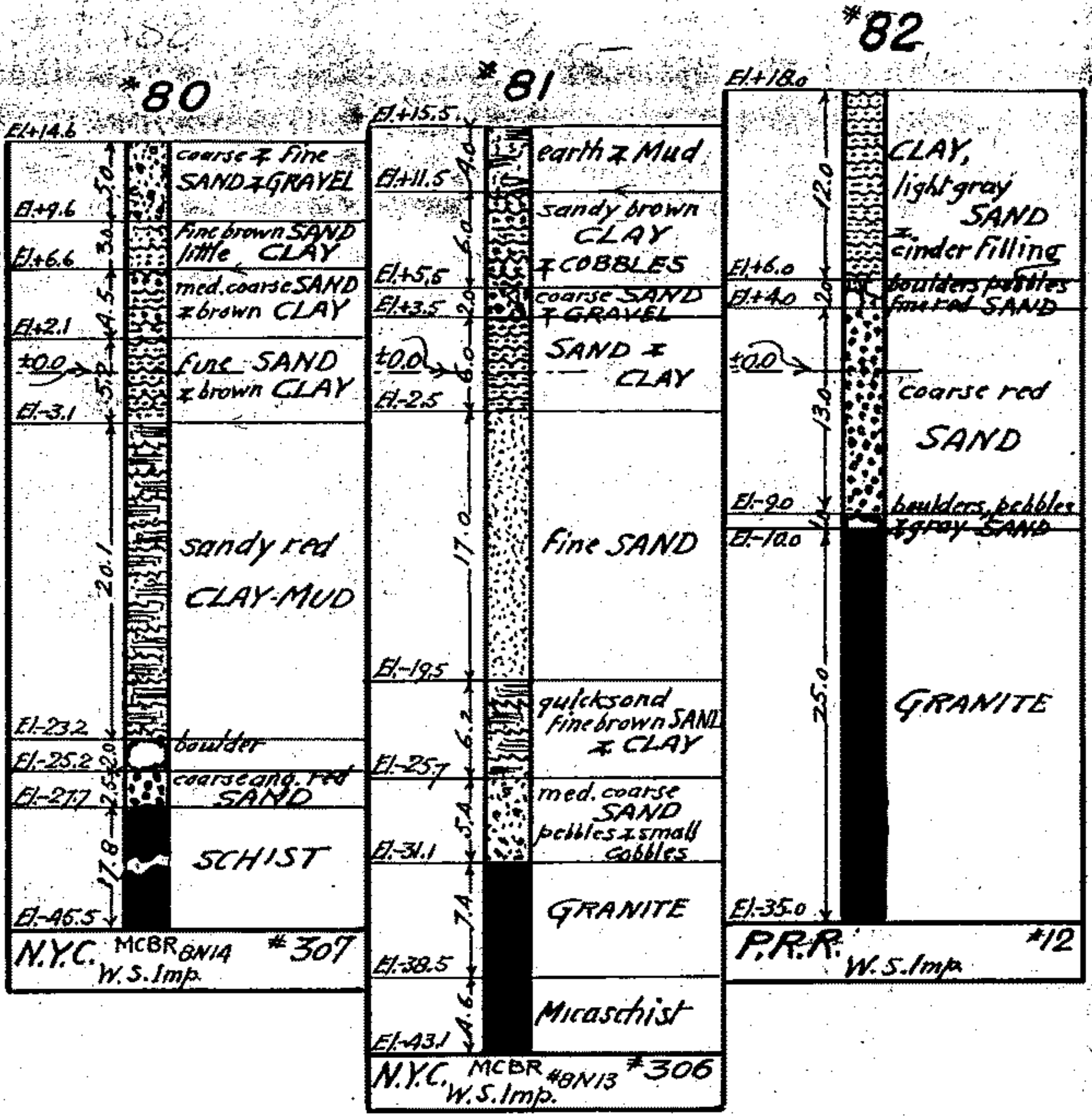

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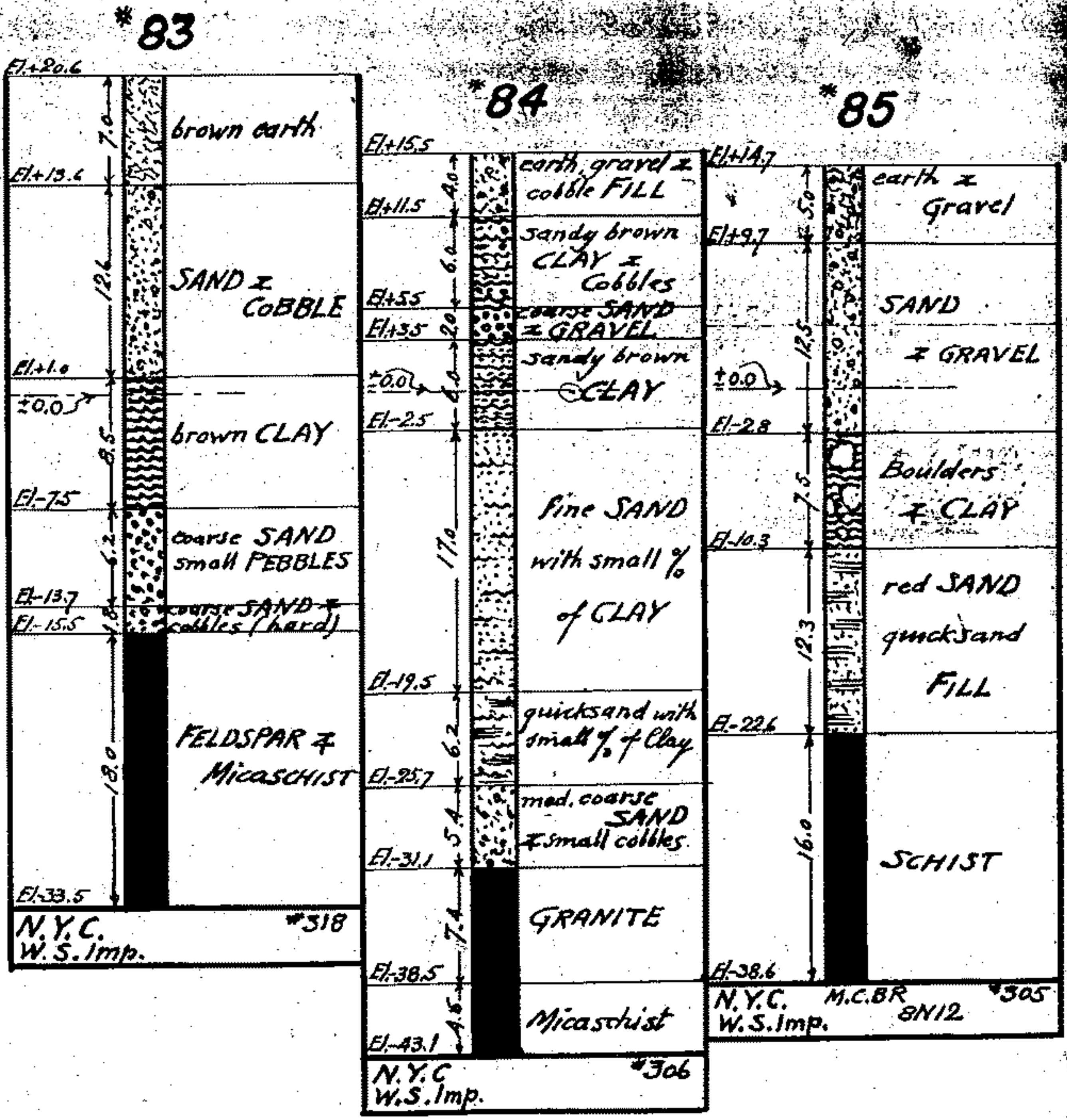

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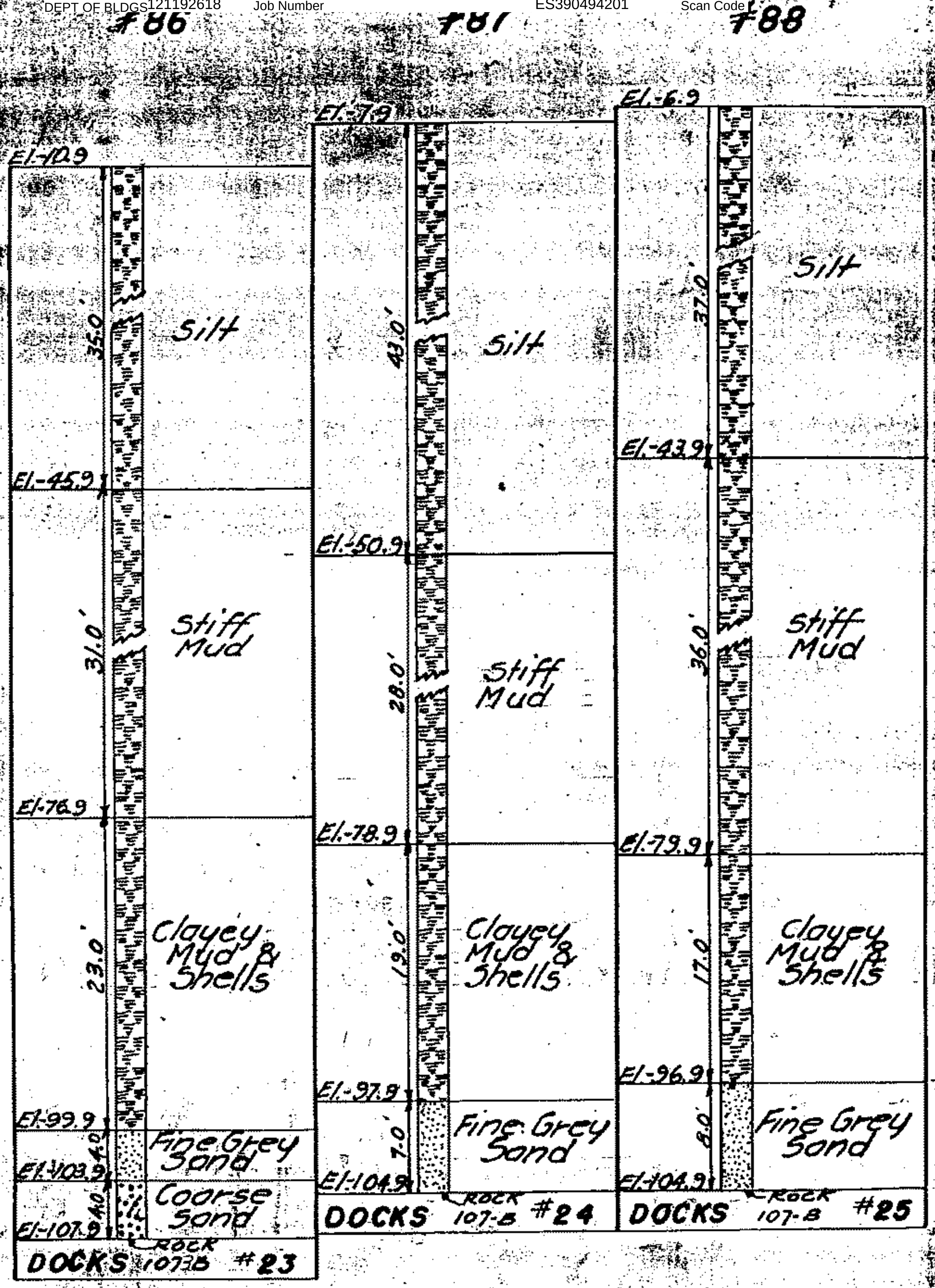

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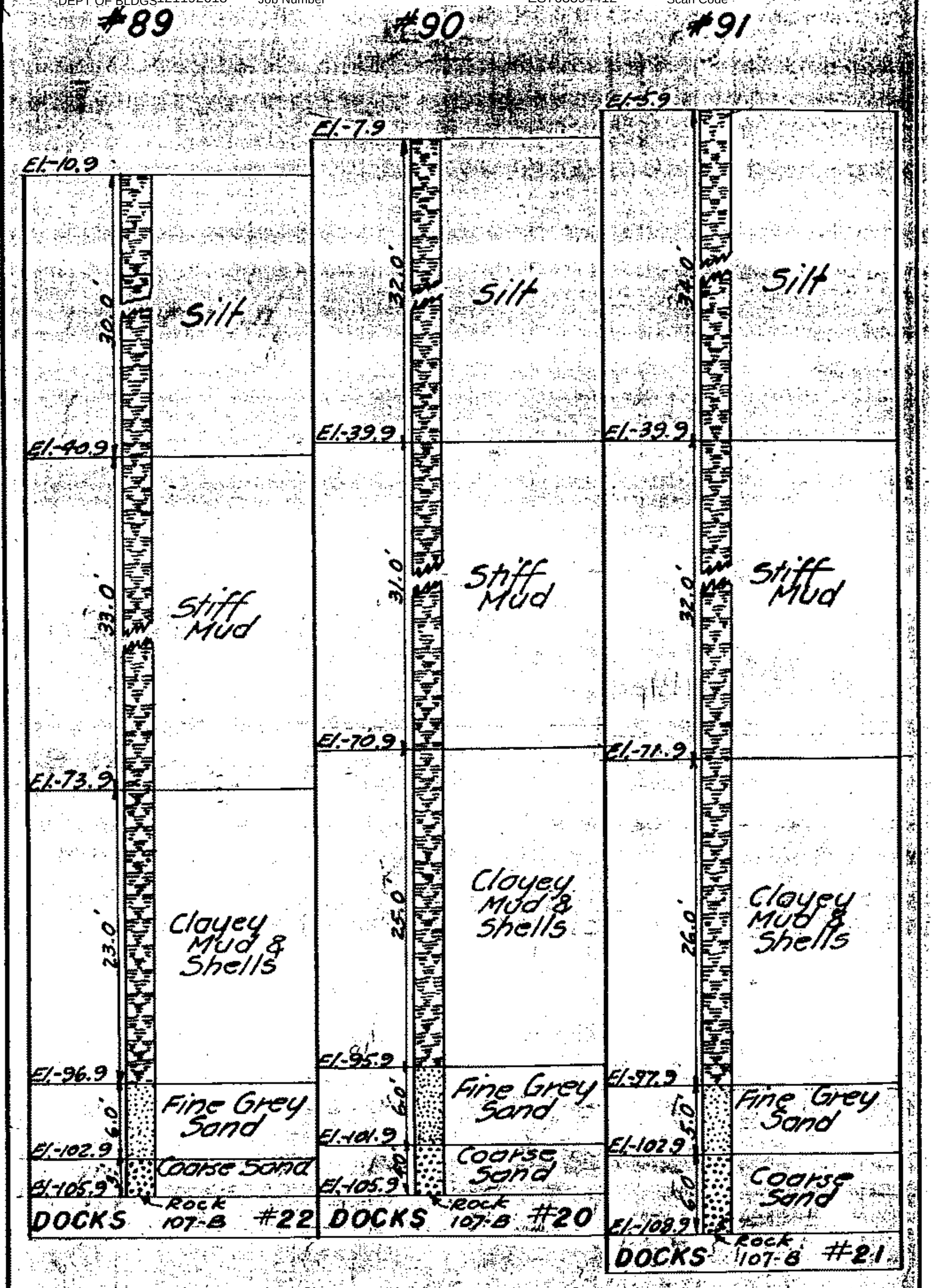

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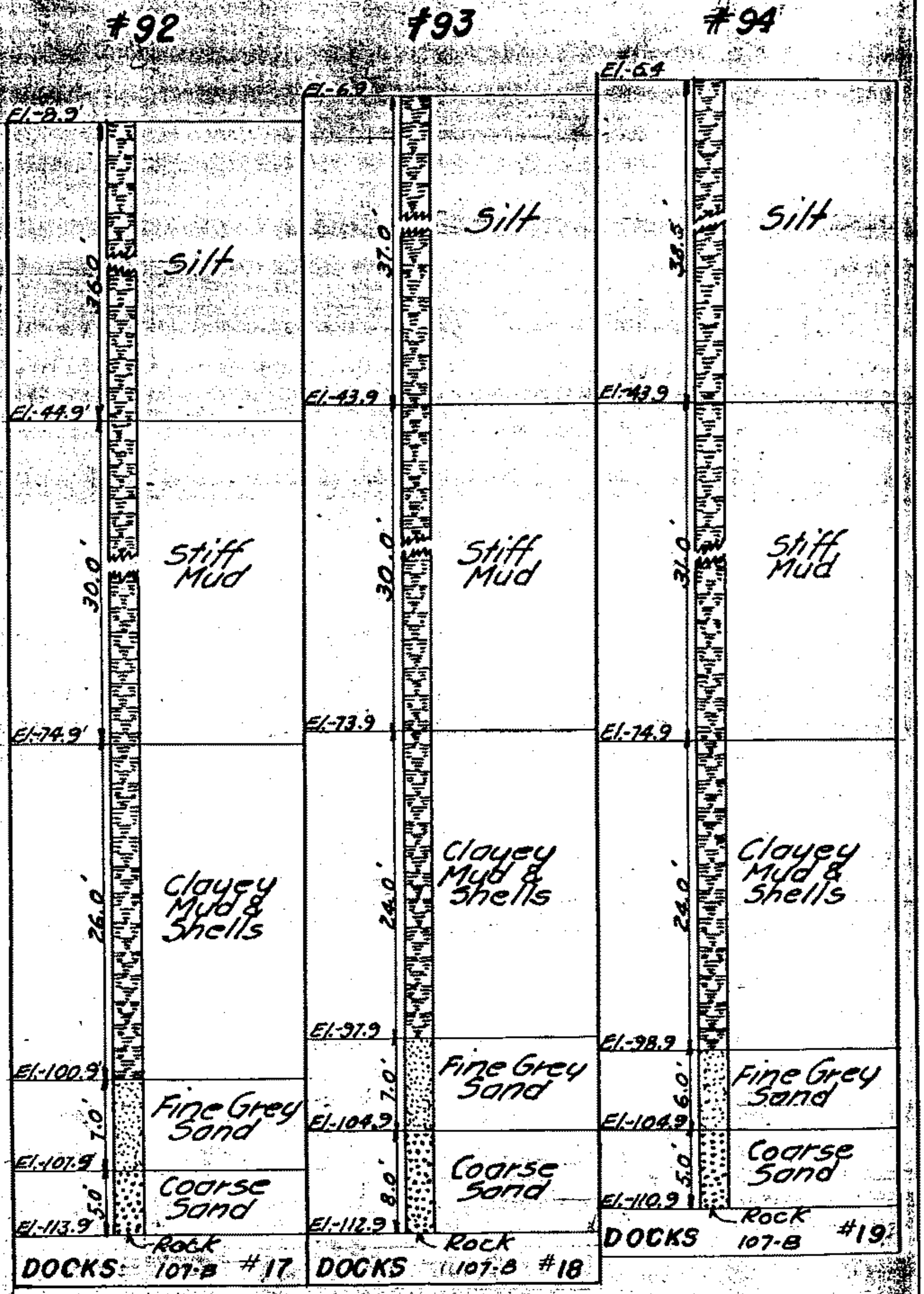

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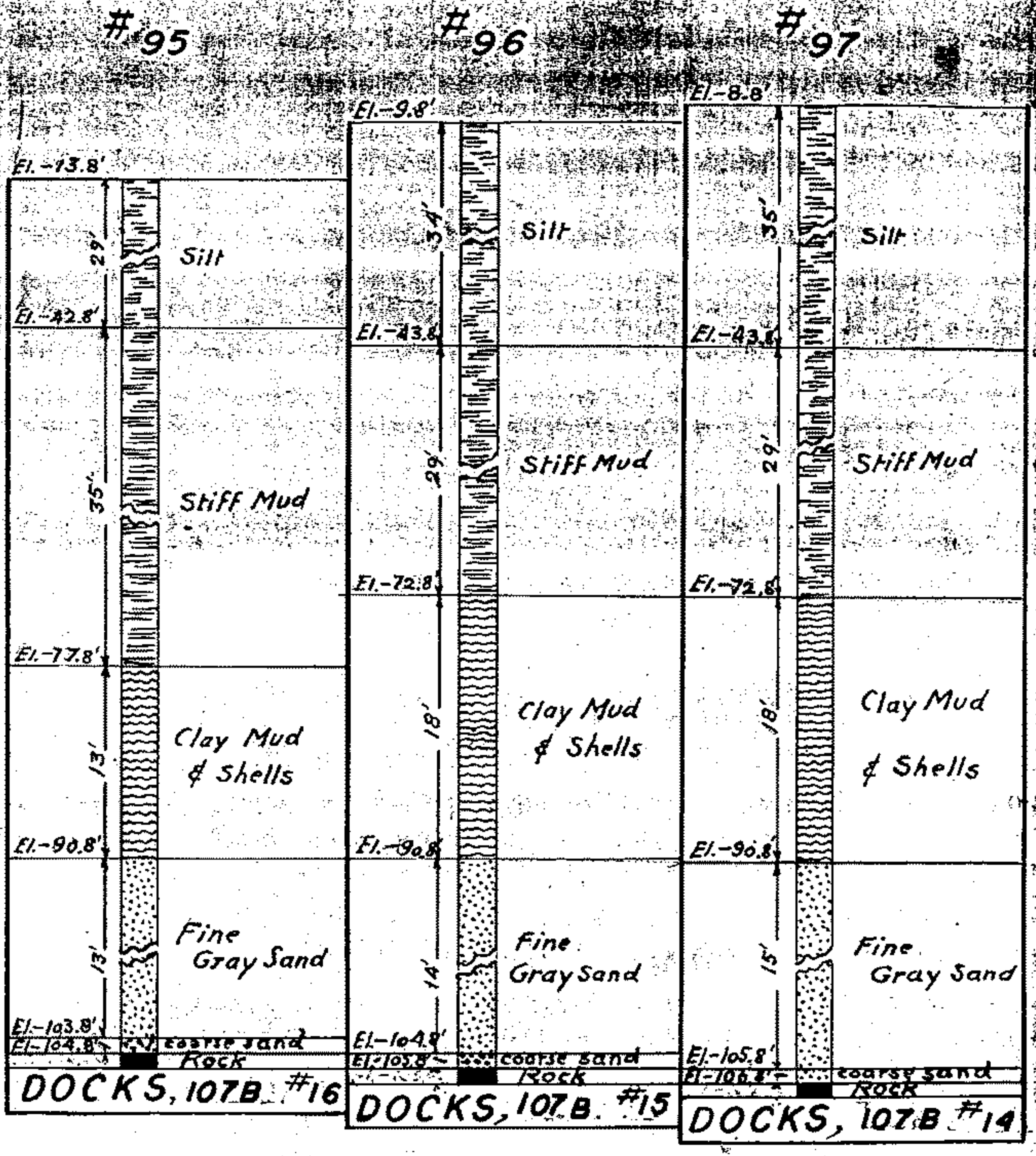

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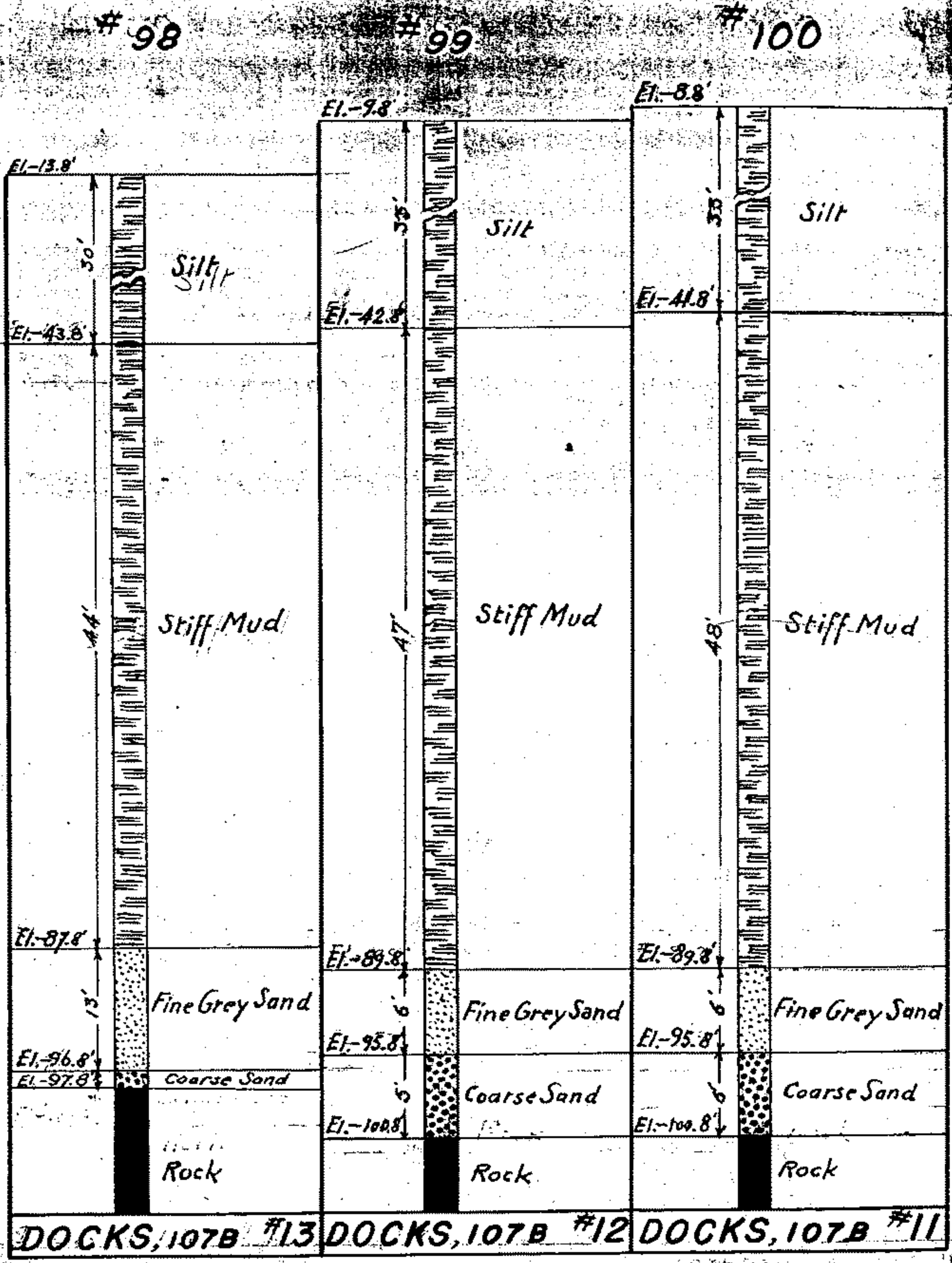

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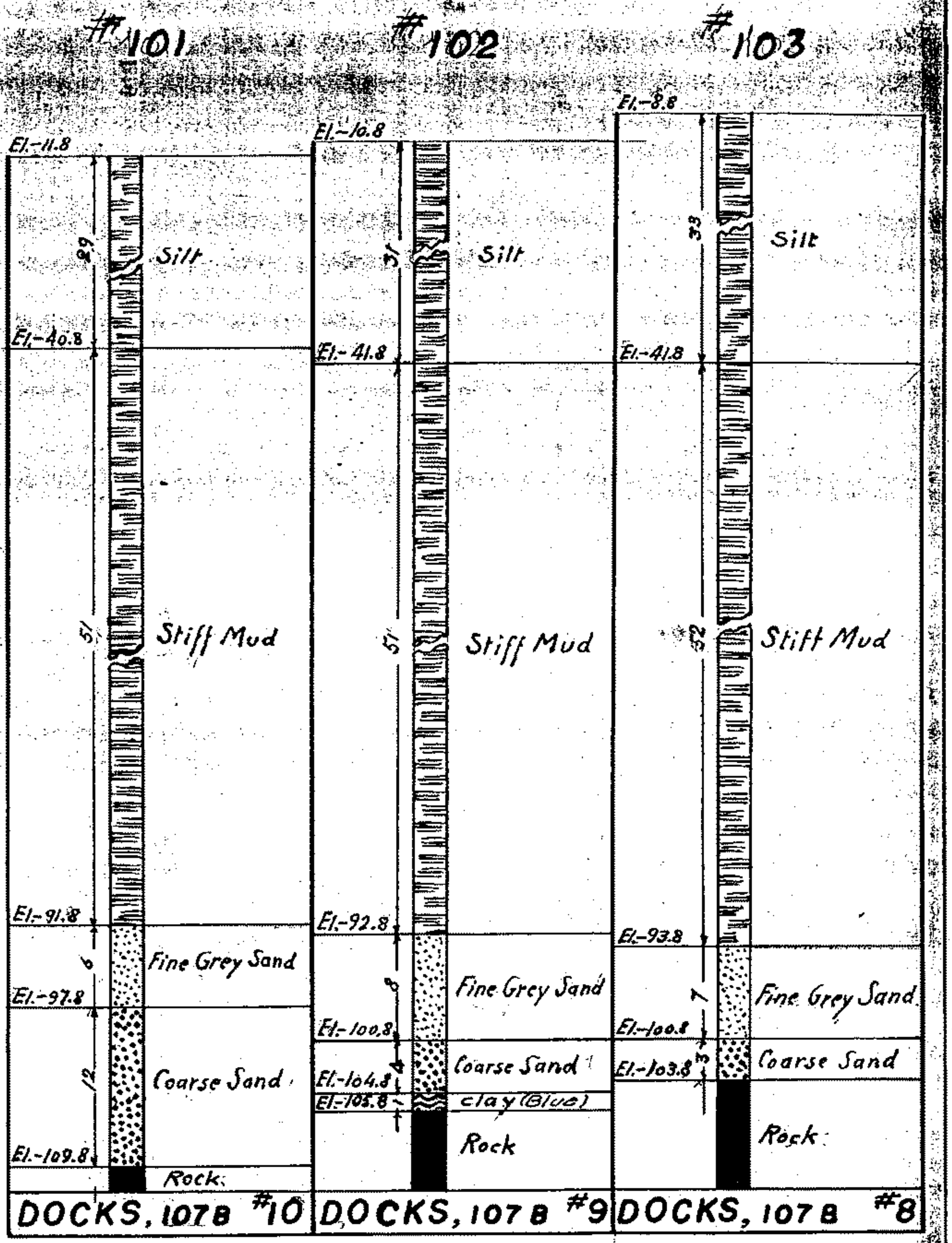

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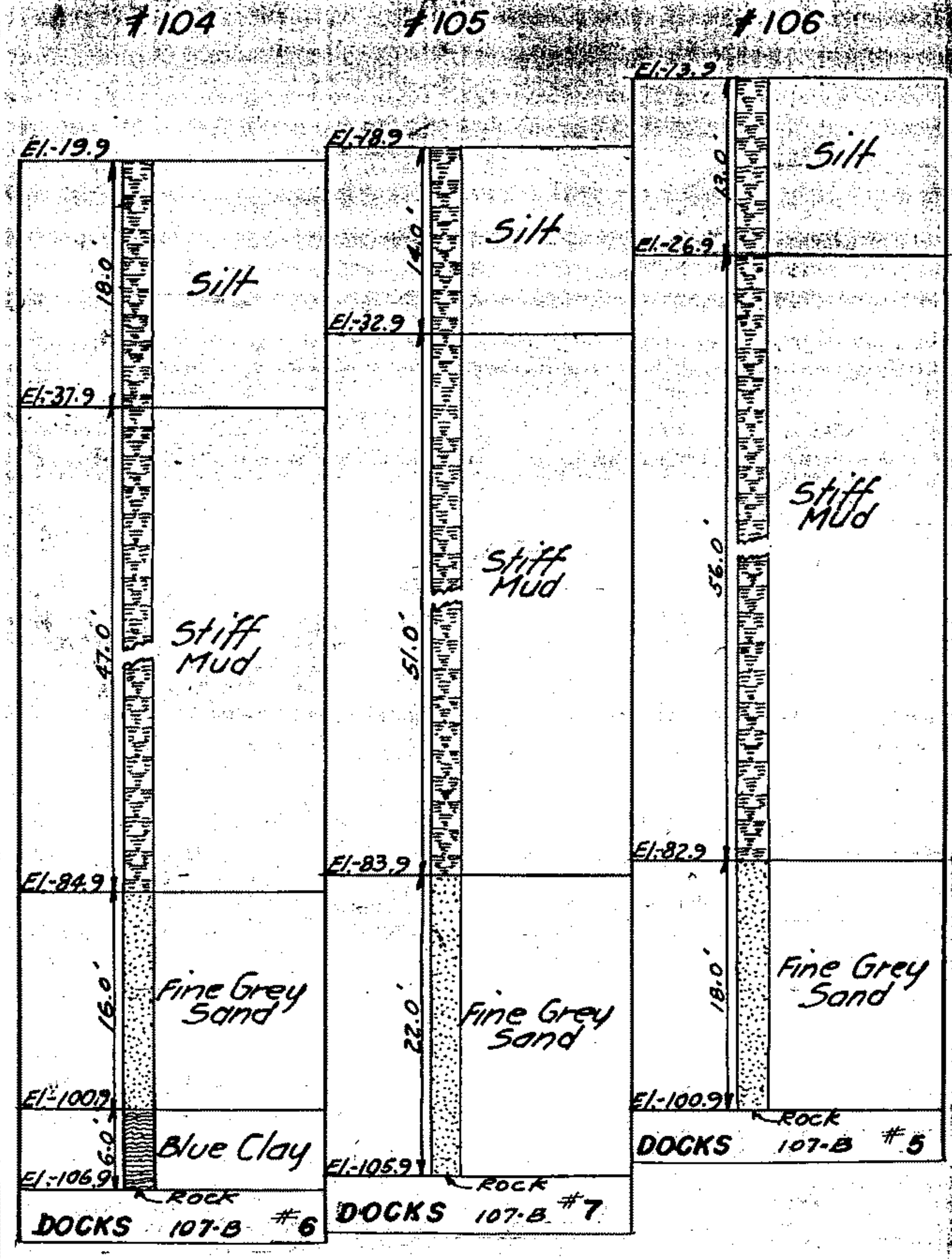

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VOL. 2 SH. 10

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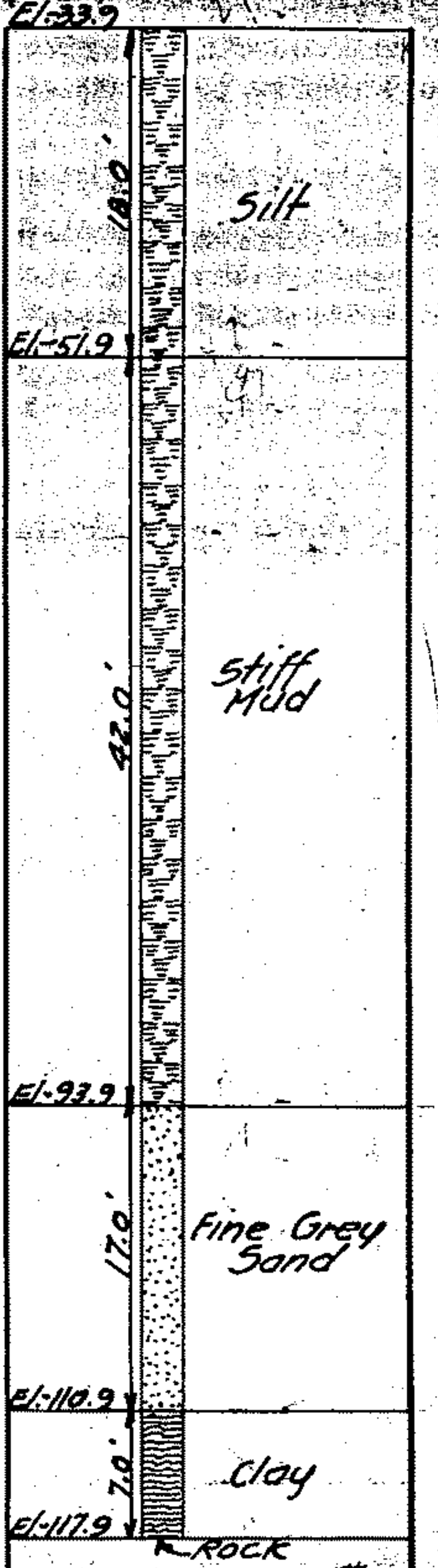
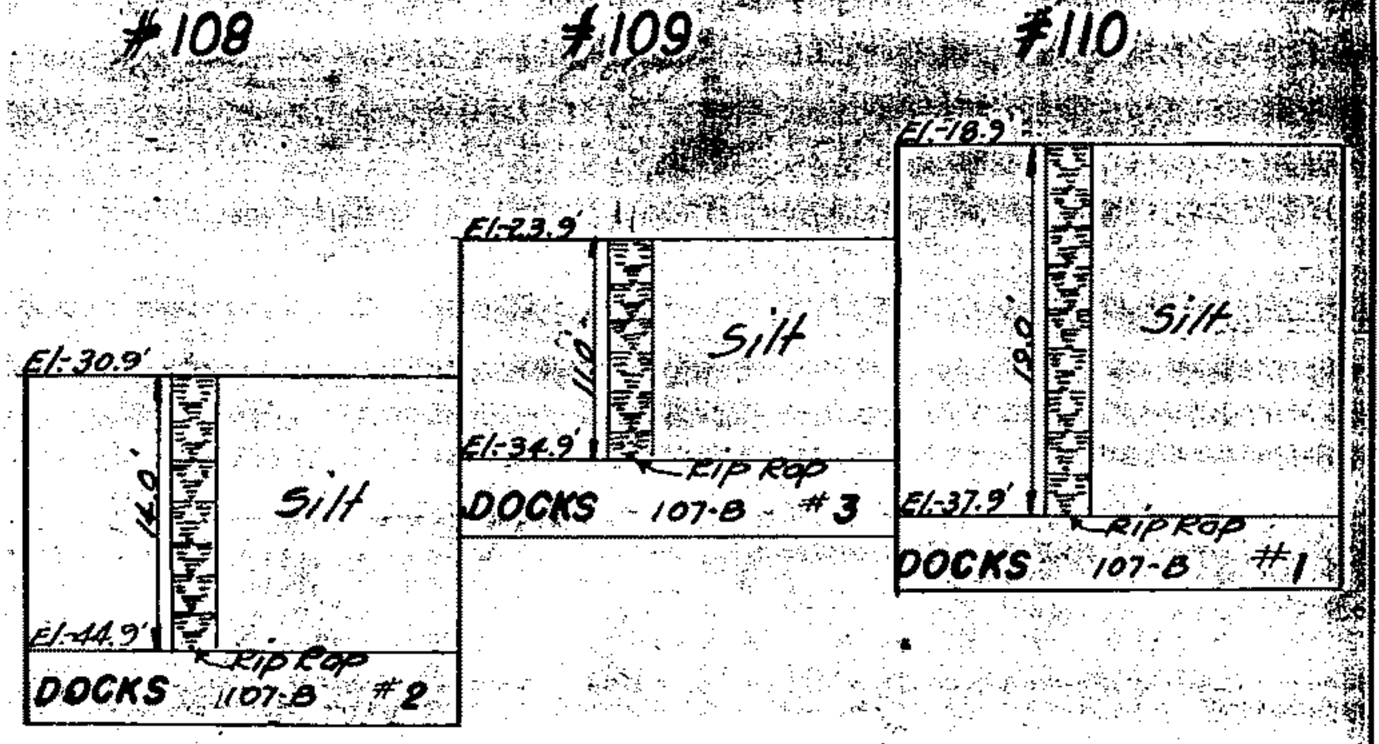


DOCKS 107-B #4

ROCK DATA

VOL 2 SH 10



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VOL 2 SH 10

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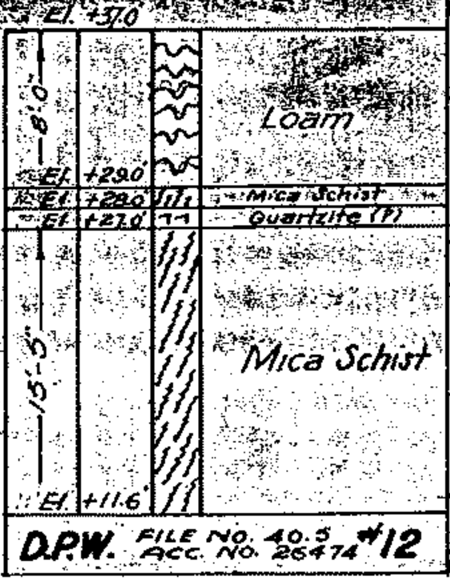

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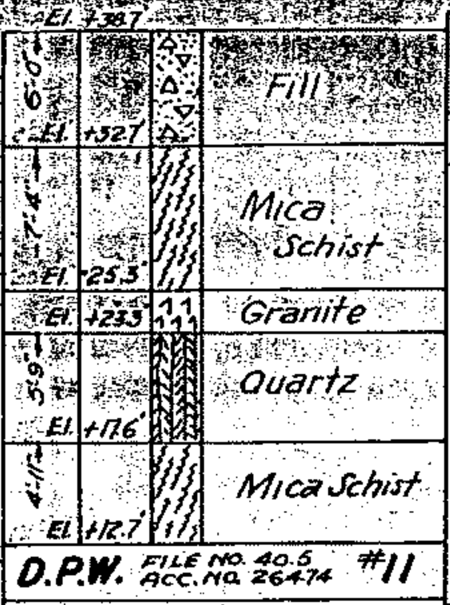

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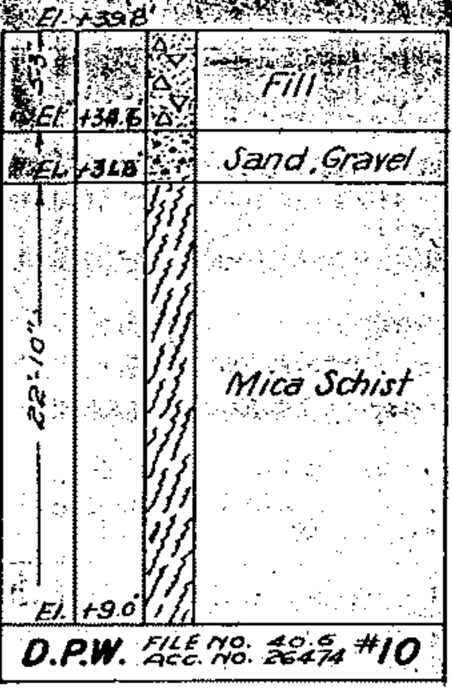

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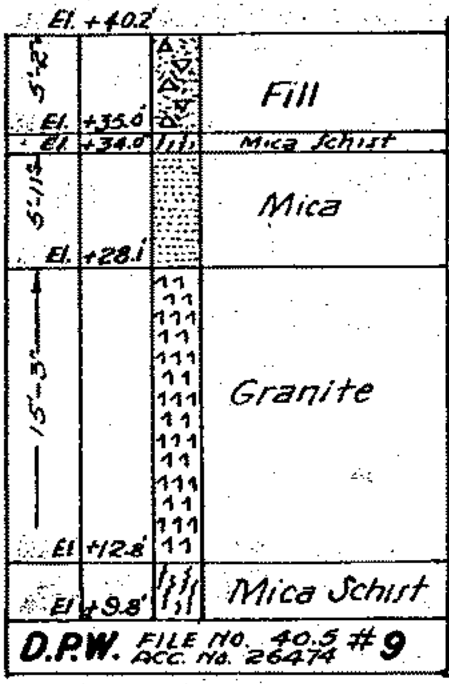

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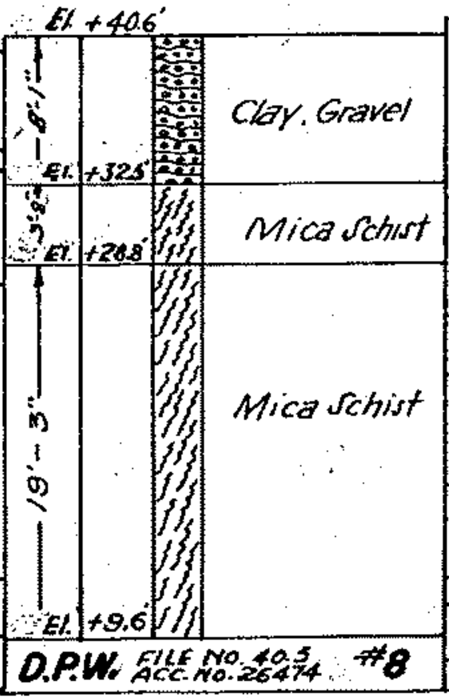

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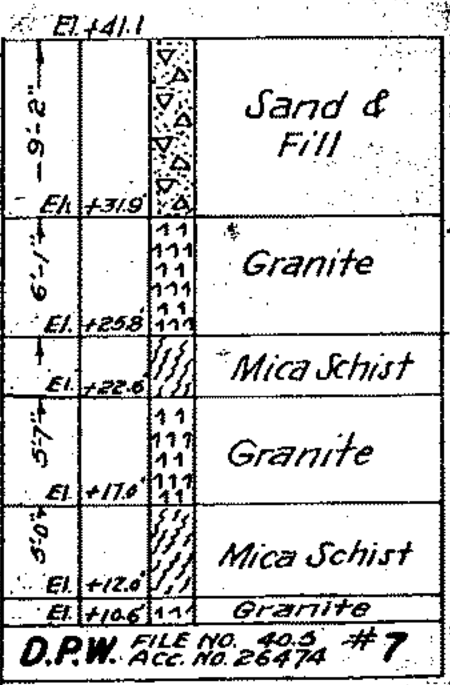

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VOL. 2 SHEET 10

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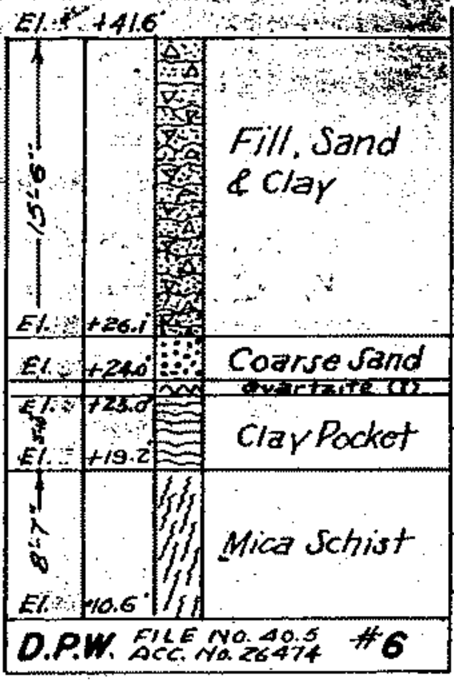

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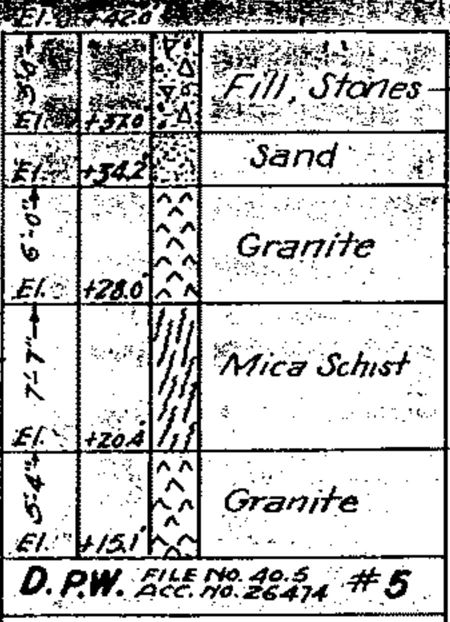

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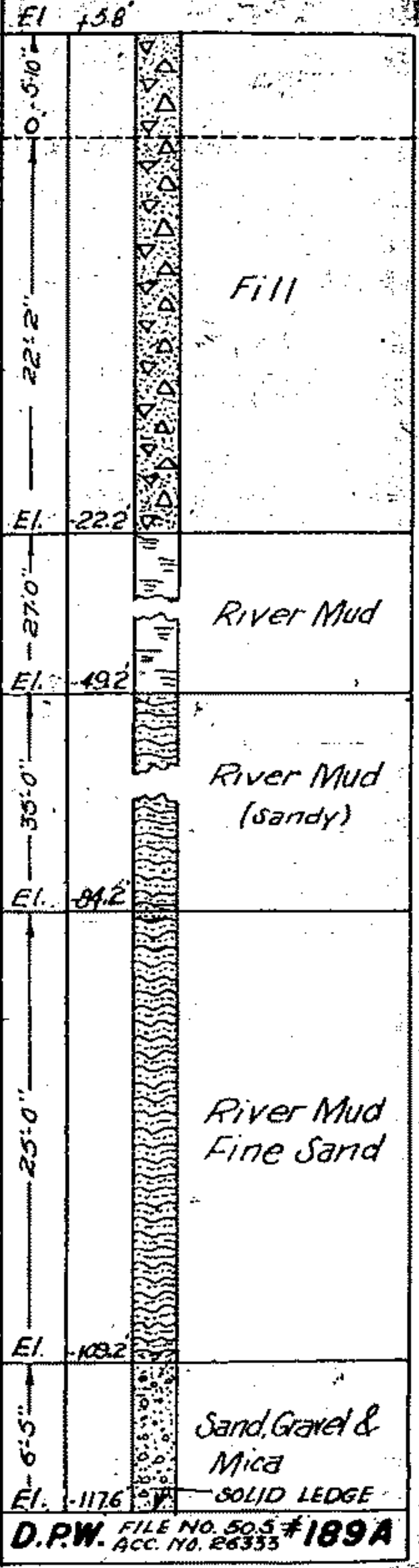

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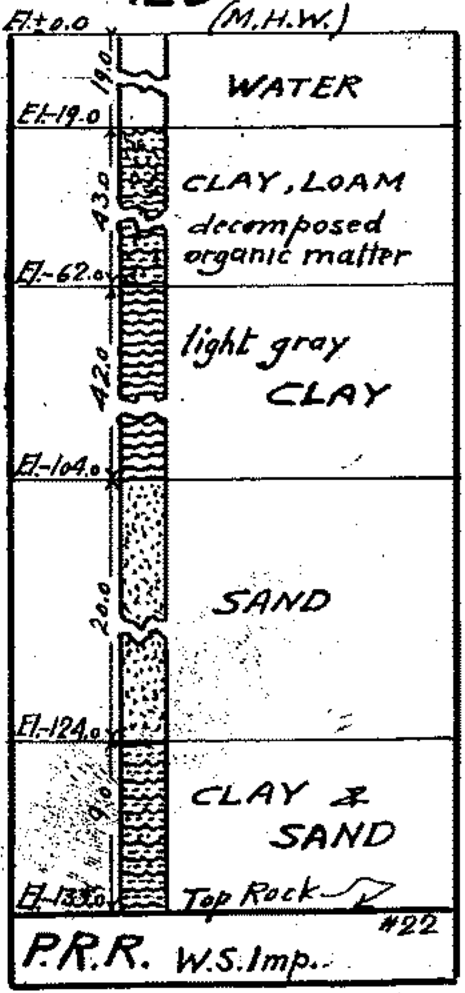

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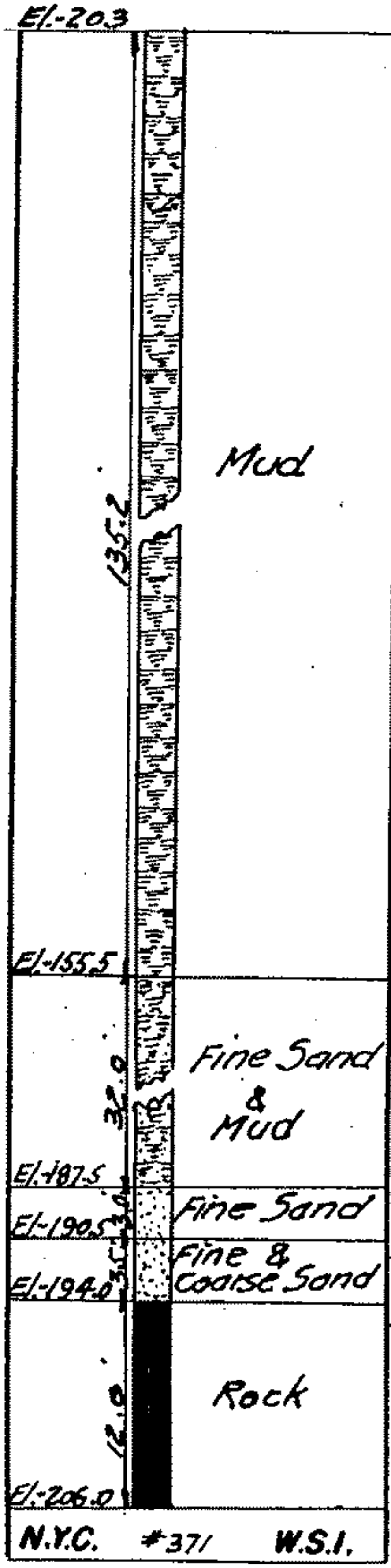

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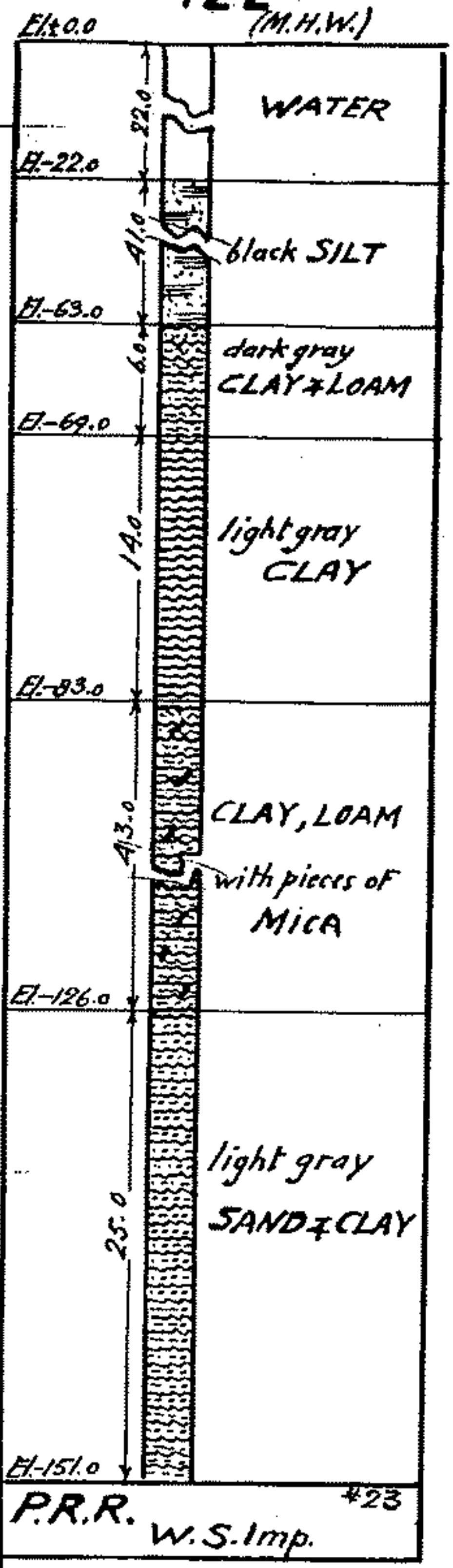

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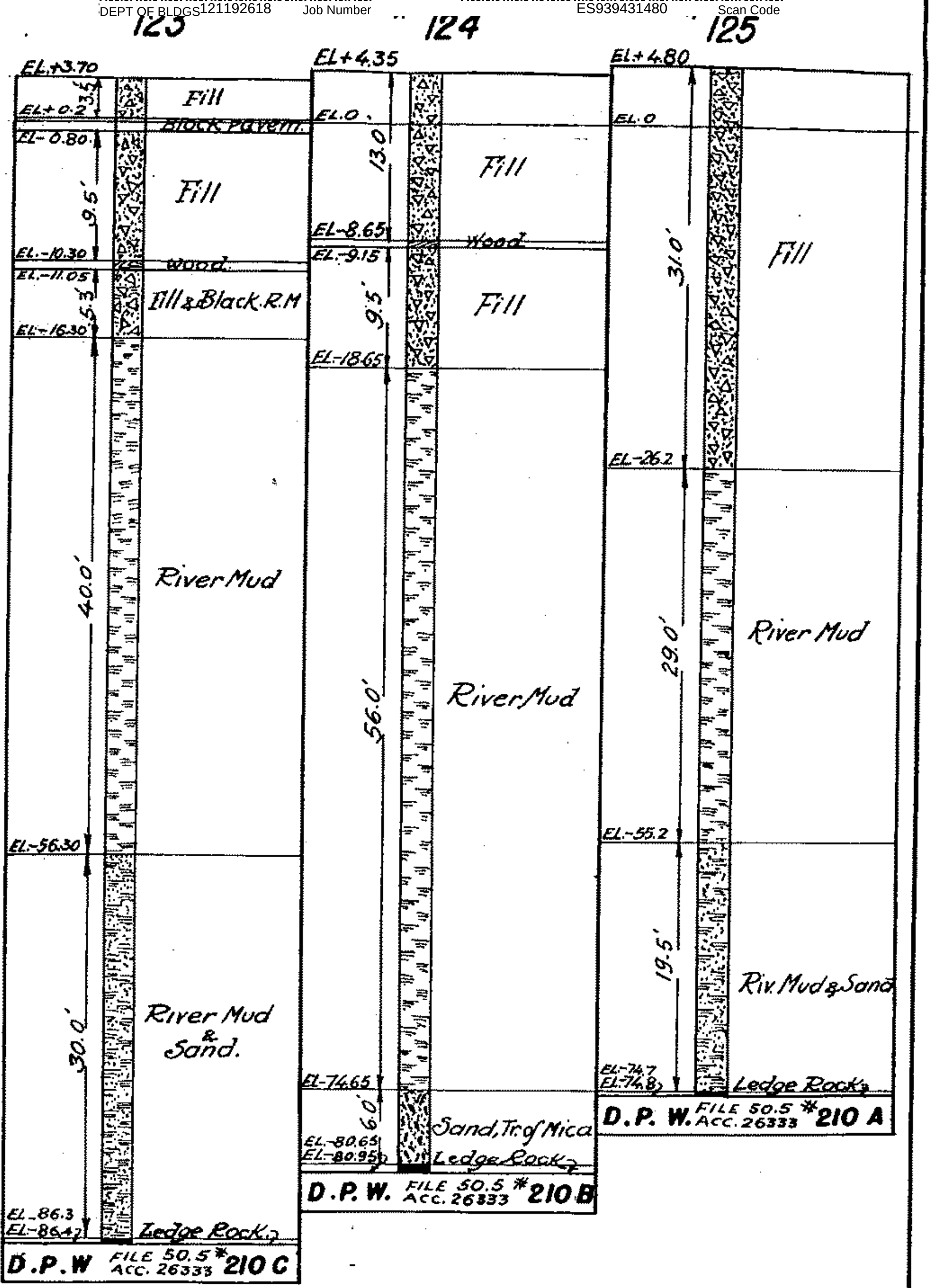
VOL. 2 SH 10



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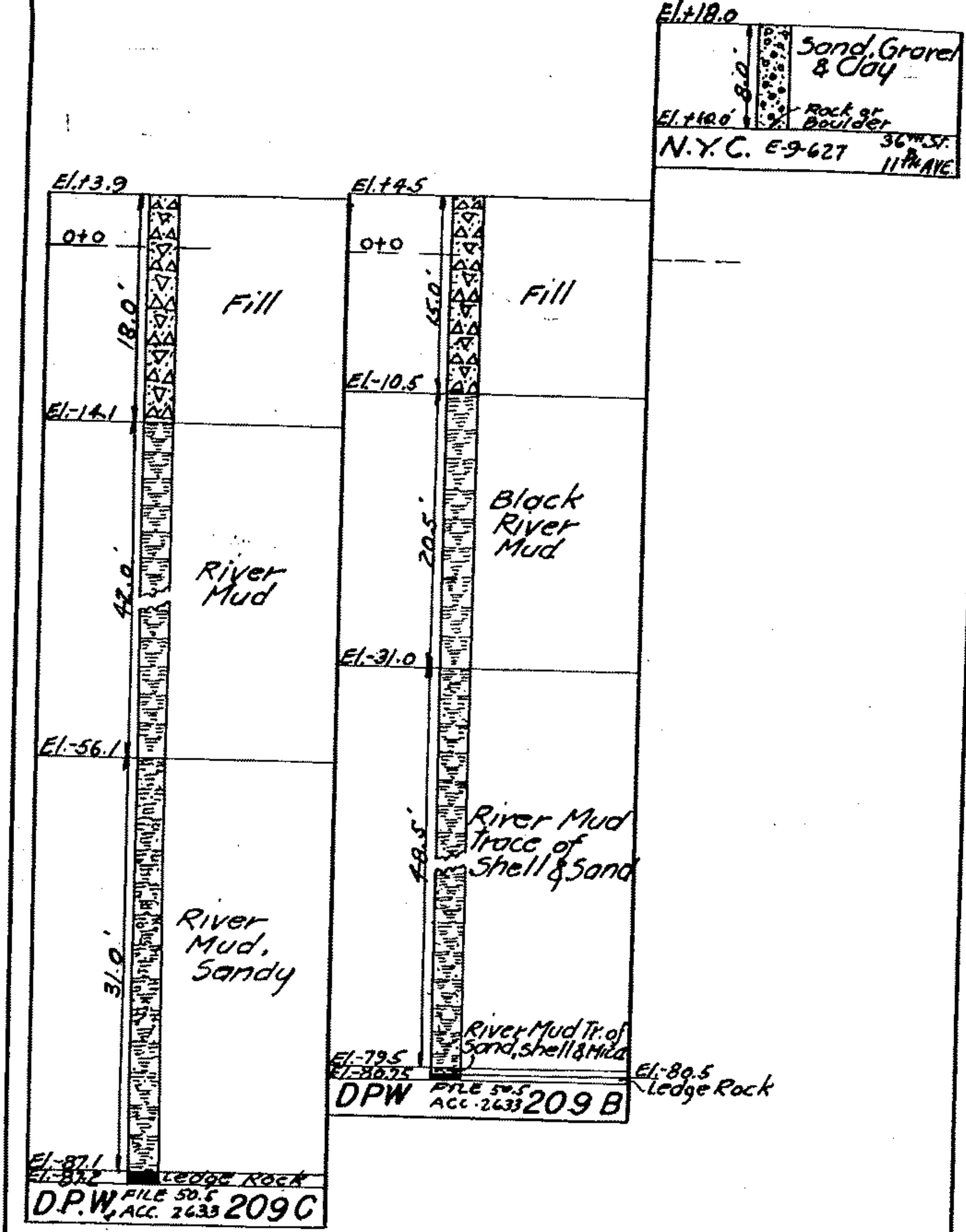

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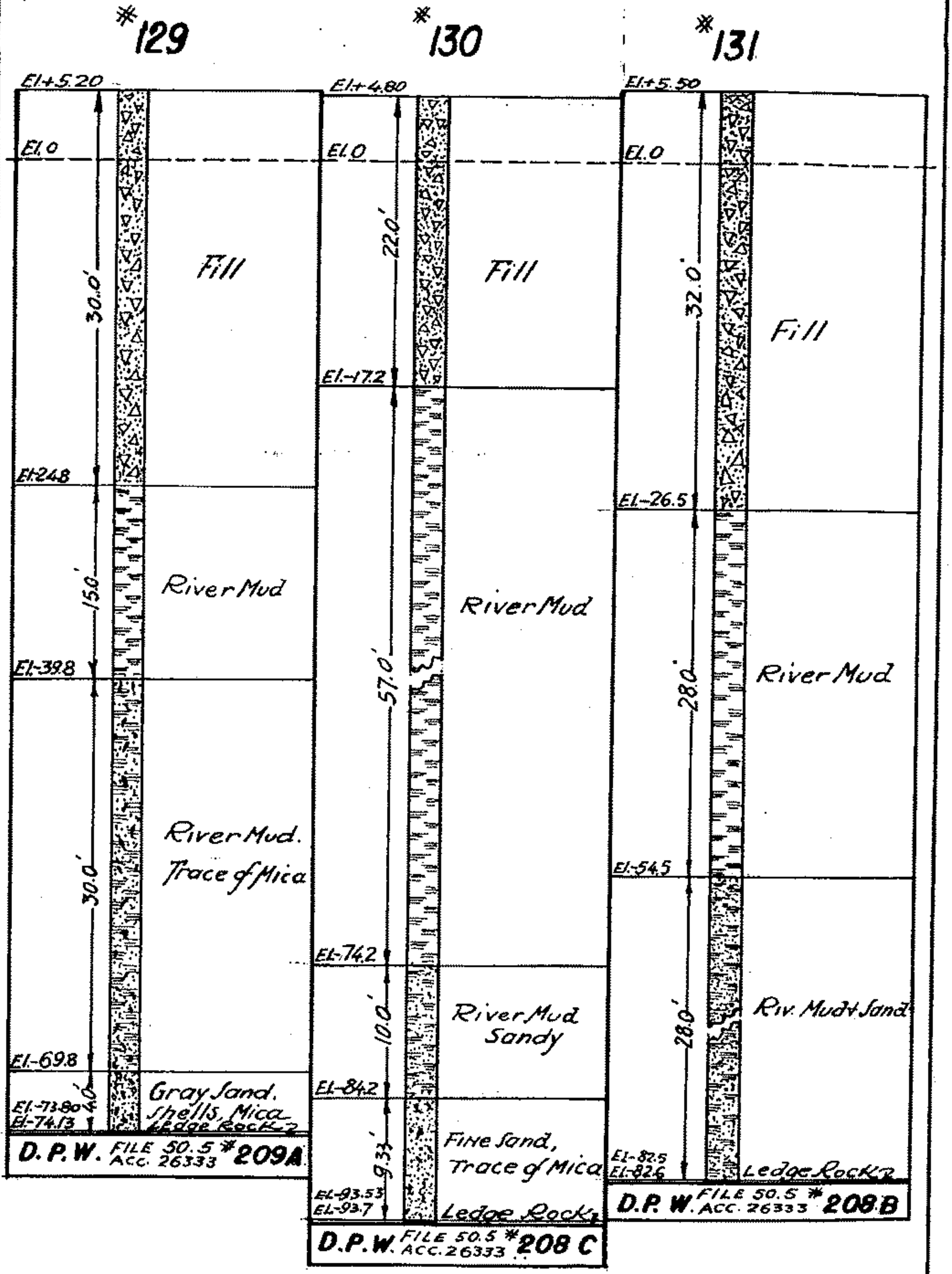
VOL. 2 SH. 10

Ch. Levin



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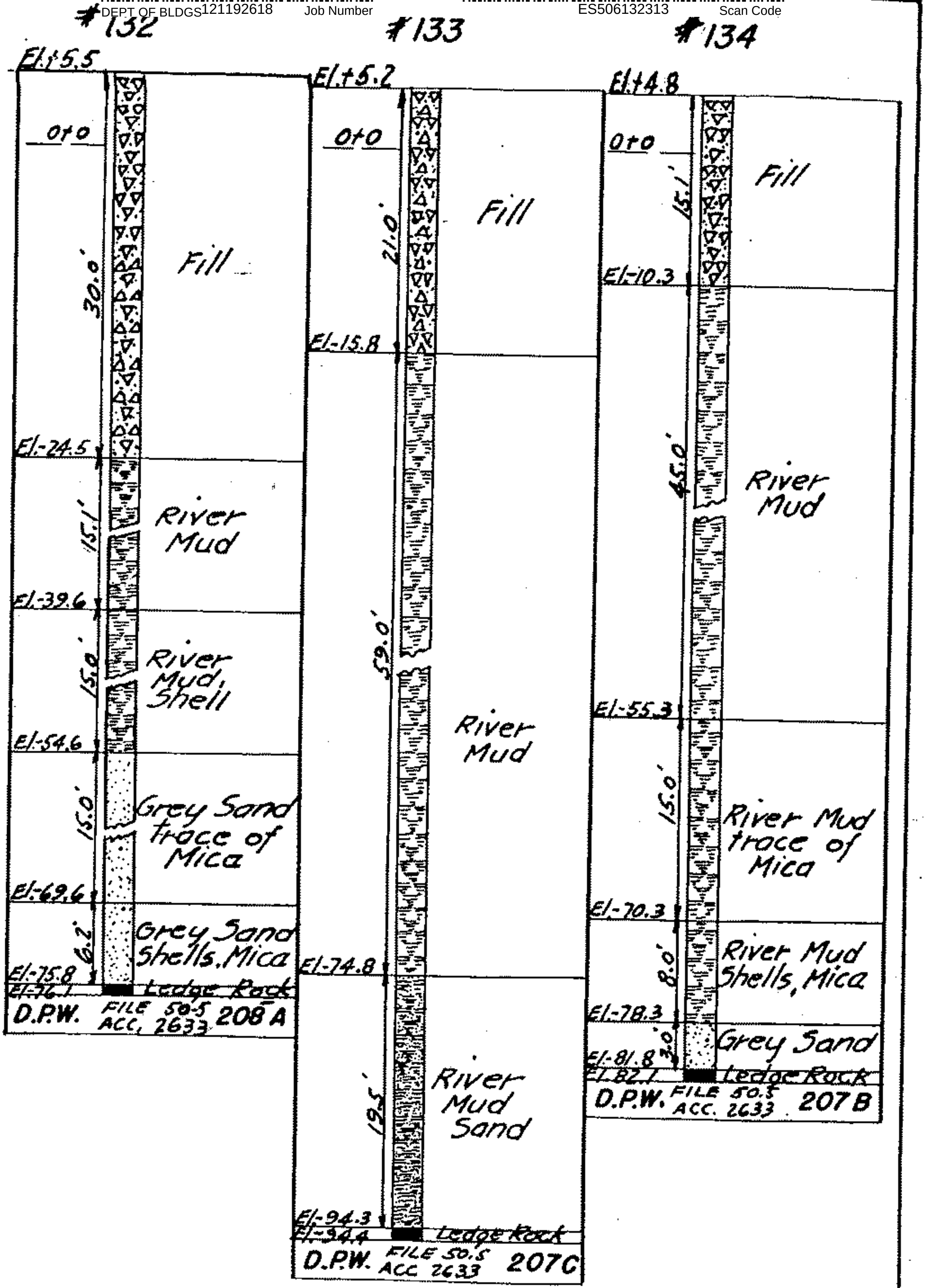

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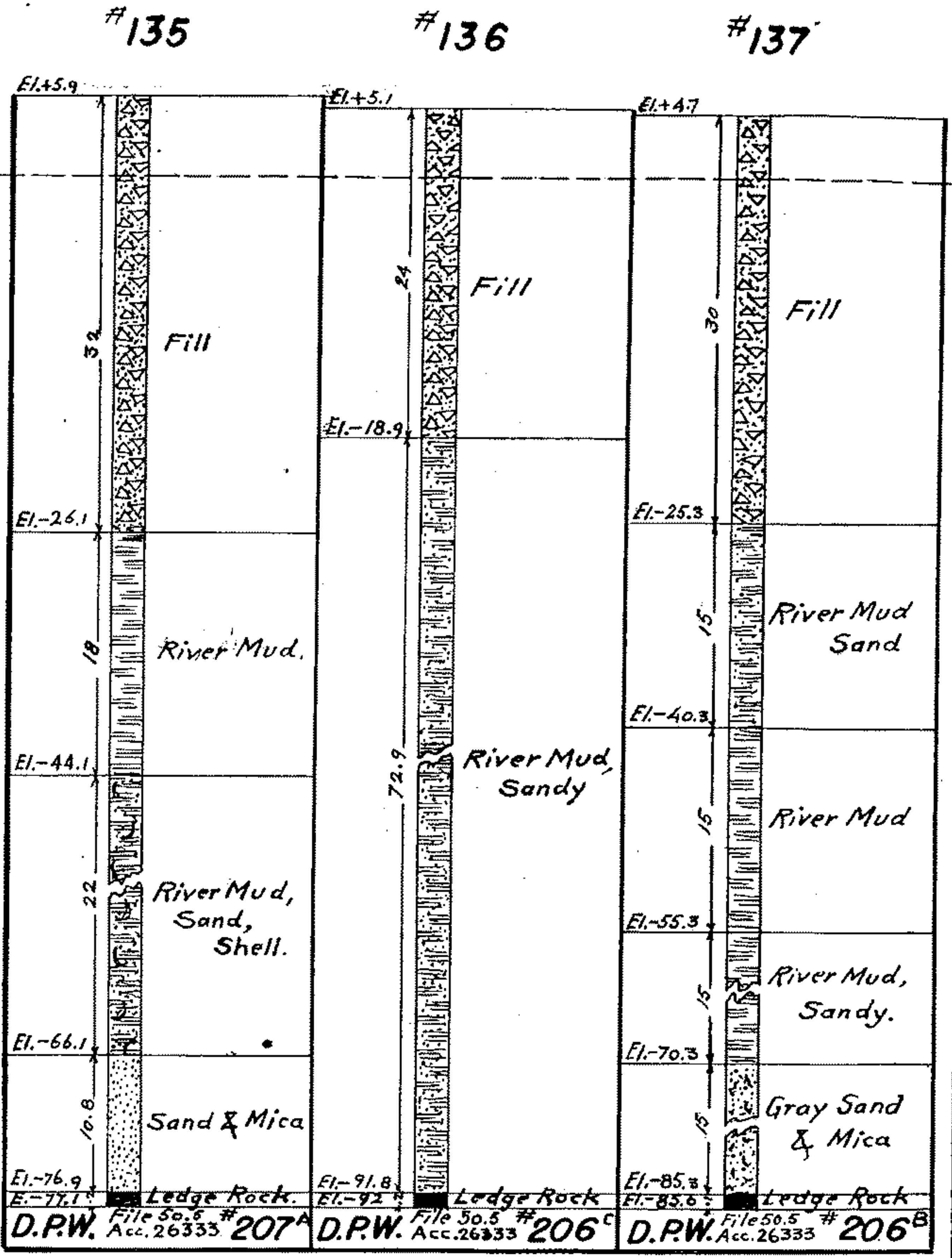

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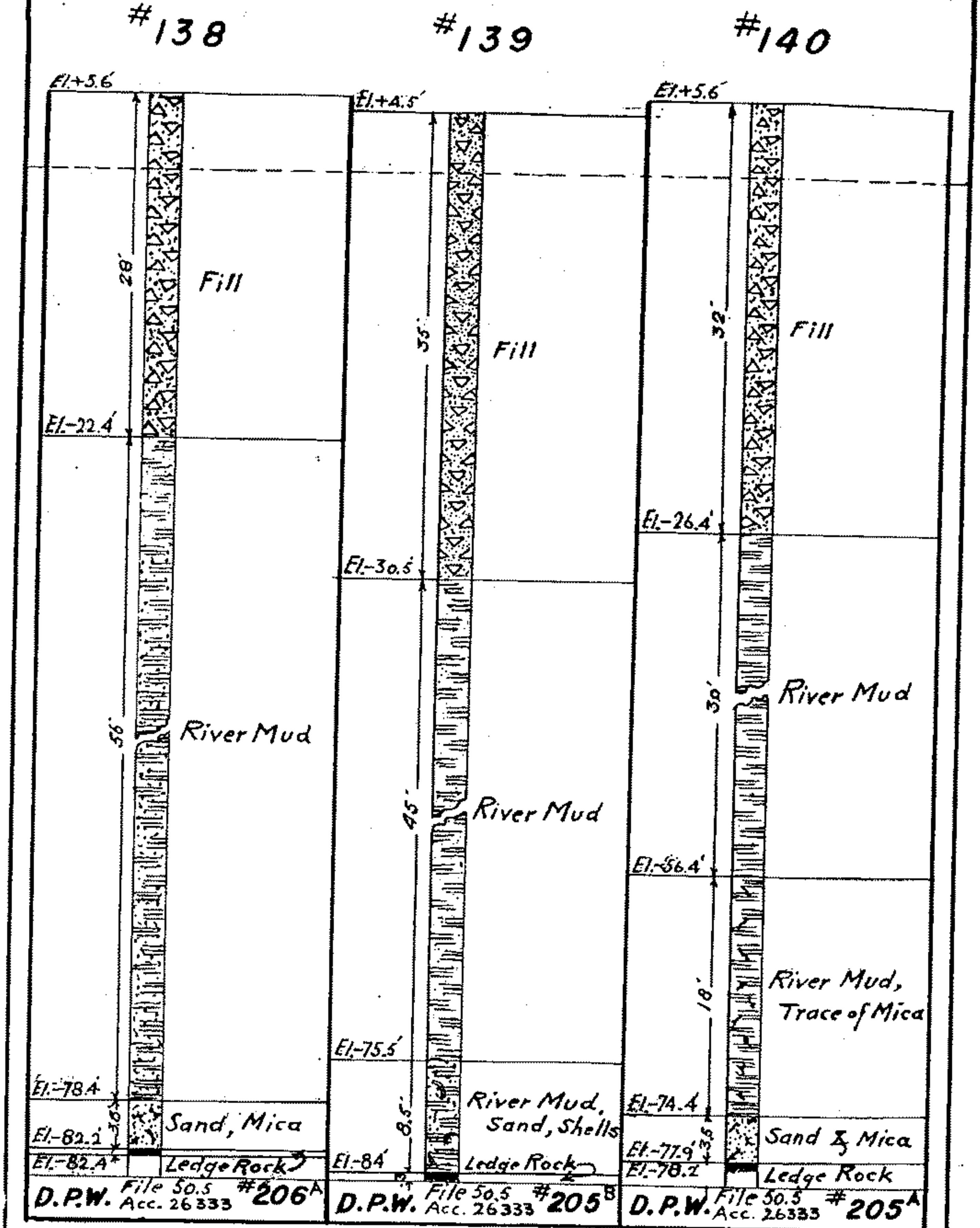

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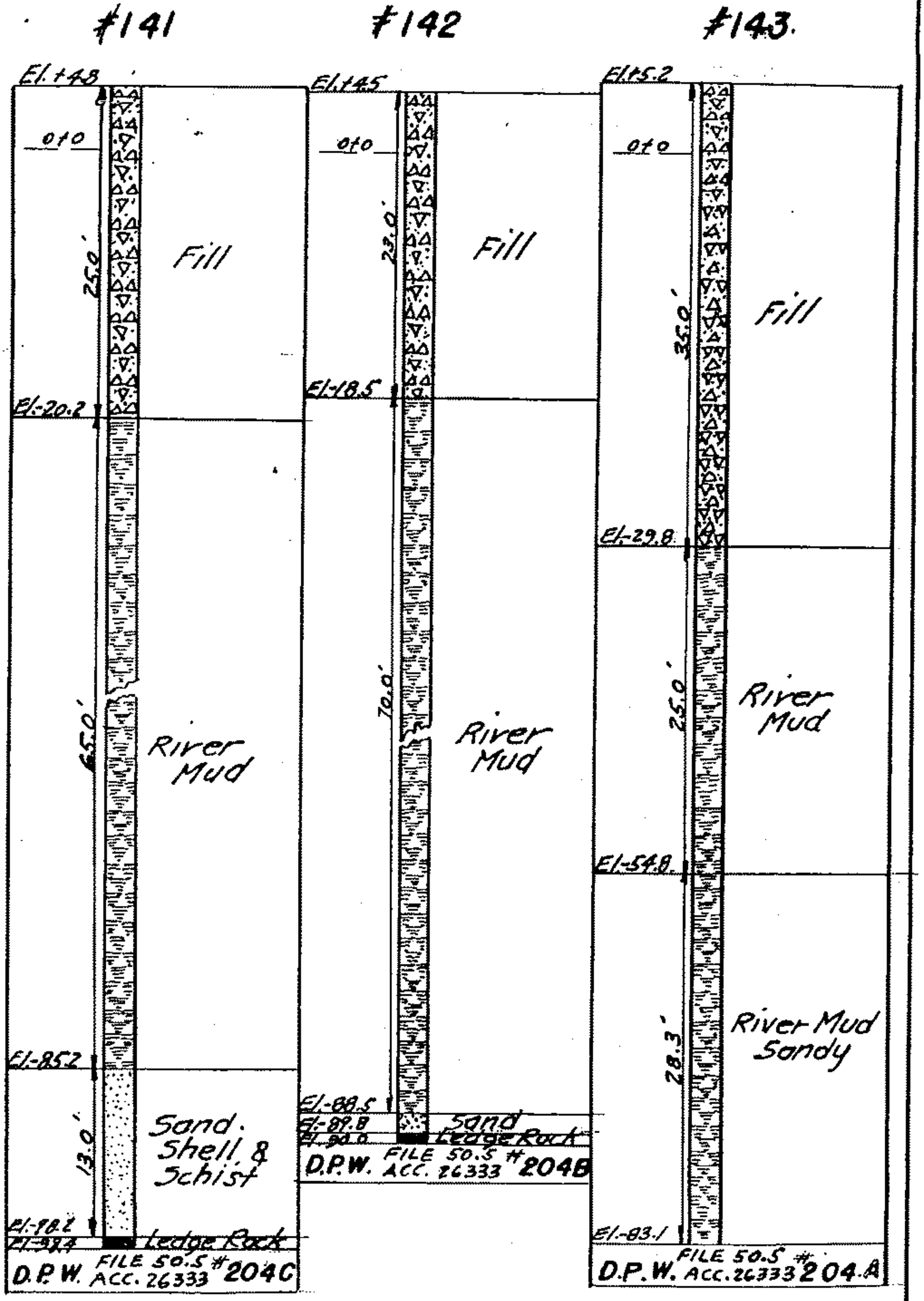

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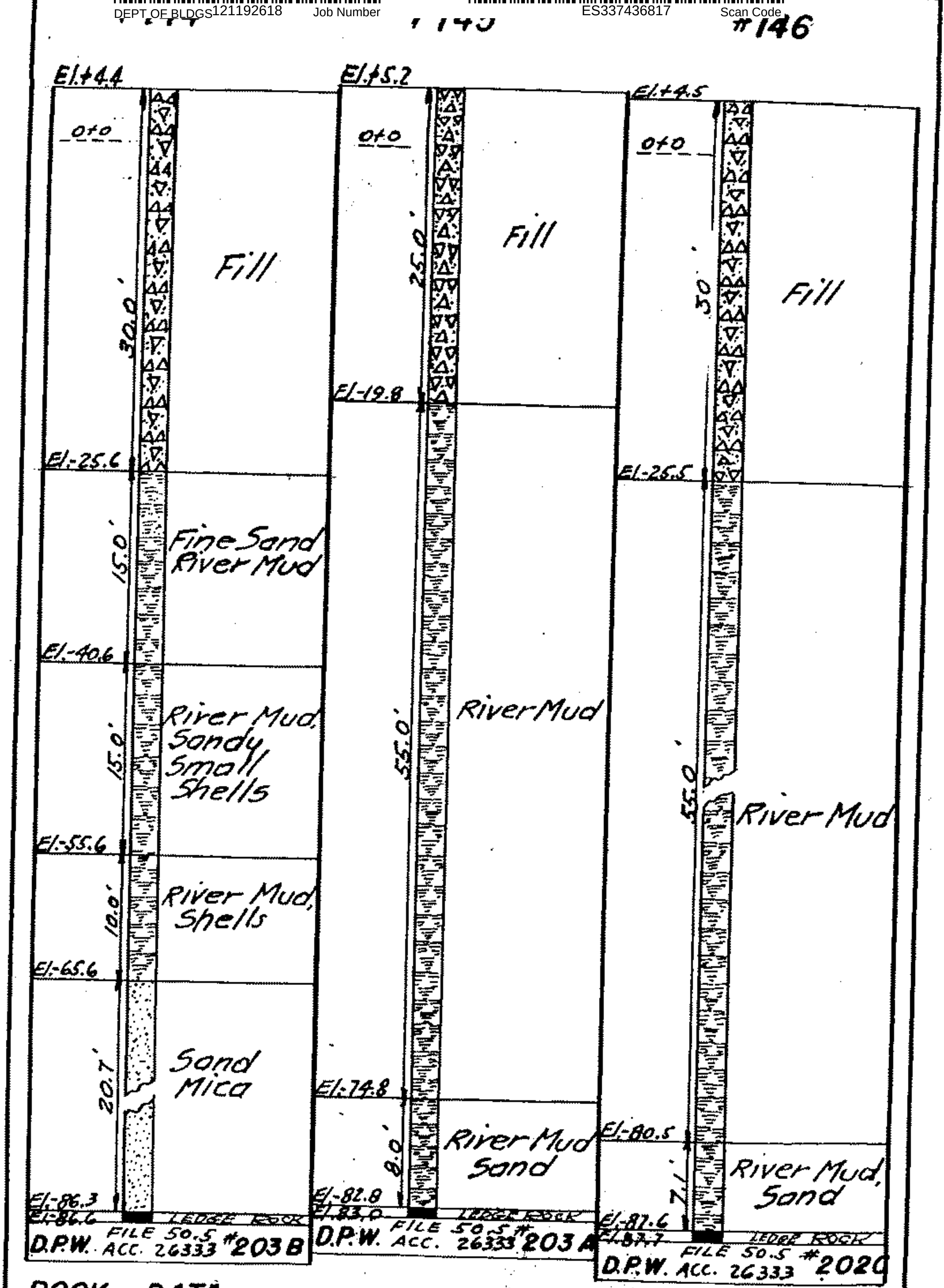

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VOL. 2 SH. 10

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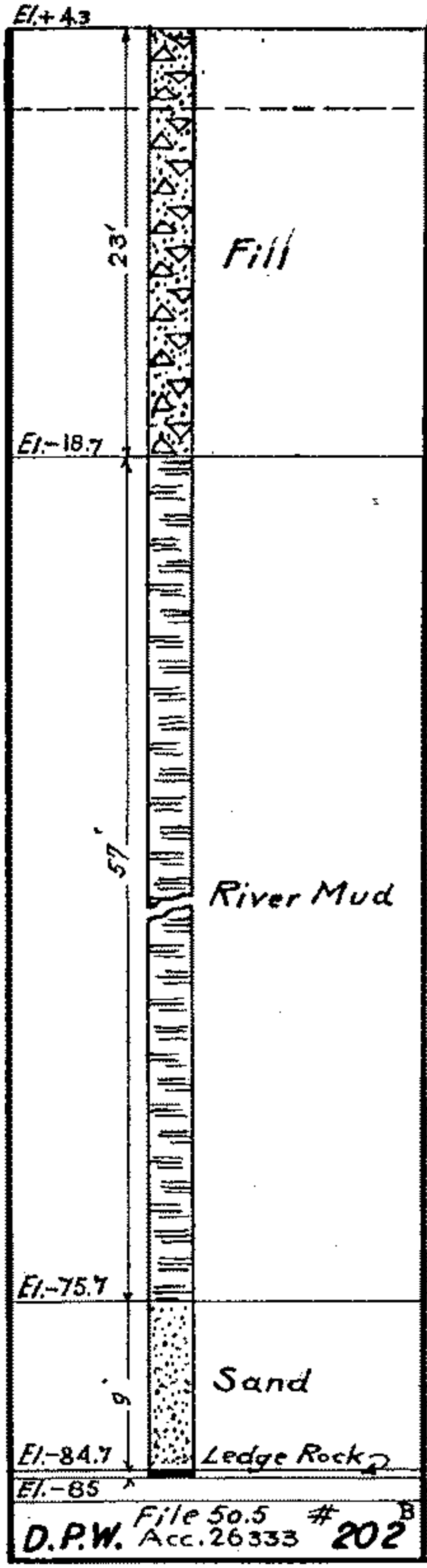

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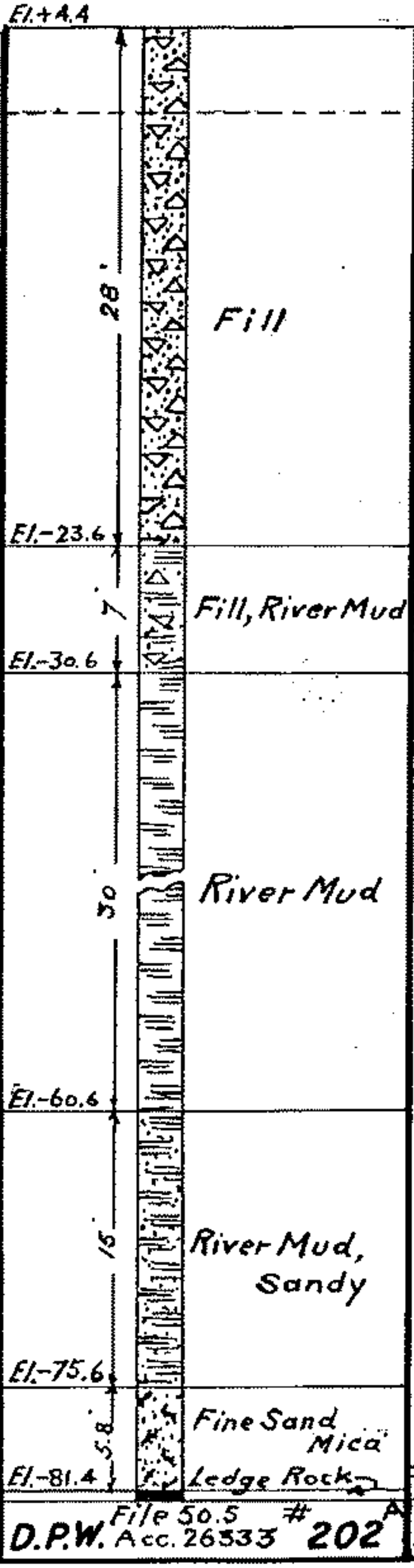

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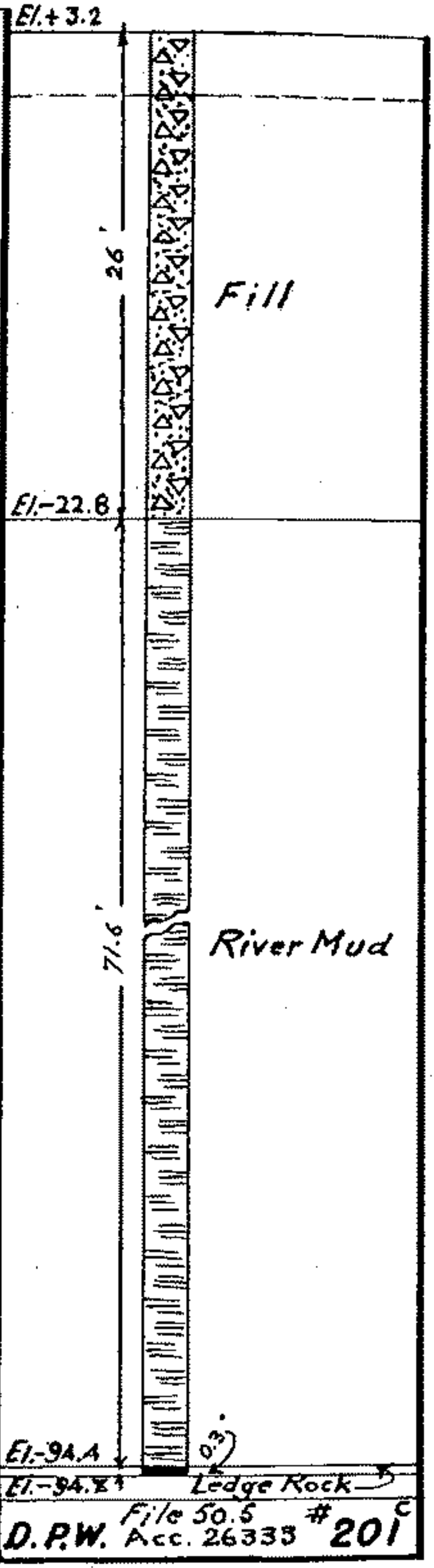

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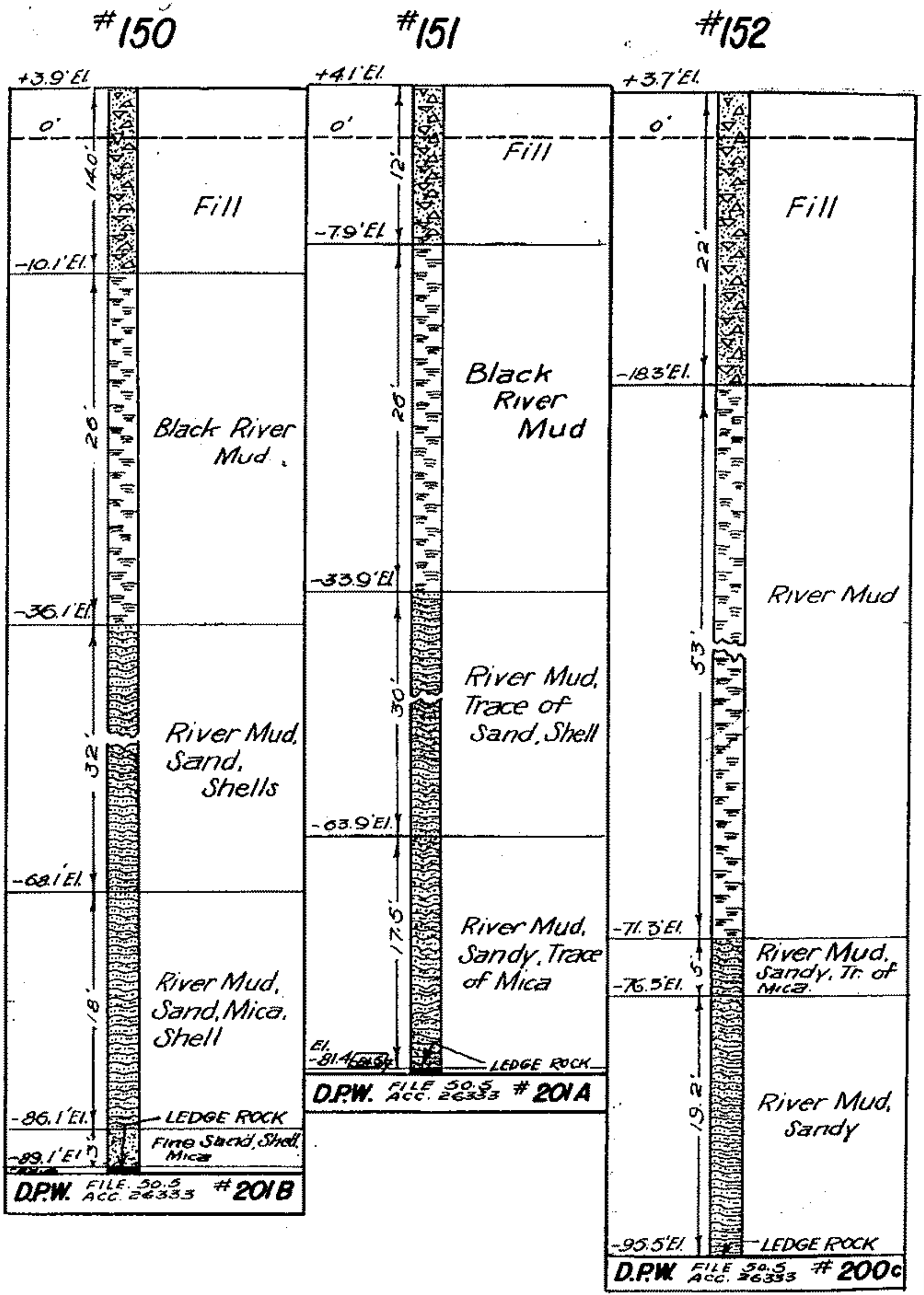

