UNIVERSITÀ DEGLI STUDI DI TRIESTE

Carlo Antonio Stival
via A. Valerio 6/1
34127 Trieste
+390405583478
cstival@units.it

SUBJECT 1

Characterizing efficient envelopes

Structural and Technological Design of Building Envelopes

1.1

The building skin: technological requirements and functional layers

Functions

VERTICAL ENVELOPE

functions

opaque envelope

Define the indoor-outdoor boundary
Provide equilibrium and mechanical resistance
Ensure comfort in indoor conditions
Ensure aesthetic quality

- PROTECTION AGAINST WEATHERING
- STRUCTURAL STRENGTH
- CONTROL OF INDOOR COMFORT CONDITIONS
  - Thermal insulation
  - Acoustic insulation
- FIRE RESISTANCE AND REACTION TO FIRE
- EFFICIENCY IN WEIGHT-TO-LOAD RATIO
- DURABILITY
- BUILDING SERVICES INTEGRATION
- AESTHETIC APPEARANCE
- SAFETY / SECURITY

transparent envelope

Define the indoor-outdoor boundary
Ensure comfort in indoor conditions
Ensure aesthetic quality

- MECHANICAL RESISTANCE
- CONTROL OF INDOOR COMFORT CONDITIONS
- PROTECTION AGAINST WEATHERING
- EFFICIENCY IN WEIGHT-TO-LOAD RATIO
- DURABILITY
- AESTHETIC APPEARANCE
- SAFETY / SECURITY

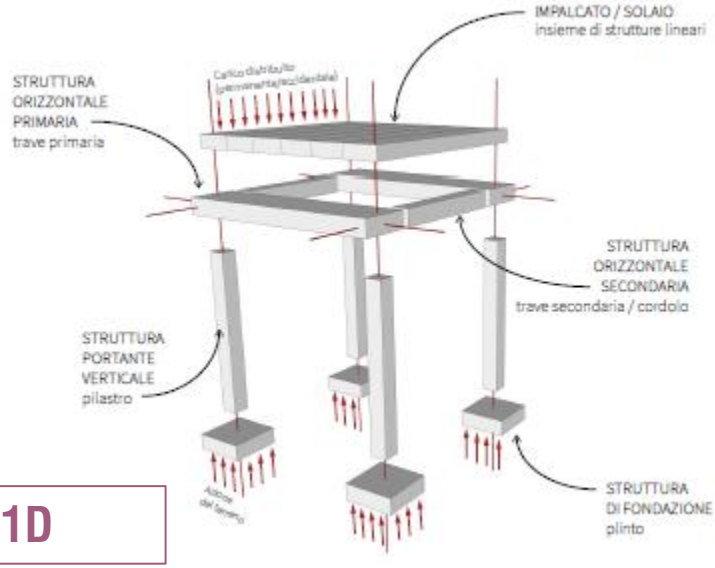
Relation between requirements and functional layers

STRUCTURAL STRENGTH

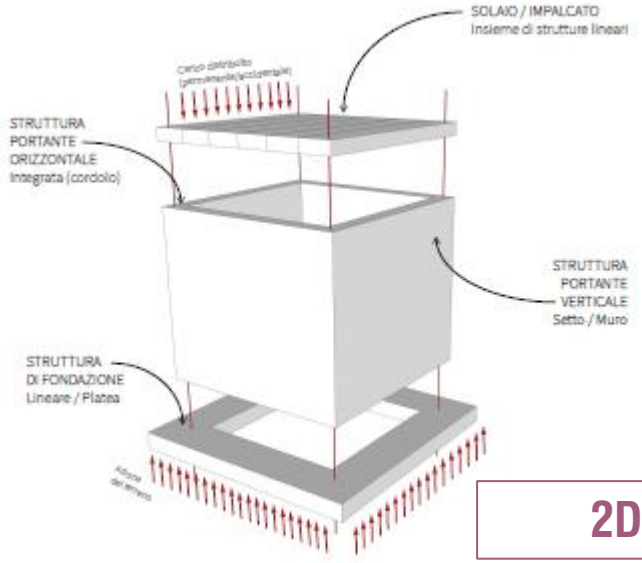
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LOAD-BEARING LAYER

Load-bearing function performed by the building envelope in relation to the applied loads (self-weight; self-weight of the overlying structural elements; permanent non-structural loads; imposed loads).



1D



2D

Relation between requirements and functional layers

WIND LOAD RESISTANCE

↓

LOAD-BEARING LAYER

↓

AIRTIGHT LAYER

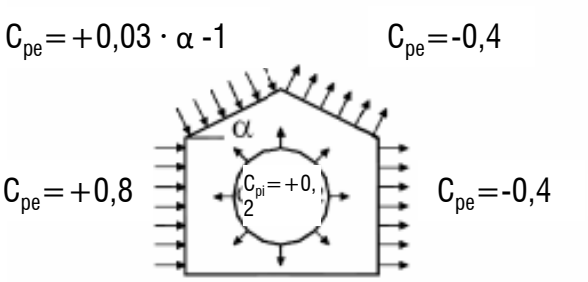
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CLADDING LAYER

Verification of stresses resulting from the air pressure differential between the indoor and outdoor environments induced by airflow acting on the building.



