Re-thinking the tower block

Environmental and functional re-programming of derelict high rises in Central Sao Paulo - Brazil

Author:
Dipl.Ing. Swen Geiss,
Senior Lecturer, University of East London
team51.5 architects, www.team51-5.com
Collaboration:
Dr. Susannah Hagan, University of East London
Prof. Joanna Goncalves, University of Sao Paulo

the context

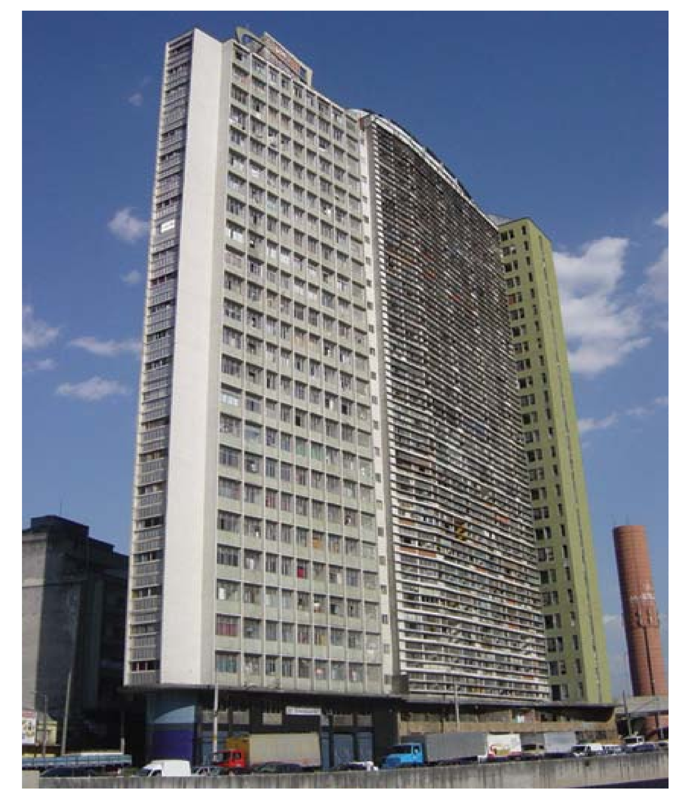
high demand for [social] housing
There is a need for approx. 900.000 extra housing units in the metropolitan area of Sao Paulo. [Prof. Dr. Goncalves]

empty building
There are nearly 40000 abandoned buildings with in Sao Paulo forming an unused resource. [T. Phillips - Guardian]

large households & small flats
The average household in Sao Paulo consist of 3.3 person and the average m˛ floor area per person is approx. 10 - 13 m˛. [Prof. Dr. Roméro - FAUUSP]

[relatively] low energy demands
The average energy demand in low cost & social housing is about 55 kWh/m˛ and sums up to an energy demand of about 550 - 650 kWh/a per person. [Prof. Dr. Roméro - FAUUSP]

high potential for renewables
72,9% of all electricity is sourced by hydro power station, the annual solar radiation in Sao Paulo is 2000 kWh/ m˛a.



The large stock of unused high rises (in Central Sao Paulo) could potentially offer solutions to the alarming housing shortage of the biggest city of South America. Re-densification of inner city run down neighbourhood would reduce the pressure for a further [sprawling] growth.

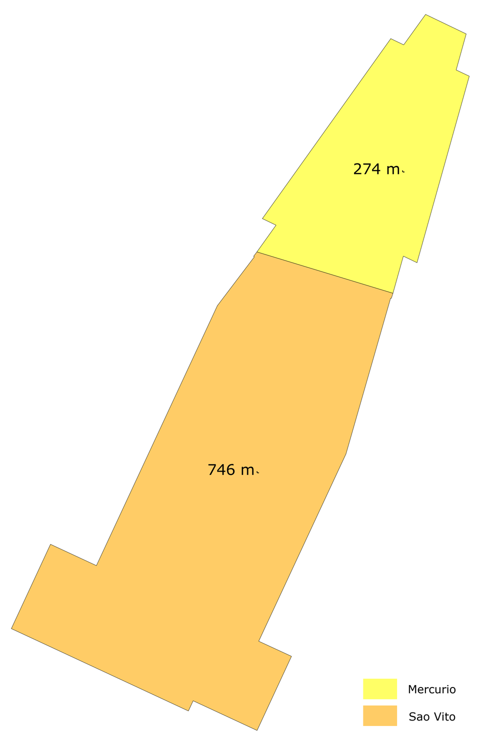
Despite their 'density', high rises are perceived as a rather unsustainable building typology. The ongoing case study intends to investigate into the potentials and limits of the functional and environmental re-programming of two derelict, formerly squatted high rises. The challenge is re-transform them into inhabitable spaces and to improve comfort and living conditions, whilst lowering the demand of resources and energy during a future occupation. Additionally the towers need to be (re-)connect into the nearby urban context in order to transform them into driving forces of a new local ecology (and the subsequent economy).