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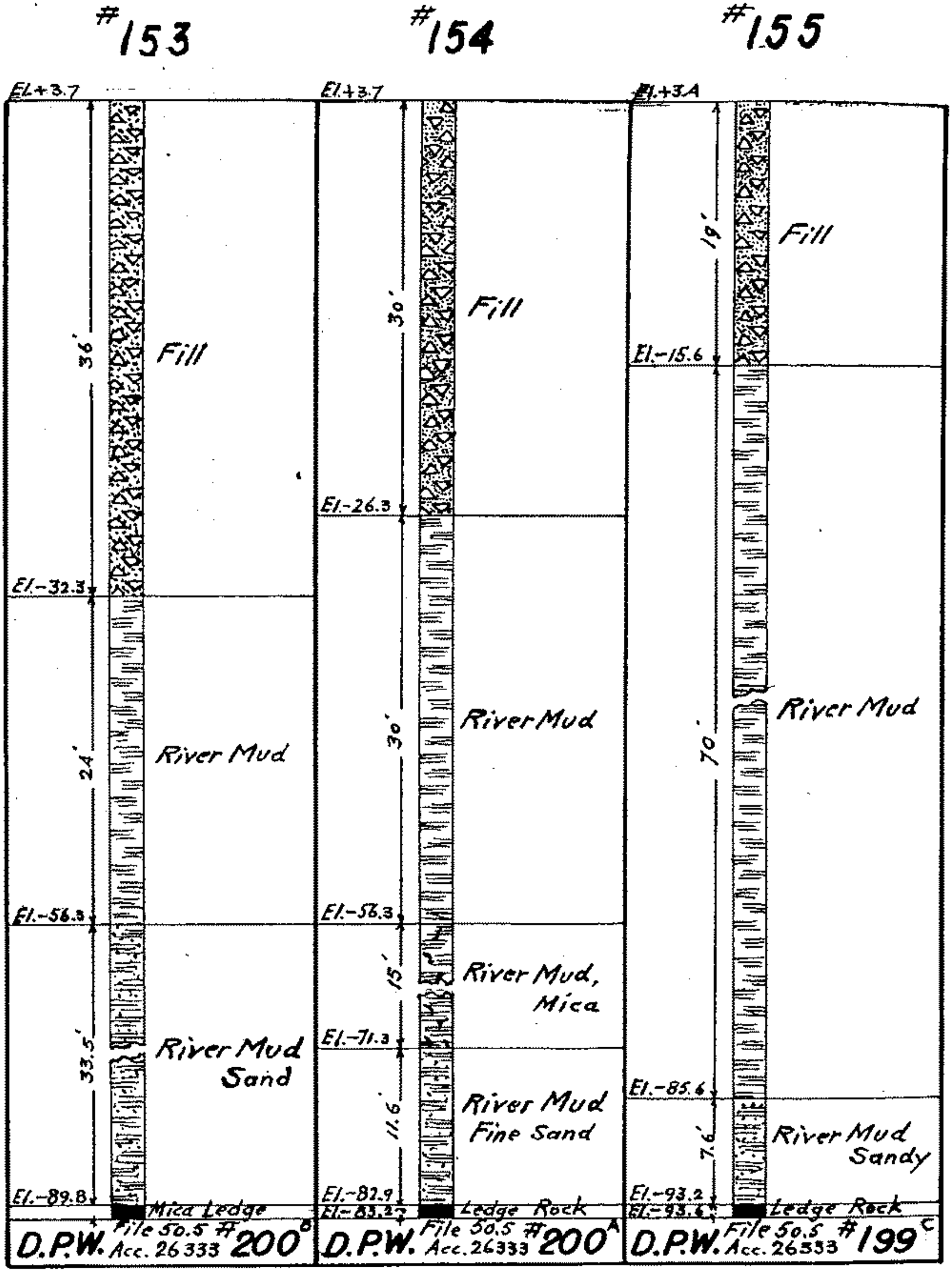

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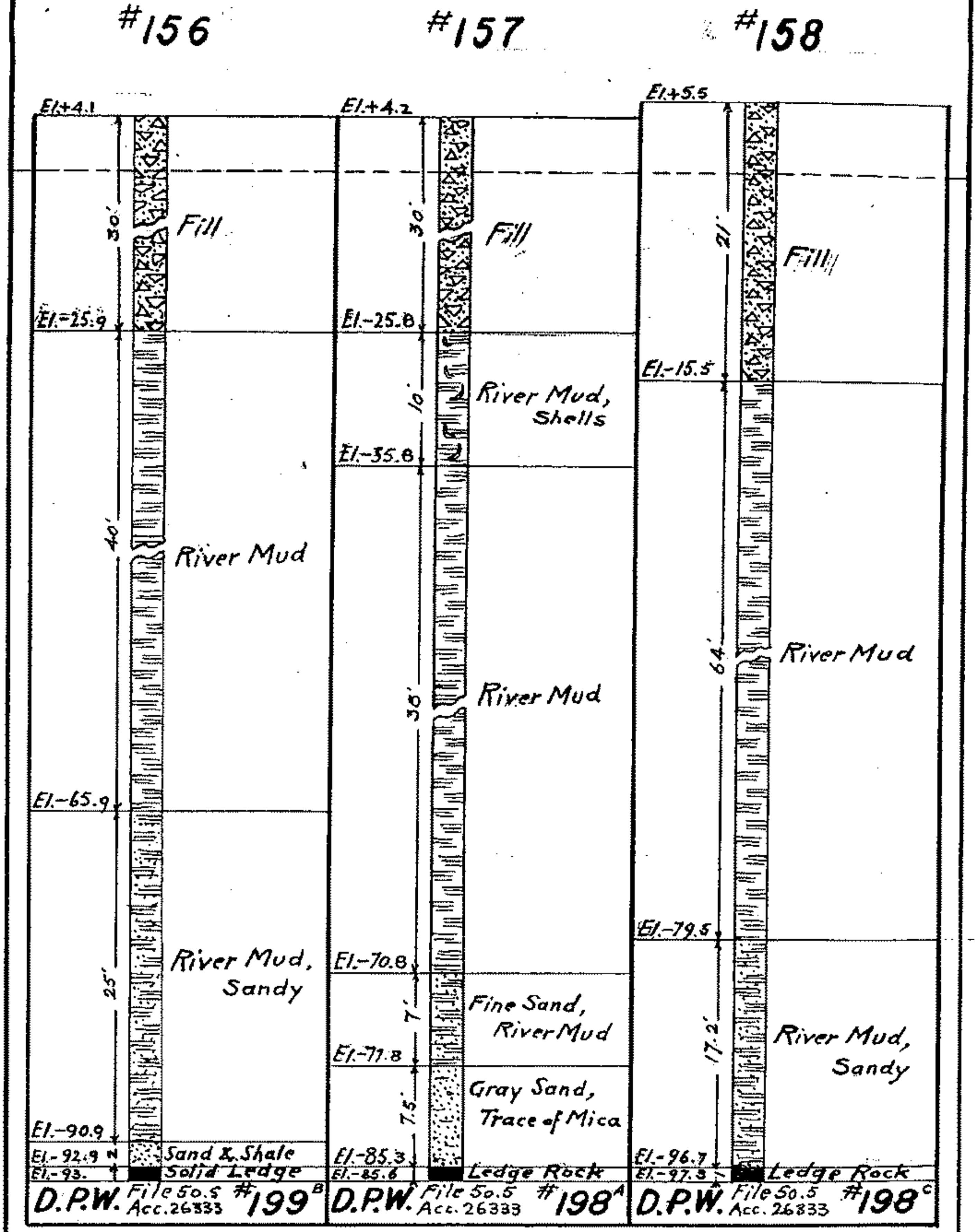

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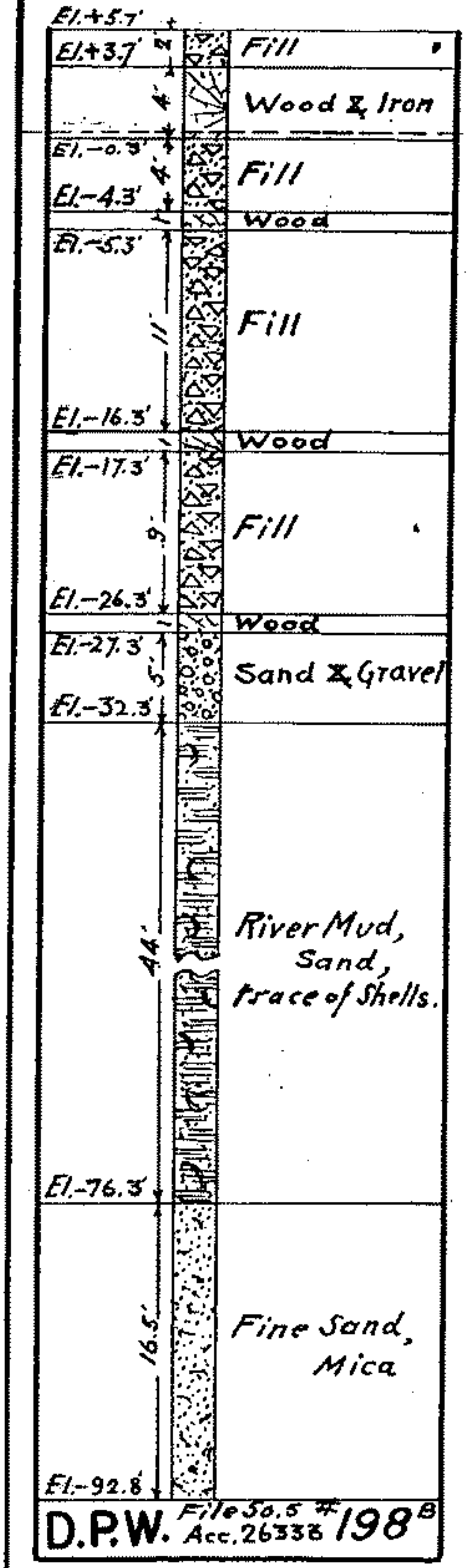

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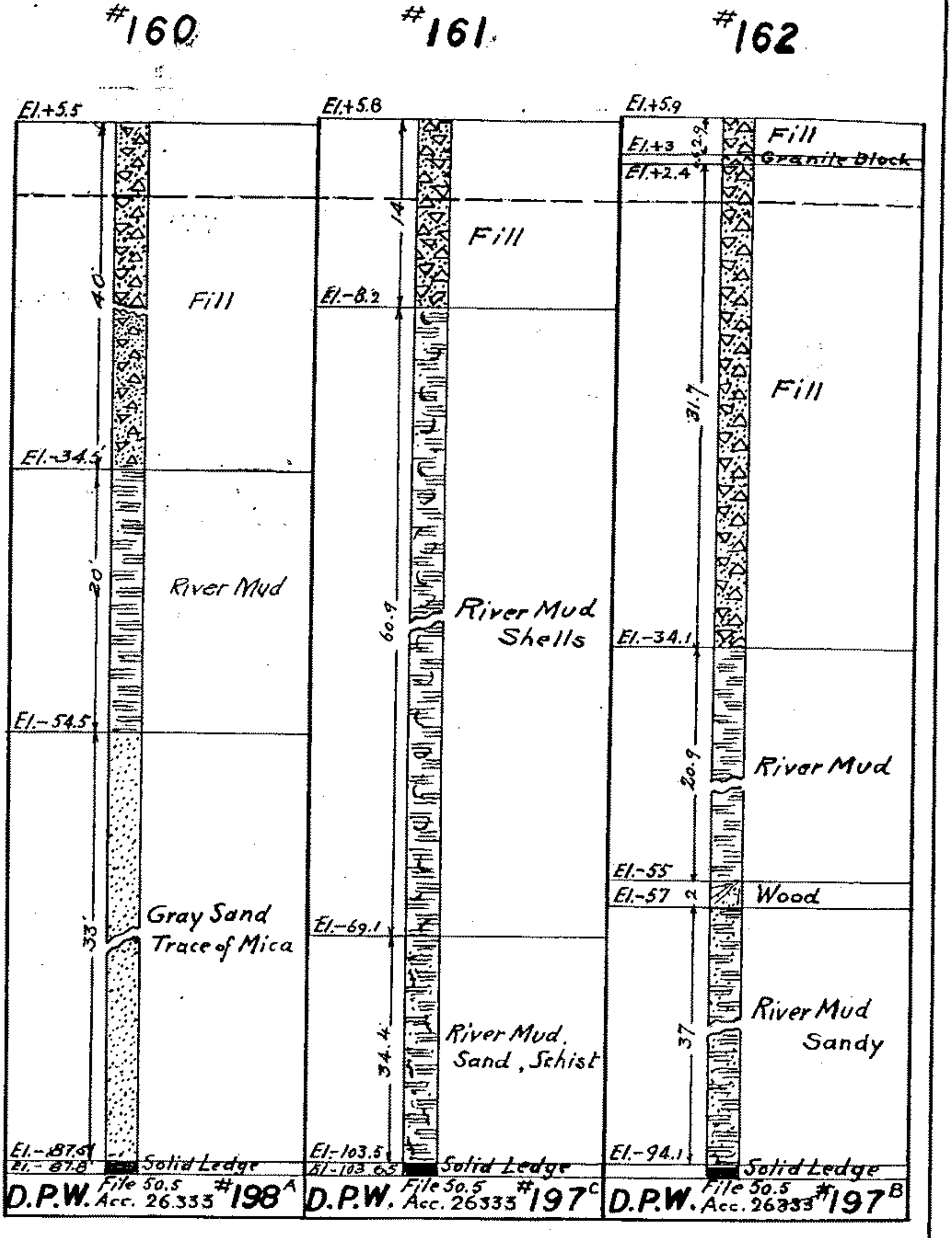

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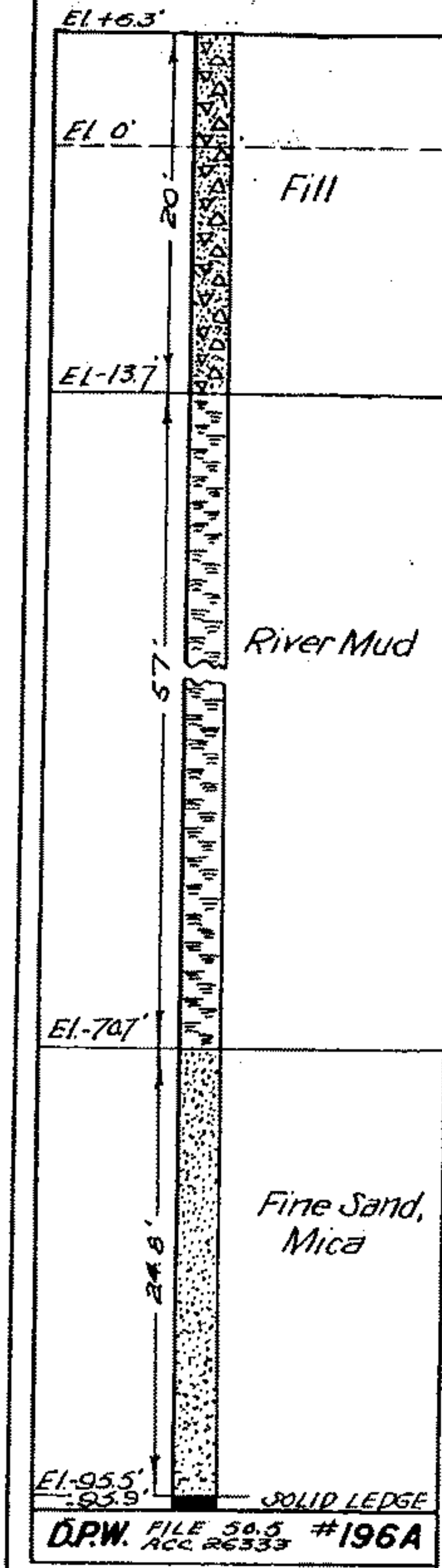

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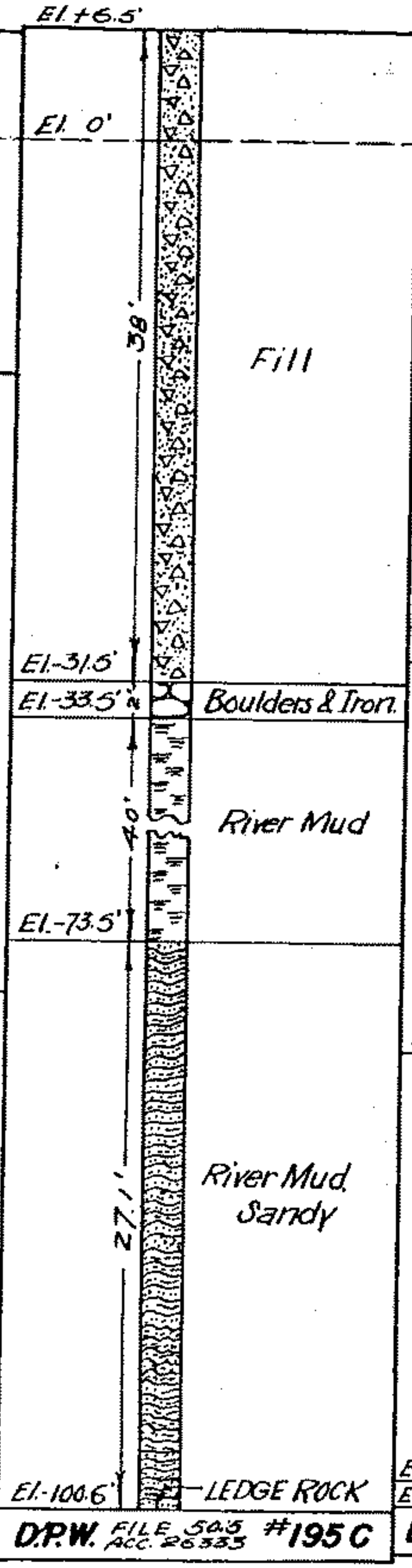

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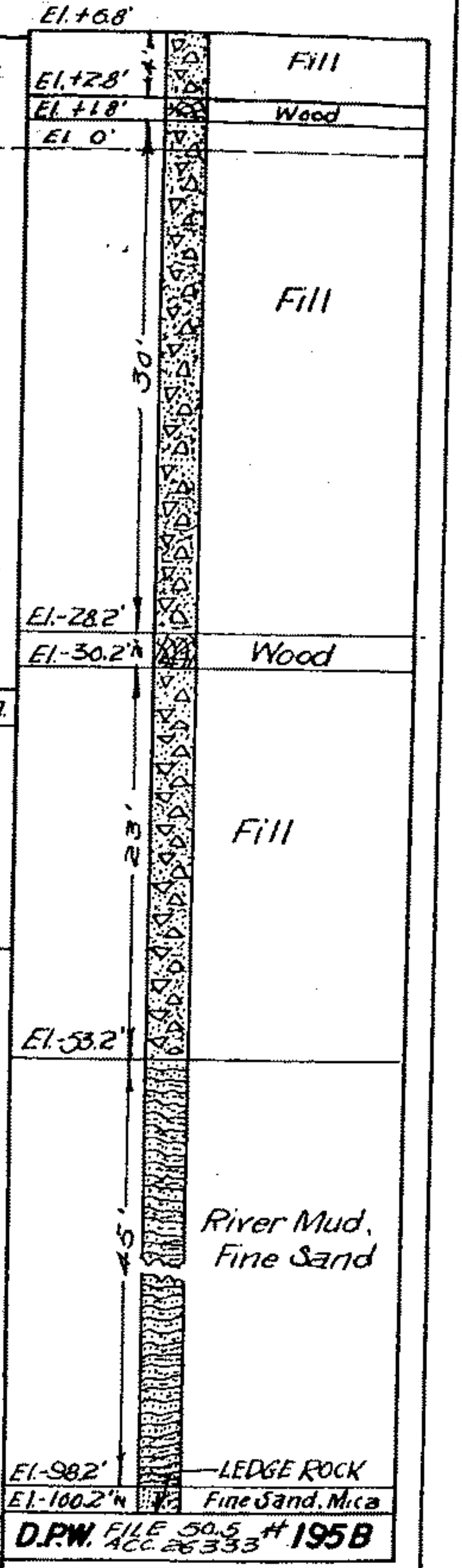

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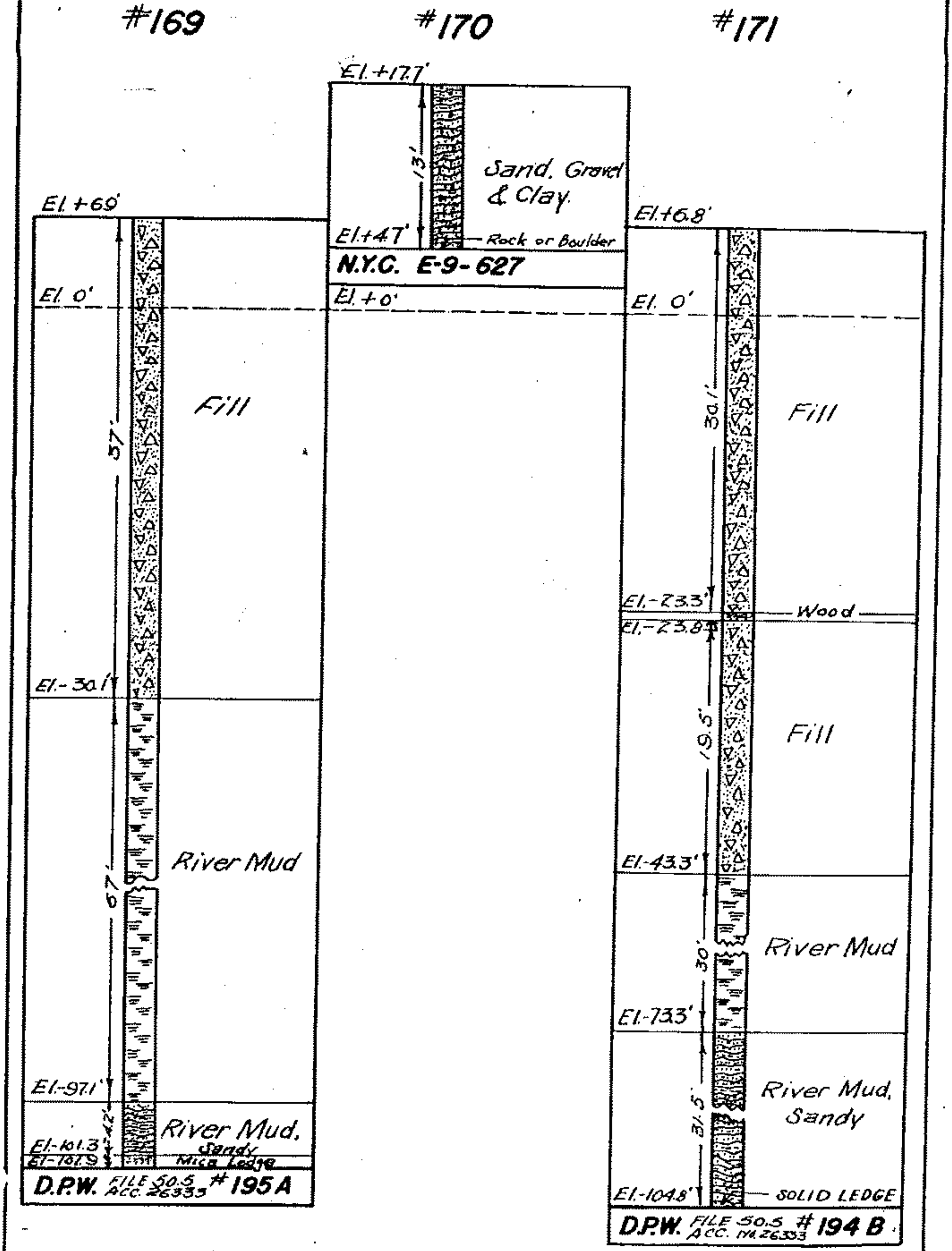

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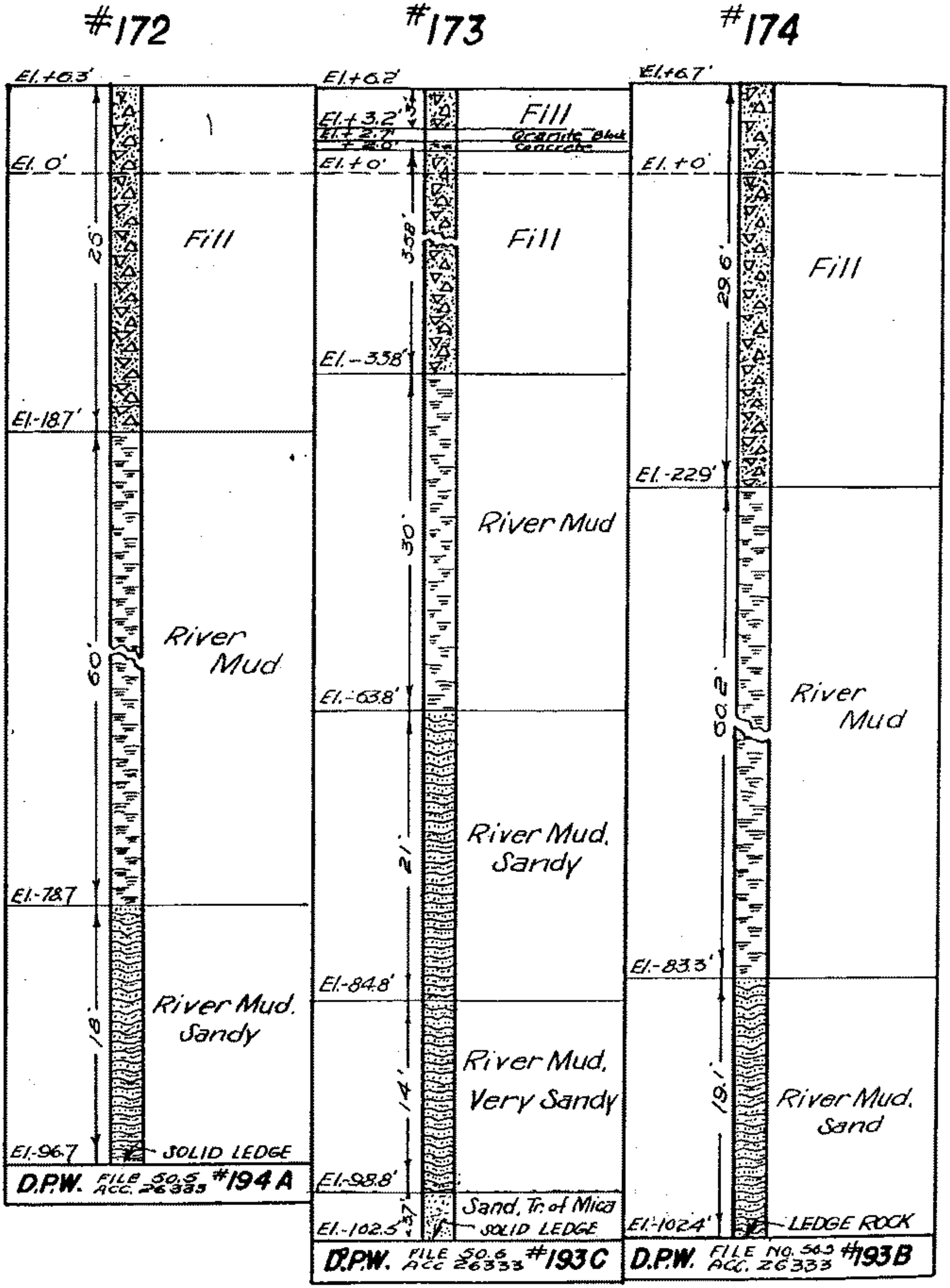

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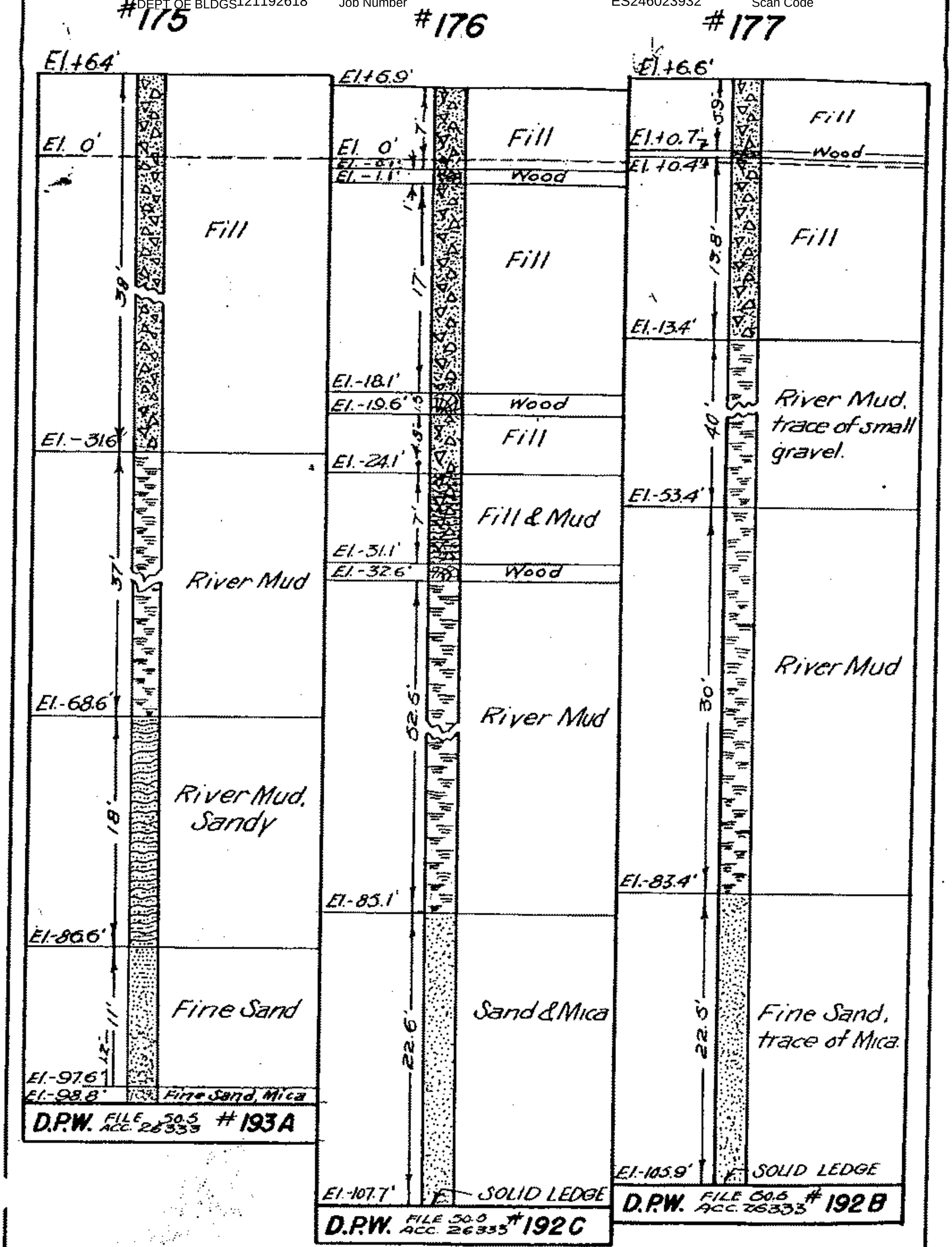

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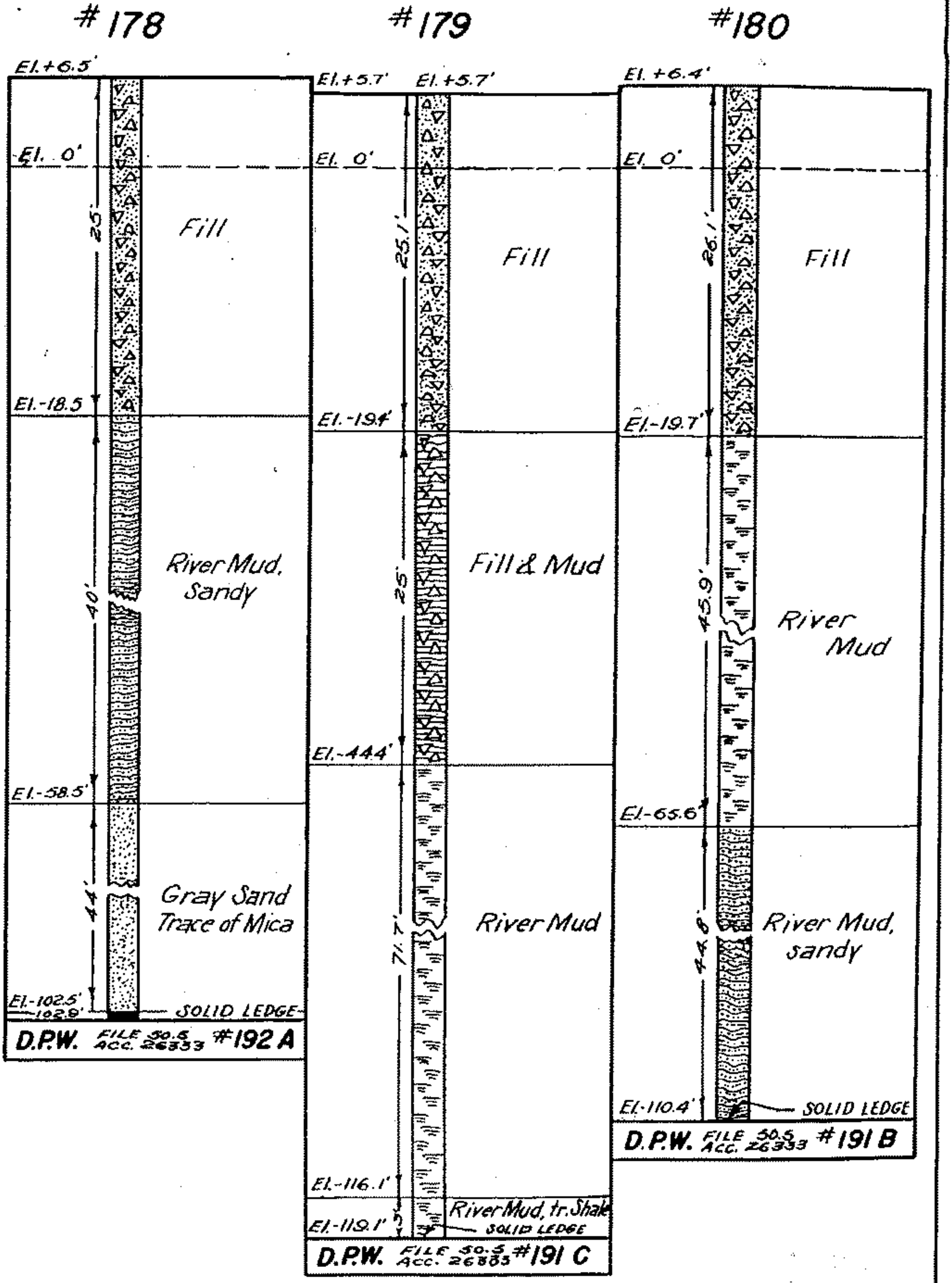

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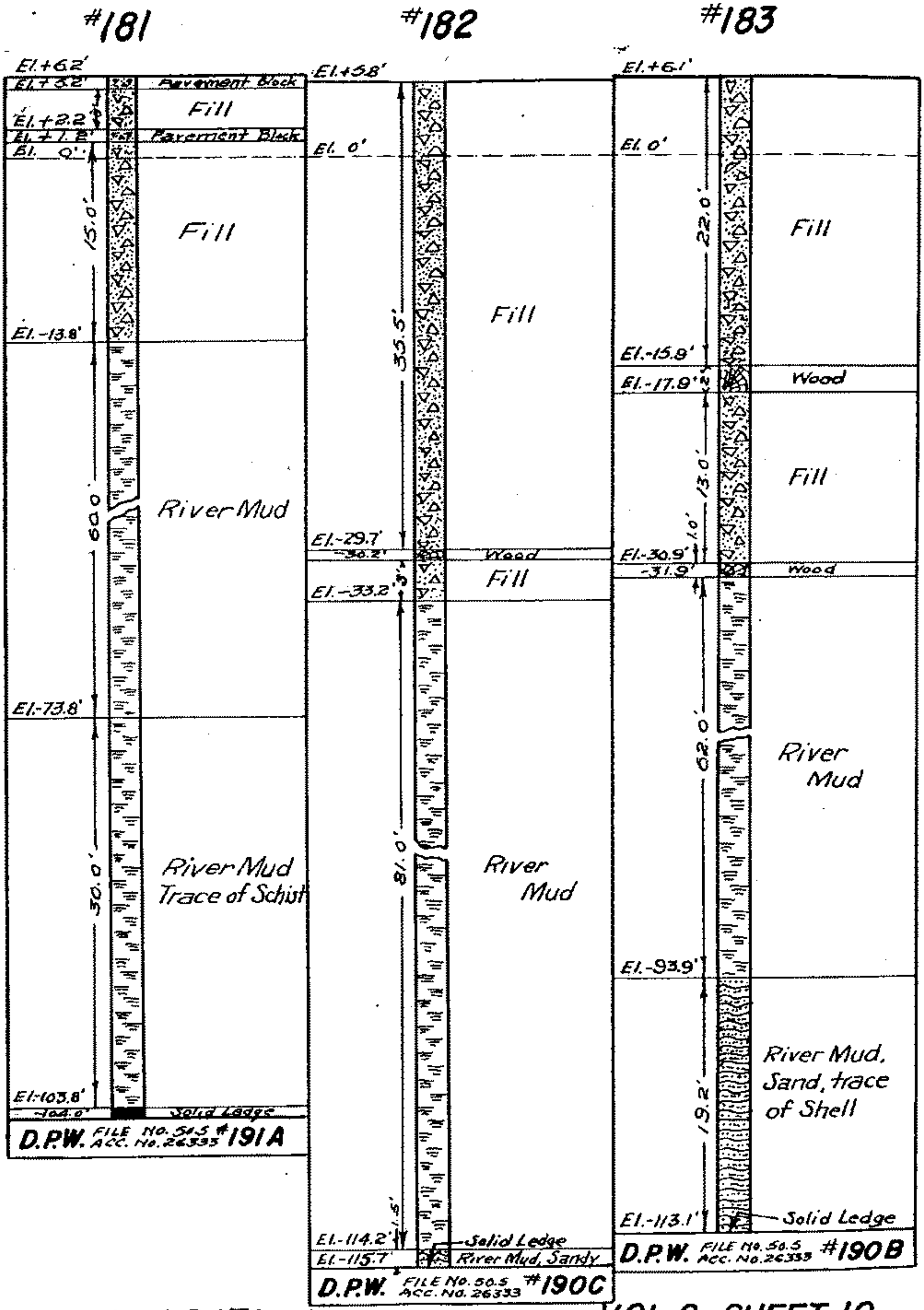

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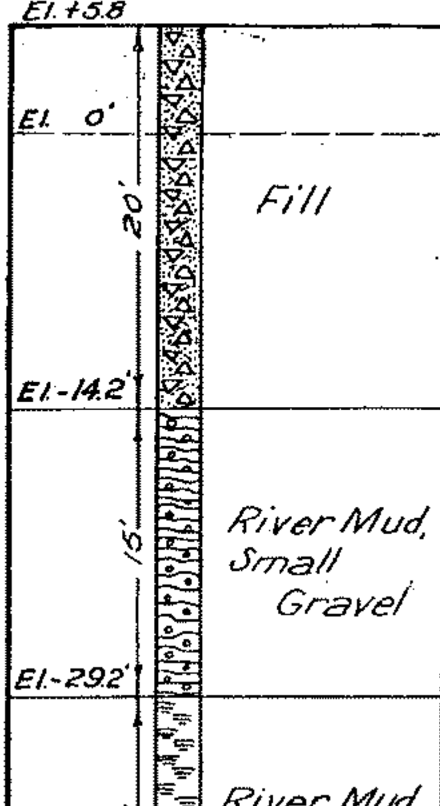

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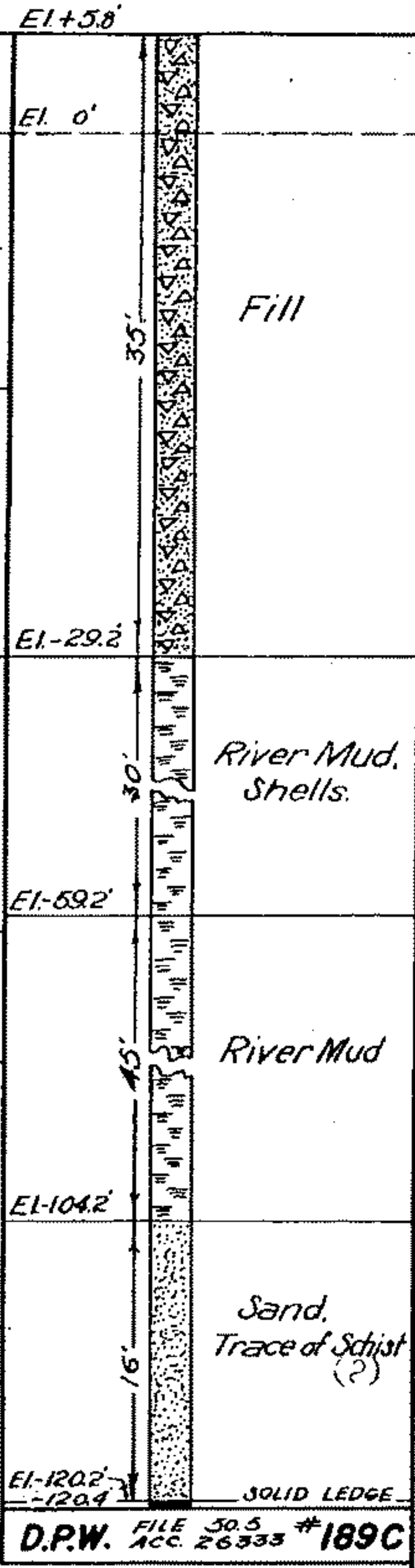

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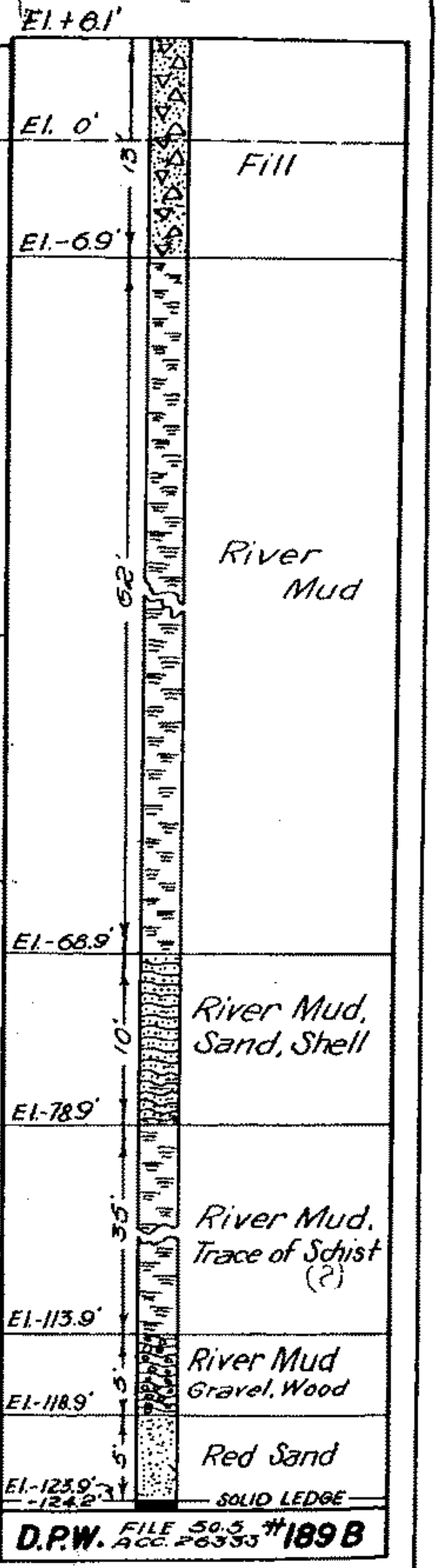

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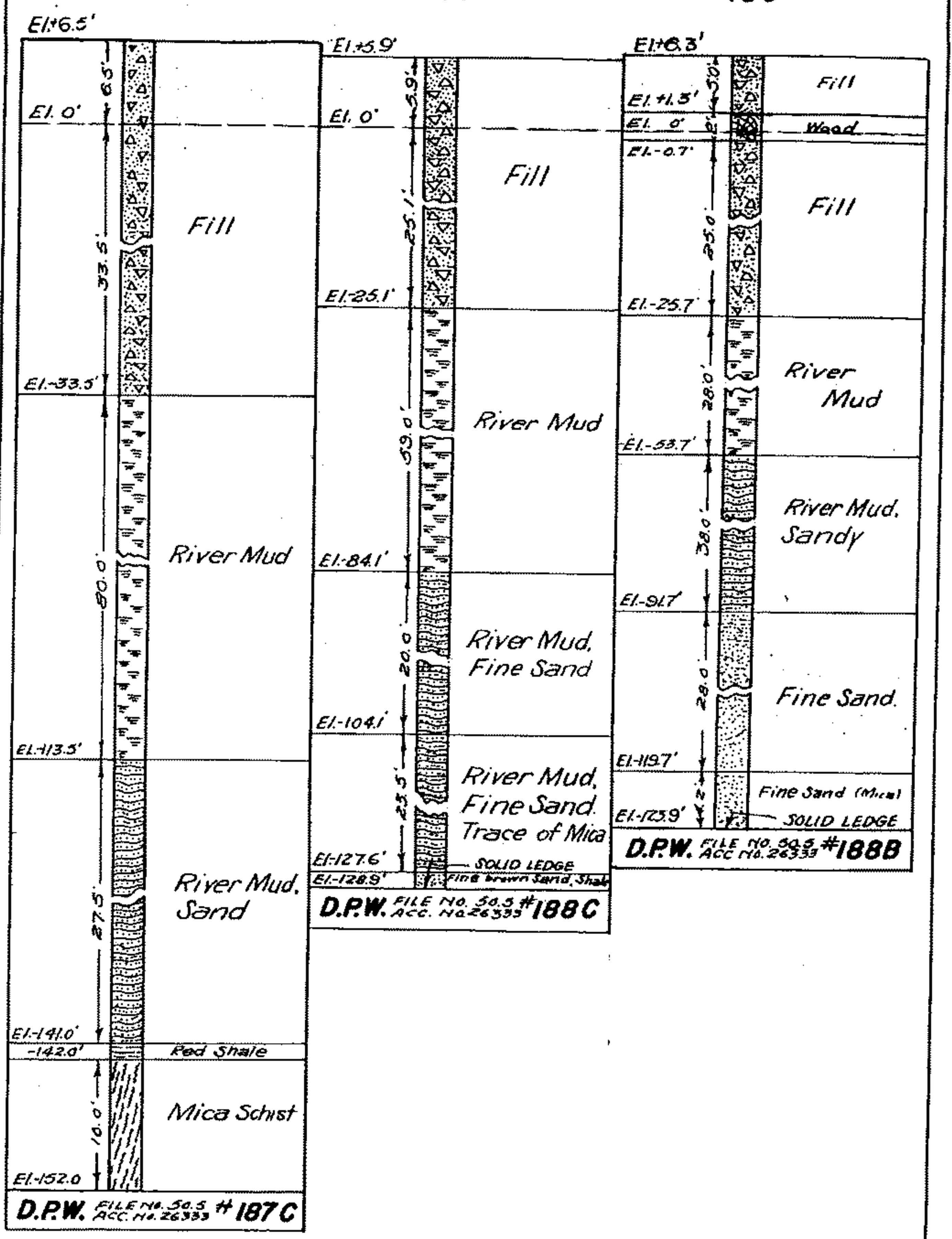

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VOL. 2 SHEET 10

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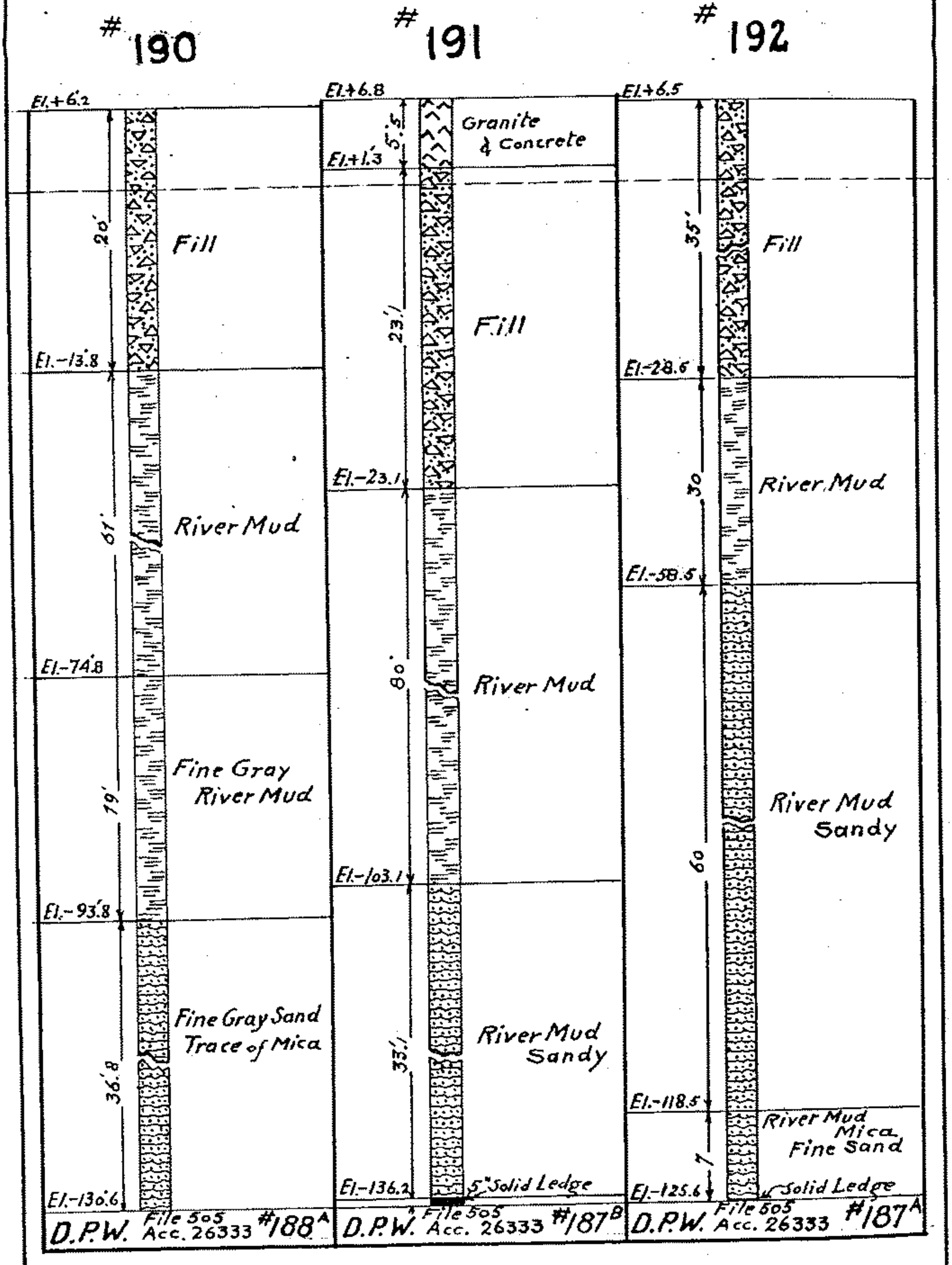

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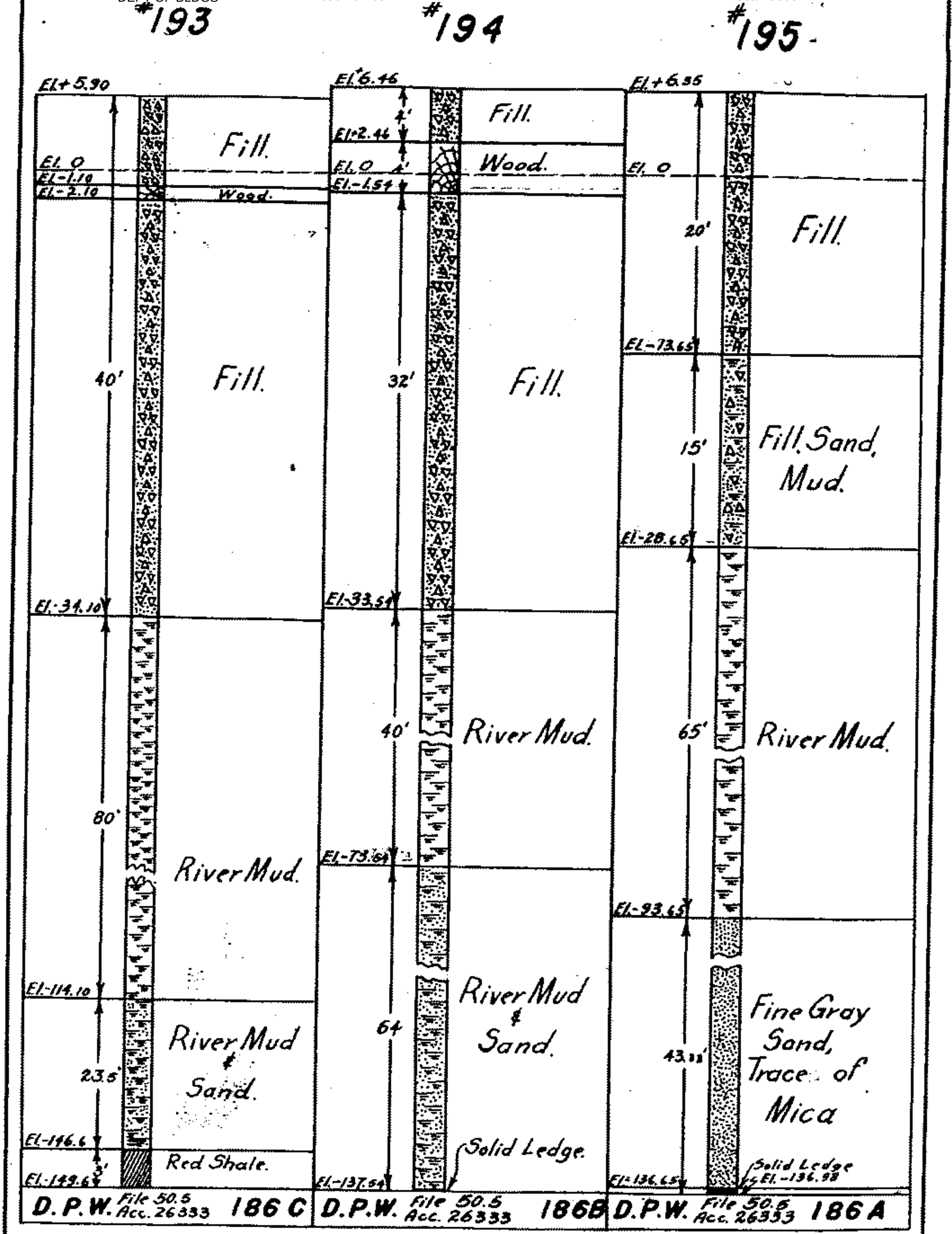

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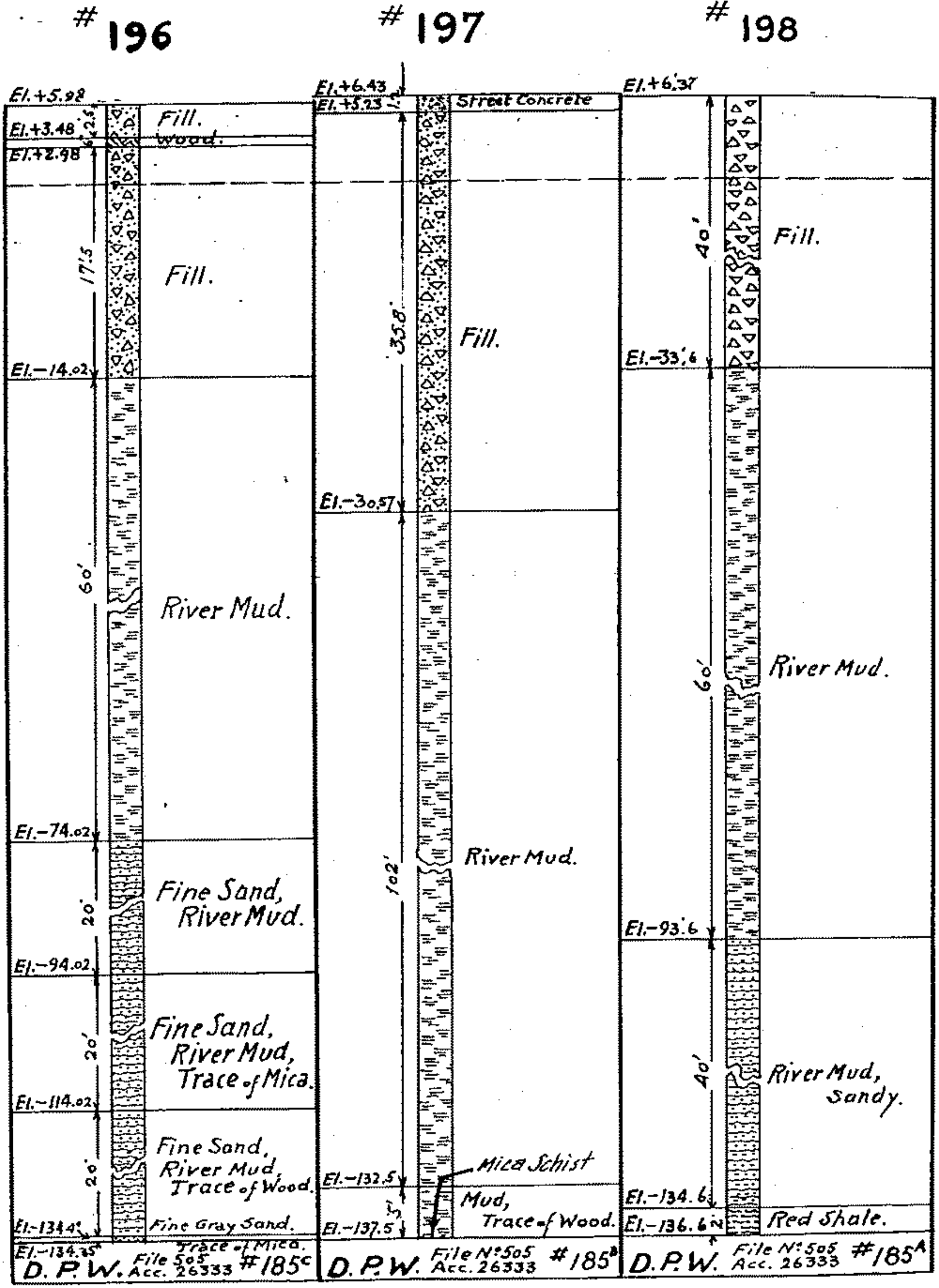

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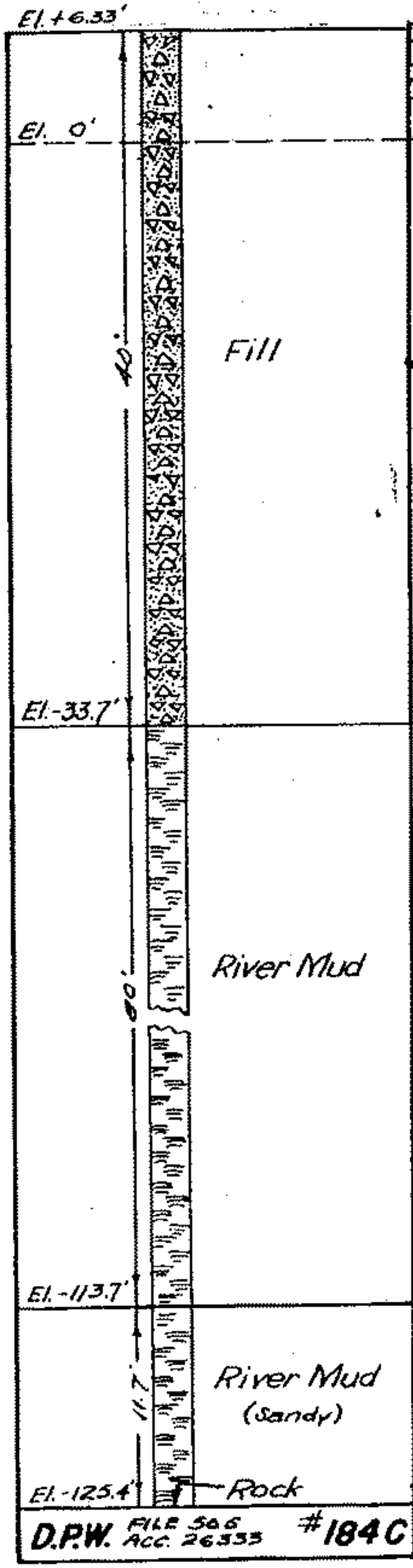
VOL.2 SHEET 10

2-27-34

#199



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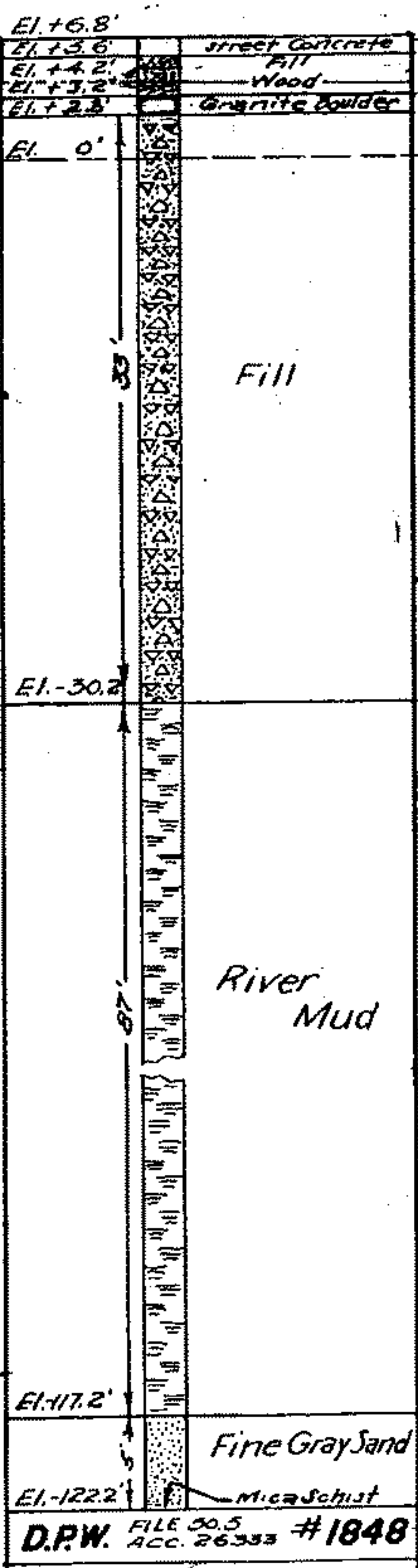

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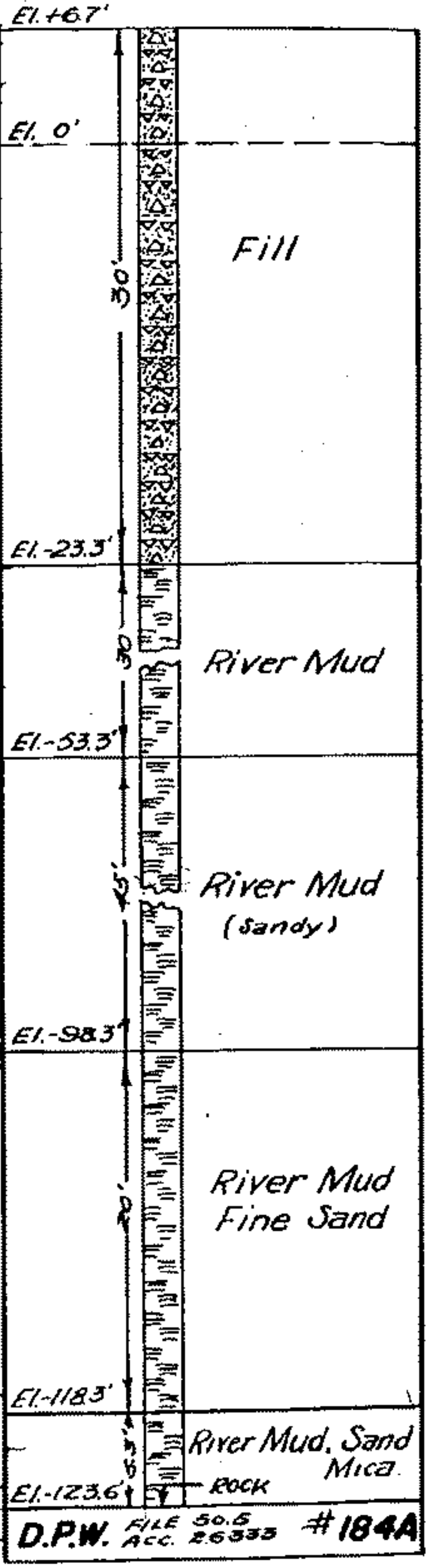
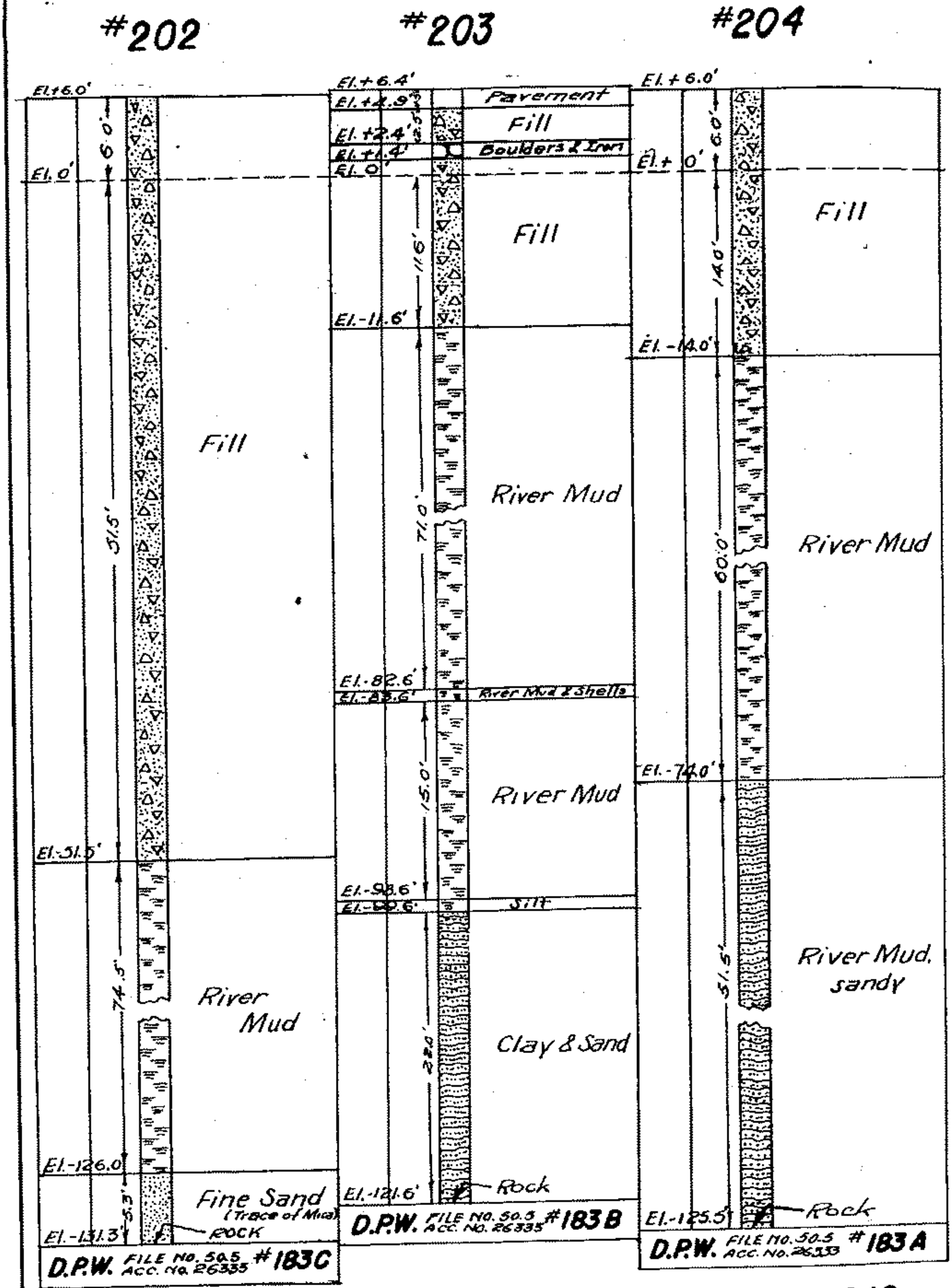


ROCK DATA

VOL.2 SHEET 10



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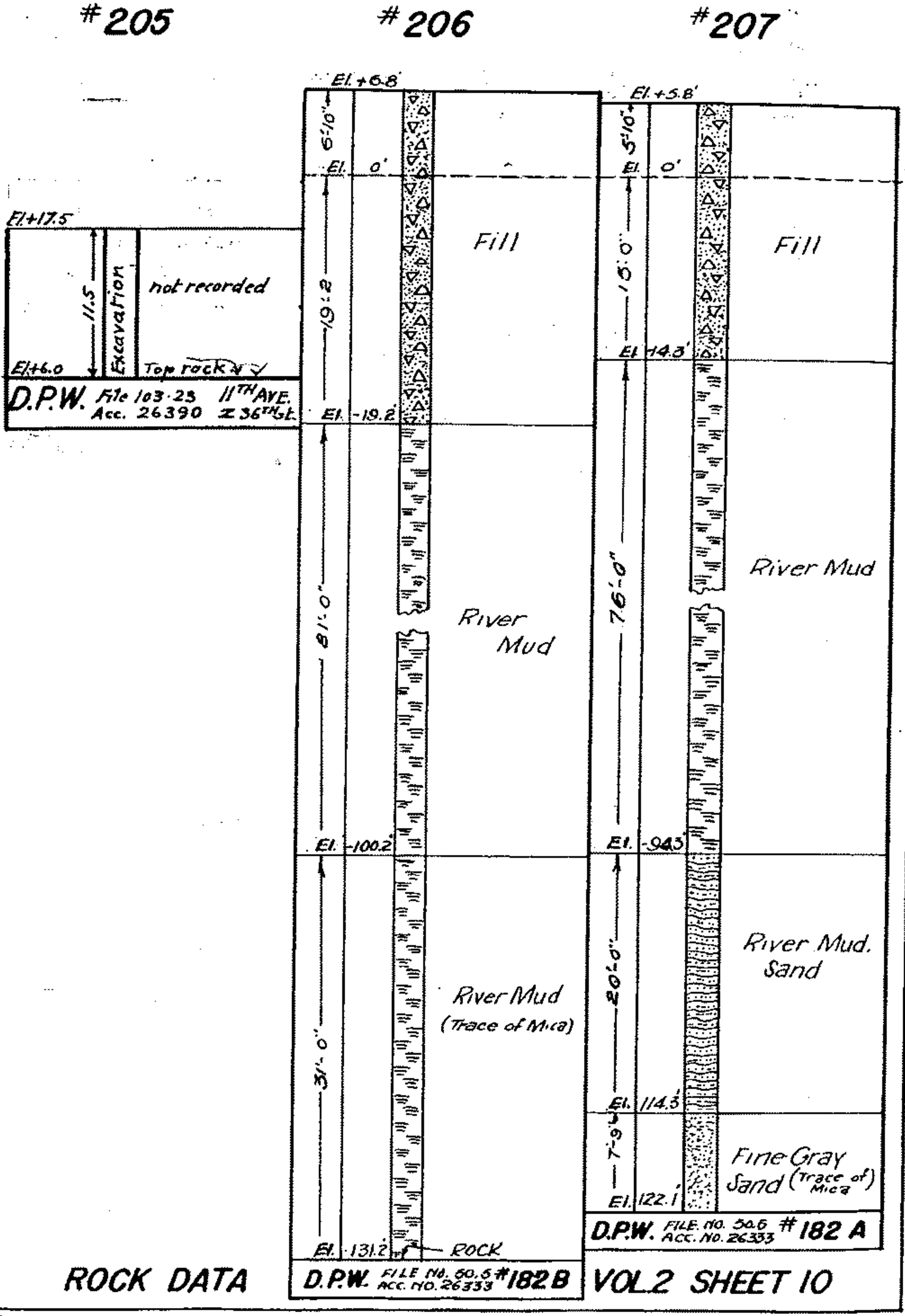

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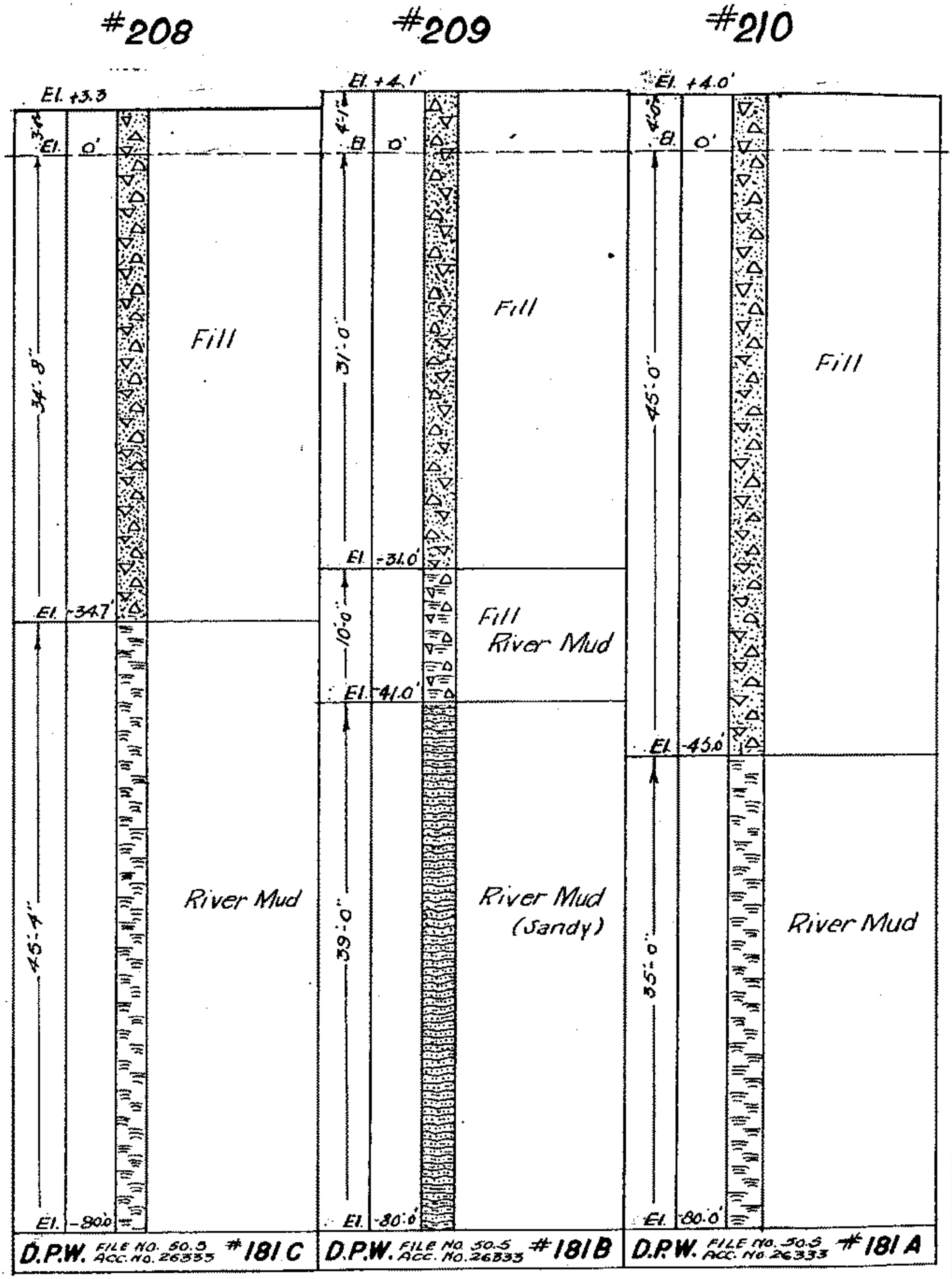
VOL.2 SHEET 10

Consult: Ch. L. SBT. 2-27-34



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VOL. 2 SHEET 10

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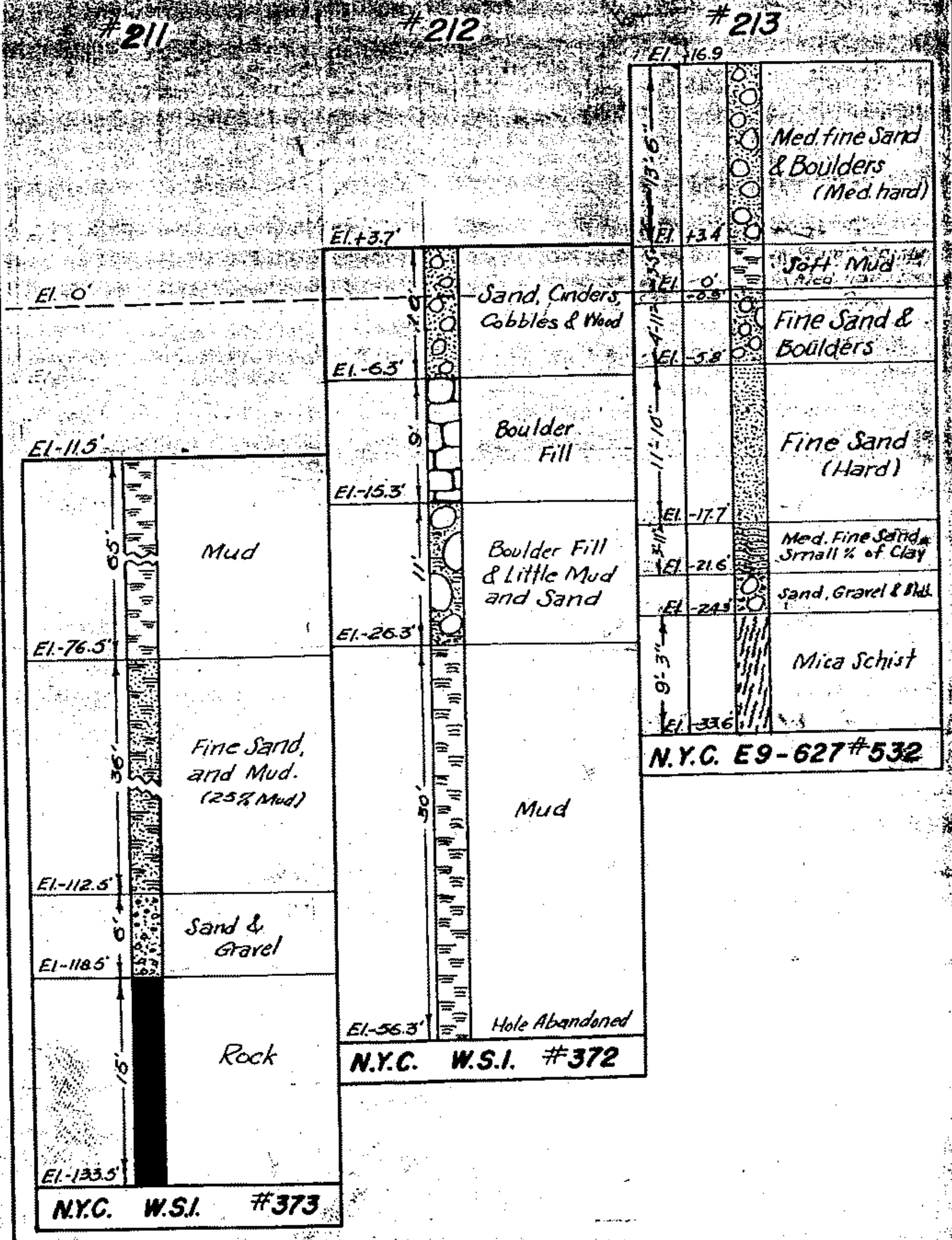

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VOL. 2 SHEET 10

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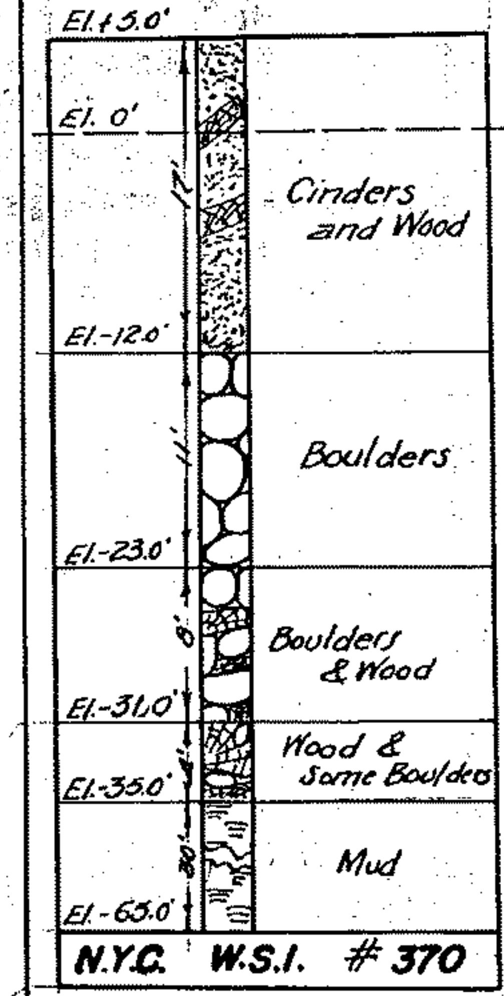

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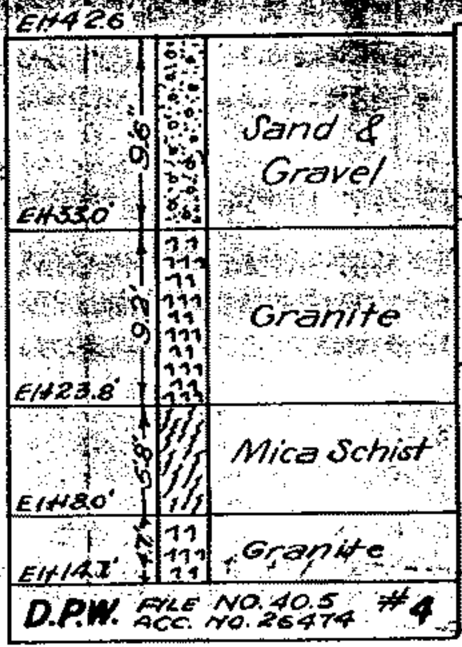

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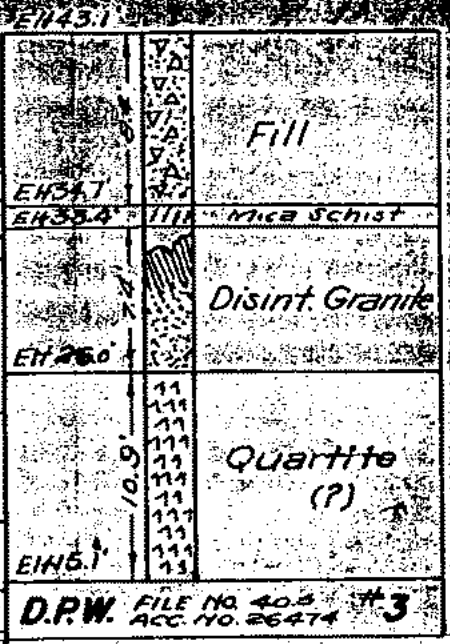


ROCK DATA

VOL.2 SHEET 10

#217

El +43.7

	El +42.0	Fill
26'-2"		Mica Schist
	El +15.8	

D.P.W. FILE No. 40.5 Acc. No. 26474 #2

#218

El +44.2

	El +41.8	Fill
7'-6"		Mica Schist
	El +34.3	
	El +33.0	Quartz
17'-5"		Mica Schist
	El +15.6	

D.P.W. FILE No. 40.5 Acc. No. 26474 #1

#219

El +30.1

7'-3"		Fill & Sand
	El +22.8	
	[illegible]	Quartzite (?)
5'-7"		Granite
	El +16.4	

D.P.W. FILE No. 40.5 Acc. No. 26474 #B4

#220

El +33.1

6'-7"		Coarse Sand
	El +26.5	
7'-1"		Mica Schist
	El +19.4	
	El +18.0	Quartzite (?)
	El +16.5	Mica Schist

D.P.W. FILE No. 40.5 Acc. No. 26474 #B3

#221

El +35.8

5'-0"		Fill
	El +30.8	
4'-0"		Coarse Sand
	El +26.8	
4'-0"		Granite
	El +22.8	
	El +22.2	Mica Schist
6'-10"		Quartz Granite
	El +15.3	

D.P.W. FILE No. 40.5 Acc. No. 26474 #B2

#222

El +38.5

10'-2"		Clay
	El +28.3	
	El +27.3	Soft Mica Schist
15'-3"		Mica Schist
	El +12.1	
	El +10.6	Granite

D.P.W. FILE No. 40.5 Acc. No. 26474 #B1

#223

El +24.2

7'-8"		Fill
	El +16.5	
7'-0"		Clay, Sand
	El +9.5	

D.P.W. FILE No. 40.5 Acc. No. 26474 #A6

#224

El +27.7

5'-2"		Sand
	El +22.5	
9'-10"		Clay, Sand & Gravel
	El +12.7	

D.P.W. FILE No. 40.5 Acc. No. 26474 #A5

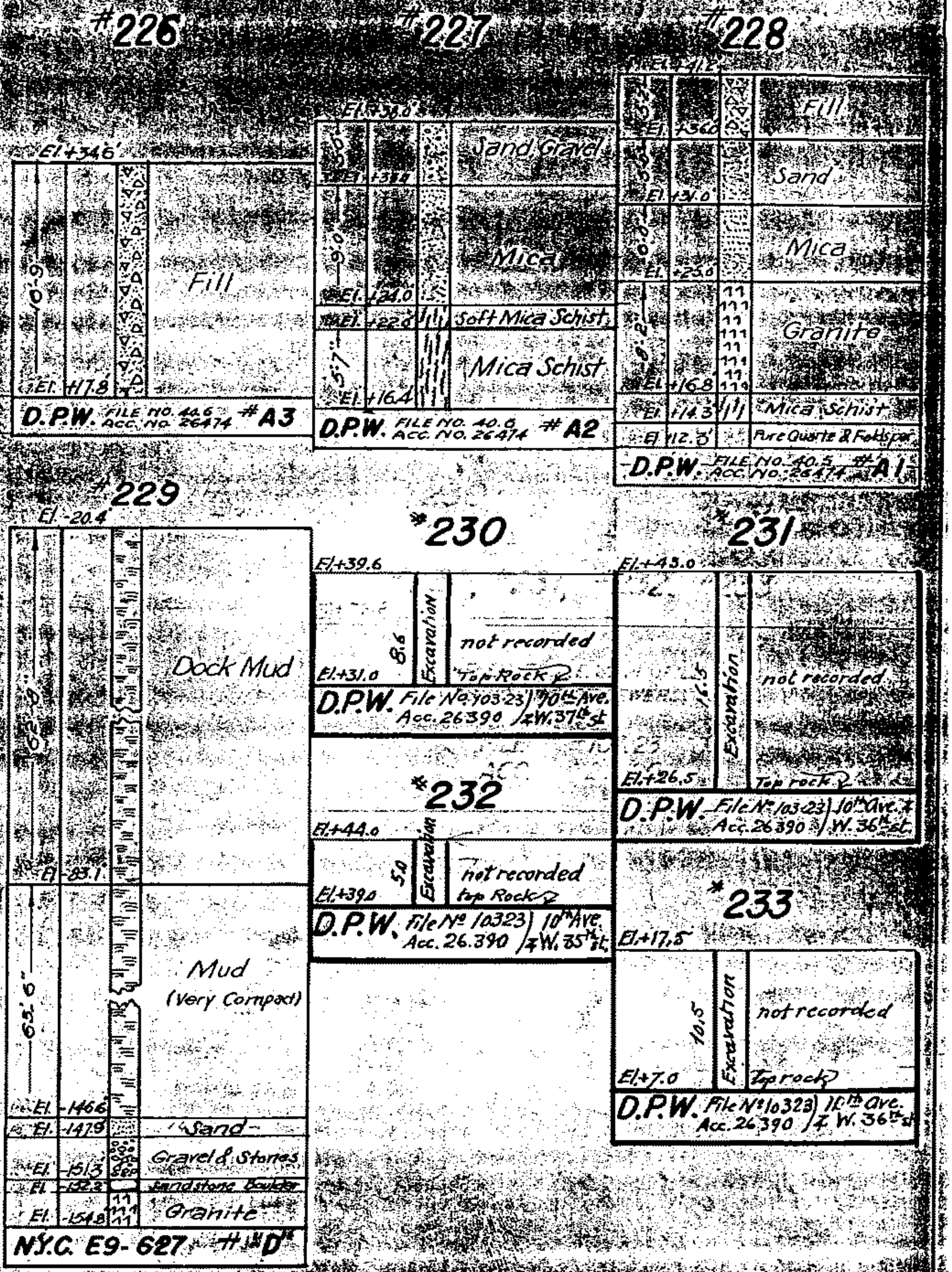
#225

El +31.2

7'-7"		Fill
	El +23.6	
7'-7"		Soft Mica Schist
	El +16.0	

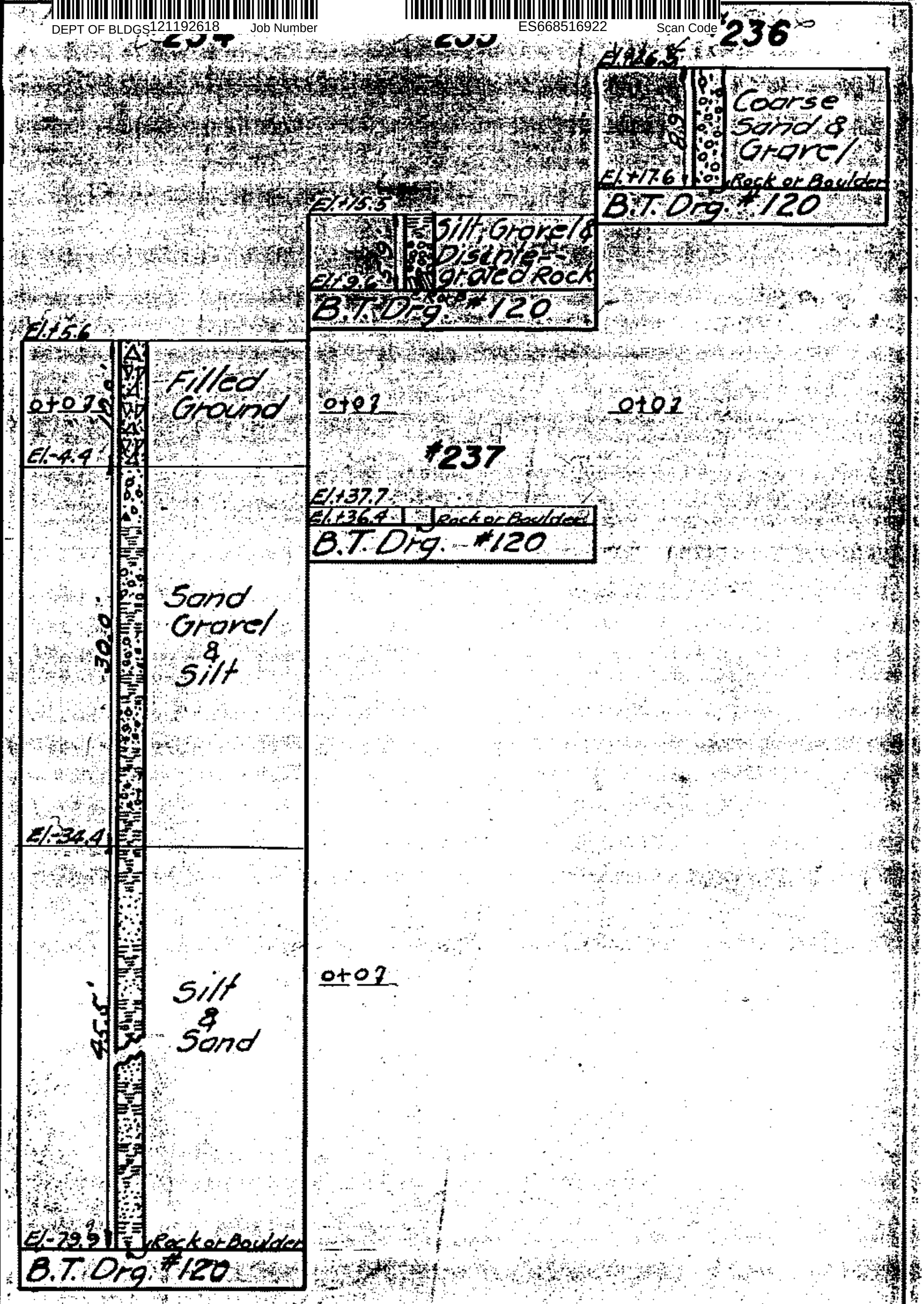
D.P.W. FILE No. 40.5 Acc. No. 26474 #A4

ROCK DATA VOL. 22 SHEET 10



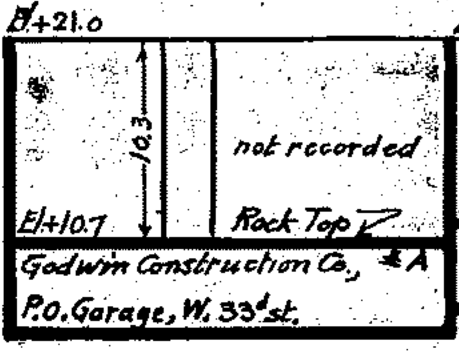
ROCK DATA

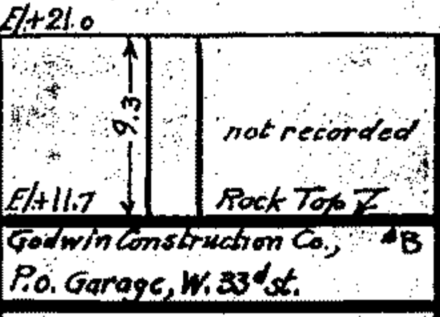
VOL.2 SHEET 10

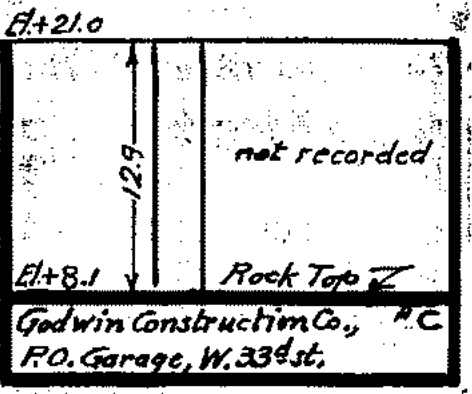

#234
#235
#236
El.+26.5
6.8
Coarse Sand & Gravel
El.+17.6
Rock or Boulder
B.T. Drg. #120
El.+15.5
Silt, Gravel & Disintegrated Rock
El.+9.2
Rock
B.T. Drg. #120
El.+5.6
0+07
Filled Ground
El.-4.4
0+07
0+07
#237
El.+37.7
El.+36.4
Rock or Boulder
B.T. Drg. #120
30.0
Sand Gravel & Silt
El.-34.4
0+07
45.5
Silt & Sand
El.-79.9
Rock or Boulder
B.T. Drg. #120

