MASONRY INSTITUTE OF WASHINGTON

EVERYTHINGMASONRY

NWMI Northwest Masonry Institute

The 2016 Masonry Systems Guide, Northwest Edition

8 Primary Systems

Design Made Easy. Construction Bid Differently. Masonry Built Even Better.

MASONRY INDUSTRY LOOKING TO CHANGE THE CONVERSATION

Masonry has been used successfully in building construction in the Northwest region (Washington, Oregon, and Idaho) for many decades as both the primary structural system and as a cladding. Masonry has withstood the test of time not only because of its natural resistance to fire, water, impact, and organic growth, but also because of its design versatility.

In 2015, The Masonry Institute of Washington (MIW) and the Northwest Masonry Institute (NWMI) requested stakeholders in the architectural, engineering, building industries and masonry manufacturing to commit to a series of meetings regarding the use of masonry products to identify how the industry could better meet the needs of the A/E/C community

Complete Masonry System

A major outcome identified, was the need for a masonry building envelope and systems guide. The 2016 Masonry Systems Guide, Northwest Edition (MSG) is the result.

The MSG is a technical guide incorporating specifications and illustrations for the successful design and construction of the masonry building envelope.

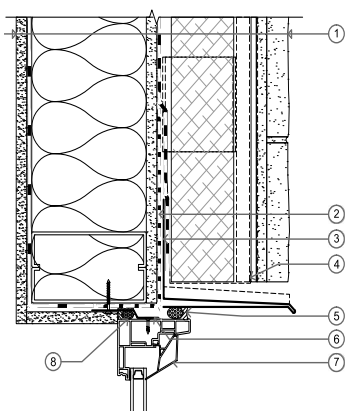
"There is not a more capable building system than brick and block construction. The masonry industry listened to what we needed and produced it. "

Historically, structural mass masonry wall assemblies were commonplace, primarily due to their superior fire resistance, durability, and weatherability. Over time, such assemblies have given way to alternate structural framing materials. By definition, mass structures inherently address the many above-grade wall functions, including control of water, air, heat, sound, and fire. Replacing the mass structure increases the complexity of the wall design as follows:

- Wall cavity and/or exterior insulation may be necessary for thermal and sound control.
- An air barrier is necessary to limit the uncontrolled exchange of air—and consequently the uncontrolled exchange of moisture (primarily vapor), heat, sound, and pollutants that move with air—between the interior and exterior environments.
- Moisture control is rethought to ensure that moisture-sensitive structural and insulation components are protected.

The 2016 Masonry Systems Guide outlines and details eight primary building envelope systems spanning over 350 pages and includes highly detailed and easy to read illustrations. Each system has been designed by a team of architectural and engineering experts specializing in the design and engineering of building envelopes with the assistance of masonry product and installation experts. The designed systems have been thoroughly vetted by masonry experts who exceed 500 years of direct industry experience.

The industry has began training professionals and installers of masonry systems on the new systems approach, both from a bidding and installation standpoint. Mason Contractors have participated in several days and hours of training for being able to coordinate, pricing , schedules and installation practices for the full masonry system. The industry recognizes a change in practice requires a cultural change and are willing to make the additional commitment.