Buildings with a wall featuring openings whose total area is less than 1/3 of the wall's overall surface area.



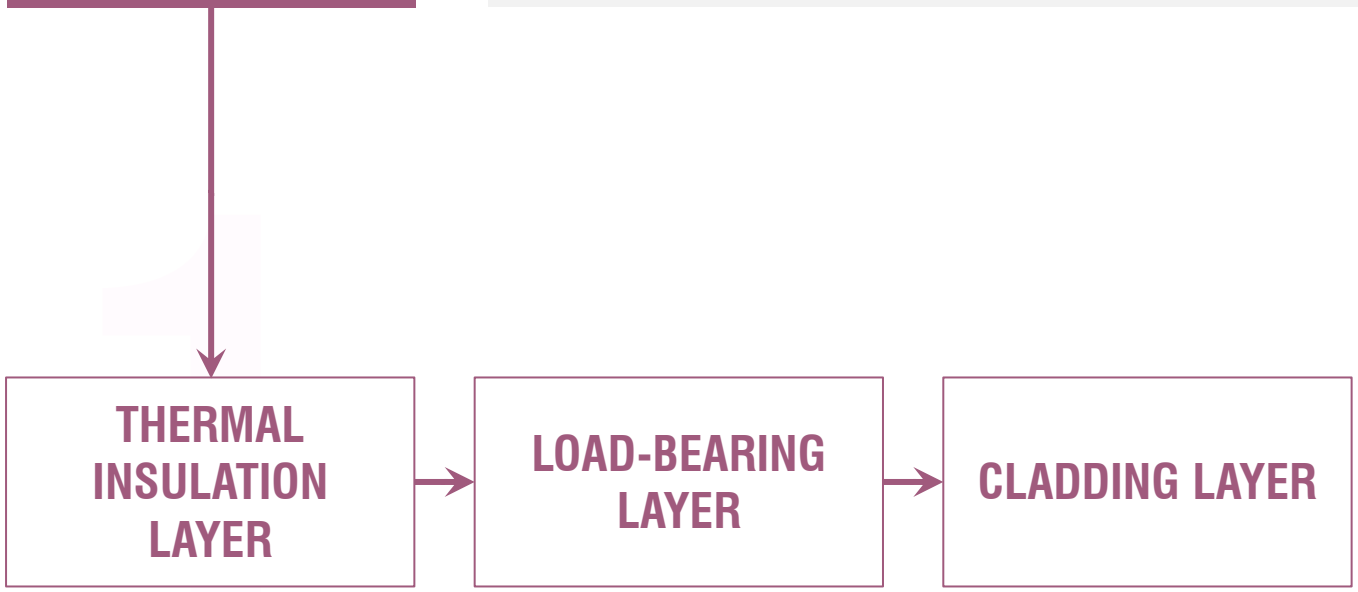
Relation between requirements and functional layers

THERMAL INSULATION

Resistance to heat transfer, with the aim of reducing energy consumption and ensuring the achievement of thermal comfort conditions.

THERMAL INERTIA

Ability to attenuate indoor temperature fluctuations, thereby delaying the onset of overheating caused by solar radiation.



Relation between requirements and functional layers

SURFACE CONDENSATION ASSESSMENT

Absence of condensation on internal surfaces. This requirement is particularly important for walls with low thermal inertia, limited thermal insulation, and consequently low internal surface temperatures.

INTERSTITIAL CONDENSATION ASSESSMENT

Absence of interstitial condensation within the building envelope, thereby safeguarding the integrity of all functional layers.