ROCK DATA

40







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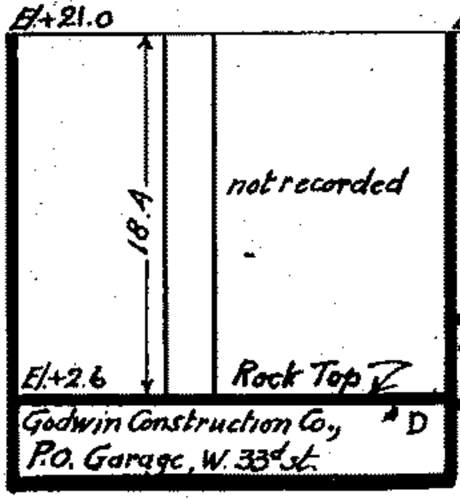

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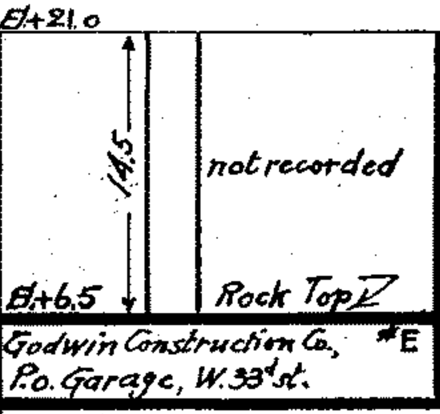

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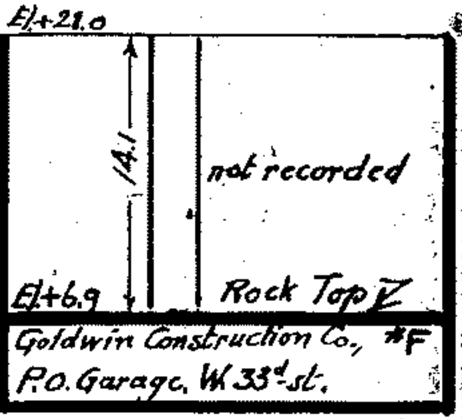

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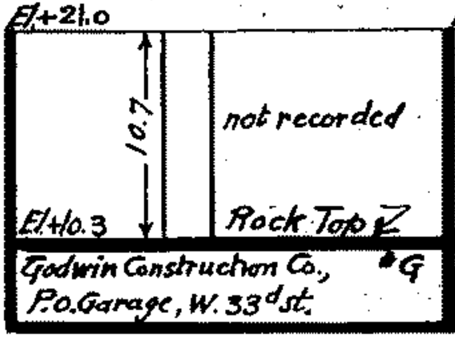

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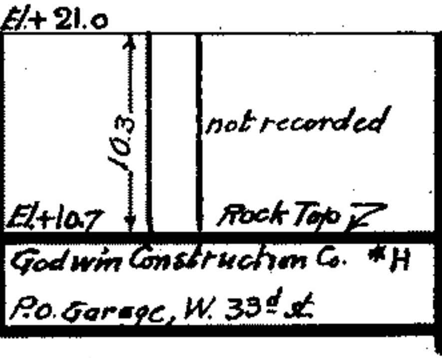

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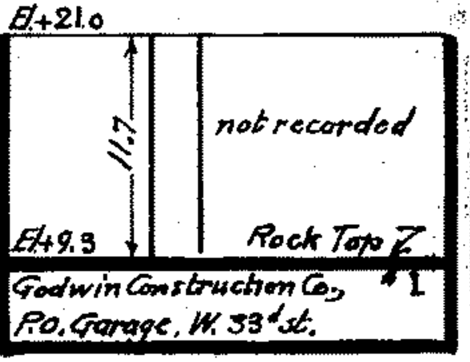

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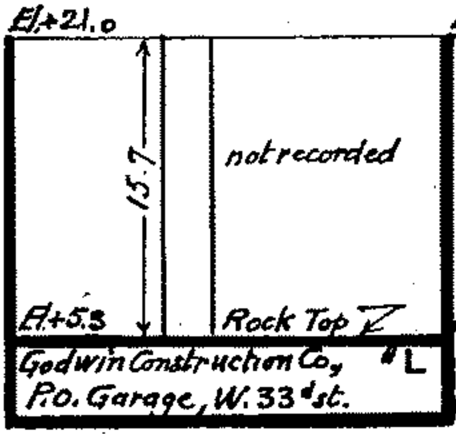

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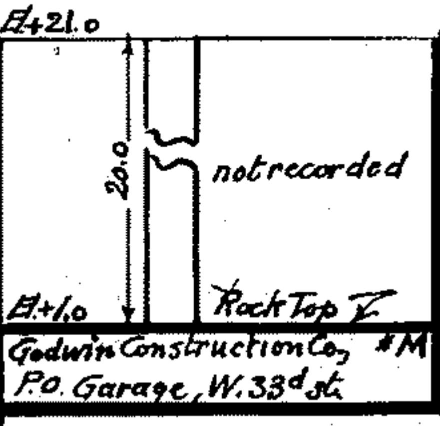

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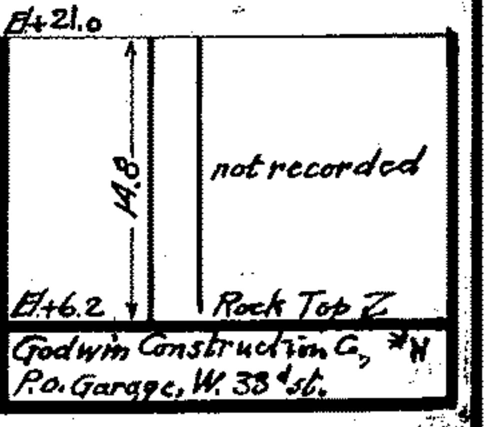
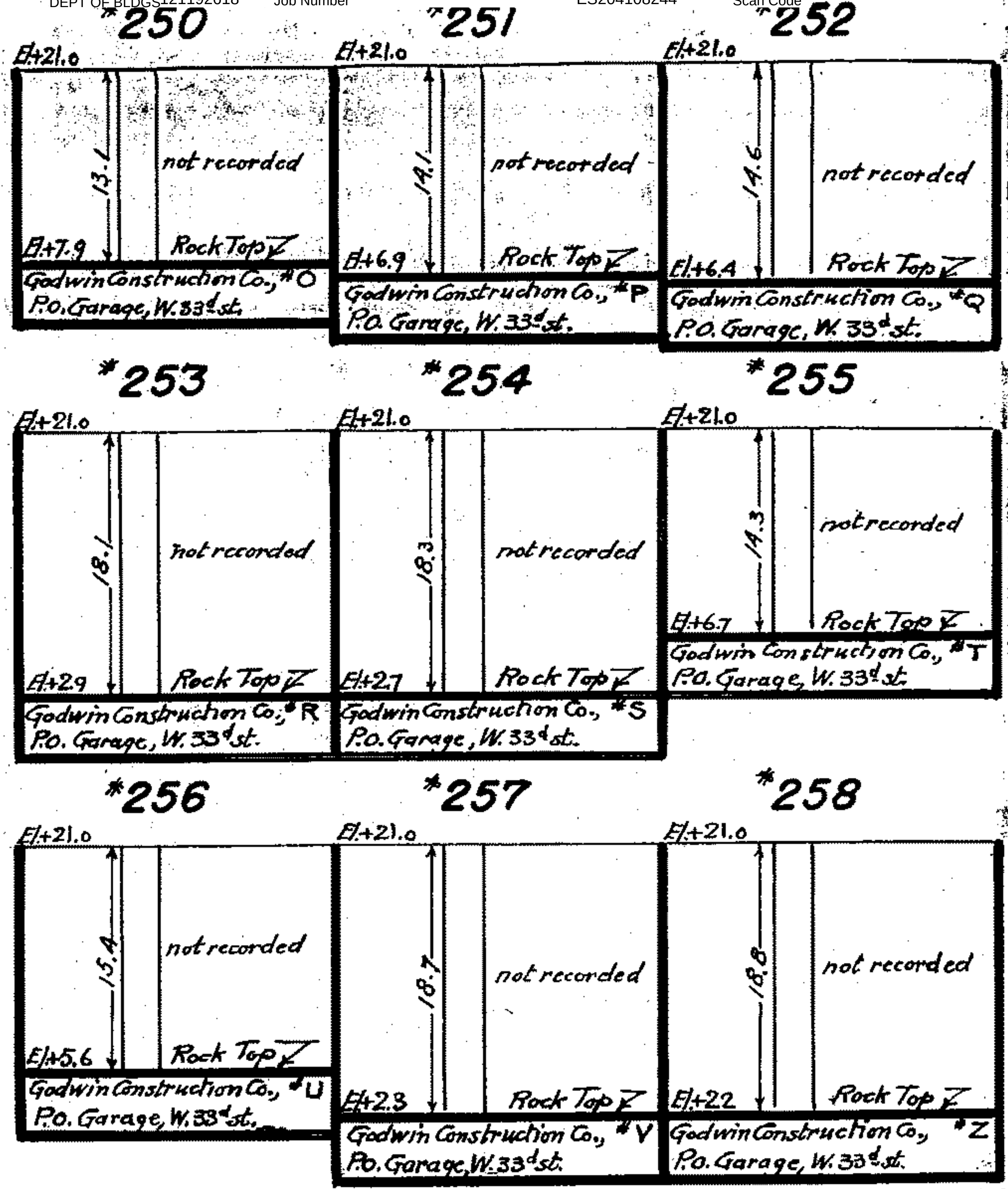


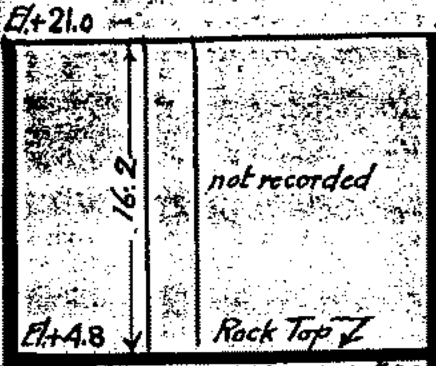
ROCK DATA VOL. 2, SHEET 10

2/10/36



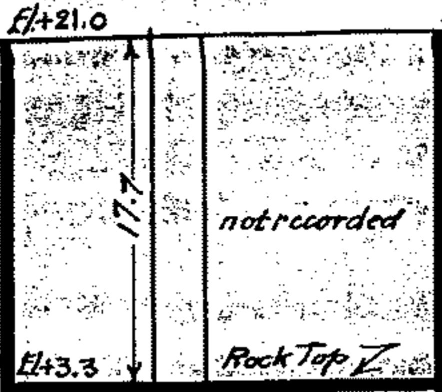
ROCK DATA VOL. 2, SHEET 10

259



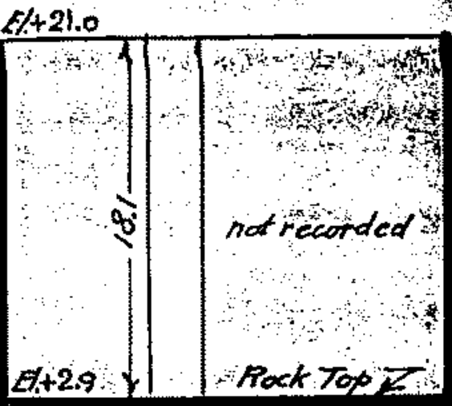
Godwin Construction Co., #X
P.O. Garage, W.33d st.

260



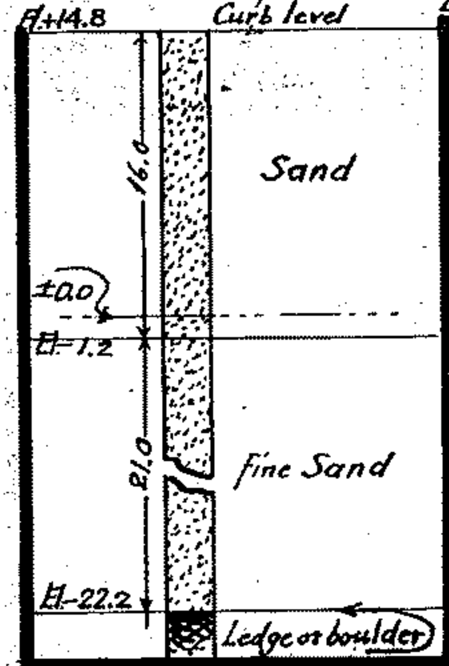
Godwin Construction Co., #Y
P.O. Garage, W. 33d st.

261



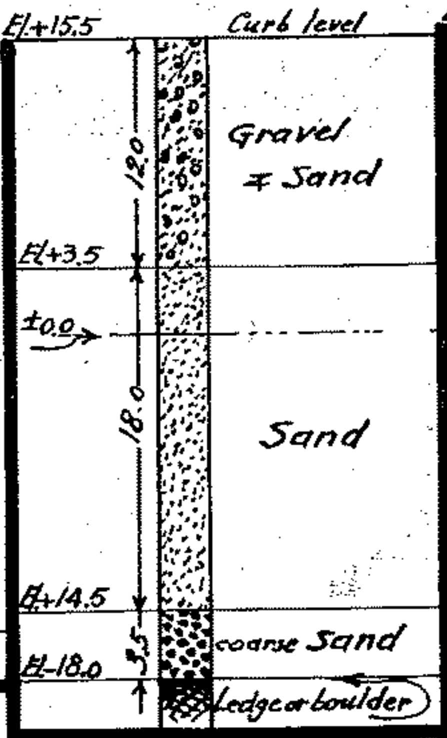
Godwin Construction Co., #K
P.O. Garage, W. 33d st.

#262



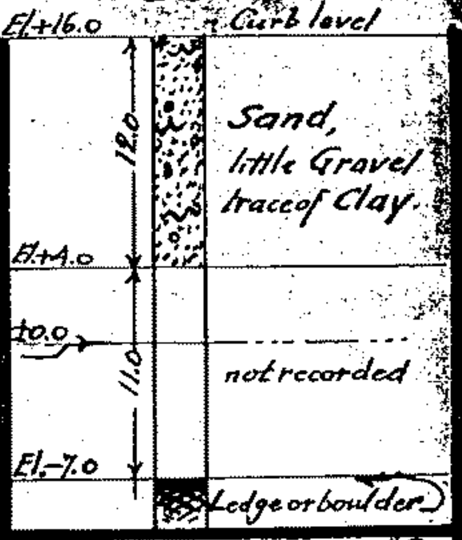
Board of Transport., #17
W.30th st. ± 30' W. of 10th Ave.

#263



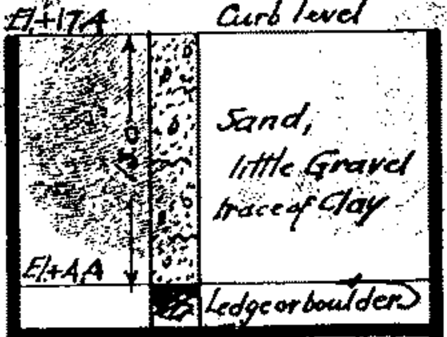
Board of Transport., #18
W.31st st., 26' W. of 10th Ave.

#264



Board of Transport., #20
11th Ave., 22'.0 N. of 35th st.

#265

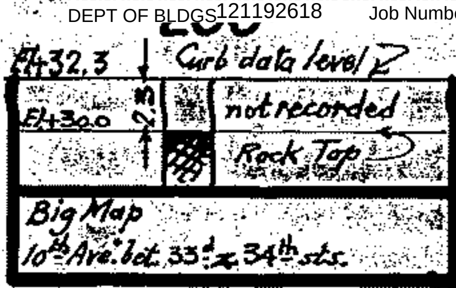


Board of Transport. #21
11th Ave. 30'.5 N. of 36th st.

ROCK DATA VOL. 2, SHEET 10

3/10/36

7-23-36



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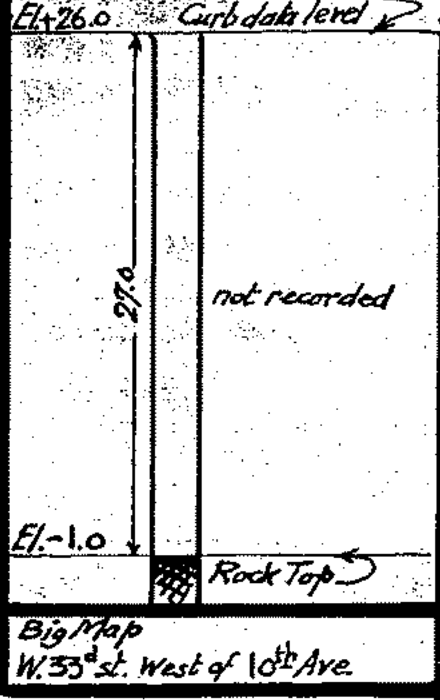

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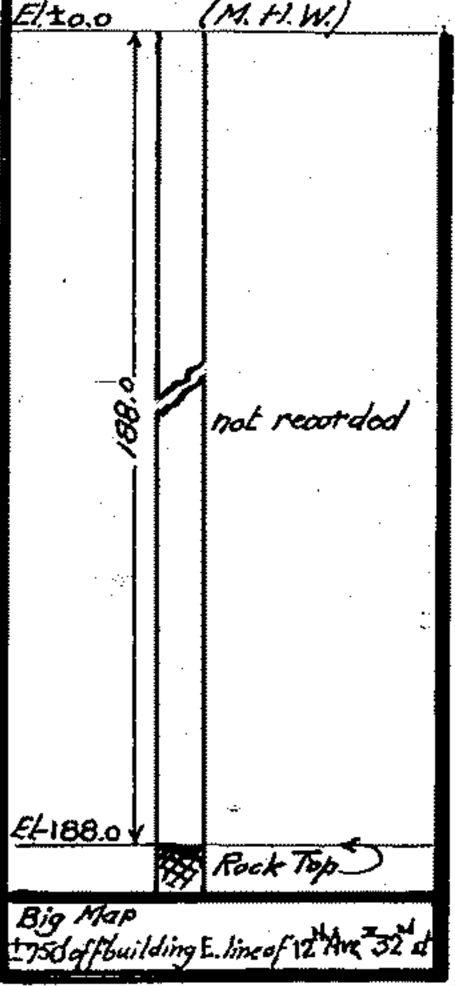

ROCK DATA VOL.2, SHEET 10

2.5.31 4-17-31

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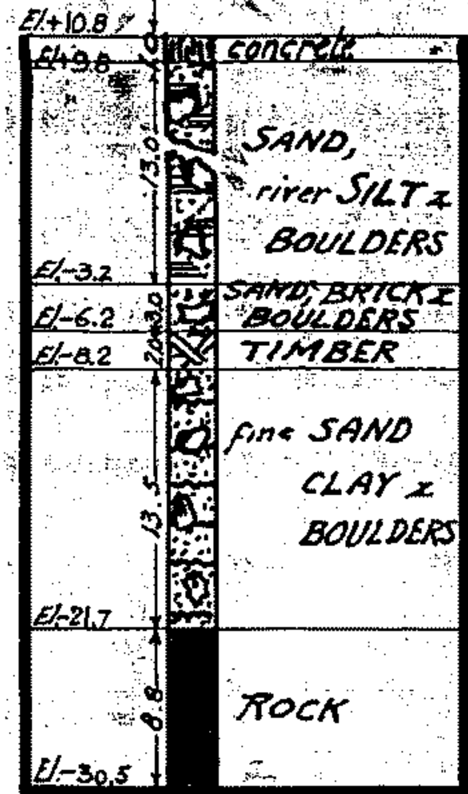
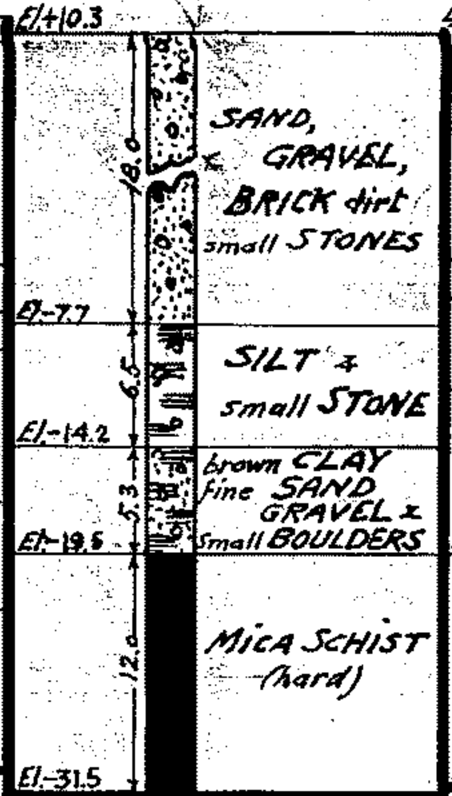


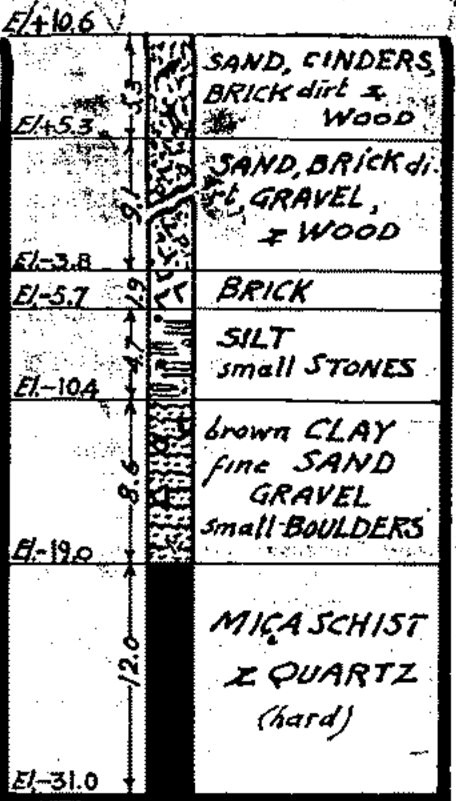
N.Y. Central R.R., Stage 16, #6A
11th Ave., below 31st st.

*270



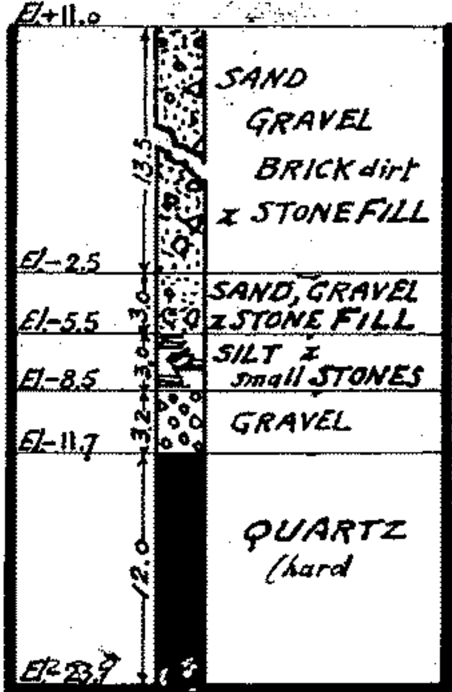
N.Y. Central R.R., Stage 16, #1095
11th Ave., below 31st st.

*271



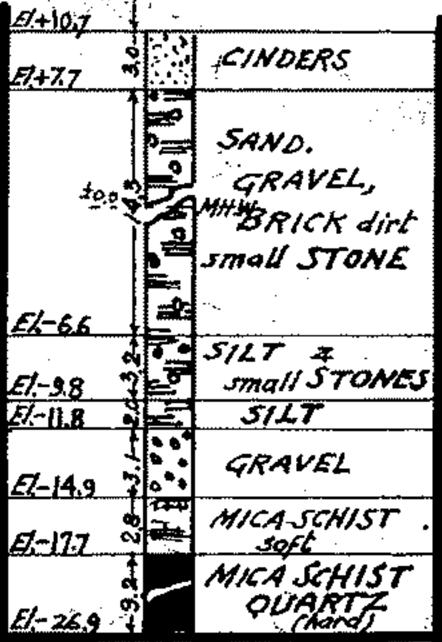
N.Y. Central R.R., Stage 16, #1094
11th Ave. & W. 31st st.

*272



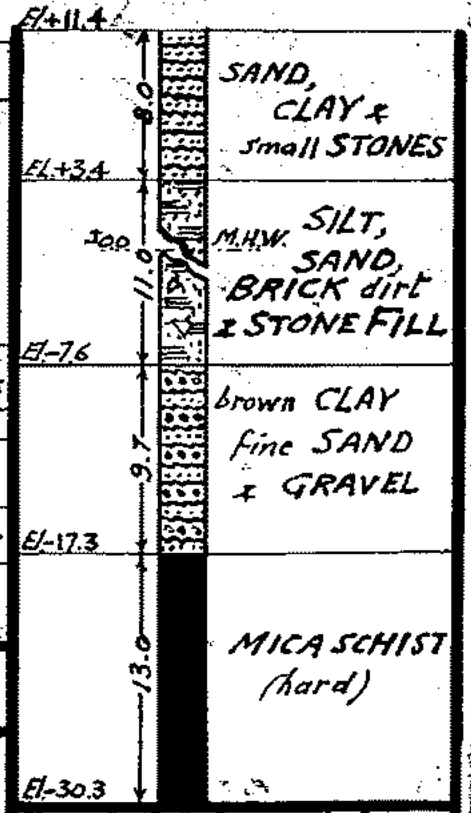
N.Y. Central R.R., Stage 16, #1093
11th Ave. & W. 31st st.

*273



N.Y. CENTRAL R.R., Stage 16, #1092
11th AVE., N. of W. 31st st.

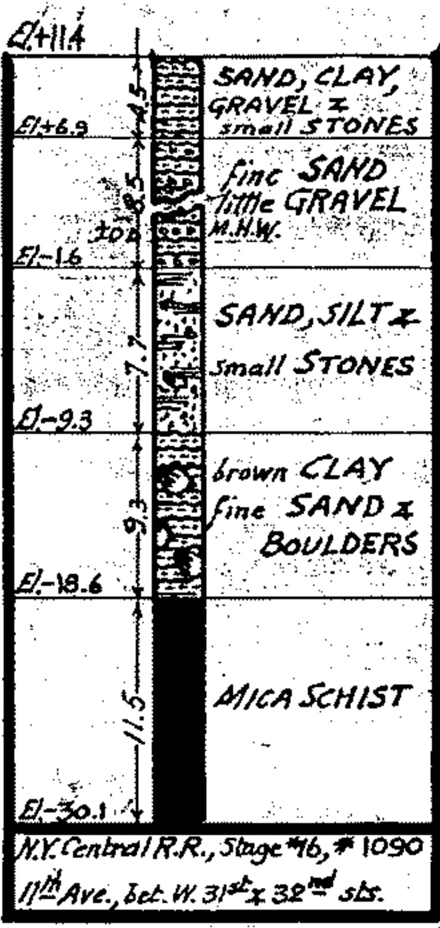
*274



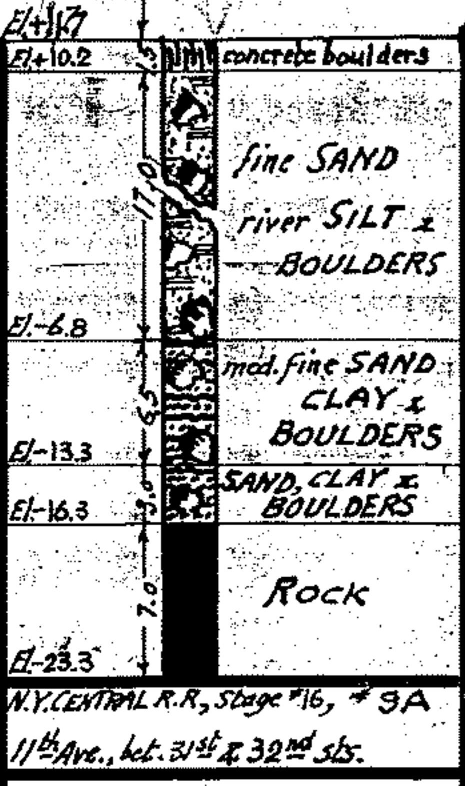
N.Y. CENTRAL R.R., Stage 16, #1091
11th Ave., N. of W. 31st st.

ROCK DATA

VOL. 2, SHEET 10

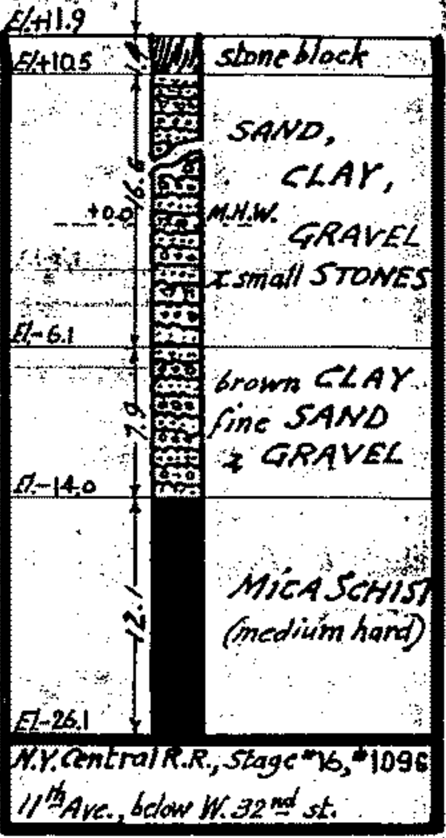


N.Y. Central R.R., Stage #16, # 1090
11th Ave., bet. W. 31st & 32nd sts.



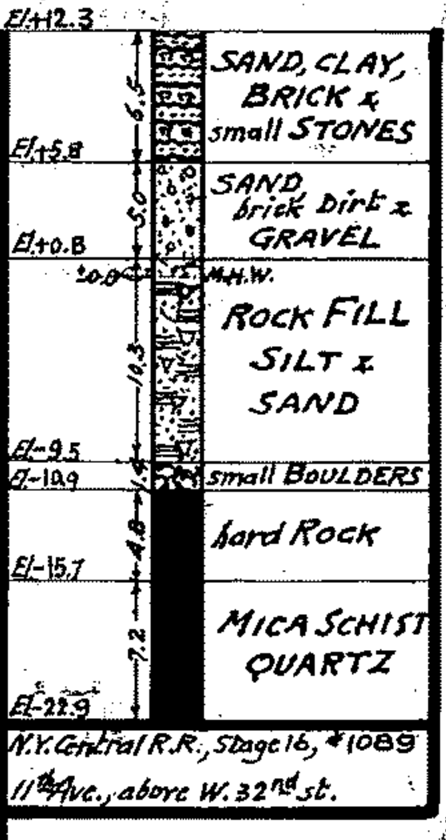
N.Y. CENTRAL R.R., Stage #16, # 3A
11th Ave., bet. 31st & 32nd sts.

#277



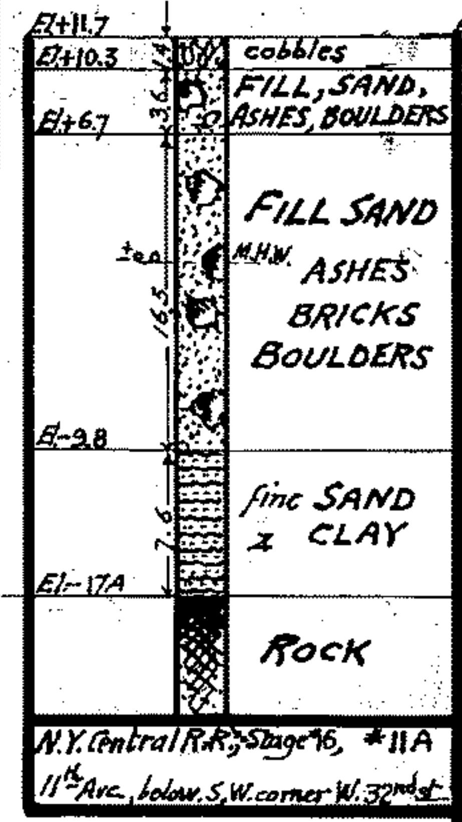
N.Y. Central R.R., Stage #16, #1096
11th Ave., below W. 32nd st.

#280



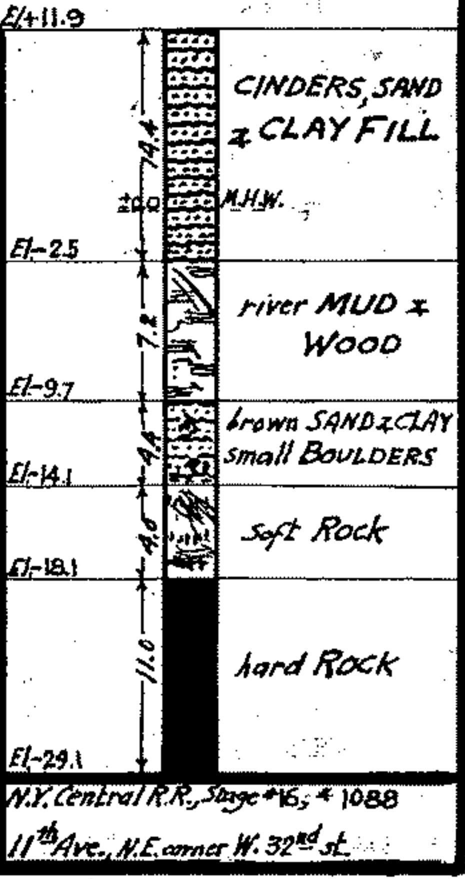
N.Y. Central R.R., Stage 16, #1089
11th Ave., above W. 32nd st.

#278



N.Y. Central R.R., Stage #16, # 11A
11th Ave., below S.W. corner W. 32nd st.

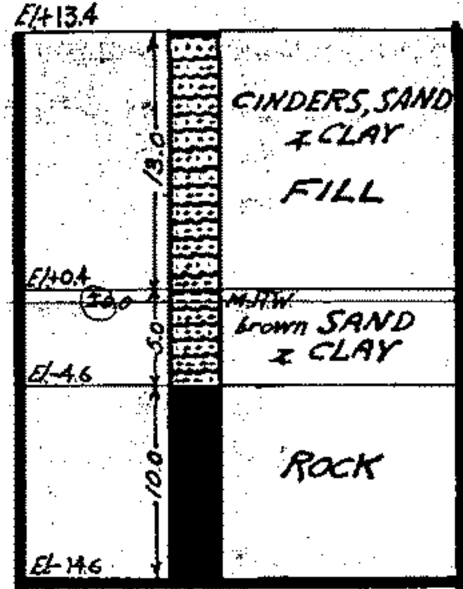
#279



N.Y. Central R.R., Stage #16, # 1088
11th Ave., N.E. corner W. 32nd st.

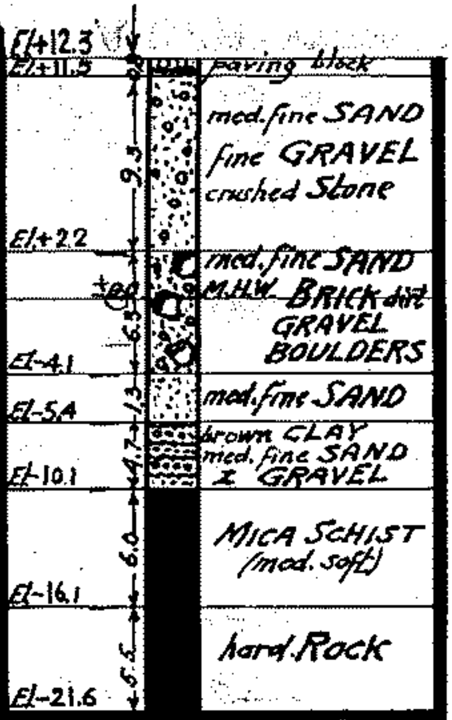
ROCK DATA VOL. 2, SHEET 10

281



N.Y. Central R.R., stage #16, #1086
11th Ave., N. of W. 32nd st.

282



N.Y. Central R.R., stage #16, #1087
11th Ave., bet. 32nd & 33rd sts.

APPENDIX D
2013 Langan Boring Logs

LANGAN

Log of Boring **BH-13**

Station Number **Track 21**

Station Offset

Structure type

Project: HUDSON YARDS - PLATFORM BORINGS		Project No.: 170019118	East: 4966
Location: LIRR EAST RAIL YARD		Elevation and Datum: Approx. 7.9 feet BPMD	North: 4550
Drilling Company: Warren George, Inc.		Date Started: 8/3/13	Date Finished: 8/4/13
Drilling Equipment: AD II Truck Rig		Completion Depth: 68 ft	Rock Depth: 18 ft
Size and Type of Bit: 2-7/8", 3-7/8" Diameter Tricone Roller Bit		Number of Samples: Disturbed 3; Undisturbed --; Core 10	
Casing Diameter (in): 4"-Inner-Diameter Flush Steel Casing	Casing Depth (ft): 18	Water Level (ft.): First ▽ --; Completion ▼ --; 24 HR. ▼ --	
Casing Hammer: Safety; Weight (lbs): 140	Drop (in): 30	Drilling Foreman: Buck/ Eddie	
Sampler: 2"- Outer-Diameter Split Spoon Sampler / NX Core Barrel		Inspecting Engineer: Edward Watson/Michael Zonin	
Sampler Hammer: Safety; Weight (lbs): 140	Drop (in): 30		

MATERIAL SYMBOL	Elev. (ft) +7.9	Building Code	Sample Description	Coring (min)	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
▨	+6.7	CLASS 7	14-inch thick reinforced CONCRETE SLAB		0						
					1						-Drilled through concrete slab
					2						-11:45AM to 1:00PM- Rig maintenance
					3						-Cleared of utilities to a depth of 8' below grade using water rotary drilling with no down pressure. No obstruction encountered.
					4						
					5						-Installed 10' of 3" casing with 3' stickup
					6						-Cleaned out casing with roller bit
					7						-1:45PM Take sample S-1
		CLASS 7	Light Brown coarse to fine GRAVEL, some coarse to fine Sand [FILL] (moist)		8	S-1	SS	24	15 11 5 3	16	-1:50PM Take sample S-2
			Light Brown coarse to fine GRAVEL, trace Sand [FILL] (moist)		10	S-2	SS	4	3 5 4 6	9	
					12						-Removed 3" casing and installed 15' of 4" casing
					14						-Cleaned out casing with roller bit to about 15' below grade
			No recovery		15	S-3	SS	0	5 WOH WOH WOH		-2:05PM Take sample S-3
					16						-Roller bit to about 17' below grade
					17						-Slight rig chatter from 15' to 17' -Gray wash from 15' to 17' -Installed 5' of casing -Clean out casing with roller bit
▨	-10.1	CLASS 1	Dark Gray-Black-White Quartzofeldspathic, muscovite-biotite SCHIST, medium to fine grained, hard [CLASS 1b] Good Quality	6 5	18	C-1	NX CORE				
					20						

Log of Boring **BH-13**

LANGAN

Station Number **Track 21**
Station Offset
Structure type

Project	Project No.	East
HUDSON YARDS - PLATFORM BORINGS	170019118	4966
Location	**Elevation and Datum**	**North**
LIRR EAST RAIL YARD	Approx. 7.9 feet BPMD	4550

Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	CLASS 1	Dark Gray-Black-White Quartzofeldspathic, muscovite-biotite SCHIST, medium to fine grained, hard [CLASS 1b] Fair Quality	5	20	C-1	NX CORE	REC=59"/60" =98%	RQD=50"/60" =83%		-Roller bit to 18'-hit rock at approx 18' below grade -Cored C-1 from 3:11PM to 3:34PM -Smooth drilling -Light gray wash
			3	21						
			4	22						
			3	23	C-2	NX CORE	REC=51"/60" =85%	RQD=41"/60" =68%		-Cored C-2 from 4:01PM to 4:19PM -Smooth drilling -Light gray wash
			4	24						
			3	25						
			4	26						
			4	27						
		Dark Gray-Black-White Quartzofeldspathic, muscovite-biotite SCHIST, medium to fine grained, hard [CLASS 1b] Good Quality	4	28	C-3	NX CORE	REC=60"/60" =100%	RQD=49"/60" =82%		-Cored C-3 from 4:36PM to 4:56PM -Smooth drilling -Light gray wash
			4	29						
			4	30						
			4	31						
			4	32						
		Dark Gray-Black-White Quartzofeldspathic, muscovite-biotite SCHIST, medium to fine grained, hard [CLASS 1b] Fair Quality	4	33	C-4	NX CORE	REC=56"/60" =93%	RQD=40"/60" =67%		-Cored C-4 from 5:05PM to 5:23PM -Smooth drilling -Light gray wash
			4	34						
			4	35						
			3	36						
			3	37						
		Dark Gray-Black-White Quartzofeldspathic, muscovite-biotite SCHIST, medium to fine grained, hard [CLASS 1a] Excellent Quality	3	38	C-5	NX CORE	REC=60"/60" =100%	RQD=58"/60" =97%		-Cored C-5 from 7:25PM to 7:43PM -Smooth drilling -White wash
			3	39						
-32.1	CLASS 1	Light Gray-Black-White quartz-muscovite-biotite GRANITE, coarse to medium grained, hard [CLASS 1a] Excellent Quality	3	40						
			4	41						
			4	42						
		Light Gray-Black-White quartz-muscovite-biotite GRANITE, coarse to medium grained, hard,	4	43	C-6	NX CORE				
			5	44						
				45						

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Log of Boring **BH-13**

Station Number **Track 21** Station Offset

Structure type

Project	Project No.	East
HUDSON YARDS - PLATFORM BORINGS	170019118	4966
Location	**Elevation and Datum**	**North**
LIRR EAST RAIL YARD	Approx. 7.9 feet BPMD	4550

MATERIAL SYMBOL	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
			horizontal fractures [CLASS 1a] Excellent Quality	6	45	C-6	NX CORE	REC=60"/60" =100%	RQD=60"/60" =100%		-Cored C-6 from 8:35PM to 9:02PM -Smooth drilling, Very hard drilling -White wash
				4	46						
				5	47						
				7	48	C-7	NX CORE	REC=60"/60" =100%	RQD=60"/60" =100%		
			Light Gray-Black-White quartz-muscovite-biotite GRANITE, coarse to medium grained, hard [CLASS 1a] Excellent Quality	8	49						
				8	50						-Cored C-7 from 9:45PM to 10:21PM -Smooth drilling, Very hard drilling -White wash
				6	51						
				7	52						
		CLASS 1		7	53	C-8	NX CORE	REC=60"/60" =100%	RQD=60"/60" =100%		
			Light Gray-Black-White quartz-muscovite-biotite GRANITE and PEGMATITE, coarse to medium grained, hard [CLASS 1a] Excellent Quality	7	54						
				7	55						-Cored C-8 from 11:00PM to 11:41PM -Smooth drilling, Very hard drilling -White wash
				9	56						
				10	57						
				9	58	C-9	NX CORE	REC=60"/60" =100%	RQD=52"/60" =87%		-Cored C-9 from 12:13AM to 12:41AM -Smooth drilling, Hard drilling -White wash -Changed diamond core head
			Light Gray-Black-White quartz-muscovite-biotite GRANITE and PEGMATITE, coarse to medium grained, hard [CLASS 1a] Good Quality	10	59						
				10	60						
				3	61						-Cored C-10 from 1:04AM to 1:21AM -Smooth drilling -White wash
				2	62						
	-55.1			3	63	C-10	NX CORE	REC=42"/60" =70%	RQD=16"/60" =27%		
			Light Gray-Black-White quartz-muscovite-biotite GRANITE and PEGMATITE, coarse to medium grained, hard, highly fractured, close fracture spacing [CLASS 1d]	4	64						
		CLASS 1		3	65						1:55AM Drill rods jam up form fractured rock. WGI has difficulty removing and installed rods. 3:45PM Finish pulling rods Completed borehole grouted with a mix of soil cuttings and grout. Demobilize at 4:30AM
				3	66						
				3	67						
	-60.1		End of Boring at 68'	4	68						
					69						
					70						

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Log of Boring **BH-14**

Station Number **Track 24**

Station Offset

Structure type

Project: HUDSON YARDS - PLATFORM BORINGS

Project No.: 170019118

East: 4985

Location: LIRR EAST RAIL YARD

Elevation and Datum: Approx. 8 feet BPMD

North: 4601

Drilling Company: Warren George, Inc.

Date Started: 6/14/13

Date Finished: 6/15/13

Drilling Equipment: AD II Truck Rig

Completion Depth: 66 ft

Rock Depth: 6 ft

Size and Type of Bit: 3-7/8", 4-7/8" Diameter Tricone Roller Bit

Number of Samples: Disturbed -- Undisturbed -- Core 12

Casing Diameter (in): 3&4"-Inner-Diameter Flush Steel Casing

Casing Depth (ft): 6

Water Level (ft.): First ▽ -- Completion ▼ -- 24 HR. ▼ --

Casing Hammer: -- Weight (lbs): -- Drop (in): --

Drilling Foreman: Buck/Tom

Sampler: 2"- Outer-Diameter Split Spoon Sampler / NX Core Barrel

Inspecting Engineer: Michael Zonin

Sampler Hammer: Donut Weight (lbs): 140 Drop (in): 30

Elev. (ft) +8.0	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data Number	Sample Data Type	Sample Data Recov. (in)	Sample Data Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+7.0		12-inch thick reinforced CONCRETE SLAB		0 1						85' E of W P.L. 601' N of S P.L.
+2.0	Class 1	Decomposed/ highly weathered GNIESS/SCHIST [Class 1d] Very poor quality	SPIN	2 3 4 5 6						6/14/13 10:15PM: Use 4-7/8" diameter roller bit to grind through concrete slab 10:50PM: Observe black shavings/rock fragments at 1' below concrete slab 1' to 3': Rig chatter 3' to 5': Hard drilling Gray to white wash 12:55AM: Spin 3"casing to 6' Collect sample of weathered gniess/schist from wash
-3.0	Class 1	Gray, coarse- to medium-grained, quartz- feldspar- muscovite- biotite- garnet GRANITE, pink pegmatite intrusions, wide fracture spacing, moderate weathering with iron oxide staining in joints, with fractures dipping close to horizontal to approximately 20 degrees from horizontal, close fracture spacing from 9.5' to 10' [Class 1a] Excellent quality	3:00 3:00 3:00 3:00 3:00	7 8 9 10 11	C-1	NX CORE BARREL	REC=59"/60" =98%	RQD=56"/60" =93%		1:15AM Begin core C-1: 6' to 11' White to light gray wash Hard consistent drilling
-8.0	Class 1	Gray, coarse- to medium-grained, quartz- feldspar- muscovite- garnet GRANITE, wide fracture spacing, slightly weathered, with fractures close to horizontal, moderate weathering at 12' [Class 1b] Good quality	4:00 4:00 5:00 4:00 5:00	12 13 14 15 16	C-2	NX CORE BARREL	REC=59"/60" =98%	RQD=49"/60" =82%		2:04AM Begin core C-2: 11' to 16" Gray wash. Hard drilling
	Class 1	Gray, medium- to fine-grained, quartz- feldspar- muscovite- garnet GRANITE, wide fracture spacing, slightly weathered, with fractures close to horizontal [Class 1a] Excellent quality	3:00 3:00 3:00 3:00	17 18 19 20	C-3	NX CORE BARREL	REC=60"/60" =100%	RQD=60"/60" =100%		3:04AM Begin core C-3: 16' to 21' White wash. Hard drilling

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Log of Boring **BH-14**

Station Number **Track 24** Station Offset

Structure type

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Project	Project No.	East
HUDSON YARDS - PLATFORM BORINGS	170019118	4985
Location	**Elevation and Datum**	**North**
LIRR EAST RAIL YARD	Approx. 8 feet BPMD	4601

MATERIAL SYMBOL	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Sample Data: Type	Sample Data: Recov. (in)	Sample Data: Penetr. resist BL/6in	Sample Data: N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 1		3:00	20	C-3					
			Gray, medium- to fine-grained, quartz- feldspar- muscovite- garnet GRANITE, wide fracture spacing, slightly weathered, with fractures close to horizontal [Class 1a] Excellent quality	3:00 4:00 4:00 3:00 4:00	21 22 23 24 25	C-4	NX CORE BARREL	REC=60"/60" =100%	RQD=54"/60" =90%		3:34AM Begin core C-4: 21' to 26' White wash. Hard drilling
			Gray, coarse- to fine-grained, quartz- feldspar- muscovite- garnet GRANITE, wide fracture spacing, slightly weathered [Class 1a] Excellent quality	5:00 4:00 4:00 4:00 4:00	26 27 28 29 30	C-5	NX CORE BARREL	REC=60"/60" =100%	RQD=60"/60" =100%		3:59AM Begin core C-5: 26' to 31' White wash
			Gray, medium- to fine-grained, quartz- feldspar- muscovite- garnet GRANITE, moderate fracture spacing, moderately weathered, with fractures close to vertical, staining 31' to 32' on vertical fractures [Class 1a] Excellent quality	3:00 4:00 3:00 3:00 3:00	31 32 33 34 35	C-6	NX CORE BARREL	REC=58"/60" =97%	RQD=58"/60" =97%		4:30AM Begin core C-6: 31' to 36' White wash
			Gray, coarse- to medium-grained GRANITE, pink pegmatite intrusions, moderate fracture spacing, moderately weathered [Class 1a] Excellent quality	5:00 4:00 5:00 5:00 3:00	36 37 38 39 40	C-7	NX CORE BARREL	REC=60"/60" =100%	RQD=54"/60" =90%		5:15AM Begin core C-7: 36' to 41' White wash
			Gray to pink, fine-grained, quartz- feldspar- muscovite- garnet GRANITE, wide to slight fracture spacing, slightly weathered to unweathered, with fractures close to horizontal, medium-grained from 45' to 51' [Class 1a] Excellent quality	5:00 5:00 4:00 15:00	41 42 43 44 45	C-8	NX CORE BARREL	REC=60"/60" =100%	RQD=56.5"/60" =94%		5:45AM Begin core C-8: 41' to 46'

Log of Boring **BH-14**

Station Number **Track 24** Station Offset

Structure type

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Project	Project No.	East
HUDSON YARDS - PLATFORM BORINGS	170019118	4985
Location	**Elevation and Datum**	**North**
LIRR EAST RAIL YARD	Approx. 8 feet BPMD	4601

MATERIAL SYMBOL	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Sample Data: Type	Sample Data: Recov. (in)	Sample Data: Penetr. resist BL/6in	Sample Data: N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 1		15:00	45	C-8					
			Gray, medium- to fine-grained, quartz- feldspar- muscovite- garnet GRANITE, close to moderate fracture spacing, slightly weathered, with fractures dipping close to horizontal [Class 1a] Excellent Quality	10:00 18:00 6:00 8:00 11:00	46 47 48 49 50	C-9	NX CORE BARREL	REC=58.5"/60" =98%	RQD=58.5"/60" =98%		8:27AM Begin core C-9: 46' to 51' 8:55AM: Stopped drilling 9:25AM: Resume drilling with heavier bit
			Gray, medium- to fine-grained, quartz- fledspar- muscovite- biotite- garnet GRANITE, close to moderate fracture spacing, slightly weathered to unweathered, with fractures dipping close to horizontal [Class 1a] Excellent quality	5:00 4:00 3:00 5:00 4:00	51 52 53 54 55	C-10	NX CORE BARREL	REC=60"/60" =100%	RQD=60"/60" =100%		10:05AM Begin core C-10: 51' to 56' 10:45AM: Boring paused WG doesn't have enough water to run two drills at once
			Gray, medium- to fine-grained, quartz- feldspar- muscovite- biotite- garnet GRANITE, moderate fracture spacing, slightly weathered, with fractures dipping close to horizontal [Class 1a] Excellent quality	5:00 6:00 6:00 5:00 5:00	56 57 58 59 60	C-11	NX CORE BARREL	REC=60"/60" =100%	RQD=60"/60" =100%		11:00AM Begin core C-11: 56' to 61'
	-58.0		Gray to pink, medium- to fine-grained, quartz- feldspar- muscovite- biotite- garnet GRANITE, intrusions of pegmatite, moderate to close fracture spacing, slightly weathered to unweathered, with fractures dipping close to horizontal [Class 1a] Excellent quality	4:00 5:00 4:00 3:00 5:00	61 62 63 64 65	C-12	NX CORE BARREL	REC=58.5"/60" =98%	RQD=58.5"/60" =98%		11:37AM Begin core C-12: 61' to 66' Completed borehole grouted with a mix of soil cuttings and grout.
			End of boring at 66'		66 67 68 69 70						

DEPT OF BLDGS 121192618 Job Number

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Log of Boring **BH-15**

Station Number **Track 24** Station Offset ____

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Structure type ____

Project HUDSON YARDS - PLATFORM BORINGS	Project No. 170019118	East 5054
Location LIRR EAST RAIL YARD	Elevation and Datum Approx. 7.8 feet BPMD	North 4601
Drilling Company Warren George, Inc.	Date Started 6/14/13	Date Finished 6/14/13
Drilling Equipment Acker Soil Max	Completion Depth 73 ft	Rock Depth 13 ft
Size and Type of Bit 3-7/8", 4-7/8" Diameter Tricone Roller Bit	Number of Samples: Disturbed 2; Undisturbed --; Core 12	
Casing Diameter (in) 3&4"-Inner-Diameter Flush Steel Casing; Casing Depth (ft) 12	Water Level (ft.): First ▽ --; Completion ▼ --; 24 HR. ▽ --	
Casing Hammer --; Weight (lbs) --; Drop (in) --	Drilling Foreman Mike Kelly/ Sam Calone	
Sampler 2"- Outer-Diameter Split Spoon Sampler / NX Core Barrel		
Sampler Hammer Safety; Weight (lbs) 140; Drop (in) 30	Inspecting Engineer Michael Zonin	

MATERIAL SYMBOL	Elev. (ft) +7.8	Building Code	Sample Description	PID Reading (ppm)	Coring (min)	Depth Scale	Sample Data Number	Sample Data Type	Sample Data Recov. (in)	Sample Data Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+6.7		13-inch thick Railroad Ballast (Poorly-Graded GRAVEL)			0–1						154' E of W P.L. 601' N of S P.L. SS= Split Spoon
	+5.7		12-inch thick CONCRETE SLAB			1–2						6/14/13 8:35PM: Shovel 1" diameter ballast stone to top of concrete slab 9:05 p.m. Core through concrete ballast with 4-inch core bit
		Class 7			SPIN	2–8						9:25PM: Drill to 8' using 3-7/8" diameter roller bit Boulder at 3' Easy drilling 3' to 6' Soft dig to 8' using roller bit with no down pressure
			Tan to brown, coarse- to fine-grained, SAND, little fine-grained gravel, trace silt (wet) [FILL] [Class 7]	0.0 0.0		8–10	S-1	SS	6	15 17 6 8	23	10:25PM Take S-1(SS): 8' to 10' No odor or staining 10:30PM Spin 3" casing to 10'
	-4.2		Tan to brown, coarse- to fine-grained, SAND, some medium- to fine-grained gravel, trace silt (wet) [FILL] [Class 7]	0.0 0.0	SPIN	10–12	S-2	SS	12	14 13 10 11	23	10:50PM Take S-2(SS): 10' to 12' No staining or odor 10:50PM: Spin 3" casing and seat on rock at 12'
	-5.2	Class 1	Decomposed/ weathered rock [Class 1d] Very poor quality			12–13						11:05PM: Drill to 13' with 2-7/8" roller bit
	-10.2	Class 1	Gray to pink, medium- to fine-grained, quartz- feldspar- muscovite- garnet GRANITE, wide fracture spacing, slightly weathered, with near horizontal fractures [Class 1a] Excellent quality		4:00 5:00 7:00 20:00 21:00	13–18	C-1	NX CORE BARREL	REC=60"/60" =100%	RQD=60"/60" =100%		6/15/13 12:07AM Begin core C-1: 13' to 18' White wash. Hard drilling No down pressure
		Class 1			10:00 12:00	18–20	C-2					1:28AM Begin core C-2: 18' to 23' White wash. Hard drilling

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DEPT OF BLDGS 121192618 Job Number

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Log of Boring **BH-15**

Station Number **Track 24** Station Offset

Structure type

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Project	Project No.	East
HUDSON YARDS - PLATFORM BORINGS	170019118	5054
Location	**Elevation and Datum**	**North**
LIRR EAST RAIL YARD	Approx. 7.8 feet BPMD	4601

Elev. (ft)	Building Code	Sample Description	PID Reading (ppm)	Coring (min)	Depth Scale	Sample Data Number	Sample Data Type	Sample Data Recov. (in)	Sample Data Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gray, coarse- to medium-grained, quartz-feldspar- muscovite- garnet GRANITE, wide fracture spacing, slightly weathered, with fractures dipping approximately 30 degrees to horizontal, close fracture spacing from 20.5' to 21' [Class 1b] Good quality		3:00	20	C-2	NX CORE BARREL	REC=59"/60" =98%	RQD=47"/60" =78%		
				10:00	21						
				12:00	22						
	Class 1	Gray, coarse- to medium-grained, quartz-feldspar- muscovite- garnet GRANITE, moderate fracture spacing, moderately weathered, with near vertical fractures and fractures dipping approximately 0 degrees to 60 degrees, close fracture spacing from 24.5' to 25', highly weathered from 24.5 to 25' [Class 1b] Fair quality		6:00	23	C-3	NX CORE BARREL	REC=53"/60" =88%	RQD=38"/60" =63%		2:15AM Begin core C-3: 23' to 28' White wash
				3:00	24						
				6:00	25						
				6:00	26						
				7:00	27						
-20.2		Gray, coarse- to medium-grained, quartz-feldspar- muscovite GRANITE, moderate fracture spacing, moderately weathered, with near vertical fractures from 30' to 31' [Class 1a] Excellent quality		3:00	28	C-4	NX CORE BARREL	REC=58"/60" =97%	RQD=57"/60" =95%		3:18AM Begin core C-4 : 28' to 33' White wash
				3:00	29						
				4:00	30						
				4:00	31						
				4:00	32						
		Gray, medium- to fine-grained, quartz-feldspar- muscovite- garnet GRANITE, moderate fracture spacing, slightly weathered, with near horizontal fractures [Class 1a] Good quality		10:00	33	C-5	NX CORE BARREL	REC=52"/60" =87%	RQD=51"/60" =85%		3:45AM Begin core C-5: 33' to 38' White to light gray wash
				12:00	34						
	Class 1			12:00	35						
				10:00	36						
				15:00	37						
		Gray, quartz- feldspar- muscovite GRANITE, small to wide fracture spacing, moderately weathered [Class 1a] Excellent quality		5:00	38	C-6	NX CORE BARREL	REC=57"/60" =95%	RQD=54.5"/60" =91%		4:30AM Begin core C-6: 38' to 43' White to gray wash
				6:00	39						
				3:00	40						
				3:00	41						
				4:00	42						
-35.2	Class 1			3:00	43	C-7					7:40AM Begin core C-7: 43' to 48' No down pressure
				3:00	44						
					45						

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DEPT OF BLDGS 121192618 Job Number

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Log of Boring **BH-15**

Station Number **Track 24**

Station Offset

Structure type

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Project HUDSON YARDS - PLATFORM BORINGS	Project No. 170019118	East 5054
Location LIRR EAST RAIL YARD	Elevation and Datum Approx. 7.8 feet BPMD	North 4601

Elev. (ft)	Building Code	Sample Description	PID Reading (ppm)	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	Class 1	Gray, quartz- feldspar- muscovite GRANITE, moderate to wide fracture spacing, slightly weathered [Class 1a] Excellent quality		3:00	45	C-7	NX CORE BARREL	REC=60"/60" =100%	RQD=44"/60" =73%		
				3:00	46						
				3:00	47						
-40.2	Class 1	Gray, fine-grained, quartz- feldspar- muscovite GRANITE, moderately weathered, coarse-grained from 50.6' to 51.3' [Class 1b] Fair quality		3:00	48	C-8	NX CORE BARREL	REC=60"/60" =100%	RQD=37"/60" =62%		8:37AM Begin core C-8: 48' to 53'
				3:00	49						
				3:00	50						
				3:00	51						
				3:00	52						
-45.2	Class 1	53' to 56.3': Gray, fine-grained, quartz- feldspar- muscovite- pyroxene GRANITE, slightly weathered, with a near vertical fracture at 55.1' [Class 1a] Excellent quality		2:00	53	C-9	NX CORE BARREL	REC=56"/60" =93%	RQD=55"/60" =92%		9:35AM Begin core C-9: 53' to 58'
				3:00	54						
				2:00	55						
-48.5	Class 1	56.3' to 57.7': Pink to gray, fine-grained, quartz- feldspar- PEGMATITE, unfractured, unweathered [Class 1a] Excellent quality		3:00	56						
-50.2		Pink to gray, coarse-grained, quartz- feldspar- muscovite- garnet PEGMATITE, moderate fracture spacing, slightly weathered, with fractures close to horizontal, fine-grained GRANITE from 3" to 9" [Class 1a] Good quality		2:00	57						
				3:00	58	C-10	NX CORE BARREL	REC=58"/60" =97%	RQD=53"/60" =88%		10:15AM Begin core C-10: 58' to 63'
				3:00	59						
				3:00	60						
				3:00	61						
				3:00	62						
				3:00	63	C-11	NX CORE BARREL	REC=59"/60" =98%	RQD=52"/60" =87%		10: 40AM Begin core C-11: 63' to 68'
	Class 1	Gray, quartz- feldspar- muscovite- granite- GRANITE and PEGMATITE, slightly weathered [Class 1a] Excellent quality		4:00	64						
				3:00	65						
				3:00	66						
				3:00	67						
				3:00	68	C-12					1:45PM Begin core C-12: 68' to 73'
				3:00	69						
					70						

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DEPT OF BLDGS 121192618 Job Number

ES086702078 Scan Code

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Log of Boring **BH-15**

Station Number **Track 24**

Station Offset

Structure type

Project	Project No.	East
HUDSON YARDS - PLATFORM BORINGS	170019118	5054
Location	**Elevation and Datum**	**North**
LIRR EAST RAIL YARD	Approx. 7.8 feet BPMD	4601

MATERIAL SYMBOL	Elev. (ft)	Building Code	Sample Description	PID Reading (ppm)	Coring (min)	Depth Scale	Sample Data: Number	Sample Data: Type	Sample Data: Recov. (in)	Sample Data: Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	-65.2	Class 1	Gray, quartz- feldspar- muscovite GRANITE, moderately fractured, coarse-grained pegmatite veins from 68.6' to 68.7' and 69.6' to 69.7', near vertical fracture from 69.8' to 71.3' [Class 1a] Excellent quality		3:00 3:00 3:00	70 71 72	C-12	NX CORE BARREL	REC=54"/60" =90%	RQD=54"/60" =90%		
			End of boring at 73'			73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95						2:00PM: Completed borehole grouted with a mix of soil cuttings and grout.

\\LANGAN.COM\DATA\NY\DATA1\170019118\ENGINEERING DATA\GEOTECHNICAL\GINTLOGS\170019118 HUDSON YARDS.GPJ ... 10/21/2013 10:50:47 AM ... Report: Log - LANGAN ...Template TEMPLATE.GDT

DEPT OF BLDGS121192618 Job Number

ES967396739 Scan Code

1 of 2

Log of Boring **BH-16**

Station Number **Track 29** Station Offset

Structure type

LANGAN

Project: HUDSON YARDS - PLATFORM BORINGS		Project No.: 170019118	East: 5010
Location: LIRR EAST RAIL YARD		Elevation and Datum: Approx. 8 feet BPMD	North: 4684
Drilling Company: Warren George, Inc.		Date Started: 6/29/12	Date Finished: 6/29/13
Drilling Equipment: AD II Truck Rig		Completion Depth: 38 ft	Rock Depth: 8 ft
Size and Type of Bit: 2-7/8", 5-7/8" Diameter Tricone Roller Bit		Number of Samples: Disturbed 1 / Undisturbed -- / Core 6	
Casing Diameter (in): 3&4"-Inner-Diameter Flush Steel Casing	Casing Depth (ft): 8	Water Level (ft.): First ▽ -- / Completion ▼ -- / 24 HR. ▼ --	
Casing Hammer: Donut	Weight (lbs): 140 / Drop (in): 30	Drilling Foreman: Mike Kelly	
Sampler: 2"- Outer-Diameter Split Spoon Sampler / NX Core Barrel		Inspecting Engineer: Corrie Campbell / Michael Zonin	
Sampler Hammer: Safety	Weight (lbs): 140 / Drop (in): 30		

Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+8.0		24-inch thick reinforced CONCRETE SLAB		0						110' E of W P.L. 684' N of S P.L. SS= Split Spoon
				1						
+6.0				2						06/29/13 5:45AM: Core through 2-foot thick concrete slab
				3						6:25AM: Soft dig to 6' by spinning 3" diameter casing with no down pressure
			SPIN	4						
	Class 7			5						Probe to 7'
		Brown, coarse- to fine-grained, SAND, some fine-grained gravel, trace silt (moist) [SP] [Class 7]		6						6:49AM Take S-1(SS): 6' to 7.5' Resistance at 7'-5"
				7	S-1	HA	17			7:12AM: Drill to 10' using core barrel
0.0			2:00	8						Boulders from 6' to 10' 7:40AM Install casing: 0' to 10' 7:56AM: Drill to 10' Resistance at 10'
	Class 1	Decomposed/ weathered rock [Class 1d] Very poor quality	1:00	9						8:05AM: Attempt to start coring at 10'. Core barrel clogged
-2.0			3:00	10	C-1	NX CORE BARREL	REC=39"/60" =65%	RQD=32"/60" =53%		
		Gray to pink, coarse- to medium-grained, quartz-feldspar- muscovite- garnet GRANITE, close to moderate fracture spacing, slightly weathered, with fractures dipping approximately 75 degrees from horizontal, moderate weathering at 12' [Class 1b] Fair quality	5:00	11						
			3:00	12						8:18AM Begin core C-1: 8' to 13' 8:35AM: Complete C-1
			2:00	13						
			2:00	14						8:47AM Begin core C-2: 13' to 18'
	Class 1	Gray, medium- to fine-grained, quartz- feldspar- muscovite- garnet GRANITE, very close to moderate fracture spacing, slightly to moderately weathered, with 2 fracture sets dipping close to horizontal and approximately 80 degrees from horizontal [Class 1b] Good quality	2:00	15	C-2	NX CORE BARREL	REC=60"/60" =100%	RQD=45"/60" =75%		8:59AM: Complete C-2
			3:00	16						Install 2' of casing: 8' to 10'
			3:00	17						9:30AM to 9:51AM Fix pin on rig
			3:00	18						
			3:00	19	C-3					10:14AM Begin core C-3: 18' to 23'
				20						

\\LANGAN.COM\DATA\NY\DATA1\170019118\ENGINEERING DATA\GEOTECHNICAL\GINTLOGS\170019118 HUDSON YARDS.GPJ ... 10/21/2013 10:50:50 AM ... Report: Log - LANGAN ...Template TEMPLATE.GDT

DEPT OF BLDGS121192618 Job Number

ES073136643 Scan Code

2 of 2

LANGAN

Log of Boring **BH-16**

Station Number **Track 29**

Station Offset

Structure type

Project	Project No.	East
HUDSON YARDS - PLATFORM BORINGS	170019118	5010

Location	Elevation and Datum	North
LIRR EAST RAIL YARD	Approx. 8 feet BPMD	4684

Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gray, medium- to fine-grained, quartz- feldspar- muscovite- garnet GRANITE, close to wide fracture spacing, slightly weathered to unweathered, with fractures dipping close to horizontal, instrusions of PEGMATITE from 48 inches to 51 inches [Class 1b] Good quality	3:00 3:00 4:00	20 21 22 23	C-3	NX CORE BARREL	REC=55"/60" =92%	RQD=48"/60" =80%		10:30AM: Complete C-3
-20.0	Class 1	Gray, medium- to fine-grained, quartz- feldspar- muscovite- garnet GRANITE, close to moderate fracture spacing, unweathered to moderately weathered, with fractures dipping close to horizontal, intrusions of PEGMATITE from 25' to 27' [Class 1b] Fair quality	3:00 3:00 4:00 2:00 3:00	24 25 26 27 28	C-4	NX CORE BARREL	REC=60"/60" =100%	RQD=34"/60" =57%		10:43AM Begin core C-4: 23' to 28' 10:50AM to 11:13AM Fix hose on rig 11:23AM: Complete C-4
-25.0	Class 1	Gray, medium- to fine-grained, quartz- feldspar- muscovite- garnet GRANITE, clsoe to moderate fracture spacing, unweathered to slightly weathered, with fractures dipping close to vertical, staining 31' to 32' on vertical fractures [Class 1a] Excellent quality	2:00 2:00 2:00 2:00 4:00	29 30 31 32 33	C-5	NX CORE BARREL	REC=60"/60" =100%	RQD=51"/60" =85%		11:41AM Begin core C-5: 28' to 33' 11:353M: Complete C-5
-30.0	Class 1	Gray, coarse- to medium-grained quartz- feldspar- muscovite- garnet GRANITE, close to moderate fracture spacing, unweathered, fractures dipping close to horizontal and 60 degrees from horizontal [Class 1b] Good quality	3:00 2:00 4:00 3:00 3:00	34 35 36 37 38	C-6	NX CORE BARREL	REC=46"/60" =77%	RQD=45"/60" =75%		12:13PM Begin core C-6: 33' to 38' 12:28PM: Complete C-6 12:40PM to 1:00PM Try to recover remaining foot of core - unsuccessful
		End of boring at 38'		39 40 41 42 43 44 45						1:00PM to 2:00PM Clean up 6/29/2013: Completed borehole grouted with a mix of soil cuttings and grout.

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DEPT OF BLDGS 121192618 Job Number

ES417552569 Scan Code

1 of 2

Log of Boring **BH-17**

Station Number **Track 29** Station Offset

Structure type

LANGAN

Project HUDSON YARDS - PLATFORM BORINGS	Project No. 170019118	East 5074
Location LIRR EAST RAIL YARD	Elevation and Datum Approx. 8 feet BPMD	North 4685
Drilling Company Warren George, Inc.	Date Started 6/28/13	Date Finished 6/28/13
Drilling Equipment AD II Truck Rig	Completion Depth 34 ft	Rock Depth 5.5 ft

Size and Type of Bit 2-7/8", 5-7/8" Diameter Tricone Roller Bit			Number of Samples	Disturbed --	Undisturbed --	Core 6
Casing Diameter (in) 3&4"-Inner-Diameter Flush Steel Casing		Casing Depth (ft) 5.5	Water Level (ft.)	First ▽ --	Completion ▼ --	24 HR. ▼ --
Casing Hammer Donut	Weight (lbs) 140	Drop (in) 30	Drilling Foreman Mike Kelly			
Sampler 2"- Outer-Diameter Split Spoon Sampler / NX Core Barrel			Inspecting Engineer Michael Zonin			
Sampler Hammer Safety	Weight (lbs) 140	Drop (in) 30				

MATERIAL SYMBOL	Elev. (ft) +8.0	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data Number	Sample Data Type	Sample Data Recov. (in)	Sample Data Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+6.6		18-inch thick Railroad Ballast (Poorly-Graded GRAVEL)		0 1						174' E of W P.L. 685' N of S P.L. 6/28/13 9:40PM: Begin removing ballast stone 10:05PM: Use 4-7/8" diameter roller bit to grind through concrete slab Hard drilling: 2.5' to 5' Spin 3"casing to 5.5'
	+5.6		8-inch thick CONCRETE SLAB		2						
	+3.0		Pea gravel, cobbles	SPIN	3 4 5						
	+2.5	Class 1	Weathered rock or till								
	-2.5	Class 1	Light gray, medium- to fine-grained, quartz-feldspar- muscovite- garnet GRANITE, wide fracture spacing, slightly weathered to unweathered, iron staning on fractures, with fractures dipping approximately 45 degrees to 60 degrees from horizontal [Class 1a] Excellent quality	5:00 4:00 5:00 6:00 4:00	6 7 8 9 10	C-1	NX CORE BARREL	REC=60"/60" =100%	RQD=54"/60" =90%		12:35AM Begin core C-1: 5.5' to 10.5' White wash 12:59AM: Complete C-1
	-7.5	Class 1	Light gray, medium- to fine-grained, quartz-feldspar- muscovite- garnet GRANITE, moderate fracture spacing, slightly weathered, staining on fractures, with fractures dipping approximately 0 degrees to 45 degrees from horizontal [Class 1b] Good quality	3:00 5:00 4:00 6:00 5:00	11 12 13 14 15	C-2	NX CORE BARREL	REC=60"/60" =100%	RQD=49"/60" =82%		1:12AM Begin core C-2: 10.5' to 15.5' White wash. Hard drilling 1:35AM: Complete C-2
		Class 1	Light gray, coarse- to fine-grained, quartz-feldspar- muscovite- garnet GRANITE, wide fracture spacing, unweathered, with fractures dipping approximately 15 degrees from horizontal, vertical fracture 20' to 20.5' [Class 1a] Excellent quality	4:00 3:00 3:00 4:00	16 17 18 19 20	C-3	NX CORE BARREL	REC=59"/60" =98%	RQD=55"/60" =92%		1:50AM Begin core C-3: 15.5' to 20.5' White wash. Hard drilling 2:03AM: Complete C-3

DEPT OF BLDGS 121192618 Job Number

ES714469330 Scan Code

Log of Boring **BH-17**

Station Number **Track 29** Station Offset

Structure type

LANGAN

Project	Project No.	East
HUDSON YARDS - PLATFORM BORINGS	170019118	5074
Location	**Elevation and Datum**	**North**
LIRR EAST RAIL YARD	Approx. 8 feet BPMD	4685

MATERIAL SYMBOL	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
				4:00	20						
	-12.5	Class 1	Light gray, medium- to fine-grained, quartz- feldspar- muscovite- garnet GRANITE, moderate to close fracture spacing, moderately to slightly weathered, with fractures dipping approximately 45 degrees from horizontal, coarse-grained from 23.8' to 24.3' [Class 1b] Fair quality	6:00 7:00 12:00 21:00	21 22 23 24	C-4	NX CORE BARREL	REC=45"/48" =94%	RQD=29"/48" =60%		2:15AM Begin core C-4: 20.5' to 24.5' White wash. Hard drilling 3:20AM: Core tip clogged No advancement Break run at 24.5'
	-16.5	Class 1	24.5' to 25.5': Light gray, coarse- grained, quartz- feldspar- muscovite GRANITE [Class 1a] Excellent quality 25.5' to 29.5': Light gray, medium- to fine-grained, quartz- feldspar- muscovite- biotite GRANITE, wide fracture spacing, slightly weathered, with fractures near horizontal [Class 1a] Excellent quality	14:00 12:00 11:00 9:00 9:00	25 26 27 28 29	C-5	NX CORE BARREL	REC=60"/60" =100%	RQD=59"/60" =98%		3:45AM Begin core C-5: 24.5' to 29.5' White wash 4:40AM: Complete C-5
		Class 1	Light gray, medium- tocoarse-grained, quartz- feldspar- muscovite- garnet GRANITE, wide fracture spacing, unweathered, with fractures dipping approximately 45 degrees from horizontal [Class 1a] Excellent quality	2:00 2:00 3:00 2:00 2:00	30 31 32 33	C-6	NX CORE BARREL	REC=53"/54" =98%	RQD=53"/54" =98%		4:45AM Begin core C-6: 29.5' to 34' White wash 5:04AM Complete boring at 34'
	-26.0		End of boring at 34'		34 35 36 37 38 39 40 41 42 43 44 45						5:10AM: Completed borehole grouted with a mix of soil cuttings and grout.

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APPENDIX E
Laboratory Test Results

Langan #170019118
Hudson Yards - Platform
LABORATORY TESTING DATA SUMMARY

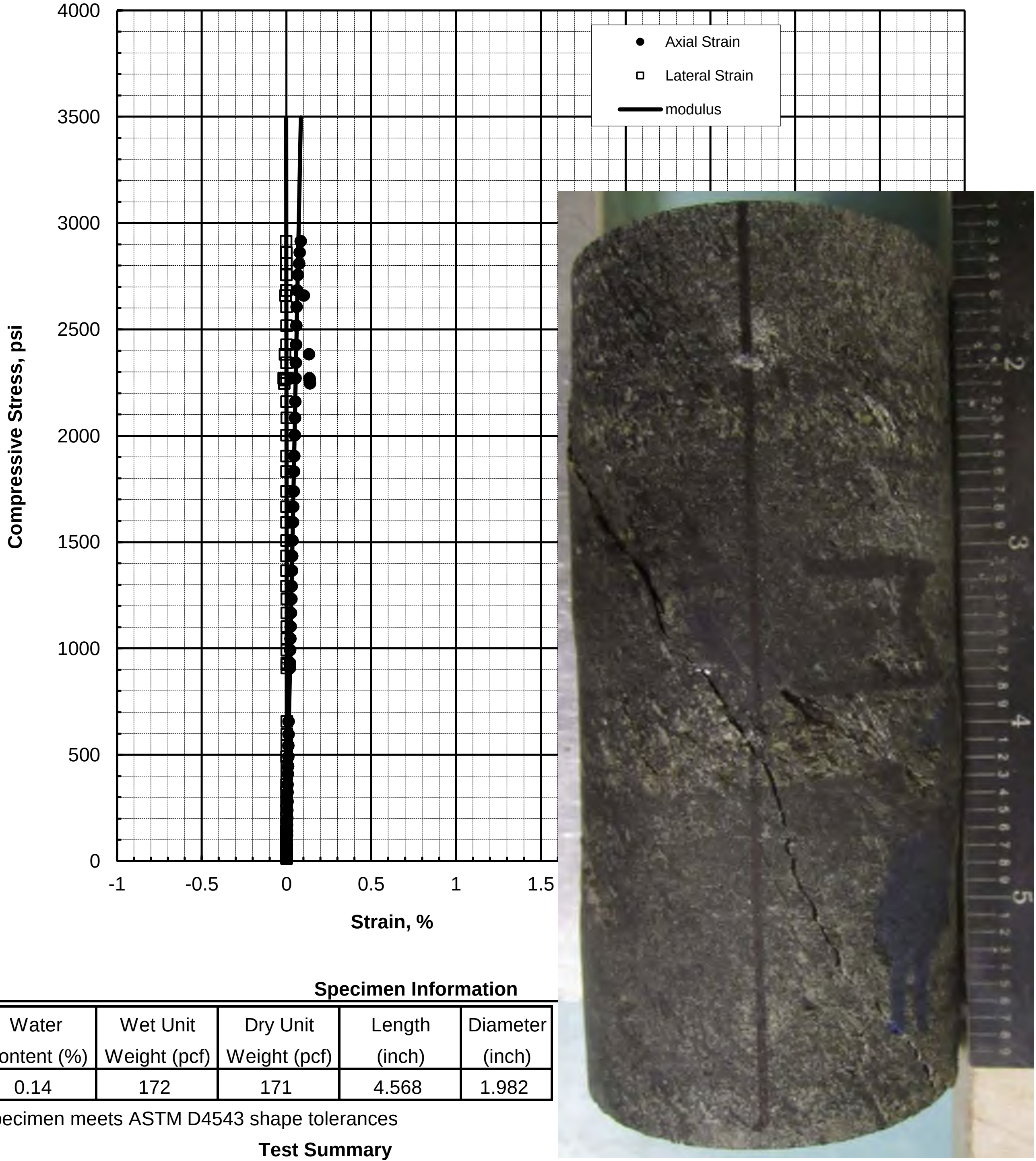
SAMPLE IDENTIFICATION			STATE PROPERTIES			ENGINEERING PROPERTY TESTS						REMARKS
BORING NO.	RUN	DEPTH (ft)	WATER CONTENT (1) (%)	TOTAL UNIT WEIGHT (pcf)	DRY UNIT WEIGHT (pcf)	TEST TYPE	LOAD ORIENTATION	UNCONFINED COMPRESSIVE STRENGTH (psi)	STRAIN TO PEAK (%)	YOUNG's MOD. E (2) (psi)	POISSON'S RATIO ν (-)	
BH-3	C-4	38-39	0.14	172	171	Ucmod	Axial	2910	0.08	4.0E+06	0.04	
BH-4	C-2	18-19.5	0.29	179	178	UC	Axial	2260	0.20	1.2E+06		
BH-4	C-12	69.1-69.5	0.14	171	171	Ucmod	Axial	9470	0.29	5.7E+06	0.08	
BH-5	C-3	28-29	0.09	181	181	UC	Axial	2340	0.25	9.6E+05		
BH-6	C-1	18-19	0.16	177	177	UC	Axial	5190	0.25	2.2E+06		
BH-6	C-8	54-54.5	0.10	164	164	Ucmod	Axial	17930	0.41	3.7E+06	0.10	
BH-6	C-12	70-71	0.17	164	164	UC	Axial	18260	0.31	7.9E+06		
BH-7	C-1	17-17.5	0.24	190	190	Ucmod	Axial	15870	0.18	8.3E+06	0.21	
BH-9	C-2	24-24.5	0.12	168	168	UC	Axial	8610	0.20	5.2E+06		
BH-10	C-2	15.5-16.5	0.21	163	163	Ucmod	Axial	8140	0.14	6.3E+06	0.24	
BH-11	C-3	15-15.5	0.20	164	163	UC	Axial	15560	0.22	7.7E+06		
BH-12	C-6	57.5-58.2	0.13	173	172	Ucmod	Axial	8940	0.12	7.9E+06	0.22	
BH-13	C-1	22-23	0.15	187	186	UC	Axial	5230	0.14	4.3E+06		
BH-13	C-8	55.5-56	0.09	164	164	Ucmod	Axial	17070	0.75	6.2E+06	0.13	
BH-13	C-10	63.5-64.5	0.19	163	163	UC	Axial	15570	0.27	6.3E+06		
BH-14	C-9	17.5-18	0.15	164	164	Ucmod	Axial	19270	0.24	9.0E+06	0.24	
BH-14	C-12	65.5-66	0.22	163	163	UC	Axial	8450	0.28	3.1E+06		
BH-15	C-1	17.5-18	0.17	165	164	Ucmod	Axial	12580	0.25	6.0E+06	0.20	
BH-15	C-2	18.5-18.9	0.20	163	163	UC	Axial	17820	0.28	6.8E+06		
BH-15	C-4	30.5-30.9	0.24	163	163	UC	Axial	12440	0.22	6.2E+06		
BH-15	C-8	48-49	0.19	164	164	UC	Axial	16240	0.24	7.2E+06		
BH-15	C-11	64-65	0.12	163	162	Ucmod	Axial	11560	0.34	5.0E+06	0.18	
BH-27	C-3	23-24	0.25	168	168	UC	Axial	2330	0.27	1.0E+06		

Notes:
(1) Water contents determined after trimming and shearing.
(2) Modulus values on test type UC estimated from platen to platen measurement.

TerraSense, LLC
45J Commerce Way
Totowa, NJ 07512
(973) 812-1818

Prepared by: CMJ
Reviewed by: GET

Project No.: 7920-351
File: RockSum1.xls
Date: 10/1/2013



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.14	172	171	4.568	1.982

Specimen meets ASTM D4543 shape tolerances

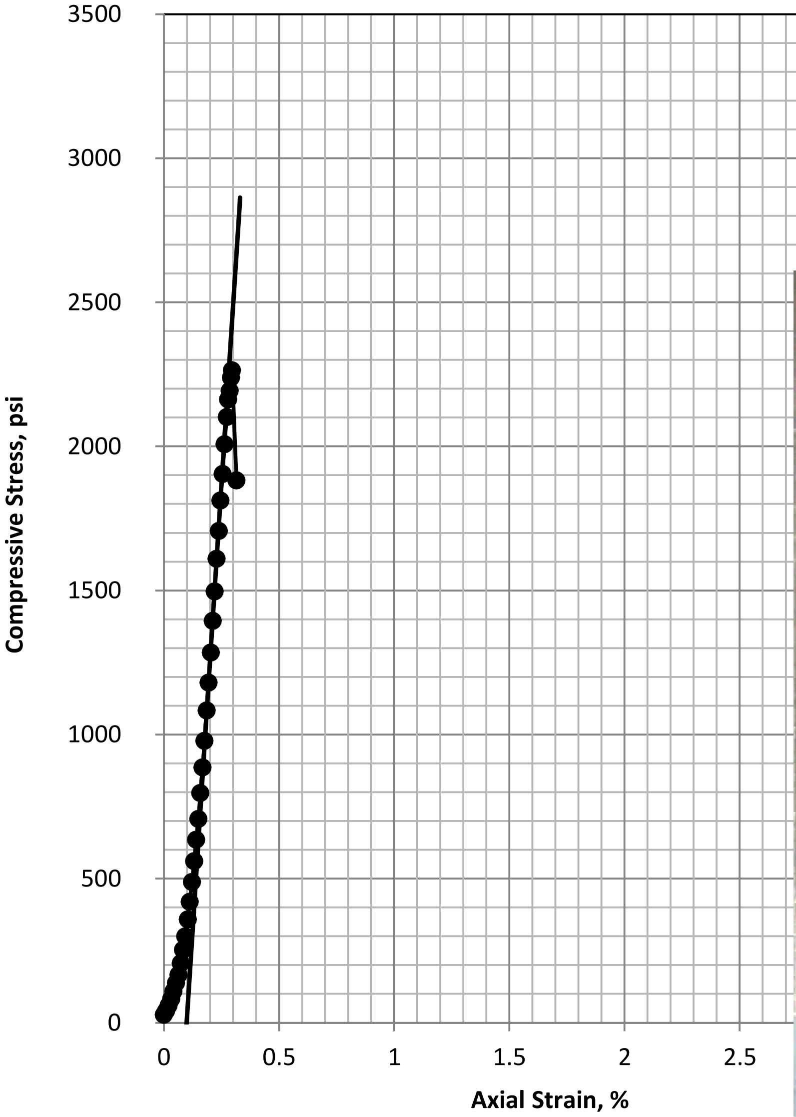
Test Summary

Strain Rate (%/min)	Strain to Peak (%)	q_u (psi)	Elastic Modulus (psi)	Poisson's Ratio
0.07	0.08	2910	4.03E+06	0.04

FAILURE PHOTO

Tested by: DT Test Date: Aug-29-13

Langan Project # 170019118	**Hudson Yards Platform**	**COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH AND ELASTIC MODULUS TEST Boring: BH-3 Sample: C-4 Depth 38-39 ft.**
TerraSense, LLC Project # 7920-351		



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.29	179	178	4.515	2.004

Specimen meets ASTM D4543 shape tolerances

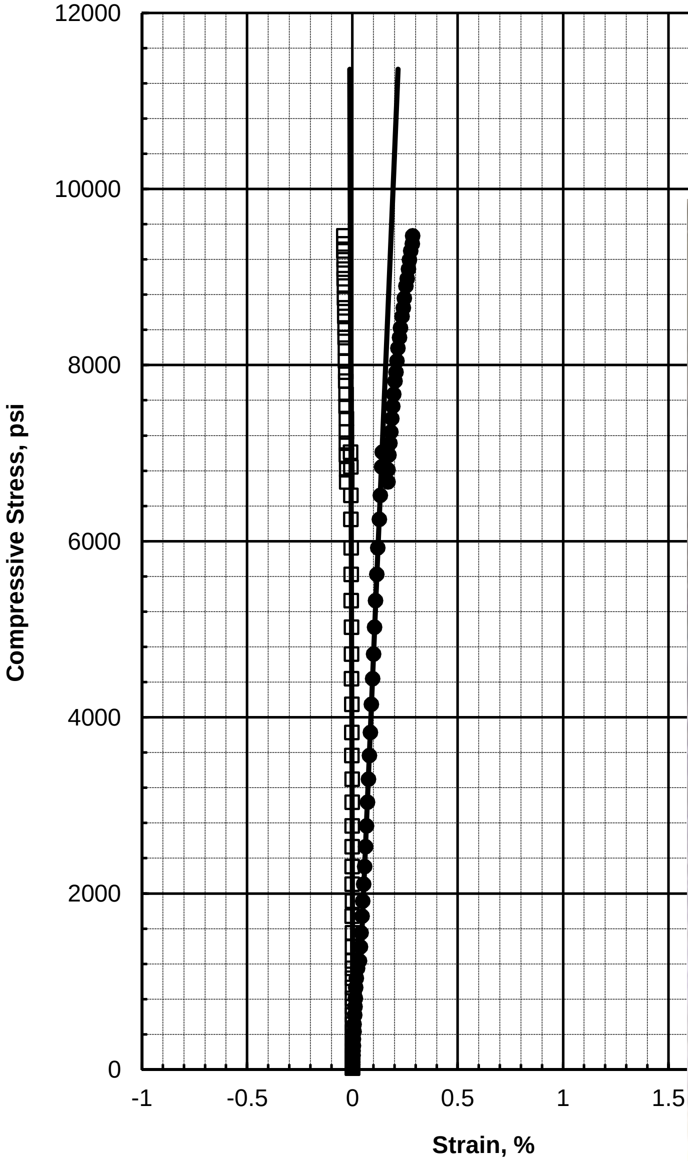
FAILURE PHOTO

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.18	0.20	2260	1.23E+06

Test by: DT
Test Date: Aug-20-13
Reviewed by: GET

Langan Project # 170019118	**Hudson Yards Platform**	**COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH TEST**
TerraSense, LLC Project # 7920-351		**Boring: BH-4 Sample: C-2 Depth 18-19.5 ft.**



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.14	171	171	4.583	1.983

Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Strain to Peak (%)	q_u (psi)	Elastic Modulus (psi)	Poisson's Ratio
0.08	0.29	9470	5.71E+06	0.08

FAILURE PHOTO

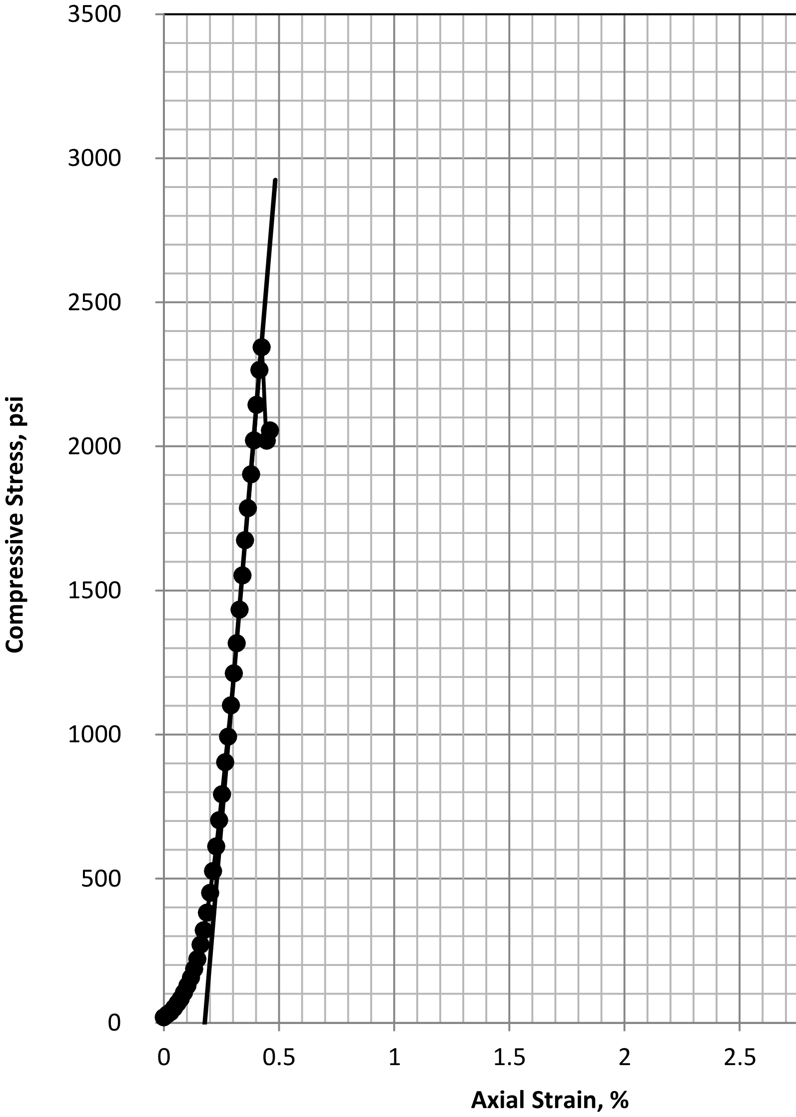
Tested by: DT Test Date: Aug-28-13

Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards
Platform

COMPRESSIVE STRESS VS STRAIN
UNCONFINED COMPRESSIVE STRENGTH
AND ELASTIC MODULUS TEST
Boring: BH-4 Sample: C-12
Depth 69.1-69.5 ft.