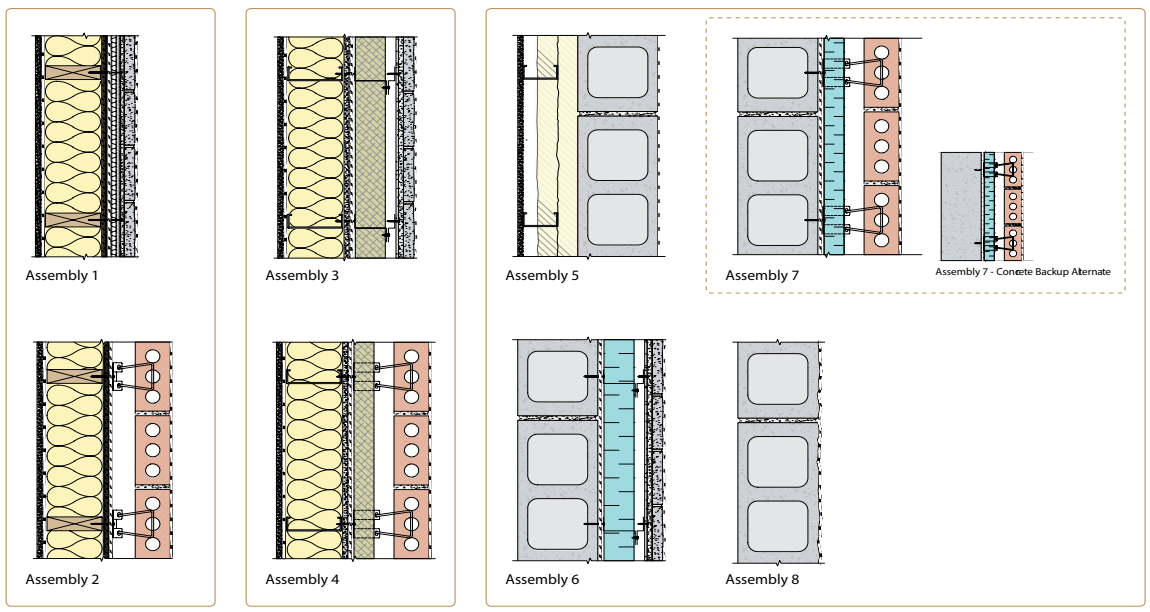


STRENGTH IN DETAILS

Successful design and construction can only be achieved through attention to detail. The Masonry Systems Guide is focused on the details. The comprehensive guide features 64, 2D and 3D renderings accompanied by extensive written technical specifications. Details for wood framed, steel framed, CMU/ Concrete substrates in addition to details for doors, windows, top of wall, base of wall, floor levels, and penetrations are all included in the MSG.

The 2016 Masonry Systems Guide, a first ever of its kind, masonry system print guide and companion website, will provide

The 2016 Masonry Systems Guide will help you design, engineer and build confidently with masonry. It is your resource for better design and construction processes. Did you know we are always interested in connecting with you for support in your masonry projects? In addition to the MSG, we are your resource for all information related to masonry.



Traditional decorative and durable cornice and cornerstone elements and built-in drip edges at strategic locations were typical of mass masonry structures and responsible for deflecting much of the water cascading down the face of these buildings. These design elements have been either eliminated or traded for more modularized and economized veneer units that, while reminiscent of historic mass masonry construction detailing, do not have the same water-deflecting characteristics. Fortunately, most veneer assemblies are able to accommodate the added moisture ingress due to a concealed drainage cavity and flashings. The result is a similar material aesthetic, fire resistivity, and durability, yet a flatter and simpler appearance lacking the intrinsic ability to deflect water away from the masonry-clad wall face and away from areas most sensitive to water entry, e.g., wall penetrations such as vents, windows, and doors.

Though the evolution of the above-grade wall design has led to more complex overall assemblies, product selection, and code compliance than in previous years, it has also demonstrated the durable and accommodating nature of modern above-grade wall assemblies to the local climate conditions of the Northwest region.

A New Conversation for Mason Contractors

The masonry industry recognizes building envelope requirements have changed in the last 20 years.

Certified Contractors are willing to be held to a higher standard of quality workmanship on every project.

Certified Contractors will build a complete masonry system from the sheathing out. They are experts in the masonry product, thermal modeling, accessory budgeting, insulations, and weatherization.

Current 2016 Certified Mason Tile & PCC Contractors

Cascade Construction Company, Inc.
Tacoma, WA

Fairweather Masonry, Inc.
Bellevue, WA

Henderson Masonry, Inc.
Des Moines, WA

Johnston Construction Company, Inc.
Tacoma, WA

Keystone Masonry, Inc.
Yelm, WA

Wards' Masonry, Inc.
Everett, WA

Bain Masonry, Inc. *
Enumclaw, WA

Dizard, Frisch & Lund Masonry Inc.
Lynnwood, WA

The Henson Company
Seattle, WA

Spilker Masonry, Inc.
Spokane, WA

Patricelli Tile, Inc.
Seattle, WA

United Professional Caulking & Restoration, Inc.
Seattle, WA

Clark Services, Inc.*
Auburn, WA

*currently completing program requirements.