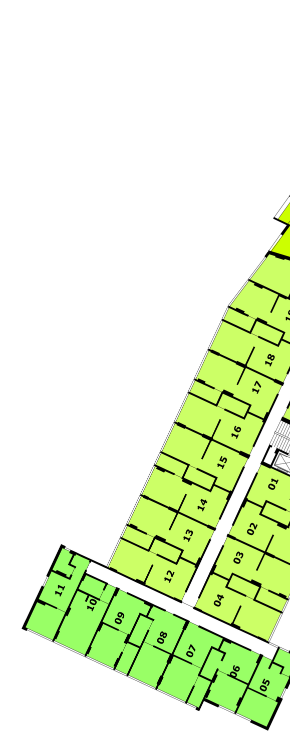
In the long perspective, the case study intend to develop transferable concepts for an environmentally driven, climate related re-organisation of big buildings and their urban context according the following parameters:

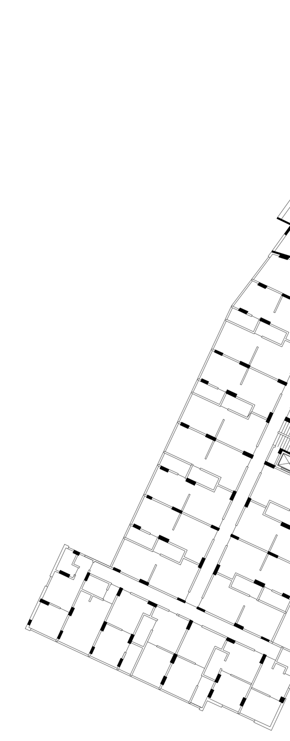
density - solar access - energy - water

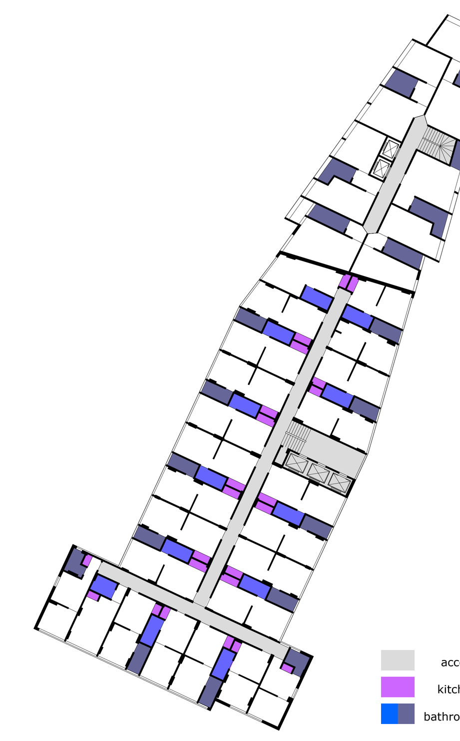
The tower formed of two parts was built between 1952 and 1954. Mercurio was first designed as a Hotel, Sao Vito as a middle class apartment block. The building consists of two commercial levels on the ground and first floor and 23 - 25 residential floors. Those are offering predominantly studio apartments [so called kitchenettes] of approx. 25m˛ and some more generous 1-bed room flats of up to 60 m˛.

Due to a lack of maintenance the building is fallen in major disrepair and has been squatted which turned the building into a vertical favela. After a recent clearing, the future of the building stays unclear.