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.09	181	181	4.430	1.969

Specimen meets ASTM D4543 shape tolerances

FAILURE PHOTO

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.19	0.25	2340	9.55E+05

Test by: DT
Test Date: Aug-21-13
Reviewed by: GET

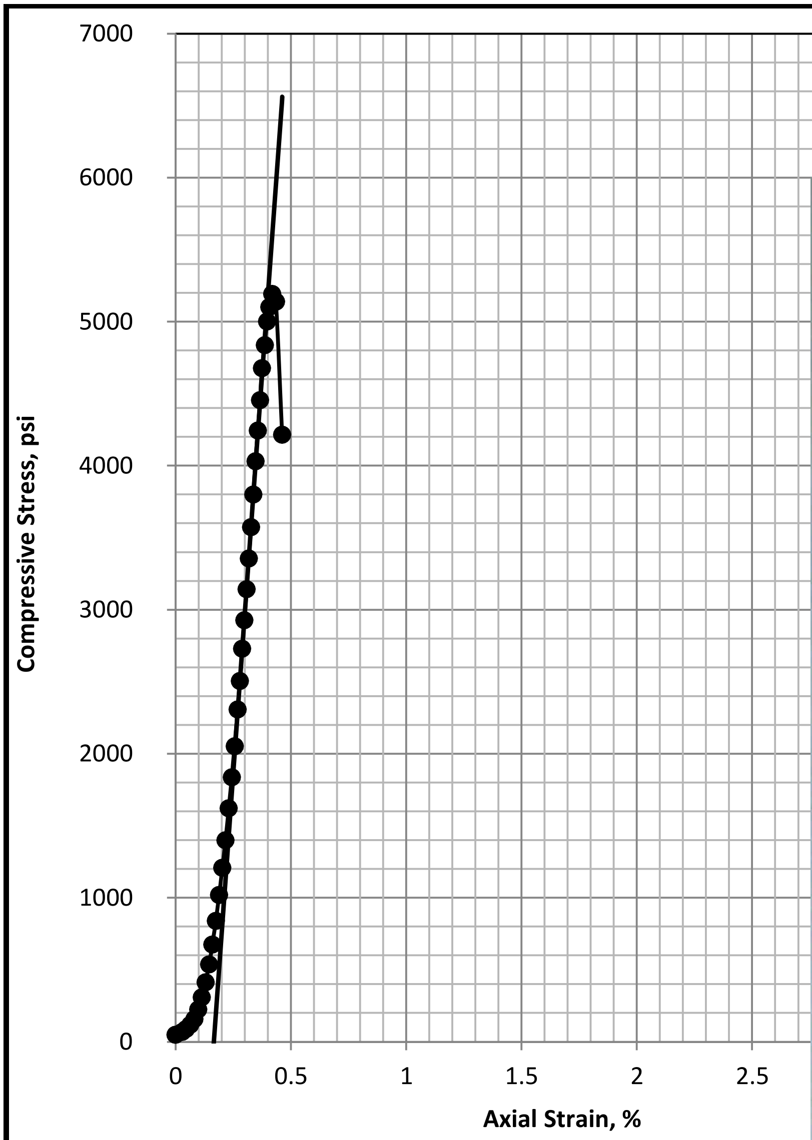
Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards
Platform

COMPRESSIVE STRESS VS STRAIN
UNCONFINED COMPRESSIVE
STRENGTH TEST

Boring: BH-5 Sample: C-3
Depth 28-29 ft.



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.16	177	177	4.596	1.980

Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.15	0.25	5190	2.21E+06

Test by: DT
Test Date: Aug-21-13
Reviewed by: GET

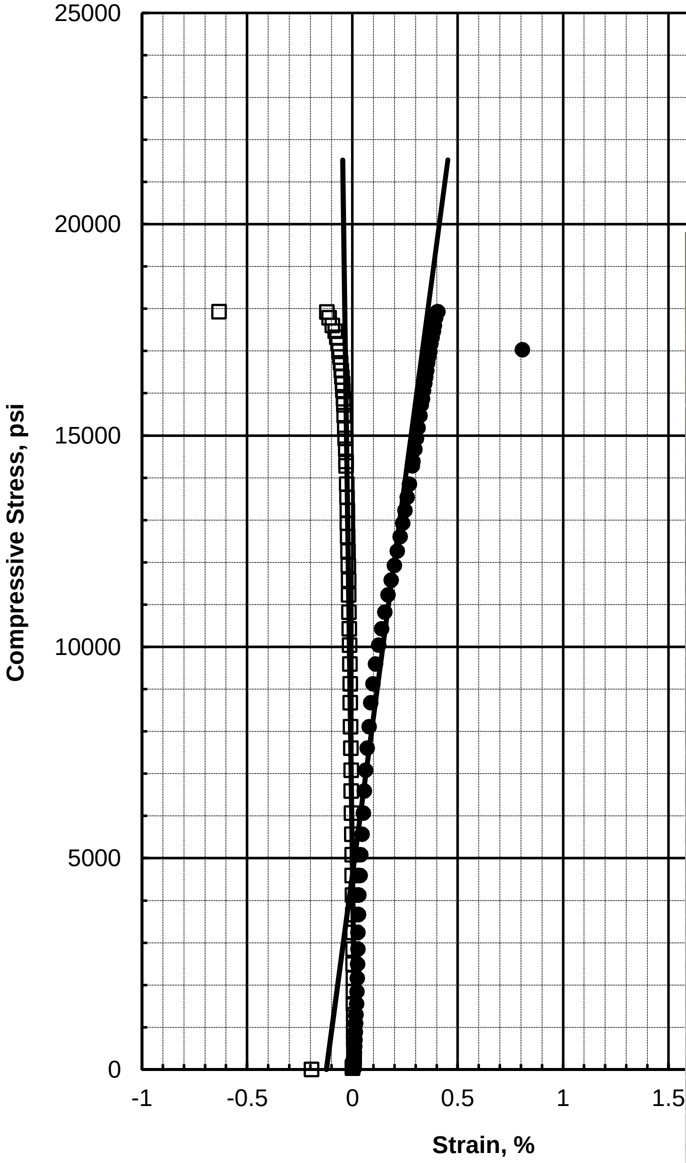
Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards Platform

COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH TEST

Boring: BH-6 Sample: C-1
Depth 18-19 ft.



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.10	164	164	4.421	1.988

Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Strain to Peak (%)	q_u (psi)	Elastic Modulus (psi)	Poisson's Ratio
0.35	0.41	17930	3.73E+06	0.10

FAILURE PHOTO

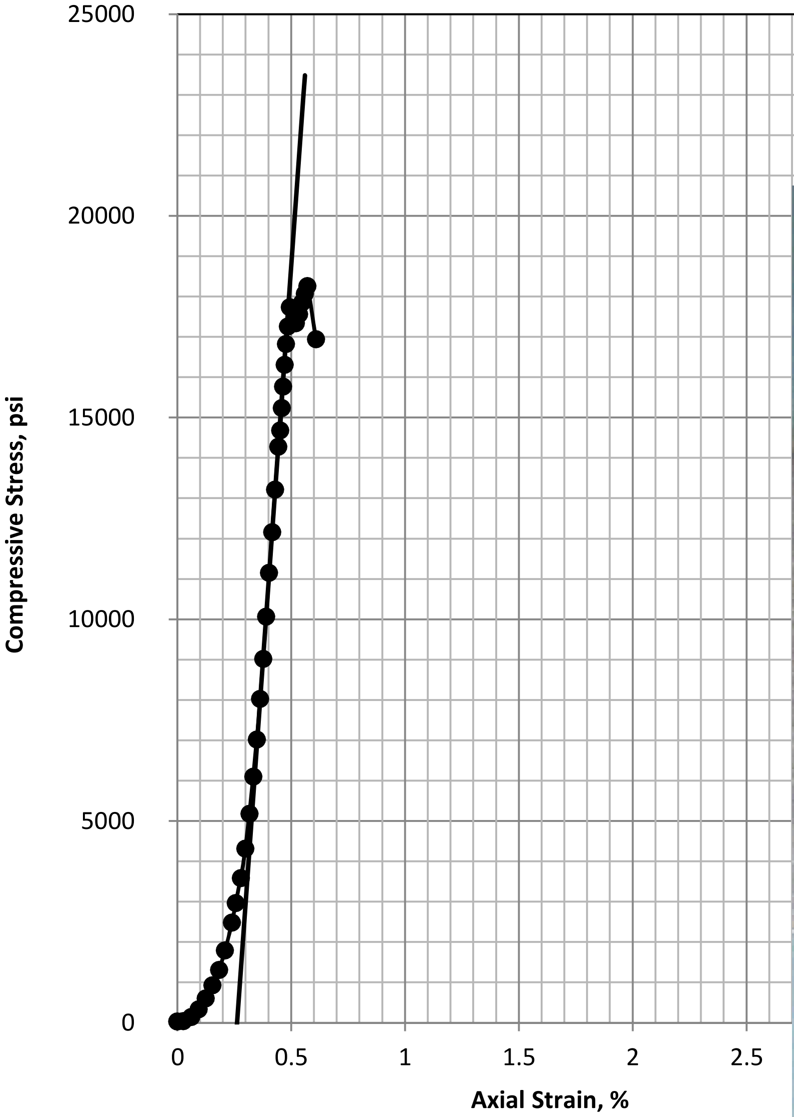
Tested by: DT Test Date: Aug-28-13

Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards Platform

COMPRESSIVE STRESS VS STRAIN
UNCONFINED COMPRESSIVE STRENGTH AND ELASTIC MODULUS TEST
Boring: BH-6 Sample: C-8
Depth 54-54.5 ft.



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.17	164	164	4.493	1.983

Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.08	0.31	18260	7.89E+06

Test by: DT
Test Date: Aug-21-13
Reviewed by: GET

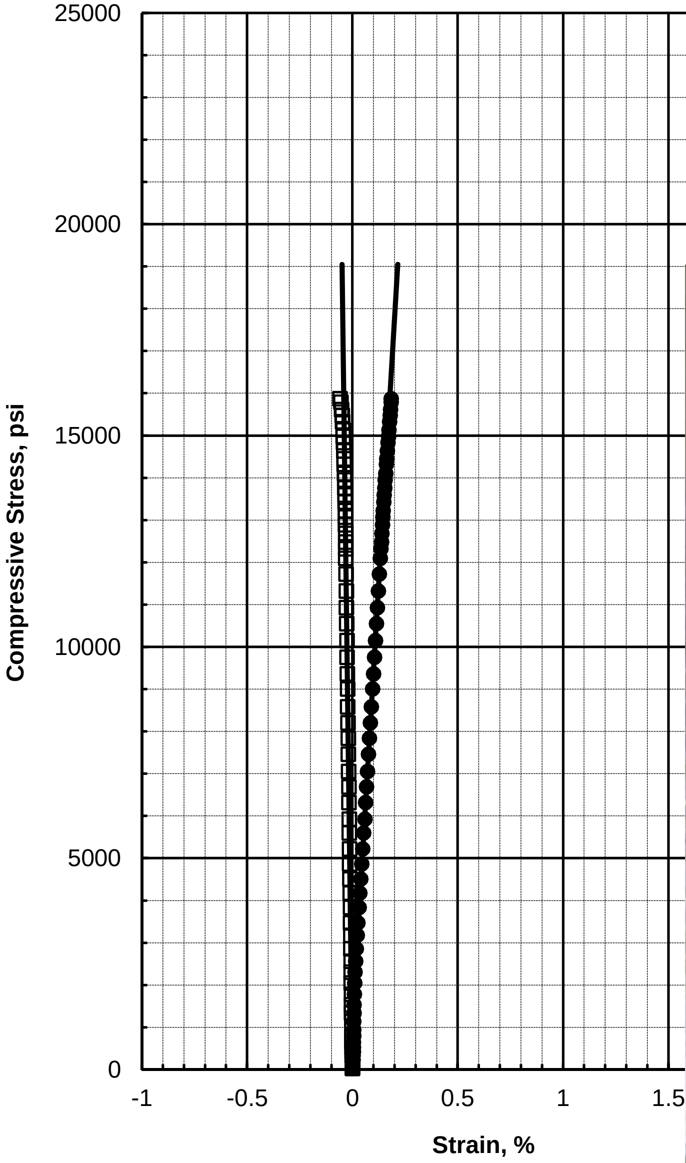
Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards Platform

COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH TEST

Boring: BH-6 Sample: C-12
Depth 70-71 ft.



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.24	190	190	4.794	1.823

Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Strain to Peak (%)	q_u (psi)	Elastic Modulus (psi)	Poisson's Ratio
0.05	0.18	15870	8.34E+06	0.21

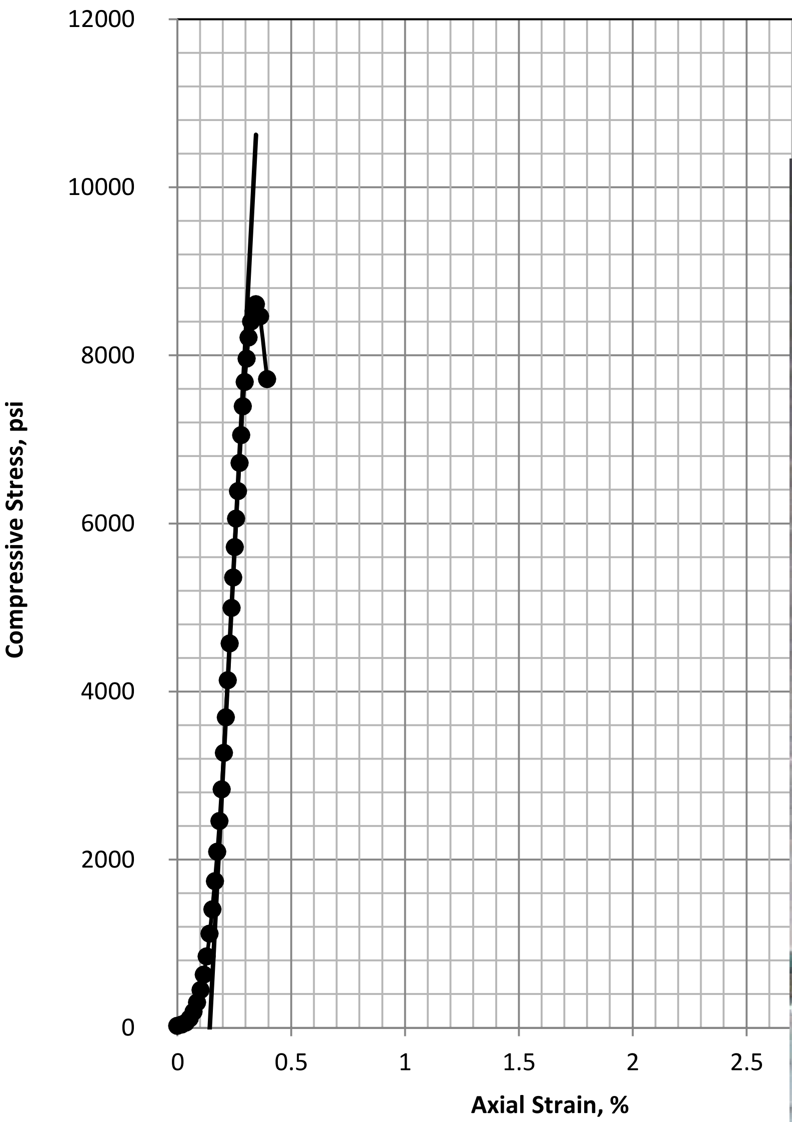
Tested by: DT Test Date: Aug-29-13

Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards
Platform

COMPRESSIVE STRESS VS STRAIN
UNCONFINED COMPRESSIVE STRENGTH
AND ELASTIC MODULUS TEST
Boring: BH-7 Sample: C-1
Depth 17-17.5 ft.



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.12	168	168	4.515	1.980

Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.10	0.20	8610	5.23E+06

Test by: DT
Test Date: Aug-20-13
Reviewed by: GET

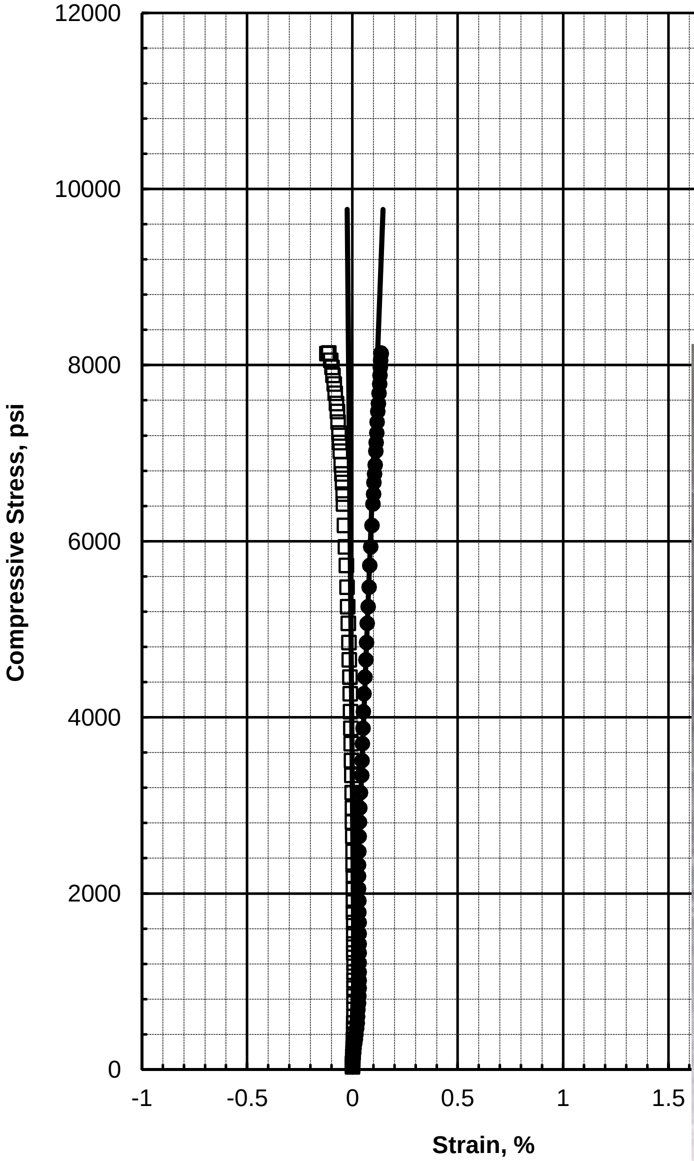
Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards
Platform

COMPRESSIVE STRESS VS STRAIN
UNCONFINED COMPRESSIVE
STRENGTH TEST

Boring: BH-9 Sample: C-2
Depth 24-24.5 ft.



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.21	163	163	4.559	1.988

Specimen meets ASTM D4543 shape tolerances

Test Summary

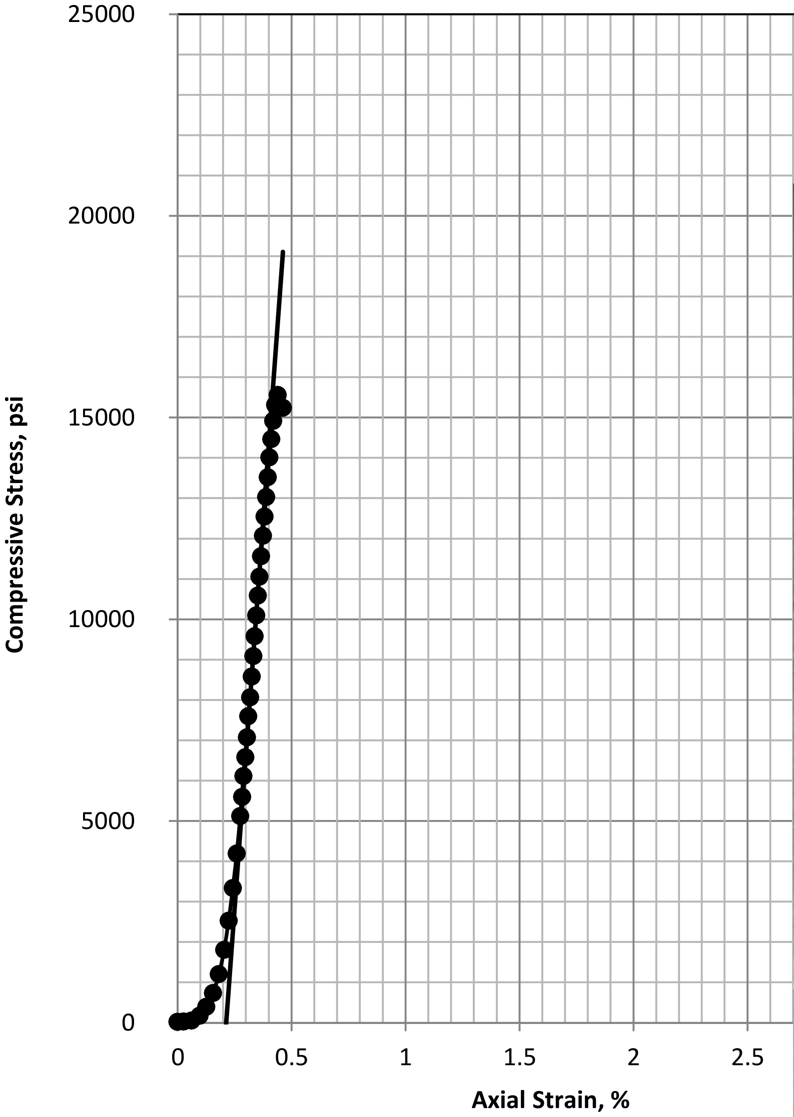
Strain Rate (%/min)	Strain to Peak (%)	q_u (psi)	Elastic Modulus (psi)	Poisson's Ratio
0.04	0.14	8140	6.32E+06	0.24

Tested by: DT Test Date: Aug-28-13

Langan **Project # 170019118**	**Hudson Yards Platform**	**COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH AND ELASTIC MODULUS TEST** **Boring: BH-10 Sample: C-2** **Depth 15.5-16.5 ft.**
TerraSense, LLC **Project # 7920-351**		

Analysis File: UCmod.XLS

10/1/2013
UCMbh10c2.xls



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.20	164	163	4.574	1.986

Specimen meets ASTM D4543 shape tolerances

FAILURE PHOTO

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.09	0.22	15560	7.69E+06

Test by: DT
Test Date: Aug-21-13
Reviewed by: GET

Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

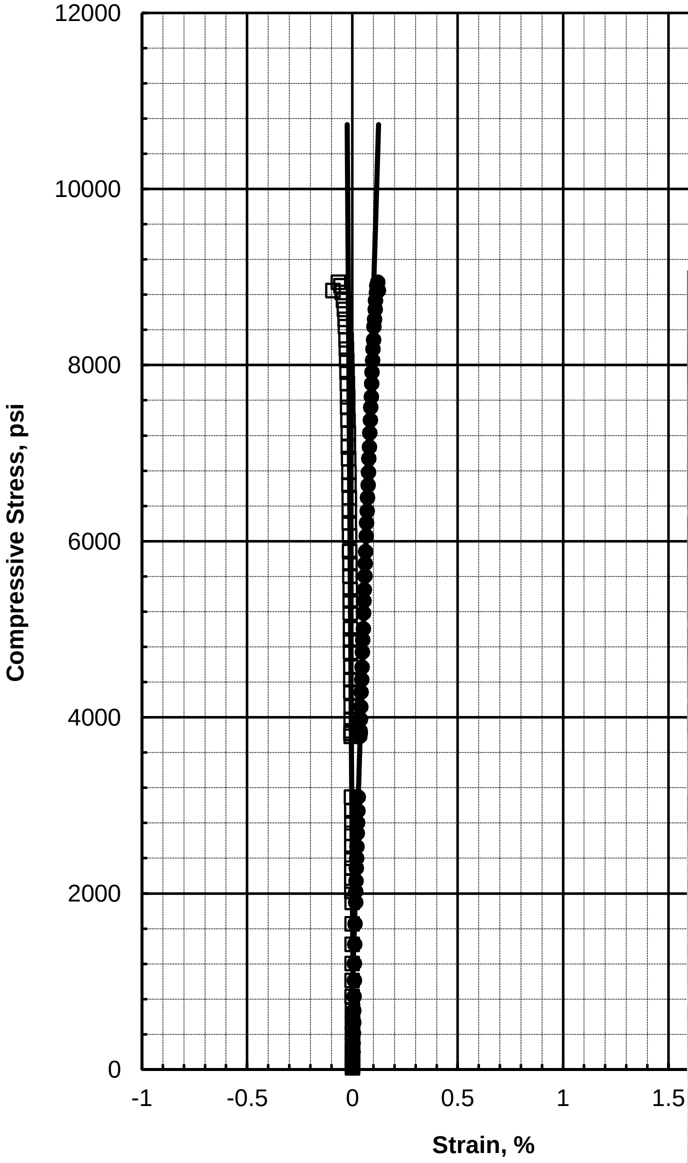
Hudson Yards Platform

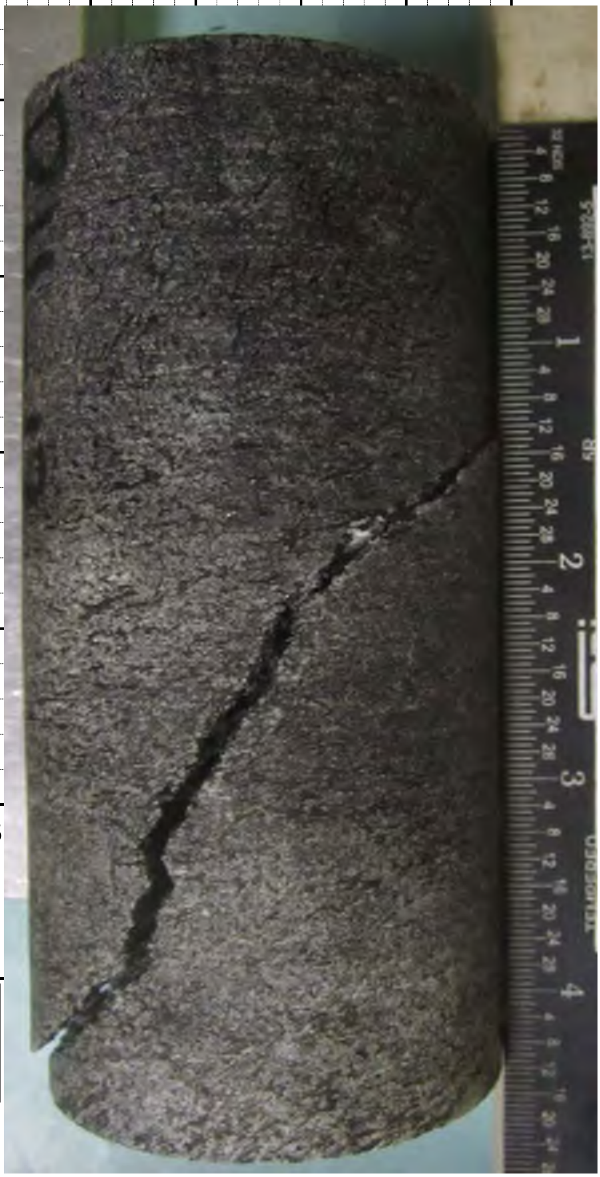
COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH TEST

Boring: BH-11 Sample: C-3
Depth 15-15.5 ft.

Analysis File: UCrock7rev1 (3/11)

10/1/2013
UCbh11c3.xlsx





FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.13	173	172	4.441	1.988

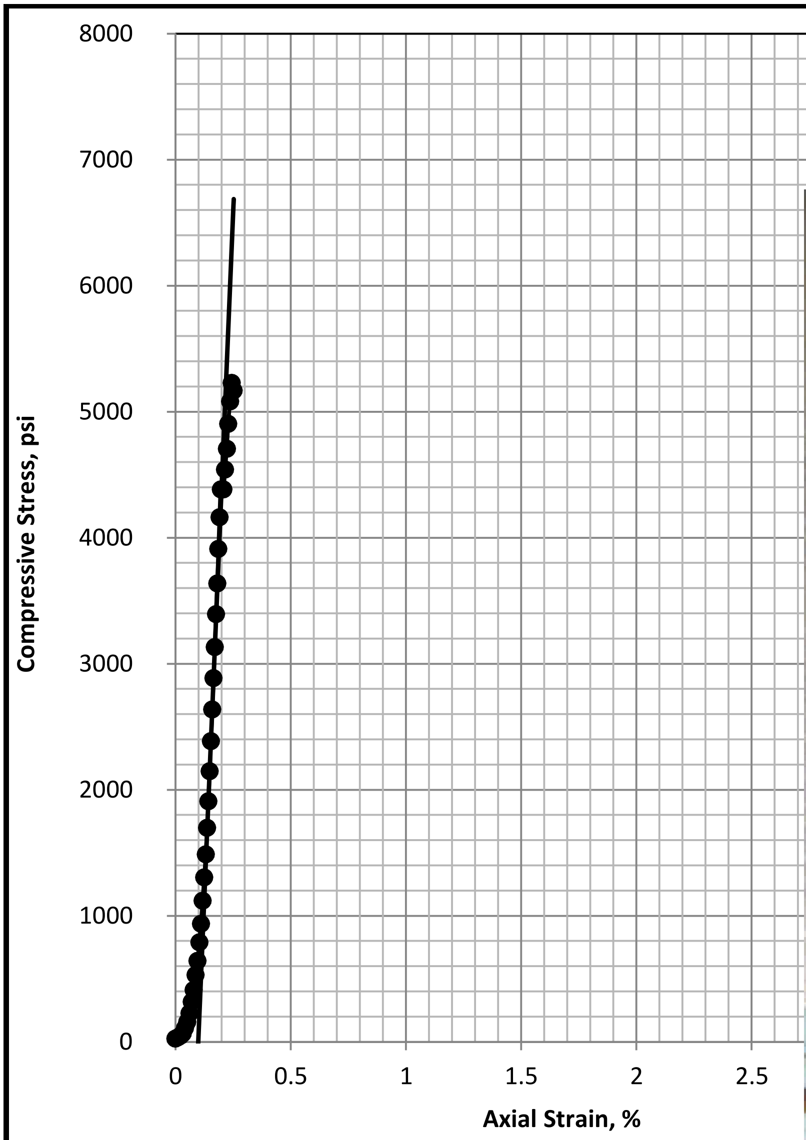
Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Strain to Peak (%)	q_u (psi)	Elastic Modulus (psi)	Poisson's Ratio
0.05	0.12	8940	7.89E+06	0.22

Tested by: DT Test Date: Aug-29-13

Langan Project # 170019118	**Hudson Yards Platform**	**COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH AND ELASTIC MODULUS TEST Boring: BH-12 Sample: C-6 Depth 57.5-58.2 ft.**
TerraSense, LLC Project # 7920-351		



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.15	187	186	4.570	1.986

Specimen meets ASTM D4543 shape tolerances

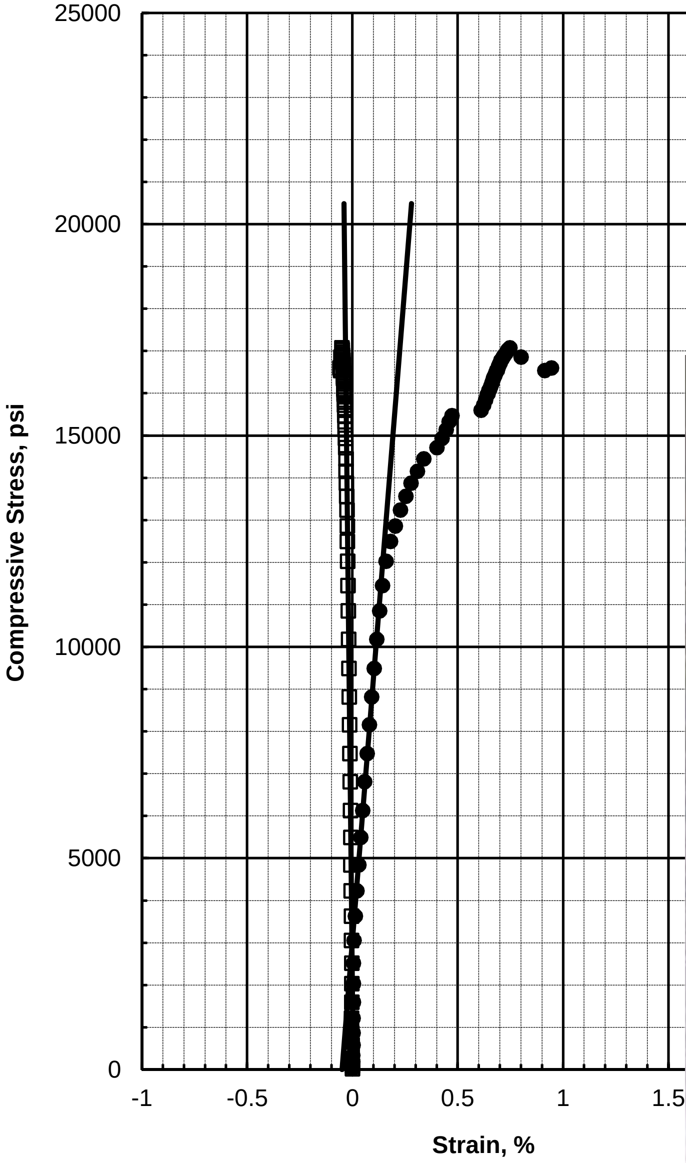
FAILURE PHOTO

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.11	0.14	5230	4.35E+06

Test by: DT
Test Date: Aug-20-13
Reviewed by: GET

Langan Project # 170019118 TerraSense, LLC Project # 7920-351	Hudson Yards Platform	COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH TEST Boring: BH-13 Sample: C-1 Depth 22-23 ft.



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.09	164	164	4.575	1.986

Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Strain to Peak (%)	q_u (psi)	Elastic Modulus (psi)	Poisson's Ratio
0.13	0.75	17070	6.23E+06	0.13

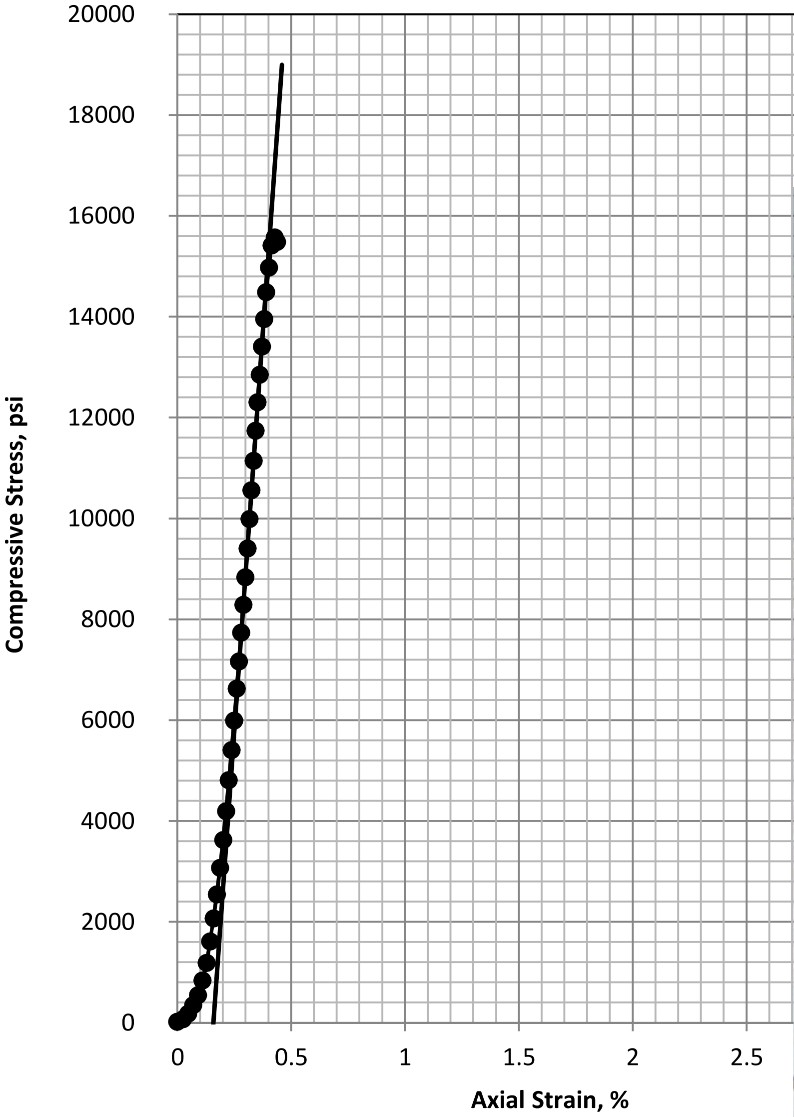
Tested by: DT Test Date: Aug-28-13

Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards Platform

COMPRESSIVE STRESS VS STRAIN
UNCONFINED COMPRESSIVE STRENGTH AND ELASTIC MODULUS TEST
Boring: BH-13 Sample: C-8
Depth 55.5-56 ft.



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.19	163	163	4.553	1.985

Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.09	0.27	15570	6.31E+06

Test by: DT
Test Date: Aug-20-13
Reviewed by: GET

Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

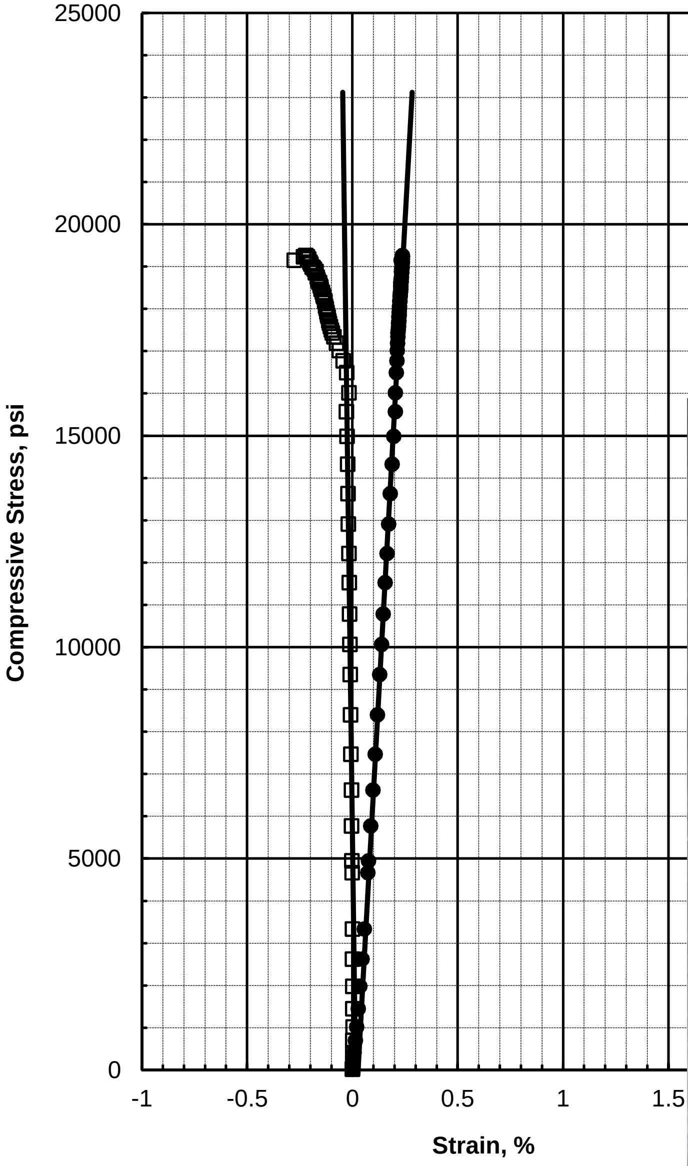
Hudson Yards
Platform

COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH TEST

Boring: BH-13 Sample: C-10
Depth 63.5-64.5 ft.

Analysis File: UCrock7rev1 (3/11)

10/1/2013
UCbh13c10.xlsx



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.15	164	164	3.899	1.989

Specimen does not meet ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Strain to Peak (%)	q_u (psi)	Elastic Modulus (psi)	Poisson's Ratio
0.03	0.24	19270	9.01E+06	0.24

FAILURE PHOTO

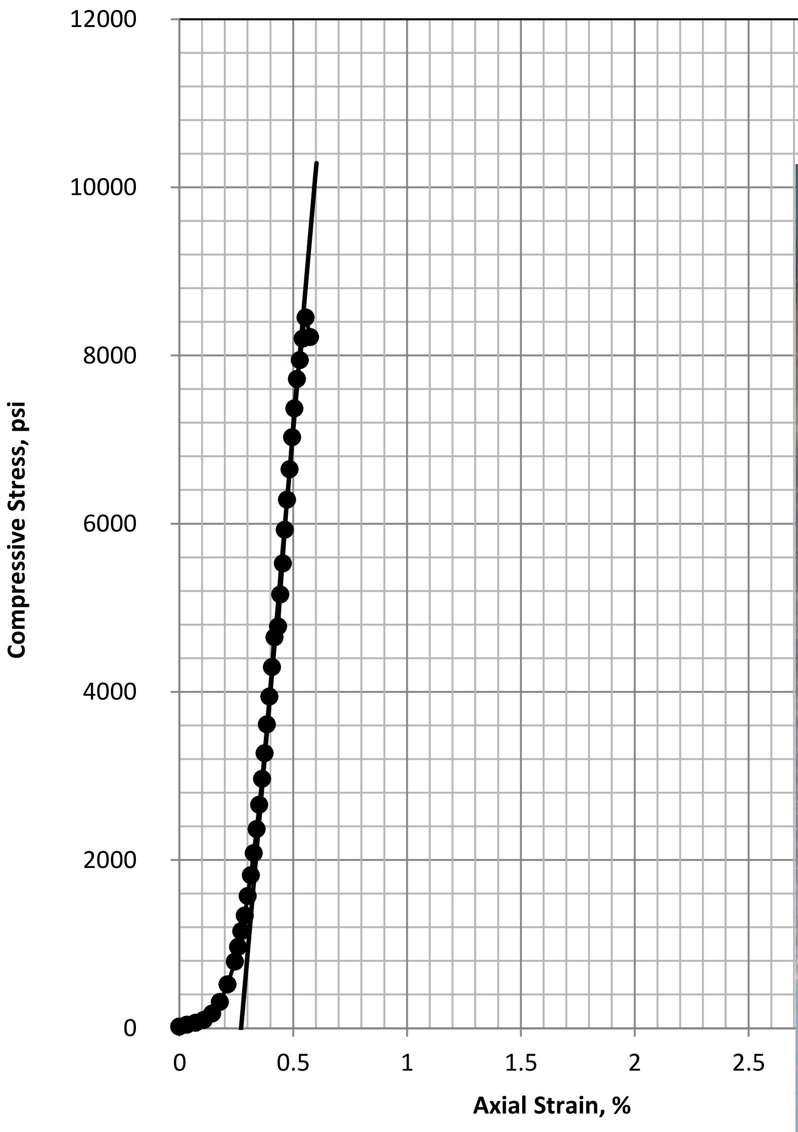
Tested by: DT Test Date: Aug-29-13

Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards Platform

COMPRESSIVE STRESS VS STRAIN
UNCONFINED COMPRESSIVE STRENGTH AND ELASTIC MODULUS TEST
Boring: BH-14 Sample: C-9
Depth 17.5-18 ft.



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.22	163	163	4.406	1.986

Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.13	0.28	8450	3.10E+06

Test by: DT
Test Date: Aug-21-13
Reviewed by: GET

Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

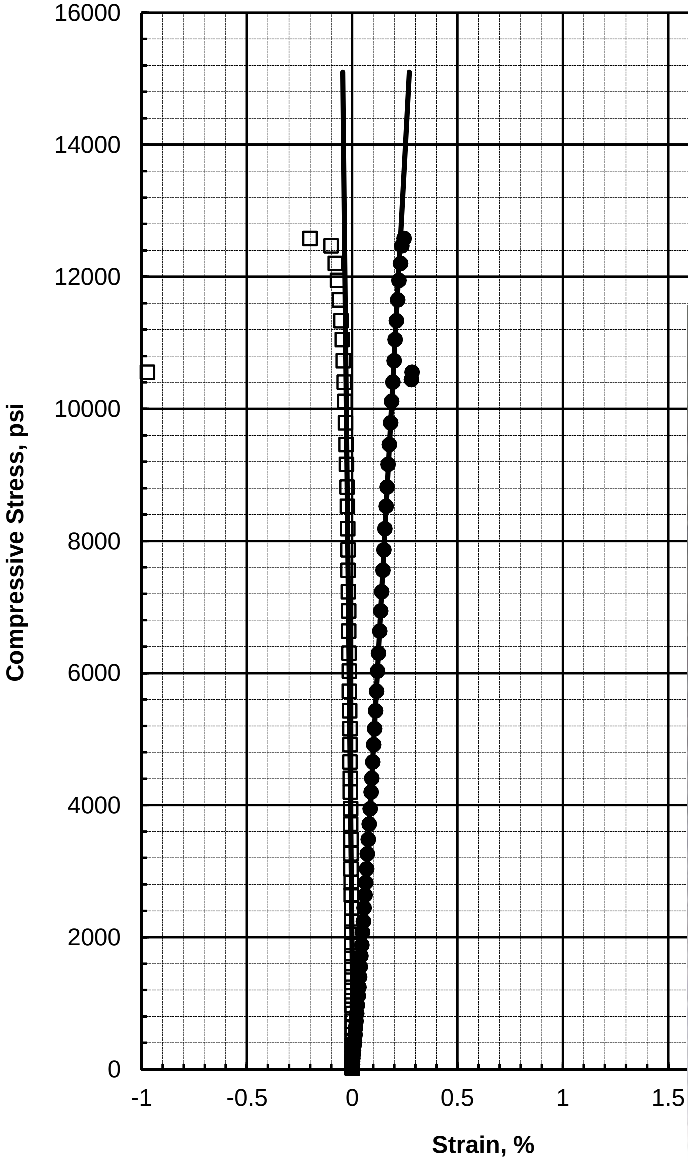
Hudson Yards Platform

COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH TEST

Boring: BH-14 Sample: C-12
Depth 65.5-66 ft.

Analysis File: UCrock7rev1 (3/11)

10/1/2013
UCbh14c12.xlsx



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.17	165	164	4.449	1.988

Specimen meets ASTM D4543 shape tolerances

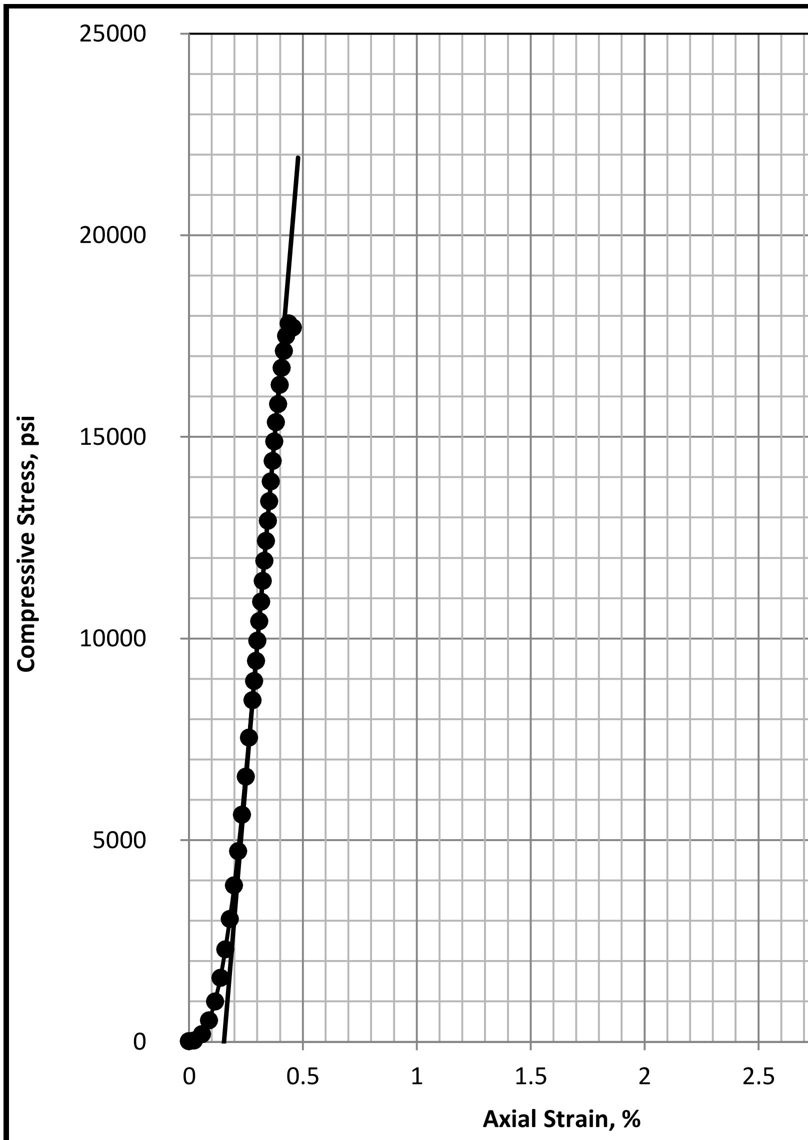
Test Summary

Strain Rate (%/min)	Strain to Peak (%)	q_u (psi)	Elastic Modulus (psi)	Poisson's Ratio
0.06	0.25	12580	5.98E+06	0.20

FAILURE PHOTO

Tested by: DT Test Date: Aug-28-13

Langan Project # 170019118 TerraSense, LLC Project # 7920-351	Hudson Yards Platform	COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH AND ELASTIC MODULUS TEST Boring: BH-15 Sample: C-1 Depth 17.5-18 ft.



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.20	163	163	4.361	1.998

Specimen meets ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.09	0.28	17820	6.75E+06

Test by:	DT
Test Date:	Aug-21-13
Reviewed by:	GET

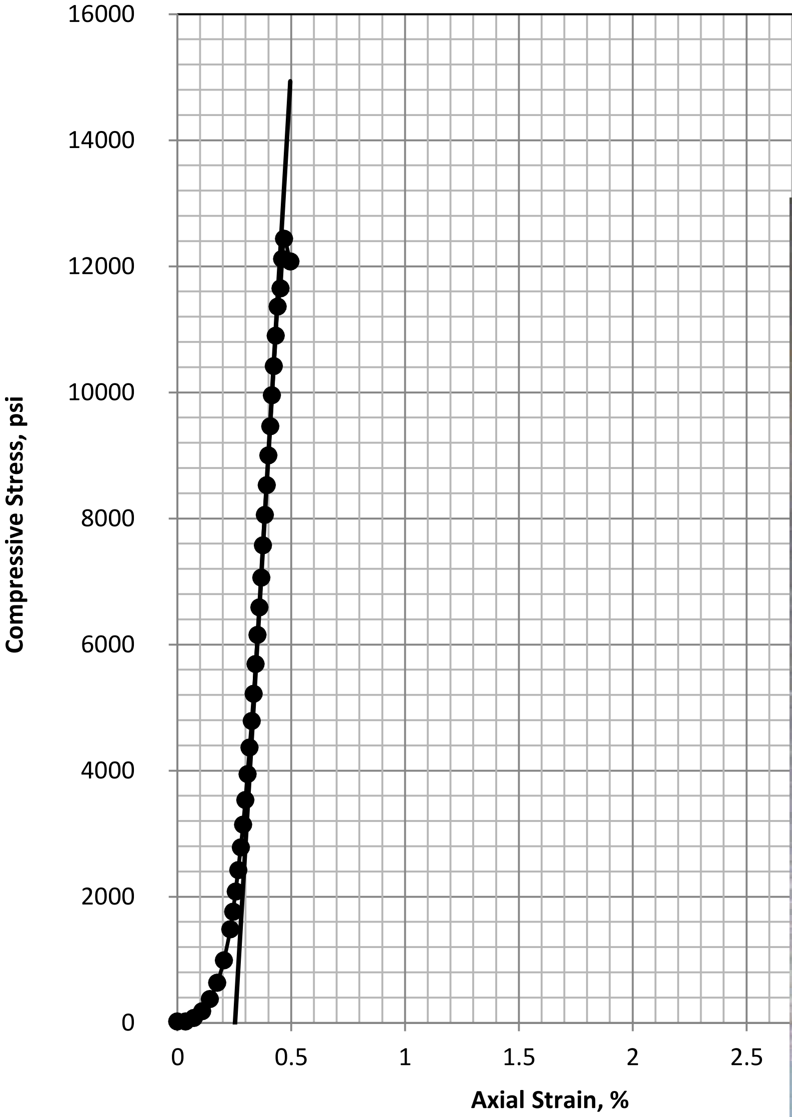
Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards
Platform

COMPRESSIVE STRESS VS STRAIN
UNCONFINED COMPRESSIVE
STRENGTH TEST

Boring: BH-15 Sample: C-2
Depth 18.5-18.9 ft.



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.24	163	163	4.313	1.987

Specimen meets ASTM D4543 shape tolerances

Test Summary

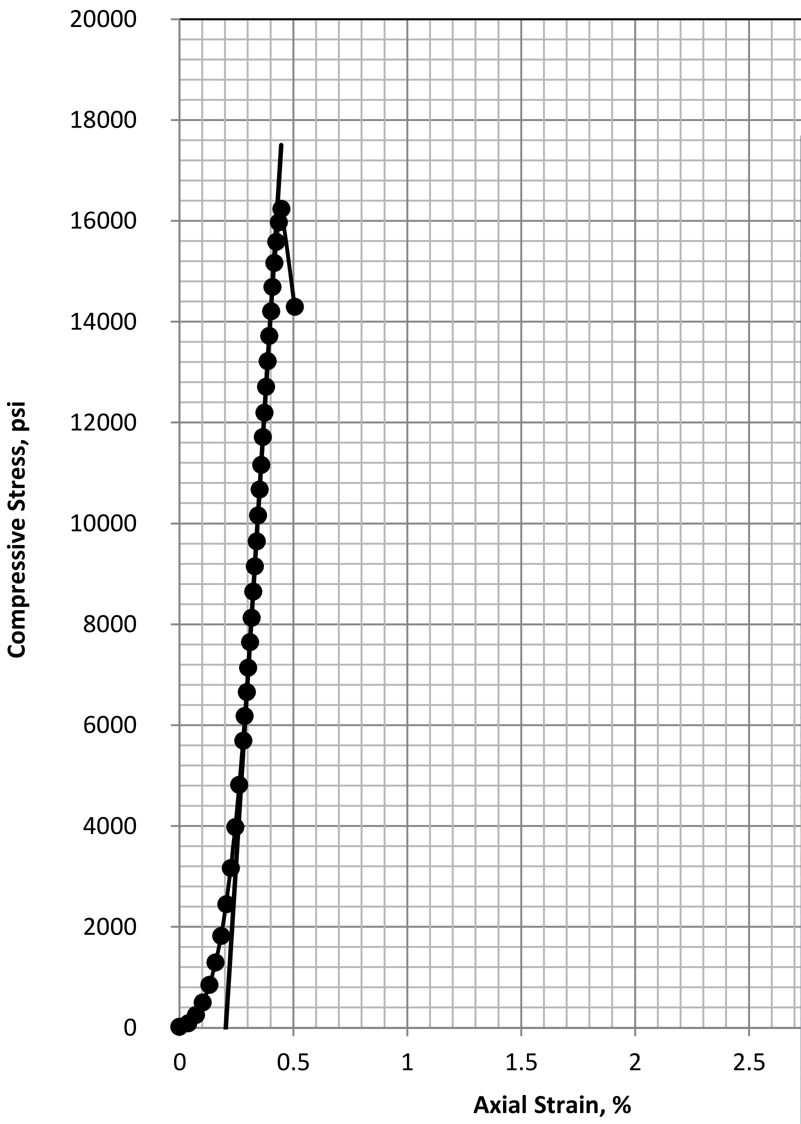
Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.10	0.22	12440	6.16E+06

Test by: DT
Test Date: Aug-21-13
Reviewed by: GET

Langan Project # 170019118	**Hudson Yards Platform**	**COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH TEST**
TerraSense, LLC Project # 7920-351		**Boring: BH-15 Sample: C-4 Depth 30.5-30.9 ft.**

Analysis File: UCrock7rev1 (3/11)

10/1/2013
UCbh15c4.xlsx



FAILURE PHOTO

Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.19	164	164	4.578	1.965

Specimen meets ASTM D4543 shape tolerances

Test Summary

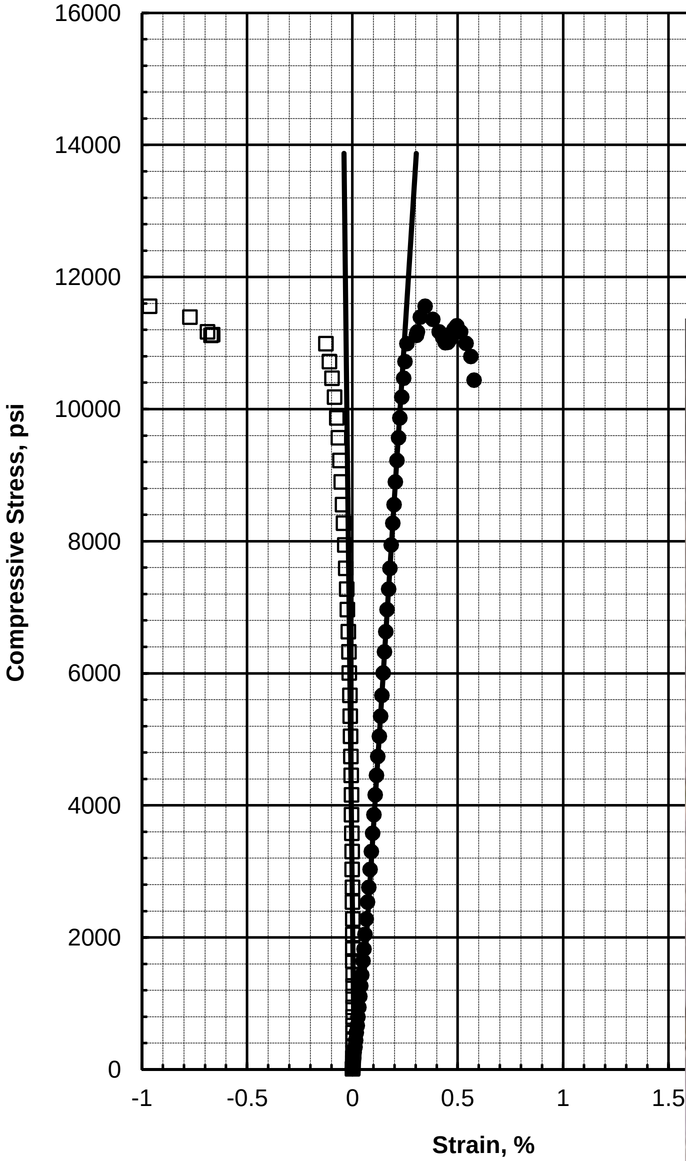
Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.09	0.24	16240	7.19E+06

Test by: DT
Test Date: Aug-21-13
Reviewed by: GET

Langan Project # 170019118	**Hudson Yards Platform**	**COMPRESSIVE STRESS VS STRAIN UNCONFINED COMPRESSIVE STRENGTH TEST**
TerraSense, LLC Project # 7920-351		**Boring: BH-15 Sample: C-8 Depth 48-49 ft.**

Analysis File: UCrock7rev1 (3/11)

10/1/2013
UCbh15c8.xlsx



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.12	163	162	3.923	1.974

Specimen does not meet ASTM D4543 shape tolerances

Test Summary

Strain Rate (%/min)	Strain to Peak (%)	q_u (psi)	Elastic Modulus (psi)	Poisson's Ratio
0.14	0.34	11560	5.02E+06	0.18

Tested by: DT Test Date: Aug-29-13

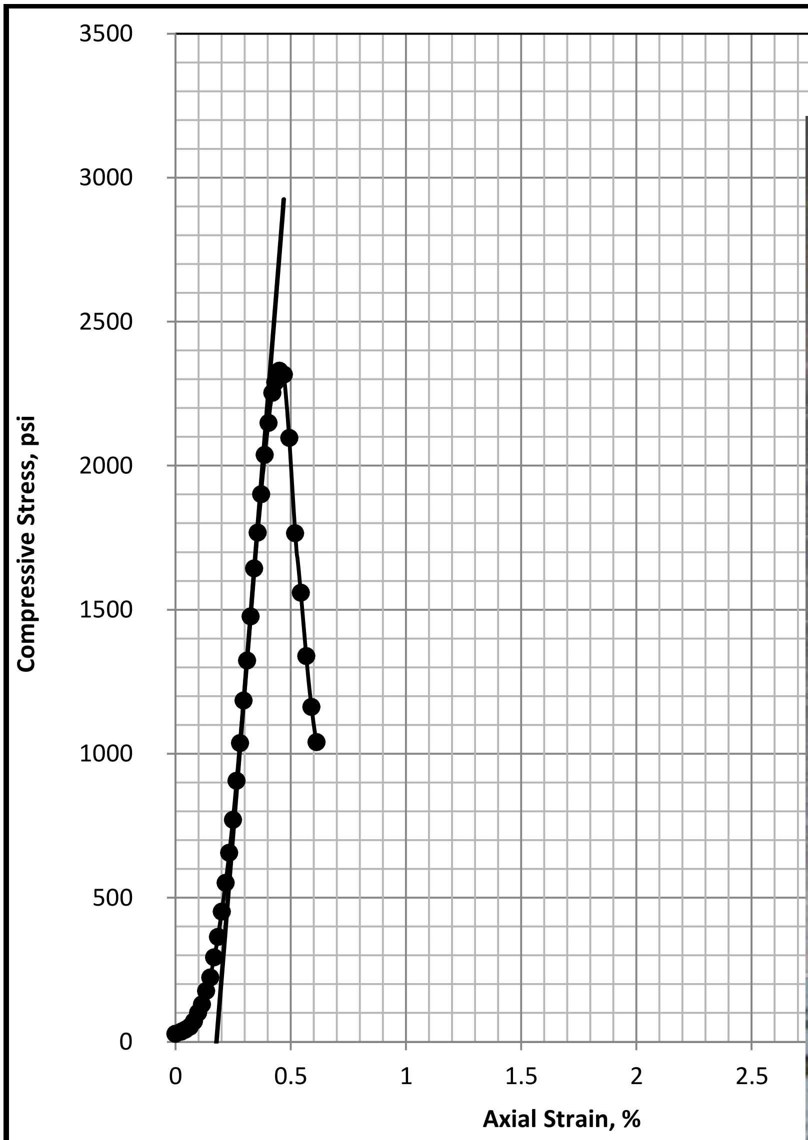
FAILURE PHOTO

Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards Platform

COMPRESSIVE STRESS VS STRAIN
UNCONFINED COMPRESSIVE STRENGTH AND ELASTIC MODULUS TEST
Boring: BH-15 Sample: C-11
Depth 64-65 ft.



Specimen Information

Water Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Length (inch)	Diameter (inch)
0.25	168	168	4.489	1.989

Specimen meets ASTM D4543 shape tolerances

FAILURE PHOTO

Test Summary

Strain Rate (%/min)	Corrected Strain Strain to to Peak (%)	q_u (psi)	Estimated (shown) Elastic Modulus (psi)
0.18	0.27	2330	1.00E+06

Test by: DT
Test Date: Aug-20-13
Reviewed by: GET

Langan
Project # 170019118

TerraSense, LLC
Project # 7920-351

Hudson Yards
Platform

COMPRESSIVE STRESS VS STRAIN
UNCONFINED COMPRESSIVE
STRENGTH TEST

Boring: BH-27 Sample: C-3
Depth 23-24 ft.

Analysis File: UCrock7rev1 (3/11)

10/1/2013
UCbh27c3.xlsx

APPENDIX F
Load Test Results

DEPT OF BLDGS121192618 Job Number ES433834472 Scan Code

DATA REPORT

REPORT ON DRILLED SHAFT LOAD TESTING (OSTERBERG METHOD)

TS-1 - Hudson Yards Tower A
Manhattan, NY (LT-1240-1)

Prepared for: Frontier-Kemper Constructors, Inc.
415 Fifth Avenue
Pelham, NY 10803

Attention: Mr. Paul Dixit, P.E.

PROJECT NO: LT-1240-1, October 01, 2013

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LOADTEST USA
2631-D NW 41st St
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Fax: +1 352 378 3934

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P.O. Box 2863, Dubai, UAE.
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14 Scotts Avenue, Sunbury Upon Thames
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Fax: +44 (0) 1932 784807

Asia
Fugro LOADTEST Singapore Pte. Ltd.
159 Sin Ming Road, #05-07 Amtech Building
Singapore, 575625
Phone: +65 6377 5665
Fax: +65 6377 3359

LOADTEST

October 01, 2013

Frontier-Kemper Constructors, Inc.
415 Fifth Avenue
Pelham, NY 10803

Attention: Mr. Paul Dixit, P.E.

Load Test Report: TS-1 - Hudson Yards Tower A
Location: Manhattan, NY (LT-1240-1)

Dear Mr.Dixit,

The enclosed report contains the data and analysis summary for the Osterberg Cell (O-cell) test performed on TS-1 - Hudson Yards Tower A, on September 25, 2013. For your convenience, we have included an executive summary of the test results in addition to our standard detailed data report.

We would like to express our gratitude for the on-site and off-site assistance provided by your team and we look forward to working with you on future projects.

We trust that the information contained herein will suit your current project needs. If you have any questions or require further technical assistance, please do not hesitate to contact us at 352-378-3717.

Best Regards,

Shing K. Pang, P.E.
Regional Manager, Loadtest USA

TS-1 - Hudson Yards Tower A
Manhattan, NY (LT-1240-1)

EXECUTIVE SUMMARY

On September 25, 2013, Loadtest USA performed an O-cell test on the nominal 36.0-inch diameter test shaft TS-1. Frontier-Kemper Constructors, Inc. completed construction of the 32.95-foot deep shaft socketed in bedrock on September 16, 2013. Sub-surface conditions at the test shaft location consist primarily of overburden underlain by mica schist. Representatives of Langan Engineering Inc. and others observed construction and testing of the shaft.

The maximum sustained bi-directional load applied to the shaft was 5,913 kips. At the maximum load, the displacements above and below the O-cell assembly were 0.477 inches and 0.166 inches, respectively. Unit side shear data indicated a mobilized average net side shear of 146 ksf between the O-cell and the top of concrete. The maximum applied unit end bearing is calculated to be 690 ksf. Unit values correspond to the above respective displacements.

LIMITATIONS OF EXECUTIVE SUMMARY

We include this executive summary to provide a very brief presentation of some of the key elements of this O-cell test. It is by no means intended to be a comprehensive or stand-alone representation of the test results. The full text of the report and the attached appendices contain important information which the engineer can use to come to more informed conclusions about the data presented herein.

TS-1 - Hudson Yards Tower A
Manhattan, NY (LT-1240-1)

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- Test Shaft Construction 1

Osterberg Cell Testing 1

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- Concrete Strength Estimate, Appendix E.

SITE CONDITIONS AND SHAFT CONSTRUCTION

Site Sub-surface Conditions: The sub-surface stratigraphy at the general location of the test shaft is reported to consist of overburden underlain by mica schist. The generalized subsurface profile is included in Figure A and a boring log indicating conditions near the shaft is presented in Appendix D. More detailed geologic information can be obtained from Langan Engineering Inc.

Test Shaft Construction: Frontier-Kemper Constructors, Inc. completed construction of the dedicated test shaft socketed in rock on September 16, 2013. The nominal 36-inch diameter test shaft was excavated to a base elevation of -22.67 ft. The shaft was started by installing a 48-inch O.D. casing, drilling out the overburden and casting a plug of concrete to seal the casing tip. A down-the-hole hammer was used for excavating the rock socket. Note that some groundwater seeped into the excavation during drilling. A mini-SID was used to inspect the shaft base. After the shaft was approved for concrete placement, the carrying frame with attached O-cell assembly was inserted into the excavation and temporarily supported from the steel casing. Concrete was then delivered by pump into the base of the shaft until the top of the concrete reached an elevation of -17.04 ft. Representatives of Langan Engineering Inc. and others observed construction of the shaft.

OSTERBERG CELL TESTING

Shaft Instrumentation: Test shaft instrumentation and assembly was carried out under the direction of Loadtest USA. The loading assembly consisted of one 26-inch diameter O-cell, located 1.33 feet above the shaft base. The Osterberg cell was calibrated to 2,921 kips and then welded closed prior to shipping by American Equipment and Fabricating Corporation. Calibrations of the O-cell and instrumentation used for this test are included in Appendix B. O-cell testing instrumentation included:

- Paired shaft compression telltale casing (nominal ½-inch steel pipe) attached diametrically opposed to the carrying frame, extending from the top of the O-cell assembly to ground level.
- Four Linear Vibrating Wire Displacement Transducers (LVWDTs, Geokon Model 4450 series) positioned between the lower and upper plates of the O-cell assembly.
- Three levels of four sister bar vibrating wire strain gages (Geokon Model 4911 Series) attached at approximately 90° spacing to the carrying frame above the O-cell assembly (see Figure B).

- Two lengths of steel pipe, extending from the top of the shaft to the top of the bottom plate, to vent the break in the shaft formed by the expansion of the O-cell.

Details concerning the instrumentation placement appear in Table B and Figures A & B. The strain gages were positioned as directed by Langan Engineering Inc..

Test Arrangement: Throughout the load test, key elements of shaft displacement response were monitored using the equipment and instruments described herein:

- Top of shaft displacement was monitored using a pair of automated digital survey levels (Leica NA3000 series) from a distance of approximately 22.5 feet (Appendix A, Pages 1 & 2).

- Shaft compression displacement was measured using two ¼-inch telltale rods positioned inside the casing and monitored by LVWDTs attached to the top of the shaft (Appendix A, Pages 1 & 2).

- Expansion of the O-cell assembly was measured using the four Expansion LVWDTs described under Shaft Instrumentation (Appendix A, Pages 3 & 4).

Both a Bourdon pressure gage and a vibrating wire pressure transducer were used to measure the pressure applied to the O-cell at each load interval. The pressure transducer was used for automatically setting and maintaining loads, real time plotting and for data analysis. The Bourdon pressure gage readings were used as a real-time visual reference and as a check on the transducer. There was close agreement between the Bourdon gage and the pressure transducer.

Data Acquisition: All instrumentation were connected through a data logger (Data Electronics 615 GeoLogger) to a laptop computer allowing data to be recorded and stored automatically at 30-second intervals and displayed in real time. The same laptop computer synchronized to the data logging system was used to acquire the Leica NA3000 data.

Testing Procedures: Testing was begun by pressurizing the O-cell in order to break the tack welds that hold it closed (for handling and for placement in the shaft) and to form the fracture plane in the concrete surrounding the base of the O-cell. After the break occurred, the pressure was immediately released and the testing commenced. Zero readings for all instrumentation were taken prior to the preliminary weld-breaking load-unload cycle, which in this case involved a maximum applied load of 463 kips to the shaft at the O-cell elevation.

The Osterberg cell load test was conducted as follows: The 26-inch diameter O-cell, with its base located 1.33 feet above the shaft base, was pressurized in 25 nominally equal increments, resulting in a maximum bi-directional load of 5,913 kips applied to the combined end bearing and lower side shear shaft section below the O-cell and the upper side shear above. The loading was halted after increment 1L-25 because the anticipated ultimate loads had already been exceeded. The O-cell was then de-pressurized in five decrements and the test was concluded.

The load increments were applied using the Quick Load Test Method for Individual Piles (ASTM D1143 *Standard Test Method for Piles Under Static Axial Load*). Each successive load increment was held constant for eight minutes by automatically adjusting the O-cell pressure. Approximately one minute was used to move between increments. The data logger automatically recorded the instrument readings every 30 seconds, but herein only the 1, 2, 4 and 8 minute readings during each increment of maintained load are reported.

TEST RESULTS AND ANALYSES

General: The loads applied by the O-cell assembly act in two opposing directions, resisted by the capacity of the shaft above and below. For the purpose of the analysis herein, it is assumed that the O-cell does not impose an additional upward load until its expansion force exceeds the buoyant weight of the shaft above the O-cell. Therefore, *net load*, which is defined as gross O-cell load minus the buoyant weight of the shaft above, is used to determine side shear resistance above the O-cell and to construct the equivalent top load displacement curve. For this test a shaft buoyant weight of 3 kips above the O-cell was calculated.

Upper Side Shear Resistance: The maximum upward *net load* applied to the upper side shear was 5,910 kips which occurred at load interval 1L-25 (Appendix A, Figures 1 to 3). At this loading, the upward displacement of the top of the O-cell was 0.477 inches.

Combined End Bearing and Lower Side Shear Resistance: The maximum downward load applied was 5,913 kips which occurred at load interval 1L-25 (Appendix A, Figures 1 to 3). At this loading, the average downward displacement of the O-cell base was 0.166 inches.

Strain Gage Analysis: The strain gage data is tabulated in Appendix A. On the day of the test, the unconfined compressive strength f'_c was estimated to be 13,175 psi (see Appendix E). Using the reported concrete unit weight γ_c of 149.2 pcf, the ACI formula ($E_c=0.033 \times \gamma_c^{1.5} \times \sqrt{f'_c}$) was used to calculate an elastic modulus for the concrete. This, combined with the area of reinforcing steel and nominal shaft diameter, provided an average shaft stiffness (AE) of 7,027,000 kips. Figure 4 plots the average strain at each level during the test. Figure 5 plots the total increase in shaft load versus elevation for each load increment. Defining the load transfer zones as shown in Table A and after subtracting the buoyant shaft weight in each zone above the O-cell, Figure 6 plots the net unit side shear versus displacement (t-z) curves for each zone. Shear values for loading increment 1L-25 follow in Table A:

TABLE A: Average Net Unit Side Shear Values for 1L-25

Load Transfer Zone	Displacement[1]	Net Unit Side Shear[2]
Zero Shear to Strain Gage Level 3	↑ 0.46 in	17.2 ksf (28.9 ksf at 1L-17)
Strain Gage Level 3 to Strain Gage Level 2	↑ 0.46 in	220 ksf
Strain Gage Level 2 to Strain Gage Level 1	↑ 0.46 in	179 ksf
Strain Gage Level 1 to O-cell	↑ 0.47 in	115 ksf (117 ksf at 1L-24)
Zero Shear to O-cell (Rock Socket Average)	↑ 0.47 in	146 ksf

[1] Average displacement of load transfer zone. Note that net unit shear values derived from the strain gages may not be ultimate values. See Figures 6 for unit shear vs. displacement plots.

[2] For upward-loaded shear, the buoyant weight of shaft in each zone has been subtracted from the load shed in the respective zone.

The load resisted in side shear in the 1.33-foot shaft section below the O-cell is calculated to be 1,037 kips assuming an interpolated unit side shear value of 82.7 ksf and a nominal shaft diameter of 36 inches. The maximum applied load to end bearing is 4,876 kips and the unit end bearing at the base of the shaft is calculated to be 690 ksf at the above noted displacement. A mobilized unit end bearing curve is presented in Figure 7.

Creep Limit: See Appendix C for our O-cell method for determining creep limit loading. The combined end bearing and lower side shear creep data (Appendix A, Figure C-1) indicate that no apparent creep limit was reached at a maximum displacement of 0.166 inches. The upper side shear creep data (Appendix A, Figure C-2) indicate that no apparent creep limit was reached at a maximum displacement of 0.477 inches. A top loaded shaft will not begin creep until both components begin creep displacement. This will occur at the maximum of the displacements required to reach the creep limit for each component. Due to the absence of a clearly defined shaft component creep limits, a creep limit for the equivalent top-loaded shaft cannot be estimated.

Shaft Compression Comparison: The measured maximum shaft compression, averaged from two telltales, is 0.018 inches at 1L-25 (Appendix A). Using a shaft stiffness of 7,027,000 kips and the load distribution in Figure 5 at 1L-25, an elastic compression of 0.013 inches over the length of the compression telltales is calculated. This agreement provides evidence that the values of the estimated shaft stiffness are reasonable.

LIMITATIONS AND STANDARD OF CARE

The instrumentation, testing services and data analysis provided by Loadtest USA, outlined in this report, were performed in accordance with the accepted standards of care recognized by professionals in the drilled shaft and foundation engineering industry.

Please note that some of the information contained in this report is based on data (i.e. shaft diameter, elevations and concrete strength) provided by others. The engineer, therefore, should come to his or her own conclusions with regard to the analyses as they depend on this information. In particular, Loadtest USA typically does not observe and record drilled shaft construction details to the level of precision that the project engineer may require. In many cases, we may not be present for the entire duration of shaft construction. Since construction technique can play a significant role in determining the load bearing capacity of a drilled shaft, the engineer should pay close attention to the drilled shaft construction details that were recorded elsewhere.

We trust that this information will meet your current project needs. If you have any questions, please do not hesitate to contact us at 352-378-3717.

Prepared for Loadtest USA by

Brian Haney, B.S.C.E.

Reviewed for Loadtest USA by

Shing K. Pang, P.E.

Robert C. Simpson, M.S.

LOADTEST

TABLE B
SUMMARY OF DIMENSIONS, ELEVATIONS & SHAFT PROPERTIES

Shaft: (TS-1 - Hudson Yards Tower A - Manhattan, NY)

Nominal shaft diameter (EL -17.04 ft to -22.67 ft) = 36 in
O-cell: 26H-6-00119 = 26 in
Length of shear zone above break at base of O-cell = 31.62 ft
Length of shear zone below break at base of O-cell = 1.33 ft
Side shear area above O-cell base = 40.5 ft^2
Side shear area below O-cell base = 12.5 ft^2
Shaft base area = 7.1 ft^2
Bouyant weight of shaft above base of O-cell = 3 kips
Estimated shaft stiffness, AE (EL -17.04 ft to -22.67 ft) = 7,027,000 kips

Elevation of ground surface = +10.28 ft
Elevation of water table = -1.00 ft
Elevation of top of shaft concrete = -17.04 ft
Elevation of base of O-cell assembly [1] = -21.34 ft
Elevation of shaft base = -22.67 ft

Casings:

Elevation of top of permanent casing (48.0 in O.D., 47.0 in I.D.) = +13.66 ft
Elevation of bottom of permanent casing (48.0 in O.D., 47.0 in I.D.) = -2.12 ft

Telltale Sections:

Elevation of top of telltale used for shaft compression = +10.28 ft
Elevation of bottom of telltale used for shaft compression = -20.20 ft

Strain Gages:

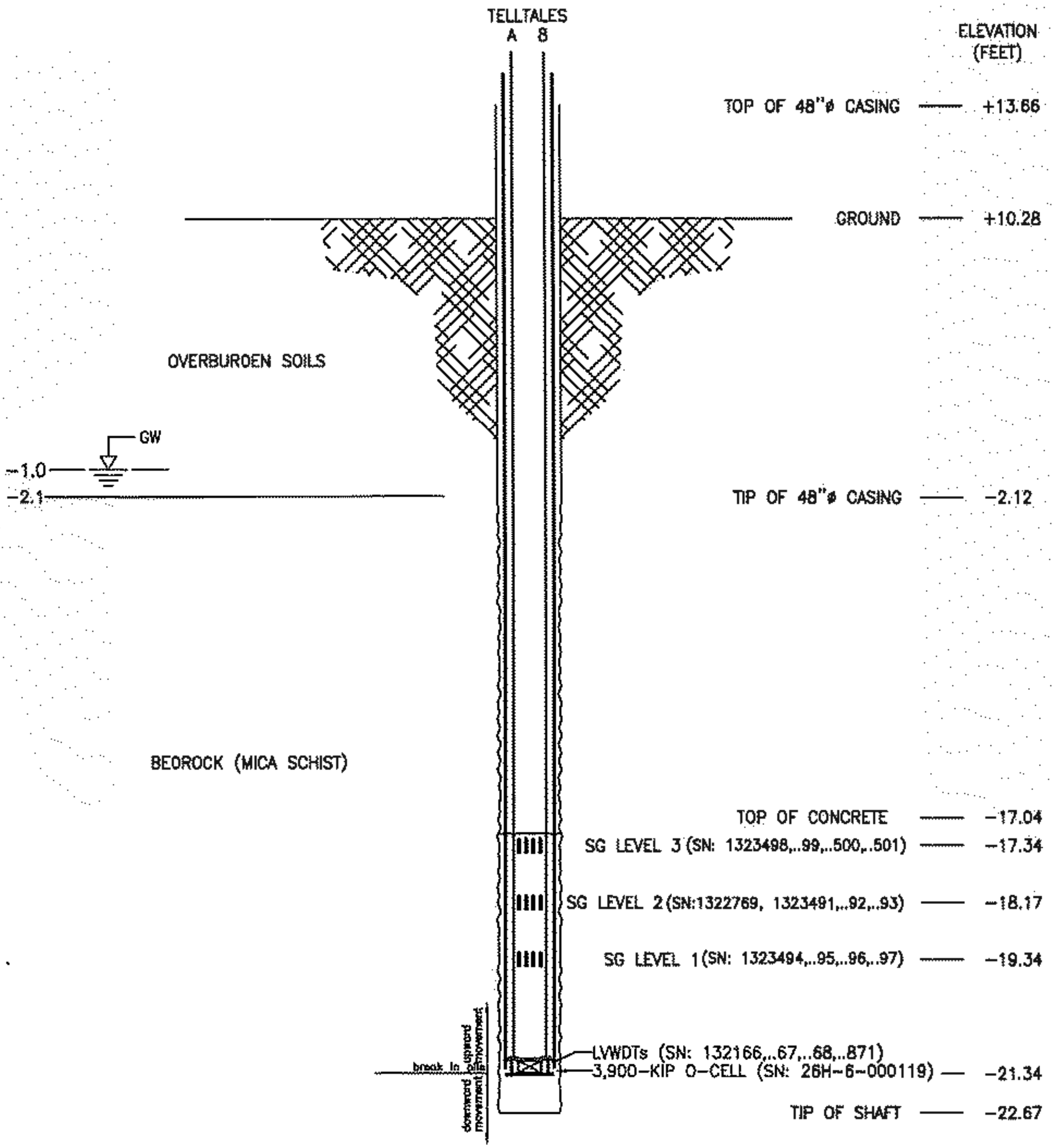
Elevation of Strain Gage Level 3 = -17.34 ft
Elevation of Strain Gage Level 2 = -18.17 ft
Elevation of Strain Gage Level 1 = -19.34 ft

Miscellaneous:

Top plate diameter (2.0 inch thick) = 30 in
Bottom plate diameter (2.0 inch thick) = 30 in
Carrying Frame Section (EL. +19.91 ft to -20.20, 2 No.) = C5x6.7
Estimated 9 day unconfined compressive concrete strength = 13,175 psi
Assumed concrete unit weight = 149.2 pcf
O-cell LVWDTs @ 0°, 90°, 180° and 270° with radius = 14.5 in

[1] The break between upward and downward movement at the O-cell assembly

NOTE: NOMINAL SHAFT DIAMETER 36"ø



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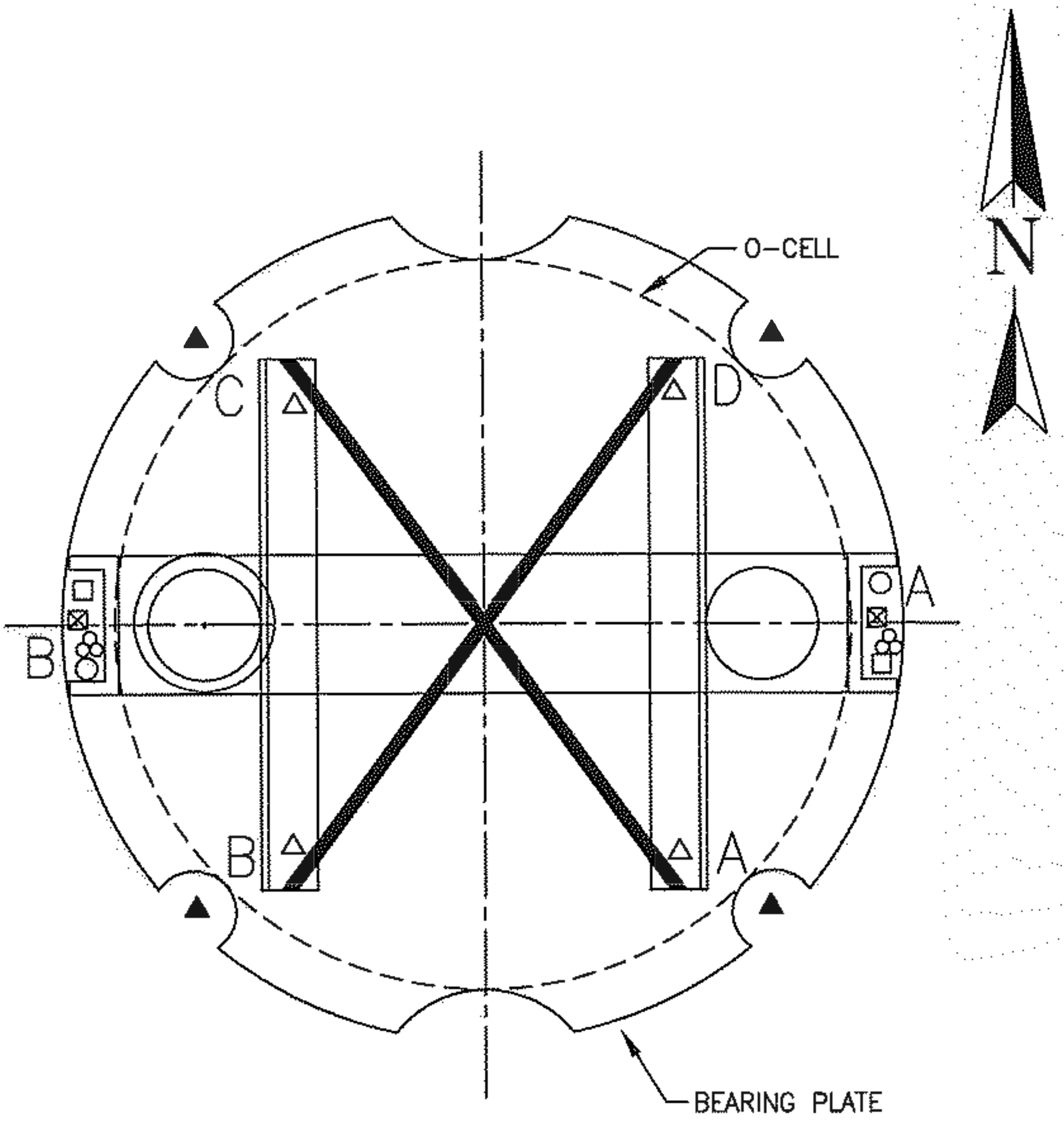
FAX: 352-378-3934

AS BUILT SECTION OF TEST SHAFT #1

Hudson Yards Tower A – Manhattan, NY

DWN BY: SKP	DATE: 17 Jul 2013	CHECKED BY: BDH	LT-1240-1
REVISED BY: AJS	DATE: 30 Sep 2013	SCALE: NTS	**FIGURE A**



LEGEND:

STRAIN GAGE	△
LVWDT	▲
TELLTALE	○
VENT PIPE	□
HYDRAULIC HOSES	☒
CABLE BUNDLE	∴

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Gainesville, FL 32606
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FAX: 352-378-3934