The Training

Certified Mason Contractors are trained, educated and ready to build a complete masonry system. It's not just about the masonry product. It's about the weather barriers, energy saving construction and the life cycle of the whole building envelope. We focus on the penetrations, the openings and the fabulous masonry façade. A certified mason contractor will stand behind their work every time.

The Guarantee

Every Certified Masonry, Tile, and PCC Contractor has met the following objectives:

- In good standing with the Washington State Department of Labor and all contractor registration requirements.
- Trained and bidding to the 2016 Masonry Systems Guide
- Annual bank letter of financial responsibility
- Annual WISHA/ DOSH Safety Consultation
- 24 hour access to an experienced safety consultant
- Training agent with the State of Washington
- 50 hours + 8 hours of annual continuing management/safety training education
- An annual industry practicum review
- Complete a 50 hour training program

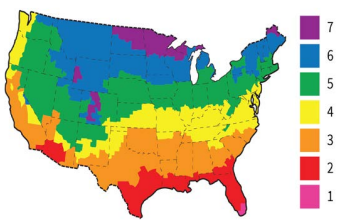
Specify a Certified Contractor

Certified Mason, PCC and tile Contractor **<u>installers</u>** have met the following criteria:

- At least four years of trade training
- Annually continuing education requirements of eight hours
- Access to professional industry technical experts available to resolve installation challenges
- Trained on future masonry technology that will aid in productivity and ergonomic injuries.

ADDRESSING 8 MASONRY SYSTEMS

The focus of MSG guide is to provide comprehensive design and construction detailing information for 8 primary



above-grade wall assembly options successfully used in the Northwest climate that are composed of clay or concrete masonry as an adhered or anchored veneer or single-wythe CMU wall application. The focus for each assembly is to clarify the overall above-grade wall building enclosure design as it relates to managing heat, air, and moisture (both liquid water and vapor) transfer between the interior environment and exterior environment and to demonstrate the constructibility of these structures to ensure long-term durability. Cladding considerations including attachment and installation methods are also addressed. Each assembly within this guide is addressed specific to the Northwest region, including Washington, Oregon, and Idaho and considers local climate, codes, and building preferences and practices.

Online at:
masonrysystemsguide.com

Each Chapter is dedicated to one of the primary above-grade wall assemblies and provides assembly-specific discussion, guidance, photos, and/or diagrammatic illustrations. Two- and three-dimensional details and cutaway wall sections are provided at the end of each chapter, summarizing the chapter content and illustrating its use in real-world applications.

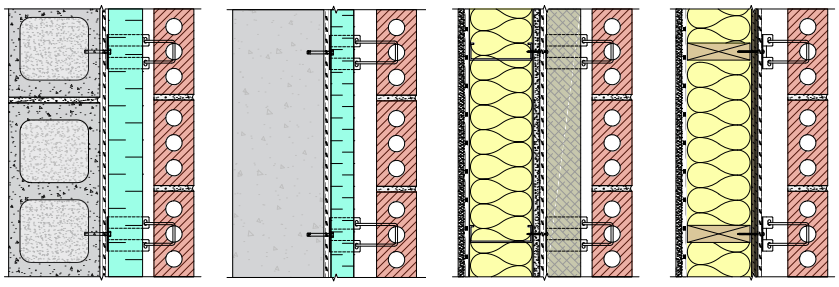
The sections following the 8 assembly chapters contain additional information regarding thermal modeling parameters, published industry references, and product resources.

The information presented within the publication is not meant to be exhaustive of all assembly variations, product performance properties, or detailing approaches but rather represents a selection of the best practices in the Northwest. Additional chapters and information will continue to be developed as areas are identified.