the building as existing - M 1 : 250

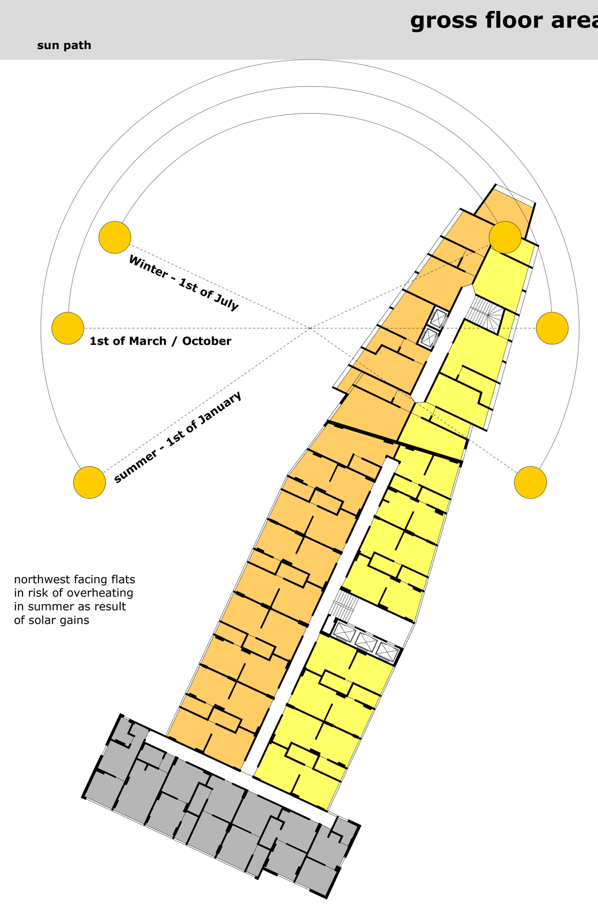
gross floor area | **general typology** | **structure** | **access & services**

Apart from the general lack of maintenance the block shows the following four major difficulties:

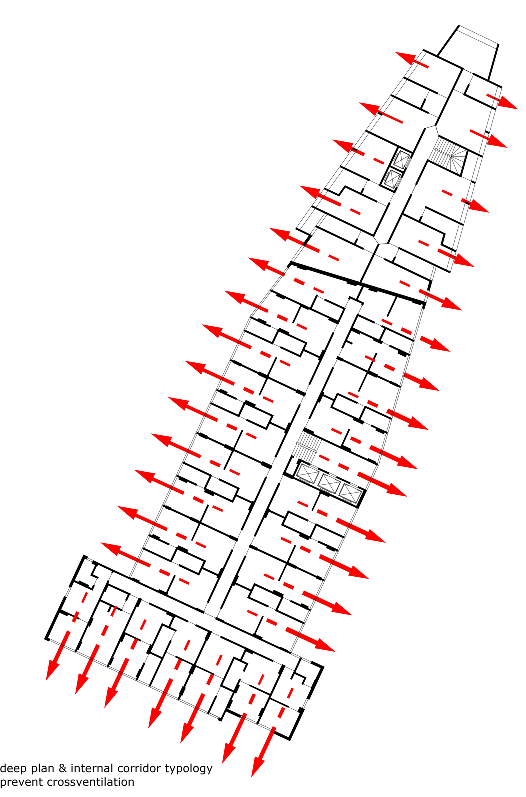
The deep plan organizes small single aspect units with larger numbers of internal rooms. This subsequently leads to a lack of daylight and cross ventilation for the majority of the flats.

The development of the facades shows a lack of [solar] differentiation between the north-eastern and the western facade which is exposed to high solar radiation in the afternoon, which leads to overheating, particulary during the hot and humid summer season.

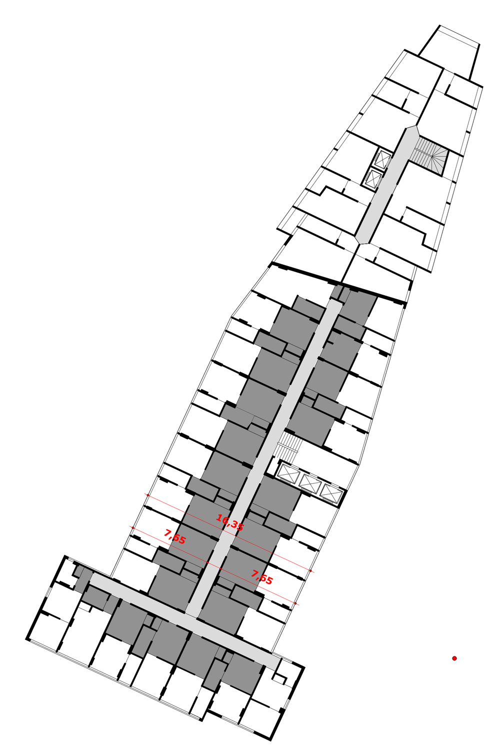
Additionally the building lacks of sufficient means of escape.