INSTRUMENTATION LAYOUT

Hudson Yards Tower A – Manhattan, NY

DWN BY: AJS	DATE: 30 Sep 2013	CHECKED BY: SKP	LT-1240-1
REVISED BY:	DATE:	SCALE: NTS	**FIGURE B**

Osterberg Cell Load-Displacement

TS-1 - Hudson Yards Tower A - Manhattan, NY

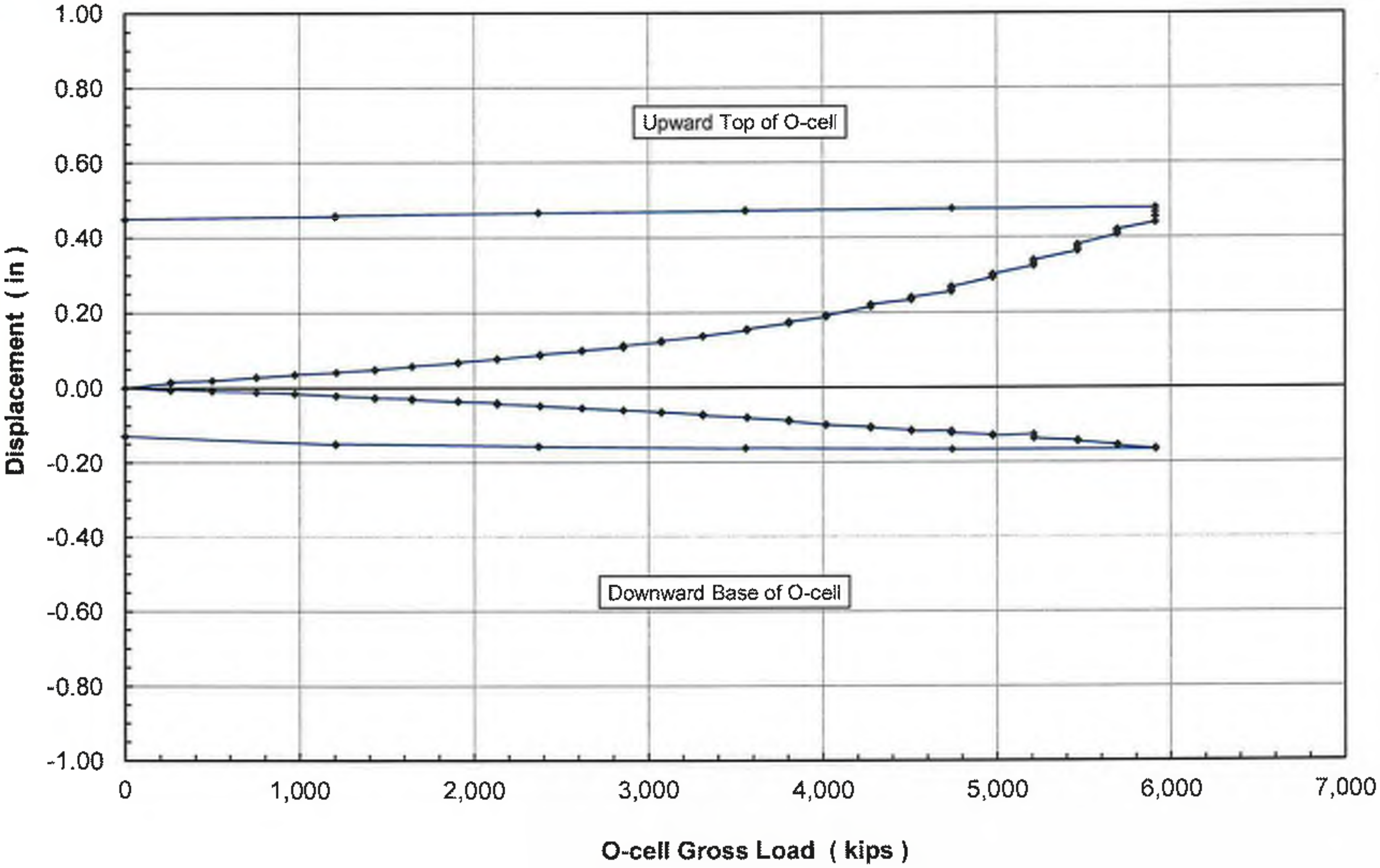

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Figure 1 of 7

LOADTEST

Time-Osterberg Cell Load

TS-1 - Hudson Yards Tower A - Manhattan, NY

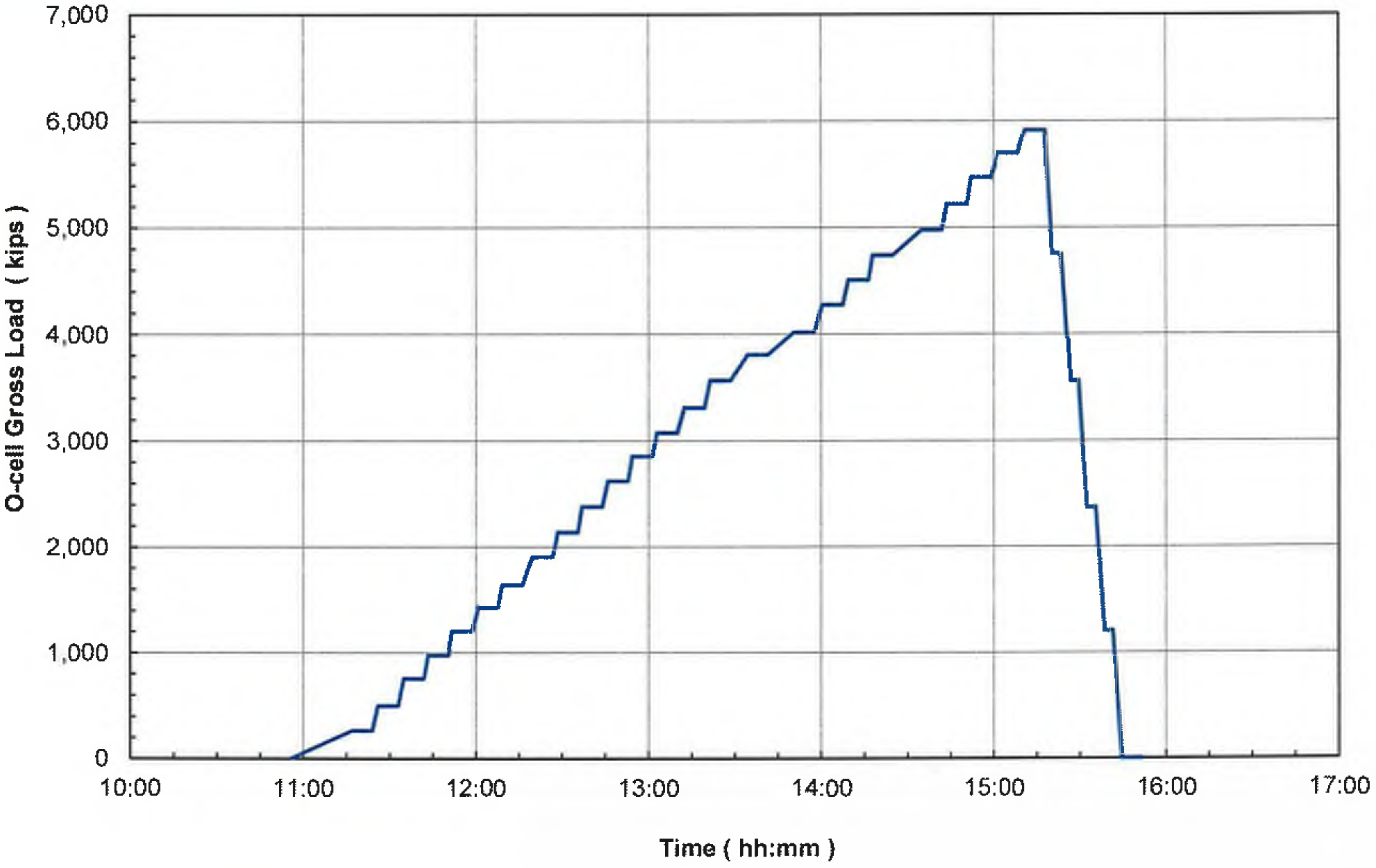

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Figure 2 of 7

Time-Osterberg Cell Displacement

TS-1 - Hudson Yards Tower A - Manhattan, NY

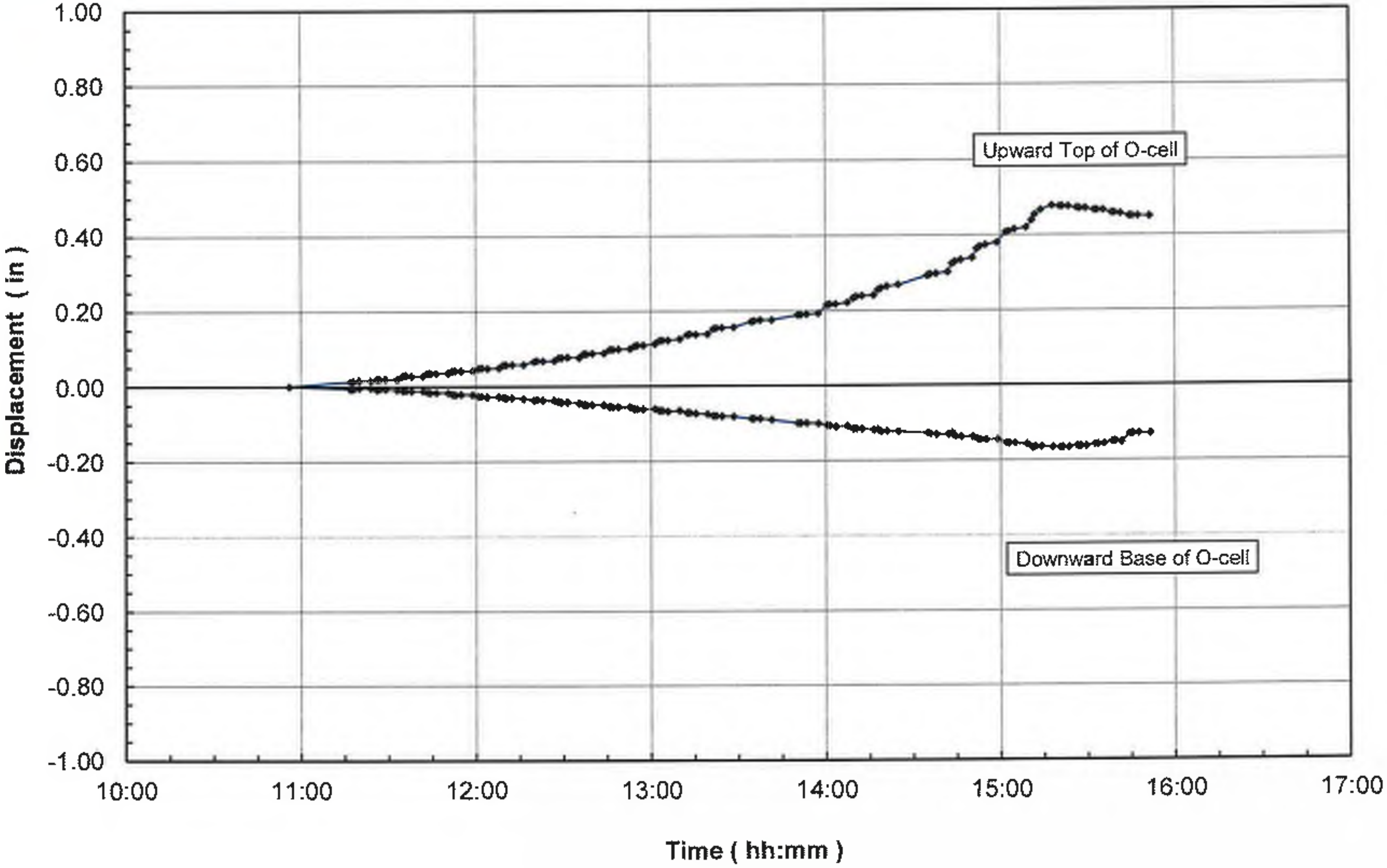

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Figure 3 of 7

O-cell Load-Strain Gage Microstrain

TS-1 - Hudson Yards Tower A - Manhattan, NY

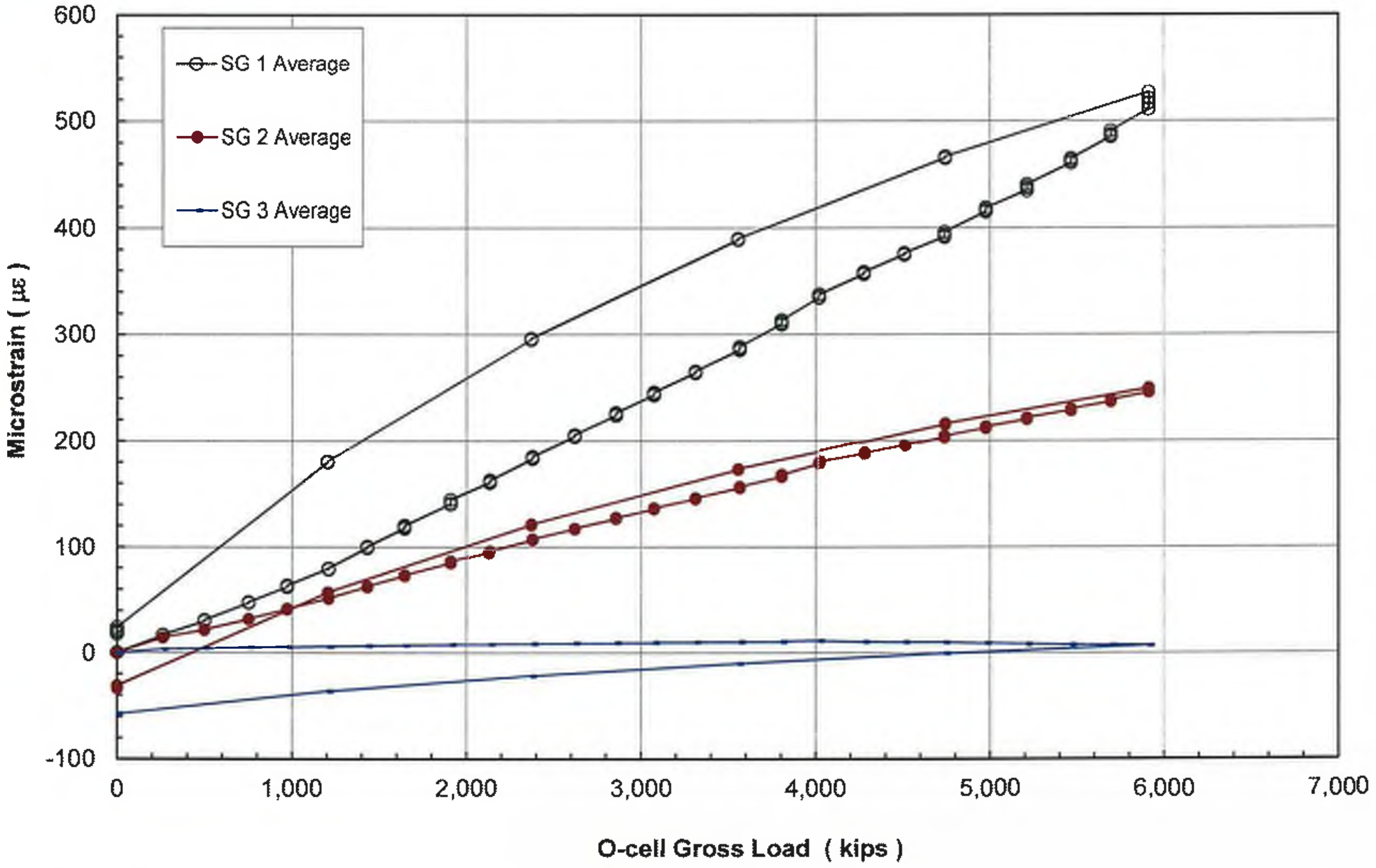

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Figure 4 of 7

Strain Gage Load Distribution

TS-1 - Hudson Yards Tower A - Manhattan, NY

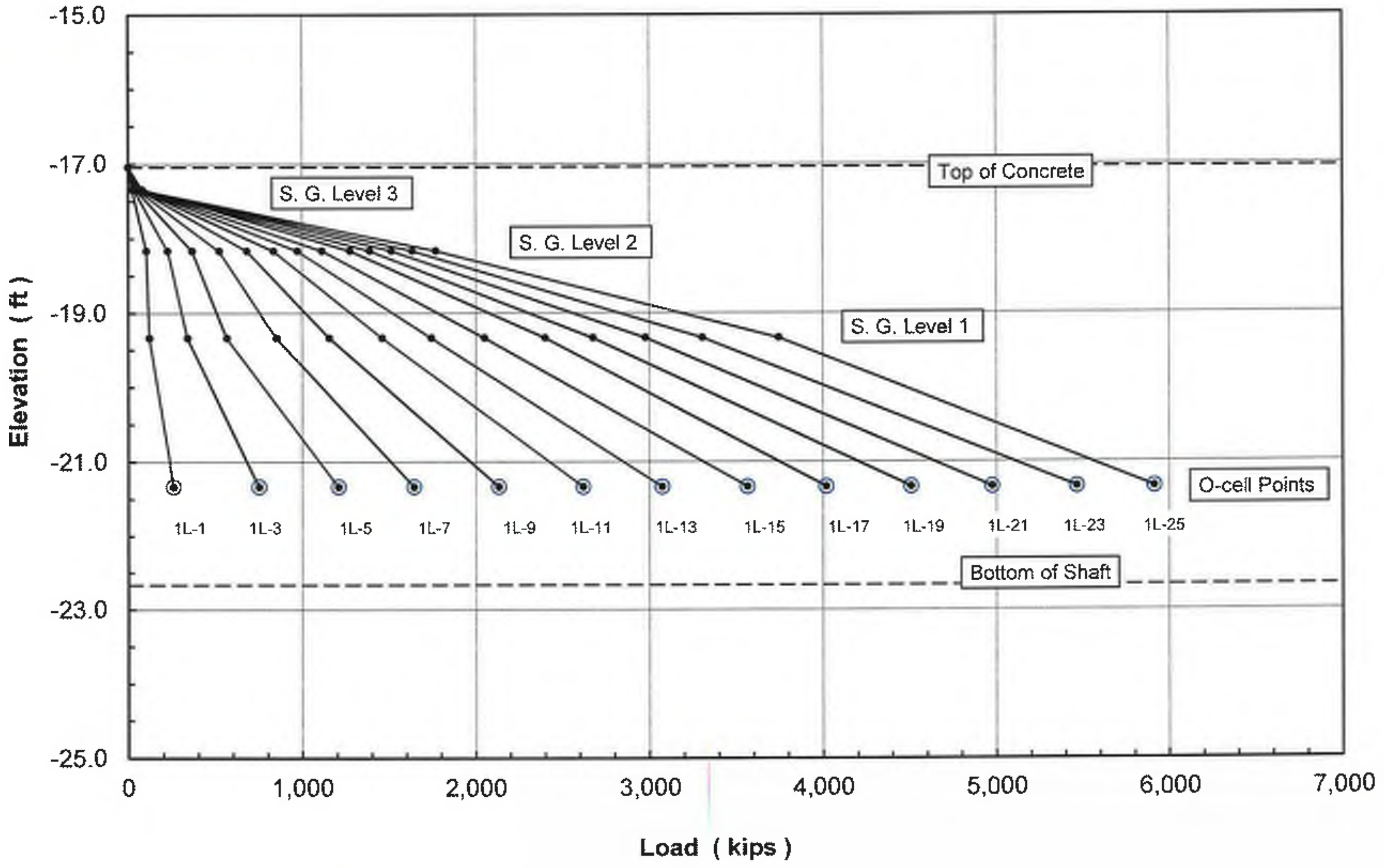

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Figure 5 of 7

Mobilized Upward Unit Side Shear

TS-1 - Hudson Yards Tower A - Manhattan, NY

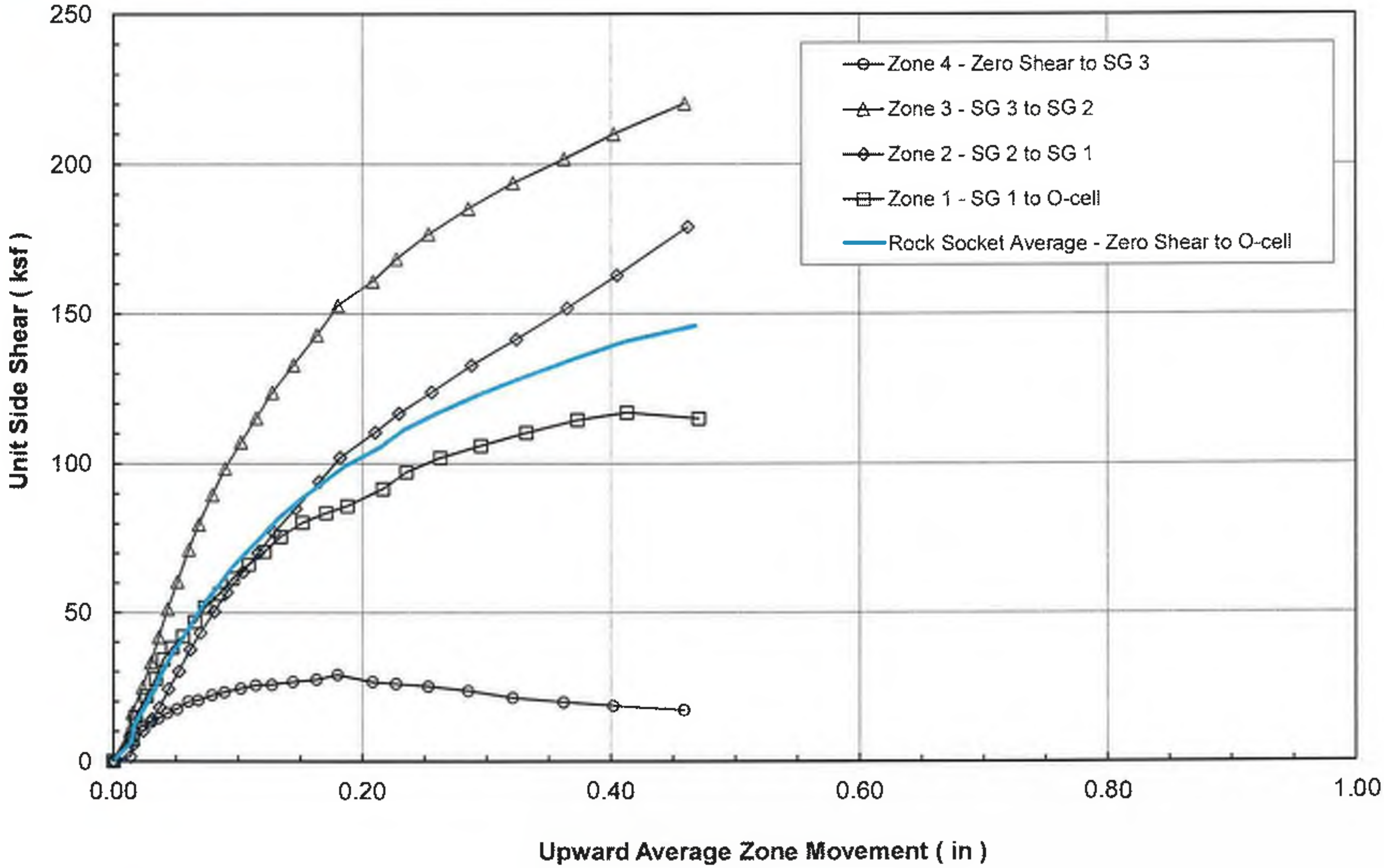

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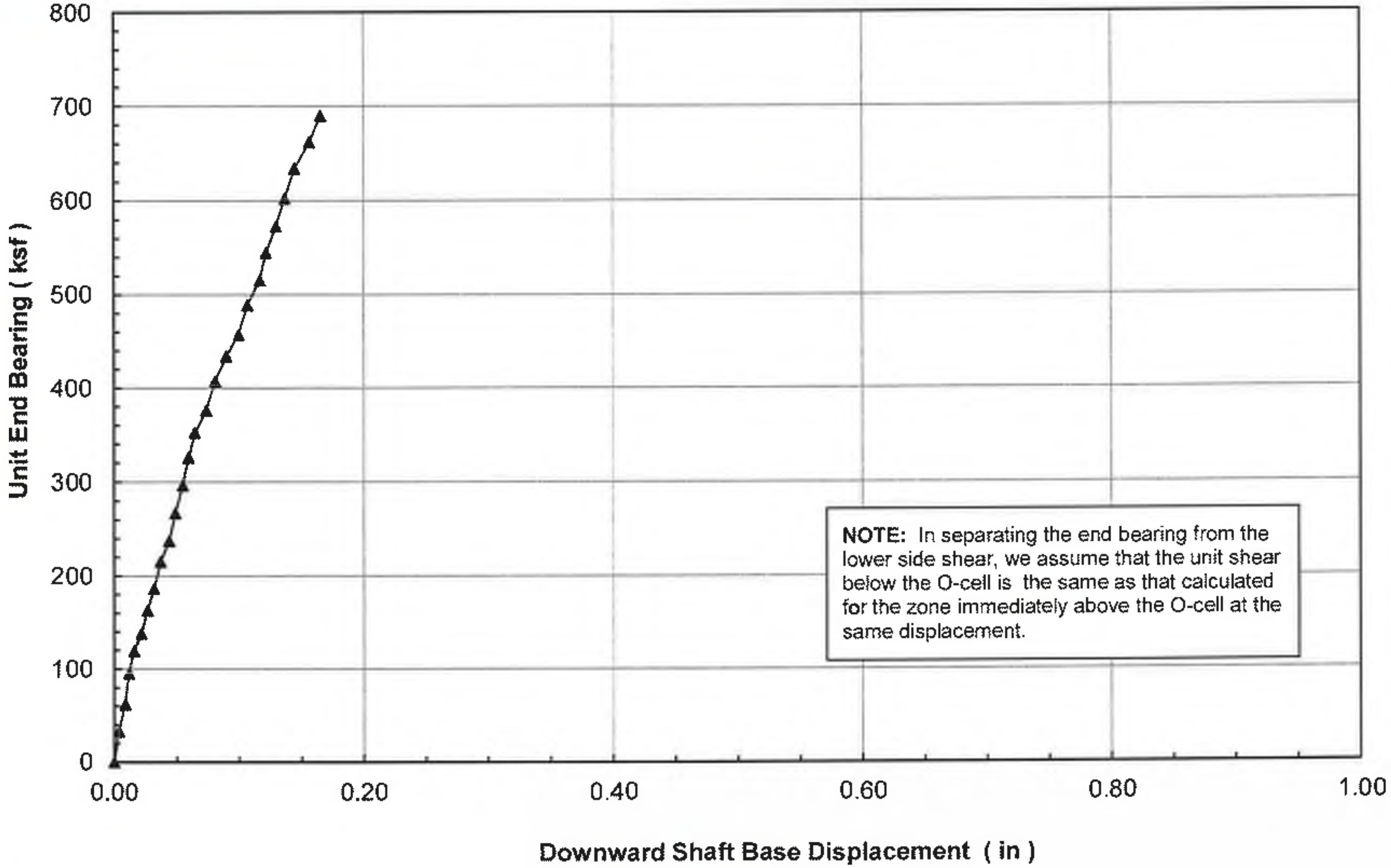
Figure 6 of 7

Mobilized Unit End Bearing

TS-1 - Hudson Yards Tower A - Manhattan, NY



NOTE: In separating the end bearing from the lower side shear, we assume that the unit shear below the O-cell is the same as that calculated for the zone immediately above the O-cell at the same displacement.

Loadtest USA Project No. LT-1240-1

Figure 7 of 7

APPENDIX A

FIELD DATA & DATA REDUCTION

LOADTEST

Upward Top of Shaft Movement and Upper Shaft Compression
TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Top of Shaft			Upper Compression Telltales		
			Pressure (psi)	Load (kips)	A-NA3000 (in)	C-NA3000 (in)	Average (in)	A-134998 (in)	C-134999 (in)	Average (in)
1 L - 0	-	10:56:00	0	0	0.000	0.000	0.000	0.000	0.000	0.000
1 L - 1	1	11:17:00	650	261	0.011	0.012	0.011	0.003	0.002	0.002
1 L - 1	2	11:18:00	650	261	0.012	0.012	0.012	0.003	0.002	0.002
1 L - 1	4	11:20:00	650	261	0.012	0.013	0.013	0.003	0.002	0.003
1 L - 1	8	11:24:00	650	261	0.012	0.014	0.013	0.003	0.002	0.003
1 L - 2	1	11:26:00	1,260	498	0.015	0.017	0.016	0.004	0.003	0.003
1 L - 2	2	11:27:00	1,260	498	0.015	0.017	0.016	0.004	0.003	0.004
1 L - 2	4	11:29:00	1,260	498	0.015	0.017	0.016	0.004	0.003	0.004
1 L - 2	8	11:33:00	1,260	498	0.014	0.016	0.015	0.004	0.004	0.004
1 L - 3	1	11:35:00	1,910	751	0.022	0.023	0.023	0.005	0.004	0.005
1 L - 3	2	11:36:00	1,910	751	0.023	0.025	0.024	0.005	0.004	0.005
1 L - 3	4	11:38:00	1,910	751	0.022	0.023	0.023	0.005	0.004	0.005
1 L - 3	8	11:42:00	1,910	751	0.022	0.025	0.023	0.006	0.004	0.005
1 L - 4	1	11:43:30	2,480	972	0.029	0.029	0.029	0.007	0.004	0.006
1 L - 4	2	11:44:30	2,480	972	0.028	0.029	0.029	0.008	0.004	0.006
1 L - 4	4	11:46:30	2,480	972	0.028	0.030	0.029	0.008	0.004	0.006
1 L - 4	8	11:50:30	2,480	972	0.029	0.031	0.030	0.007	0.004	0.006
1 L - 5	1	11:52:00	3,090	1,209	0.034	0.036	0.035	0.008	0.004	0.006
1 L - 5	2	11:53:00	3,090	1,209	0.035	0.036	0.035	0.008	0.004	0.006
1 L - 5	4	11:55:00	3,090	1,209	0.035	0.038	0.036	0.008	0.004	0.006
1 L - 5	8	11:59:00	3,090	1,209	0.035	0.037	0.036	0.008	0.004	0.006
1 L - 6	1	12:01:00	3,660	1,431	0.040	0.043	0.041	0.009	0.005	0.007
1 L - 6	2	12:02:00	3,660	1,431	0.041	0.044	0.042	0.009	0.005	0.007
1 L - 6	4	12:04:00	3,660	1,431	0.041	0.044	0.042	0.009	0.004	0.006
1 L - 6	8	12:08:00	3,660	1,431	0.042	0.045	0.043	0.008	0.005	0.006
1 L - 7	1	12:09:30	4,210	1,645	0.049	0.051	0.050	0.010	0.005	0.007
1 L - 7	2	12:10:30	4,210	1,645	0.049	0.052	0.050	0.009	0.005	0.007
1 L - 7	4	12:12:30	4,210	1,645	0.049	0.053	0.051	0.010	0.005	0.007
1 L - 7	8	12:16:30	4,210	1,645	0.050	0.053	0.051	0.010	0.005	0.007
1 L - 8	1	12:20:00	4,890	1,909	0.057	0.059	0.058	0.010	0.006	0.008
1 L - 8	2	12:21:00	4,890	1,909	0.059	0.061	0.060	0.011	0.006	0.008
1 L - 8	4	12:23:00	4,890	1,909	0.058	0.061	0.059	0.011	0.005	0.008
1 L - 8	8	12:27:00	4,890	1,909	0.058	0.062	0.060	0.011	0.005	0.008
1 L - 9	1	12:28:30	5,470	2,134	0.066	0.069	0.067	0.012	0.006	0.009
1 L - 9	2	12:29:30	5,470	2,134	0.066	0.069	0.067	0.012	0.005	0.009
1 L - 9	4	12:31:30	5,470	2,134	0.068	0.070	0.069	0.012	0.005	0.008
1 L - 9	8	12:35:30	5,470	2,134	0.066	0.070	0.068	0.012	0.005	0.008
1 L - 10	1	12:37:00	6,100	2,379	0.075	0.079	0.077	0.012	0.006	0.009
1 L - 10	2	12:38:00	6,100	2,379	0.075	0.080	0.077	0.013	0.006	0.009
1 L - 10	4	12:40:00	6,100	2,379	0.076	0.080	0.078	0.012	0.006	0.009
1 L - 10	8	12:44:00	6,100	2,379	0.078	0.080	0.079	0.012	0.006	0.009
1 L - 11	1	12:46:00	6,720	2,620	0.085	0.090	0.088	0.013	0.006	0.009
1 L - 11	2	12:47:00	6,720	2,620	0.087	0.089	0.088	0.012	0.006	0.009
1 L - 11	4	12:49:00	6,720	2,620	0.087	0.090	0.088	0.013	0.006	0.010
1 L - 11	8	12:53:00	6,720	2,620	0.088	0.091	0.089	0.013	0.007	0.010
1 L - 12	1	12:54:30	7,330	2,857	0.096	0.099	0.097	0.013	0.007	0.010
1 L - 12	2	12:55:30	7,330	2,857	0.096	0.101	0.099	0.013	0.007	0.010
1 L - 12	4	12:57:30	7,330	2,857	0.098	0.101	0.099	0.013	0.007	0.010
1 L - 12	8	13:01:30	7,330	2,857	0.099	0.104	0.102	0.013	0.007	0.010
1 L - 13	1	13:03:00	7,890	3,075	0.108	0.112	0.110	0.013	0.008	0.011
1 L - 13	2	13:04:00	7,890	3,075	0.109	0.114	0.111	0.013	0.008	0.011
1 L - 13	4	13:06:00	7,890	3,075	0.109	0.113	0.111	0.013	0.008	0.011
1 L - 13	8	13:10:00	7,890	3,075	0.113	0.115	0.114	0.014	0.008	0.011
1 L - 14	1	13:12:30	8,500	3,312	0.123	0.126	0.124	0.015	0.009	0.012
1 L - 14	2	13:13:30	8,500	3,312	0.125	0.128	0.127	0.014	0.009	0.011
1 L - 14	4	13:15:30	8,500	3,312	0.125	0.127	0.126	0.014	0.008	0.011
1 L - 14	8	13:19:30	8,500	3,312	0.126	0.128	0.127	0.015	0.008	0.011
1 L - 15	1	13:21:30	9,150	3,565	0.139	0.142	0.140	0.016	0.009	0.012
1 L - 15	2	13:22:30	9,150	3,565	0.140	0.144	0.142	0.015	0.009	0.012
1 L - 15	4	13:24:30	9,150	3,565	0.141	0.145	0.143	0.015	0.009	0.012
1 L - 15	8	13:28:30	9,150	3,565	0.142	0.146	0.144	0.015	0.009	0.012
1 L - 16	1	13:34:30	9,770	3,806	0.158	0.160	0.159	0.015	0.009	0.012
1 L - 16	2	13:35:30	9,770	3,806	0.159	0.163	0.161	0.015	0.009	0.012
1 L - 16	4	13:37:30	9,770	3,806	0.161	0.165	0.163	0.015	0.009	0.012
1 L - 16	8	13:41:30	9,770	3,806	0.161	0.165	0.163	0.015	0.009	0.012

Upward Top of Shaft Movement and Upper Shaft Compression
TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Top of Shaft			Upper Compression Telltales		
			Pressure (psi)	Load (kips)	A-NA3000 (in)	C-NA3000 (in)	Average (in)	A-134998 (in)	C-134999 (in)	Average (in)
1 L - 17	1	13:50:30	10,320	4,020	0.174	0.178	0.176	0.015	0.009	0.012
1 L - 17	2	13.51:30	10,320	4,020	0.176	0.179	0.177	0.015	0.009	0.012
1 L - 17	4	13:53:30	10,320	4,020	0.176	0.180	0.178	0.015	0.009	0.012
1 L - 17	8	13:57:30	10,320	4,020	0.179	0.182	0.180	0.015	0.009	0.012
1 L - 18	1	14:00:30	10,980	4,276	0.200	0.204	0.202	0.016	0.010	0.013
1 L - 18	2	14:01:30	10,980	4,276	0.201	0.204	0.203	0.016	0.010	0.013
1 L - 18	4	14:03:30	10,980	4,276	0.203	0.206	0.204	0.016	0.010	0.013
1 L - 18	8	14:07:30	10,980	4,276	0.205	0.210	0.208	0.016	0.010	0.013
1 L - 19	1	14:09:30	11,580	4,509	0.219	0.222	0.220	0.016	0.010	0.013
1 L - 19	2	14:10:30	11,580	4,509	0.222	0.226	0.224	0.016	0.010	0.013
1 L - 19	4	14:12:30	11,580	4,509	0.224	0.228	0.226	0.016	0.010	0.013
1 L - 19	8	14:16:30	11,580	4,509	0.225	0.230	0.227	0.016	0.010	0.013
1 L - 20	1	14:18:00	12,170	4,739	0.238	0.244	0.241	0.017	0.011	0.014
1 L - 20	2	14:19:00	12,170	4,739	0.242	0.246	0.245	0.017	0.011	0.014
1 L - 20	4	14:21:00	12,170	4,739	0.247	0.253	0.250	0.018	0.011	0.014
1 L - 20	8	14:25:00	12,170	4,739	0.251	0.254	0.252	0.018	0.011	0.015
1 L - 21	1	14:35:00	12,780	4,976	0.274	0.278	0.276	0.020	0.012	0.016
1 L - 21	2	14:36:00	12,780	4,976	0.276	0.282	0.279	0.020	0.012	0.016
1 L - 21	4	14:38:00	12,780	4,976	0.280	0.283	0.281	0.020	0.012	0.016
1 L - 21	8	14:42:00	12,780	4,976	0.283	0.287	0.285	0.020	0.012	0.016
1 L - 22	1	14:43:30	13,390	5,213	0.304	0.308	0.306	0.021	0.013	0.017
1 L - 22	2	14:44:30	13,390	5,213	0.308	0.314	0.311	0.021	0.013	0.017
1 L - 22	4	14:46:30	13,390	5,213	0.313	0.319	0.316	0.021	0.013	0.017
1 L - 22	8	14:50:30	13,390	5,213	0.320	0.323	0.321	0.021	0.013	0.017
1 L - 23	1	14:52:00	14,040	5,466	0.343	0.347	0.345	0.022	0.013	0.017
1 L - 23	2	14:53:00	14,040	5,466	0.348	0.354	0.351	0.022	0.013	0.017
1 L - 23	4	14:55:00	14,040	5,466	0.354	0.358	0.356	0.021	0.013	0.017
1 L - 23	8	14:59:00	14,040	5,466	0.360	0.364	0.362	0.020	0.013	0.017
1 L - 24	1	15:02:00	14,630	5,695	0.386	0.391	0.389	0.020	0.013	0.017
1 L - 24	2	15:03:00	14,630	5,695	0.389	0.394	0.392	0.020	0.013	0.017
1 L - 24	4	15:05.00	14,630	5,695	0.394	0.400	0.397	0.020	0.014	0.017
1 L - 24	8	15:09:00	14,630	5,695	0.399	0.404	0.402	0.020	0.014	0.017
1 L - 25	1	15:11:00	15,190	5,913	0.418	0.423	0.421	0.020	0.014	0.017
1 L - 25	2	15:12:00	15,190	5,913	0.437	0.436	0.435	0.021	0.015	0.018
1 L - 25	4	15:14:00	15,190	5,913	0.446	0.450	0.448	0.021	0.015	0.018
1 L - 25	8	15:18:00	15,190	5,913	0.457	0.460	0.459	0.020	0.015	0.018
1 U - 1	1	15:20:30	12,180	4,743	0.456	0.460	0.458	0.019	0.014	0.017
1 U - 1	2	15:21:30	12,180	4,743	0.455	0.460	0.458	0.019	0.014	0.017
1 U - 1	4	15:23:30	12,180	4,743	0.455	0.460	0.458	0.019	0.014	0.017
1 U - 2	1	15:26:30	9,130	3,557	0.454	0.458	0.456	0.017	0.013	0.015
1 U - 2	2	15:27:30	9,130	3,557	0.453	0.457	0.455	0.017	0.012	0.015
1 U - 2	4	15:29:30	9,130	3,557	0.452	0.457	0.455	0.017	0.012	0.015
1 U - 3	1	15:32:30	6,080	2,371	0.451	0.455	0.453	0.015	0.010	0.012
1 U - 3	2	15:33:30	6,080	2,371	0.451	0.454	0.453	0.015	0.010	0.012
1 U - 3	4	15:35:30	6,080	2,371	0.450	0.455	0.453	0.014	0.010	0.012
1 U - 4	1	15.38.30	3,080	1,205	0.448	0.452	0.449	0.011	0.006	0.009
1 U - 4	2	15:39:30	3,080	1,205	0.447	0.452	0.450	0.011	0.006	0.008
1 U - 4	4	15:41.30	3,080	1,205	0.446	0.451	0.448	0.011	0.006	0.008
1 U - 5	1	15:44.30	0	0	0.443	0.446	0.445	0.006	0.001	0.004
1 U - 5	2	15:45:30	0	0	0.442	0.447	0.445	0.006	0.002	0.004
1 U - 5	4	15:47:30	0	0	0.442	0.447	0.445	0.006	0.002	0.004
1 U - 5	8	15:51:30	0	0	0.442	0.446	0.444	0.006	0.002	0.004

LOADTEST

O-cell Expansion

TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell Pressure (psi)	O-cell Load (kips)	O-cell Expansion A-1321766 (in)	B-1321767 (in)	C-1321768 (in)	D-1321671 (in)	Average (in)
1 L - 0	-	10:56:00	0	0	0.000	0.000	0.000	0.000	0.000
1 L - 1	1	11:17:00	650	261	0.020	0.027	0.018	0.014	0.020
1 L - 1	2	11:18:00	650	261	0.021	0.027	0.018	0.015	0.020
1 L - 1	4	11:20:00	650	261	0.021	0.027	0.018	0.014	0.020
1 L - 1	8	11:24:00	650	261	0.021	0.027	0.018	0.015	0.020
1 L - 2	1	11:26:00	1,260	498	0.028	0.034	0.024	0.021	0.027
1 L - 2	2	11:27:00	1,260	498	0.029	0.034	0.024	0.021	0.027
1 L - 2	4	11:29:00	1,260	498	0.029	0.034	0.024	0.021	0.027
1 L - 2	8	11:33:00	1,260	498	0.029	0.035	0.024	0.021	0.026
1 L - 3	1	11:35:00	1,910	751	0.043	0.047	0.035	0.032	0.039
1 L - 3	2	11:36:00	1,910	751	0.044	0.048	0.035	0.033	0.040
1 L - 3	4	11:38:00	1,910	751	0.044	0.048	0.035	0.033	0.040
1 L - 3	8	11:42:00	1,910	751	0.045	0.048	0.035	0.033	0.040
1 L - 4	1	11:43:30	2,480	972	0.056	0.055	0.044	0.042	0.050
1 L - 4	2	11:44:30	2,480	972	0.057	0.059	0.045	0.042	0.051
1 L - 4	4	11:46:30	2,480	972	0.057	0.059	0.045	0.043	0.051
1 L - 4	8	11:50:30	2,480	972	0.058	0.060	0.045	0.043	0.052
1 L - 5	1	11:52:00	3,090	1,209	0.070	0.071	0.054	0.053	0.062
1 L - 5	2	11:53:00	3,090	1,209	0.071	0.071	0.055	0.053	0.063
1 L - 5	4	11:55:00	3,090	1,209	0.071	0.072	0.055	0.054	0.063
1 L - 5	8	11:59:00	3,090	1,209	0.072	0.072	0.056	0.054	0.064
1 L - 6	1	12:01:00	3,660	1,431	0.084	0.084	0.065	0.064	0.074
1 L - 6	2	12:02:00	3,660	1,431	0.085	0.085	0.066	0.065	0.075
1 L - 6	4	12:04:00	3,660	1,431	0.086	0.085	0.066	0.065	0.076
1 L - 6	8	12:08:00	3,660	1,431	0.087	0.086	0.067	0.066	0.076
1 L - 7	1	12:09:30	4,210	1,645	0.098	0.097	0.075	0.075	0.086
1 L - 7	2	12:10:30	4,210	1,645	0.100	0.098	0.077	0.076	0.088
1 L - 7	4	12:12:30	4,210	1,645	0.101	0.099	0.077	0.077	0.088
1 L - 7	8	12:16:30	4,210	1,645	0.102	0.100	0.078	0.078	0.090
1 L - 8	1	12:20:00	4,890	1,909	0.116	0.114	0.090	0.090	0.103
1 L - 8	2	12:21:00	4,890	1,909	0.117	0.115	0.090	0.091	0.103
1 L - 8	4	12:23:00	4,890	1,909	0.118	0.116	0.091	0.092	0.104
1 L - 8	8	12:27:00	4,890	1,909	0.120	0.116	0.093	0.093	0.105
1 L - 9	1	12:28:30	5,470	2,134	0.132	0.128	0.102	0.103	0.116
1 L - 9	2	12:29:30	5,470	2,134	0.134	0.130	0.104	0.105	0.118
1 L - 9	4	12:31:30	5,470	2,134	0.135	0.131	0.104	0.105	0.119
1 L - 9	8	12:35:30	5,470	2,134	0.136	0.132	0.105	0.107	0.120
1 L - 10	1	12:37:00	6,100	2,379	0.152	0.147	0.118	0.119	0.134
1 L - 10	2	12:38:00	6,100	2,379	0.153	0.148	0.118	0.120	0.135
1 L - 10	4	12:40:00	6,100	2,379	0.154	0.149	0.119	0.121	0.136
1 L - 10	8	12:44:00	6,100	2,379	0.155	0.151	0.120	0.123	0.137
1 L - 11	1	12:46:00	6,720	2,620	0.170	0.165	0.133	0.135	0.151
1 L - 11	2	12:47:00	6,720	2,620	0.171	0.166	0.134	0.136	0.152
1 L - 11	4	12:49:00	6,720	2,620	0.172	0.167	0.135	0.137	0.153
1 L - 11	8	12:53:00	6,720	2,620	0.173	0.168	0.136	0.138	0.154
1 L - 12	1	12:54:30	7,330	2,857	0.187	0.181	0.148	0.150	0.167
1 L - 12	2	12:55:30	7,330	2,857	0.190	0.184	0.150	0.152	0.169
1 L - 12	4	12:57:30	7,330	2,857	0.192	0.186	0.150	0.154	0.170
1 L - 12	8	13:01:30	7,330	2,857	0.194	0.188	0.152	0.156	0.172
1 L - 13	1	13:03:00	7,890	3,075	0.208	0.202	0.164	0.169	0.186
1 L - 13	2	13:04:00	7,890	3,075	0.210	0.203	0.166	0.170	0.187
1 L - 13	4	13:06:00	7,890	3,075	0.211	0.205	0.167	0.171	0.189
1 L - 13	8	13:10:00	7,890	3,075	0.213	0.207	0.168	0.172	0.190
1 L - 14	1	13:12:30	8,500	3,312	0.231	0.224	0.185	0.189	0.207
1 L - 14	2	13:13:30	8,500	3,312	0.232	0.226	0.186	0.190	0.209
1 L - 14	4	13:15:30	8,500	3,312	0.234	0.226	0.187	0.191	0.210
1 L - 14	8	13:19:30	8,500	3,312	0.236	0.229	0.190	0.193	0.212
1 L - 15	1	13:21:30	9,150	3,565	0.257	0.250	0.207	0.212	0.231
1 L - 15	2	13:22:30	9,150	3,565	0.259	0.252	0.209	0.213	0.233
1 L - 15	4	13:24:30	9,150	3,565	0.261	0.254	0.210	0.215	0.235
1 L - 15	8	13:28:30	9,150	3,565	0.263	0.256	0.212	0.217	0.237
1 L - 16	1	13:34:30	9,770	3,806	0.286	0.278	0.232	0.237	0.258
1 L - 16	2	13:35:30	9,770	3,806	0.288	0.280	0.234	0.239	0.260
1 L - 16	4	13:37:30	9,770	3,806	0.290	0.283	0.236	0.241	0.262
1 L - 16	9	13:41:30	9,770	3,806	0.293	0.285	0.238	0.243	0.265

O-cell Expansion

TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		O-cell Expansion				
			Pressure (psi)	Load (kips)	A-1321766 (in)	B-1321767 (in)	C-1321768 (in)	D-1321871 (in)	Average (in)
1 L - 17	1	13:50:30	10,320	4,020	0.316	0.308	0.258	0.264	0.287
1 L - 17	2	13.51:30	10,320	4,020	0.317	0.309	0.259	0.265	0.288
1 L - 17	4	13:53:30	10,320	4,020	0.319	0.311	0.261	0.267	0.289
1 L - 17	8	13:57:30	10,320	4,020	0.322	0.314	0.263	0.269	0.292
1 L - 18	1	14:00:30	10,980	4,276	0.352	0.342	0.289	0.296	0.320
1 L - 18	2	14:01:30	10,980	4,276	0.354	0.345	0.290	0.298	0.322
1 L - 18	4	14:03:30	10,980	4,276	0.357	0.346	0.293	0.300	0.325
1 L - 18	8	14:07:30	10,980	4,276	0.361	0.352	0.295	0.303	0.328
1 L - 19	1	14:09:30	11,580	4,509	0.381	0.372	0.313	0.321	0.347
1 L - 19	2	14:10:30	11,580	4,509	0.385	0.376	0.317	0.325	0.351
1 L - 19	4	14:12.30	11,580	4,509	0.389	0.380	0.320	0.327	0.354
1 L - 19	8	14:16:30	11,580	4,509	0.393	0.384	0.323	0.329	0.357
1 L - 20	1	14:18:00	12,170	4,739	0.407	0.398	0.336	0.342	0.371
1 L - 20	2	14:19:00	12,170	4,739	0.419	0.409	0.346	0.351	0.381
1 L - 20	4	14:21:00	12,170	4,739	0.423	0.413	0.350	0.355	0.385
1 L - 20	8	14:25:00	12,170	4,739	0.428	0.415	0.354	0.360	0.390
1 L - 21	1	14:35:00	12,780	4,976	0.459	0.449	0.382	0.386	0.419
1 L - 21	2	14:36:00	12,780	4,976	0.462	0.453	0.385	0.391	0.423
1 L - 21	4	14:38:00	12,780	4,976	0.466	0.457	0.389	0.395	0.427
1 L - 21	8	14:42:00	12,780	4,976	0.470	0.461	0.392	0.398	0.431
1 L - 22	1	14:43:30	13,390	5,213	0.489	0.481	0.410	0.415	0.449
1 L - 22	2	14:44:30	13,390	5,213	0.505	0.497	0.425	0.430	0.464
1 L - 22	4	14:46:30	13,390	5,213	0.510	0.502	0.429	0.434	0.469
1 L - 22	8	14:50:30	13,390	5,213	0.517	0.509	0.435	0.440	0.475
1 L - 23	1	14:52:00	14,040	5,466	0.547	0.540	0.464	0.467	0.504
1 L - 23	2	14:53:00	14,040	5,466	0.555	0.548	0.471	0.476	0.512
1 L - 23	4	14:55:00	14,040	5,466	0.562	0.555	0.476	0.481	0.518
1 L - 23	8	14:59:00	14,040	5,466	0.568	0.562	0.481	0.486	0.524
1 L - 24	1	15:02:00	14,630	5,695	0.605	0.599	0.516	0.520	0.560
1 L - 24	2	15:03:00	14,630	5,695	0.610	0.603	0.520	0.524	0.564
1 L - 24	4	15:05:00	14,630	5,695	0.615	0.609	0.525	0.526	0.569
1 L - 24	8	15:09:00	14,630	5,695	0.622	0.616	0.530	0.534	0.576
1 L - 25	1	15:11:00	15,190	5,913	0.651	0.645	0.558	0.561	0.604
1 L - 25	2	15:12:00	15,190	5,913	0.664	0.658	0.571	0.572	0.617
1 L - 25	4	15:14:00	15,190	5,913	0.678	0.672	0.585	0.586	0.630
1 L - 25	8	15:18:00	15,190	5,913	0.691	0.686	0.597	0.598	0.643
1 U - 1	1	15:20:30	12,180	4,743	0.689	0.683	0.593	0.599	0.641
1 U - 1	2	15:21:30	12,180	4,743	0.689	0.683	0.593	0.599	0.641
1 U - 1	4	15:23:30	12,180	4,743	0.689	0.683	0.593	0.599	0.641
1 U - 2	1	15:26:30	9,130	3,557	0.682	0.675	0.584	0.591	0.633
1 U - 2	2	15:27:30	9,130	3,557	0.682	0.675	0.584	0.591	0.633
1 U - 2	4	15:29:30	9,130	3,557	0.682	0.675	0.584	0.591	0.633
1 U - 3	1	15:32:30	6,080	2,371	0.672	0.666	0.573	0.580	0.623
1 U - 3	2	15:33:30	6,080	2,371	0.672	0.666	0.573	0.580	0.623
1 U - 3	4	15:35:30	6,080	2,371	0.672	0.665	0.573	0.579	0.622
1 U - 4	1	15:38:30	3,080	1,205	0.659	0.652	0.558	0.564	0.606
1 U - 4	2	15:39:30	3,080	1,205	0.658	0.652	0.556	0.564	0.608
1 U - 4	4	15:41:30	3,080	1,205	0.658	0.651	0.557	0.564	0.608
1 U - 5	1	15:44:30	0	0	0.625	0.621	0.532	0.539	0.579
1 U - 5	2	15:45:30	0	0	0.624	0.620	0.531	0.538	0.578
1 U - 5	4	15:47:30	0	0	0.623	0.620	0.531	0.538	0.578
1 U - 5	8	15:51:30	0	0	0.623	0.619	0.531	0.537	0.577

LOADTEST

O-cell Plate Movements and Creep (calculated)
TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell			Top of Shaft Movement (in)	Total Comp (in)	Upward Movement (in)	O-cell Expansion (in)	Downward Movement (in)	Creep Up Per Hold (in)	Creep Dn Per Hold (in)
			Pressure (psi)	Load (kips)	Net Load (kips)							
1 L - 0	-	10:56:00	0	0	0	0.000	0.000	0.000	0.000	0.000		
1 L - 1	1	11:17:00	650	261	258	0.011	0.002	0.013	0.020	-0.007		
1 L - 1	2	11:18:00	650	261	258	0.012	0.002	0.014	0.020	-0.006		
1 L - 1	4	11:20.00	650	261	258	0.013	0.003	0.016	0.020	-0.004		
1 L - 1	8	11:24:00	650	261	258	0.013	0.003	0.016	0.020	-0.004	0.000	0.000
1 L - 2	1	11:26:00	1,260	498	495	0.016	0.003	0.019	0.027	-0.008		
1 L - 2	2	11:27:00	1,260	498	495	0.016	0.004	0.020	0.027	-0.007		
1 L - 2	4	11:29:00	1,260	498	495	0.016	0.004	0.020	0.027	-0.007		
1 L - 2	8	11:33:00	1,260	498	495	0.015	0.004	0.019	0.028	-0.009	0.000	0.002
1 L - 3	1	11:35:00	1,910	751	748	0.023	0.005	0.028	0.039	-0.011		
1 L - 3	2	11:36:00	1,910	751	748	0.024	0.005	0.029	0.040	-0.011		
1 L - 3	4	11:38:00	1,910	751	748	0.023	0.005	0.028	0.040	-0.012		
1 L - 3	8	11:42:00	1,910	751	748	0.023	0.005	0.028	0.040	-0.012	0.000	0.000
1 L - 4	1	11:43:30	2,480	072	969	0.029	0.006	0.035	0.050	-0.015		
1 L - 4	2	11:44:30	2,480	972	969	0.029	0.006	0.035	0.051	-0.016		
1 L - 4	4	11:46.30	2,480	972	969	0.029	0.006	0.035	0.051	-0.016		
1 L - 4	8	11:50:30	2,480	972	969	0.030	0.006	0.036	0.052	-0.016	0.001	0.000
1 L - 5	1	11:52:00	3,090	1,209	1,206	0.035	0.006	0.041	0.062	-0.021		
1 L - 5	2	11:53:00	3,090	1,209	1,206	0.035	0.006	0.041	0.063	-0.022		
1 L - 5	4	11:55:00	3,090	1,209	1,206	0.036	0.006	0.042	0.063	-0.021		
1 L - 5	8	11:59:00	3,090	1,209	1,206	0.036	0.006	0.042	0.064	-0.022	0.000	0.001
1 L - 6	1	12:01:00	3,660	1,431	1,428	0.041	0.007	0.048	0.074	-0.026		
1 L - 6	2	12:02:00	3,660	1,431	1,428	0.042	0.007	0.049	0.075	-0.026		
1 L - 6	4	12:04:00	3,660	1,431	1,428	0.042	0.006	0.048	0.076	-0.028		
1 L - 6	8	12:08:00	3,660	1,431	1,428	0.043	0.006	0.049	0.076	-0.027	0.001	0.000
1 L - 7	1	12:09:30	4,210	1,645	1,642	0.050	0.007	0.057	0.086	-0.029		
1 L - 7	2	12:10:30	4,210	1,645	1,642	0.050	0.007	0.057	0.088	-0.031		
1 L - 7	4	12:12:30	4,210	1,645	1,642	0.051	0.007	0.058	0.088	-0.030		
1 L - 7	8	12:16:30	4,210	1,645	1,642	0.051	0.007	0.058	0.090	-0.032	0.000	0.002
1 L - 8	1	12:20:00	4,890	1,909	1,906	0.058	0.008	0.066	0.103	-0.037		
1 L - 8	2	12:21:00	4,890	1,909	1,906	0.060	0.008	0.068	0.103	-0.035		
1 L - 8	4	12:23:00	4,890	1,909	1,906	0.059	0.008	0.067	0.104	-0.037		
1 L - 8	8	12:27:00	4,890	1,909	1,906	0.060	0.008	0.068	0.105	-0.037	0.001	0.000
1 L - 0	1	12:28:30	5,470	2,134	2,131	0.067	0.009	0.076	0.116	-0.040		
1 L - 9	2	12:29:30	5,470	2,134	2,131	0.067	0.009	0.078	0.118	-0.042		
1 L - 9	4	12:31:30	5,470	2,134	2,131	0.069	0.008	0.077	0.119	-0.042		
1 L - 0	8	12:35:30	5,470	2,134	2,131	0.068	0.008	0.076	0.120	-0.044	0.000	0.002
1 L - 10	1	12:37:00	6,100	2,379	2,376	0.077	0.009	0.086	0.134	-0.046		
1 L - 10	2	12:38:00	6,100	2,379	2,376	0.077	0.009	0.086	0.135	-0.049		
1 L - 10	4	12:40:00	6,100	2,379	2,376	0.078	0.009	0.087	0.136	-0.049		
1 L - 10	8	12:44:00	6,100	2,379	2,376	0.079	0.009	0.088	0.137	-0.049	0.001	0.000
1 L - 11	1	12:46:00	6,720	2,620	2,617	0.088	0.009	0.097	0.151	-0.054		
1 L - 11	2	12:47:00	6,720	2,820	2,617	0.088	0.009	0.097	0.152	-0.055		
1 L - 11	4	12:49:00	6,720	2,620	2,617	0.086	0.010	0.096	0.153	-0.055		
1 L - 11	8	12:53:00	6,720	2,620	2,617	0.089	0.010	0.099	0.154	-0.055	0.001	0.000
1 L - 12	1	12:54:30	7,330	2,857	2,854	0.097	0.010	0.107	0.167	-0.060		
1 L - 12	2	12:55:30	7,330	2,857	2,854	0.099	0.010	0.109	0.169	-0.060		
1 L - 12	4	12:57:30	7,330	2,857	2,854	0.099	0.010	0.109	0.170	-0.061		
1 L - 12	8	13:01:30	7,330	2,857	2,854	0.102	0.010	0.112	0.172	-0.060	0.003	0.000
1 L - 13	1	13:03:00	7,890	3,075	3,072	0.110	0.011	0.121	0.186	-0.065		
1 L - 13	2	13:04:00	7,890	3,075	3,072	0.111	0.011	0.122	0.187	-0.065		
1 L - 13	4	13:06:00	7,890	3,075	3,072	0.111	0.011	0.122	0.180	-0.067		
1 L - 13	8	13:10:00	7,890	3,075	3,072	0.114	0.011	0.125	0.190	-0.065	0.003	0.000
1 L - 14	1	13:12:30	8,500	3,312	3,309	0.124	0.012	0.136	0.207	-0.071		
1 L - 14	2	13:13:30	8,500	3,312	3,309	0.127	0.011	0.138	0.200	-0.071		
1 L - 14	4	13:15:30	8,500	3,312	3,309	0.126	0.011	0.137	0.210	-0.073		
1 L - 14	8	13:19.30	8,500	3,312	3,309	0.127	0.011	0.136	0.212	-0.074	0.001	0.001
1 L - 15	1	13:21.30	9,150	3,565	3,562	0.140	0.012	0.152	0.231	-0.079		
1 L - 15	2	13:22.30	0,150	3,565	3,562	0.142	0.012	0.154	0.233	-0.079		
1 L - 15	4	13:24:30	9,150	3,565	3,562	0.143	0.012	0.155	0.235	-0.080		
1 L - 15	8	13:28:30	9,150	3,565	3,562	0.144	0.012	0.156	0.237	-0.081	0.001	0.001
1 L - 16	1	13:34:30	0,770	3,806	3,803	0.159	0.012	0.171	0.258	-0.087		
1 L - 16	2	13:35:30	9,770	3,806	3,803	0.161	0.012	0.173	0.260	-0.087		
1 L - 16	4	13:37:30	9,770	3,806	3,807	0.163	0.012	0.175	0.262	-0.087		
1 L - 16	8	13:41:30	9,770	3,806	3,803	0.163	0.012	0.175	0.265	-0.090	0.000	0.003

LOADTEST

O-cell Plate Movements and Creep (calculated)
TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell Pressure (psi)	O-cell Load (kips)	O-cell Net Load (kips)	Top of Shaft Movement (in)	Total Comp (in)	Upward Movement (in)	O-cell Expansion (in)	Downward Movement (in)	Creep Up Per Hold (in)	Creep Dn Per Hold (in)
1 L - 17	1	13:50:30	10,320	4,020	4,017	0.176	0.012	0.188	0.287	-0.099		
1 L - 17	2	13:51.30	10,320	4,020	4,017	0.177	0.012	0.189	0.288	-0.099		
1 L - 17	4	13:53:30	10,320	4,020	4,017	0.178	0.012	0.190	0.289	-0.099		
1 L - 17	8	13:57:30	10,320	4,020	4,017	0.180	0.012	0.192	0.292	-0.100	0.002	0.001
1 L - 18	1	14:00:30	10,980	4,276	4,273	0.202	0.013	0.215	0.320	-0.105		
1 L - 18	2	14:01:30	10,980	4,276	4,273	0.203	0.013	0.216	0.322	-0.106		
1 L - 18	4	14:03:30	10,980	4,276	4,273	0.204	0.013	0.217	0.325	-0.108		
1 L - 18	8	14:07:30	10,980	4,276	4,273	0.208	0.013	0.221	0.326	-0.107	0.004	0.000
1 L - 19	1	14:09:30	11,580	4,509	4,506	0.220	0.013	0.233	0.347	-0.114		
1 L - 19	2	14:10:30	11,580	4,509	4,506	0.224	0.013	0.237	0.351	-0.114		
1 L - 19	4	14:12:30	11,580	4,509	4,506	0.226	0.013	0.239	0.354	-0.115		
1 L - 19	8	14:16:30	11,580	4,509	4,506	0.227	0.013	0.240	0.357	-0.117	0.001	0.002
1 L - 20	1	14:18:00	12,170	4,739	4,736	0.241	0.014	0.255	0.371	-0.116		
1 L - 20	2	14:19:00	12,170	4,739	4,736	0.245	0.014	0.259	0.381	-0.122		
1 L - 20	4	14:21:00	12,170	4,739	4,736	0.250	0.014	0.264	0.385	-0.121		
1 L - 20	8	14:25:00	12,170	4,739	4,736	0.253	0.015	0.268	0.390	-0.122	0.004	0.001
1 L - 21	1	14:35:00	12,780	4,976	4,973	0.276	0.016	0.292	0.419	-0.127		
1 L - 21	2	14:36:00	12,780	4,976	4,973	0.279	0.016	0.295	0.423	-0.128		
1 L - 21	4	14:38:00	12,780	4,976	4,973	0.281	0.016	0.297	0.427	-0.130		
1 L - 21	8	14:42:00	12,780	4,976	4,973	0.285	0.016	0.301	0.431	-0.130	0.004	0.000
1 L - 22	1	14:43:30	13,390	5,213	5,210	0.306	0.017	0.323	0.449	-0.126		
1 L - 22	2	14:44:30	13,390	5,213	5,210	0.311	0.017	0.328	0.464	-0.136		
1 L - 22	4	14:46:30	13,390	5,213	5,210	0.316	0.017	0.333	0.469	-0.136		
1 L - 22	8	14:50:30	13,390	5,213	5,210	0.321	0.017	0.338	0.475	-0.137	0.005	0.001
1 L - 23	1	14:52:00	14,040	5,466	5,463	0.345	0.017	0.362	0.504	-0.142		
1 L - 23	2	14:53:00	14,040	5,466	5,463	0.351	0.017	0.368	0.512	-0.144		
1 L - 23	4	14:55:00	14,040	5,466	5,463	0.356	0.017	0.373	0.518	-0.145		
1 L - 23	8	14:59:00	14,040	5,466	5,463	0.362	0.017	0.379	0.524	-0.145	0.006	0.000
1 L - 24	1	15:02:00	14,630	5,695	5,692	0.389	0.017	0.406	0.560	-0.154		
1 L - 24	2	15:03:00	14,630	5,695	5,692	0.392	0.017	0.409	0.564	-0.155		
1 L - 24	4	15:05:00	14,630	5,695	5,692	0.397	0.017	0.414	0.569	-0.155		
1 L - 24	8	15:09:00	14,630	5,695	5,692	0.402	0.017	0.419	0.575	-0.157	0.005	0.002
1 L - 25	1	15:11.00	15,190	5,913	5,910	0.421	0.017	0.438	0.604	-0.166		
1 L - 25	2	15:12:00	15,190	5,913	5,910	0.435	0.018	0.453	0.617	-0.164		
1 L - 25	4	15:14:00	15,190	5,913	5,910	0.448	0.018	0.466	0.630	-0.164		
1 L - 25	8	15:18:00	15,190	5,913	5,910	0.459	0.018	0.477	0.643	-0.166	0.011	0.002
1 U - 1	1	15:20:30	12,180	4,743	4,740	0.458	0.017	0.475	0.641	-0.166		
1 U - 1	2	15:21:30	12,180	4,743	4,740	0.458	0.017	0.475	0.641	-0.166		
1 U - 1	4	15:23:30	12,180	4,743	4,740	0.458	0.017	0.475	0.641	-0.166		
1 U - 2	1	15:26:30	9,130	3,557	3,554	0.456	0.015	0.471	0.633	-0.162		
1 U - 2	2	15:27:30	9,130	3,557	3,554	0.455	0.015	0.470	0.633	-0.163		
1 U - 2	4	15:29:30	9,130	3,557	3,554	0.455	0.015	0.470	0.633	-0.163		
1 U - 3	1	15:32:30	6,080	2,371	2,368	0.453	0.012	0.465	0.623	-0.158		
1 U - 3	2	15:33:30	6,080	2,371	2,368	0.453	0.012	0.465	0.623	-0.158		
1 U - 3	4	15:35:30	6,080	2,371	2,368	0.453	0.012	0.465	0.622	-0.157		
1 U - 4	1	15:36:30	3,080	1,205	1,202	0.449	0.009	0.458	0.608	-0.150		
1 U - 4	2	15:39:30	3,080	1,205	1,202	0.450	0.008	0.456	0.608	-0.150		
1 U - 4	4	15:41:30	3,080	1,205	1,202	0.448	0.008	0.456	0.606	-0.152		
1 U - 5	1	15:44:30	0	0	0	0.445	0.004	0.449	0.579	-0.130		
1 U - 5	2	15:45:30	0	0	0	0.445	0.004	0.449	0.576	-0.129		
1 U - 5	4	15:47:30	0	0	0	0.445	0.004	0.449	0.578	-0.129		
1 U - 5	8	15:51:30	0	0	0	0.444	0.004	0.448	0.577	-0.129		

LOADTEST

Strain Gage Readings and Loads at Level 1
TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Strain Gage Level 1					
			Pressure (psi)	Load (kips)	1A-1323494 (με)	1B-1323495 (με)	1C-1323496 (με)	1D-1323497 (με)	Av. Strain (με)	Load (kips)
1 L - 0	-	10:56:00	0	0	0.0	0.0	0.0	0.0	0.0	0
1 L - 1	1	11:17:00	650	261	16.6	15.7	14.2	18.8	16.4	116
1 L - 1	2	11:18:00	650	261	17.1	15.9	14.7	19.1	16.7	119
1 L - 1	4	11:20:00	650	261	17.3	16.0	14.9	19.5	16.9	120
1 L - 1	8	11:24:00	650	261	17.3	16.0	15.1	19.5	17.0	121
1 L - 2	1	11:26:00	1,260	498	28.8	24.3	30.8	34.9	29.7	211
1 L - 2	2	11:27:00	1,260	498	28.7	24.3	31.3	35.1	29.8	212
1 L - 2	4	11:29:00	1,260	498	28.8	24.3	31.7	35.7	30.1	214
1 L - 2	8	11:33:00	1,260	498	28.9	24.6	32.5	36.7	30.7	218
1 L - 3	1	11:35:00	1,910	751	41.2	32.3	54.2	59.9	46.9	334
1 L - 3	2	11:36:00	1,910	751	41.4	32.3	54.8	60.7	47.3	336
1 L - 3	4	11:38:00	1,910	751	41.4	32.2	55.1	60.9	47.4	337
1 L - 3	8	11:42:00	1,910	751	41.5	32.3	55.9	61.5	47.8	340
1 L - 4	1	11:43:30	2,480	972	54.7	41.3	71.8	80.7	62.1	442
1 L - 4	2	11:44:30	2,480	972	54.4	41.0	71.8	80.9	62.0	441
1 L - 4	4	11:46:30	2,480	972	54.4	41.2	72.3	81.2	62.3	443
1 L - 4	8	11:50:30	2,480	972	55.2	41.9	73.9	82.9	63.5	452
1 L - 5	1	11:52:00	3,090	1,209	70.9	53.0	90.1	103.6	79.4	565
1 L - 5	2	11:53:00	3,090	1,209	69.7	52.1	89.3	102.9	78.5	558
1 L - 5	4	11:55:00	3,090	1,209	69.8	52.6	90.2	103.9	79.1	562
1 L - 5	8	11:59:00	3,090	1,209	69.8	52.9	90.9	104.7	79.6	566
1 L - 6	1	12:01:00	3,660	1,431	84.6	71.1	112.7	127.5	99.0	704
1 L - 6	2	12:02:00	3,660	1,431	84.5	71.4	113.7	128.3	99.5	707
1 L - 6	4	12:04:00	3,660	1,431	84.2	71.8	114.6	129.2	100.0	711
1 L - 6	8	12:08:00	3,660	1,431	83.8	71.8	115.5	129.7	100.2	713
1 L - 7	1	12:09:30	4,210	1,645	95.9	87.4	133.9	152.1	117.3	835
1 L - 7	2	12:10:30	4,210	1,645	96.6	89.0	135.8	153.6	118.7	845
1 L - 7	4	12:12:30	4,210	1,645	96.4	89.1	136.4	154.2	119.0	847
1 L - 7	8	12:16:30	4,210	1,645	96.3	89.9	138.2	155.5	120.0	854
1 L - 8	1	12:20:00	4,890	1,909	111.8	107.6	160.4	181.3	140.3	999
1 L - 8	2	12:21:00	4,890	1,909	112.6	108.6	162.0	182.6	141.4	1,006
1 L - 8	4	12:23:00	4,890	1,909	112.0	108.3	162.4	182.8	141.4	1,006
1 L - 8	8	12:27:00	4,890	1,909	114.5	110.8	166.1	186.3	144.4	1,027
1 L - 9	1	12:28:30	5,470	2,134	127.8	123.9	183.2	206.6	160.4	1,141
1 L - 9	2	12:29:30	5,470	2,134	126.9	123.9	184.4	207.6	160.7	1,143
1 L - 9	4	12:31:30	5,470	2,134	127.1	124.3	185.8	208.7	161.5	1,149
1 L - 9	8	12:35:30	5,470	2,134	127.8	124.9	187.8	210.1	162.6	1,157
1 L - 10	1	12:37:00	6,100	2,379	143.5	141.6	212.1	234.2	182.9	1,301
1 L - 10	2	12:38:00	6,100	2,379	143.4	141.6	212.7	234.8	183.1	1,302
1 L - 10	4	12:40:00	6,100	2,379	144.0	142.3	214.5	236.2	184.2	1,311
1 L - 10	8	12:44:00	6,100	2,379	144.0	142.7	216.3	237.5	185.1	1,317
1 L - 11	1	12:46:00	6,720	2,620	159.7	158.0	236.6	260.1	203.5	1,448
1 L - 11	2	12:47:00	6,720	2,620	159.3	158.0	237.2	260.7	203.8	1,450
1 L - 11	4	12:49:00	6,720	2,620	159.5	158.3	238.6	262.0	204.6	1,455
1 L - 11	8	12:53:00	6,720	2,620	159.2	158.7	240.4	263.1	205.4	1,461
1 L - 12	1	12:54:30	7,330	2,857	175.7	174.5	259.7	284.1	223.5	1,590
1 L - 12	2	12:55:30	7,330	2,857	175.3	174.8	261.7	285.9	224.4	1,596
1 L - 12	4	12:57:30	7,330	2,857	174.5	174.8	262.8	286.6	224.6	1,598
1 L - 12	8	13:01:30	7,330	2,857	175.6	175.6	265.0	288.4	226.2	1,609
1 L - 13	1	13:03:00	7,890	3,075	190.2	190.1	282.5	308.5	242.8	1,727
1 L - 13	2	13:04:00	7,890	3,075	190.3	190.4	283.8	310.2	243.7	1,733
1 L - 13	4	13:06:00	7,890	3,075	189.5	189.9	284.1	310.4	243.5	1,732
1 L - 13	8	13:10:00	7,890	3,075	189.9	191.4	287.2	312.8	245.2	1,745
1 L - 14	1	13:12:30	8,500	3,312	206.0	207.0	306.1	334.7	263.4	1,874
1 L - 14	2	13:13:30	8,500	3,312	205.9	207.4	307.4	336.0	264.2	1,879
1 L - 14	4	13:15:30	8,500	3,312	204.9	207.7	308.2	336.6	264.2	1,880
1 L - 14	8	13:19:30	8,500	3,312	204.9	208.2	310.1	337.8	265.2	1,887
1 L - 15	1	13:21:30	9,150	3,565	222.7	225.7	331.3	361.7	285.2	2,029
1 L - 15	2	13:22:30	9,150	3,565	222.5	226.6	332.6	362.6	286.1	2,035
1 L - 15	4	13:24:30	9,150	3,565	222.0	227.1	334.0	363.9	286.7	2,040
1 L - 15	8	13:28:30	9,150	3,565	222.1	229.2	336.6	365.5	288.4	2,051
1 L - 16	1	13:34:30	9,770	3,806	239.8	248.6	359.8	390.4	309.6	2,202
1 L - 16	2	13:35:30	9,770	3,806	238.8	248.9	360.3	390.8	309.7	2,203
1 L - 16	4	13:37:30	9,770	3,806	239.5	250.3	362.5	392.8	311.7	2,214
1 L - 16	8	13:41:30	9,770	3,806	240.5	252.5	365.8	395.5	313.5	2,230

LOADTEST

Strain Gage Readings and Loads at Level 1
TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Strain Gage Level 1					
			Pressure (psi)	Load (kips)	1A-1323494 (με)	1B-1323495 (με)	1C-1323496 (με)	1D-1323497 (με)	Av. Strain (με)	Load (kips)
1 L - 17	1	13:50:30	10,320	4,020	258.0	272.0	387.3	419.4	334.2	2,377
1 L - 17	2	13:51:30	10,320	4,020	257.8	272.1	387.7	420.0	334.4	2,379
1 L - 17	4	13:53:30	10,320	4,020	258.7	272.7	388.4	420.5	335.1	2,384
1 L - 17	8	13:57:30	10,320	4,020	260.7	275.5	391.2	422.8	337.5	2,401
1 L - 18	1	14:00:30	10,980	4,276	279.0	292.8	410.4	443.7	356.5	2,536
1 L - 18	2	14:01:30	10,980	4,276	279.3	294.1	411.3	443.8	357.1	2,541
1 L - 18	4	14:03:30	10,980	4,276	279.0	295.2	412.0	443.5	357.4	2,543
1 L - 18	8	14:07:30	10,980	4,276	279.8	296.4	414.2	443.7	358.5	2,550
1 L - 19	1	14:09:30	11,580	4,509	296.3	311.1	431.5	460.7	375.0	2,668
1 L - 19	2	14:10:30	11,580	4,509	294.7	310.6	432.5	460.8	374.7	2,665
1 L - 19	4	14:12:30	11,580	4,509	294.5	311.0	433.9	461.5	375.2	2,669
1 L - 19	8	14:16:30	11,580	4,509	293.8	312.1	436.4	462.6	376.2	2,676
1 L - 20	1	14:18:00	12,170	4,739	309.3	322.5	453.6	479.9	391.3	2,784
1 L - 20	2	14:19:00	12,170	4,739	308.7	324.8	456.3	481.3	392.8	2,794
1 L - 20	4	14:21.00	12,170	4,739	308.0	326.0	457.6	482.0	393.4	2,799
1 L - 20	8	14:25:00	12,170	4,739	308.7	329.7	461.7	483.8	396.0	2,817
1 L - 21	1	14:35:00	12,780	4,976	322.4	347.0	485.7	505.2	415.1	2,953
1 L - 21	2	14:36:00	12,780	4,976	322.2	347.9	486.8	505.6	415.6	2,957
1 L - 21	4	14:38:00	12,780	4,976	322.1	349.1	488.7	506.5	416.6	2,964
1 L - 21	8	14:42:00	12,780	4,976	323.8	351.7	491.4	507.9	418.7	2,979
1 L - 22	1	14:43:30	13,390	5,213	339.7	362.1	510.5	526.9	434.8	3,093
1 L - 22	2	14:44:30	13,390	5,213	340.2	365.6	513.9	528.5	437.1	3,109
1 L - 22	4	14:46:30	13,390	5,213	340.2	367.7	516.1	529.2	438.3	3,118
1 L - 22	8	14:50:30	13,390	5,213	341.1	371.3	520.1	530.1	440.7	3,135
1 L - 23	1	14:52:00	14,040	5,466	356.8	388.3	543.8	551.4	460.5	3,276
1 L - 23	2	14:53:00	14,040	5,466	357.3	389.5	544.9	551.2	460.7	3,277
1 L - 23	4	14:55:00	14,040	5,466	356.0	392.5	548.1	552.4	462.7	3,292
1 L - 23	8	14:59:00	14,040	5,466	356.7	395.7	551.6	553.7	464.5	3,307
1 L - 24	1	15:02:00	14,630	5,695	376.0	412.2	577.7	574.5	485.1	3,451
1 L - 24	2	15:03:00	14,630	5,695	377.0	414.3	580.0	575.3	486.6	3,462
1 L - 24	4	15:05:00	14,630	5,695	376.2	415.7	581.9	575.4	487.3	3,467
1 L - 24	8	15:09:00	14,630	5,695	376.3	419.6	586.9	577.7	490.6	3,490
1 L - 25	1	15:11:00	15,190	5,913	394.6	438.2	610.9	598.4	510.6	3,632
1 L - 25	2	15:12:00	15,190	5,913	397.7	448.3	615.8	602.3	516.0	3,671
1 L - 25	4	15:14:00	15,190	5,913	401.2	456.2	621.6	603.6	520.6	3,704
1 L - 25	8	15:18:00	15,190	5,913	406.0	464.8	628.7	606.8	526.6	3,746
1 U - 1	1	15:20:30	12,160	4,743	367.7	409.8	552.1	537.5	466.7	3,320
1 U - 1	2	15:21:30	12,160	4,743	367.0	409.1	550.8	536.2	465.8	3,313
1 U - 1	4	15:23:30	12,160	4,743	366.3	408.6	550.0	535.7	465.2	3.309
1 U - 2	1	15:26:30	9,130	3,557	312.9	339.2	456.0	451.6	389.9	2,774
1 U - 2	2	15:27:30	9,130	3,557	312.7	338.7	456.2	451.1	389.4	2,770
1 U - 2	4	15:29:30	9,130	3,557	312.3	338.1	454.0	450.1	388.6	2.765
1 U - 3	1	15:32:30	6,080	2,371	251.2	255.9	333.7	344.3	296.3	2,108
1 U - 3	2	15:33:30	6,080	2,371	250.9	255.3	332.7	343.5	295.6	2,103
1 U - 3	4	15:35:30	6,080	2,371	250.9	254.8	331.6	342.5	294.9	2,098
1 U - 4	1	15:38:30	3,080	1,205	167.1	145.3	195.8	214.4	180.6	1,285
1 U - 4	2	15:39:30	3,080	1,205	167.0	144.9	194.2	213.2	179.8	1,279
1 U - 4	4	15:41:30	3,080	1,205	167.1	144.8	193.7	212.8	179.6	1,278
1 U - 5	1	15:44:30	0	0	16.1	-27.0	47.6	58.5	23.8	169
1 U - 5	2	15:45:30	0	0	14.0	-29.0	44.7	55.6	21.3	152
1 U - 5	4	15:47:30	0	0	12.7	-30.1	43.1	54.0	19.9	142
1 U - 5	8	15:51:30	0	0	10.8	-31.9	40.7	51.4	17.8	126

LOADTEST

Strain Gage Readings and Loads at Level 2
TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Strain Gage Level 2					
			Pressure (psi)	Load (kips)	2A-1322769 (με)	2B-1323491 (με)	2C-1323492 (με)	2D-1323493 (με)	Av. Strain (με)	Load (kips)
1 L - 0	-	10:58:00	0	0	0.0	0.0	0.0	0.0	0.0	0
1 L - 1	1	11:17:00	650	261	16.4	11.2	9.5	19.9	14.2	101
1 L - 1	2	11:18:00	850	261	16.4	11.4	9.8	20.1	14.4	102
1 L - 1	4	11:20:00	650	261	16.5	11.6	9.7	20.2	14.5	103
1 L - 1	8	11:24:00	660	261	16.6	11.5	9.9	20.3	14.6	104
1 L - 2	1	11:26:00	1,260	498	22.3	16.6	17.3	27.3	21.4	152
1 L - 2	2	11:27:00	1,260	496	22.3	18.9	17.5	27.3	21.5	153
1 L - 2	4	11:29:00	1,260	496	22.4	19.0	17.6	27.6	21.7	154
1 L - 2	8	11:33:00	1,260	498	22.6	19.2	17.9	28.0	21.9	156
1 L - 3	1	11:35:00	1,910	751	31.2	28.6	27.8	37.5	31.4	223
1 L - 3	2	11:36:00	1,910	751	31.4	28.8	28.1	38.1	31.6	225
1 L - 3	4	11:38:00	1,910	751	31.5	29.0	28.1	38.2	31.7	226
1 L - 3	8	11:42:00	1,910	751	31.8	29.1	28.3	38.6	31.9	227
1 L - 4	1	11:43:30	2,480	972	40.8	38.6	36.8	47.0	40.7	290
1 L - 4	2	11.44:30	2,480	972	40.8	38.5	36.4	47.0	40.7	289
1 L - 4	4	11.46:30	2,480	972	41.0	38.7	36.7	47.1	40.9	291
1 L - 4	8	11:50:30	2,480	972	41.6	39.4	37.4	48.1	41.6	296
1 L - 5	1	11:52:00	3,090	1,209	52.0	50.0	46.2	56.9	51.3	365
1 L - 5	2	11:53:00	3,090	1,209	51.6	49.6	45.8	56.7	50.9	362
1 L - 5	4	11:55:00	3,090	1,209	51.9	49.9	46.2	57.1	51.3	365
1 L - 5	8	11:59:00	3,090	1,209	52.2	50.1	46.6	57.4	51.6	367
1 L - 6	1	12:01:00	3,660	1,431	62.9	62.2	56.4	66.6	82.1	441
1 L - 6	2	12:02:00	3,660	1,431	63.3	62.2	56.6	67.1	62.3	442
1 L - 6	4	12:04:00	3,660	1,431	63.5	62.6	57.1	67.4	62.6	446
1 L - 6	8	12:08:00	3,660	1,431	63.4	62.5	57.2	67.5	62.7	446
1 L - 7	1	12:09:30	4,210	1,645	73.6	73.3	65.8	76.2	72.2	514
1 L - 7	2	12:10:30	4,210	1,645	73.9	73.7	66.4	76.7	72.7	517
1 L - 7	4	12:12:30	4,210	1,645	74.0	73.7	66.7	77.0	72.9	518
1 L - 7	8	12:16:30	4,210	1,645	74.3	74.2	67.3	77.7	73.4	522
1 L - 8	1	12:20:00	4,890	1,909	86.5	85.9	77.4	87.5	84.3	600
1 L - 8	2	12:21:00	4,890	1,909	87.0	86.2	77.8	88.0	84.8	603
1 L - 8	4	12:23:00	4,890	1,909	86.6	86.2	78.1	88.2	84.9	604
1 L - 8	8	12:27:00	4,890	1,909	88.5	87.5	79.6	89.5	86.3	614
1 L - 9	1	12:28:30	5,470	2,134	98.1	96.8	87.2	96.8	94.7	674
1 L - 9	2	12:29:30	5,470	2,134	98.0	96.7	87.6	97.1	94.9	675
1 L - 9	4	12:31:30	5,470	2,134	98.4	97.1	88.0	97.5	95.3	678
1 L - 9	8	12:35:30	5,470	2,134	98.8	97.5	88.8	98.0	95.8	682
1 L - 10	1	12:37:00	6,100	2,379	111.2	108.4	98.8	106.8	106.3	756
1 L - 10	2	12:38:00	6,100	2,379	111.2	108.3	98.9	106.8	106.3	756
1 L - 10	4	12:40:00	6,100	2,379	111.7	108.6	99.7	107.5	106.9	760
1 L - 10	8	12:44:00	6,100	2,379	111.9	108.9	100.4	107.9	107.3	763
1 L - 11	1	12:46:00	6,720	2,620	123.2	118.8	108.8	115.4	116.5	829
1 L - 11	2	12:47:00	6,720	2,620	123.1	118.6	109.0	115.5	116.6	829
1 L - 11	4	12:49:00	6,720	2,620	123.3	118.8	109.5	116.1	116.9	832
1 L - 11	8	12:53:00	6,720	2,620	123.4	119.1	110.2	116.6	117.3	835
1 L - 12	1	12:54:30	7,330	2,857	134.8	128.9	118.1	123.6	126.3	899
1 L - 12	2	12:55:30	7,330	2,857	134.8	129.0	118.9	124.3	126.7	902
1 L - 12	4	12:57:30	7,330	2,857	134.7	129.0	119.2	124.5	126.8	902
1 L - 12	8	13:01:30	7,330	2,857	135.2	129.6	120.2	125.0	127.5	907
1 L - 13	1	13:03:00	7,890	3,075	145.3	138.1	127.2	131.1	135.4	963
1 L - 13	2	13:04:00	7,890	3,075	145.5	138.4	127.6	131.9	135.9	967
1 L - 13	4	13:06:00	7,890	3,075	145.1	138.0	127.6	131.8	135.7	965
1 L - 13	8	13:10:00	7,890	3,075	145.9	139.0	129.2	132.7	136.7	972
1 L - 14	1	13:12:30	8,500	3,312	156.9	147.7	136.5	139.1	145.0	1,032
1 L - 14	2	13:13:30	8,500	3,312	157.2	147.9	137.2	139.5	145.5	1,035
1 L - 14	4	13:15:30	8,500	3,312	157.0	147.9	137.5	139.8	145.5	1,035
1 L - 14	8	13:19:30	8,500	3,312	157.2	148.4	138.4	140.1	146.0	1,039
1 L - 15	1	13:21:30	9,150	3,565	169.7	157.6	146.5	147.5	155.4	1,105
1 L - 15	2	13:22:30	9,150	3,565	169.6	157.8	146.7	147.4	155.4	1,105
1 L - 15	4	13:24:30	9,150	3,565	169.6	158.4	147.7	148.1	156.0	1,109
1 L - 15	8	13:28:30	9,150	3,565	170.1	159.2	148.7	148.5	156.6	1,114
1 L - 16	1	13:34:30	9,770	3,806	183.1	168.4	156.5	156.0	166.0	1,181
1 L - 16	2	13:35:30	9,770	3,806	182.7	168.7	156.8	155.8	166.0	1,181
1 L - 16	4	13:37:30	9,770	3,806	183.4	169.5	157.6	156.5	166.8	1,186
1 L - 16	8	13:41:30	9,770	3,806	184.4	170.8	159.0	157.5	167.9	1,195

LOADTEST

Strain Gage Readings and Loads at Level 2
TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Strain Gage Level 2					
			Pressure (psi)	Load (kips)	2A-1322769 (με)	2B-1323491 (με)	2C-1323492 (με)	2D-1323493 (με)	Av. Strain (με)	Load (kips)
1 L - 17	1	13:50:30	10,320	4,020	197.1	182.3	167.9	165.5	178.2	1,268
1 L - 17	2	13:51:30	10,320	4,020	196.9	182.2	187.9	165.6	178.2	1,268
1 L - 17	4	13:53:30	10,320	4,020	197.2	182.2	167.8	165.6	178.2	1,268
1 L - 17	8	13:57:30	10,320	4,020	198.5	183.5	168.9	166.4	179.3	1,276
1 L - 18	1	14:00:30	10,980	4,276	209.7	189.9	174.2	172.7	186.6	1,328
1 L - 18	2	14:01:30	10,980	4,276	209.9	190.4	174.6	172.8	186.9	1,330
1 L - 18	4	14:03:30	10,980	4,276	209.6	190.7	174.8	172.6	186.9	1,330
1 L - 18	8	14:07:30	10,980	4,276	209.9	191.2	175.5	172.9	187.4	1,333
1 L - 19	1	14:09:30	11,580	4,509	221.4	198.5	180.9	177.7	194.6	1,365
1 L - 19	2	14:10:30	11,580	4,509	220.5	198.3	180.6	178.0	194.4	1,363
1 L - 19	4	14:12:30	11,580	4,509	220.5	198.8	181.2	178.2	194.7	1,365
1 L - 19	8	14:16:30	11,580	4,509	220.8	199.7	182.1	178.7	195.3	1,390
1 L - 20	1	14:18:00	12,170	4,739	232.2	206.3	188.0	184.5	202.7	1,442
1 L - 20	2	14:19:00	12,170	4,739	232.1	206.9	187.7	184.2	202.7	1,442
1 L - 20	4	14:21:00	12,170	4,739	232.0	207.4	188.0	184.3	202.9	1,444
1 L - 20	8	14:25:00	12,170	4,739	233.2	209.2	189.6	185.1	204.3	1,453
1 L - 21	1	14:35:00	12,780	4,976	244.1	216.4	195.8	189.9	211.5	1,505
1 L - 21	2	14:36:00	12,780	4,976	244.0	218.7	196.0	189.7	211.6	1,505
1 L - 21	4	14:38:00	12,780	4,976	244.1	217.5	196.6	189.6	211.9	1,508
1 L - 21	8	14:42:00	12,780	4,976	245.2	218.8	197.8	190.0	213.0	1,515
1 L - 22	1	14:43:30	13,390	5,213	256.6	224.1	203.5	194.4	219.7	1,563
1 L - 22	2	14:44:30	13,390	5,213	257.2	224.6	203.9	193.2	219.7	1,563
1 L - 22	4	14:46:30	13,390	5,213	257.7	225.5	204.5	193.0	220.2	1,566
1 L - 22	8	14:50:30	13,390	5,213	259.0	227.5	206.2	193.2	221.5	1,575
1 L - 23	1	14:52:00	14,040	5,466	271.7	233.8	212.2	195.6	228.3	1,624
1 L - 23	2	14:53:00	14,040	5,466	270.7	233.9	211.9	194.4	227.7	1,620
1 L - 23	4	14:55:00	14,040	5,466	271.6	235.4	213.2	194.4	228.7	1,627
1 L - 23	8	14:59:00	14,040	5,466	272.5	237.1	214.8	194.6	229.7	1,634
1 L - 24	1	15:02:00	14,830	5,695	284.1	243.6	221.2	196.2	236.3	1,681
1 L - 24	2	15:03:00	14,630	5,695	284.8	244.8	222.0	196.2	237.0	1,686
1 L - 24	4	15:05:00	14,630	5,695	284.6	245.5	222.5	195.7	237.0	1,686
1 L - 24	8	15:09:00	14,630	5,695	286.0	247.5	223.9	195.7	238.3	1,695
1 L - 25	1	15:11:00	15,190	5,913	297.2	255.2	229.9	197.5	245.0	1,742
1 L - 25	2	15:12:00	15,190	5,913	298.5	257.4	230.2	196.8	246.7	1,748
1 L - 25	4	15:14:00	15,190	5,913	300.3	260.6	231.3	196.8	247.2	1,759
1 L - 25	8	15:18:00	15,190	5,913	302.4	263.9	232.6	196.6	248.9	1,771
1 U - 1	1	15:20:30	12,180	4,743	268.4	232.1	197.7	165.1	215.8	1,535
1 U - 1	2	15:21:30	12,180	4,743	267.7	231.3	197.1	165.0	215.3	1,531
1 U - 1	4	15:23:30	12,180	4,743	266.8	230.4	196.6	165.1	214.7	1,528
1 U - 2	1	15:26:30	9,130	3,557	221.9	191.0	154.3	126.3	173.4	1,233
1 U - 2	2	15:27:30	9,130	3,557	221.4	190.6	154.1	126.0	173.0	1,231
1 U - 2	4	15:29:30	9,130	3,557	221.0	190.2	153.5	125.8	172.6	1,228
1 U - 3	1	15:32:30	6,080	2,371	163.8	140.9	101.5	78.7	121.2	862
1 U - 3	2	15:33:30	6,080	2,371	163.5	140.4	101.0	78.3	120.8	859
1 U - 3	4	15:35:30	6,080	2,371	163.0	140.1	100.5	78.2	120.4	857
1 U - 4	1	15:38:30	3,060	1,205	90.1	76.3	39.6	22.2	57.1	406
1 U - 4	2	15:39:30	3,080	1,305	89.8	75.7	39.1	22.1	56.7	403
1 U - 4	4	15:41:30	3,060	1,205	89.8	75.4	39.1	22.2	56.6	403
1 U - 5	1	15:44:30	0	0	-21.3	-21.8	-34.6	-47.7	-31.3	-223
1 U - 5	2	15:45:30	0	0	-22.5	-23.3	-35.6	-48.2	-32.4	-230
1 U - 5	4	15:47:30	0	0	-23.4	-24.2	-36.1	-48.5	-33.1	-235
1 U - 5	8	15:51:30	0	0	-24.7	-25.5	-36.9	-49.1	-34.1	-242

Strain Gage Readings and Loads at Level 3
TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Strain Gage Level 3					
			Pressure (psi)	Load (kips)	3A-1323498 (με)	3B-1323499 (με)	3C-1323500 (με)	3D-1323501 (με)	Av. Strain (με)	Load (kips)
1 L - 0	-	10:56:00	0	0	0.0	0.0	0.0	0.0	0.0	0
1 L - 1	1	11:17:00	650	261	4.5	-1.1	0.0	8.6	3.1	22
1 L - 1	2	11:18:00	650	261	5.0	-1.0	-0.1	8.8	3.1	22
1 L - 1	4	11:20:00	650	261	4.6	-1.1	-0.2	8.8	3.1	22
1 L - 1	8	11:24:00	650	261	4.5	-1.2	0.0	8.8	3.1	22
1 L - 2	1	11:26:00	1,260	498	5.8	-0.8	0.7	10.3	4.0	29
1 L - 2	2	11:27:00	1,260	498	6.1	-0.8	0.6	10.3	4.1	29
1 L - 2	4	11:29:00	1,260	498	5.9	-1.0	0.7	10.4	4.0	28
1 L - 2	8	11:33:00	1,260	498	6.0	-1.0	0.6	10.4	4.0	29
1 L - 3	1	11:35:00	1,910	751	7.2	-1.1	1.0	12.0	4.8	34
1 L - 3	2	11:36:00	1,910	751	7.1	-1.0	0.8	11.9	4.7	33
1 L - 3	4	11:38:00	1,910	751	7.2	-1.0	0.4	11.9	4.6	33
1 L - 3	8	11:42:00	1,910	751	7.1	-1.0	0.5	12.0	4.6	33
1 L - 4	1	11:43:30	2,480	972	8.4	-1.1	0.4	13.2	5.2	37
1 L - 4	2	11:44:30	2,480	972	8.2	-1.2	0.3	13.3	5.2	37
1 L - 4	4	11:46:30	2,480	972	8.2	-1.2	0.5	13.2	5.2	37
1 L - 4	8	11:50:30	2,480	972	6.1	-1.1	0.3	13.4	5.2	37
1 L - 5	1	11:52:00	3,090	1,209	9.2	-1.2	0.5	14.7	5.8	41
1 L - 5	2	11:53:00	3,090	1,209	9.1	-1.4	0.3	14.7	5.7	40
1 L - 5	4	11:55:00	3,090	1,209	9.1	-1.3	0.4	14.7	5.7	41
1 L - 5	8	11:59:00	3,090	1,209	8.8	-1.2	0.3	14.8	5.7	40
1 L - 6	1	12:01:00	3,660	1,431	10.2	-1.0	0.4	16.0	6.4	45
1 L - 6	2	12:02:00	3,660	1,431	10.5	-1.1	0.4	16.3	6.5	46
1 L - 6	4	12:04:00	3,660	1,431	10.2	-1.1	0.1	16.1	6.3	45
1 L - 6	6	12:08:00	3,660	1,431	10.2	-1.2	0.4	16.1	6.4	45
1 L - 7	1	12:09:30	4,210	1,645	11.2	-1.0	0.2	17.2	6.9	49
1 L - 7	2	12:10:30	4,210	1,645	11.3	-1.0	0.2	17.1	6.9	49
1 L - 7	4	12:12:30	4,210	1,645	11.2	-1.0	0.3	17.3	6.9	49
1 L - 7	8	12:16:30	4,210	1,645	10.9	-1.0	0.5	17.3	6.9	49
1 L - 8	1	12:20:00	4,890	1,909	12.1	-0.8	0.1	18.6	7.5	53
1 L - 8	2	12:21:00	4,690	1,909	12.2	-0.8	0.0	16.7	7.5	53
1 L - 8	4	12:23:00	4,890	1,909	12.1	-0.8	0.2	18.6	7.5	54
1 L - 8	8	12:27:00	4,890	1,909	12.4	-0.5	0.5	19.1	7.9	56
1 L - 9	1	12:28:30	5,470	2,134	12.9	-0.6	0.0	19.6	8.0	57
1 L - 9	2	12:29:30	5,470	2,134	12.6	-0.6	0.0	19.5	7.9	56
1 L - 9	4	12:31:30	5,470	2,134	12.7	-0.5	0.0	19.5	7.9	57
1 L - 9	8	12:35:30	5,470	2,134	12.8	-0.4	0.1	19.7	8.1	57
1 L - 10	1	12:37:00	6,100	2,379	13.3	-0.2	0.0	20.1	8.3	59
1 L - 10	2	12:38:00	6,100	2,379	13.5	-0.2	0.3	20.3	8.5	60
1 L - 10	4	12:40:00	6,100	2,379	13.5	-0.1	0.6	20.8	8.6	61
1 L - 10	8	12:44:00	6,100	2,379	13.6	0.1	0.6	20.7	8.7	62
1 L - 11	1	12:46:00	6,720	2,620	14.1	0.2	0.2	20.9	8.9	63
1 L - 11	2	12:47:00	6,720	2,620	14.1	0.2	0.3	20.9	8.9	63
1 L - 11	4	12:49:00	6,720	2,620	14.4	0.4	0.5	21.0	9.0	64
1 L - 11	8	12:53:00	6,720	2,620	14.3	0.6	0.6	21.1	9.1	65
1 L - 12	1	12:54:30	7,330	2,857	14.4	0.8	0.0	21.4	9.1	65
1 L - 12	2	12:55:30	7,330	2,857	14.8	0.6	0.3	21.4	9.3	66
1 L - 12	4	12:57:30	7,330	2,857	14.6	0.8	0.2	21.8	9.3	66
1 L - 12	8	13:01:30	7,330	2,857	15.1	1.0	0.6	21.9	9.6	69
1 L - 13	1	13:03:00	7,890	3,075	15.2	1.0	0.1	21.8	9.5	68
1 L - 13	2	13:04:00	7,890	3,075	15.7	1.1	0.4	21.9	9.8	70
1 L - 13	4	13:06:00	7,890	3,075	15.0	1.0	0.4	22.1	9.6	69
1 L - 13	8	13:10:00	7,890	3,075	15.6	1.4	0.9	22.3	10.0	71
1 L - 14	1	13:12:30	6,500	3,312	15.6	1.2	0.5	21.9	9.8	70
1 L - 14	2	13:13:30	8,500	3,312	15.6	1.4	0.4	22.0	9.9	70
1 L - 14	4	13:15:30	6,500	3,312	15.9	1.4	0.5	22.1	10.1	72
1 L - 14	8	13:19:30	6,500	3,312	15.9	1.7	0.6	22.3	10.1	72
1 L - 15	1	13:21:30	9,150	3,565	16.0	1.6	0.0	22.1	9.9	71
1 L - 15	2	13:22:30	9,150	3,565	16.0	1.6	0.7	22.1	10.0	71
1 L - 15	4	13:24:30	9,150	3,565	16.2	1.8	0.3	22.2	10.1	72
1 L - 15	8	13:28:30	9,150	3,565	16.4	2.1	1.0	22.6	10.5	75
1 L - 16	1	13:34:30	9,770	3,806	16.5	1.9	0.0	22.1	10.1	72
1 L - 16	2	13:35:30	9,770	3,806	16.3	1.9	0.3	22.3	10.2	73
1 L - 16	4	13:37:30	9,770	3,806	16.7	2.0	0.4	22.4	10.4	74
1 L - 16	8	13:41:30	9,770	3,806	17.2	2.6	0.7	22.8	10.6	77

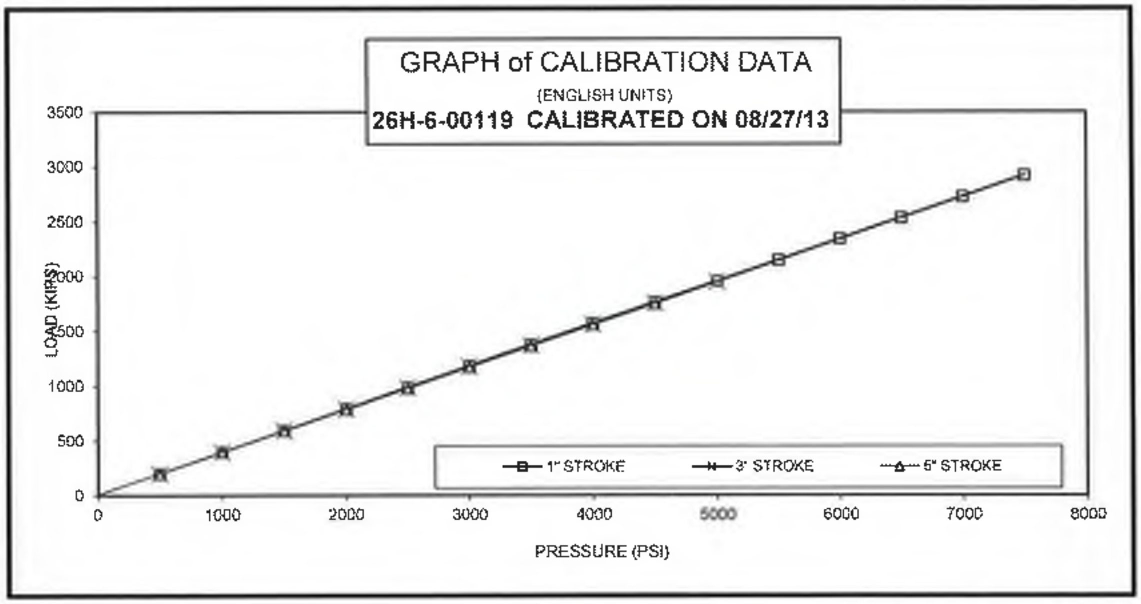
Strain Gage Readings and Loads at Level 3
TS-1 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell Pressure (psi)	O-cell Load (kips)	Strain Gage Level 3 3A-1323498 (με)	3B-1323499 (με)	3C-1323500 (με)	3D-1323501 (με)	Av. Strain (με)	Load (kips)
1 L - 17	1	13:50:30	10,320	4,020	18.5	3.5	0.7	23.5	11.6	82
1 L - 17	2	13:51:30	10,320	4,020	18.1	3.4	0.4	23.5	11.4	81
1 L - 17	4	13:53:30	10,320	4,020	18.2	3.1	-0.1	23.4	11.2	79
1 L - 17	8	13:57:30	10,320	4,020	18.5	3.5	0.2	23.5	11.4	81
1 L - 18	1	14:00:30	10,980	4,276	17.6	2.1	-1.5	22.8	10.2	73
1 L - 18	2	14:01:30	10,980	4,276	17.5	2.1	-1.4	22.7	10.2	73
1 L - 18	4	14:03:30	10,980	4,276	17.8	2.3	-1.3	23.0	10.5	74
1 L - 18	8	14:07:30	10,980	4,276	17.8	2.4	-1.1	22.9	10.5	75
1 L - 19	1	14:09:30	11,580	4,509	17.6	1.9	-2.4	22.3	9.9	70
1 L - 19	2	14:10:30	11,580	4,509	17.6	1.9	-2.4	22.3	9.8	70
1 L - 19	4	14:12:30	11,580	4,509	17.5	2.0	-2.3	22.3	9.9	70
1 L - 19	8	14:16:30	11,580	4,509	18.0	2.4	-2.2	22.7	10.2	73
1 L - 20	1	14:18:00	12,170	4,739	18.5	1.9	-2.8	22.3	10.0	71
1 L - 20	2	14:19:00	12,170	4,739	17.9	1.7	-3.5	22.2	9.6	68
1 L - 20	4	14:21:00	12,170	4,739	17.8	1.8	-3.5	22.1	9.6	68
1 L - 20	8	14:25:00	12,170	4,739	18.1	2.3	-3.2	22.5	9.9	70
1 L - 21	1	14:35:00	12,780	4,976	17.5	1.6	-4.7	21.1	8.8	63
1 L - 21	2	14:36:00	12,780	4,976	17.2	1.6	-4.7	21.2	8.8	63
1 L - 21	4	14:38:00	12,780	4,976	17.5	1.9	-4.7	21.2	9.0	64
1 L - 21	8	14:42:00	12,780	4,976	17.8	2.0	-4.3	21.5	9.3	66
1 L - 22	1	14:43:30	13,390	5,213	17.8	1.0	-5.8	20.9	8.5	60
1 L - 22	2	14:44:30	13,390	5,213	17.2	0.6	-6.8	20.4	7.9	56
1 L - 22	4	14:46:30	13,390	5,213	17.5	0.9	-6.4	20.5	8.1	56
1 L - 22	8	14:50:30	13,390	5,213	17.8	1.4	-6.8	21.1	8.4	60
1 L - 23	1	14:52:00	14,040	5,466	17.8	-0.2	-8.5	20.2	7.3	52
1 L - 23	2	14:53:00	14,040	5,466	17.5	-0.1	-9.1	20.2	7.1	51
1 L - 23	4	14:55:00	14,040	5,466	17.8	0.3	-8.6	20.5	7.5	53
1 L - 23	8	14:59:00	14,040	5,466	18.2	0.6	-8.5	20.9	7.8	55
1 L - 24	1	15:02:00	14,630	5,695	18.3	-0.7	-10.7	20.9	6.9	49
1 L - 24	2	15:03:00	14,630	5,695	18.4	-0.5	-10.9	21.1	7.0	50
1 L - 24	4	15:05:00	14,630	5,695	18.4	-0.3	-10.6	21.1	7.1	51
1 L - 24	8	15:09:00	14,630	5,695	18.7	0.2	-10.7	21.2	7.4	52
1 L - 25	1	15:11:00	15,190	5,913	18.8	-0.8	-12.2	20.8	6.6	47
1 L - 25	2	15:12:00	15,190	5,913	19.2	-0.8	-13.3	20.9	6.5	46
1 L - 25	4	15:14:00	15,190	5,913	18.7	-0.5	-13.4	21.6	6.6	47
1 L - 25	8	15:16:00	15,190	5,913	19.3	0.0	-13.7	21.6	6.8	48
1 U - 1	1	15:20:30	12,180	4,743	9.4	-5.3	-19.7	12.6	-0.7	-5
1 U - 1	2	15:21:30	12,180	4,743	9.6	-5.2	-19.6	12.7	-0.6	-4
1 U - 1	4	15:23:30	12,180	4,743	9.8	-5.2	-19.5	12.9	-0.5	-3
1 U - 2	1	15:26:30	9,130	3,557	-3.2	-12.0	-27.6	1.5	-10.3	-73
1 U - 2	2	15:27:30	9,130	3,557	-3.7	-11.9	-27.6	1.6	-10.4	-74
1 U - 2	4	15:29:30	9,130	3,557	-3.4	-11.7	-27.7	1.3	-10.3	-74
1 U - 3	1	15:32:30	6,080	2,371	-19.1	-19.8	-37.0	-12.1	-22.0	-156
1 U - 3	2	15:33:30	6,080	2,371	-19.2	-19.7	-37.3	-12.3	-22.1	-157
1 U - 3	4	15:35:30	6,080	2,371	-19.3	-19.4	-37.0	-11.8	-21.9	-155
1 U - 4	1	15:38:30	3,080	1,205	-39.6	-30.2	-48.4	-28.0	-36.6	-260
1 U - 4	2	15:39:30	3,080	1,205	-39.8	-29.6	-47.9	-28.2	-36.4	-259
1 U - 4	4	15:41:30	3,080	1,205	-39.8	-29.3	-47.9	-27.8	-36.2	-257
1 U - 5	1	15:44:30	0	0	-74.5	-45.2	-62.4	-49.3	-57.9	-412
1 U - 5	2	15:45:30	0	0	-74.4	-44.6	-62.2	-49.0	-57.5	-409
1 U - 5	4	15:47:30	0	0	-74.8	-44.1	-62.0	-49.0	-57.4	-409
1 U - 5	8	15:51:30	0	0	-75.3	-43.4	-61.0	-49.0	-57.2	-407

TS-1 - Hudson Yards Tower A
Manhattan, NY (LT-1240-1)

APPENDIX B

O-CELL AND INSTRUMENTATION CALIBRATION SHEETS



STROKE:	1 INCH	3 INCH	5 INCH
PRESSURE PSI	LOAD KIPS	LOAD KIPS	LOAD KIPS
0	0	0	0
500	199	196	199
1000	397	396	396
1500	595	594	590
2000	792	788	783
2500	986	982	977
3000	1182	1176	1171
3500	1376	1368	1363
4000	1570	1560	1557
4500	1763	1754	1749
5000	1956	1949	
5500	2148		
6000	2343		
6500	2534		
7000	2727		
7500	2921		

26" O-CELL, SERIAL # 26H-6-00119

LOAD CONVERSION FORMULA

LOAO = PRESSURE * 0.3887 + (8.19)
(KIPS) (PSI)

Regression Output:

Constant	8.1866	kips
X Coefficient	0.3887	kip / psi
R Square	1.0000	
No. of Observations	34	
Degrees of Freedom	32	
Std Err of Y Est	4.29	
Std Err of X Coeff	0.0004	

CALIBRATION STANDARDS:

All data presented are derived from 6" dia. certified hydraulic pressure gauges and electronic load transducer, manufactured and calibrated by the University of Illinois at Champaign, Illinois. All calibrations and certifications are traceable through the Laboratory Master Deadweight Gauges directly to the National Institute of Standards and Technology. No specific guidelines exist for calibration of load test jacks and equipment but procedures comply with similar guidelines for calibration of gages, ANSI specifications B40.1.