Assemblies

The 8 primary above-grade wall assemblies featured within this guide are Chapter 1: CMU (or Concrete Alternate) Wall with Anchored Masonry Veneer

- Steel-Framed Wall with Anchored Masonry Veneer
- Wood-Framed Wall with Anchored Masonry Veneer
- Integrally Insulated CMU Wall
- Interior-Insulated CMU Wall
- CMU Wall with Adhered Masonry Veneer
- Steel-Framed Wall with Adhered Masonry Veneer
- Wood-Framed Wall with Adhered Masonry Veneer (Thick or Thin Bed Method)

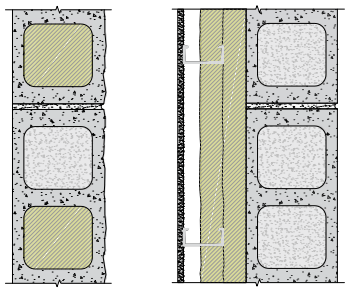


CHAPTER 1(A)
CMU Wall with Anchored Masonry Veneer

CHAPTER 1(B)
Concrete Wall Alternate with Anchored Masonry Veneer

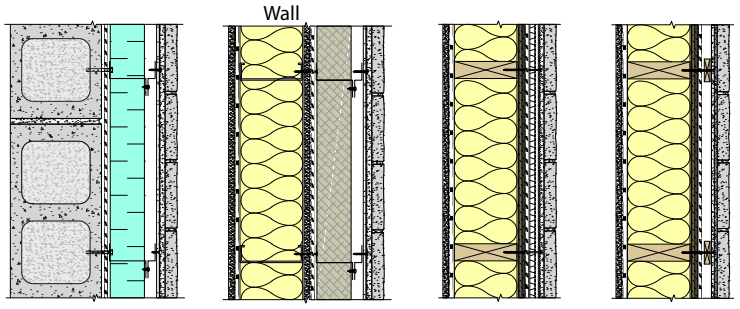
CHAPTER 2
Steel-Framed Wall with Anchored Masonry Veneer

CHAPTER 3
Wood-Framed Wall with Anchored Masonry Veneer



CHAPTER 4
Integrally Insulated CMU Wall

CHAPTER 5
Interior-Insulated CMU



CHAPTER 6
CMU Wall with Adhered Masonry Veneer

CHAPTER 7
Steel-Framed Wall with Adhered Masonry Veneer

CHAPTER 8(A)
Wood-Framed Wall with Adhered Masonry Veneer (Thick Bed Method)

CHAPTER 8(B)
Wood-Framed Wall with Adhered Masonry Veneer (Thin Bed Method)

Fig. 1-1 Chapters 1 through 8 assembly summary. Assemblies are depicted in plan view with interior located at left and exterior located at right.

Assembly Comparison Matrix

An Assembly Comparison Matrix is provided to assist designers with assembly selection. Comparison categories are those generally considered for both commercial and/or residential applications and include:

- Recommended Occupancy Type
- Building Enclosure Design Approach and Recommended Exposure
- Long-Term Wall Assembly Durability
- Typical Wall Thickness
- Typical Cladding Design Compliance
- Thermal Performance Considerations
- Special Construction Considerations
- Constructibility Ease with Limited/No Access to Exterior
- Fire Resistivity Considerations
- Maintenance Considerations
- Price Per Square Foot

Pricing Analysis

A pricing analysis is provided for each assembly within this guide and demonstrates the relative price per square foot. Pricing is for components outboard of the wall sheathing for framed or CMU backup wall assemblies. For exterior-exposed CMU wall systems, pricing includes all components except interior finishes and steel framing (where it occurs). Pricing is based on a 10,000- square-foot wall area and is valued for the 2015–2016 calendar year.

Overall pricing breakdowns and additional related discussion is included in a summary table at the end of each assembly chapter.

www.masonrysystemsguide.

Thermal Performance and Energy Code Compliance

The energy performance of buildings in the Northwest is governed by:

- State of Washington (except Seattle) – 2012 Washington State Energy Code (WSEC), based on the 2012 International Energy Conservation Code (IECC) with amendment, effective July 1, 2013
- City of Seattle, Washington – 2012 Seattle Energy Code (SEC), based on the 2012 WSEC with amendments, effective December 27, 2013
- State of Oregon – 2014 Oregon Energy Efficiency Specialty Code (OEESC), based on the 2009 IECC with amendments, effective July 1, 2014
- State of Idaho – 2012 International Energy Conservation Code (IECC) without amendments, effective January 1, 2015

In general, these energy codes address the minimum requirements for both the thermal envelope and air barrier system critical barriers of the opaque above-grade wall assemblies included within this guide.