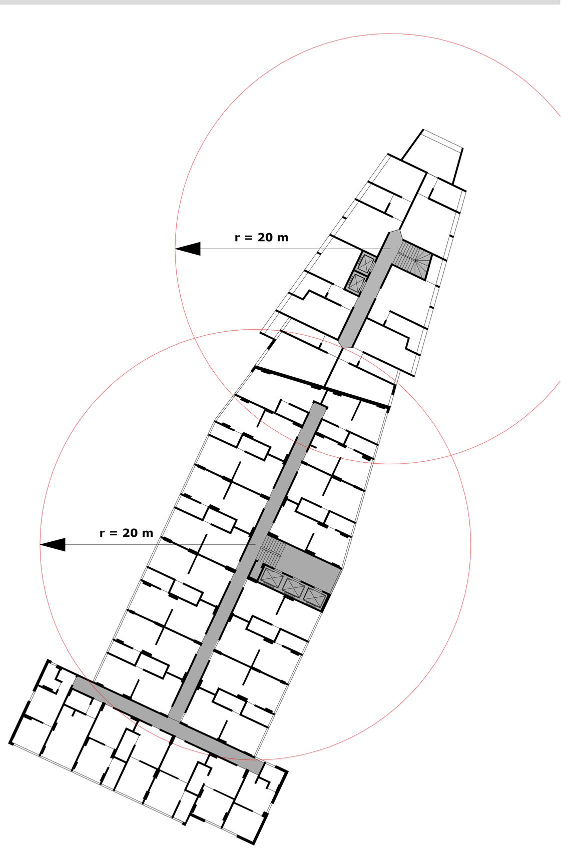
single aspect southfacing flats
with very little passive solar gains



deep plan & internal corridor typology
prevent crossventilation



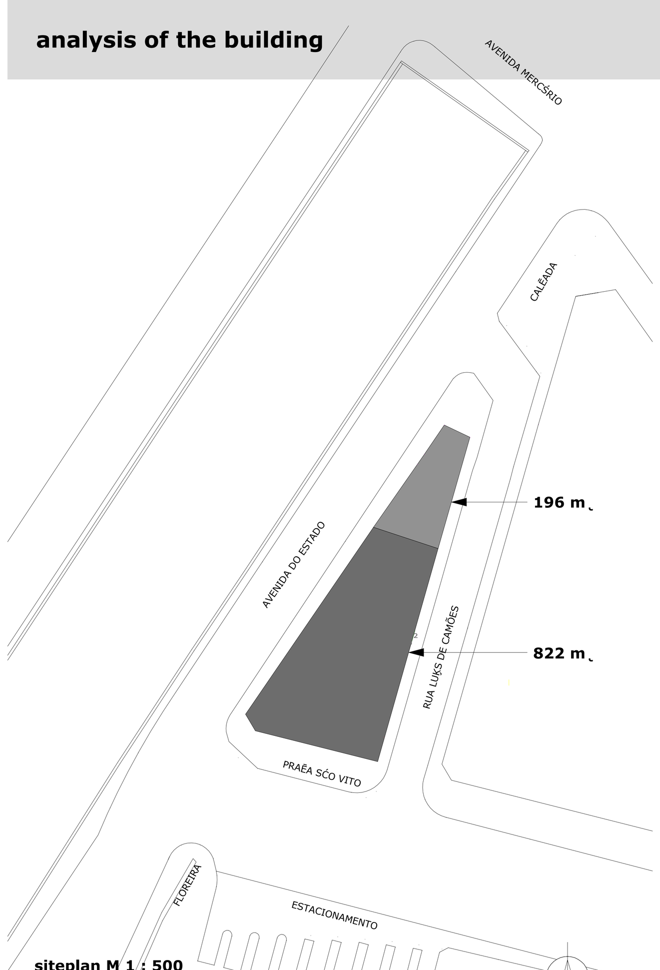
deep plan and internal corridor typology prevent crossventilation



lack of seodnary means of escape and enclosed fire staircases

analysis of the building

lack of solar differentiation | **lack of crossventilation** | **lack of daylight** | **lack of fire escape**



siteplan M 1 : 500

plot area	1.018 m˛
building foot print	1.020 m˛
number of floors	25 / 27
number of residential floors	2
number of commercial floors	23 - 25
total gross floor area	27.100 m˛
floor area ratio	26.6
total gross floor area -residential	21.860 m˛
total gross floor area -commercial	1.940 m˛
total gross floor area - access	3.280 m˛
net floor area - residential *1	19.240 m˛
number of dwelling	738
number of habitable room	690
assumed number of inhabitants *2	1.200
dph - dwelling per hectare * 3	7.250
rhp - habitable rooms per hectare	6.778
pph - people per hectare	11.788