* AE & FC CUSTOMER: LOADTEST Inc
* AE & FC JOB NO: SO11013
* CUSTOMER P.O. NO.: LT-1240-2

* CONTRACTOR.: FRONTIER-KEMPER
* JOB LOCATION: NEW YORK, NY
* DATED: 08/27/13

SERVICE ENGINEER ______ DATE: 8-27-13

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323502

Cable Length: 56 feet

Prestress: 35,000 psi

Regression Zero: 7011

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7064	7063	7064		
1500	7712	7716	7714	650	-0.24
3000	8422	8427	8425	711	-0.22
4500	9147	9151	9149	724	0.30
6000	9847	9848	9848	699	-0.10
100	7063	7065	7064		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.354 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323503

Cable Length: 56 feet

Prestress: 35,000 psi

Regression Zero: 6957

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7012	7012	7012		
1500	7675	7675	7675	663	-0.31
3000	8411	8411	8411	736	-0.01
4500	9143	9143	9143	732	0.16
6000	9865	9865	9865	722	-0.02
100	7013	7012	7013		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.348 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323504

Cable Length: 56 feet

Prestress: 35,000 psi

Regression Zero: 7158

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7206	7214	7210		
1500	7873	7881	7877	667	-0.10
3000	8596	8603	8600	723	-0.08
4500	9321	9329	9325	725	0.05
6000	10039	10055	10047	722	0.06
100	7215	7224	7220		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.350 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St, Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323505

Cable Length: 56 feet

Prestress: 35,000 psi

Regression Zero: 6795

Temperature: 22.8 °C

Technician: KRogers

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	6848	6844	6846		
1500	7498	7496	7497	651	-0.26
3000	8218	8217	8218	721	0.12
4500	8925	8931	8928	710	0.16
6000	9630	9631	9631	703	-0.09
100	6844	6845	6845		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.354 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323506

Cable Length: 55 feet

Prestress: 35,000 psi

Regression Zero: 7202

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7259	7258	7259		
1500	7908	7909	7909	650	-0.25
3000	8623	8624	8624	715	-0.21
4500	9346	9342	9344	720	0.03
6000	10062	10061	10062	718	0.16
100	7259	7260	7260		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.353 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323507

Cable Length: 55 feet

Prestress: 35,000 psi

Regression Zero: 7260

Temperature: 22.8 °C

Technician: KRogers

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7311	7308	7310		
1500	7987	7988	7988	678	-0.14
3000	8722	8730	8726	738	0.09
4500	9457	9464	9461	735	0.19
6000	10183	10182	10183	722	-0.14
100	7309	7320	7315		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.346 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

<u>Users are advised to establish their own zero conditions.</u>

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323508

Cable Length: 55 feet

Prestress: 35,000 psi

Regression Zero: 6882

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	6938	6938	6938		
1500	7602	7604	7603	665	-0.29
3000	8339	8338	8339	736	-0.07
4500	9074	9071	9073	734	0.08
6000	9799	9803	9801	728	0.06
100	6938	6940	6939		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.347 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323509

Cable Length: 55 feet

Prestress: 35,000 psi

Regression Zero: 7182

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7235	7232	7234		
1500	7888	7892	7890	656	-0.22
3000	8613	8609	8611	721	0.01
4500	9325	9330	9328	717	0.08
6000	10042	10036	10039	711	-0.02
100	7233	7236	7235		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.352 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

<u>Users are advised to establish their own zero conditions.</u>

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323510

Cable Length: 54 feet

Prestress: 35,000 psi

Regression Zero: 7197

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7250	7259	7255		
1500	7914	7918	7916	661	-0.32
3000	8648	8649	8649	733	-0.17
4500	9383	9388	9386	737	0.13
6000	10110	10114	10112	726	0.07
100	7258	7263	7261		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.347 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323511

Cable Length: 54 feet

Prestress: 35,000 psi

Regression Zero: 7126

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7183	7178	7181		
1500	7836	7839	7838	657	-0.24
3000	8557	8556	8557	719	-0.23
4500	9287	9285	9286	729	0.16
6000	10002	9999	10001	715	0.02
100	7178	7184	7181		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.351 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St, Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323512

Cable Length: 54 feet

Prestress: 35,000 psi

Regression Zero: 7086

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7142	7138	7140		
1500	7792	7797	7795	655	-0.18
3000	8511	8508	8510	715	-0.14
4500	9227	9228	9228	718	0.01
6000	9942	9947	9945	717	0.12
100	7139	7142	7141		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.353 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323513

Cable Length: 54 feet

Prestress: 35,000 psi

Regression Zero: 7169

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7226	7224	7225		
1500	7865	7868	7867	642	-0.22
3000	8563	8571	8567	700	-0.33
4500	9280	9281	9281	714	0.03
6000	9987	9990	9989	708	0.18
100	7225	7226	7226		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.356 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 150 mm

Calibration Date: August 14, 2013

Serial Number: 1321872

Temperature: 23.4 °C

Calibration Instruction: CI-4400

Technician:

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2404	2403	2404	-0.29	-0.19	-0.03	-0.02
30.0	3397	3398	3398	30.10	0.07	30.06	0.04
60.0	4383	4382	4383	60.22	0.15	60.02	0.02
90.0	5362	5360	5361	90.14	0.09	89.95	-0.04
120.0	6339	6338	6339	120.03	0.02	119.99	-0.01
150.0	7311	7311	7311	149.77	-0.16	150.02	0.01

(mm) Linear Gage Factor (G): **0.03058** **(mm/ digit)**

Regression Zero: **2413**

Polynomial Gage Factors: **A: 7.8004E-08** **B: 0.02982** **C:**

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): **0.001204** **(inches/digit)**

Polynomial Gage Factors: **A: 3.071E-09** **B: 0.001174** **C:**

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear,** $D = G(R_1 - R_0)$

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 150 mm

Calibration Date: August 14, 2013

Serial Number: 1321873

Temperature: 23.4 °C

Calibration Instruction: CI-4400

Technician:

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2468	2466	2467	-0.28	-0.18	-0.03	-0.02
30.0	3462	3458	3460	30.12	0.08	30.05	0.03
60.0	4444	4443	4444	60.22	0.15	60.00	0.00
90.0	5423	5422	5423	90.19	0.13	89.97	-0.02
120.0	6398	6398	6398	120.05	0.03	119.99	-0.01
150.0	7369	7369	7369	149.77	-0.15	150.02	0.01

(mm) Linear Gage Factor (G): 0.03061 (mm/ digit)

Regression Zero: 2476

Polynomial Gage Factors: A: 8.081E-08 B: 0.02981 C:

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001205 (inches/digit)

Polynomial Gage Factors: A: 3.1815E-09 B: 0.001174 C:

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear, $D = G(R_1 - R_0)$**

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 150 mm

Calibration Date: August 14, 2013

Serial Number: 1321875

Temperature: 23.4 °C

Calibration Instruction: CI-4400

Technician:

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2495	2492	2494	-0.32	-0.21	-0.05	-0.03
30.0	3487	3486	3487	30.13	0.08	30.07	0.05
60.0	4470	4469	4470	60.27	0.18	60.05	0.03
90.0	5445	5444	5445	90.16	0.11	89.95	-0.03
120.0	6418	6416	6417	119.98	-0.01	119.93	-0.05
150.0	7389	7389	7389	149.78	-0.14	150.05	0.04

(mm) Linear Gage Factor (G): 0.03066 **(mm/ digit)**

Regression Zero: 2504

Polynomial Gage Factors: **A:** 8.4079E-08 **B:** 0.02983 **C:** ____________

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001207 **(inches/digit)**

Polynomial Gage Factors: **A:** 3.3102E-09 **B:** 0.001174 **C:** ____________

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear, $D = G(R_1 - R_0)$**

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

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GEOKON
48 Spencer St, Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 150 mm

Serial Number: 1321876

Calibration Instruction: CI-4400

Calibration Date: August 14, 2013

Temperature: 23.4 °C

Technician:

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2484	2481	2483	-0.38	-0.25	-0.03	-0.02
30.0	3480	3479	3480	30.11	0.07	30.04	0.03
60.0	4466	4466	4466	60.28	0.18	60.01	0.00
90.0	5447	5445	5446	90.24	0.16	89.98	-0.01
120.0	6421	6419	6420	120.03	0.02	119.98	-0.02
150.0	7387	7391	7389	149.66	-0.22	150.02	0.01

(mm) Linear Gage Factor (G): **0.03058** **(mm/ digit)**

Regression Zero: **2495**

Polynomial Gage Factors: **A:** **1.0782E-07** **B:** **0.02952** **C:** ____

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): **0.001204** **(inches/digit)**

Polynomial Gage Factors: **A:** **4.245E-09** **B:** **0.001162** **C:** ____

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear,** $D = G(R_1 - R_0)$

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

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APPENDIX C

O-CELL METHOD FOR DETERMINING CREEP LIMIT LOADING

O-CELL METHOD FOR DETERMINING A CREEP LIMIT LOADING ON THE EQUIVALENT TOP-LOADED SHAFT (September, 2000)

Background: O-cell testing provides a sometimes useful method for evaluating that load beyond which a top-loaded drilled shaft might experience significant unwanted creep behavior. We refer to this load as the "creep limit," also sometimes known as the "yield limit" or "yield load".

To our knowledge, Housel (1959) first proposed the method described below for determining the creep limit. Stoll (1961), Bourges and Levillian (1988), and Fellenius (1996) provide additional references. This method also follows from long experience with the pressuremeter test (PMT). Figure 8 and section 9.4 from ASTM D4719-94, reproduced below, show and describe the creep curve routinely determined from the PMT. The creep curve shows how the movement or strain obtained over a fixed time interval, 30 to 60 seconds, changes versus the applied pressure. One can often detect a distinct break in the curve at the pressure P_e in Figure 8. Plastic deformations may become significant beyond this break loading and progressively more severe creep can occur.

Definition: Similarly with O-cell testing using the ASTM Quick Method, one can conveniently measure the additional movement occurring over the final time interval at each constant load step, typically 2 to 4 minutes. A break in the curve of load vs. movement (as at P_e with the PMT) indicates the creep limit.

We usually indicate such a creep limit in the O-cell test for either one, or both, of the side shear and end bearing components, and herein designate the corresponding movements as M_{CL1} and M_{CL2}. We then combine the creep limit data to predict a creep limit load for the equivalent top loaded shaft.

Procedure if both M_{CL1} and M_{CL2} available: Creep cannot begin until the shaft movement exceeds the M_{CL} values. A conservative approach would assume that creep begins when movements exceed the lesser of the M_{CL} values. However, creep can occur freely only when the shaft has moved the greater of the two M_{CL} values. Although less conservative, we believe the latter to match behavior better and therefore set the creep limit as that load on the equivalent top-loaded movement curve that matches the greater M_{CL}.

Procedure if only M_{CL1} available: If we cannot determine a creep limit in the second component before it reaches its maximum movement M_x, we treat M_x as M_{CL2}. From the above method one can say that the creep limit load exceeds, by some unknown amount, that obtained when using $M_{CL2} = M_x$.

Procedure if no creep limit observed: Then, according to the above, the creep limit for the equivalent top-loaded shaft will exceed, again by some unknown amount, that load on the equivalent curve that matches the movement of the component with the maximum movement.

Limitations: The accuracy in estimating creep limits depends, in part, on the scatter of the data in the creep limit plots. The more scatter, the more difficult to define a limit. The user should make his or her own interpretation if he or she intends to make important use of the creep limit interpretations. Sometimes we obtain excessive scatter of the data and do not attempt an interpretation for a creep limit and will indicate this in the report.

Excerpts from ASTM D4719
"Standard Test Method for Pressuremeter Testing in Soils"

> 9.4 For Procedure A, plot the volume increase readings (V_{60}) between the 30 s and 60 s reading on a separate graph. Generally, a part of the same graph is used, see Fig. 8. For Procedure B, plot the pressure decrease reading between the 30 s and 60 s reading on a separate graph. The test curve shows an almost straight line section within the range of either low volume increase readings (V_{60}) for Procedure A or low pressure decrease for Procedure B. In this range, a constant soil deformation modulus can be measured. Past the so-called creep pressure, plastic deformations become prevalent.

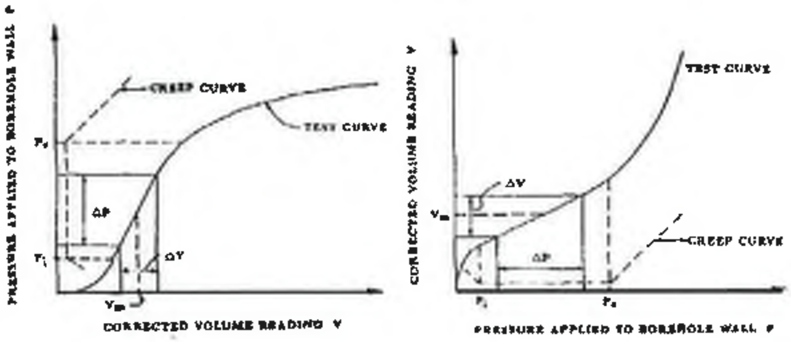


FIG. 8 Pressuremeter Test Curves for Procedure A

References

Housel, W.S. (1959), "Dynamic & Static Resistance of Cohesive Soils", ASTM STP 254, pp. 22-23.

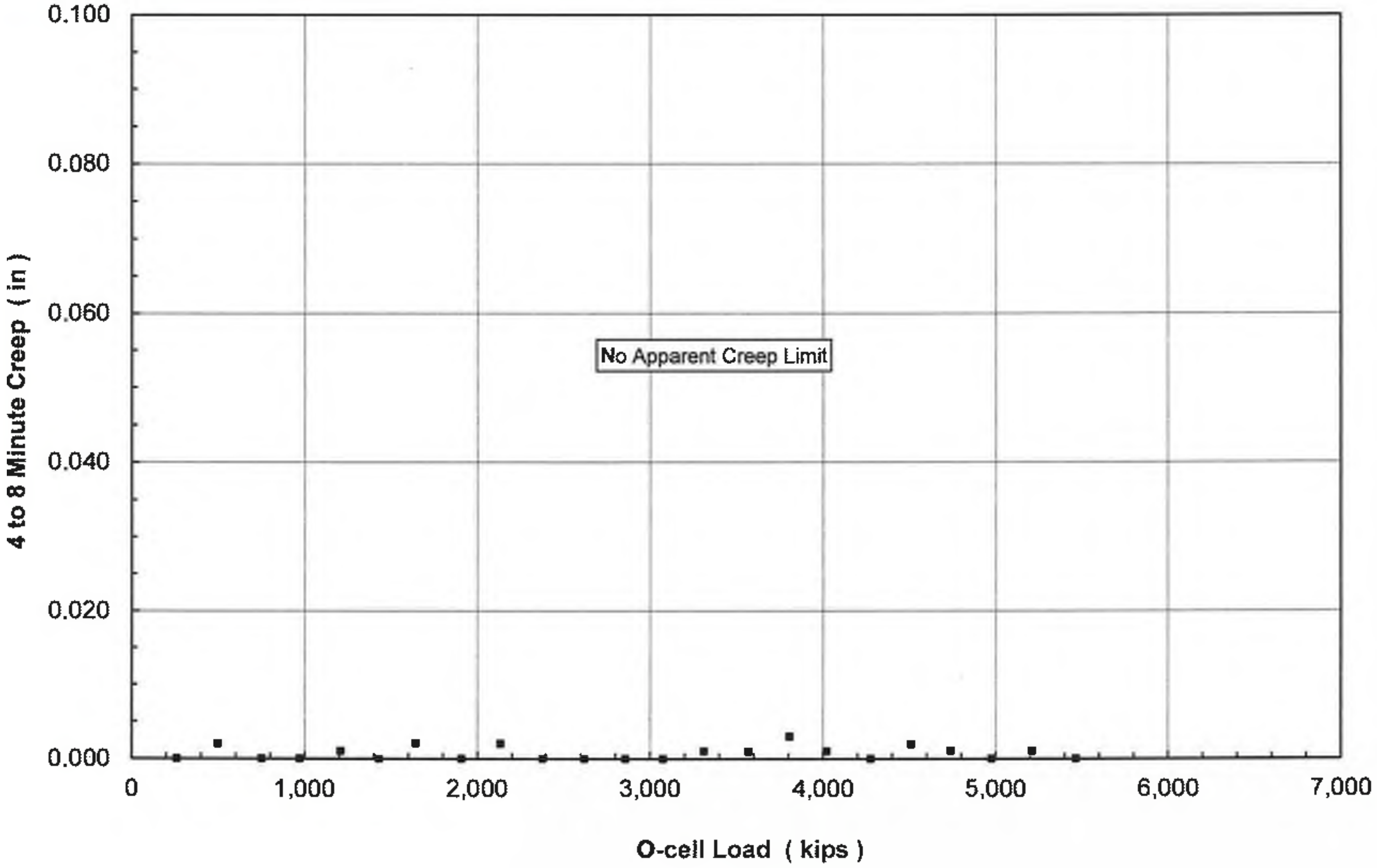
Stoll, M.U.W. (1961, Discussion, Proc. 5th ICSMFE, Paris, Vol. III, pp. 279-281.

Bourges, F. and Levillian, J-P (1988), "force portante des rideaux plans metalliques charges verticalmement," Bull. No. 158, Nov.-Dec., des laboratoires des ponts et chaussees, p. 24.

Fellenius, Bengt H. (1996), Basics of Foundation Design, BiTech Publishers Ltd., p.79.

Combined End Bearing and Lower Side Shear Creep Limit

TS-1 - Hudson Yards Tower A - Manhattan, NY

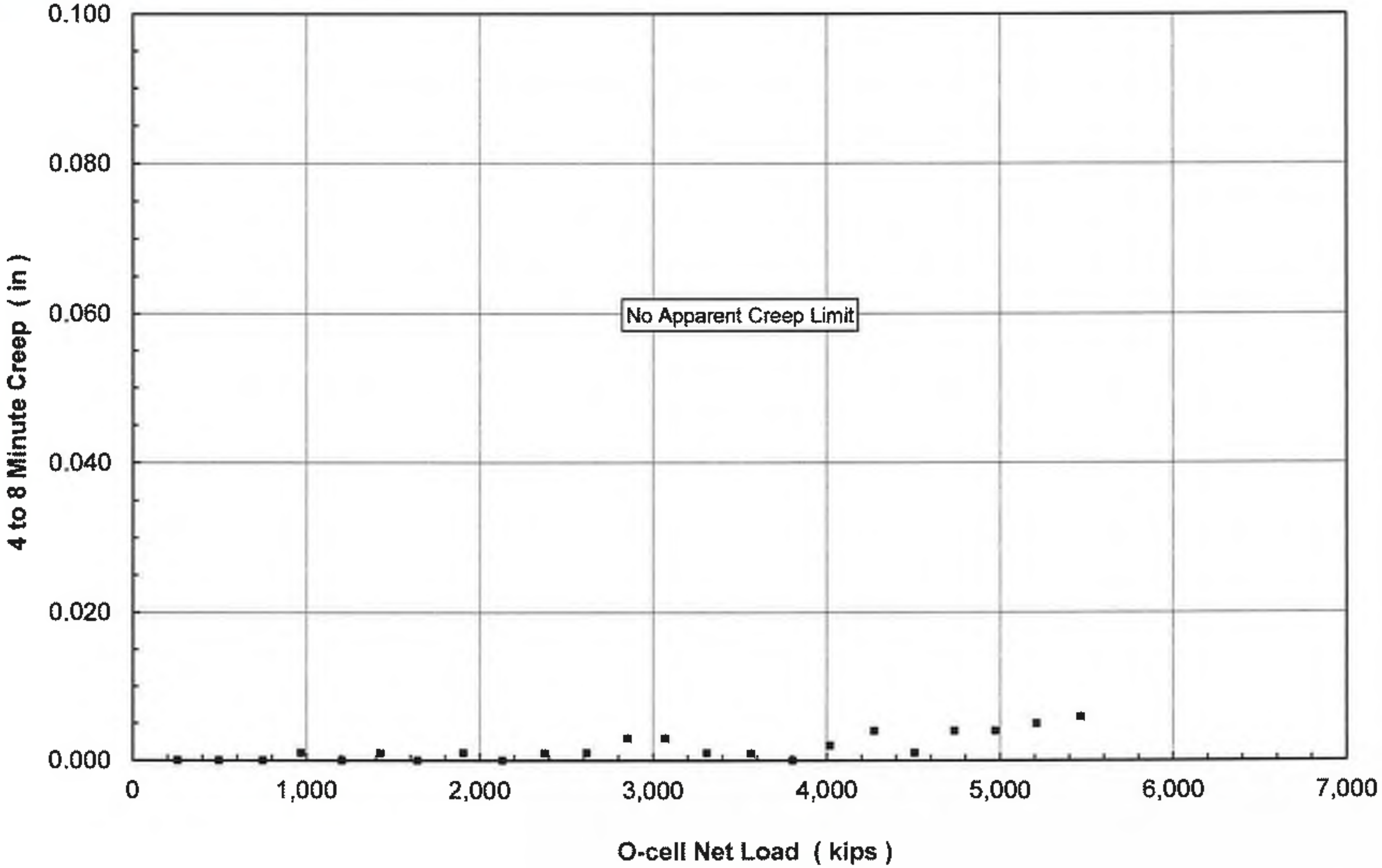


Loadtest USA Project No. LT-1240-1

Figure C-1

Upper Side Shear Creep Limit

TS-1 - Hudson Yards Tower A - Manhattan, NY



Loadtest USA Project No. LT-1240-1

Figure C-2

APPENDIX D

SOIL BORING LOG

DEPT OF BLDGS 121192618 Job Number

ES901087107 Scan Code

LANGAN

LOG OF BORING BH-5 SHEET 1 OF 4

PROJECT	HUDSON YARDS - PLATFORM BORINGS
PROJECT NO.	170019118
LOCATION	EAST RAIL YARDS (ERY)
ELEVATION AND DATUM	EL 7:
DRILLING AGENCY	WARREN GEORGE, INC.
DATE STARTED	6/2/2013
DATE FINISHED	6/2/13
DRILLING EQUIPMENT	Turret
COMPLETION DEPTH	32'
ROCK DEPTH	17' ±
SIZE AND TYPE OF BIT	2⅞ & 5⅞ diameter tricone roller bit
NO. SAMPLES	DIST. 5 · UNDIST. 0 · CORE 3
CASING	3-inch-diameter flush joint steel casing
WATER LEVEL	FIRST NA · COMPL. NA · 24 HR NA
CASING HAMMER	-
WEIGHT	-
DROP	-
FOREMAN	Jim Wilson/Eddie Cardona
SAMPLER	2-inch-diameter split spoon
SAMPLER HAMMER	Donut
WEIGHT	140 lbs
DROP	30 in
INSPECTOR	Jason Healy

NYC BC	MATERIAL SYMBOL	SAMPLE DESCRIPTION	CASING (Bl/ft) or CORE TIME (min)	DEPTH SCALE	SAMPLES NO LOC	TYPE	RECOV FT	PENETR RESIST BL/6 IN
Class 7	GRAVEL	Railroad 18" BALLAST (Poorly Graded Gravel)		0–1.5				
Class 7	CONCRETE	18" Concrete Slab		1.5–3				
Class 7	FILL	Brown c-f SAND, some gravel, trace silt, little rock fragments SAMPLE ES-1 taken during hand augering 4'-7'	SPIN	3–7	ES-1	EN		
SAND	3b	glacial sands brown c-f sand, little f gravel, trace silt		7–9	ES-2	SS	[illegible]	9 8 10 12
		Weathered rock fragments		9–10	ES-3	SS		21 50/1"
Weathered Rock	Class 1d	Weathered Rock (?)	SPIN	10–14	S-1			50/2"

REMARKS (DRILLING FLUID, DEPTH OF CASING, CASING BLOWS, FLUID LOSS, ETC.)

3:00 am
- Clear ballast by hand w/shovel

3:15 am [illegible] drilling
[illegible]
- [illegible] 3:35 am
[illegible] to 4'-7'
- Collect ES-1
- [illegible] casing to 4' - 4:05 am
- Roller Bit to 7'
- [illegible]
- Take ES-2 [illegible]
- [illegible] be
- Install casing to 9'
- Drill to 10'
- Take SS @ 10' - 50/2"
- no recovery
- Drill to 15' - Hard drilling
- to 15' -

LANGAN

JOB NO. 170019118
DATE: 6/21/2013

LOG OF BORING NO. BH- 5
SHEET 2 OF 4

NYC BC	MATERIAL SYMBOL	SAMPLE DESCRIPTION	CORE TIME (min/ft)	DEPTH SCALE	NO. LOC	TYPE	RECOV. FT.	PENETR RESIST BL/6 IN.	PID	Odor
Class 1d		Weathered Rock		14–15	S-2	SS	6"	100/1"		
				15–17						
		GRAY MODERATELY WEATHERED, SLIGHTLY TO MODERATELY FRACTURED MICA SCHIST WITH INTRUSIONS OF PEGMATITE AND DIP ANGLE APPROX 45° FROM HORIZ	5MIN 5MIN 4MIN 6MIN 7MIN	17–22	C-1	NX-CORE	RQD = 35IN/60IN = 58%	TCR = 48IN/60IN = 80%		
		GRAY SLIGHTLY WEATHERED SLIGHTLY TO MODERATELY FRACTURED MICA SCHIST WITH TRACE PEGMATITE INTRUSIONS AND DIP ANGLE APPROX 50° FROM HORIZONTAL	6MIN 5MIN 6MIN 8MIN 6MIN	22–27	C-2	NX-CORE	RQD = 33IN/60IN = 55%	TCR: 52IN/60IN = 87%		
		GRAY SLIGHTLY TO MODERATELY WEATHERED, SLIGHTLY TO MODERATELY FRACTURED MICA SCHIST WITH DIP ANGLE APPROX 30° FROM HORIZONTAL [CLASS 1B]	4MIN 4MIN 4MIN 6MIN	27–31	C-3	NX-CORE	RQD = 41IN/60IN = 68%	TCR = 57IN/60IN = 95%		

REMARKS (DRILLING FLUID, DEPTH OF CASING, CASING BLOWS, FLUID LOSS, ETC.)

- [illegible] to 16.5'
- [illegible] drilling @ 16.5'
- 6/21/2013 - LANGAN & WARREN GEORGE ARRIVE AT 6:00AM
- LIRR [illegible] & SET UP FROM 6:00AM TO 7:14AM
- INSTALLED 5FT OF 3-INCH-DIAMETER CASING FROM 10FT TO 15FT FROM 7:14AM TO 7:24AM
- INSTALL 2 FT OF 3-INCH-DIAMETER CASING [illegible] FROM 7:27AM TO 7:31AM
- DRILL TO 16.5 FEET USING 2 7/8" DIAMETER TRI-CONE ROLLER BIT
  - SOME ROD CHATTER FROM 16 TO 16.5'
- BROWN WASH
- ADD [illegible] TUB
- BEGIN CORING C-1 W/ NX-CORE BARREL [illegible] AT 7:45AM
- COMPLETE CORE @ 8:10AM
- INSTALL 2 FEET OF CASING FROM 15' TO 17' FROM 8:26AM TO 8:35AM
- START CORE C-2 W/NX-CORE BARREL @ 8:53AM
- END CORE C-2 W/NX-CORE BARREL @ 9:20AM
- START CORE C-3 W/NX-CORE BARREL @ 9:43AM
- END CORE C-3 @ 10:06AM
- DRILLERS GO ON BREAK FROM 10:15AM TO 10:30AM

LANGAN

JOB NO. **170019118**

DATE:

LOG OF BORING NO. BH - 5

SHEET 3 OF 4

NYC BC	MATERIAL SYMBOL	SAMPLE DESCRIPTION	TIME TO CORE (MIN)	CASING (B/FT) or CORE TIME (min/ft)	DEPTH SCALE	SAMPLES NO. LOC	TYPE	RECOV FT.	PENETR RESIST BL/6 IN.	PID	Odor	REMARKS (DRILLING FLUID, DEPTH OF CASING, CASING BLOWS, FLUID LOSS, ETC.)
			5MIN		31							
		END OF BORING @ 32' b.g.s.			32							
					33							
					34							
					35							
					36							
					37							
					38							
					39							
					40							
					41							
					42							
					43							
					44							
					45							
					46							
					47							

LANGAN
ENGINEERING & ENVIRONMENTAL SERVICES

JOB NO. 170019115
DATE 61

LOG OF BORING NO. BH-5

SHEET 4 OF 4

	SAMPLE DESCRIPTION	DEPTH SCALE	NO.LOC.	TYPE	RECOV. FT.	PENETR. RESIST BL/6 in.	REMARKS (DRILLING FLUID, DEPTH OF CASING, CASING BLOWS, FLUID LOSS, ETC.)
	3 in 4 in	68 69 70 71 72					Fractured rock stuck in bit for 2nd time and clogging up bit. [illegible] rods [illegible] time and restart C-12 @ 1:32AM - End C-12 @ 1:51AM - End of boring @ 70' - Demobilize from BH-4 and move to BH-5 (2:15AM - 3:15AM)

APPENDIX E

CONCRETE STRENGTH ESTIMATE

DEPT OF BLDGS121192618 Job Number ES783101590 Scan Code

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REPORT ON CONCRETE FIELD AND LABORATORY TEST RESULTS

(NYC DEPARTMENT OF BUILDINGS CONCRETE TESTING LABORATORY LICENSE #73)

Project ID:	**68S7.02**	Inspection Date:	**09/16/2013**
Project:	**Perini - Hudson Yards Platform**	Created On:	**09/27/2013**
Address:	**401 10th Ave New York 10019**	Yards Placed:	
Client:	**Perini**		

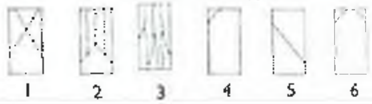
To:

CC: Duke Samala
*

Attention:

Concrete:	*Sampling of Concrete (ASTM C172), Slump (ASTM C143), Air Content (ASTM C23 Pressure I / C173 Volume), Unit Weight (ASTM C138), Temperature (ASTM C1064),Casting Specimen (ASTM C31) Compressive Strength (ASTM C39)*
SSC:	*Slump flow, T50 VSI (ASTM C1611), J-ring Flow (ASTM C1621), Seggregation Probe (FHWA method)*

ASTM C39 Break Types



Cast Date:	09/16/2013	Sample Type:	Concrete Cylinders	Slump, Inches:		Air,%(Pressure):	1.3
Set No:	1	Curing Method:	Standard Curing	Conc Temp, F:	80	Unit Weight, pcf:	149.2
Truck No:		Load No:		Mix Class, psi:	12000	Mix Type:	
Location:	401 10th ave. Ny, Ny 10019						
Remarks:							

Sample Id	Barcode No	Age	Test Date	Size, Inches	Area	Load, lbs	Stress,psi	% Str	Brk Type	Tested By	Remarks
13CCY-56090	00043437	1	09/17/2013	4 x 8	12.57	1080	90	1	2	David Santos	17Hrs@8:30am
13CCY-56091	00043443	1	09/17/2013	4 x 8	12.57	1985	160	1	2	David Santos	17Hrs@8:30am
13CCY-56092	00043441	1	09/17/2013	4 x 8	12.57	1920	150	1	2	David Santos	17Hrs@8:30am
13CCY-56093	00043442	1	09/17/2013	4 x 8	12.57	2690	210	2	2	David Santos	18Hrs@9:30am
13CCY-56094	00043446	1	09/17/2013	4 x 8	12.57	2535	200	2	2	David Santos	18Hrs@9:30am
13CCY-56095	00043445	1	09/17/2013	4 x 8	12.57	2585	210	2	3	David Santos	18Hrs@9:30am
13CCY-56096	00043444	1	09/17/2013	4 x 8	12.57	14320	1140	10	2	denis kireyev	24Hrs@3:30PM
13CCY-56097	00043449	1	09/17/2013	4 x 8	12.57	15010	1190	10	2	denis kireyev	24Hrs@3:30PM
13CCY-56098	00043447	1	09/17/2013	4 x 8	12.57	14955	1190	10	3	denis kireyev	24Hrs@3:30PM
13CCY-56099	00043448	3	09/19/2013	4 x 8	12.57	115820	9210	77	3	denis kireyev	
13CCY-56100	00043438	3	09/19/2013	4 x 8	12.57	114480	9110	76	1	denis kireyev	
13CCY-56101	00043439	3	09/19/2013	4 x 8	12.57	112840	8980	75	2	denis kireyev	
13CCY-56102	00043440	7	09/23/2013	4 x 8	12.57	154190	12270	100+	2	Denis Kireyev	
13CCY-56103	00043434	7	09/23/2013	4 x 8	12.57	157250	12510	100+	2	denis kireyev	
13CCY-56104	00043435	7	09/23/2013	4 x 8	12.57	156610	12460	100+	3	denis kireyev	
13CCY-56105	00043426	28	10/14/2013	4 x 8							
13CCY-56106	00043432	28	10/14/2013	4 x 8							
13CCY-56107	00043427	28	10/14/2013	4 x 8							
13CCY-58108	00043431	11	09/27/2013	4 x 8	12.57	173620	13810	100+	2	Denis Kireyev	
13CCY-56109	00043430	11	09/27/2013	4 x 8	12.57	175020	13920	100+	3	denis kireyev	
13CCY-56110	00043433	11	09/27/2013	4 x 8	12.57	172110	13690	100+	2	denis kireyev	
13CCY-56111	00043429	56	11/11/2013	4 x 8							
13CCY-56112	00043428	58	11/11/2013	4 x 8							
13CCY-56113		56	11/11/2013	4 x 8							
13CCY-56114		56	11/11/2013	4 x 8							

Average Strength: 1 Days: 500; 3 Days: 9100; 7 Days: 12410; 11 Days: 13810;

Field Tech: Paing Soe, ACI # 01252259, Expiry Date: 10/25/2017

Lab Tech: Kireyev Denis, ACI # 01136707, Expiry Date: 01/21/2017; Santos David, ACI # 01210580, Expiry Date: 01/21/2017

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REPORT ON CONCRETE FIELD AND LABORATORY TEST RESULTS

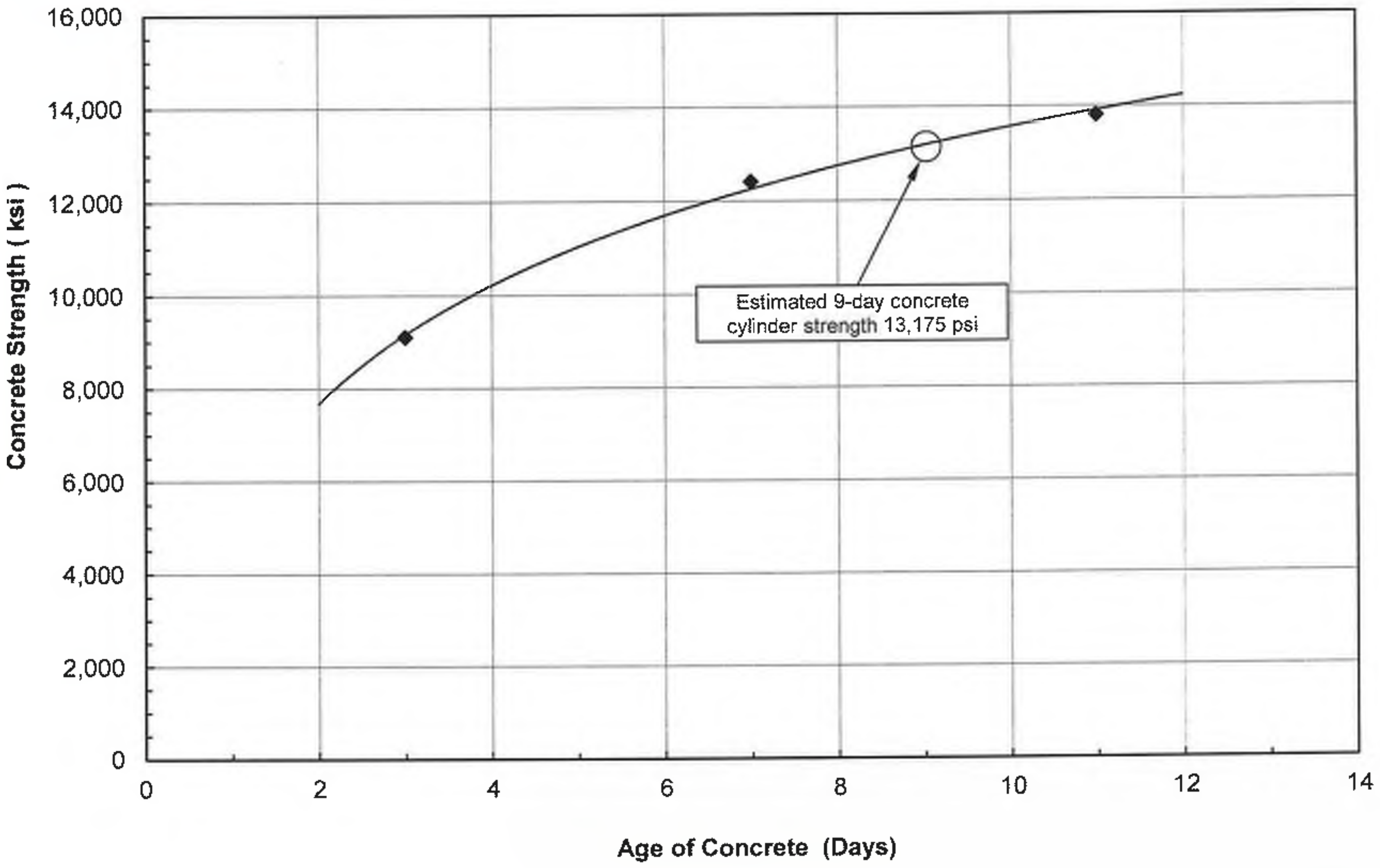
(NYC DEPARTMENT OF BUILDINGS CONCRETE TESTING LABORATORY LICENSE #73)

Project ID:	**6857.02**	Inspection Date:	**09/16/2013**
Project:	**Perini - Hudson Yards Platform**	Created On:	**09/27/2013**
Address:	**401 10th Ave New York 10019**	Yards Placed:	
Client:	**Perini**		

Edward Torossian, PE
Lab Director

Concrete Strength vs. Age (logarithmic approximation)

TS-1 - Hudson Yards Tower A - Manhattan, NY



Estimated 9-day concrete cylinder strength 13,175 psi

Loadtest USA Project No. LT-1240-1

Figure E-1

DATA REPORT

REPORT ON DRILLED SHAFT LOAD TESTING (OSTERBERG METHOD)

TS-2 - Hudson Yards Tower A
Manhattan, NY (LT-1240-2)

Prepared for: **Frontier-Kemper Constructors, Inc.**
415 Fifth Avenue
Pelham, NY 10803

Attention: **Mr. Paul Dixit, P.E.**

PROJECT NO: **LT-1240-2, October 01, 2013**

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LOADTEST USA is a division of Fugro Consultants Inc.
www.loadtest.com

LOADTEST

October 01, 2013

Frontier-Kemper Constructors, Inc.
415 Fifth Avenue
Pelham, NY 10803

Attention: Mr. Paul Dixit, P.E.

Load Test Report: TS-2 - Hudson Yards Tower A
Location: Manhattan, NY (LT-1240-2)

Dear Mr. Dixit,

The enclosed report contains the data and analysis summary for the Osterberg Cell (O-cell) test performed on TS-2 - Hudson Yards Tower A, on September 26, 2013. For your convenience, we have included an executive summary of the test results in addition to our standard detailed data report.

We would like to express our gratitude for the on-site and off-site assistance provided by your team and we look forward to working with you on future projects.

We trust that the information contained herein will suit your current project needs. If you have any questions or require further technical assistance, please do not hesitate to contact us at 352-378-3717.

Best Regards,

Shing K. Pang, P.E.
Regional Manager, Loadtest USA

TS-2 - Hudson Yards Tower A
Manhattan, NY (LT-1240-2)

EXECUTIVE SUMMARY

On September 26, 2013, Loadtest USA performed an O-cell test on the nominal 36-inch diameter test shaft TS-2. Frontier-Kemper Constructors, Inc. completed construction of the 34.91-foot deep shaft socketed in bedrock on September 16, 2013. Sub-surface conditions at the test shaft location consist primarily of overburden underlain by mica schist. Representatives of Langan Engineering, Inc. and others observed construction and testing of the shaft.

The maximum sustained bi-directional load applied to the shaft was 5,703 kips. At the maximum load, the displacements above and below the O-cell assembly were 0.201 inches and 0.314 inches, respectively. Unit side shear data indicated a mobilized average net side shear of 129 ksf between the O-cell and the top of concrete. The maximum applied unit end bearing is calculated to be 588 ksf. Unit values correspond to the above respective displacements.

LIMITATIONS OF EXECUTIVE SUMMARY

We include this executive summary to provide a very brief presentation of some of the key elements of this O-cell test. It is by no means intended to be a comprehensive or stand-alone representation of the test results. The full text of the report and the attached appendices contain important information which the engineer can use to come to more informed conclusions about the data presented herein.

TS-2 - Hudson Yards Tower A
Manhattan, NY (LT-1240-2)

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- Field Data & Data Reduction, Appendix A.
- O-cell and Instrumentation Calibration Sheets, Appendix B.
- O-cell Method for Determining Creep Limit Loading, Appendix C.
- Soil Boring Log, Appendix D.
- Concrete Strength Estimate, Appendix E.

SITE CONDITIONS AND SHAFT CONSTRUCTION

Site Sub-surface Conditions: The sub-surface stratigraphy at the general location of the test shaft is reported to consist of overburden underlain by mica schist. The generalized subsurface profile is included in Figure A and a boring log indicating conditions near the shaft is presented in Appendix E. More detailed geologic information can be obtained from Langan Engineering, Inc.

Test Shaft Construction: Frontier-Kemper Constructors, Inc. completed construction of the dedicated test shaft socketed in rock on September 16, 2013. The nominal 36-inch diameter test shaft was excavated to a base elevation of -26.23 ft. The shaft was started by installing a 48-inch O.D. casing, drilling out the overburden and casting a plug of concrete to seal the casing tip. A down-the-hole hammer was used for excavating the rock socket. Note that some groundwater seeped into the shaft during drilling. A mini-SID was used to inspect the shaft base. After the shaft was approved for concrete placement, the carrying frame with attached O-cell assembly was inserted into the excavation and temporarily supported from the steel casing. Concrete was then delivered by pump into the base of the shaft until the top of the concrete reached an elevation of -20.10 ft. Representatives of Langan Engineering, Inc. and others observed construction of the shaft.

OSTERBERG CELL TESTING

Shaft Instrumentation: Test shaft instrumentation and assembly was carried out under the direction of Loadtest USA. The loading assembly consisted of one 26-inch diameter O-cell, located 1.45 feet above the shaft base. The Osterberg cell was calibrated to 2,917 kips and then welded closed prior to shipping by American Equipment and Fabricating Corporation. Calibrations of the O-cell and instrumentation used for this test are included in Appendix B. O-cell testing instrumentation included:

- Paired shaft compression telltale casing (nominal ½-inch steel pipe) attached diametrically opposed to the carrying frame, extending from the top of the O-cell assembly to ground level.
- Four Linear Vibrating Wire Displacement Transducers (LVWDTs, Geokon Model 4450 series) positioned between the lower and upper plates of the O-cell assembly.
- Three levels of four sister bar vibrating wire strain gages (Geokon Model 4911 Series) attached at approximately 90° spacing to the carrying frame above the O-cell assembly (see Figure B).

- Two lengths of steel pipe, extending from the top of the shaft to the top of the bottom plate, to vent the break in the shaft formed by the expansion of the O-cell.

Details concerning the instrumentation placement appear in Table B and Figures A & B. The strain gages were positioned as directed by Langan Engineering, Inc.

Test Arrangement: Throughout the load test, key elements of shaft displacement response were monitored using the equipment and instruments described herein:

- Top of shaft displacement was monitored using a pair of automated digital survey levels (Leica NA3000 series) from a distance of approximately 24.8 feet (Appendix A, Pages 1 & 2).

- Shaft compression displacement was measured using two ¼-inch telltale rods positioned inside the casing and monitored by LVWDTs attached to the top of the shaft (Appendix A, Pages 1 & 2).

- Expansion of the O-cell assembly was measured using the four Expansion LVWDTs described under Shaft Instrumentation (Appendix A, Pages 3 & 4).

Both a Bourdon pressure gage and a vibrating wire pressure transducer were used to measure the pressure applied to the O-cell at each load interval. The pressure transducer was used for automatically setting and maintaining loads, real time plotting and for data analysis. The Bourdon pressure gage readings were used as a real-time visual reference and as a check on the transducer. There was close agreement between the Bourdon gage and the pressure transducer.

Data Acquisition: All instrumentation were connected through a data logger (Data Electronics 615 GeoLogger) to a laptop computer allowing data to be recorded and stored automatically at 30-second intervals and displayed in real time. The same laptop computer synchronized to the data logging system was used to acquire the Leica NA3000 data.

Testing Procedures: Testing was begun by pressurizing the O-cell in order to break the tack welds that hold it closed (for handling and for placement in the shaft) and to form the fracture plane in the concrete surrounding the base of the O-cell. After the break occurred, the pressure was immediately released and the testing commenced. Zero readings for all instrumentation were taken prior to the preliminary weld-breaking load-unload cycle, which in this case involved a maximum applied load of 472 kips to the shaft at the O-cell elevation.

The Osterberg cell load test was conducted as follows: The 26-inch diameter O-cell, with its base located 1.45 feet above the shaft base, was pressurized in 21 nominally equal increments, resulting in a maximum bi-directional load of 5,703 kips applied to the combined end bearing and lower side shear shaft section below the O-cell and the upper side shear above. The loading was halted after increment 1L-21 because the anticipated ultimate loads had already been exceeded. The O-cell was then de-pressurized in five decrements and the test was concluded.

The load increments were applied using the Quick Load Test Method for Individual Piles (ASTM D1143 *Standard Test Method for Piles Under Static Axial Load*). Each successive load increment was held constant for eight minutes by automatically adjusting the O-cell pressure. Approximately one minute was used to move between increments. The data logger automatically recorded the instrument readings every 30 seconds, but herein only the 1, 2, 4 and 8 minute readings during each increment of maintained load are reported.

TEST RESULTS AND ANALYSES

General: The loads applied by the O-cell assembly act in two opposing directions, resisted by the capacity of the shaft above and below. For the purpose of the analysis herein, it is assumed that the O-cell does not impose an additional upward load until its expansion force exceeds the buoyant weight of the shaft above the O-cell. Therefore, *net load*, which is defined as gross O-cell load minus the buoyant weight of the shaft above, is used to determine side shear resistance above the O-cell and to construct the equivalent top load displacement curve. For this test a shaft buoyant weight of 3 kips above the O-cell was calculated.

Upper Side Shear Resistance: The maximum upward *net load* applied to the upper side shear was 5,700 kips which occurred at load interval 1L-21 (Appendix A, Figures 1 to 3). At this loading, the upward displacement of the top of the O-cell was 0.201 inches.

Combined End Bearing and Lower Side Shear Resistance: The maximum downward load applied was 5,703 kips which occurred at load interval 1L-21 (Appendix A, Page 6, Figures 1 to 3). At this loading, the average downward displacement of the O-cell base was 0.314 inches.

Strain Gage Analysis: The strain gage data is tabulated in Appendix A. On the day of the test, the unconfined compressive strength f'_c was estimated to be 13,808 psi (see Appendix E). Using the reported concrete unit weight γ_c of 149.2 pcf, the ACI formula ($E_c = 0.033 \times \gamma_c^{1.5} \times \sqrt{f'_c}$) was used to calculate an elastic modulus for the concrete. This, combined with the area of reinforcing steel and nominal shaft diameter, provided an average shaft stiffness (AE) of 7,129,000 kips. Figure 4 plots the average strain at each level during the test. Figure 5 plots the total increase in shaft load versus elevation for each load increment. Defining the load transfer zones as shown in Table A and after subtracting the buoyant shaft weight in each zone above the O-cell, Figure 6 plots the net unit side shear versus displacement (t-z) curves for each zone. Shear values for loading increment 1L-21 follow in Table A:

TABLE A: Average Net Unit Side Shear Values for 1L-21

Load Transfer Zone	Displacement[1]	Net Unit Side Shear[2]
Zero Shear to Strain Gage Level 3	↑ 0.19 in	109 ksf
Strain Gage Level 3 to Strain Gage Level 2	↑ 0.19 in	197 ksf
Strain Gage Level 2 to Strain Gage Level 1	↑ 0.19 in	108 ksf
Strain Gage Level 1 to O-cell	↑ 0.20 in	113 ksf
Zero Shear to O-cell (Rock Socket Average)	↑ 0.20 in	129 ksf

[1] Average displacement of load transfer zone. Note that net unit shear values derived from the strain gages may not be ultimate values. See Figures 6 for unit shear vs. displacement plots.

[2] For upward-loaded shear, the buoyant weight of shaft in each zone has been subtracted from the load shed in the respective zone.

The load resisted in side shear in the 1.45-foot shaft section below the O-cell is calculated to be 1,546 kips assuming a unit side shear value of 113 ksf and a nominal shaft diameter of 36.0 inches. The maximum applied load to end bearing is 4,157 kips and the unit end bearing at the base of the shaft is calculated to be 588 ksf at the above noted displacement. A mobilized unit end bearing curve is presented in Figure 7.

Creep Limit: See Appendix C for our O-cell method for determining creep limit loading. The combined end bearing and lower side shear creep data (Appendix A, Figure C-1) indicate that no apparent creep limit was reached at a maximum displacement of 0.314 inches. The upper side shear creep data (Appendix A, Figure C-2) indicate that no apparent creep limit was reached at a maximum displacement of 0.201 inches. A top loaded shaft will not begin creep until both components begin creep displacement. This will occur at the maximum of the displacements required to reach the creep limit for each component. Due to the absence of a clearly defined shaft component creep limits, a creep limit for the equivalent top-loaded shaft cannot be estimated.

Shaft Compression Comparison: The measured maximum shaft compression, averaged from two telltales, is 0.016 inches at 1L-21 (Appendix A). Using a shaft stiffness of 7,129,000 kips and the load distribution in Figure 5 at 1L-21, an elastic compression of 0.014 inches over the length of the compression telltales is calculated. This agreement provides evidence that the values of the estimated shaft stiffness are reasonable.

LIMITATIONS AND STANDARD OF CARE

The instrumentation, testing services and data analysis provided by Loadtest USA, outlined in this report, were performed in accordance with the accepted standards of care recognized by professionals in the drilled shaft and foundation engineering industry.

Please note that some of the information contained in this report is based on data (i.e. shaft diameter, elevations and concrete strength) provided by others. The engineer, therefore, should come to his or her own conclusions with regard to the analyses as they depend on this information. In particular, Loadtest USA typically does not observe and record drilled shaft construction details to the level of precision that the project engineer may require. In many cases, we may not be present for the entire duration of shaft construction. Since construction technique can play a significant role in determining the load bearing capacity of a drilled shaft, the engineer should pay close attention to the drilled shaft construction details that were recorded elsewhere.

We trust that this information will meet your current project needs. If you have any questions, please do not hesitate to contact us at 352-378-3717.

Prepared for Loadtest USA by

Jon Sinnreich, M. Eng.

Reviewed for Loadtest USA by

Shing K. Pang, P.E.

Robert C. Simpson, M.S.

TABLE B
SUMMARY OF DIMENSIONS, ELEVATIONS & SHAFT PROPERTIES

Shaft: (TS-2 - Hudson Yards Tower A - Manhattan, NY)
Nominal shaft diameter (EL -20.10 ft to -26.23 ft) = 36 in
O-cell: 26H-6-00118 = 26 in
Length of shaft zone above break at base of O-cell = 4.68 ft
Length of shaft zone below break at base of O-cell = 1.45 ft
Side shear area above O-cell base = 44.1 ft^2
Side shear area below O-cell base = 13.7 ft^2
Shaft base area = 7.1 ft^2
Bouyant weight of shaft above base of O-cell = 3 kips
Estimated shaft stiffness, AE (EL -20.10 ft to -26.23 ft) = 7,129,000 kips

Elevation of ground surface = +8.68 ft
Elevation of water table = -3.00 ft
Elevation of top of shaft concrete = -20.10 ft
Elevation of base of O-cell assembly [1] = -24.78 ft
Elevation of shaft base = -26.23 ft

Casings:
Elevation of top of permanent casing (48.0 in O.D., 47.0 in I.D.) = +12.60 ft
Elevation of bottom of permanent casing (48.0 in O.D., 47.0 in I.D.) = -4.01 ft

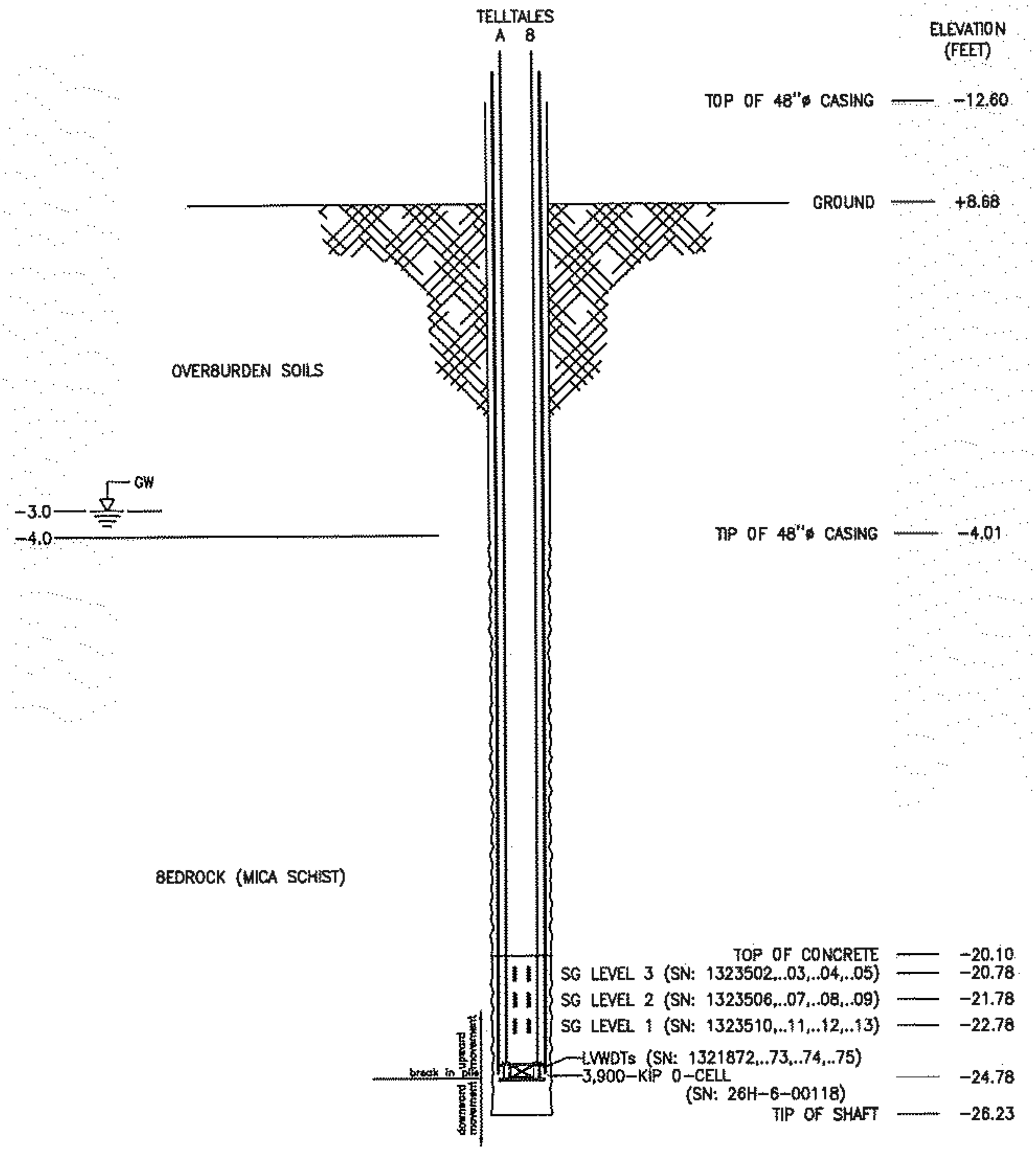
Telltale Sections:
Elevation of top of telltale used for upper shaft compression = +8.68 ft
Elevation of bottom of telltale used for upper shaft compression = -23.64 ft

Strain Gages:
Elevation of Strain Gage Level 3 = -20.78 ft
Elevation of Strain Gage Level 2 = -21.78 ft
Elevation of Strain Gage Level 1 = -22.78 ft

Miscellaneous:
Top plate diameter (2.0 inch thick) = 30 in
Bottom plate diameter (2.0 inch thick) = 30 in
Carrying Frame Section (EL. +16.39 ft to -23.64, 2 No.) = C5x6.7
Estimated 10 day unconfined compressive concrete strength = 13,561 psi
Assumed concrete unit weight = 149.2 pcf
O-cell LVWDTs @ 0°, 90°, 180° and 270° with radius = 14.5 in

[1] The break between upward and downward movement at the O-cell assembly

NOTE: NOMINAL SHAFT DIAMETER 36"Ø



BASED ELEVATIONS PROVIDED BY TUTOR PERINI

LOADTEST
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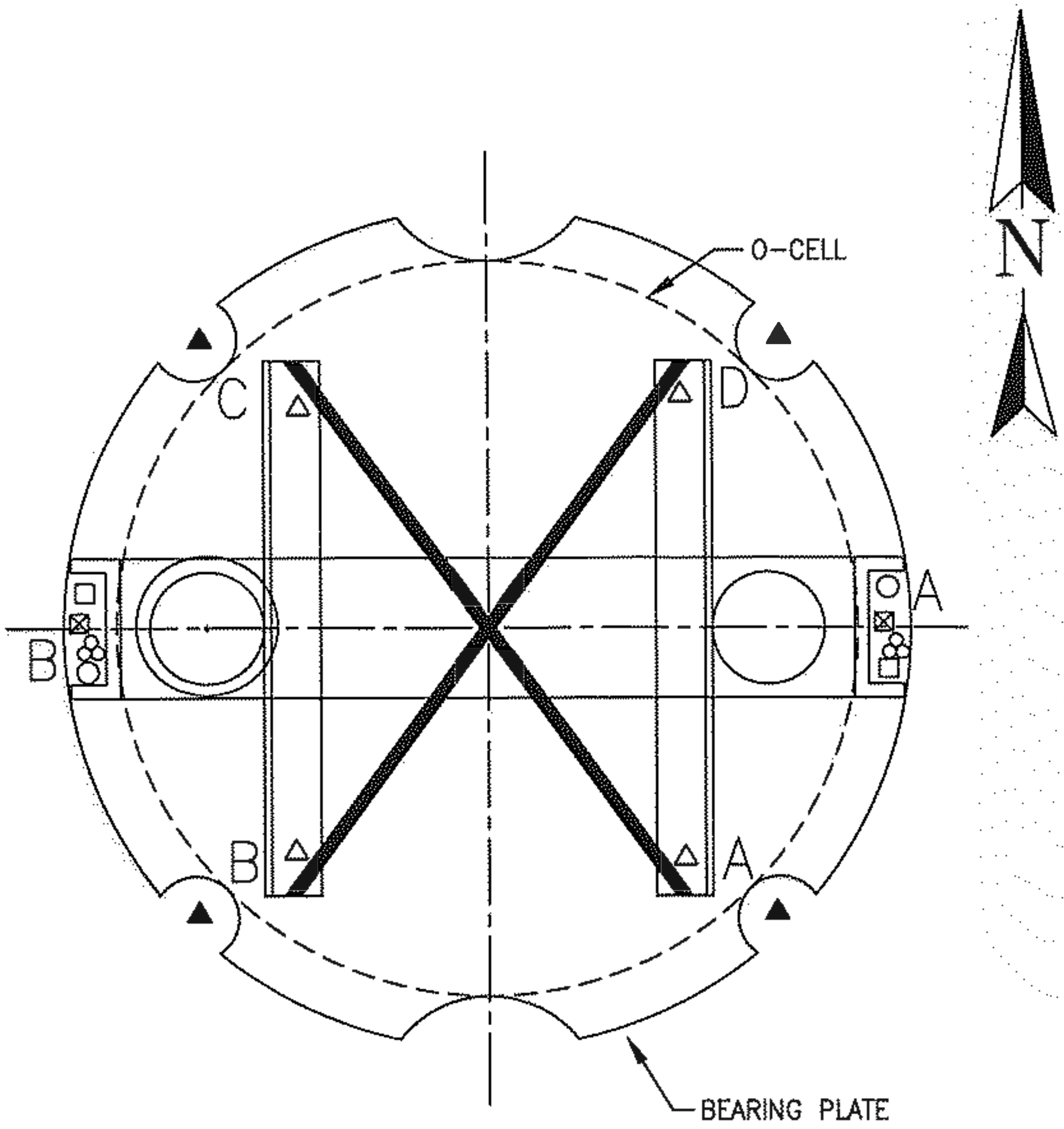
Gainesville, FL 32606
Phone: 800-368-1138
FAX: 352-378-3934

AS BUILT SECTION OF TEST SHAFT
HUDSON YARDS TOWER A – MANHATTAN, NY

DWN BY: AJS	DATE: 30 Sep 2013	CHECKED BY:	LT-1240-2
REVISED BY:	DATE:	SCALE: NTS	**FIGURE A**



LEGEND:

STRAIN GAGE	△
LVWDT	▲
TELLTALE	○
VENT PIPE	□
HYDRAULIC HOSES	☒
CABLE BUNDLE	∴

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www.LOADTEST.com

2631-D NW 41st St.
Gainesville, FL 32606
Phone: 800-368-1138
FAX: 352-378-3934

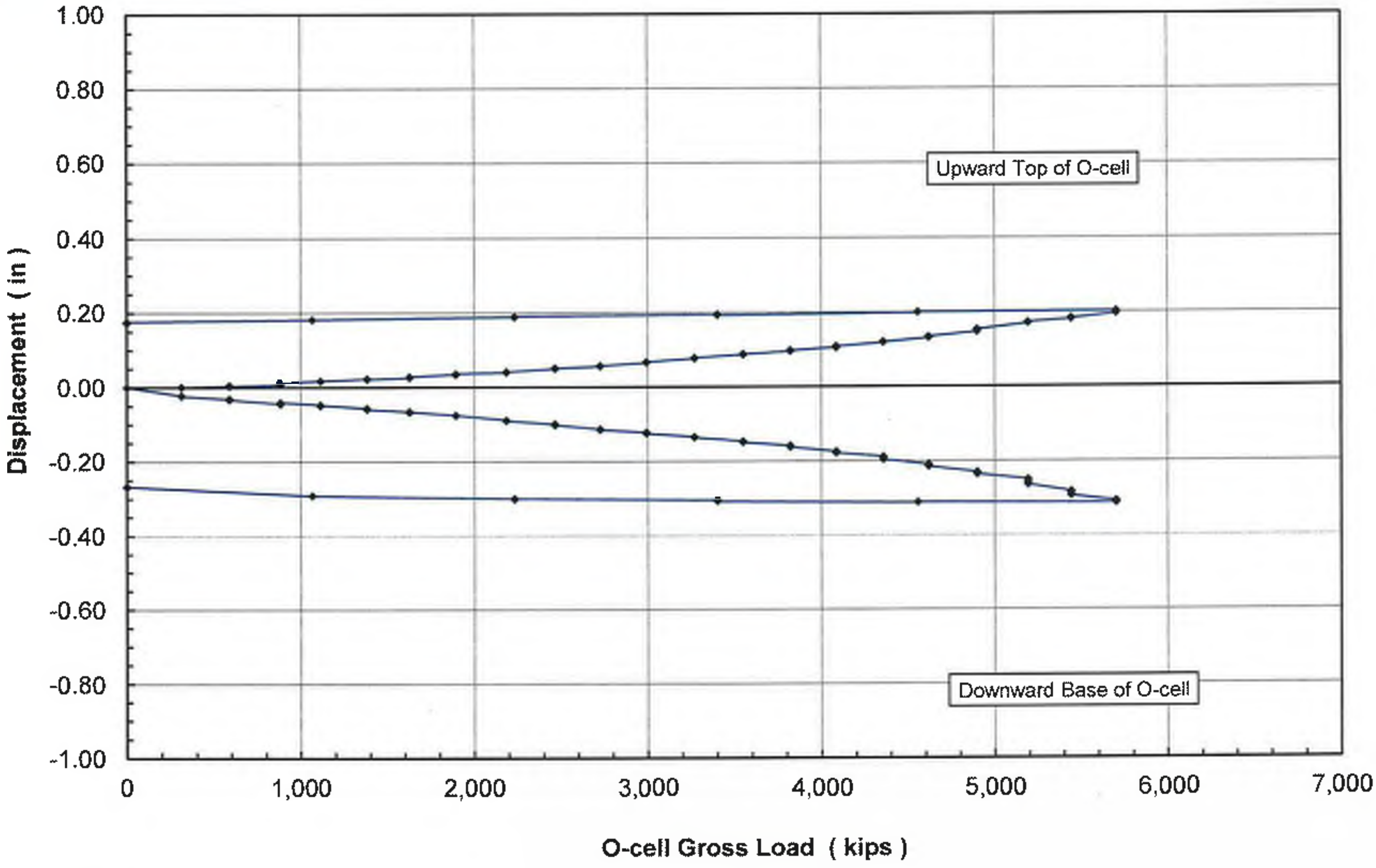
INSTRUMENTATION LAYOUT

Hudson Yards Tower A – Manhattan, NY

DWN BY: AJS	DATE: 30 Sep 2013	CHECKED BY: SKP	LT-1240-2
REVISED BY:	DATE:	SCALE: NTS	**FIGURE B**

Osterberg Cell Load-Displacement

TS-2 - Hudson Yards Tower A - Manhattan, NY

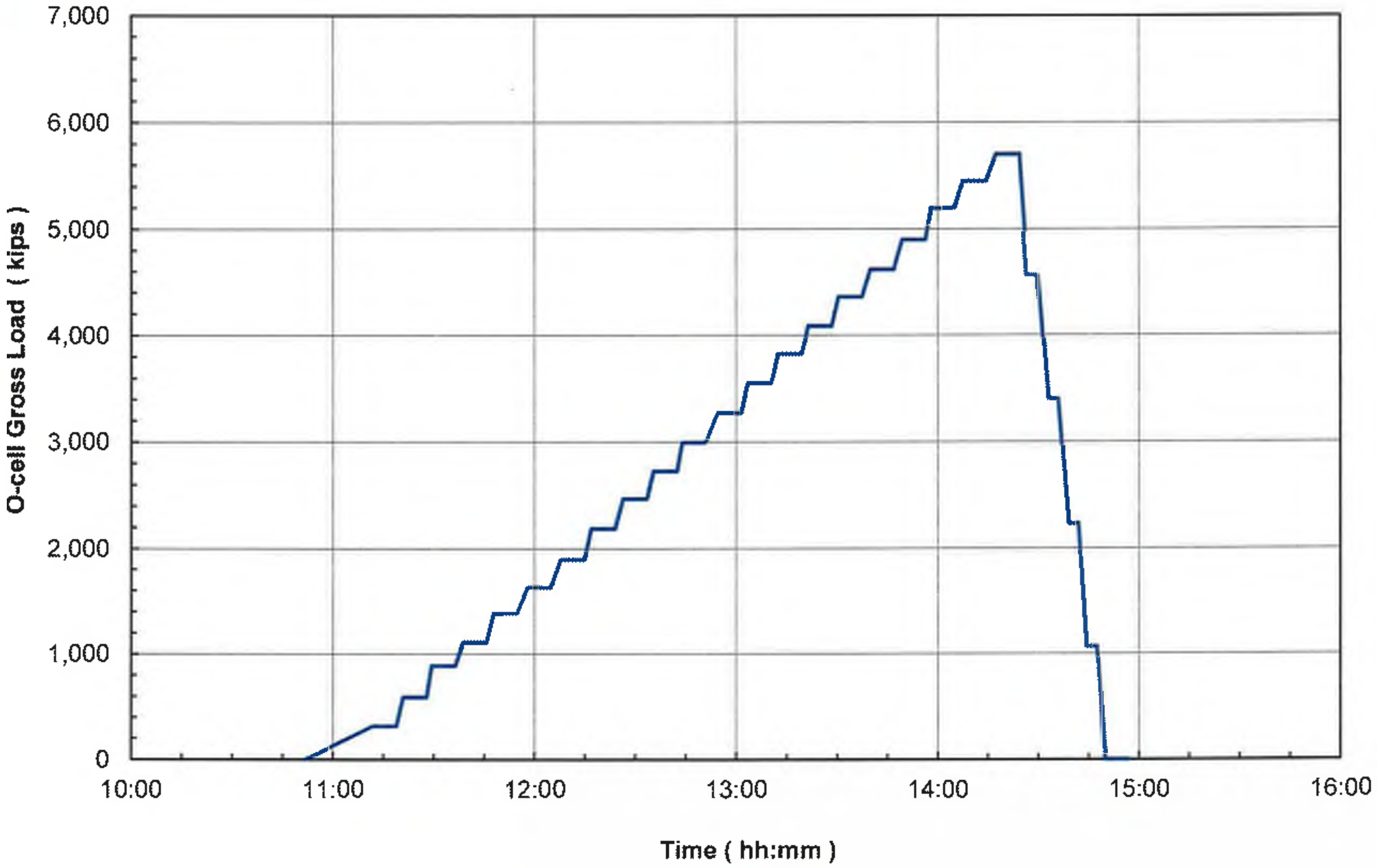


Loadtest USA Project No. LT-1240-2

Figure 1 of 7

Time-Osterberg Cell Load

TS-2 - Hudson Yards Tower A - Manhattan, NY

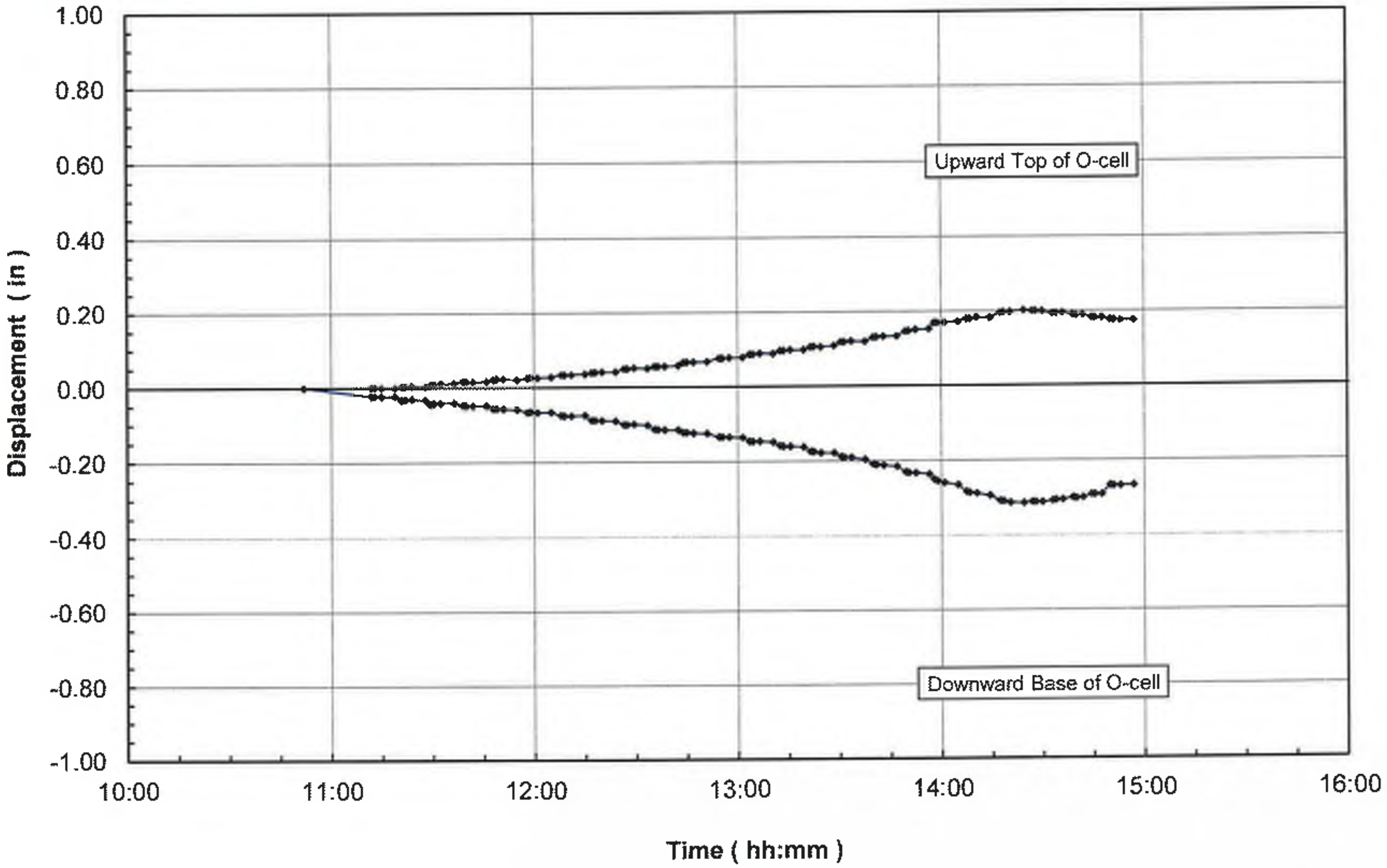


Loadtest USA Project No. LT-1240-2

Figure 2 of 7

Time-Osterberg Cell Displacement

TS-2 - Hudson Yards Tower A - Manhattan, NY



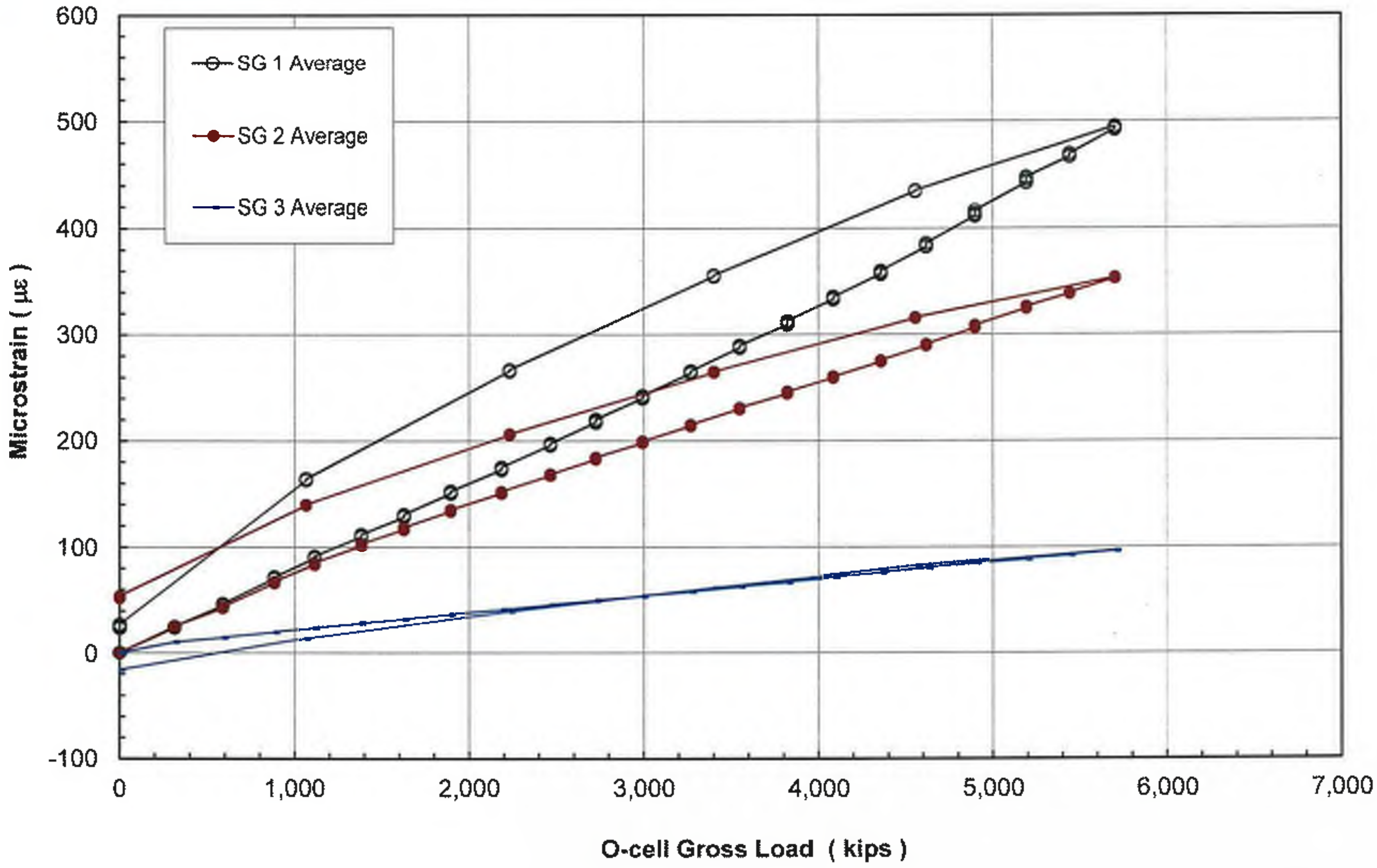
Loadtest USA Project No. LT-1240-2

Figure 3 of 7

LOADTEST

O-cell Load-Strain Gage Microstrain

TS-2 - Hudson Yards Tower A - Manhattan, NY

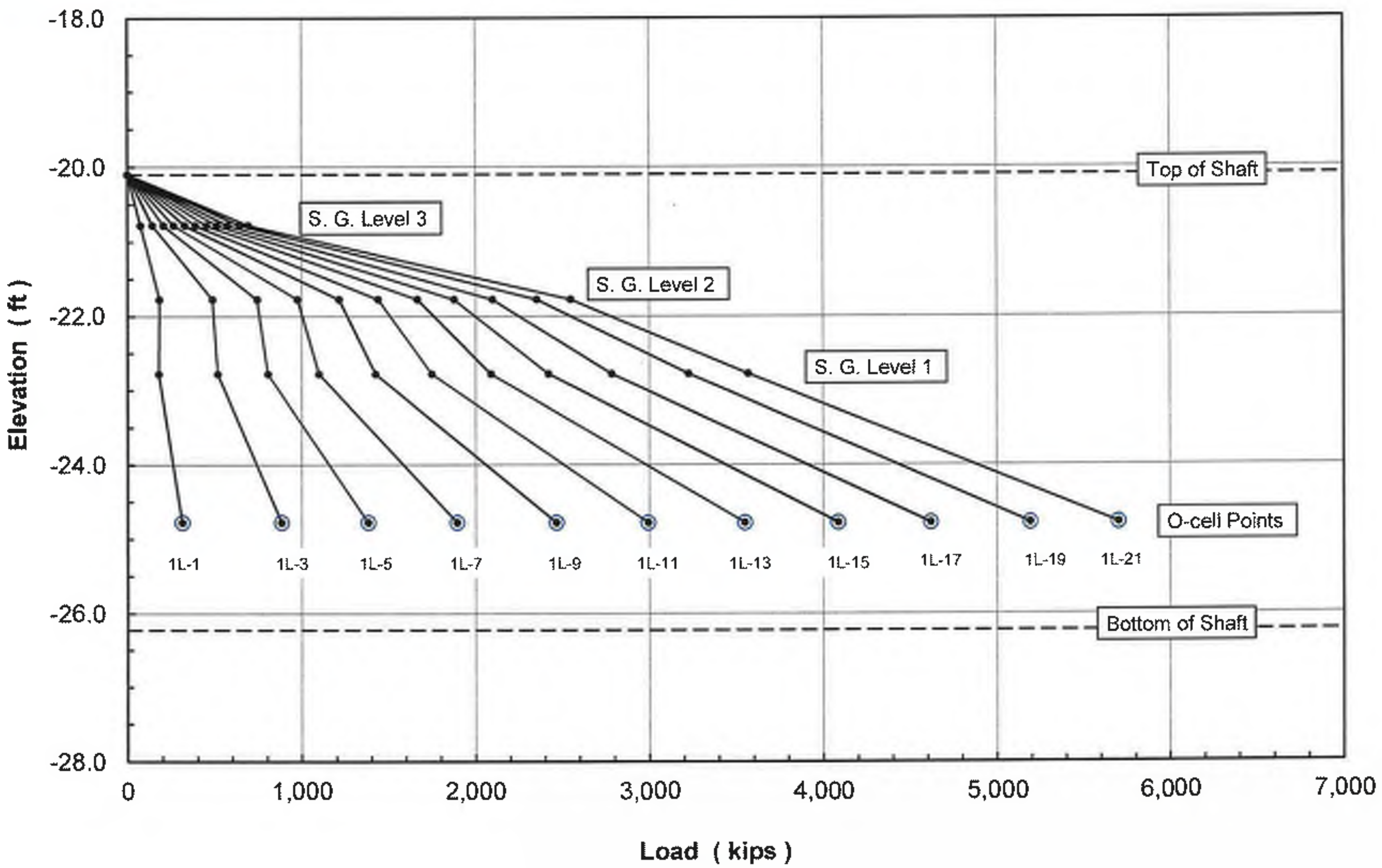


Loadtest USA Project No. LT-1240-2

Figure 4 of 7

Strain Gage Load Distribution

TS-2 - Hudson Yards Tower A - Manhattan, NY

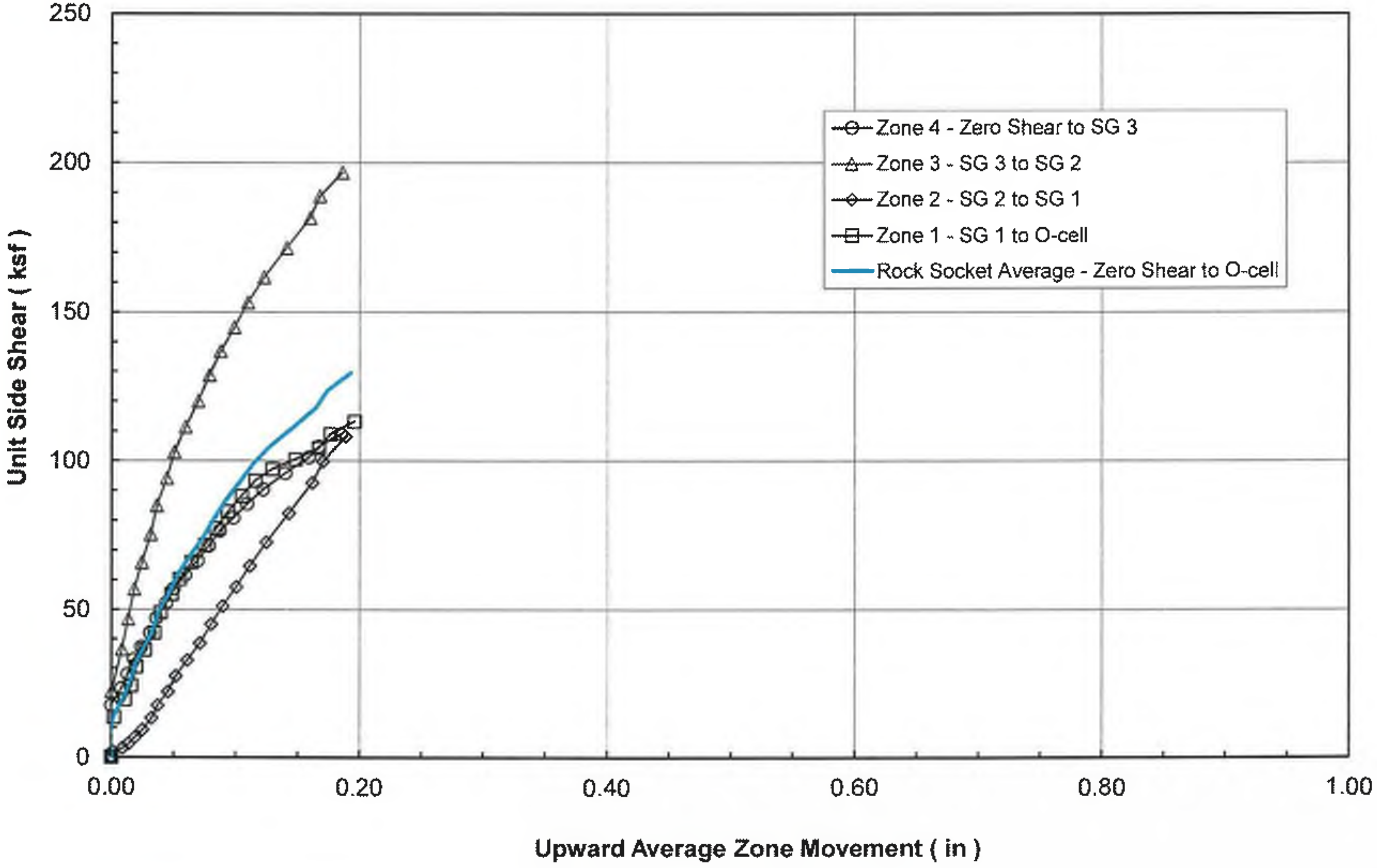


Loadtest USA Project No. LT-1240-2

Figure 5 of 7

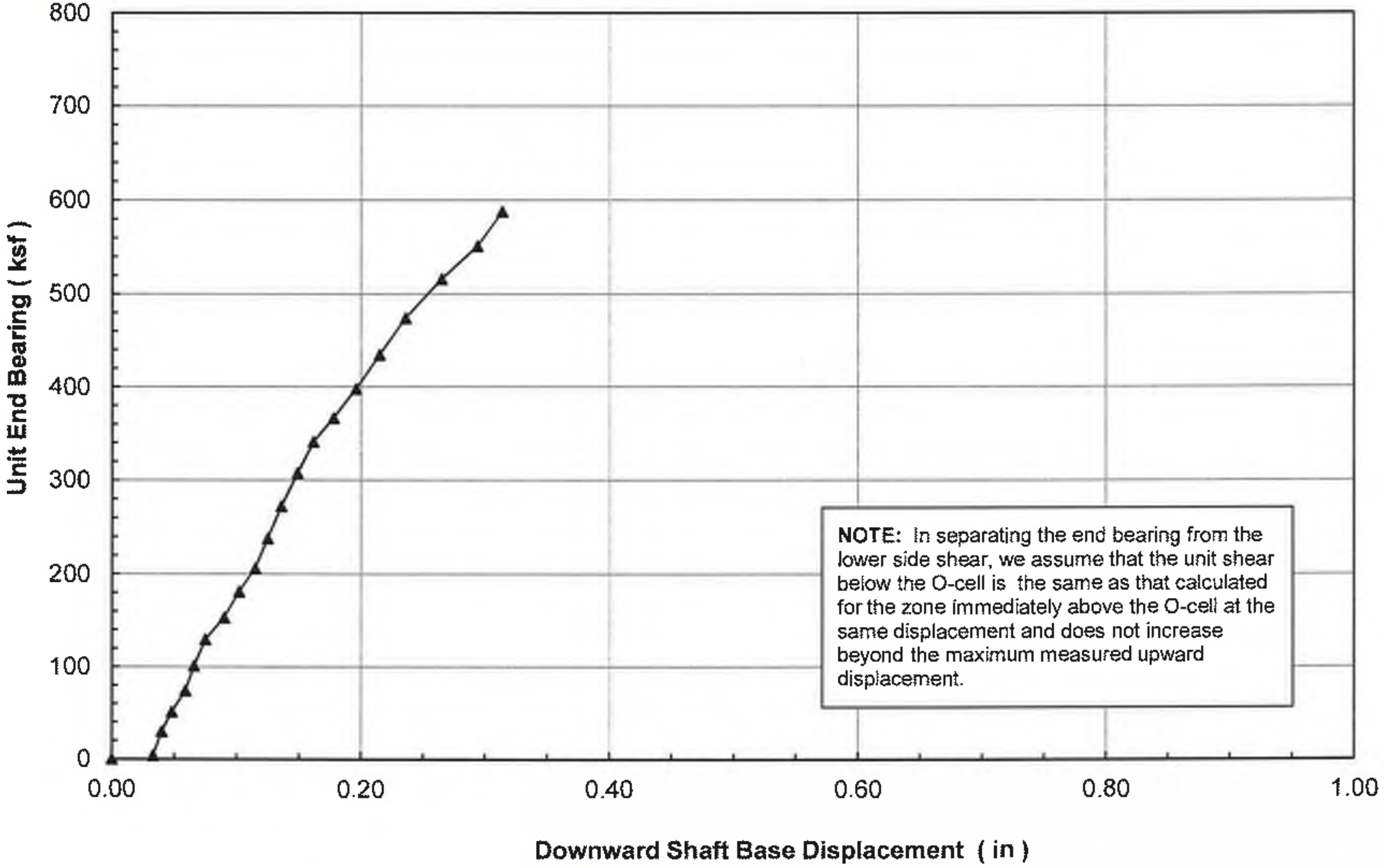
Mobilized Upward Unit Side Shear

TS-2 - Hudson Yards Tower A - Manhattan, NY



Mobilized Unit End Bearing

TS-2 - Hudson Yards Tower A - Manhattan, NY



NOTE: In separating the end bearing from the lower side shear, we assume that the unit shear below the O-cell is the same as that calculated for the zone immediately above the O-cell at the same displacement and does not increase beyond the maximum measured upward displacement.