Within 2016 MSG discussions related to the energy code and their commercial energy code compliance provisions are explicitly addressed.

The energy codes that govern in the Northwest define the prescriptive thermal performance of above-grade walls that form the thermal envelope. Under commercial provisions, prescriptive performance requirements for opaque above-grade walls are differentiated in the IECC based codes by,

- Climate zone (Zone Marine 4, Zone 5, or Zone 6),
- Occupancy (All Other or Group R)
- Classification (i.e., mass, metal building, metal-framed, or wood-framed and other).

Tables in the MSG summarizes the prescriptive above-grade wall thermal envelope requirements as they apply to the assemblies. Requirements include both minimum R-value (located above each U-factor) and maximum U-factor. Minimum R-value requirements are for nominal insulation and include continuous insulation (ci), U-factors define the maximum thermal transmittance of the assembly when insulation and other bridging elements that are required to be considered by the governing code—such as framing members and, in some cases, cladding attachments and supports—are considered. The prescriptive U-factor has also been provided as an equivalent assembly effective R-value and is frequently preferred when using masonry systems as it provides more flexibility while still meeting the required codes.

For simplicity, the R-value is the inverse of the U-factor. In order to utilize the U-Factor Alternative Compliance Strategy: the project-specific assembly U-factor will need to be determined.

Non-prescriptive Compliance Option

When a project seeks this compliance option, an above-grade wall assembly's thermal performance is determined as a U-factor; however, it may or may not be required to meet the prescriptive values.

Discussion and numerous tables are available within Northwest energy codes and ASHRAE 90.1 to assist with determining the U-factors of above-grade wall assemblies. Where assemblies are not represented within these resources, various methods are available for calculating the effective thermal performance of the wall and can be found in the 2016 Masonry Systems Guide. Appropriate calculation methods should be confirmed with the local jurisdiction as not all of these methods may be accepted:

- Parallel Path and Isothermal Planes (refer to the ASHRAE Handbook of Fundamentals): Typically used for assemblies with low-conductivity materials. Where material conductivity varies minimally, a parallel path method is typically used, such as with a wood-framed wall. When material conductivities within the assembly vary moderately, such as in a CMU wall, the isothermal planes method is typically used. These methods should not be relied upon for assemblies with highly conductive materials (e.g., steel studs) or intermittent components such as fasteners or ties through exterior insulation.

Continued on next page.

Non-Prescriptive Compliance Option

Masonry: U-Factor Preferred

- Zone Method and Modified Zone Method (refer to the ASHRAE Handbook of Fundamentals).
- Two-Dimensional Computer Modeling: Programs such as Lawrence Berkley National Laboratory's THERM calculate two-dimensional heat transfer.
- Three-Dimensional Computer Modeling: Programs such as HEAT3 (buildingphysics.com) calculate three-dimensional heat transfer.
- Numerous options for thermally optimizing each assembly and Modeling results can be demonstrated as an effective R-value by converting a U-factor by dividing 1 by the R-value.

Masonry ties, shelf angles, and cladding support systems of various types—contribute to the effective thermal performance of each masonry assembly. Based on modeling results, insulation thicknesses and types as well as cladding support materials and types may be estimated for project-specific assemblies. Modeling does not account for the impact of thermal mass.