*1 based on an average of 12% construction
*2 based on 17m˛ net floor area per person
*3 high density development in London range around 250 - 400 dwelling pwe hectare

solar radiation [on horizontal surfaces]* 4	1.912 kWh/m˛a
potential surfaces for solar harvesting	
roof surface	1020 m˛
- annual solar potential	1.326.000 kWh
opaque [south] facades	186 m˛
- annual solar potential	130.173 kWh/a
opaque [west] facades	763 m˛
- annual solar potential	631.000 kWh/a
glazed [south] facades	289 m˛
- 50% annual solar potential	101.000 kWh/a
glazed [west] facades	3612 m˛
- 50% annual solar potential	1.493.000 kWh/a
total annual potential	4.310.000 kWh/a
potential solar thermal out put *5	1.508.000 kWh/a
potential PV out put *6	431.000 kWh/a

*4 University of Sao Paulo
*5 based on a typical 35% system efficiency
*6 based on a typical 10% system efficiency

[renewable] electricity production *7 from hydro power station	72.9%
energy consumption in social housing	55 kWh/m˛a
energy consumption per person & year	650 kWh/a
energy consumption [m˛-based]	1.060.000 kWh
energy consumption [person based]	780.000 kWh
assumed energy consumption	920.000 kWh
energy equivilant - fossil oil	92.000 litre
thermal energy demand	248.400 kWh
- warm water [27%]	
non-thermal energy demand *7	671.600 kWh
- lighting [21%]	193.200 kWh
- refridgerator [19%]	174.800 kWh
- equipments [33%]	303.600 kWh
necessary solar collector surface [out put 500kWh/m˛a]	497 m˛
necessary Photovoltaic surface [out put 200kWh/m˛a]	3.358 m˛
necessary Photovoltaic surface 35% coverage [out put 200kWh/m˛a]	1.175 m˛

*7 Prof. Roméro - FAUUSP - University of Sao Paulo

annual water demand	52.500 mł
annual water demand - toilet flushing	10.500 mł
annual water demand - laundry	3.500 mł
annual water demand - others	38.500 mł
annual rain fall *8	1.455 mm/a
possible rain water harvest	1.190 mł
possible grey water harvest	2.800 mł
possible drinking water reduction	< 10 %
rain water foot print	36080 m˛

*8 Climaticus 2.0 - FAUUSP - University of Sao Paulo

analysis of the building

density - plot area ratio & use | **solar access - radiation & energy potential** | **energy - supply & demand** | **water - supply & demand**

The option of the strategic proposal include elements of
- space planning and layout
- [passive] constructive-architectural changes and
- [active] technology based measures:

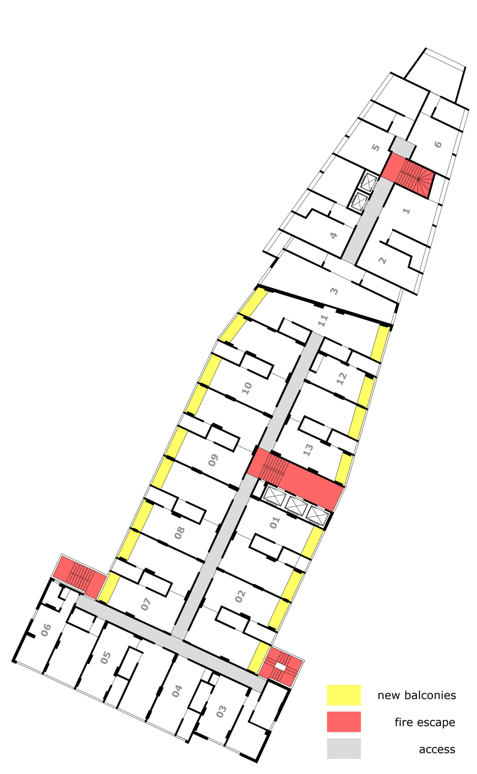
The spatial re-organisation offers the opportunity to develop a larger variety of flats and / or if wanted a general reduction of inhabited space and subsequently user density. Depending on the layout 1-2 new fire escape could be added.