Figure 7 of 7

TS-2 - Hudson Yards Tower A
Manhattan, NY (LT-1240-2)

APPENDIX A

FIELD DATA & DATA REDUCTION

Upward Top of Shaft Movement and Upper Shaft Compression
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Top of Shaft			Upper Compression Telltales		
			Pressure (psi)	Load (kips)	A-NA3000 (in)	C-NA3000 (in)	Average (in)	A-134998 (in)	C-134999 (in)	Average (in)
1 L - 0	-	10:52:00	0	0	0.000	0.000	0.000	0.000	0.000	0.000
1 L - 1	1	11:12:00	790	313	-0.001	-0.003	-0.002	0.003	0.004	0.003
1 L - 1	2	11:13:00	790	313	-0.001	-0.003	-0.002	0.003	0.004	0.003
1 L - 1	4	11:15:00	790	313	-0.003	-0.003	-0.003	0.002	0.003	0.003
1 L - 1	8	11:19:00	790	313	-0.003	-0.003	-0.003	0.003	0.003	0.003
1 L - 2	1	11:21:00	1,500	589	0.001	0.000	0.000	0.003	0.003	0.003
1 L - 2	2	11:22:00	1,500	589	0.001	0.001	0.001	0.003	0.003	0.003
1 L - 2	4	11:24:00	1,500	589	0.003	0.001	0.002	0.003	0.003	0.003
1 L - 2	8	11:28:00	1,500	589	-0.002	0.001	0.000	0.003	0.003	0.003
1 L - 3	1	11:29:30	2,260	884	0.003	0.005	0.004	0.003	0.004	0.003
1 L - 3	2	11:30:30	2,260	884	0.005	0.006	0.005	0.003	0.004	0.004
1 L - 3	4	11:32:30	2,260	884	0.007	0.007	0.007	0.004	0.004	0.004
1 L - 3	8	11:36:30	2,260	884	0.009	0.008	0.008	0.004	0.004	0.004
1 L - 4	1	11:39:00	2,850	1,114	0.014	0.012	0.013	0.003	0.004	0.004
1 L - 4	2	11:40:00	2,850	1,114	0.012	0.012	0.012	0.004	0.004	0.004
1 L - 4	4	11:42:00	2,850	1,114	0.012	0.012	0.012	0.004	0.004	0.004
1 L - 4	8	11:46:00	2,850	1,114	0.013	0.012	0.013	0.004	0.004	0.004
1 L - 5	1	11:48:00	3,540	1,382	0.018	0.018	0.018	0.004	0.004	0.004
1 L - 5	2	11:49:00	3,540	1,382	0.019	0.018	0.019	0.004	0.004	0.004
1 L - 5	4	11:51:00	3,540	1,382	0.019	0.018	0.019	0.004	0.004	0.004
1 L – 5	8	11:55:00	3,540	1,382	0.018	0.018	0.018	0.003	0.004	0.003
1 L - 6	1	11:58:00	4,170	1,627	0.021	0.021	0.021	0.004	0.004	0.004
1 L - 6	2	11:59:00	4,170	1,627	0.023	0.022	0.023	0.004	0.004	0.004
1 L - 6	4	12:01:00	4,170	1,627	0.021	0.023	0.022	0.003	0.004	0.004
1 L - 6	8	12:05:00	4,170	1,627	0.023	0.024	0.024	0.004	0.005	0.004
1 L - 7	1	12:08:00	4,860	1,895	0.030	0.029	0.029	0.004	0.005	0.005
1 L - 7	2	12:09:00	4,860	1,895	0.030	0.029	0.029	0.003	0.005	0.004
1 L - 7	4	12:11:00	4,860	1,895	0.030	0.030	0.030	0.003	0.005	0.004
1 L - 7	8	12:15:00	4,860	1,895	0.031	0.030	0.031	0.006	0.005	0.005
1 L - 8	1	12:17:00	5,610	2,186	0.035	0.035	0.035	0.003	0.005	0.004
1 L - 8	2	12:18:00	5,610	2,186	0.034	0.036	0.035	0.005	0.006	0.005
1 L - 8	4	12:20:00	5,610	2,186	0.036	0.036	0.036	0.005	0.005	0.005
1 L - 8	8	12:24:00	5,610	2,186	0.035	0.036	0.036	0.005	0.006	0.005
1 L - 9	1	12:26:30	6,330	2,466	0.042	0.043	0.043	0.006	0.006	0.006
1 L - 9	2	12:27:30	6,330	2,466	0.042	0.043	0.043	0.006	0.006	0.006
1 L - 9	4	12:29:30	6,330	2,466	0.046	0.043	0.045	0.007	0.006	0.006
1 L - 9	8	12:33:30	6,330	2,466	0.044	0.044	0.044	0.007	0.006	0.006
1 L - 10	1	12:35:30	7,000	2,726	0.049	0.049	0.049	0.005	0.007	0.006
1 L - 10	2	12:36:30	7,000	2,726	0.049	0.049	0.049	0.005	0.007	0.006
1 L - 10	4	12:38:30	7,000	2,726	0.049	0.051	0.050	0.004	0.006	0.005
1 L - 10	8	12:42:30	7,000	2,726	0.049	0.051	0.050	0.008	0.007	0.007
1 L - 11	1	12:44:00	7,690	2,994	0.057	0.057	0.057	0.008	0.007	0.008
1 L - 11	2	12:45:00	7,690	2,994	0.056	0.059	0.058	0.008	0.007	0.008
1 L - 11	4	12:47:00	7,690	2,004	0.058	0.058	0.058	0.008	0.007	0.008
1 L - 11	8	12:51:00	7,690	2,994	0.058	0.059	0.059	0.008	0.008	0.008
1 L - 12	1	12:54:30	8,400	3,270	0.068	0.068	0.068	0.009	0.008	0.008
1 L - 12	2	12:55:30	8,400	3,270	0.067	0.068	0.068	0.008	0.008	0.008
1 L - 12	4	12:57:30	8,400	3,270	0.068	0.068	0.068	0.009	0.008	0.009
1 L - 12	8	13:01:30	8,400	3,270	0.069	0.069	0.069	0.009	0.008	0.009
1 L - 13	1	13:03:30	9,120	3,550	0.077	0.077	0.077	0.010	0.008	0.009
1 L - 13	2	13:04:30	9,120	3,550	0.077	0.077	0.077	0.010	0.008	0.009
1 L - 13	4	13:06:30	9,120	3,550	0.078	0.079	0.079	0.009	0.008	0.009
1 L - 13	8	13:10:30	9,120	3,550	0.077	0.078	0.078	0.010	0.008	0.009

LOADTEST

Upward Top of Shaft Movement and Upper Shaft Compression
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Top of Shaft			Upper Compression Telltales		
			Pressure (psi)	Load (kips)	A-NA3000 (in)	C-NA3000 (in)	Average (in)	A-134998 (in)	C-134999 (in)	Average (in)
1 L - 14	1	13:12:30	9,820	3,822	0.084	0.085	0.085	0.011	0.009	0.010
1 L - 14	2	13:13:30	9,820	3,822	0.085	0.085	0.085	0.010	0.009	0.010
1 L - 14	4	13:15:30	9,820	3,822	0.086	0.087	0.087	0.010	0.009	0.010
1 L - 14	8	13:19:30	9,820	3,822	0.086	0.087	0.087	0.010	0.009	0.010
1 L - 15	1	13:21:30	10,500	4,086	0.095	0.095	0.095	0.011	0.009	0.010
1 L - 15	2	13:22:30	10,500	4,086	0.096	0.096	0.096	0.011	0.009	0.010
1 L - 15	4	13:24:30	10,500	4,086	0.097	0.097	0.097	0.007	0.009	0.008
1 L - 15	8	13:28:30	10,500	4,086	0.098	0.099	0.098	0.010	0.009	0.010
1 L - 16	1	13:30:30	11,200	4,358	0.107	0.108	0.108	0.011	0.010	0.010
1 L - 16	2	13:31:30	11,200	4,358	0.108	0.108	0.108	0.011	0.010	0.010
1 L - 16	4	13:33:30	11,200	4,358	0.109	0.110	0.110	0.011	0.010	0.010
1 L - 16	8	13:37:30	11,200	4,358	0.108	0.110	0.109	0.010	0.010	0.010
1 L - 17	1	13:40:00	11,870	4,619	0.118	0.120	0.119	0.012	0.010	0.011
1 L - 17	2	13:41:00	11,870	4,619	0.118	0.122	0.120	0.012	0.010	0.011
1 L - 17	4	13:43:00	11,870	4,619	0.120	0.122	0.121	0.012	0.011	0.011
1 L - 17	8	13:47:00	11,870	4,619	0.121	0.123	0.122	0.012	0.011	0.011
1 L - 18	1	13:49:30	12,590	4,899	0.132	0.137	0.135	0.010	0.012	0.011
1 L - 18	2	13:50:30	12,590	4,899	0.134	0.138	0.136	0.010	0.012	0.011
1 L - 18	4	13:52:30	12,590	4,899	0.138	0.140	0.139	0.010	0.012	0.011
1 L - 18	8	13:56:30	12,590	4,899	0.138	0.141	0.140	0.012	0.012	0.012
1 L - 19	1	13:58:00	13,350	5,194	0.155	0.157	0.156	0.011	0.012	0.012
1 L - 19	2	13:59:00	13,350	5,194	0.156	0.157	0.156	0.011	0.012	0.012
1 L - 19	4	14:01:00	13,350	5,194	0.156	0.159	0.158	0.010	0.013	0.011
1 L - 19	8	14:05:00	13,350	5,194	0.158	0.160	0.159	0.012	0.012	0.012
1 L - 20	1	14:07:30	13,990	5,443	0.164	0.168	0.166	0.013	0.013	0.013
1 L - 20	2	14:08:30	13,990	5,443	0.164	0.168	0.166	0.014	0.013	0.013
1 L - 20	4	14:10:30	13,990	5,443	0.166	0.169	0.168	0.016	0.013	0.014
1 L - 20	8	14:14:30	13,990	5,443	0.164	0.169	0.167	0.015	0.014	0.014
1 L - 21	1	14:17:30	14,660	5,703	0.177	0.183	0.180	0.014	0.014	0.014
1 L - 21	2	14:18:30	14,660	5,703	0.180	0.182	0.181	0.016	0.014	0.015
1 L - 21	4	14:20:30	14,660	5,703	0.179	0.184	0.182	0.016	0.014	0.015
1 L - 21	8	14:24:30	14,660	5,703	0.184	0.186	0.185	0.017	0.014	0.016
1 U - 1	1	14:27:00	11,710	4,557	0.184	0.184	0.184	0.015	0.014	0.015
1 U - 1	2	14:28:00	11,710	4,557	0.183	0.184	0.184	0.016	0.014	0.015
1 U - 1	4	14:30:00	11,710	4,557	0.181	0.184	0.183	0.016	0.014	0.015
1 U - 2	1	14:33:00	8,740	3,402	0.179	0.182	0.181	0.010	0.012	0.011
1 U - 2	2	14:34:00	8,740	3,402	0.180	0.182	0.181	0.011	0.012	0.012
1 U - 2	4	14:36:00	8,740	3,402	0.180	0.182	0.181	0.013	0.012	0.013
1 U - 3	1	14:39:00	5,730	2,233	0.179	0.180	0.180	0.008	0.010	0.009
1 U - 3	2	14:40:00	5,730	2,233	0.177	0.179	0.178	0.008	0.010	0.009
1 U - 3	4	14:42:00	5,730	2,233	0.177	0.180	0.179	0.007	0.010	0.009
1 U - 4	1	14:44:30	2,730	1,067	0.174	0.176	0.175	0.005	0.008	0.006
1 U - 4	2	14:45:30	2,730	1,067	0.173	0.176	0.175	0.005	0.007	0.006
1 U - 4	4	14:47:30	2,730	1,067	0.173	0.176	0.175	0.005	0.007	0.006
1 U - 5	1	14:50:00	0	0	0.171	0.173	0.172	0.002	0.004	0.003
1 U - 5	2	14:51:00	0	0	0.171	0.171	0.171	0.002	0.004	0.003
1 U - 5	4	14:53:00	0	0	0.169	0.172	0.171	0.001	0.004	0.002
1 U - 5	8	14:57:00	0	0	0.169	0.172	0.171	0.001	0.004	0.002

LOADTEST

O-cell Expansion
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		O-cell Expansion				
			Pressure (psi)	Load (kips)	A-1321872 (in)	B-1321873 (in)	C-1321875 (in)	D-1321878 (in)	Average (in)
1 L - 0	-	10:52:00	0	0	0.000	0.000	0.000	0.000	0.000
1 L - 1	1	11:12:00	790	313	0.023	0.023	0.022	0.002	0.023
1 L - 1	2	11:13:00	790	313	0.023	0.023	0.022	0.018	0.023
1 L - 1	4	11:15:00	790	313	0.023	0.024	0.023	0.019	0.023
1 L - 1	8	11:19:00	790	313	0.023	0.024	0.018	0.000	0.023
1 L - 2	1	11:21:00	1,500	589	0.035	0.034	0.025	0.016	0.035
1 L - 2	2	11:22:00	1,500	589	0.035	0.035	0.038	0.017	0.035
1 L - 2	4	11:24:00	1,500	589	0.036	0.035	0.038	0.022	0.035
1 L - 2	8	11:28:00	1,500	589	0.036	0.035	0.039	0.015	0.036
1 L - 3	1	11:29:30	2,260	884	0.052	0.050	0.050	0.039	0.051
1 L - 3	2	11:30:30	2,260	884	0.052	0.050	0.046	0.040	0.051
1 L - 3	4	11:32:30	2,260	884	0.053	0.051	0.039	0.024	0.052
1 L - 3	8	11:36:30	2,260	884	0.053	0.052	0.052	0.024	0.052
1 L - 4	1	11:39:00	2,850	1,114	0.085	0.063	0.050	0.034	0.064
1 L - 4	2	11:40:00	2,850	1,114	0.065	0.063	0.049	0.034	0.064
1 L - 4	4	11:42:00	2,850	1,114	0.066	0.064	0.054	0.036	0.065
1 L - 4	8	11:46:00	2,850	1,114	0.066	0.064	0.061	0.034	0.065
1 L - 5	1	11:48:00	3,540	1,382	0.079	0.077	0.072	0.054	0.078
1 L - 5	2	11:49:00	3,540	1,382	0.080	0.077	0.073	0.055	0.079
1 L - 5	4	11:51:00	3,540	1,382	0.081	0.078	0.078	0.055	0.080
1 L - 5	8	11:55:00	3.540	1,382	0.082	0.079	0.078	0.056	0.080
1 L - 6	1	11:58:00	4,170	1,627	0.092	0.089	0.089	0.066	0.091
1 L - 6	2	11:59:00	4,170	1,627	0.094	0.090	0.090	0.067	0.092
1 L - 6	4	12:01:00	4,170	1,627	0.095	0.091	0.091	0.068	0.093
1 L - 6	8	12:05:00	4,170	1,627	0.096	0.092	0.073	0.069	0.094
1 L - 7	1	12:08:00	4,860	1,895	0.111	0.106	0.106	0.081	0.109
1 L - 7	2	12:09:00	4,860	1,895	0.111	0.107	0.086	0.082	0.109
1 L - 7	4	12:11:00	4,860	1,895	0.112	0.108	0.107	0.083	0.110
1 L - 7	8	12:15:00	4,860	1,895	0.114	0.109	0.087	0.083	0.111
1 L - 8	1	12:17:00	5,610	2,186	0.130	0.124	0.121	0.105	0.127
1 L - 8	2	12:18:00	5,610	2,186	0.131	0.125	0.100	0.106	0.128
1 L - 8	4	12:20:00	5,610	2,186	0.133	0.126	0.099	0.108	0.130
1 L - 8	8	12:24:00	5,610	2,186	0.134	0.128	0.127	0.109	0.131
1 L - 9	1	12:26:30	6,330	2,466	0.152	0.145	0.110	0.116	0.149
1 L - 9	2	12:27:30	6,330	2,466	0.153	0.146	0.113	0.116	0.149
1 L - 9	4	12:29:30	6,330	2,466	0.154	0.147	0.149	0.117	0.150
1 L - 9	8	12:33:30	6,330	2,466	0.155	0.148	0.114	0.118	0.152
1 L - 10	1	12:35:30	7,000	2,726	0.171	0.164	0.135	0.140	0.168
1 L - 10	2	12:36:30	7,000	2,726	0.172	0.165	0.159	0.141	0.169
1 L - 10	4	12:38:30	7,000	2,726	0.174	0.166	0.166	0.124	0.170
1 L - 10	8	12:42:30	7,000	2,726	0.175	0.168	0.164	0.144	0.172
1 L - 11	1	12:44:00	7,690	2,994	0.191	0.183	0.183	0.158	0.187
1 L - 11	2	12:45:00	7,690	2,994	0.192	0.185	0.184	0.160	0.188
1 L - 11	4	12:47:00	7,690	2,994	0.194	0.186	0.186	0.161	0.190
1 L - 11	8	12:51:00	7,690	2,994	0.196	0.188	0.144	0.163	0.192
1 L - 12	1	12:54:30	8,400	3,270	0.214	0.207	0.205	0.158	0.210
1 L - 12	2	12:55:30	8,400	3,270	0.215	0.207	0.165	0.180	0.211
1 L - 12	4	12:57:30	8,400	3,270	0.216	0.209	0.164	0.185	0.212
1 L - 12	8	13:01:30	8,400	3,270	0.217	0.210	0.166	0.186	0.214
1 L - 13	1	13:03:30	9,120	3,550	0.235	0.228	0.225	0.168	0.232
1 L - 13	2	13:04:30	9,120	3,550	0.236	0.229	0.227	0.171	0.233
1 L - 13	4	13:06:30	9,120	3,550	0.238	0.231	0.162	0.209	0.234
1 L - 13	8	13:10:30	9,120	3,550	0.240	0.233	0.185	0.214	0.236

LOADTEST

O-cell Expansion
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Incremen	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		O-cell Expansion				
			Pressure (psi)	Load (kips)	A-1321872 (in)	B-1321873 (in)	C-1321875 (in)	D-1321876 (in)	Average (in)
1 L - 14	1	13:12:30	9,820	3,822	0.256	0.250	0.252	0.190	0.253
1 L - 14	2	13:13:30	9,820	3,822	0.258	0.252	0.253	0.190	0.255
1 L - 14	4	13:15:30	9,820	3,822	0.260	0.254	0.256	0.229	0.257
1 L - 14	8	13:19:30	9,820	3,822	0.262	0.256	0.259	0.193	0.259
1 L - 15	1	13:21:30	10,500	4,086	0.281	0.277	0.216	0.254	0.279
1 L - 15	2	13:22:30	10,500	4,086	0.283	0.279	0.280	0.253	0.281
1 L – 15	4	13:24:30	10,500	4,086	0.285	0.281	0.220	0.255	0.283
1 L - 15	8	13:28:30	10,500	4,086	0.288	0.284	0.219	0.219	0.286
1 L - 16	1	13:30:30	11,200	4,358	0.307	0.305	0.304	0.279	0.306
1 L - 16	2	13:31:30	11,200	4,358	0.309	0.306	0.305	0.283	0.308
1 L - 16	4	13:33:30	11,200	4,358	0.312	0.311	0.248	0.238	0.311
1 L - 16	8	13:37:30	11,200	4,358	0.315	0.314	0.248	0.298	0.315
1 L - 17	1	13:40:00	11,870	4,619	0.339	0.340	0.263	0.315	0.339
1 L - 17	2	13:41:00	11,870	4,619	0.341	0.342	0.343	0.263	0.341
1 L - 17	4	13:43:00	11,870	4,619	0.344	0.345	0.260	0.318	0.344
1 L - 17	8	13:47:00	11,870	4,619	0.348	0.348	0.347	0.329	0.348
1 L - 18	1	13:49:30	12,590	4,899	0.376	0.377	0.295	0.291	0.376
1 L - 18	2	13:50:30	12,590	4,899	0.378	0.380	0.294	0.297	0.379
1 L - 18	4	13:52:30	12,590	4,899	0.382	0.383	0.291	0.350	0.383
1 L - 18	8	13:56:30	12,590	4,899	0.386	0.389	0.389	0.336	0.388
1 L - 19	1	13:58:00	13,350	5,194	0.417	0.419	0.412	0.392	0.418
1 L - 19	2	13:59:00	13,350	5,194	0.422	0.423	0.426	0.319	0.423
1 L - 19	4	14:01:00	13,350	5,194	0.428	0.430	0.335	0.409	0.429
1 L - 19	8	14:05:00	13,350	5,194	0.436	0.437	0.433	0.332	0.436
1 L - 20	1	14:07:30	13,990	5,443	0.461	0.463	0.360	0.351	0.462
1 L - 20	2	14:08:30	13,990	5,443	0.464	0.467	0.468	0.437	0.465
1 L - 20	4	14:10:30	13,990	5,443	0.468	0.471	0.461	0.444	0.470
1 L - 20	8	14:14:30	13,990	5,443	0.473	0.477	0.375	0.360	0.475
1 L - 21	1	14:17:30	14,660	5,703	0.500	0.504	0.395	0.487	0.502
1 L - 21	2	14:18:30	14,660	5,703	0.503	0.508	0.511	0.385	0.505
1 L - 21	4	14:20:30	14,660	5,703	0.507	0.512	0.400	0.446	0.510
1 L - 21	8	14:24:30	14,660	5,703	0.513	0.518	0.522	0.480	0.515
1 U - 1	1	14:27:00	11,710	4,557	0.508	0.512	0.495	0.397	0.510
1 U - 1	2	14:28:00	11,710	4,557	0.508	0.512	0.515	0.389	0.510
1 U - 1	4	14:30:00	11,710	4,557	0.509	0.512	0.514	0.393	0.510
1 U - 2	1	14:33:00	8,740	3,402	0.497	0.503	0.367	0.463	0.500
1 U - 2	2	14:34:00	8,740	3,402	0.495	0.503	0.504	0.373	0.499
1 U - 2	4	14:36:00	8,740	3,402	0.494	0.503	0.503	0.384	0.499
1 U - 3	1	14:39:00	5,730	2,233	0.486	0.491	0.377	0.473	0.489
1 U - 3	2	14:40:00	5,730	2,233	0.486	0.491	0.487	0.472	0.489
1 U - 3	4	14:42:00	5,730	2,233	0.486	0.491	0.488	0.474	0.488
1 U - 4	1	14:44:30	2,730	1,067	0.470	0.477	0.383	0.432	0.473
1 U - 4	2	14:45:30	2,730	1,067	0.469	0.476	0.475	0.368	0.473
1 U - 4	4	14:47:30	2,730	1,067	0.469	0.476	0.475	0.454	0.473
1 U - 5	1	14:50:00	0	0	0.441	0.445	0.320	0.340	0.443
1 U - 5	2	14:51:00	0	0	0.441	0.445	0.445	0.407	0.443
1 U - 5	4	14:53:00	0	0	0.441	0.444	0.443	0.317	0.442
1 U - 5	8	14:57:00	0	0	0.439	0.444	0.440	0.426	0.441

O-cell Plate Movements and Creep (calculated)
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell			Top of Shaft Movement (in)	Total Comp. (in)	Upward Movement (in)	O-cell Expansion (in)	Downward Movement (in)	Creep Up Per Hold (in)	Creep Dn Per Hold (in)
			Pressure (psi)	Load (kips)	Net Load (kips)							
1 L - 0	-	10:52:00	0	0	0	0.000	0.000	0.000	0.000	0.000		
1 L - 1	1	11:12:00	790	313	310	-0.002	0.003	0.001	0.023	-0.022		
1 L - 1	2	11:13:00	790	313	310	-0.002	0.003	0.001	0.023	-0.022		
1 L - 1	4	11:15:00	790	313	310	-0.003	0.003	0.000	0.023	-0.023		
1 L - 1	8	11:19:00	790	313	310	-0.003	0.003	0.000	0.023	-0.023	0.000	0.000
1 L - 2	1	11:21:00	1,500	589	586	0.000	0.003	0.003	0.035	-0.032		
1 L - 2	2	11:22:00	1,500	589	586	0.001	0.003	0.004	0.035	-0.031		
1 L - 2	4	11:24:00	1,500	589	586	0.002	0.003	0.005	0.035	-0.030		
1 L - 2	8	11:28:00	1,500	589	586	0.000	0.003	0.003	0.036	-0.033	0.000	0.003
1 L - 3	1	11:29:30	2,260	884	881	0.004	0.003	0.007	0.051	-0.044		
1 L - 3	2	11:30:30	2,260	884	881	0.005	0.004	0.009	0.051	-0.042		
1 L - 3	4	11:32:30	2,260	884	881	0.007	0.004	0.011	0.052	-0.041		
1 L - 3	8	11:36:30	2,260	884	881	0.008	0.004	0.012	0.052	-0.040	0.001	0.000
1 L - 4	1	11:39:00	2,850	1,114	1,111	0.013	0.004	0.017	0.064	-0.047		
1 L - 4	2	11:40:00	2,850	1,114	1,111	0.012	0.004	0.016	0.064	-0.046		
1 L - 4	4	11:42:00	2,850	1,114	1,111	0.012	0.004	0.016	0.065	-0.049		
1 L - 4	8	11:46:00	2,650	1,114	1,111	0.013	0.004	0.017	0.065	-0.048	0.001	0.000
1 L - 5	1	11:48:00	3,540	1,382	1,379	0.018	0.004	0.022	0.078	-0.056		
1 L - 5	2	11:49:00	3,540	1,382	1,379	0.019	0.004	0.023	0.079	-0.056		
1 L - 5	4	11:51:00	3,540	1,382	1,379	0.019	0.004	0.023	0.080	-0.057		
1 L - 5	6	11:55:00	3,540	1,382	1,379	0.018	0.003	0.021	0.080	-0.059	0.000	0.002
1 L - 6	1	11:58:00	4,170	1,627	1,624	0.021	0.004	0.025	0.091	-0.066		
1 L - 6	2	11:59:00	4,170	1,627	1,624	0.023	0.004	0.027	0.092	-0.065		
1 L - 6	4	12:01:00	4,170	1,627	1,824	0.022	0.004	0.026	0.093	-0.067		
1 L - 6	8	12:05:00	4,170	1,627	1,624	0.024	0.004	0.028	0.094	-0.066	0.002	0.000
1 L - 7	1	12:08:00	4,860	1,895	1,892	0.029	0.005	0.034	0.109	-0.075		
1 L - 7	2	12:09:00	4,860	1,895	1,892	0.029	0.004	0.033	0.109	-0.076		
1 L - 7	4	12:11:00	4,860	1,895	1,892	0.030	0.004	0.034	0.110	-0.076		
1 L - 7	8	12:15:00	4,860	1,895	1,892	0.031	0.005	0.036	0.111	-0.075	0.002	0.000
1 L - 8	1	12:17:00	5,610	2,186	2,183	0.035	0.004	0.039	0.127	-0.088		
1 L - 8	2	12:18:00	5,610	2,186	2,183	0.035	0.005	0.040	0.128	-0.088		
1 L - 8	4	12:20:00	5,610	2,186	2,183	0.036	0.005	0.041	0.130	-0.089		
1 L - 8	8	12:24:00	5,610	2,186	2,183	0.036	0.005	0.041	0.131	-0.090	0.000	0.001
1 L - 9	1	12:26:30	6,330	2,466	2,463	0.043	0.006	0.049	0.149	-0.100		
1 L - 9	2	12:27:30	6,330	2,466	2,463	0.043	0.006	0.049	0.149	-0.100		
1 L - 9	4	12:29:30	6,330	2,466	2,463	0.045	0.006	0.051	0.150	-0.099		
1 L - 9	8	12:33:30	6,330	2,466	2,463	0.044	0.006	0.050	0.152	-0.102	0.000	0.003
1 L - 10	1	12:35:30	7,000	2,726	2,723	0.049	0.006	0.055	0.168	-0.113		
1 L - 10	2	12:36:30	7,000	2,726	2,723	0.049	0.006	0.055	0.169	-0.114		
1 L - 10	4	12:38:30	7,000	2,726	2,723	0.050	0.005	0.055	0.170	-0.115		
1 L - 10	8	12:42:30	7,000	2,726	2,723	0.050	0.007	0.057	0.172	-0.115	0.002	0.000
1 L - 11	1	12:44:00	7,690	2,994	2,991	0.057	0.008	0.085	0.187	-0.122		
1 L - 11	2	12:45:00	7,690	2,994	2,991	0.058	0.008	0.066	0.188	-0.122		
1 L - 11	4	12:47:00	7,690	2,994	2,991	0.058	0.008	0.066	0.190	-0.124		
1 L - 11	8	12:51:00	7,690	2,994	2,991	0.059	0.008	0.067	0.192	-0.125	0.001	0.001
1 L - 12	1	12:54:30	8,400	3,270	3,267	0.068	0.008	0.076	0.210	-0.134		
1 L - 12	2	12:55:30	8,400	3,270	3,267	0.068	0.008	0.076	0.211	-0.135		
1 L - 12	4	12:57:30	8,400	3,270	3,267	0.068	0.009	0.077	0.212	-0.135		
1 L - 12	8	13:01:30	8,400	3,270	3,267	0.069	0.009	0.078	0.214	-0.136	0.001	0.001
1 L - 13	1	13:03:30	9,120	3,550	3,547	0.077	0.009	0.086	0.232	-0.146		
1 L - 13	2	13:04:30	9,120	3,550	3,547	0.077	0.009	0.088	0.233	-0.147		
1 L - 13	4	13:06:30	9,120	3,550	3,547	0.079	0.009	0.088	0.234	-0.146		
1 L - 13	8	13:10:30	9,120	3,550	3,547	0.078	0.009	0.087	0.236	-0.149	0.000	0.003

LOADTEST

O-cell Plate Movements and Creep (calculated)
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell Pressure (psi)	O-cell Load (kips)	O-cell Net Load (kips)	Top of Shaft Movement (in)	Total Comp. (in)	Upward Movement (in)	O-cell Expansion (in)	Downward Movement (in)	Creep Up Per Hold (in)	Creep Dn Per Hold (in)
1 L - 14	1	13:12:30	9,820	3,822	3,819	0.085	0.010	0.095	0.253	-0.158		
1 L - 14	2	13:13:30	9,820	3,822	3,819	0.085	0.010	0.095	0.255	-0.160		
1 L - 14	4	13:15:30	9,820	3,822	3,819	0.087	0.010	0.097	0.257	-0.160		
1 L - 14	8	13:19:30	9,820	3,822	3,819	0.087	0.010	0.097	0.259	-0.162	0.000	0.002
1 L - 15	1	13:21:30	10,500	4,086	4,083	0.095	0.010	0.105	0.279	-0.174		
1 L - 15	2	13:22:30	10,500	4,086	4,083	0.096	0.010	0.106	0.281	-0.175		
1 L - 15	4	13:24:30	10,500	4,086	4,083	0.097	0.008	0.105	0.283	-0.178		
1 L - 15	8	13:28:30	10,500	4,086	4,083	0.098	0.010	0.108	0.286	-0.178	0.003	0.000
1 L - 16	1	13:30:30	11,200	4,358	4,355	0.108	0.010	0.118	0.308	-0.188		
1 L - 16	2	13:31:30	11,200	4,358	4,355	0.108	0.010	0.118	0.308	-0.190		
1 L - 16	4	13:33:30	11,200	4,358	4,355	0.110	0.010	0.120	0.311	-0.191		
1 L - 16	8	13:37:30	11,200	4,358	4,355	0.109	0.010	0.119	0.315	-0.196	0.000	0.005
1 L - 17	1	13:40:00	11,870	4,619	4,616	0.119	0.011	0.130	0.339	-0.209		
1 L - 17	2	13:41:00	11,870	4,619	4,616	0.120	0.011	0.131	0.341	-0.210		
1 L - 17	4	13:43:00	11,870	4,619	4,616	0.121	0.011	0.132	0.344	-0.212		
1 L - 17	8	13:47:00	11,870	4,619	4,616	0.122	0.011	0.133	0.348	-0.215	0.001	0.003
1 L - 18	1	13:49:30	12,590	4,899	4,896	0.135	0.011	0.146	0.376	-0.230		
1 L - 18	2	13:50:30	12,590	4,899	4,896	0.136	0.011	0.147	0.379	-0.232		
1 L - 18	4	13:52:30	12,590	4,899	4,896	0.139	0.011	0.150	0.383	-0.233		
1 L - 18	8	13:56:30	12,590	4,899	4,896	0.140	0.012	0.152	0.388	-0.236	0.002	0.003
1 L - 19	1	13:58:00	13,350	5,194	5,191	0.156	0.012	0.168	0.418	-0.250		
1 L - 19	2	13:59:00	13,350	5,194	5,191	0.156	0.012	0.168	0.423	-0.255		
1 L - 19	4	14:01:00	13,350	5,194	5,191	0.158	0.011	0.169	0.429	-0.260		
1 L - 19	8	14:05:00	13,350	5,194	5,191	0.159	0.012	0.171	0.436	-0.265	0.002	0.005
1 L - 20	1	14:07:30	13,990	5,443	5,440	0.166	0.013	0.179	0.462	-0.283		
1 L - 20	2	14:08:30	13,990	5,443	5,440	0.166	0.013	0.179	0.465	-0.286		
1 L - 20	4	14:10:30	13,990	5,443	5,440	0.168	0.014	0.182	0.470	-0.288		
1 L - 20	8	14:14:30	13,990	5,443	5,440	0.167	0.014	0.181	0.475	-0.294	0.000	0.006
1 L - 21	1	14:17:30	14,660	5,703	5,700	0.180	0.014	0.194	0.502	-0.308		
1 L - 21	2	14:18:30	14,660	5,703	5,700	0.181	0.015	0.198	0.505	-0.309		
1 L - 21	4	14:20:30	14,660	5,703	5,700	0.182	0.015	0.197	0.510	-0.313		
1 L - 21	8	14:24:30	14,660	5,703	5,700	0.185	0.016	0.201	0.515	-0.314	0.004	0.001
1 U - 1	1	14:27:00	11,710	4,557	4,554	0.184	0.015	0.199	0.510	-0.311		
1 U - 1	2	14:28:00	11,710	4,557	4,554	0.184	0.015	0.199	0.510	-0.311		
1 U - 1	4	14:30:00	11,710	4,557	4,554	0.183	0.015	0.198	0.510	-0.312		
1 U - 2	1	14:33:00	8,740	3,402	3,399	0.181	0.011	0.192	0.500	-0.308		
1 U - 2	2	14:34:00	8,740	3,402	3,399	0.181	0.012	0.193	0.499	-0.306		
1 U - 2	4	14:36:00	8,740	3,402	3,399	0.181	0.013	0.194	0.499	-0.305		
1 U - 3	1	14:39:00	5,730	2,233	2,230	0.180	0.009	0.189	0.489	-0.300		
1 U - 3	2	14:40:00	5,730	2,233	2,230	0.178	0.009	0.187	0.489	-0.302		
1 U - 3	4	14:42:00	5,730	2,233	2,230	0.179	0.009	0.188	0.488	-0.300		
1 U - 4	1	14:44:30	2,730	1,067	1,064	0.175	0.006	0.181	0.473	-0.292		
1 U - 4	2	14:45:30	2,730	1,067	1,064	0.175	0.006	0.181	0.473	-0.292		
1 U - 4	4	14:47:30	2,730	1,067	1,064	0.175	0.006	0.181	0.473	-0.292		
1 U - 5	1	14:50:00	0	0	0	0.172	0.003	0.175	0.443	-0.268		
1 U - 5	2	14:51:00	0	0	0	0.171	0.003	0.174	0.443	-0.269		
1 U - 5	4	14:53:00	0	0	0	0.171	0.002	0.173	0.442	-0.269		
1 U - 5	8	14:57:00	0	0	0	0.171	0.002	0.173	0.441	-0.268		

Strain Gage Readings and Loads at Level 1
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Strain Gage Level 1					
			Pressure (psi)	Load (kips)	1A-1323502 (με)	1B-1323503 (με)	1C-1323504 (με)	1D-1323505 (με)	Av. Strain (με)	Load (kips)
1 L - 0	-	10:52:00	0	0	0.0	0.0	0.0	0.0	0.0	0
1 L - 1	1	11:12:00	790	313	28.9	25.5	21.4	20.1	24.0	173
1 L - 1	2	11:13:00	790	313	28.8	25.5	21.1	20.0	23.8	172
1 L - 1	4	11:15:00	790	313	29.5	26.3	22.1	20.8	24.7	178
1 L - 1	8	11:19:00	790	313	29.6	26.6	22.4	20.9	24.9	179
1 L - 2	1	11:21:00	1,500	589	45.8	44.3	48.4	40.9	44.9	324
1 L - 2	2	11:22:00	1,500	589	45.9	44.6	48.6	41.2	45.1	325
1 L - 2	4	11:24:00	1,500	589	46.0	44.9	49.1	41.7	45.4	328
1 L - 2	8	11:28:00	1,500	589	46.6	45.8	50.6	42.7	46.4	335
1 L - 3	1	11:29:30	2,260	884	61.8	68.1	88.2	64.8	70.2	507
1 L - 3	2	11:30:30	2,260	884	62.0	68.7	87.0	65.3	70.7	510
1 L - 3	4	11:32:30	2,260	884	62.3	69.0	87.6	65.7	71.1	513
1 L - 3	8	11:36:30	2,260	884	62.6	69.7	88.4	66.3	71.7	518
1 L - 4	1	11:39:00	2,850	1,114	74.5	86.8	114.1	81.6	89.3	644
1 L - 4	2	11:40:00	2,850	1,114	74.8	87.3	114.6	82.1	89.6	648
1 L - 4	4	11:42:00	2,850	1,114	75.0	87.8	115.4	82.5	90.2	651
1 L - 4	8	11:46:00	2,850	1,114	75.7	88.9	116.7	83.5	91.2	658
1 L - 5	1	11:48:00	3,540	1,382	88.4	106.5	142.7	100.0	109.4	789
1 L - 5	2	11:49:00	3,540	1,382	88.8	107.2	143.9	100.8	110.2	795
1 L - 5	4	11:51:00	3,540	1,382	89.0	108.0	145.3	102.0	111.1	802
1 L - 5	8	11:55:00	3,540	1,382	89.6	108.8	146.0	102.5	111.7	806
1 L - 6	1	11:58:00	4,170	1,627	101.2	123.1	170.1	117.7	128.0	924
1 L - 6	2	11:59:00	4,170	1,627	101.9	124.6	172.8	119.8	129.8	936
1 L - 6	4	12:01:00	4,170	1,627	102.6	125.3	173.1	120.3	130.3	940
1 L - 6	8	12:05:00	4,170	1,627	102.7	125.9	173.5	120.8	130.7	943
1 L - 7	1	12:08:00	4,860	1,895	115.8	145.8	199.3	139.8	150.2	1,083
1 L - 7	2	12:09:00	4,860	1,895	116.1	146.4	200.1	140.4	150.8	1,088
1 L - 7	4	12:11:00	4,860	1,895	116.6	147.2	201.0	141.2	151.5	1,093
1 L - 7	8	12:15:00	4,860	1,895	117.2	148.5	202.0	142.3	152.5	1,100
1 L - 8	1	12:17:00	5,610	2,186	131.4	168.3	227.7	162.5	172.4	1,244
1 L - 8	2	12:18:00	5,610	2,186	131.5	168.7	228.4	163.3	173.0	1,248
1 L - 8	4	12:20:00	5,610	2,186	132.0	169.5	229.3	164.3	173.8	1,254
1 L - 8	8	12:24:00	5,610	2,186	132.9	170.0	230.8	165.8	175.0	1,263
1 L - 9	1	12:26:30	6,330	2,466	148.9	191.2	255.7	186.7	195.6	1,411
1 L - 9	2	12:27:30	6,330	2,466	149.2	191.5	256.3	187.2	196.1	1,415
1 L - 9	4	12:29:30	6,330	2,466	149.5	191.9	256.9	188.0	196.6	1,418
1 L - 9	8	12:33:30	6,330	2,466	150.3	192.9	258.0	189.2	197.6	1,426
1 L - 10	1	12:35:30	7,000	2,726	166.6	212.9	280.9	207.9	217.1	1,566
1 L - 10	2	12:36:30	7,000	2,726	167.4	213.8	282.4	209.2	218.2	1,574
1 L - 10	4	12:38:30	7,000	2,726	167.7	214.3	283.0	210.0	218.8	1,579
1 L - 10	8	12:42:30	7,000	2,726	169.0	215.5	284.4	211.7	220.1	1,588
1 L - 11	1	12:44:00	7,690	2,994	185.0	236.0	307.4	230.4	239.7	1,730
1 L - 11	2	12:45:00	7,690	2,994	185.6	236.7	308.9	231.8	240.7	1,737
1 L - 11	4	12:47:00	7,690	2,994	185.5	236.8	309.4	232.4	241.0	1,739
1 L - 11	8	12:51:00	7,690	2,994	186.5	238.1	311.4	234.4	242.6	1,750
1 L - 12	1	12:54:30	8,400	3,270	203.1	259.2	336.0	255.0	263.3	1,900
1 L - 12	2	12:55:30	8,400	3,270	203.5	259.9	337.9	256.6	264.5	1,908
1 L - 12	4	12:57:30	8,400	3,270	203.7	260.4	338.3	257.2	264.9	1,911
1 L - 12	8	13:01:30	8,400	3,270	204.0	260.8	339.3	258.2	265.6	1,916
1 L - 13	1	13:03:30	9,120	3,550	221.7	282.6	364.6	279.8	287.2	2,072
1 L - 13	2	13:04:30	9,120	3,550	221.7	282.3	364.6	279.9	287.1	2,072
1 L - 13	4	13:06:30	9,120	3,550	222.1	283.2	366.4	281.7	288.4	2,081
1 L - 13	8	13:10:30	9,120	3,550	223.5	284.1	368.1	283.4	289.8	2,091

LOADTEST

Strain Gage Readings and Loads at Level 1
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Strain Gage Level 1					
			Pressure (psi)	Load (kips)	1A-1323502 (με)	1B-1323503 (με)	1C-1323504 (με)	1D-1323505 (με)	Av. Strain (με)	Load (kips)
1 L - 14	1	13:12:30	9,820	3,822	239.8	304.3	390.3	302.5	309.2	2,231
1 L - 14	2	13:13:30	9,820	3,822	240.2	304.9	392.1	304.4	310.4	2,239
1 L - 14	4	13:15:30	9,820	3,822	241.0	305.8	394.1	306.3	311.8	2,250
1 L - 14	8	13:19:30	9,820	3,822	241.5	306.1	395.9	307.8	312.8	2,257
1 L - 15	1	13:21:30	10,500	4,086	258.9	327.0	418.6	327.2	332.9	2,402
1 L - 15	2	13:22:30	10,500	4,086	258.4	326.7	419.2	327.7	333.0	2,402
1 L - 15	4	13:24:30	10,500	4,086	259.1	327.3	421.5	330.0	334.5	2,413
1 L - 15	8	13:28:30	10,500	4,086	259.8	328.0	423.1	331.6	335.6	2,422
1 L - 16	1	13:30:30	11,200	4,358	279.6	349.1	446.6	351.9	356.8	2,574
1 L - 16	2	13:31:30	11,200	4,358	279.1	348.7	447.2	352.6	356.9	2,575
1 L - 16	4	13:33:30	11,200	4,358	279.9	349.4	449.6	354.8	358.4	2,586
1 L - 16	8	13:37:30	11,200	4,358	280.6	350.5	452.1	357.1	360.1	2,598
1 L - 17	1	13:40:00	11,870	4,619	300.1	375.0	476.3	377.9	382.3	2,759
1 L - 17	2	13:41:00	11,870	4,619	300.8	376.1	478.4	379.6	383.8	2,769
1 L - 17	4	13:43:00	11,870	4,619	300.3	376.2	478.5	379.7	383.7	2,768
1 L - 17	8	13:47:00	11,870	4,619	301.6	378.1	481.6	382.5	385.9	2,785
1 L - 18	1	13:49:30	12,590	4,899	324.3	405.0	509.7	405.2	411.0	2,966
1 L - 18	2	13:50:30	12,590	4,899	324.9	405.8	511.2	406.2	412.0	2,973
1 L - 18	4	13:52:30	12,590	4,899	326.2	407.6	513.1	407.7	413.7	2,985
1 L - 18	8	13:56:30	12,590	4,899	328.3	410.4	516.4	410.2	416.3	3,004
1 L - 19	1	13:58:00	13,350	5,194	352.3	437.5	543.2	435.7	442.2	3,190
1 L - 19	2	13:59:00	13,350	5,194	352.7	438.6	544.0	435.7	442.8	3,195
1 L - 19	4	14:01:00	13,350	5,194	355.3	442.1	546.2	437.6	445.3	3,213
1 L - 19	8	14:05:00	13,350	5,194	357.0	445.2	546.9	440.0	447.2	3,227
1 L - 20	1	14:07:30	13,990	5,443	373.6	465.6	567.8	457.5	466.1	3,363
1 L - 20	2	14:08:30	13,990	5,443	373.8	466.1	568.6	458.5	466.8	3,368
1 L - 20	4	14:10:30	13,990	5,443	374.0	467.0	569.3	459.2	467.4	3,372
1 L - 20	8	14:14:30	13,990	5,443	375.6	468.9	571.8	481.7	469.5	3,386
1 L - 21	1	14:17:30	14,660	5,703	395.8	496.1	596.5	478.5	491.7	3,548
1 L - 21	2	14:18:30	14,660	5,703	396.3	496.6	596.5	479.1	492.1	3,551
1 L - 21	4	14:20:30	14,860	5,703	397.4	498.1	597.7	480.7	493.5	3,561
1 L - 21	8	14:24:30	14,660	5,703	398.7	499.4	598.6	481.8	494.6	3,589
1 U - 1	1	14:27:00	11,710	4,557	344.9	453.1	526.0	416.9	435.2	3,140
1 U - 1	2	14:29:00	11,710	4,557	344.9	453.0	525.9	416.8	435.2	3,140
1 U - 1	4	14:30:00	11,710	4,557	344.2	452.2	524.8	415.8	434.3	3,133
1 U - 2	1	14:33:00	8,740	3,402	276.5	394.2	428.8	324.4	356.0	2,569
1 U - 2	2	14:34:00	8,740	3,402	275.9	393.7	427.5	323.2	355.1	2,562
1 U - 2	4	14:36:00	8,740	3,402	275.7	393.4	426.9	322.7	354.7	2,559
1 U - 3	1	14:39:00	5,730	2,233	205.3	329.7	312.9	219.3	266.8	1,925
1 U - 3	2	14:40:00	5,730	2,233	204.9	329.2	311.7	218.3	266.0	1,919
1 U - 3	4	14:42:00	5,730	2,233	204.6	328.6	310.8	217.8	265.5	1,915
1 U - 4	1	14:44:30	2,730	1,067	120.6	245.7	187.7	103.9	164.5	1,187
1 U - 4	2	14:45:30	2,730	1,067	120.5	245.4	186.9	103.3	164.0	1,184
1 U - 4	4	14:47:30	2,730	1,067	119.6	244.7	184.8	101.9	162.8	1,175
1 U - 5	1	14:50:00	0	0	-15.1	82.2	57.5	-16.4	27.0	195
1 U - 5	2	14:51:00	0	0	-15.5	81.1	55.5	-18.1	25.8	186
1 U - 5	4	14:53:00	0	0	-16.1	79.9	53.3	-19.8	24.3	176
1 U - 5	8	14:57:00	0	0	-16.8	79.1	52.0	-20.9	23.4	169

Strain Gage Readings and Loads at Level 2
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Strain Gage Level 2					
			Pressure (psi)	Load (kips)	2A-1323506 (με)	2B-1323507 (με)	2C-1323508 (με)	2D-1323509 (με)	Av. Strain (με)	Load (kips)
1 L - 0	-	10:52:00	0	0	0.0	0.0	0.0	0.0	0.0	0
1 L - 1	1	11:12:00	790	313	24.6	28.2	23.1	22.8	24.7	178
1 L - 1	2	11:13:00	790	313	24.6	28.1	23.0	22.7	24.6	177
1 L - 1	4	11:15:00	790	313	25.0	28.7	23.7	23.2	25.2	182
1 L - 1	8	11:19:00	790	313	25.1	28.9	23.9	23.4	25.3	183
1 L - 2	1	11:21:00	1,500	589	37.5	45.9	47.3	38.6	42.3	305
1 L - 2	2	11:22:00	1,500	589	37.6	46.3	47.6	38.6	42.6	307
1 L - 2	4	11:24:00	1,500	589	37.7	46.6	48.3	39.1	42.9	310
1 L - 2	6	11:28:00	1,500	589	38.5	47.5	49.6	40.0	43.9	317
1 L - 3	1	11:29:30	2,260	884	53.3	72.4	81.9	56.3	66.0	476
1 L - 3	2	11:30:30	2,260	884	53.4	73.0	82.7	56.7	66.5	480
1 L - 3	4	11:32:30	2,260	884	54.0	73.6	83.5	57.0	67.0	484
1 L - 3	8	11:36:30	2,260	884	54.3	74.1	84.5	57.6	67.6	488
1 L - 4	1	11:39:00	2,850	1,114	66.0	92.3	106.1	68.9	83.3	601
1 L - 4	2	11:40:00	2,850	1,114	66.4	92.8	106.8	69.2	83.8	605
1 L - 4	4	11:42:00	2,850	1,114	66.8	93.2	107.6	69.6	84.3	608
1 L - 4	8	11:46:00	2,850	1,114	67.5	94.1	108.9	70.3	85.2	615
1 L - 5	1	11:48:00	3,540	1,382	79.4	112.3	130.1	61.5	100.8	727
1 L - 5	2	11:49:00	3,540	1,382	80.0	113.1	131.1	82.5	101.7	734
1 L - 5	4	11:51:00	3,540	1,382	80.7	113.8	132.5	82.7	102.4	739
1 L - 5	8	11:55:00	3,540	1,382	81.0	114.5	133.5	83.2	103.0	743
1 L - 6	1	11:58:00	4,170	1,627	91.1	129.7	151.4	92.7	116.2	839
1 L - 6	2	11:59:00	4,170	1,627	92.4	131.2	153.6	93.9	117.6	850
1 L - 6	4	12:01:00	4,170	1,627	92.5	131.5	154.4	94.3	118.2	853
1 L - 6	8	12:05:00	4,170	1,627	92.8	131.9	155.1	94.6	118.6	856
1 L - 7	1	12:08:00	4,860	1,895	104.2	148.6	174.7	106.1	133.4	962
1 L - 7	2	12:09:00	4,860	1,895	104.5	148.9	175.5	106.6	133.9	966
1 L - 7	4	12:11:00	4,860	1,895	105.0	149.5	176.4	107.1	134.5	970
1 L - 7	8	12:15:00	4,860	1,895	105.5	150.2	177.5	107.9	135.3	976
1 L - 8	1	12:17:00	5,610	2,186	117.4	166.4	196.4	121.1	150.3	1,085
1 L - 8	2	12:18:00	5,610	2,186	117.7	166.7	196.9	121.2	150.6	1,087
1 L - 8	4	12:20:00	5,610	2,186	118.3	167.2	197.7	121.8	151.2	1,091
1 L - 8	8	12:24:00	5,610	2,186	119.0	167.8	199.0	123.0	152.2	1,098
1 L - 9	1	12:26:30	6,330	2,466	131.7	183.6	216.6	136.8	167.2	1,206
1 L - 9	2	12:27:30	6,330	2,466	132.0	183.8	217.0	137.3	167.5	1,209
1 L - 9	4	12:29:30	6,330	2,466	132.3	183.9	217.7	137.8	167.9	1,212
1 L - 9	8	12:33:30	6,330	2,466	133.1	184.5	218.6	138.5	188.7	1,217
1 L - 10	1	12:35:30	7,000	2,726	145.2	198.9	234.0	151.6	182.4	1,316
1 L - 10	2	12:36:30	7,000	2,726	145.8	199.4	234.8	152.3	183.1	1,321
1 L - 10	4	12:38:30	7,000	2,726	146.2	199.5	235.5	152.8	183.5	1,324
1 L - 10	8	12:42:30	7,000	2,726	147.1	200.1	236.7	153.7	184.4	1,331
1 L - 11	1	12:44:00	7,690	2,994	159.1	214.8	251.1	166.6	197.9	1,428
1 L - 11	2	12:45:00	7,690	2,994	159.7	215.1	252.1	167.3	198.6	1,433
1 L - 11	4	12:47:00	7,690	2,994	159.8	214.9	252.6	167.7	198.8	1,434
1 L - 11	8	12:51:00	7,690	2,994	160.7	215.6	253.9	168.8	199.7	1,441
1 L - 12	1	12:54:30	8,400	3,270	173.2	230.1	269.4	182.6	213.8	1,543
1 L - 12	2	12:55:30	8,400	3,270	173.7	230.6	270.5	183.6	214.6	1,549
1 L - 12	4	12:57:30	8,400	3,270	174.0	230.7	270.8	183.8	214.8	1,550
1 L - 12	8	13:01:30	8,400	3,270	174.3	230.7	271.5	184.3	215.2	1,553
1 L - 13	1	13:03:30	9,120	3,550	187.4	245.9	286.7	198.9	229.7	1,657
1 L - 13	2	13:04:30	9,120	3,550	187.4	245.6	286.8	199.0	229.7	1,657
1 L - 13	4	13:06:30	9,120	3,550	187.9	245.8	287.9	199.8	230.4	1,662
1 L - 13	8	13:10:30	9,120	3,550	188.6	246.1	288.8	200.6	231.1	1,667

LOADTEST

Strain Gage Readings and Loads at Level 2
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Strain Gage Level 2					
			Pressure (psi)	Load (kips)	2A-1323506 (με)	2B-1323507 (με)	2C-1323508 (με)	2D-1323509 (με)	Av. Strain (με)	Load (kips)
1 L - 14	1	13:12:30	9,820	3,822	200.7	260.1	302.1	213.5	244.1	1,761
1 L - 14	2	13:13:30	9,820	3,822	201.1	260.3	303.2	214.3	244.7	1,766
1 L - 14	4	13:15:30	9,820	3,822	201.8	260.6	304.3	215.3	245.5	1,772
1 L - 14	8	13:19:30	9,820	3,822	202.3	260.5	305.5	216.2	246.1	1,778
1 L - 15	1	13:21:30	10,500	4,086	214.9	274.6	318.4	229.0	259.2	1,870
1 L - 15	2	13:22:30	10,500	4,086	214.6	273.9	318.7	229.2	259.1	1,870
1 L - 15	4	13:24:30	10,500	4,086	215.4	274.1	320.2	230.4	260.0	1,876
1 L - 15	8	13:28:30	10,500	4,086	215.6	273.9	320.9	231.1	260.4	1,879
1 L - 16	1	13:30:30	11,200	4,358	229.4	288.0	333.7	244.6	273.9	1,976
1 L - 16	2	13:31:30	11,200	4,358	229.3	287.7	334.8	245.4	274.3	1,979
1 L - 10	4	13:33:30	11,200	4,358	229.9	287.6	335.4	245.9	274.7	1,982
1 L - 10	8	13:37:30	11,200	4,358	230.4	287.8	336.8	246.9	275.5	1,986
1 L - 17	1	13:40:00	11,870	4,619	244.2	302.5	349.5	260.7	289.2	2,087
1 L - 17	2	13:41:00	11,870	4,619	244.9	302.9	350.8	261.8	290.1	2,093
1 L - 17	4	13:43:00	11,870	4,619	244.6	302.4	350.9	261.9	290.0	2,092
1 L - 17	8	13:47:00	11,870	4,619	245.4	302.9	352.5	262.8	290.9	2,099
1 L - 18	1	13:49:30	12,590	4,899	260.9	318.3	366.6	278.2	306.0	2,208
1 L - 18	2	13:50:30	12,590	4,899	261.3	318.5	367.4	278.9	306.5	2,211
1 L - 18	4	13:52:30	12,590	4,899	262.2	318.9	368.4	279.6	307.3	2,217
1 L - 18	8	13:56:30	12,590	4,899	263.4	320.1	370.2	280.8	308.6	2,227
1 L - 19	1	13:58:00	13,350	5,194	279.8	336.0	383.0	297.7	324.1	2,339
1 L - 19	2	13:59:00	13,350	5,194	279.8	335.6	383.6	298.0	324.2	2,339
1 L - 19	4	14:01:00	13,350	5,194	281.2	336.8	385.0	298.9	325.5	2,348
1 L - 19	8	14:05:00	13,350	5,194	282.2	337.3	385.8	300.1	326.3	2,355
1 L - 20	1	14:07:30	13,990	5,443	293.8	349.8	396.7	312.0	338.1	2,439
1 L - 20	2	14:08:30	13,990	5,443	293.8	349.6	397.3	312.3	338.2	2,441
1 L - 20	4	14:10:30	13,990	5,443	293.7	349.3	397.9	312.5	338.4	2,441
1 L - 20	8	14:14:30	13,990	5,443	294.5	349.7	399.0	313.5	339.2	2,447
1 L - 21	1	14:17:30	14,660	5,703	308.0	364.7	411.4	326.7	352.7	2,545
1 L - 21	2	14:18:30	14,660	5,703	307.9	364.2	411.4	326.7	352.5	2,544
1 L - 21	4	14:20:30	14,660	5,703	308.6	364.5	412.1	327.5	353.2	2,548
1 L - 21	8	14:24:30	14,660	5,703	308.7	364.3	412.5	327.8	353.3	2,549
1 U - 1	1	14:27:00	11,710	4,557	270.8	332.1	370.6	290.6	316.0	2,280
1 U - 1	2	14:28:00	11,710	4,557	270.6	332.0	370.5	290.3	315.8	2,279
1 U - 1	4	14:30:00	11,710	4,557	270.0	331.2	369.8	289.8	315.2	2,274
1 U - 2	1	14:33:00	8,740	3,402	219.4	289.8	313.0	238.0	265.1	1,912
1 U - 2	2	14:34:00	8,740	3,402	218.9	289.4	312.3	237.4	264.5	1,908
1 U - 2	4	14:36:00	8,740	3,402	218.6	288.9	312.0	237.1	264.2	1,906
1 U - 3	1	14:39:00	5,730	2,233	162.5	243.1	243.2	177.0	206.4	1,489
1 U - 3	2	14:40:00	5,730	2,233	161.9	242.6	242.5	176.4	205.8	1,485
1 U - 3	4	14:42:00	5,730	2,233	161.6	242.1	242.1	176.1	205.5	1,483
1 U - 4	1	14:44:30	2,730	1,067	99.7	189.1	162.6	108.5	140.0	1,010
1 U - 4	2	14:45:30	2,730	1,067	99.5	188.6	162.3	108.3	139.7	1,008
1 U - 4	4	14:47:30	2,730	1,067	99.1	188.1	161.5	108.0	139.2	1,004
1 U - 5	1	14:50:00	0	0	15.6	101.1	07.3	32.1	54.0	390
1 U - 5	2	14:51:00	0	0	15.1	100.1	06.2	31.3	53.2	384
1 U - 5	4	14:53:00	0	0	14.5	99.1	64.9	30.7	52.3	378
1 U - 5	8	14:57:00	0	0	14.2	98.3	64.3	30.1	51.7	373

Strain Gage Readings and Loads at Level 3
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Strain Gage Level 3					
			Pressure (psi)	Load (kips)	3A-1323510 (με)	3B-1323511 (με)	3C-1323512 (με)	3D-1323513 (με)	Av. Strain (με)	Load (kips)
1 L - 0	-	10:52:00	0	0	0.0	0.0	0.0	0.0	0.0	0
1 L - 1	1	11:12:00	790	313	10.6	13.9	10.7	5.8	10.2	74
1 L - 1	2	11:13:00	790	313	10.7	13.9	10.6	5.8	10.3	74
1 L - 1	4	11:15:00	790	313	10.9	14.0	10.7	6.0	10.4	75
1 L - 1	8	11:19:00	790	313	10.8	14.1	11.0	6.0	10.5	76
1 L - 2	1	11:21:00	1,500	589	13.6	19.3	14.4	10.3	14.4	104
1 L - 2	2	11:22:00	1,500	589	13.7	19.4	14.3	10.3	14.5	104
1 L - 2	4	11:24:00	1,500	589	13.9	19.6	14.4	10.3	14.6	105
1 L - 2	8	11:28:00	1,500	589	14.2	19.9	14.7	10.6	14.9	107
1 L - 3	1	11:29:30	2,260	884	17.5	27.5	17.3	15.7	19.5	141
1 L - 3	2	11:30:30	2,260	884	17.7	27.8	17.3	15.9	19.7	142
1 L - 3	4	11:32:30	2,260	884	17.7	27.9	17.4	15.9	19.8	143
1 L - 3	8	11:36:30	2,260	884	17.9	28.3	17.5	16.2	20.0	144
1 L - 4	1	11:39:00	2,650	1,114	20.7	34.0	20.0	20.1	23.7	171
1 L - 4	2	11:40:00	2,850	1,114	20.7	34.4	20.0	20.4	23.9	172
1 L - 4	4	11:42:00	2,850	1,114	20.8	34.4	20.2	20.5	24.0	173
1 L - 4	8	11:46:00	2,850	1,114	20.9	34.7	20.3	20.8	24.2	175
1 L - 5	1	11:48:00	3,540	1,382	23.8	40.8	23.0	25.0	28.1	203
1 L - 5	2	11:49:00	3,540	1,382	24.1	41.2	23.2	25.5	28.5	206
1 L - 5	4	11:51:00	3,540	1,382	24.0	41.2	23.2	25.5	28.5	205
1 L - 5	8	11:55:00	3,540	1,382	24.2	41.6	23.4	25.7	28.7	207
1 L - 6	1	11:58:00	4,170	1,627	26.7	46.3	25.3	29.7	32.0	231
1 L - 6	2	11:59:00	4,170	1,627	27.0	46.9	25.6	30.3	32.5	234
1 L - 6	4	12:01:00	4,170	1,627	26.9	47.0	25.5	30.4	32.5	234
1 L - 6	8	12:05:00	4,170	1,627	27.1	47.1	25.4	30.5	32.5	235
1 L - 7	1	12:08:00	4,860	1,895	29.8	52.1	27.8	35.0	36.2	261
1 L - 7	2	12:09:00	4,860	1,895	29.9	52.2	28.0	35.2	36.3	262
1 L - 7	4	12:11:00	4,860	1,895	30.1	52.3	28.1	35.5	36.5	263
1 L - 7	8	12:15:00	4,860	1,895	30.4	52.5	28.2	35.8	36.7	265
1 L - 8	1	12:17:00	5,610	2,186	33.6	57.4	31.7	40.2	40.7	294
1 L - 8	2	12:18:00	5,610	2,186	33.5	57.2	31.8	40.3	40.7	294
1 L - 8	4	12:20:00	5,610	2,186	33.6	57.5	32.0	40.6	40.9	295
1 L - 8	8	12:24:00	5,610	2,186	34.0	57.5	32.2	40.8	41.1	297
1 L - 9	1	12:26:30	6,330	2,466	37.4	61.9	36.2	45.2	45.2	326
1 L - 9	2	12:27:30	6,330	2,466	37.5	61.6	36.3	45.3	45.2	326
1 L - 9	4	12:29:30	6,330	2,466	37.7	62.0	36.5	45.5	45.4	328
1 L - 9	8	12:33:30	6,330	2,466	38.0	62.2	36.7	45.8	45.7	329
1 L - 10	1	12:35:30	7,000	2,726	41.3	65.9	40.2	49.6	49.3	355
1 L - 10	2	12:36:30	7,000	2,726	41.5	66.1	40.6	49.9	49.5	357
1 L - 10	4	12:38:30	7,000	2,726	41.6	66.1	40.7	50.1	49.6	358
1 L - 10	8	12:42:30	7,000	2,726	42.2	66.3	41.0	50.4	50.0	361
1 L - 11	1	12:44:00	7,690	2,994	45.3	69.8	44.4	54.0	53.4	385
1 L - 11	2	12:45:00	7,690	2,994	45.5	70.0	44.9	54.4	53.7	387
1 L - 11	4	12:47:00	7,690	2,994	45.5	70.0	44.9	54.6	53.7	398
1 L - 11	8	12:51:00	7,690	2,994	46.0	70.2	45.4	54.9	54.1	390
1 L - 12	1	12:54:30	8,400	3,270	49.5	73.9	49.1	59.2	57.9	418
1 L - 12	2	12:55:30	8,400	3,270	49.8	74.2	49.7	59.5	58.3	421
1 L - 12	4	12:57:30	8,400	3,270	49.9	74.2	49.6	59.6	58.3	421
1 L - 12	8	13:01:30	8,400	3,270	50.0	74.3	49.7	59.7	58.4	422
1 L - 13	1	13:03:30	9,120	3,550	53.7	78.2	53.9	63.9	62.4	450
1 L - 13	2	13:04:30	9,120	3,550	53.6	78.1	53.8	64.0	62.4	450
1 L - 13	4	13:06:30	9,120	3,550	53.9	78.3	54.1	64.2	62.6	452
1 L - 13	8	13:10:30	9,120	3,550	54.2	78.4	54.5	64.5	62.9	454

LOADTEST

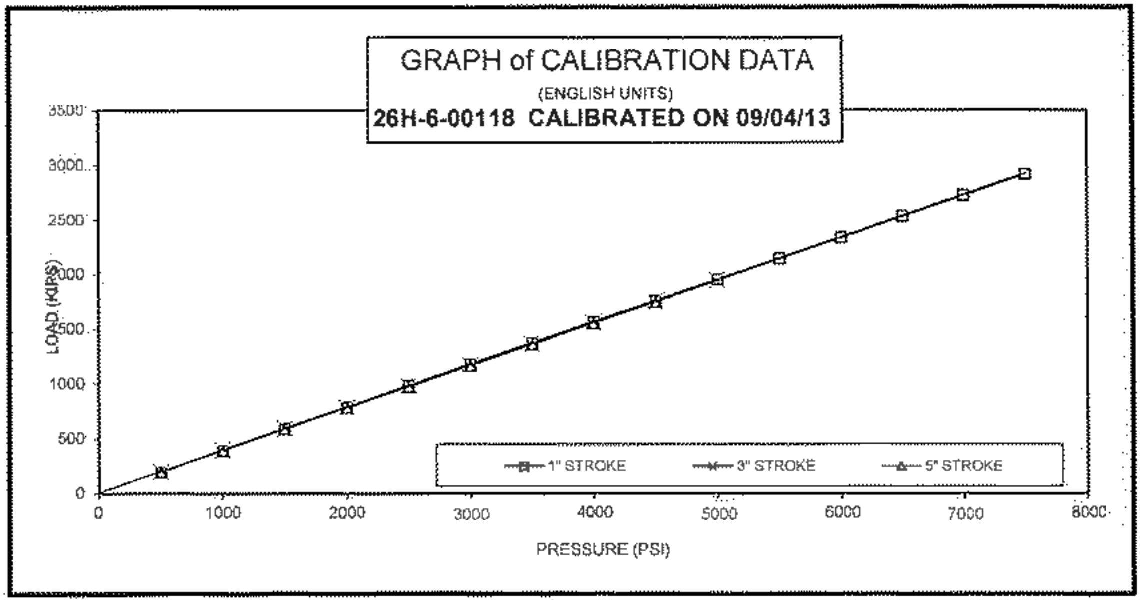
Strain Gage Readings and Loads at Level 3
TS-2 - Hudson Yards Tower A - Manhattan, NY

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	O-cell		Strain Gage Level 3					
			Pressure (psi)	Load (kips)	3A-1323510 (µε)	3B-1323511 (µε)	3C-1323512 (µε)	3D-1323513 (µε)	Av. Strain (µε)	Load (kips)
1 L - 14	1	13:12:30	9,820	3,822	57.4	82.2	57.8	68.4	66.5	479
1 L - 14	2	13:13:30	9,820	3,822	57.6	82.3	58.0	68.7	66.7	481
1 L - 14	4	13:15:30	9,820	3,822	58.0	82.6	58.5	69.1	67.0	484
1 L - 14	8	13:19:30	9,820	3,822	58.2	82.8	58.9	69.6	67.4	486
1 L - 15	1	13:21:30	10,500	4,086	61.4	86.2	62.0	73.0	70.7	510
1 L - 15	2	13:22:30	10,500	4,086	61.3	86.0	62.0	73.2	70.6	509
1 L - 15	4	13:24:30	10,500	4,086	61.8	86.3	62.4	73.7	71.1	513
1 L - 15	8	13:28:30	10,500	4,086	61.9	86.5	62.6	74.0	71.2	514
1 L - 16	1	13:30:30	11,200	4,358	65.4	89.9	65.8	77.4	74.6	538
1 L - 16	2	13:31:30	11,200	4,358	65.5	90.1	66.2	77.8	74.9	540
1 L - 16	4	13:33:30	11,200	4,358	65.8	90.0	66.2	78.1	75.0	541
1 L - 16	8	13:37:30	11,200	4,359	66.0	90.4	66.6	78.6	75.4	544
1 L - 17	1	13:40:00	11,870	4,619	69.6	94.1	69.8	82.2	78.9	569
1 L - 17	2	13:41:00	11,870	4,619	70.0	94.5	70.2	82.7	79.3	573
1 L - 17	4	13:43:00	11,870	4,619	69.7	94.5	70.3	82.7	79.3	572
1 L - 17	8	13:47:00	11,870	4,619	70.3	94.7	70.5	83.3	79.7	575
1 L - 18	1	13:49:30	12,590	4,899	74.0	98.1	74.1	87.5	83.4	602
1 L - 18	2	13:50:30	12,590	4,899	74.1	98.4	74.4	87.5	83.6	603
1 L - 18	4	13:52:30	12,590	4,899	74.5	98.6	74.6	88.0	83.9	605
1 L - 18	8	13:56:30	12,590	4,899	75.0	99.3	75.2	88.6	84.5	610
1 L - 19	1	13:58:00	13,350	5,194	78.7	102.9	78.7	92.2	88.2	636
1 L - 19	2	13:59:00	13,350	5,194	78.7	103.1	78.8	92.7	88.3	637
1 L - 19	4	14:01:00	13,350	5,194	79.2	103.5	79.1	93.1	88.7	640
1 L - 19	8	14:05:00	13,350	5,194	79.5	104.0	79.8	93.7	89.3	644
1 L - 20	1	14:07:30	13,990	5,443	82.0	107.2	81.6	96.6	91.8	663
1 L - 20	2	14:08:30	13,990	5,443	82.1	107.2	81.7	96.8	92.0	664
1 L - 20	4	14:10:30	13,990	5,443	82.0	107.3	81.8	97.2	92.1	664
1 L - 20	8	14:14:30	13,900	5,443	82.3	107.8	82.3	97.6	92.5	667
1 L - 21	1	14:17:30	14,660	5,703	85.4	111.8	84.9	101.3	95.8	691
1 L - 21	2	14:18:30	14,660	5,703	85.2	111.6	84.8	101.4	95.7	691
1 L - 21	4	14:20:30	14,660	5,703	85.6	111.9	65.1	101.9	96.1	693
1 L - 21	8	14:24:30	14,660	5,703	85.6	112.1	85.2	102.0	96.2	694
1 U - 1	1	14:27:00	11,710	4,557	69.1	97.8	71.0	88.2	81.5	588
1 U - 1	2	14:28:00	11,710	4,557	69.2	97.6	71.0	88.2	81.5	588
1 U - 1	4	14:30:00	11,710	4.557	68.9	97.6	70.7	88.1	81.3	587
1 U - 2	1	14:33:00	8,740	3,402	47.4	78.3	51.5	69.6	61.7	445
1 U - 2	2	14:34:00	8,740	3,402	47.2	78.2	51.2	69.5	61.5	444
1 U - 2	4	14:36:00	8,740	3,402	47.2	78.2	51.4	69.5	61.6	444
1 U - 3	1	14:39:00	5,730	2,233	23.8	56.3	29.2	47.8	39.3	284
1 U - 3	2	14:40:00	5,730	2,233	23.7	56.2	29.3	47.8	39.2	283
1 U - 3	4	14:42:00	5,730	2,233	23.6	56.1	29.2	47.7	39.2	283
1 U - 4	1	14:44:30	2,730	1,067	-1.4	30.6	4.7	23.0	14.2	103
1 U - 4	2	14:45:30	2,730	1,067	-1.3	30.7	4.7	23.1	14.3	103
1 U - 4	4	14:47:30	2.730	1,067	-1.5	30.4	4.8	22.9	14.1	102
1 U - 5	1	14:50:00	0	0	-30.8	-6.7	-21.1	-5.6	-16.1	-116
1 U - 5	2	14:51:00	0	0	-31.0	-6.8	-20.9	-5.7	-16.1	-116
1 U - 5	4	14:53:00	0	0	-31.0	-7.1	-21.1	-5.8	-16.2	-117
1 U - 5	8	14:57:00	0	0	-30.9	-7.0	-20.9	-5.9	-16.2	-117

TS-2 - Hudson Yards Tower A
Manhattan, NY (LT-1240-2)

APPENDIX B

O-CELL AND INSTRUMENTATION CALIBRATION SHEETS



GRAPH of CALIBRATION DATA
(ENGLISH UNITS)
26H-6-00118 CALIBRATED ON 09/04/13

STROKE:	1 INCH	3 INCH	5 INCH
PRESSURE PSI	LOAD KIPS	LOAD KIPS	LOAD KIPS
0	0	0	0
500	196	197	197
1000	395	394	392
1500	593	591	588
2000	789	785	781
2500	985	981	973
3000	1181	1174	1167
3500	1374	1365	1359
4000	1567	1560	1553
4500	1760	1754	1746
5000	1953	1946	
5500	2145		
6000	2337		
6500	2533		
7000	2726		
7500	2917		

26" O-CELL, SERIAL # 28H-6-00118

LOAD CONVERSION FORMULA

LOAO = PRESSURE * 0.3886 + (6.11)
(KIPS) (PSI)

Regression Output:

Constant	6.1128 kips
X Coefficient	0.3886 kip / psi
R Square	1.0000
No. of Observations	34
Degrees of Freedom	32
Std Err of Y Est	4.66
Std Err of X Coeff	0.0004

CALIBRATION STANDARDS:

All data presented are derived from 6" dia. certified hydraulic pressure gauges and electronic load transducer, manufactured and calibrated by the University of Illinois at Champaign, Illinois. All calibrations and certifications are traceable through the Laboratory Master Deadweight Gauges directly to the National Institute of Standards and Technology. No specific guidelines exist for calibration of load test jacks and equipment but procedures comply with similar guidelines for calibration of gages, ANSI specifications B40.1.

* AE & FC CUSTOMER: LOADTEST Inc	* CONTRACTOR.: FRONTIER-KEMPER
* AE & FC JOB NO: SO11012	* JOB LOCATION: NEW YORK, NY
* CUSTOMER P.O. NO.: LT-1240-1	* DATED: 09/04/13

SERVICE ENGINEER:____________________ DATE:____________________

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1322769

Cable Length: 56 feet

Prestress: 35,000 psi

Regression Zero: 7016

Temperature: 23.3 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7071	7073	7072		
1500	7724	7727	7726	654	-0.31
3000	8445	8449	8447	721	-0.20
4500	9172	9172	9172	725	0.04
6000	9893	9891	9892	720	0.10
100	7073	7071	7072		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.351 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323491

Cable Length: 56 feet

Prestress: 35,000 psi

Regression Zero: 7171

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7225	7231	7228		
1500	7885	7889	7887	659	-0.40
3000	8627	8633	8630	743	0.12
4500	9349	9357	9353	723	-0.04
6000	10085	10084	10085	732	0.09
100	7231	7234	7233		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.348 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323492

Cable Length: 56 feet

Prestress: 35,000 psi

Regression Zero: 7143

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7197	7196	7197		
1500	7844	7845	7845	648	-0.24
3000	8555	8556	8556	711	-0.15
4500	9269	9274	9272	716	0.12
6000	9977	9978	9978	706	0.03
100	7196	7197	7197		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.354 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323493

Cable Length: 56 feet

Prestress: 35,000 psi

Regression Zero: 6839

Temperature: 22.8 °C

Technician: KRogers

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	6894	6890	6892		
1500	7541	7542	7542	650	-0.28
3000	8266	8250	8258	716	-0.07
4500	8970	8978	8974	716	0.13
6000	9682	9679	9681	707	-0.01
100	6891	6897	6894		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.354 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

<u>Users are advised to establish their own zero conditions.</u>

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323494

Cable Length: 55 feet

Prestress: 35,000 psi

Regression Zero: 7186

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7236	7239	7238		
1500	7906	7912	7909	671	-0.09
3000	8633	8638	8636	727	-0.06
4500	9362	9371	9367	731	0.12
6000	10088	10089	10089	722	0.00
100	7239	7247	7243		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.348 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4
Serial Number: 1323495
Prestress: 35,000 psi
Temperature: 22.8 °C
Calibration Instruction: CI-VW Rebar
Date of Calibration: August 26, 2013
Cable Length: 55 feet
Regression Zero: 7071
Technician:

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7128	7124	7126		
1500	7789	7783	7786	660	-0.28
3000	8512	8515	8514	728	-0.13
4500	9244	9242	9243	729	0.09
6000	9962	9967	9965	722	0.04
100	7125	7125	7125		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.349 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323496

Cable Length: 55 feet

Prestress: 35,000 psi

Regression Zero: 7054

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7112	7110	7111		
1500	7762	7764	7763	652	-0.34
3000	8485	8487	8486	723	-0.19
4500	9212	9215	9214	728	0.12
6000	9931	9931	9931	717	0.07
100	7111	7113	7112		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.351 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323497

Cable Length: 55 feet

Prestress: 35,000 psi

Regression Zero: 7206

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7262	7263	7263		
1500	7919	7921	7920	657	-0.34
3000	8652	8650	8651	731	-0.08
4500	9382	9384	9383	732	0.20
6000	10102	10100	10101	718	0.00
100	7264	7267	7266		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.349 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323498

Cable Length: 54 feet

Prestress: 35,000 psi

Regression Zero: 7207

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7253	7256	7255		
1500	7914	7916	7915	660	-0.09
3000	8634	8631	8633	718	0.16
4500	9336	9343	9340	707	0.04
6000	10046	10048	10047	707	-0.06
100	7257	7255	7256		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.354 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

<u>Users are advised to establish their own zero conditions.</u>

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323499

Cable Length: 54 feet

Prestress: 35,000 psi

Regression Zero: 6808

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	6860	6858	6859		
1500	7515	7519	7517	658	-0.16
3000	8233	8231	8232	715	-0.11
4500	8952	8958	8955	723	0.22
6000	9661	9659	9660	705	-0.08
100	6858	6865	6862		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.353 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

<u>Users are advised to establish their own zero conditions.</u>

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323500

Cable Length: 54 feet

Prestress: 35,000 psi

Regression Zero: 7075

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7129	7125	7127		
1500	7783	7784	7784	657	-0.16
3000	8496	8499	8498	714	-0.12
4500	9209	9217	9213	715	-0.03
6000	9928	9931	9930	717	0.09
100	7126	7131	7129		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.353 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON
48 Spencer St. Lebanon, NH 03766 USA

Sister Bar Calibration Report

Model Number: 4911-4

Date of Calibration: August 26, 2013

Serial Number: 1323501

Cable Length: 54 feet

Prestress: 35,000 psi

Regression Zero: 7148

Temperature: 22.8 °C

Technician:

Calibration Instruction: CI-VW Rebar

Applied Load (pounds)	Readings				Linearity % Max. Load
	Cycle #1	Cycle #2	Average	Change	
100	7203	7198	7201		
1500	7847	7849	7848	647	-0.29
3000	8558	8569	8564	716	-0.03
4500	9272	9275	9274	710	0.04
6000	9979	9983	9981	707	0.02
100	7201	7200	7201		

For conversion factor, load to strain, refer to table C-2 of the Installation Manual

Gage Factor: 0.355 microstrain/ digit (GK-401 Pos. "B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load - Applied Load)/Max. Applied Load) X 100 percent

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 150 mm

Calibration Date: August 14, 2013

Serial Number: 1321766

Temperature: 23.5 °C

Calibration Instruction: CI-4400

Technician:

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2492	2490	2491	-0.30	-0.20	-0.01	-0.01
30.0	3494	3491	3493	30.07	0.04	30.00	0.00
60.0	4489	4488	4489	60.27	0.18	60.03	0.02
90.0	5478	5476	5477	90.25	0.17	90.01	0.00
120.0	6460	6457	6459	120.01	0.01	119.95	-0.03
150.0	7439	7438	7439	149.73	-0.18	150.03	0.02

(mm) Linear Gage Factor (G): 0.03033 (mm/ digit)

Regression Zero: 2501

Polynomial Gage Factors: A: 9.1569E-08 B: 0.02942 C: ________

Calculate C by setting $D = 0$ and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001194 (inches/digit)

Polynomial Gage Factors: A: 3.6051E-09 B: 0.001158 C: ________

Calculate C by setting $D = 0$ and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear,** $D = G(R_1 - R_0)$

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 150 mm

Calibration Date: August 14, 2013

Serial Number: 1321767

Temperature: 23.5 °C

Calibration Instruction: CI-4400

Technician:

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2490	2489	2490	-0.23	-0.15	-0.02	-0.01
30.0	3489	3483	3486	30.06	0.04	30.02	0.01
60.0	4481	4474	4478	60.19	0.13	60.03	0.02
90.0	5467	5457	5462	90.11	0.07	89.95	-0.03
120.0	6449	6444	6447	120.03	0.02	120.00	0.00
150.0	7424	7428	7426	149.80	-0.13	150.01	0.01

(mm) Linear Gage Factor (G): 0.03039 (mm/ digit)

Regression Zero: 2497

Polynomial Gage Factors: A: 6.294E-08 B: 0.02977 C:

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001197 (inches/digit)

Polynomial Gage Factors: A: 2.478E-09 B: 0.001172 C:

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear, $D = G(R_1 - R_0)$**

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 150 mm

Calibration Date: August 14, 2013

Serial Number: 1321768

Temperature: 23.5 °C

Calibration Instruction: CI-4400

Technician:

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2525	2521	2523	-0.27	-0.18	0.00	0.00
30.0	3531	3528	3530	30.08	0.05	30.00	0.00
60.0	4531	4529	4530	60.24	0.16	60.00	0.00
90.0	5528	5521	5525	90.23	0.15	89.99	0.00
120.0	6515	6513	6514	120.07	0.04	120.00	0.00
150.0	7499	7497	7498	149.73	-0.18	150.00	0.00

(mm) Linear Gage Factor (G): 0.03015 (mm/ digit)

Regression Zero: 2532

Polynomial Gage Factors: A: 8.5122E-08 B: 0.02930 C:

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001187 (inches/digit)

Polynomial Gage Factors: A: 3.3512E-09 B: 0.001153 C:

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear, $D = G(R_1 - R_0)$**

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

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GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 150 mm

Calibration Date: August 14, 2013

Serial Number: 1321871

Temperature: 23.4 °C

Calibration Instruction: CI-4400

Technician:

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2490	2486	2488	-0.34	-0.22	-0.03	-0.02
30.0	3487	3485	3486	30.09	0.06	30.04	0.03
60.0	4476	4475	4476	60.26	0.18	60.03	0.02
90.0	5458	5458	5458	90.22	0.15	89.99	-0.01
120.0	6435	6433	6434	119.98	-0.01	119.93	-0.05
150.0	7410	7410	7410	149.74	-0.17	150.04	0.03

(mm) Linear Gage Factor (G): **0.03049** **(mm/ digit)**

Regression Zero: **2499**

Polynomial Gage Factors: **A:** **9.2225E-08** **B:** **0.02958** **C:**

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): **0.001200** **(inches/digit)**

Polynomial Gage Factors: **A:** **3.6309E-09** **B:** **0.001164** **C:**

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement:

Linear, $D = G(R_1 - R_0)$

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

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APPENDIX C

O-CELL METHOD FOR DETERMINING CREEP LIMIT LOADING

O-CELL METHOD FOR DETERMINING A CREEP LIMIT LOADING ON THE EQUIVALENT TOP-LOADED SHAFT (September, 2000)

Background: O-cell testing provides a sometimes useful method for evaluating that load beyond which a top-loaded drilled shaft might experience significant unwanted creep behavior. We refer to this load as the "creep limit," also sometimes known as the "yield limit" or "yield load".

To our knowledge, Housel (1959) first proposed the method described below for determining the creep limit. Stoll (1961), Bourges and Levillian (1988), and Fellenius (1996) provide additional references. This method also follows from long experience with the pressuremeter test (PMT). Figure 8 and section 9.4 from ASTM D4719-94, reproduced below, show and describe the creep curve routinely determined from the PMT. The creep curve shows how the movement or strain obtained over a fixed time interval, 30 to 60 seconds, changes versus the applied pressure. One can often detect a distinct break in the curve at the pressure P_e in Figure 8. Plastic deformations may become significant beyond this break loading and progressively more severe creep can occur.

Definition: Similarly with O-cell testing using the ASTM Quick Method, one can conveniently measure the additional movement occurring over the final time interval at each constant load step, typically 2 to 4 minutes. A break in the curve of load vs. movement (as at P_e with the PMT) indicates the creep limit.

We usually indicate such a creep limit in the O-cell test for either one, or both, of the side shear and end bearing components, and herein designate the corresponding movements as M_{CL1} and M_{CL2}. We then combine the creep limit data to predict a creep limit load for the equivalent top loaded shaft.