Continuous Insulation

Continuous insulation is referenced in the prescriptive requirements for many assemblies within the 2016 MSG. Where continuous insulation is required or used to meet code compliance, the definitions of continuous insulation must be carefully considered; definitions vary by jurisdiction within the Northwest region and include:

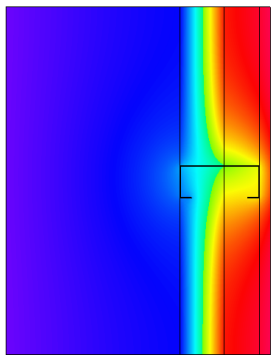


Fig. 1-2 Two-dimensional thermal modeling of a steel stud with cavity insulation interior of a mass wall

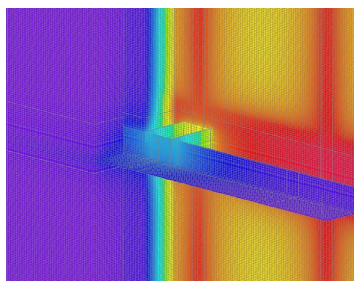


Fig. 1-3 Three-dimensional thermal model of a masonry veneer standoff shelf angle at a floor line

- 2012 IECC: No definition is provided. This guide recommends referring to ASHRAE 90.1-2010 and confirming local requirements with the governing jurisdiction.
- 2012 WSEC and 2012 SEC: "Insulation that is continuous across all structural members without thermal bridges other than service openings and penetrations by metal fasteners with a cross-sectional area, as measured in the plane of the surface, of less than 0.04% of the opaque surface area of the assembly. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope."
- 2014 OEESC: "Insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building."
- ASHRAE 90.1-2010: "Insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope."
- Based on the above definitions:

  Continuous insulation can be interior, exterior, or integral to the building envelope, for example, continuous insulation interior of a CMU wall.

  Insulation bridged by structural members (e.g., framing or anchored veneer shelf angles) may not be considered continuous and therefore should be clarified with the governing jurisdiction on a project-specific basis.

  Service openings (e.g., doors, ducts, etc.) have no impact on whether insulation is classified as continuous or not.

  Fasteners or metal fasteners may need to be considered.

Mass Wall Considerations

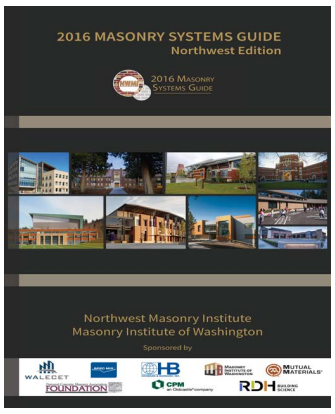
A mass wall has the ability to store thermal energy (i.e., heat) that can be released at a later time, reducing peak heating and cooling loads and increasing occupant thermal comfort. The benefit of thermal mass varies with climate zone and is more beneficial in warmer climates; however, thermal mass can still provide some benefit in cooler climates. Energy codes within the Northwest region take into consideration thermal mass properties by allowing mass wall assemblies to meet lesser prescriptive R-values (greater U-factors) than framed wall types. When complying with the energy code through a whole-building modeling approach, the benefits of thermal mass are directly considered within the building model.

The 2012 IECC, WSEC, and SEC and the 2014 OEESC define a mass wall as "weighing not less than 35 psf of wall area; or not less than 25 psf of wall area if the material weight is not more than 120 pcf." Under this definition, 6-inch or larger lightweight (103 pcf) CMU or heavier block qualifies as a mass wall, as does a typical concrete backup wall. The classification of a "mass wall" typically encompasses the backup wall structure; veneer inclusions should be confirmed with the local governing jurisdiction. Chapters 1, 4, 5, and 6 assemblies with CMU backup wall structure typically qualify as mass walls.

In the states of Oregon and Washington (excluding the City of Seattle), integrally insulated CMU walls such as the Chapter 4 assembly are exempt from prescriptive performance R-value and U-factors when the following two conditions are met:

1. "At least 50% of block cores are filled with perlite or equivalent fill insulation." An alternate to perlite is a phenolic resin core foam insulation.
2. "Space use includes warehouse (storage and retail), gymnasium, auditorium, church chapel, arena, kennel, manufacturing plant, indoor swimming pool, pump station, water and waste water treatment facility, storage facility, restroom/concessions, mechanical/electric structures, storage area, and motor vehicle service facility." In Washington only, "Where additional uses not listed (such as office, retail, etc.) are contained within the building, the exterior walls that enclose these areas may not utilize

Better Design and Construction Process



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- Building Enclosure Characteristics and Performance
- Compliance with Energy Code Requirements
- Cost Analysis
- Product Resources

The 2016 Masonry Systems Guide, a first ever of its kind, masonry system print guide and companion website, will provide a standardized systems guide of best practices for masonry wall systems design and construction.