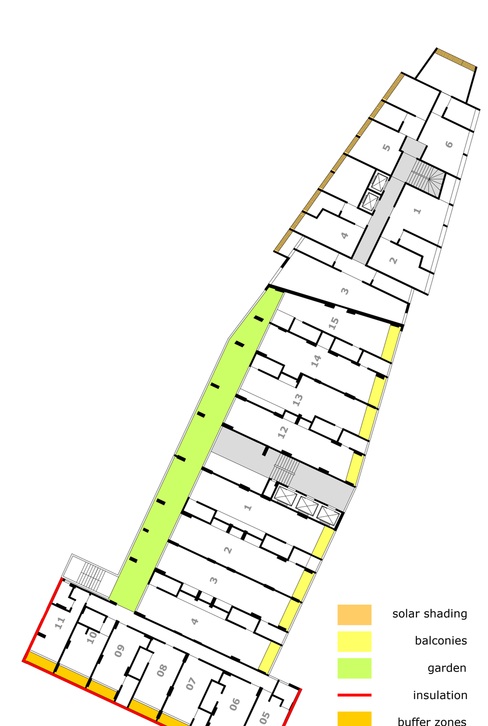
The reduction of internal partition reduces the need for artificial lighting during daytime and could enhance the opportunity of cross ventilation.

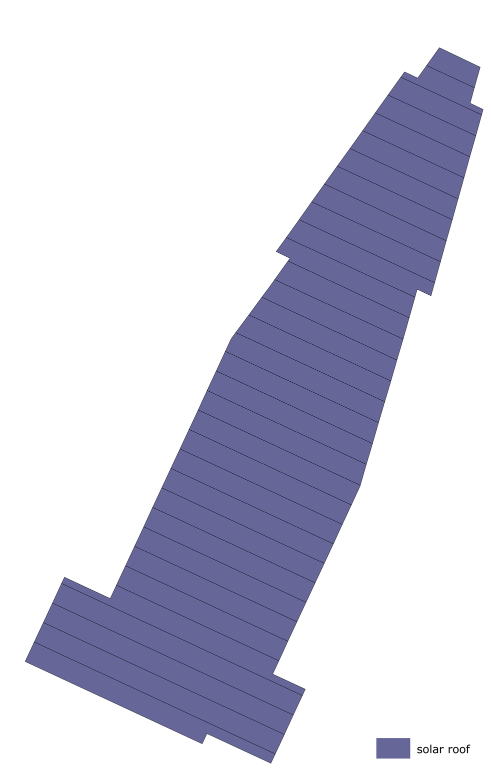
New private and communal spaces such as balconies and sky gardens would raise the usability of the building for different user groups i.e. families. Additionally those transitional spaces would offer the opportunity to develop a passive solar differentiation of the building. Areas of extra insulation, buffering zones and shading to prevent over heating would lower the demand for heating in winter and cooling in summer.

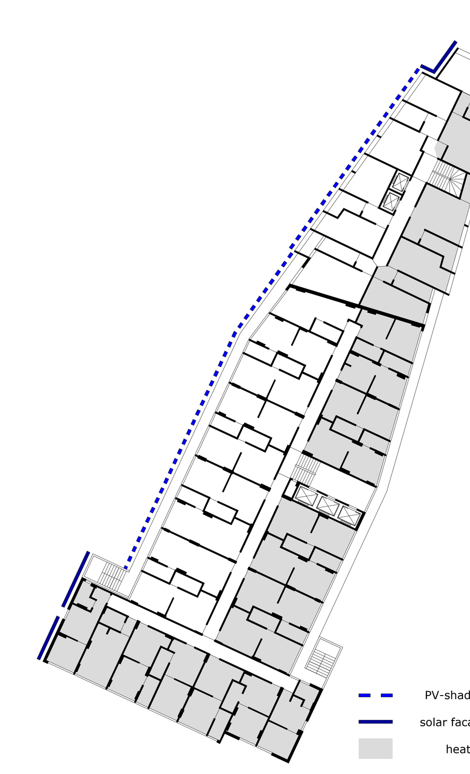
Ideally this differentiation would lead as well the integration of regenerative technologies such as solar thermal, Photovoltaics and rainwater harvesting.

The development of a productive roof, harvesting 100% of the annual warm water needs and a fraction of the buildings water demand would have first priority. A solar building skin, integrating Photovoltaics in a opaque cladding and / or shading devices, could generate at least 35% of the buildings electricity demands. It would complete the environmental re-programming and make the tower the first carbon neutral high rise of Sao Paulo.









strategic proposals - M 1 : 250

space planning | **[passive] solar differentiation** | **productive roof surface** | **[active] solar differentiation**