Procedure if both M_{CL1} and M_{CL2} available: Creep cannot begin until the shaft movement exceeds the M_{CL} values. A conservative approach would assume that creep begins when movements exceed the lesser of the M_{CL} values. However, creep can occur freely only when the shaft has moved the greater of the two M_{CL} values. Although less conservative, we believe the latter to match behavior better and therefore set the creep limit as that load on the equivalent top-loaded movement curve that matches the greater M_{CL}.

Procedure if only M_{CL1} available: If we cannot determine a creep limit in the second component before it reaches its maximum movement M_x, we treat M_x as M_{CL2}. From the above method one can say that the creep limit load exceeds, by some unknown amount, that obtained when using $M_{CL2} = M_x$.

Procedure if no creep limit observed: Then, according to the above, the creep limit for the equivalent top-loaded shaft will exceed, again by some unknown amount, that load on the equivalent curve that matches the movement of the component with the maximum movement.

Limitations: The accuracy in estimating creep limits depends, in part, on the scatter of the data in the creep limit plots. The more scatter, the more difficult to define a limit. The user should make his or her own interpretation if he or she intends to make important use of the creep limit interpretations. Sometimes we obtain excessive scatter of the data and do not attempt an interpretation for a creep limit and will indicate this in the report.

Excerpts from ASTM D4719
"Standard Test Method for Pressuremeter Testing in Soils"

> 9.4 For Procedure A, plot the volume increase readings (V_{60}) between the 30 s and 60 s reading on a separate graph. Generally, a part of the same graph is used, see Fig. 8. For Procedure B, plot the pressure decrease reading between the 30 s and 60 s reading on a separate graph. The test curve shows an almost straight line section within the range of either low volume increase readings (V_{60}) for Procedure A or low pressure decrease for Procedure B. In this range, a constant soil deformation modulus can be measured. Past the so-called creep pressure, plastic deformations become prevalent.

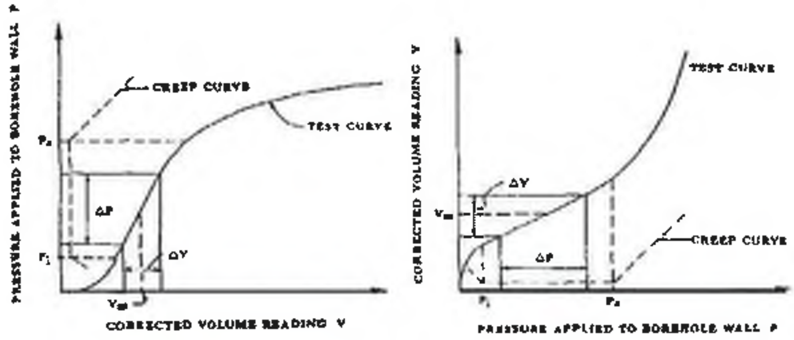


FIG. 8 Pressuremeter Test Curves for Procedure A

References

Housel, W.S. (1959), "Dynamic & Static Resistance of Cohesive Soils", ASTM STP 254, pp. 22-23.

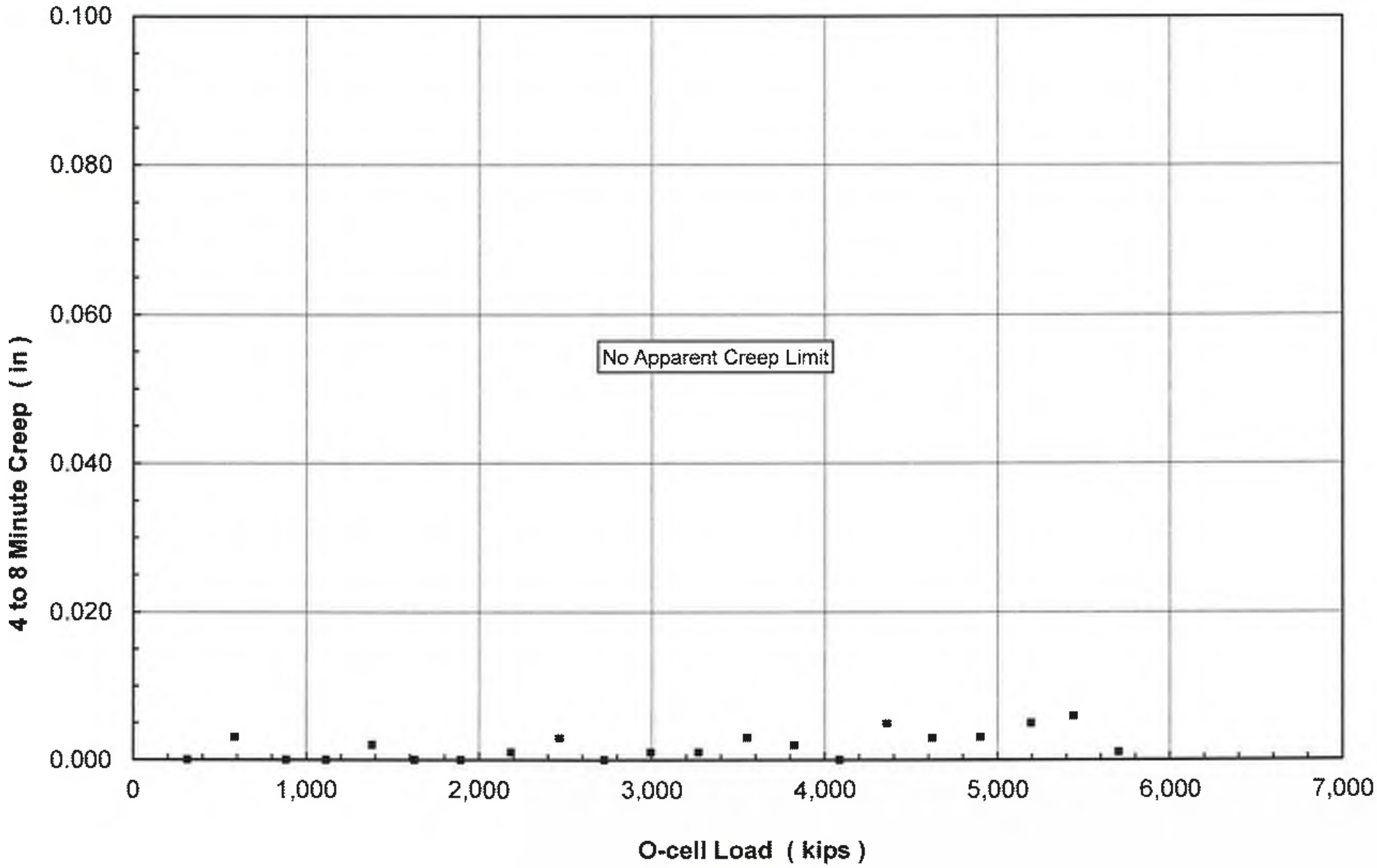
Stoll, M.U.W. (1961, Discussion, Proc. 5th ICSMFE, Paris, Vol. III, pp. 279-281.

Bourges, F. and Levillian, J-P (1988), "force portante des rideaux plans metalliques charges verticalmement," Bull. No. 158, Nov.-Dec., des laboratoires des ponts et chaussees, p. 24.

Fellenius, Bengt H. (1996), Basics of Foundation Design, BiTech Publishers Ltd., p.79.

Combined End Bearing and Lower Side Shear Creep Limit

TS-2 - Hudson Yards Tower A - Manhattan, NY

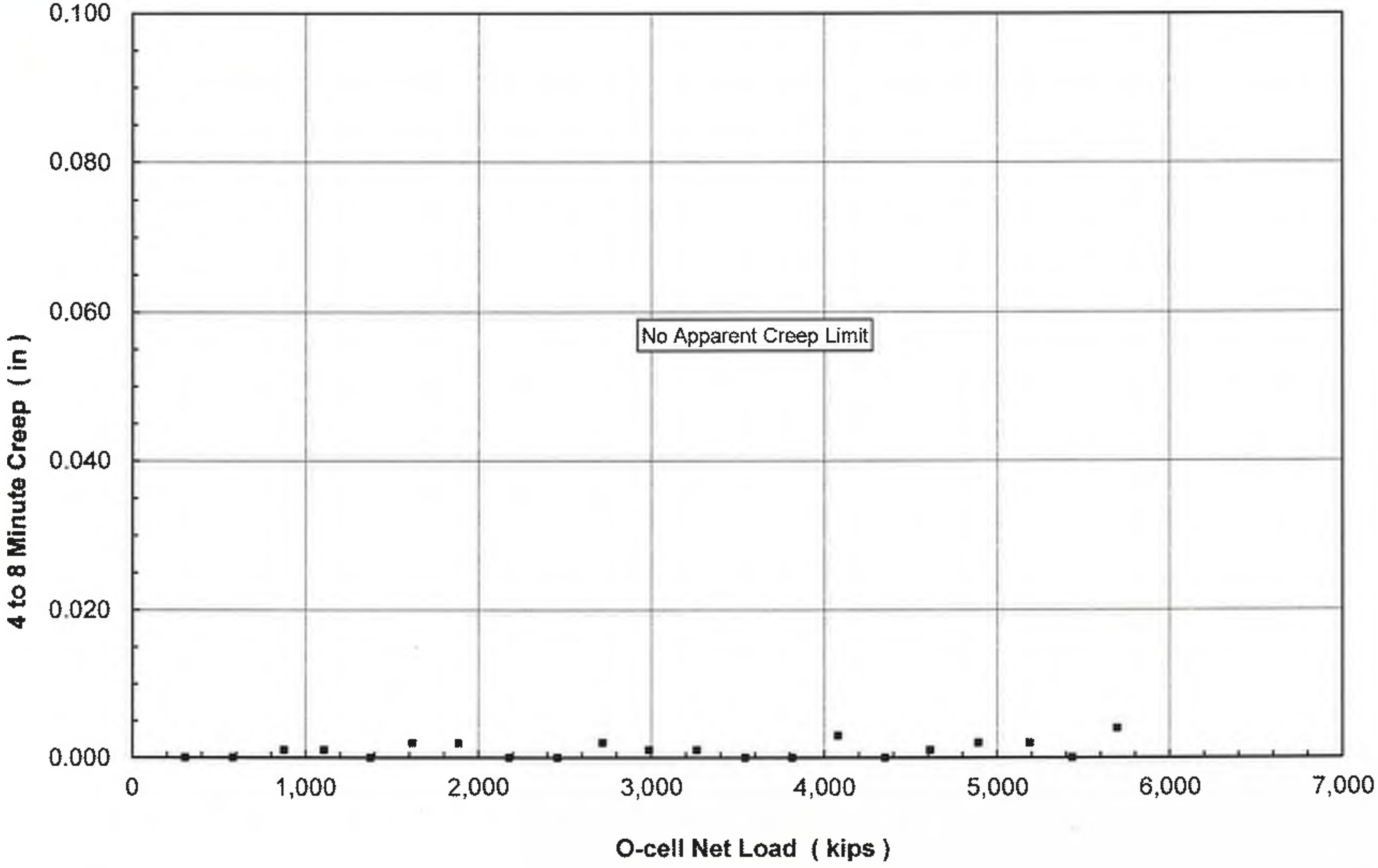


Loadtest USA Project No. LT-1240-2

Figure C-1

Upper Side Shear Creep Limit

TS-2 - Hudson Yards Tower A - Manhattan, NY



Loadtest USA Project No. LT-1240-2

Figure C-2

TS-2 - Hudson Yards Tower A
Manhattan, NY (LT-1240-2)

APPENDIX D

SOIL BORING LOG

DEPT OF BLDGS 121192618 Job Number

ES937242537 Scan Code

LANGAN

LOG OF BORING BH-5 SHEET 1 OF 4

PROJECT: HUDSON YARDS - PLATFORM BORINGS
PROJECT NO.: 170019118
LOCATION: EAST RAIL YARDS (ERY)
ELEVATION AND DATUM: [illegible]
DRILLING AGENCY: WARREN GEORGE, INC.
DATE STARTED: 6/2/2013
DATE FINISHED: 6/2/13
DRILLING EQUIPMENT: Turret
COMPLETION DEPTH: 32'
ROCK DEPTH: 17' ±
SIZE AND TYPE OF BIT: 2 7/8 & 5 7/8 [illegible] ROLLER BIT
NO. SAMPLES: DIST. 5 UNDIST. 0 CORE 3
CASING: 3-INCH-DIAMETER FLUSH JOINT STEEL CASING
WATER LEVEL: FIRST N/A COMPL. N/A 24 HR N/A
CASING HAMMER: – WEIGHT: – DROP: –
FOREMAN: Jim Wilson/Eddie Cardona
SAMPLER: 2-INCH-DIAMETER SPLIT SPOON
SAMPLER HAMMER: [illegible] WEIGHT: 140 lb DROP: 30 IN
INSPECTOR: Jason Herty

NYC BC	MATERIAL SYMBOL	SAMPLE DESCRIPTION	CASING (BL/FT) or CORE TIME (min)	DEPTH SCALE	NO LOC	TYPE	RECOV FT.	PENETR RESIST BL/6 IN
CLASS 7	GRAVEL	RAILROAD 18" BALLAST (mostly Granite gravel)		0–1				
CLASS 7	CONCRETE	18" Concrete Slab		2				
Class 7	FILL	brown c-f SAND, some gravel, tr. silt + ptr. rock fragments SAMPLE ES-1 collected during hand augering 4'-7'	SPIN	3–7	ES-1			
SAND	3b	glacial sands brown c-f sand ptr. f. gravel tr. silt		7–9	ES-2	SS	[illegible]	9 8 10 12
		Weathered rock fragments		9–10	ES-3	SS		24 50/5"
Weathered Rock	Class 1d	Weathered Rock (?)	SPIN	10–14	S-1			50/2"

REMARKS (DRILLING FLUID, DEPTH OF CASING, CASING BLOWS, FLUID LOSS, ETC.)

3:00 pm
- Clear ballast by hand w/shovel
3:15 [illegible] drilling
[illegible]
[illegible] 3:35 pm
[illegible] to 4'-7'
- Collect ES-1
- Install casing to 4' - 4:05 pm
- Roller bit to 7'
[illegible]
- Take ES-2 with SS [illegible]
  - [illegible]
- Install casing to 9'
- Drill to 10'
  Take SSP 10' - 50/2"
  - no recovery
- Drill to 15' - hard drilling
- to 15' –

DEPT OF BLDGS 121192618 Job Number

ES288750679 Scan Code

LANGAN

JOB NO. 170019118

DATE: 6/2/2015

LOG OF BORING NO. BH - 5

SHEET 2 OF 4

NYC BC	DEPTH SCALE	SAMPLE DESCRIPTION	CORE TIME (min/ft)	NO. LOC	TYPE	RECOV. FT.	PENETR RESIST BL/6 IN.
Class 1d	14–17	Weathered Rock		2	S	6"	100/1"
	17–22	GRAY MODERATELY WEATHERED, SLIGHTLY TO MODERATELY FRACTURED MICA SCHIST WITH INTRUSIONS OF PEGMATITE AND DIP ANGLE APPROX 45° FROM HORIZ.	3MIN 3MIN 4MIN 6MIN 7MIN	C-1	NX-CORE	RQD = 35IN/60IN = 58%	TCR = 48IN/60IN = 80%
	22–27	GRAY SLIGHTLY WEATHERED SLIGHTLY TO MODERATELY FRACTURED MICA SCHIST WITH TRACE PEGMATITE INTRUSIONS AND DIP ANGLE APPROX 50° FROM HORIZONTAL	6MIN 5MIN 6MIN 5MIN 6MIN	C-2	NX-CORE	RQD = 33IN/60IN = 55%	TCR: 52IN/60IN = 87%
	27–31	GRAY SLIGHTLY TO MODERATELY WEATHERED, SLIGHTLY TO MODERATELY FRACTURED MICA SCHIST WITH DIP ANGLE APPROX 30° FROM HORIZONTAL [CLASS 1B]	4MIN 4MIN 4MIN 6MIN	C-3	NX-CORE	RQD = 41IN/60IN = 68%	TCR: 57IN/60IN = 95%

REMARKS (DRILLING FLUID, DEPTH OF CASING, CASING BLOWS, FLUID LOSS, ETC.)

- [illegible] 16.5'
- Hold drilling @ 16.5'
- 6/2/2015 - LANGAN & WARREN GEORGE ARRIVE AT 6:00AM
- LIRR [illegible] & SET UP FROM 6:00AM TO 7:14AM
- INSTALLED [illegible] 3-INCH-DIAMETER CASING FROM 10FT TO 15FT FROM 7:14AM TO 7:27AM
- INSTALL 2 FT OF 3-INCH-DIAMETER CASING [illegible] FROM 7:27AM TO 7:31AM
- DRILL TO 16.5 FEET USING 2 7/8" [illegible] ROLLER BIT
  - SOME [illegible]
  - BROWN [illegible]
- ADD [illegible]
- BEGIN CORING C-1 W/ NX-CORE [illegible] AT 7:47AM
- COMPLETE CORE @ 8:[illegible]AM
- INSTALL 2 FEET OF CASING FROM 15' TO 17' FROM 8:20AM TO 8:35AM
- START CORE C-2 W/ NX-CORE BARREL @ 8:53AM
- END CORE C-2 W/NX-CORE BARREL @ 9:20AM
- START CORE C-3 W/NX-CORE BARREL @ 9:43AM
- END CORE C-3 @ 10:06AM
- DRILLERS GO ON BREAK FROM 10:15AM TO 10:30AM

LANGAN

JOB NO. 170019118

DATE:

LOG OF BORING NO. BH - 5

SHEET 3 OF 4

NYC BC	MATERIAL SYMBOL	SAMPLE DESCRIPTION	TIME TO CORE (MIN)	CASING (BPF) or CORE TIME (min/ft)	DEPTH SCALE	SAMPLES NO. LOC	TYPE	RECOV FT.	PENETR RESIST BL/6 IN.	PID	Odor	REMARKS (DRILLING FLUID, DEPTH OF CASING, CASING BLOWS, FLUID LOSS, ETC.)
			5 MIN		31							
		END OF BORING @ 32' bgs			32							
					33							
					34							
					35							
					36							
					37							
					38							
					34							
					40							
					41							
					42							
					43							
					44							
					45							
					46							
					47							

LANGAN

ENGINEERING & ENVIRONMENTAL SERVICES

JOB NO. 170019115

DATE 6/1

LOG OF BORING NO. BH-5

SHEET 4 OF 4

SAMPLE DESCRIPTION		DEPTH SCALE	SAMPLES NO./LOC.	TYPE	RECOV. FT.	PENETR. RESIST BL/6 in.	REMARKS (DRILLING FLUID, DEPTH OF CASING, CASING BLOWS, FLUID LOSS, ETC.)
	3 min	68					Fractured rock stuck in bit for 2nd time and clogging up bit.
	4 min	69					Pulled out rods for 2nd time and restart C-12 @ 1:32AM
		70					- End C-12 @ 1:51AM
		71					- End of boring @ 70'
		72					• Demobilization from BH-4 and move to BH-5 (2:15AM - 3:15AM)

TS-2 - Hudson Yards Tower A
Manhattan, NY (LT-1240-2)

APPENDIX E

CONCRETE STRENGTH ESTIMATE

DEPT OF BLDGS121192618 Job Number

ES055466973 Scan Code

TECTONIC
Practical Solutions. Exceptional Service

REPORT ON CONCRETE FIELD AND LABORATORY TEST RESULTS

(NYC DEPARTMENT OF BUILDINGS CONCRETE TESTING LABORATORY LICENSE #73)

Project ID:	**6857.02**	Inspection Date:	**09/16/2013**
Project:	**Perini - Hudson Yards Platform**	Created On:	**09/27/2013**
Address:	**401 10th Ave New York 10019**	Yards Placed:	
Client:	**Perini**		

To:

CC: Duke Samala

Attention:

Concrete: *Sampling of Concrete (ASTM C172), Slump (ASTM C143), Air Content (ASTM C23 Pressure / C173 Volume), Unit Weight (ASTM C138), Temperature (ASTM C1064),Casting Specimen (ASTM C31) Compressive Strength (ASTM C39)*

SSC: *Slump flow, T50 VSI (ASTM C1611), J-ring Flow (ASTM C1621), Seggregation Probe (FHWA method)*

ASTM C39 Break Types

Cast Date:	09/16/2013	Sample Type:	Concrete Cylinders	Slump, Inches:		Air,%(Pressure):	1.3
Set No:	1	Curing Method:	Standard Curing	Conc Temp, F:	80	Unit Weight, pcf:	149.2
Truck No:		Load No:		Mix Class, psi:	12000	Mix Type:	
Location:	401 10th ave. Ny, Ny 10019						
Remarks:							

Sample Id	Barcode No	Age	Test Date	Size, Inches	Area	Load, lbs	Stress,psi	% Str	Brk Type	Tested By	Remarks
13CCY-56090	00043437	1	09/17/2013	4 x 8	12.57	1080	90	1	2	David Santos	17Hrs@8:30am
13CCY-56091	00043443	1	09/17/2013	4 x 8	12.57	1985	160	1	2	David Santos	17Hrs@8:30am
13CCY-56092	00043441	1	09/17/2013	4 x 8	12.57	1920	150	1	2	David Santos	17Hrs@8:30am
13CCY-56093	00043442	1	09/17/2013	4 x 8	12.57	2690	210	2	2	David Santos	18Hrs@9:30am
13CCY-56094	00043446	1	09/17/2013	4 x 8	12.57	2535	200	2	2	David Santos	18Hrs@9:30am
13CCY-56095	00043445	1	09/17/2013	4 x 8	12.57	2585	210	2	3	David Santos	18Hrs@9:30am
13CCY-56096	00043444	1	09/17/2013	4 x 8	12.57	14320	1140	10	2	denis kireyev	24Hrs@3:30PM
13CCY-56097	00043449	1	09/17/2013	4 x 8	12.57	15010	1190	10	2	denis kireyev	24Hrs@3:30PM
13CCY-56098	00043447	1	09/17/2013	4 x 8	12.57	14955	1190	10	3	denis kireyev	24Hrs@3:30PM
13CCY-56099	00043448	3	09/19/2013	4 x 8	12.57	115820	9210	77	3	denis kireyev	
13CCY-56100	00043438	3	09/19/2013	4 x 8	12.57	114480	9110	76	1	denis kireyev	
13CCY-56101	00043439	3	09/19/2013	4 x 8	12.57	112840	8980	75	2	denis kireyev	
13CCY-56102	00043440	7	09/23/2013	4 x 8	12.57	154190	12270	100+	2	Denis Kireyev	
13CCY-56103	00043434	7	09/23/2013	4 x 8	12.57	157250	12510	100+	2	denis kireyev	
13CCY-56104	00043435	7	09/23/2013	4 x 8	12.57	156610	12460	100+	3	denis kireyev	
13CCY-56105	00043426	28	10/14/2013	4 x 8							
13CCY-56106	00043432	28	10/14/2013	4 x 8							
13CCY-56107	00043427	28	10/14/2013	4 x 8							
13CCY-56108	00043431	11	09/27/2013	4 x 8	12.57	173620	13810	100+	2	Denis Kireyev	
13CCY-56109	00043430	11	09/27/2013	4 x 8	12.57	175020	13920	100+	3	denis kireyev	
13CCY-56110	00043433	11	09/27/2013	4 x 8	12.57	172110	13690	100+	2	denis kireyev	
13CCY-56111	00043429	56	11/11/2013	4 x 8							
13CCY-56112	00043428	56	11/11/2013	4 x 8							
13CCY-56113		56	11/11/2013	4 x 8							
13CCY-56114		56	11/11/2013	4 x 8							

Average Strength: 1 Days: 500; 3 Days: 9100; 7 Days: 12410; 11 Days: 13810;

Field Tech: Paing Soe, ACI # 01252259, Expiry Date: 10/25/2017

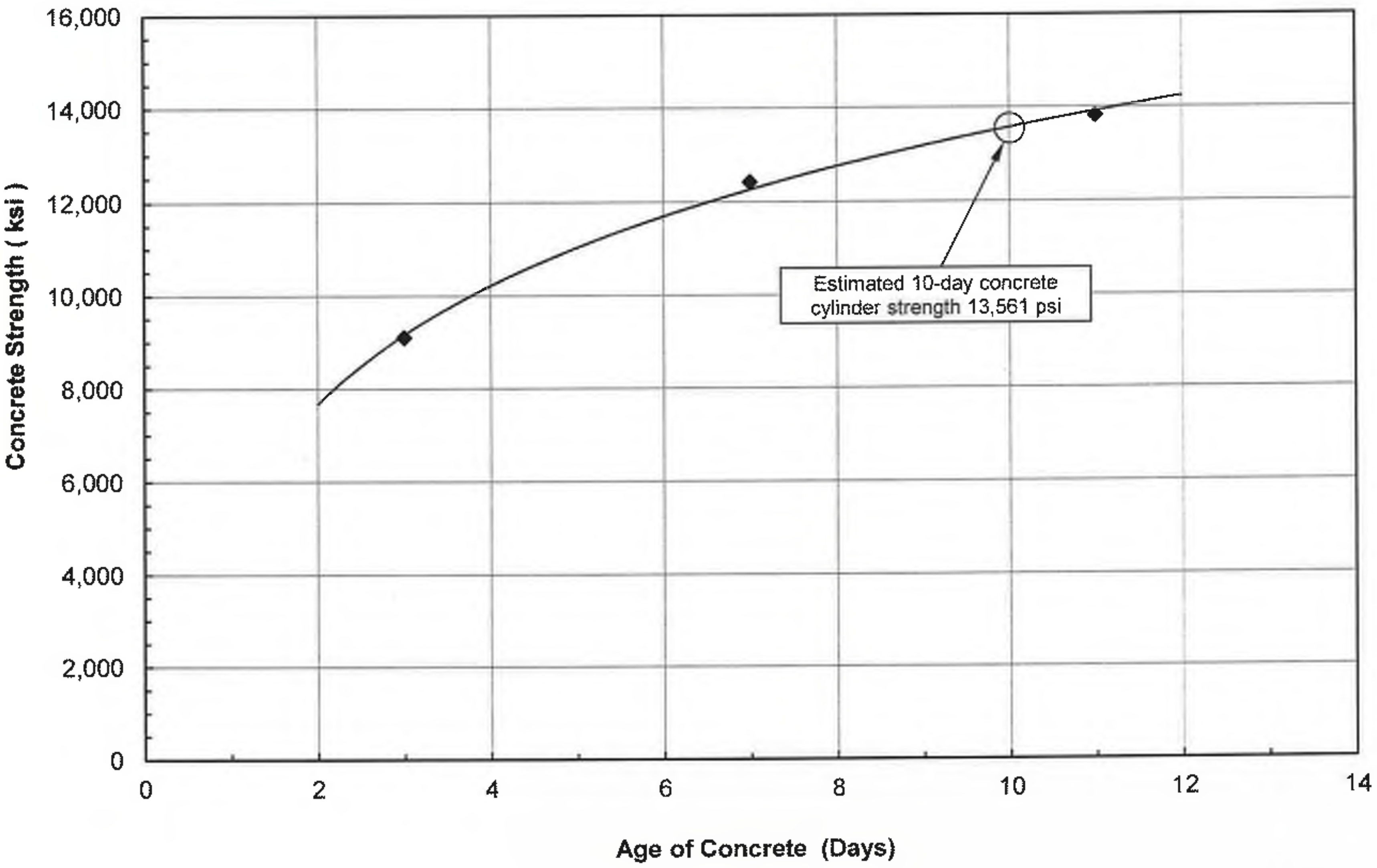
Lab Tech: Kireyev Denis, ACI # 01136707, Expiry Date: 01/21/2017; Santos David, ACI # 01210580, Expiry Date: 01/21/2017

Project ID:	**6857.02**	Inspection Date:	**09/16/2013**
Project:	**Perini - Hudson Yards Platform**	Created On:	**09/27/2013**
Address:	**401 10th Ave New York 10019**	Yards Placed:	
Client:	**Perini**		

Edward Torossian, PE
Lab Director

Concrete Strength vs. Age (logarithmic approximation)

TS-2 - Hudson Yards Tower A - Manhattan, NY



Estimated 10-day concrete cylinder strength 13,561 psi

Loadtest USA Project No. LT-1240-2

Figure E-1

APPENDIX G
Lateral Caisson Analysis

LANGAN
ENGINEERING & ENVIRONMENTAL SERVICES

Technical Memorandum

21 Penn Plaza, 360 West 31st Street, 8th Floor New York, NY 10001 T: 212.479.5400 F: 212.479.5444

To: Eli Gottlieb – Thornton Tomasetti

From: Michael Paquette, Marc Gallagher, Seth Martin

Info: Mike Spiro, Nick Mazzaferro, Mark Boekenheide – Related

Date: 30 November 2012

Re: Lateral Caisson Analysis: p-y Curves
Hudson Yards – Platform and Podium
Manhattan, New York
Langan Project No.: 170019112

This memorandum presents our lateral caisson analysis to be used for the Platform, Tower A, Tower E, and Retail Podium caisson design. Summarized below are the subsurface conditions within the East Rail Yard, the proposed caissons to support the new structures, our lateral caisson model, and examples of the anticipated lateral caisson response.

Subsurface Conditions

The subsurface conditions beneath the East Rail Yard generally consist of historical fill, over sandy silt and silty sand, over variable depth to rock. Glacial till was encountered in some of the borings, being variable in thickness and lateral extent. Both the fill and the underlying silt and sand have highly variable density as evidenced by a wide range in Standard Penetration Test (SPT) N-values in historical borings in the yards. The depth to rock interpreted from a limited number of historical borings is shown on Figure 1.

Proposed Caissons

Several 32-inch diameter caissons were previously constructed in the yards for the planned, but never built, MABSTOA bus garage. The locations of the MABSTOA caissons were taken from design drawings and are shown on Figure 1. We understand these caissons will be reused to support the platform.

In addition to reusing the MABSTOA caissons, several new caissons will be required to support the platform. The new caissons are expected to be 36-inch diameter. The locations of the caissons are yet to be determined, but will be in-between tracks.

Lateral Caisson Model using p-y Curves

We recommend the behavior of the caissons under lateral loading be analyzed using the p-y method whereby the soil and rock are modeled as a series of discrete resistances (i.e. springs) with nonlinear behavior. Nonlinear caisson material properties should also be included in the model (such as reduced pile stiffness from concrete cracking).

We have developed p-y curves for the existing 32-inch and proposed 36-inch caissons using the commercial software LPile 6.0 by Ensoft, Inc. LPile analyzes the lateral resistance of soil and rock using non-linear relationships (p-y curves) developed from various full scale load tests of piles in different conditions (e.g. sand, clay, rock, etc.). P-y curves for soil and rock depend on variables such as pile diameter, pile group configuration, soil parameters, depth below ground surface (effective stress), depth below groundwater, cyclic vs. static loading, and fixed versus pinned head conditions.

We used conservative soil and rock models to allow for inherent uncertainty and variability in the soil and rock strata. The historical fill and the sand and silt layer were modeled as a loose to medium dense sand. Bedrock was modeled to allow for weaker rock in the upper 8 to 9 feet (three pile diameters), with stronger rock below. The model included groundwater about 4 feet below existing grade based on measurements from observation wells.

The recommended p-y curves are based on the assumption that the caissons will be isolated such that pinned head conditions and no group effects apply. If caissons are tied together with a cap or grade beam, the p-y curves should be revised to account for fixed head conditions and group effects.

Soil and rock p-y curves were developed for static and cyclic loading conditions:

- Static p-y curves should be used for sustained lateral loads. Sustained lateral loads are generally not expected for this project. If impact loads need to be analyzed (such as for train derailment), we recommend the static curves be used as these curves are stiffer than the cyclic curves, and will better model the strain rate effects from dynamic impact loading. Static p-y curves are presented in Table 1a for the 32-inch caissons, and Table 1b for the 36-inch caissons.

- Strain-softening cyclic p-y curves should be used for long-period cyclic loads, such as wind loads. The cyclic p-y curves were developed based on slow rate cyclic loading conditions and are intended for use in push-over analyses. The cyclic curves are based on an envelope of observed behavior and account for gapping and cyclic degradation effects. Cyclic p-y curves are presented in Table 2a for the 32-inch caissons, and Table 2b for the 36-inch caissons.

- For seismic conditions, we recommend a simplified approach that accounts for the relative uncertainty in the lateral resistance because of strain rate effects, gapping, cyclic degradation and radiation damping. We recommend evaluating a lower bound and upper bound stiffness and designing the structure for the resulting worst condition stresses. For the lower bound case, we recommend using reduced static p-y springs to account for cyclic degradation of the initial soil stiffness caused by increased pore pressures during earthquake shaking. The increase in pore pressure reduces the effective stress of the soil, and correspondingly reduces the stiffness response. We recommend applying a p-multiplier or 0.8 to the static p-y curves for analyzing the lower bound stiffness for seismic induced lateral loads.

For the upper bound stiffness case, we recommend using the static p-y curves with no modification. In the upper bound stiffness case, the increase in lateral resistance from rate of loading effects is assumed to be counteracted by the cyclic degradation effects.

Based on the general presence of medium dense sands throughout the site, liquefaction need not be considered in the analysis.

Example Lateral Caisson Response

We analyzed the existing MABSTOA caisson at column location A-1 for comparison with results from the structural model. The depth to rock at column A-1 is about 16.5 feet, as shown on Figure 1. The MABSTOA design drawings indicate the caisson at this location has a 7-foot long rock socket with a W14X38 core beam in the bottom 14 feet of the caisson. The caisson was analyzed assuming a pinned-head condition and cyclic (wind) loading. We also assumed the caisson will support an axial service load of 830 kips as indicated on the as-built plans attached to this memo. Axial load impacts the stiffness of the caisson and also applies p-delta effects in the lateral model from eccentricity as the caisson deflects. The results of our analysis are included as the following figures:

- Figure 2 – Example load-deflection curve for MABSTOA caisson A-1 under static loads.
- Figure 3 – Example load-deflection curve for MABSTOA caisson A-1 under cyclic loads.
- Figure 4 – Example deflection versus depth curves for various lateral, static loads at MABSTOA caisson A-1.
- Figure 5 – Example deflection versus depth curves for various lateral, cyclic loads at MABSTOA caisson A-1.

Closure

We trust this information is sufficient to proceed with the lateral design of caissons for the platform and podium, please call us with any questions.

\\langan.com\data\NY\data1\170019114\Office Data\Reports\Geotechnical\2012-11-28_Platform p-y springs (MP).docx

LANGAN

Project: Hudson Yards - Tower A, Podium & Platform **Calculated By:** SKM
Project Number: 170019114 **Checked By:**
Date: 11/28/2012

Notes:

1. P-Y Curve data is for static loading conditions.
2. P-Y Curve data is for 32-inch O.D. caisson
3. P-Y Curve data does not account for group effects.
4. A multiplier of 0.8 should be applied to "p" values to evaluate seismic conditions.

[a] y = Lateral pile deflection in inches
[b] p = Lateral pile resistance in pounds per inch

Table 1a. P-Y Curve Data Points for 32-inch O.D. Caisson under Static Loading

Strata	Layer Number	Elevation at Mid-Layer (ft, BPMD)		Curve Points																
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
SOIL	1	7.0	y[a]	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.34	0.39	0.44	0.49	0.54	0.59	0.64	0.69	0.74	0.79
			p[b]	0	26	51	72	89	102	112	119	124	128	130	132	133	134	134	135	135
	2	6.0	y	0.00	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.56	0.61	0.67	0.72	0.78	0.83	0.89
			p	0	89	171	243	301	346	379	404	421	433	441	447	451	453	455	456	457
	3	5.0	y	0.00	0.06	0.12	0.18	0.24	0.30	0.36	0.41	0.47	0.53	0.59	0.65	0.71	0.77	0.83	0.89	0.95
			p	0	158	305	431	534	614	674	717	747	769	783	794	800	805	808	810	812
	4	4.0	y	0.00	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48	0.54	0.60	0.66	0.72	0.78	0.84	0.90	0.96
			p	0	225	433	613	760	874	958	1019	1063	1093	1114	1128	1138	1145	1149	1152	1155
	5	3.0	y	0.00	0.08	0.16	0.25	0.33	0.41	0.49	0.58	0.66	0.74	0.82	0.91	0.99	1.07	1.15	1.24	1.32
			p	0	266	513	726	900	1034	1135	1207	1258	1294	1319	1336	1348	1356	1361	1365	1367
	6	2.0	y	0.00	0.07	0.14	0.21	0.28	0.35	0.41	0.48	0.55	0.62	0.69	0.76	0.83	0.90	0.97	1.04	1.10
			p	0	272	525	743	921	1058	1161	1235	1287	1324	1350	1367	1379	1387	1392	1396	1399
	7	1.0	y	0.00	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.56	0.61	0.67	0.72	0.78	0.83	0.89
			p	0	258	498	706	874	1005	1102	1173	1223	1258	1282	1298	1310	1317	1322	1326	1328
	8	0.0	y	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80
			p	0	270	520	736	912	1049	1150	1224	1276	1312	1337	1355	1366	1374	1380	1383	1386
	9	-1.0	y	0.00	0.05	0.11	0.16	0.21	0.26	0.32	0.37	0.42	0.47	0.53	0.58	0.63	0.68	0.74	0.79	0.84
			p	0	319	615	871	1080	1241	1361	1448	1510	1553	1583	1603	1617	1627	1633	1637	1640
	10	-2.0	y	0.00	0.06	0.11	0.16	0.22	0.27	0.33	0.38	0.44	0.49	0.55	0.60	0.66	0.71	0.77	0.82	0.88
			p	0	373	719	1018	1261	1450	1590	1692	1764	1814	1849	1873	1889	1900	1908	1913	1916
	11	-3.0	y	0.00	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46	0.52	0.57	0.63	0.69	0.75	0.80	0.86	0.92
			p	0	431	830	1176	1457	1675	1837	1954	2038	2096	2136	2163	2182	2195	2204	2209	2213
	12	-4.0	y	0.00	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48	0.54	0.60	0.66	0.72	0.78	0.84	0.90	0.96
			p	0	493	950	1345	1667	1916	2102	2236	2331	2398	2443	2475	2496	2511	2521	2528	2532
	13	-5.0	y	0.00	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50	0.56	0.63	0.69	0.75	0.81	0.88	0.94	1.00
			p	0	559	1077	1526	1891	2173	2384	2536	2644	2720	2772	2808	2832	2848	2860	2867	2872
	14	-6.0	y	0.00	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52	0.59	0.65	0.72	0.78	0.85	0.92	0.98	1.05
			p	0	629	1213	1718	2129	2447	2684	2856	2977	3062	3121	3161	3188	3207	3220	3228	3234
	15	-7.0	y	0.00	0.07	0.14	0.20	0.27	0.34	0.41	0.48	0.54	0.61	0.68	0.75	0.82	0.89	0.95	1.02	1.09
			p	0	704	1357	1921	2381	2737	3002	3194	3330	3425	3491	3535	3566	3587	3601	3611	3617
	16	-8.0	y	0.00	0.07	0.14	0.21	0.28	0.35	0.43	0.50	0.57	0.64	0.71	0.78	0.85	0.92	0.99	1.06	1.13
			p	0	783	1509	2136	2647	3043	3338	3551	3702	3808	3881	3931	3965	3988	4004	4015	4022
	17	-9.0	y	0.00	0.07	0.15	0.22	0.29	0.37	0.44	0.52	0.59	0.66	0.74	0.81	0.88	0.96	1.03	1.10	1.18
			p	0	866	1668	2363	2928	3365	3692	3927	4095	4211	4292	4347	4385	4411	4428	4440	4448
	18	-10.0	y	0.00	0.08	0.15	0.23	0.31	0.38	0.46	0.53	0.61	0.69	0.76	0.84	0.92	0.99	1.07	1.15	1.22
			p	0	953	1836	2600	3222	3704	4063	4323	4507	4635	4724	4785	4826	4854	4874	4887	4895
	19	-11.0	y	0.00	0.08	0.16	0.24	0.32	0.40	0.48	0.55	0.63	0.71	0.79	0.87	0.95	1.03	1.11	1.19	1.27
			p	0	1044	2012	2849	3531	4059	4452	4737	4938	5079	5176	5243	5289	5319	5340	5355	5364
	20	-12.0	y	0.00	0.08	0.16	0.25	0.33	0.41	0.49	0.57	0.66	0.74	0.82	0.90	0.98	1.07	1.15	1.23	1.31
			p	0	1139	2196	3110	3854	4430	4859	5170	5390	5543	5650	5722	5772	5806	5829	5844	5855
	21	-13.0	y	0.00	0.08	0.17	0.25	0.34	0.42	0.51	0.59	0.68	0.76	0.85	0.93	1.02	1.10	1.19	1.27	1.36
			p	0	1239	2388	3382	4191	4817	5284	5622	5861	6028	6143	6223	6277	6313	6338	6355	6367
	22	-14.0	y	0.00	0.09	0.18	0.26	0.35	0.44	0.53	0.61	0.70	0.79	0.88	0.96	1.05	1.14	1.23	1.32	1.40
			p	0	1343	2588	3665	4542	5221	5726	6093	6352	6533	6658	6744	6802	6842	6869	6887	6900
	23	-15.0	y	0.00	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.81	0.91	1.00	1.09	1.18	1.27	1.36	1.45
			p	0	1451	2796	3960	4907	5640	6187	6582	6863	7058	7193	7286	7349	7392	7421	7441	7455
	24	-16.0	y	0.00	0.09	0.19	0.28	0.37	0.47	0.56	0.65	0.75	0.84	0.93	1.03	1.12	1.21	1.31	1.40	1.49
			p	0	1563	3012	4266	5286	6076	6665	7091	7393	7604	7749	7849	7917	7964	7995	8016	8031
	25	-17.0	y	0.00	0.10	0.19	0.29	0.38	0.48	0.58	0.67	0.77	0.87	0.96	1.06	1.15	1.25	1.35	1.44	1.54
			p	0	1679	3236	4583	5680	6529	7161	7619	7943	8170	8326	8433	8506	8556	8590	8613	8628
	26	-18.0	y	0.00	0.10	0.20	0.30	0.40	0.50	0.59	0.69	0.79	0.89	0.99	1.09	1.19	1.29	1.39	1.49	1.59
			p	0	1799	3469	4912	6087	6997	7675	8165	8513	8756	8923	9038	9117	9170	9206	9231	9247
	27	-19.0	y	0.00	0.10	0.20	0.31	0.41	0.51	0.61	0.71	0.82	0.92	1.02	1.12	1.22	1.33	1.43	1.53	1.63
			p	0	1924	3709	5252	6509	7482	8206	8731	9103	9362	9541	9664	9748	9805	9844	9870	9888
	28	-20.0	y	0.00	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84	0.94	1.05	1.15	1.26	1.36	1.47	1.57	1.68
			p	0	2053	3957	5604	6944	7982	8756	9315	9712	9989	10180	10311	10401	10462	10503	10531	10550
	29	-21.0	y	0.00	0.11	0.22	0.32	0.43	0.54	0.65	0.75	0.86	0.97	1.08	1.19	1.29	1.40	1.51	1.62	1.72
			p	0	2186	4213	5967	7394	8500	9323	9919	10341	10636	10840	10979	11074	11139	11183	11213	11233
	30	-22.0	y	0.00	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	1.00	1.11	1.22	1.33	1.44	1.55	1.66	1.77
			p	0	2323	4478	6341	7858	9033	9908	10541	10990	11303	11520	11668	11769	11838	11885	11917	11938
	31	-23.0	y	0.00	0.11	0.23	0.34	0.45	0.57	0.68	0.79	0.91	1.02	1.14	1.25	1.36	1.48	1.59	1.70	1.82
			p	0	2464	4750	6727	8336	9582	10511	11183	11659	11991	12221	12378	12485	12558	12608	12642	12664
	32	-24.0	y	0.00	0.12	0.23	0.35	0.47	0.58	0.70	0.81	0.93	1.05	1.16	1.28	1.40	1.51	1.63	1.75	1.86
			p	0	2610	5031	7124	8828	10148	11131	11843	12347	12699	12942	13109	13223	13300	13352	13388	13412
ROCK	-	Top of Rock	y	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.05	0.08	0.10	0.13	0.16	0.18	0.21	0.23	0.26	0.32
			p	0	2220	2752	3084	3333	3537	3711	4341	4776	5117	5401	5646	5863	6058	6236	6400	6400
	-	8 ft Below Top of Rock	y	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.05	0.08	0.10	0.13	0.16	0.18	0.21	0.23	0.26	0.32
			p	0	11693	14388	16090	17377	18429	19326	22587	24846	26617	28091	29364	30491	31504	32429	33280	33280

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Project: Hudson Yards - Tower A, Podium & Platform
Project Number: 170019114
Date: 11/28/2012
Calculated By: SKM
Checked By:

Notes:

1. P-Y Curve data is for static loading conditions.
2. P-Y Curve data is for 36-inch O.D. caisson
3. P-Y Curve data does not account for group effects.
4. A multiplier of 0.8 should be applied to "p" values to evaluate seismic conditions.

[a] y = Lateral pile deflection in inches
[b] p = Lateral pile resistance in pounds per inch

Table 1b. P-Y Curve Data Points for 36-inch O.D. Caisson under Static Loading

Strata	Layer Number	Elevation at Mid-Layer (ft, BPMD)		Curve Points																
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
SOIL	1	7.0	y[a]	0.00	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44	0.49	0.55	0.60	0.66	0.71	0.77	0.82	0.88
			p[b]	0	29	56	80	99	114	125	133	139	142	145	147	148	149	150	150	150
	2	6.0	y	0.00	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49	0.55	0.62	0.68	0.74	0.80	0.86	0.92	0.99
			p	0	99	190	269	333	383	420	447	466	479	488	495	499	502	504	505	506
	3	5.0	y	0.00	0.07	0.13	0.20	0.26	0.33	0.40	0.46	0.53	0.59	0.66	0.72	0.79	0.86	0.92	0.99	1.05
			p	0	176	338	479	594	682	749	796	830	854	870	882	889	894	898	900	902
	4	4.0	y	0.00	0.07	0.14	0.20	0.27	0.34	0.41	0.47	0.54	0.61	0.68	0.74	0.81	0.88	0.95	1.02	1.08
			p	0	253	487	689	854	982	1077	1146	1195	1229	1252	1269	1280	1287	1292	1296	1298
	5	3.0	y	0.00	0.09	0.19	0.28	0.38	0.47	0.57	0.66	0.76	0.85	0.95	1.04	1.14	1.23	1.33	1.42	1.52
			p	0	306	590	836	1036	1190	1306	1389	1448	1490	1518	1538	1551	1560	1566	1570	1573
	6	2.0	y	0.00	0.08	0.16	0.25	0.33	0.41	0.49	0.58	0.66	0.74	0.82	0.90	0.99	1.07	1.15	1.23	1.32
			p	0	324	625	885	1097	1261	1383	1472	1535	1578	1609	1629	1643	1653	1660	1664	1667
	7	1.0	y	0.00	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56	0.63	0.70	0.77	0.84	0.91	0.98	1.05	1.12
			p	0	326	628	890	1103	1268	1391	1479	1542	1586	1617	1638	1652	1661	1668	1672	1676
	8	0.0	y	0.00	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46	0.52	0.57	0.63	0.69	0.74	0.80	0.86	0.92
			p	0	307	593	839	1040	1195	1311	1395	1454	1496	1524	1544	1557	1566	1573	1577	1580
	9	-1.0	y	0.00	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44	0.49	0.54	0.60	0.65	0.71	0.76	0.82	0.87
			p	0	331	637	902	1118	1285	1410	1500	1564	1608	1639	1660	1675	1685	1691	1696	1699
	10	-2.0	y	0.00	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45	0.51	0.57	0.62	0.68	0.74	0.79	0.85	0.91
			p	0	385	742	1051	1303	1498	1643	1748	1822	1874	1910	1934	1951	1963	1970	1976	1979
	11	-3.0	y	0.00	0.06	0.12	0.18	0.24	0.30	0.36	0.41	0.47	0.53	0.59	0.65	0.71	0.77	0.83	0.89	0.95
			p	0	444	856	1212	1501	1726	1893	2014	2100	2160	2201	2229	2249	2262	2271	2277	2281
	12	-4.0	y	0.00	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.49	0.56	0.62	0.68	0.74	0.80	0.86	0.93	0.99
			p	0	507	977	1383	1714	1971	2161	2300	2397	2466	2513	2545	2567	2583	2593	2600	2604
	13	-5.0	y	0.00	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.51	0.58	0.64	0.71	0.77	0.84	0.90	0.97	1.03
			p	0	574	1106	1567	1941	2231	2448	2604	2715	2792	2846	2882	2907	2924	2936	2944	2949
	14	-6.0	y	0.00	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.54	0.60	0.67	0.74	0.80	0.87	0.94	1.00	1.07
			p	0	645	1243	1761	2182	2508	2751	2927	3052	3139	3199	3240	3268	3288	3300	3309	3315
	15	-7.0	y	0.00	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56	0.63	0.70	0.77	0.84	0.91	0.98	1.05	1.11
			p	0	721	1389	1967	2437	2802	3073	3270	3409	3506	3573	3619	3651	3672	3686	3696	3703
	16	-8.0	y	0.00	0.07	0.14	0.22	0.29	0.36	0.43	0.51	0.58	0.65	0.72	0.80	0.87	0.94	1.01	1.09	1.16
			p	0	800	1542	2184	2707	3111	3413	3631	3785	3893	3968	4019	4054	4078	4094	4105	4112
	17	-9.0	y	0.00	0.08	0.15	0.23	0.30	0.38	0.45	0.53	0.60	0.68	0.75	0.83	0.90	0.98	1.05	1.13	1.20
			p	0	884	1704	2413	2990	3437	3770	4011	4182	4301	4383	4440	4478	4505	4522	4534	4543
	18	-10.0	y	0.00	0.08	0.16	0.23	0.31	0.39	0.47	0.55	0.62	0.70	0.78	0.86	0.93	1.01	1.09	1.17	1.25
			p	0	972	1873	2653	3288	3779	4145	4410	4598	4729	4820	4882	4924	4953	4972	4986	4995
	19	-11.0	y	0.00	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.65	0.73	0.81	0.89	0.97	1.05	1.13	1.21	1.29
			p	0	1064	2051	2905	3599	4137	4538	4828	5034	5177	5276	5344	5391	5422	5444	5458	5468
	20	-12.0	y	0.00	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00	1.09	1.17	1.25	1.34
			p	0	1160	2237	3167	3925	4512	4949	5265	5489	5646	5754	5828	5879	5913	5936	5952	5963
	21	-13.0	y	0.00	0.09	0.17	0.26	0.35	0.43	0.52	0.60	0.69	0.78	0.86	0.95	1.04	1.12	1.21	1.29	1.38
			p	0	1261	2430	3442	4265	4902	5377	5721	5965	6135	6252	6333	6388	6425	6450	6468	6479
	22	-14.0	y	0.00	0.09	0.18	0.27	0.36	0.45	0.53	0.62	0.71	0.80	0.89	0.98	1.07	1.16	1.25	1.34	1.43
			p	0	1365	2632	3727	4619	5309	5824	6196	6460	6644	6771	6858	6918	6958	6986	7004	7017
	23	-15.0	y	0.00	0.09	0.18	0.28	0.37	0.46	0.55	0.64	0.74	0.83	0.92	1.01	1.10	1.20	1.29	1.38	1.47
			p	0	1474	2842	4024	4987	5733	6288	6690	6975	7173	7311	7405	7469	7513	7543	7563	7576
	24	-16.0	y	0.00	0.09	0.19	0.28	0.38	0.47	0.57	0.66	0.76	0.85	0.95	1.04	1.14	1.23	1.33	1.42	1.52
			p	0	1587	3060	4333	5369	6172	6770	7203	7509	7723	7871	7972	8042	8089	8121	8142	8157
	25	-17.0	y	0.00	0.10	0.20	0.29	0.39	0.49	0.59	0.68	0.78	0.88	0.98	1.07	1.17	1.27	1.37	1.47	1.56
			p	0	1704	3285	4653	5766	6628	7270	7734	8063	8293	8452	8561	8635	8686	8720	8743	8759
	26	-18.0	y	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.01	1.11	1.21	1.31	1.41	1.51	1.61
			p	0	1826	3519	4984	6176	7099	7787	8285	8638	8884	9054	9170	9250	9304	9341	9366	9383
	27	-19.0	y	0.00	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83	0.93	1.03	1.14	1.24	1.34	1.45	1.55	1.65
			p	0	1951	3761	5327	6601	7587	8322	8854	9231	9494	9676	9801	9886	9944	9983	10010	10028
	28	-20.0	y	0.00	0.11	0.21	0.32	0.43	0.53	0.64	0.74	0.85	0.96	1.06	1.17	1.28	1.38	1.49	1.59	1.70
			p	0	2081	4011	5681	7039	8092	8876	9443	9845	10126	10319	10452	10543	10605	10647	10675	10694
	29	-21.0	y	0.00	0.11	0.22	0.33	0.44	0.55	0.65	0.76	0.87	0.98	1.09	1.20	1.31	1.42	1.53	1.64	1.75
			p	0	2215	4269	6046	7492	8612	9447	10050	10478	10777	10983	11125	11221	11287	11331	11362	11382
	30	-22.0	y	0.00	0.11	0.22	0.34	0.45	0.56	0.67	0.78	0.90	1.01	1.12	1.23	1.34	1.46	1.57	1.68	1.79
			p	0	2353	4535	6423	7959	9149	10035	10677	11131	11448	11668	11818	11921	11990	12038	12070	12091
	31	-23.0	y	0.00	0.11	0.23	0.34	0.46	0.57	0.69	0.80	0.92	1.03	1.15	1.26	1.38	1.49	1.61	1.72	1.84
			p	0	2495	4809	6811	8440	9702	10642	11322	11804	12140	12373	12532	12641	12715	12765	12799	12822
	32	-24.0	y	0.00	0.12	0.24	0.35	0.47	0.59	0.71	0.82	0.94	1.06	1.18	1.30	1.41	1.53	1.65	1.77	1.88
			p	0	2641	5092	7211	8935	10271	11266	11986	12496	12853	13099	13268	13383	13461	13514	13550	13575
ROCK	-	Top of Rock	y	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.06	0.09	0.12	0.15	0.17	0.20	0.23	0.26	0.29	0.36
			p	0	2497	3096	3469	3750	3979	4175	4883	5373	5757	6076	6352	6596	6815	7016	7200	7200
	-	9 ft Below Top of Rock	y	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.06	0.09	0.12	0.15	0.17	0.20	0.23	0.26	0.29	0.36
			p	0	13155	16187	18101	19549	20732	21742	25411	27952	29944	31602	33035	34302	35442	36482	37440	37440

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Project: Hudson Yards - Tower A, Podium & Platform **Calculated By:** SKM
Project Number: 170019114 **Checked By:**
Date: 11/28/2012

Notes:

1. P-Y Curve data is for cyclic loading conditions.
2. P-Y Curve data is for 32-inch O.D. caisson
3. P-Y Curve data does not account for group effects.
4. A multiplier of 0.8 should be applied to "p" values to evaluate seismic conditions.

[a]y = Lateral pile deflection in inches
[b]p = Lateral pile resistance in pounds per inch

Table 2a. P-Y Curve Data Points for 32-inch O.D. Caisson under Cyclic Loading

Strata	Layer Number	Elevation at Mid-Layer (ft, BPMD)		Curve Points																
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
SOIL	1	7.0	y[a]	0.00	0.02	0.03	0.05	0.06	0.08	0.09	0.11	0.12	0.14	0.16	0.17	0.19	0.20	0.22	0.23	0.25
			p[b]	0	8	16	23	28	32	35	38	39	40	41	42	42	42	42	43	43
	2	6.0	y	0.00	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.27	0.29	0.31
			p	0	31	61	86	106	122	134	142	149	153	156	158	159	160	161	161	161
	3	5.0	y	0.00	0.02	0.05	0.07	0.09	0.12	0.14	0.17	0.19	0.21	0.24	0.26	0.28	0.31	0.33	0.36	0.38
			p	0	63	122	173	214	246	270	287	299	307	313	317	320	322	323	324	325
	4	4.0	y	0.00	0.03	0.06	0.08	0.11	0.14	0.17	0.19	0.22	0.25	0.28	0.31	0.33	0.36	0.39	0.42	0.44
			p	0	104	200	283	351	403	442	471	491	505	514	521	525	528	530	532	533
	5	3.0	y	0.00	0.04	0.09	0.13	0.17	0.22	0.26	0.30	0.35	0.39	0.43	0.48	0.52	0.57	0.61	0.65	0.70
			p	0	131	252	357	442	508	558	593	619	636	648	657	662	666	669	671	672
	6	2.0	y	0.00	0.04	0.09	0.13	0.18	0.22	0.27	0.31	0.36	0.40	0.45	0.49	0.54	0.58	0.63	0.67	0.72
			p	0	167	321	455	564	648	711	757	789	811	827	837	845	850	853	855	857
	7	1.0	y	0.00	0.05	0.09	0.14	0.19	0.23	0.28	0.33	0.37	0.42	0.47	0.51	0.56	0.61	0.65	0.70	0.75
			p	0	207	399	565	700	804	882	938	978	1006	1026	1039	1048	1054	1058	1061	1063
	8	0.0	y	0.00	0.05	0.10	0.15	0.20	0.24	0.29	0.34	0.39	0.44	0.49	0.54	0.59	0.63	0.68	0.73	0.78
			p	0	251	484	685	849	976	1071	1139	1188	1221	1245	1261	1272	1279	1284	1288	1290
	9	-1.0	y	0.00	0.05	0.10	0.15	0.20	0.26	0.31	0.36	0.41	0.46	0.51	0.56	0.61	0.67	0.72	0.77	0.82
			p	0	299	577	817	1013	1164	1277	1358	1416	1457	1484	1504	1517	1525	1532	1536	1538
	10	-2.0	y	0.00	0.05	0.11	0.16	0.21	0.27	0.32	0.38	0.43	0.48	0.54	0.59	0.64	0.70	0.75	0.80	0.86
			p	0	352	678	960	1190	1368	1501	1597	1664	1712	1745	1767	1783	1793	1800	1805	1808
	11	-3.0	y	0.00	0.06	0.11	0.17	0.22	0.28	0.34	0.39	0.45	0.51	0.56	0.62	0.67	0.73	0.79	0.84	0.90
			p	0	408	787	1115	1382	1588	1742	1854	1932	1988	2026	2052	2069	2082	2090	2095	2099
	12	-4.0	y	0.00	0.06	0.12	0.18	0.24	0.29	0.35	0.41	0.47	0.53	0.59	0.65	0.71	0.76	0.82	0.88	0.94
			p	0	469	905	1281	1587	1825	2001	2129	2220	2283	2327	2357	2377	2391	2401	2407	2412
	13	-5.0	y	0.00	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49	0.55	0.61	0.68	0.74	0.80	0.86	0.92	0.98
			p	0	534	1030	1458	1807	2077	2279	2424	2527	2599	2649	2683	2707	2722	2733	2740	2745
	14	-6.0	y	0.00	0.06	0.13	0.19	0.26	0.32	0.38	0.45	0.51	0.58	0.64	0.71	0.77	0.83	0.90	0.96	1.03
			p	0	603	1163	1647	2041	2346	2573	2738	2854	2936	2992	3031	3057	3075	3087	3095	3101
	15	-7.0	y	0.00	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.54	0.60	0.67	0.74	0.80	0.87	0.94	1.00	1.07
			p	0	677	1304	1847	2289	2631	2886	3070	3201	3292	3355	3399	3428	3448	3462	3471	3477
	16	-8.0	y	0.00	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56	0.63	0.70	0.77	0.84	0.91	0.98	1.04	1.11
			p	0	754	1454	2059	2551	2932	3216	3422	3568	3669	3740	3788	3821	3843	3858	3868	3875
	17	-9.0	y	0.00	0.07	0.14	0.22	0.29	0.36	0.43	0.51	0.58	0.65	0.72	0.80	0.87	0.94	1.01	1.09	1.16
			p	0	836	1611	2281	2827	3250	3565	3792	3954	4066	4144	4198	4234	4259	4276	4287	4295
	18	-10.0	y	0.00	0.08	0.15	0.23	0.30	0.38	0.45	0.53	0.60	0.68	0.75	0.83	0.90	0.98	1.05	1.13	1.20
			p	0	922	1776	2516	3117	3583	3930	4182	4360	4484	4570	4629	4669	4696	4715	4727	4736
	19	-11.0	y	0.00	0.08	0.16	0.23	0.31	0.39	0.47	0.55	0.62	0.70	0.78	0.86	0.94	1.01	1.09	1.17	1.25
			p	0	1012	1950	2761	3422	3933	4314	4590	4785	4922	5016	5081	5125	5155	5175	5189	5198
	20	-12.0	y	0.00	0.08	0.16	0.24	0.32	0.40	0.49	0.57	0.65	0.73	0.81	0.89	0.97	1.05	1.13	1.21	1.29
			p	0	1106	2131	3018	3740	4299	4716	5017	5231	5380	5483	5553	5602	5634	5657	5672	5682
	21	-13.0	y	0.00	0.08	0.17	0.25	0.33	0.42	0.50	0.59	0.67	0.75	0.84	0.92	1.00	1.09	1.17	1.26	1.34
			p	0	1204	2321	3287	4073	4681	5135	5463	5696	5858	5970	6047	6100	6135	6160	6176	6187
	22	-14.0	y	0.00	0.09	0.17	0.26	0.35	0.43	0.52	0.61	0.69	0.78	0.87	0.95	1.04	1.13	1.21	1.30	1.39
			p	0	1306	2518	3566	4419	5080	5572	5928	6181	6357	6479	6562	6619	6658	6684	6702	6714
	23	-15.0	y	0.00	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.80	0.89	0.98	1.07	1.16	1.25	1.34	1.43
			p	0	1413	2724	3857	4780	5495	6027	6412	6685	6876	7007	7098	7159	7201	7230	7249	7262
	24	-16.0	y	0.00	0.09	0.18	0.28	0.37	0.46	0.55	0.65	0.74	0.83	0.92	1.02	1.11	1.20	1.29	1.38	1.48
			p	0	1524	2937	4160	5155	5926	6500	6915	7210	7415	7557	7654	7721	7766	7797	7817	7831
	25	-17.0	y	0.00	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95	1.05	1.14	1.24	1.33	1.43	1.52
			p	0	1639	3159	4474	5544	6373	6990	7437	7754	7975	8127	8232	8303	8352	8385	8407	8422
	26	-18.0	y	0.00	0.10	0.20	0.29	0.39	0.49	0.59	0.69	0.78	0.88	0.98	1.08	1.18	1.27	1.37	1.47	1.57
			p	0	1758	3389	4799	5947	6836	7498	7978	8317	8554	8718	8831	8907	8959	8995	9019	9035
	27	-19.0	y	0.00	0.10	0.20	0.30	0.40	0.50	0.61	0.71	0.81	0.91	1.01	1.11	1.21	1.31	1.41	1.51	1.61
			p	0	1881	3627	5136	6364	7316	8024	8537	8901	9155	9330	9450	9532	9588	9626	9651	9669
	28	-20.0	y	0.00	0.10	0.21	0.31	0.42	0.52	0.62	0.73	0.83	0.93	1.04	1.14	1.25	1.35	1.45	1.56	1.66
			p	0	2009	3872	5484	6796	7812	8568	9116	9504	9775	9962	10091	10178	10238	10278	10305	10324
	29	-21.0	y	0.00	0.11	0.21	0.32	0.43	0.53	0.64	0.75	0.85	0.96	1.07	1.17	1.28	1.39	1.49	1.60	1.71
			p	0	2141	4126	5843	7241	8324	9130	9714	10127	10416	10615	10752	10845	10909	10952	10981	11001
	30	-22.0	y	0.00	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.10	1.21	1.31	1.42	1.53	1.64	1.75
			p	0	2276	4388	6214	7701	8852	9709	10330	10770	11077	11289	11434	11534	11601	11647	11678	11699
	31	-23.0	y	0.00	0.11	0.22	0.34	0.45	0.56	0.67	0.79	0.90	1.01	1.12	1.24	1.35	1.46	1.57	1.69	1.80
			p	0	2417	4658	6597	8174	9396	10307	10965	11432	11758	11983	12138	12243	12315	12363	12396	12419
	32	-24.0	y	0.00	0.12	0.23	0.35	0.46	0.58	0.69	0.81	0.92	1.04	1.15	1.27	1.38	1.50	1.61	1.73	1.85
			p	0	2561	4936	6990	8662	9957	10922	11620	12114	12460	12698	12862	12974	13050	13101	13136	13160
ROCK	-	Top of Rock	y	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.05	0.08	0.10	0.13	0.16	0.18	0.21	0.23	0.26	0.32
			p	0	2220	2752	3084	3333	3537	3711	4341	4776	5117	5401	5646	5863	6058	6236	6400	6400
	-	8 ft Below Top of Rock	y	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.05	0.08	0.10	0.13	0.16	0.18	0.21	0.23	0.26	0.32
			p	0	11693	14388	16090	17377	18429	19326	22587	24846	26617	28091	29364	30491	31504	32429	33280	33280

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Project: Hudson Yards - Tower A, Podium & Platform
Calculated By: SKM
Project Number: 170019114
Checked By:
Date: 11/28/2012

Notes:

1. P-Y Curve data is for cyclic loading conditions.
2. P-Y Curve data is for 36-inch O.D. caisson
3. P-Y Curve data does not account for group effects.
4. A multiplier of 0.8 should be applied to "p" values to evaluate seismic conditions.

[a] y = Lateral pile deflection in inches
[b] p = Lateral pile resistance in pounds per inch

Table 2b. P-Y Curve Data Points for 36-inch O.D. Caisson under Cyclic Loading

Strata	Layer Number	Elevation at Mid-Layer (ft, BPMD)		Curve Points																
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
SOIL	1	7.0	y[a]	0.00	0.02	0.03	0.05	0.07	0.09	0.10	0.12	0.14	0.16	0.17	0.19	0.21	0.22	0.24	0.26	0.28
			p[b]	0	9	18	25	31	36	39	42	43	45	46	46	47	47	47	47	47
	2	6.0	y	0.00	0.02	0.04	0.06	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23	0.26	0.28	0.30	0.32	0.34
			p	0	34	66	93	115	133	145	155	161	166	169	171	173	174	174	175	175
	3	5.0	y	0.00	0.03	0.05	0.08	0.10	0.13	0.15	0.18	0.20	0.23	0.25	0.28	0.30	0.33	0.36	0.38	0.41
			p	0	68	130	185	229	263	289	307	320	329	336	340	343	345	346	347	348
	4	4.0	y	0.00	0.03	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.27	0.29	0.32	0.35	0.38	0.41	0.44	0.47
			p	0	110	212	300	372	428	469	499	520	535	545	552	557	561	563	564	565
	5	3.0	y	0.00	0.05	0.09	0.14	0.18	0.23	0.28	0.32	0.37	0.41	0.46	0.51	0.55	0.60	0.64	0.69	0.74
			p	0	139	268	380	471	541	593	631	658	677	690	699	705	709	712	714	715
	6	2.0	y	0.00	0.05	0.09	0.14	0.19	0.24	0.28	0.33	0.38	0.42	0.47	0.52	0.57	0.61	0.66	0.71	0.75
			p	0	176	339	481	596	685	751	799	833	857	873	884	892	897	901	903	905
	7	1.0	y	0.00	0.05	0.10	0.15	0.20	0.24	0.29	0.34	0.39	0.44	0.49	0.54	0.59	0.63	0.68	0.73	0.78
			p	0	217	419	593	734	844	926	985	1027	1057	1077	1091	1100	1107	1111	1114	1116
	8	0.0	y	0.00	0.05	0.10	0.15	0.20	0.25	0.31	0.36	0.41	0.46	0.51	0.56	0.61	0.66	0.71	0.76	0.81
			p	0	262	506	716	887	1020	1119	1190	1241	1276	1301	1317	1329	1337	1342	1346	1348
	9	-1.0	y	0.00	0.05	0.11	0.16	0.21	0.27	0.32	0.37	0.42	0.48	0.53	0.58	0.64	0.69	0.74	0.80	0.85
			p	0	312	601	851	1054	1212	1329	1414	1474	1516	1545	1565	1579	1588	1594	1598	1601
	10	-2.0	y	0.00	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.55	0.61	0.67	0.72	0.78	0.83	0.89
			p	0	365	704	997	1235	1419	1557	1656	1727	1776	1810	1834	1849	1860	1868	1873	1876
	11	-3.0	y	0.00	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.46	0.52	0.58	0.64	0.70	0.75	0.81	0.87	0.93
			p	0	423	815	1154	1430	1643	1803	1918	2000	2057	2096	2123	2141	2154	2162	2168	2172
	12	-4.0	y	0.00	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48	0.54	0.61	0.67	0.73	0.79	0.85	0.91	0.97
			p	0	484	934	1322	1639	1884	2066	2198	2292	2357	2402	2433	2454	2469	2478	2485	2489
	13	-5.0	y	0.00	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.51	0.57	0.63	0.69	0.76	0.82	0.88	0.95	1.01
			p	0	550	1061	1502	1862	2140	2347	2497	2604	2678	2729	2764	2788	2805	2816	2823	2828
	14	-6.0	y	0.00	0.07	0.13	0.20	0.26	0.33	0.40	0.46	0.53	0.59	0.66	0.72	0.79	0.86	0.92	0.99	1.05
			p	0	620	1196	1694	2099	2412	2646	2815	2935	3019	3077	3116	3143	3162	3174	3183	3188
	15	-7.0	y	0.00	0.07	0.14	0.21	0.27	0.34	0.41	0.48	0.55	0.62	0.69	0.75	0.82	0.89	0.96	1.03	1.10
			p	0	695	1339	1896	2350	2701	2963	3152	3287	3380	3445	3489	3520	3540	3554	3564	3570
	16	-8.0	y	0.00	0.07	0.14	0.21	0.29	0.36	0.43	0.50	0.57	0.64	0.71	0.78	0.86	0.93	1.00	1.07	1.14
			p	0	773	1490	2110	2615	3006	3297	3508	3658	3762	3834	3883	3917	3940	3955	3966	3973
	17	-9.0	y	0.00	0.07	0.15	0.22	0.30	0.37	0.44	0.52	0.59	0.67	0.74	0.81	0.89	0.96	1.04	1.11	1.18
			p	0	856	1649	2336	2895	3327	3650	3883	4048	4164	4243	4298	4335	4361	4378	4390	4398
	18	-10.0	y	0.00	0.08	0.15	0.23	0.31	0.38	0.46	0.54	0.61	0.69	0.77	0.85	0.92	1.00	1.08	1.15	1.23
			p	0	942	1817	2573	3188	3665	4020	4277	4459	4586	4674	4734	4775	4803	4822	4835	4843
	19	-11.0	y	0.00	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64	0.72	0.80	0.88	0.96	1.04	1.11	1.19	1.27
			p	0	1033	1992	2821	3496	4018	4408	4689	4889	5028	5125	5191	5236	5266	5287	5301	5311
	20	-12.0	y	0.00	0.08	0.16	0.25	0.33	0.41	0.49	0.58	0.66	0.74	0.82	0.91	0.99	1.07	1.15	1.24	1.32
			p	0	1129	2175	3081	3817	4388	4813	5121	5339	5491	5596	5668	5718	5751	5774	5789	5799
	21	-13.0	y	0.00	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.68	0.77	0.85	0.94	1.02	1.11	1.19	1.28	1.36
			p	0	1228	2367	3352	4153	4774	5237	5571	5809	5974	6089	6167	6220	6257	6282	6298	6310
	22	-14.0	y	0.00	0.09	0.18	0.26	0.35	0.44	0.53	0.62	0.70	0.79	0.88	0.97	1.06	1.15	1.23	1.32	1.41
			p	0	1331	2566	3634	4503	5176	5678	6041	6298	6477	6601	6687	6745	6784	6811	6829	6841
	23	-15.0	y	0.00	0.09	0.18	0.27	0.36	0.45	0.55	0.64	0.73	0.82	0.91	1.00	1.09	1.18	1.27	1.36	1.46
			p	0	1439	2773	3928	4867	5595	6137	6529	6807	7001	7135	7227	7290	7332	7361	7381	7394
	24	-16.0	y	0.00	0.09	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.84	0.94	1.03	1.13	1.22	1.31	1.41	1.50
			p	0	1551	2989	4233	5245	6030	6614	7036	7336	7545	7690	7789	7856	7902	7933	7954	7969
	25	-17.0	y	0.00	0.10	0.19	0.29	0.39	0.48	0.58	0.68	0.77	0.87	0.97	1.06	1.16	1.26	1.35	1.45	1.55
			p	0	1667	3212	4550	5638	6480	7108	7563	7885	8109	8265	8371	8444	8493	8527	8549	8565
	26	-18.0	y	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.09	1.19	1.29	1.39	1.49	1.59
			p	0	1787	3444	4877	6044	6948	7621	8108	8453	8694	8860	8974	9052	9105	9141	9166	9182
	27	-19.0	y	0.00	0.10	0.20	0.31	0.41	0.51	0.61	0.72	0.82	0.92	1.02	1.13	1.23	1.33	1.43	1.54	1.64
			p	0	1911	3684	5217	6465	7431	8151	8672	9041	9299	9477	9599	9682	9739	9777	9803	9821
	28	-20.0	y	0.00	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.84	0.95	1.05	1.16	1.26	1.37	1.47	1.58	1.68
			p	0	2040	3931	5567	6899	7930	8699	9255	9649	9924	10114	10244	10333	10393	10435	10462	10481
	29	-21.0	y	0.00	0.11	0.22	0.32	0.43	0.54	0.65	0.76	0.87	0.97	1.08	1.19	1.30	1.41	1.51	1.62	1.73
			p	0	2172	4187	5930	7348	8446	9265	9857	10276	10569	10772	10910	11005	11069	11113	11143	11163
	30	-22.0	y	0.00	0.11	0.22	0.33	0.44	0.56	0.67	0.78	0.89	1.00	1.11	1.22	1.33	1.44	1.55	1.67	1.78
			p	0	2309	4451	6303	7811	8978	9848	10478	10924	11235	11450	11598	11698	11767	11813	11845	11866
	31	-23.0	y	0.00	0.11	0.23	0.34	0.46	0.57	0.68	0.80	0.91	1.03	1.14	1.25	1.37	1.48	1.59	1.71	1.82
			p	0	2450	4722	6688	8288	9527	10449	11117	11591	11921	12149	12306	12413	12485	12535	12568	12591
	32	-24.0	y	0.00	0.12	0.23	0.35	0.47	0.58	0.70	0.82	0.93	1.05	1.17	1.28	1.40	1.52	1.64	1.75	1.87
			p	0	2595	5002	7084	8779	10091	11069	11776	12277	12627	12869	13035	13148	13225	13277	13313	13337
ROCK	-	Top of Rock	y	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.06	0.09	0.12	0.15	0.17	0.20	0.23	0.26	0.29	0.36
			p	0	2497	3096	3469	3750	3979	4175	4883	5373	5757	6076	6352	6596	6815	7016	7200	7200
	-	9 ft Below Top of Rock	y	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.06	0.09	0.12	0.15	0.17	0.20	0.23	0.26	0.29	0.36
			p	0	13155	16187	18101	19549	20732	21742	25411	27952	29944	31602	33035	34302	35442	36482	37440	37440

Warning: It is a violation of the NYS Education Law Article 145 for any person, unless he is acting under the direction of a licensed Professional Engineer, to alter this item in any way.

Date	Description	No.
	Revisions	

NAME DATE
PROFESSIONAL XXXXXXXXXXXXX N.J. LIC. No.XXXXX

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ENGINEERING & ENVIRONMENTAL SERVICES

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NEW JERSEY PENNSYLVANIA NEW YORK CONNECTICUT FLORIDA
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NJ Certificate of Authorization No: 24GA27996400

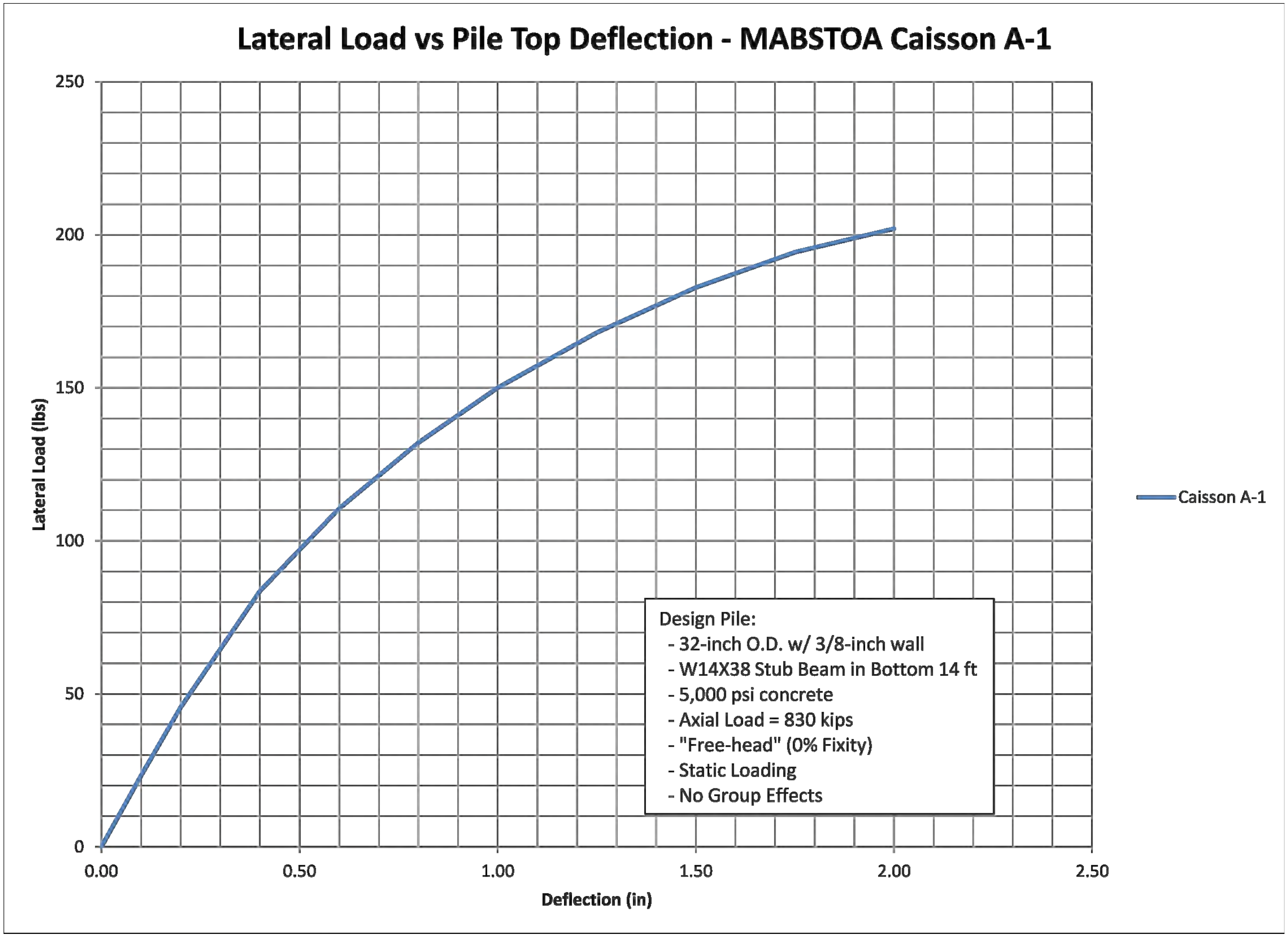
Project
HUDSON YARDS
TOWER A
NEW YORK NEW YORK

Drawing Title
ROCK CONTOUR PLAN

Project No. 170019112
Date 10-15-12
Scale 1"=30'
Drn. By JM
Last Revised 11-30-12

Drawing No.
1
Of

Filename: \\langan.com\data\NY\data1\170019112\Cadd Data - 170019112\Geotechnical\Tower A Rock Contour Map Sheet File - skm edit.dwg Date: 11/30/2012 Time: 11:48 User: jmoninghoff Style Table: Langan.stb Layout: Rock Contour Plan



Design Pile:
- 32-inch O.D. w/ 3/8-inch wall
- W14X38 Stub Beam in Bottom 14 ft
- 5,000 psi concrete
- Axial Load = 830 kips
- "Free-head" (0% Fixity)
- Static Loading
- No Group Effects

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NEW JERSEY PENNSYLVANIA NEW YORK CONNECTICUT
FLORIDA VIRGINIA CALIFORNIA
ABU DHABI DUBAI ATHENS DOHA ISTANBUL

Project
HUDSON YARDS
TOWER A, PODIUM,
AND PLATFORM
NEW YORK NY

Drawing Title
LATERAL LOAD VS. PILE
TOP DEFLECTION
MABSTOA CAISSON A-1
STATIC LOADING

Project No. 170019114
Date 11/28/2012
Scale NTS
Drawn By SKM
Submission Date 11/28/2012

Drawing No.
2

Sheet 2 of 5

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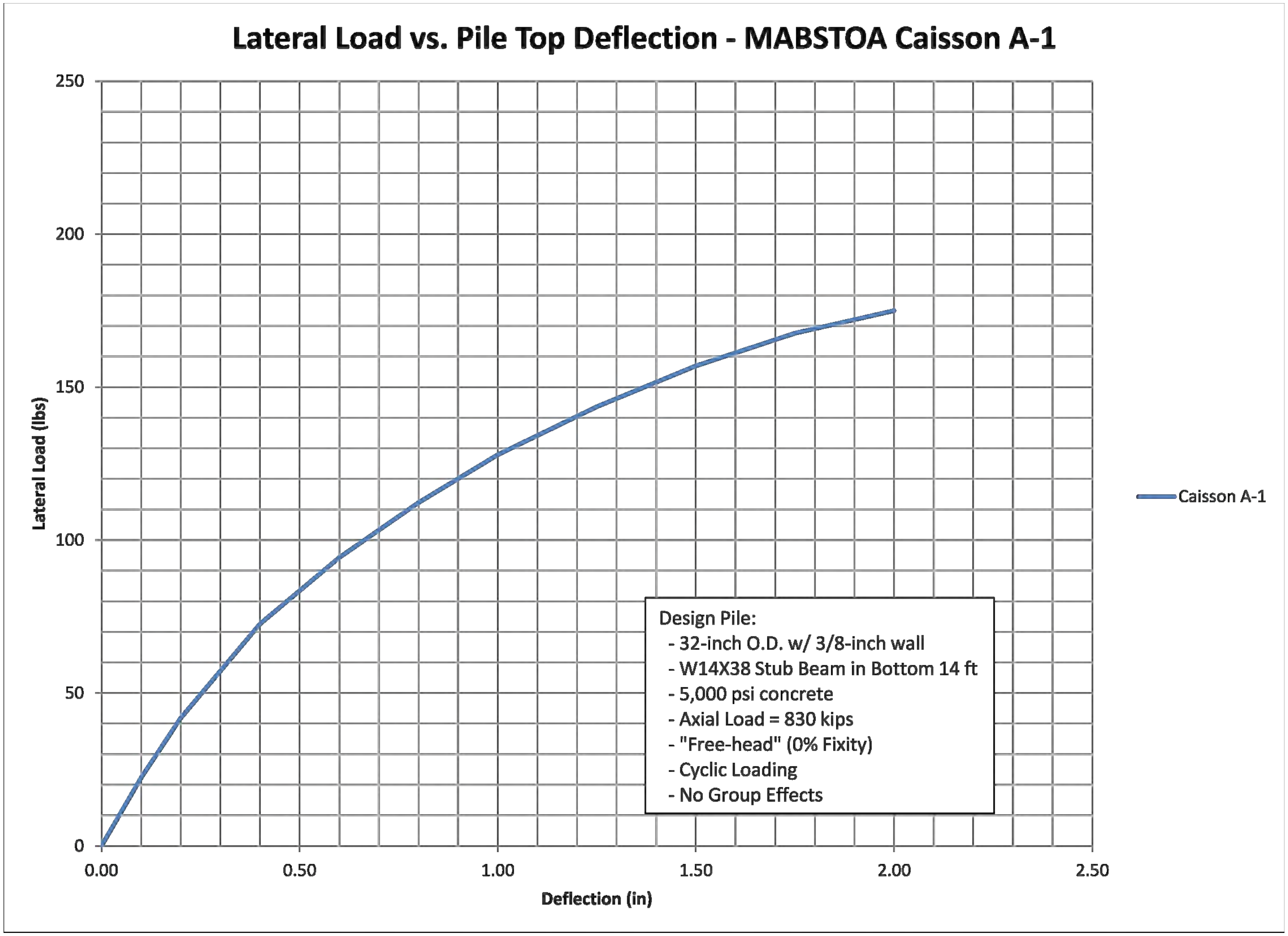
PROJECT No. 170019114



Design Pile:
- 32-inch O.D. w/ 3/8-inch wall
- W14X38 Stub Beam in Bottom 14 ft
- 5,000 psi concrete
- Axial Load = 830 kips
- "Free-head" (0% Fixity)
- Cyclic Loading
- No Group Effects

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Project

HUDSON YARDS TOWER A, PODIUM, AND PLATFORM

NEW YORK NY

Drawing Title

LATERAL LOAD VS. PILE TOP DEFLECTION MABSTOA CAISSON A-1 CYCLIC LOADING

Project No. 170019114

Date 11/28/2012

Scale NTS

Drawn By SKM

Submission Date 11/28/2012

Drawing No. 3

Sheet 3 of 5

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PROJECT No. 170019114

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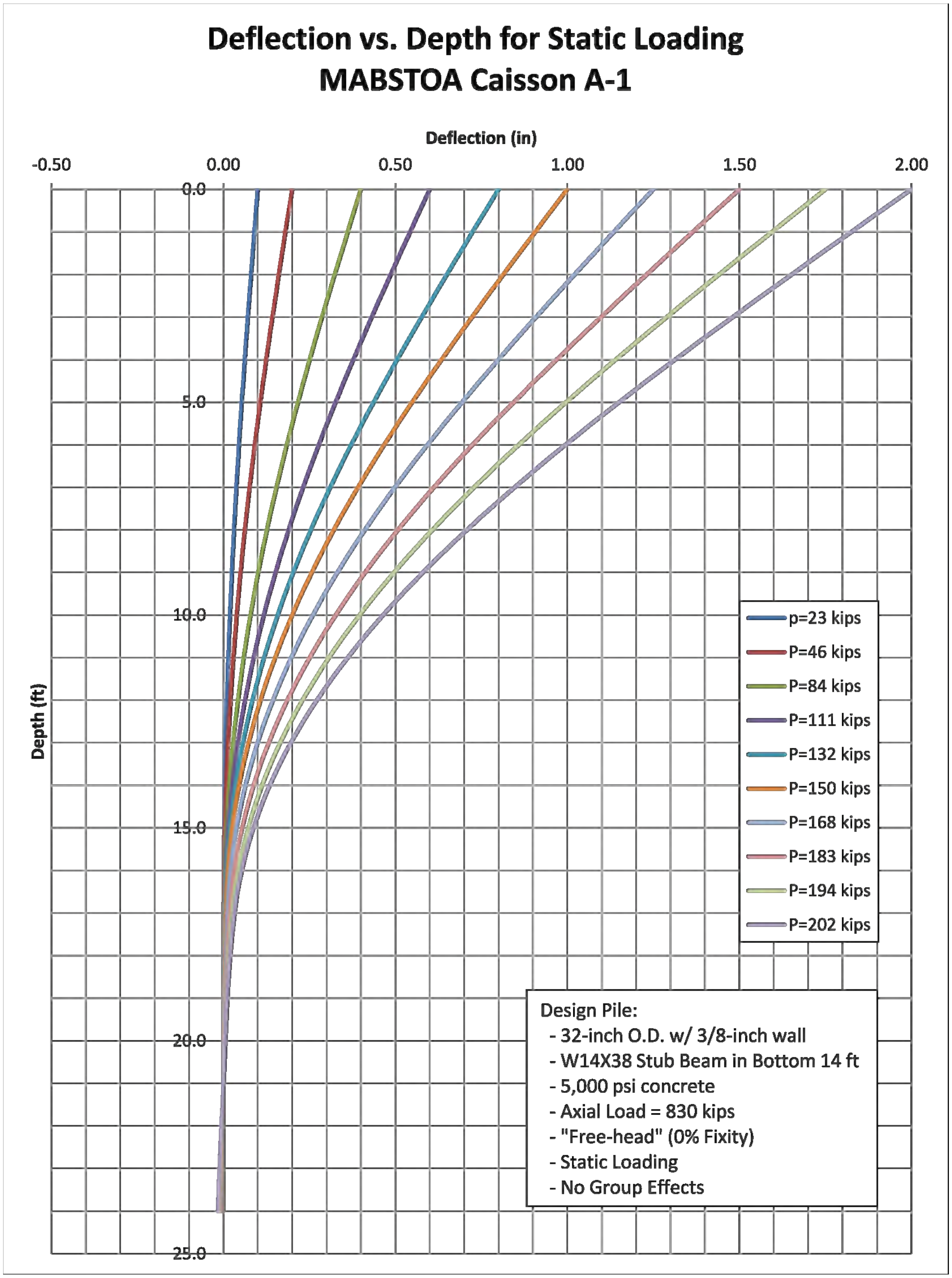

Deflection vs. Depth for Static Loading
MABSTOA Caisson A-1

Design Pile:
- 32-inch O.D. w/ 3/8-inch wall
- W14X38 Stub Beam in Bottom 14 ft
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HUDSON YARDS
TOWER A, PODIUM,
AND PLATFORM

NEW YORK NY

Drawing Title

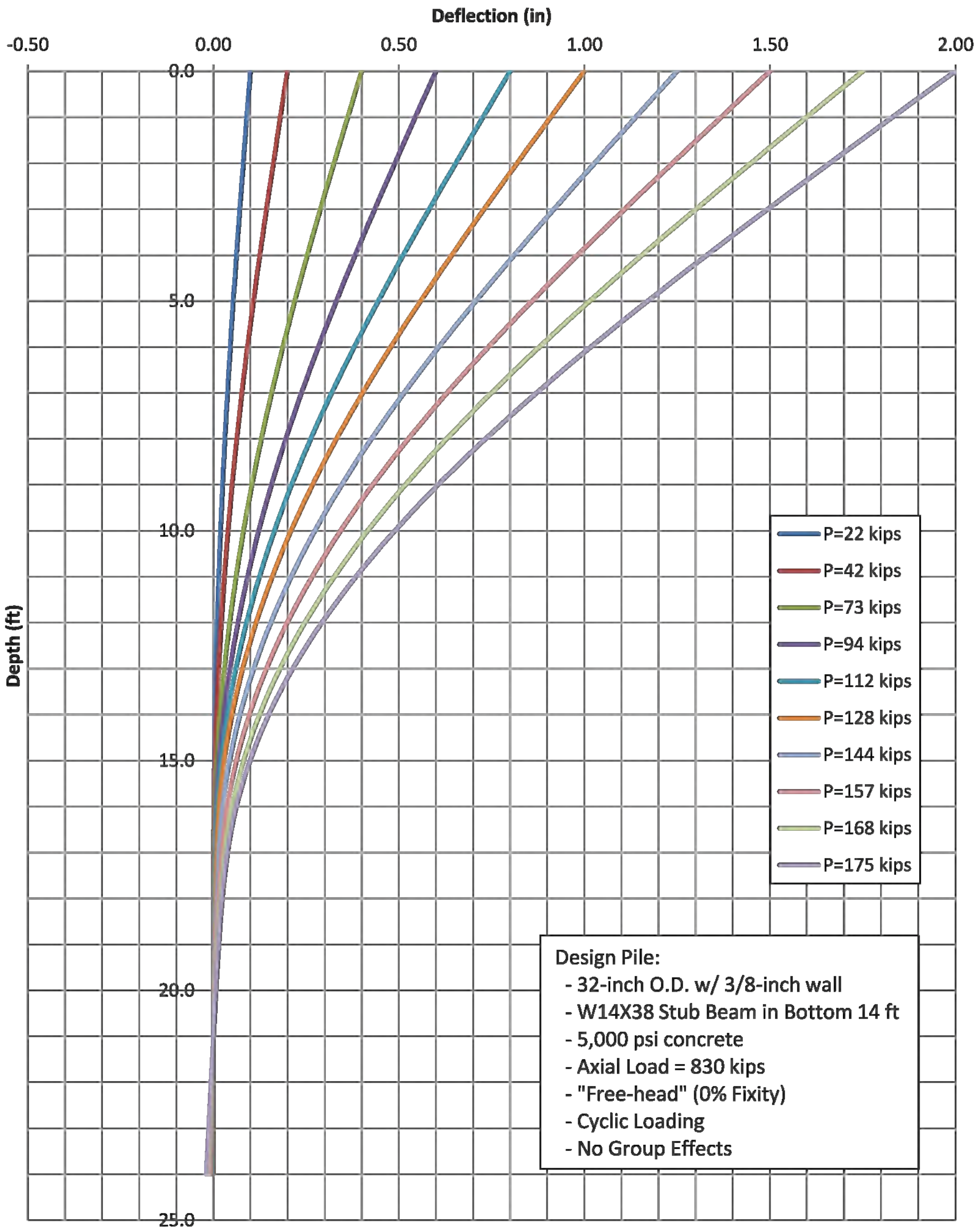
DEFLECTION VS. DEPTH
MABSTOA CAISSON A-1
STATIC LOADING

Project No.: 170019114
Date: 11/28/2012
Scale: NTS
Drawn By: SKM
Submission Date: 11/28/2012

Drawing No.
4

Sheet 4 of 5

Deflection vs. Depth for Cyclic Loading
MABSTOA Caisson A-1



Design Pile:
- 32-inch O.D. w/ 3/8-inch wall
- W14X38 Stub Beam in Bottom 14 ft
- 5,000 psi concrete
- Axial Load = 830 kips
- "Free-head" (0% Fixity)
- Cyclic Loading
- No Group Effects

PROJECT No. 170019114

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HUDSON YARDS
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NEW YORK NY

Drawing Title

DEFLECTION VS. DEPTH
MABSTOA CAISSON A-1
CYCLIC LOADING

Project No. 170019114	Drawing No. 5
Date 11/28/2012	
Scale NTS	
Drawn By SKM	
Submission Date 11/28/2012	Sheet 5 of 5