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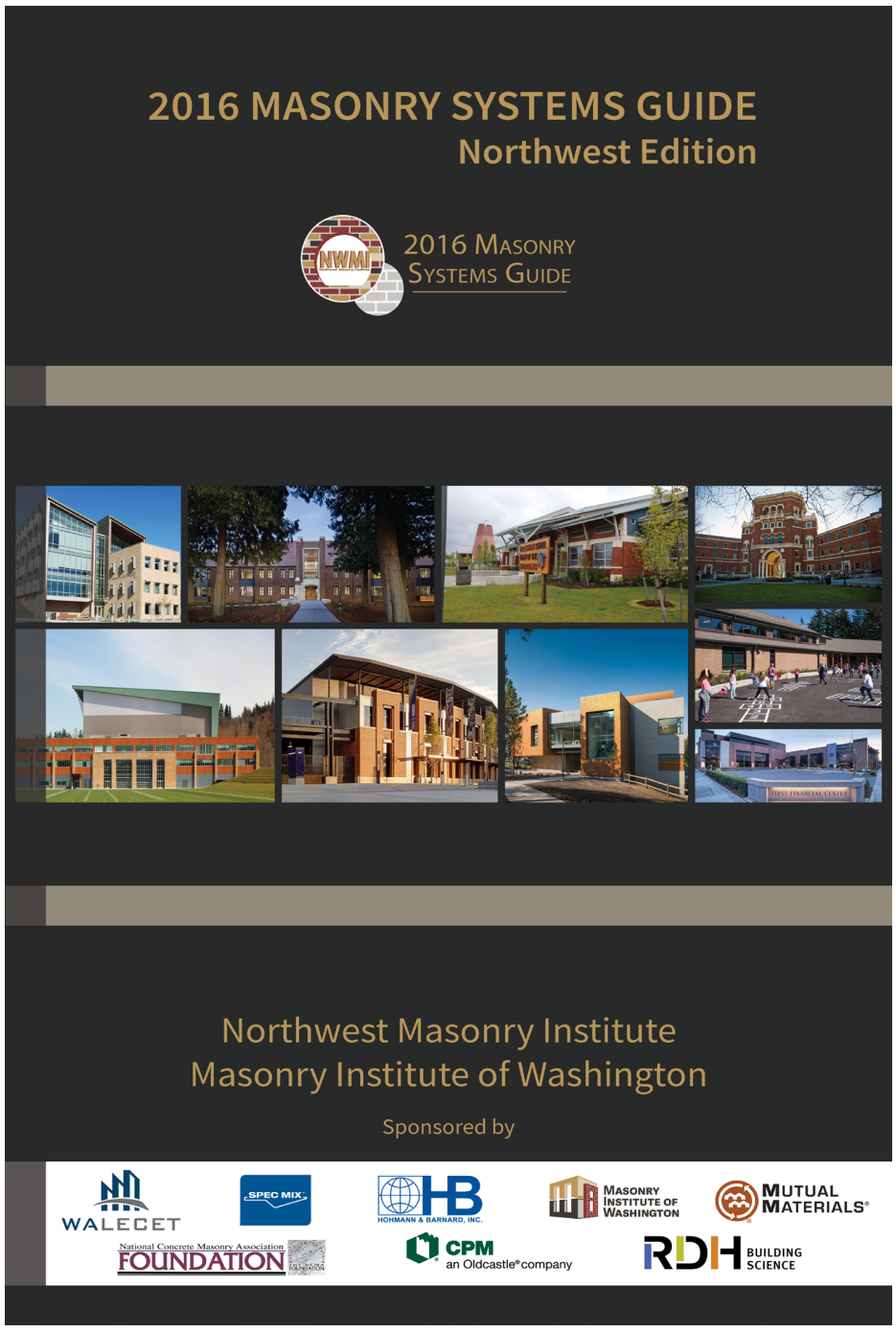

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