THERMAL INSULATION LAYER → **LOAD-BEARING LAYER** → **VAPOUR BARRIER LAYER** → **AIR VENTILATION LAYER**

1.2

Classification of building skins

Functional schemes

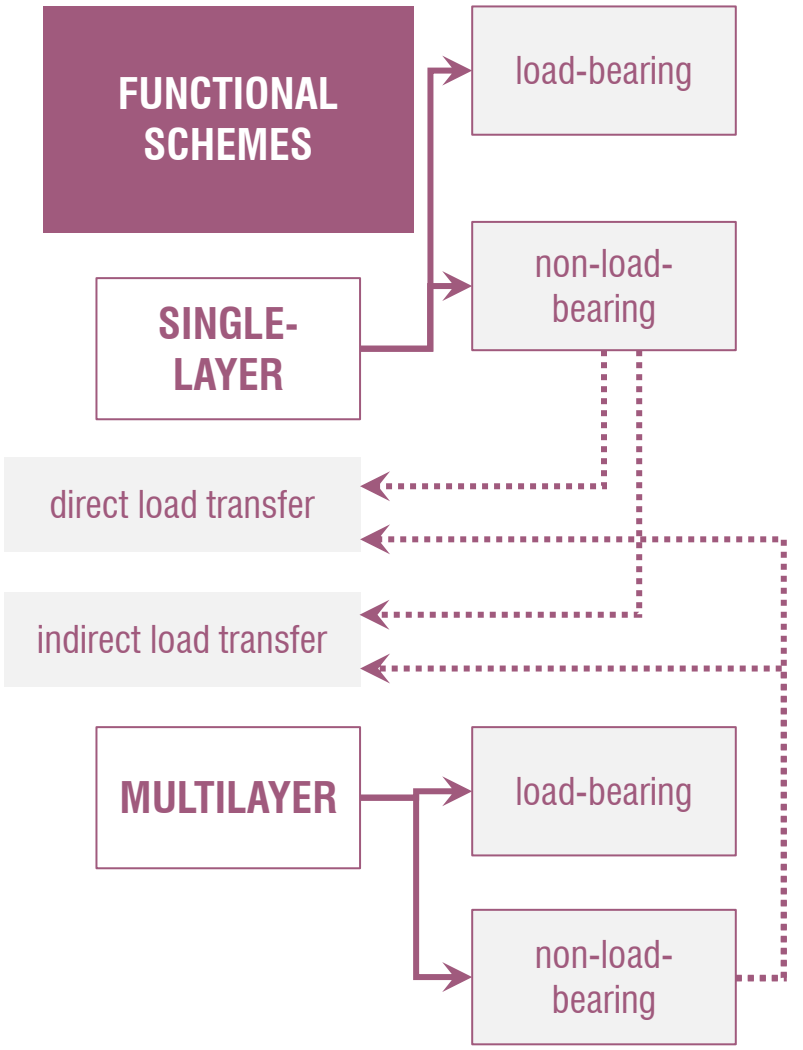
The technological characteristics of vertical building enclosures are defined by their **characterising requirements**. The **physical** and **design responses** to these requirements are developed through the identification of **functional schemes**, which are established on the basis of **behavioural models** and, consequently, **articulated** into **functional layers**.

Each individual functional layer—whether a technical element or component—is responsible for **performing at least one function**, at the level of definition corresponding to a compliant solution.

The classification of vertical walls into functional schemes takes into account:

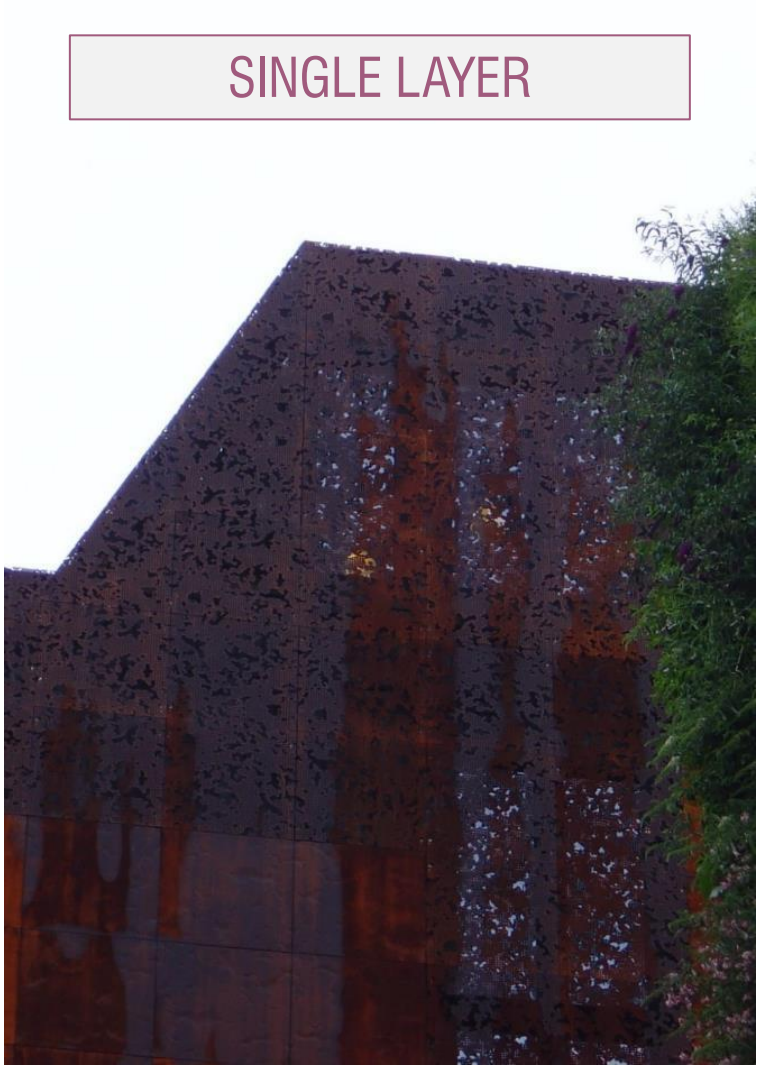
- the functional layers that make up the skin;
- their relationship with the **loads** transferred by the structural system.

With regard to the latter aspect, perimeter walls may be classified as either **load-bearing walls** or non-**load-bearing**/infill **walls**.

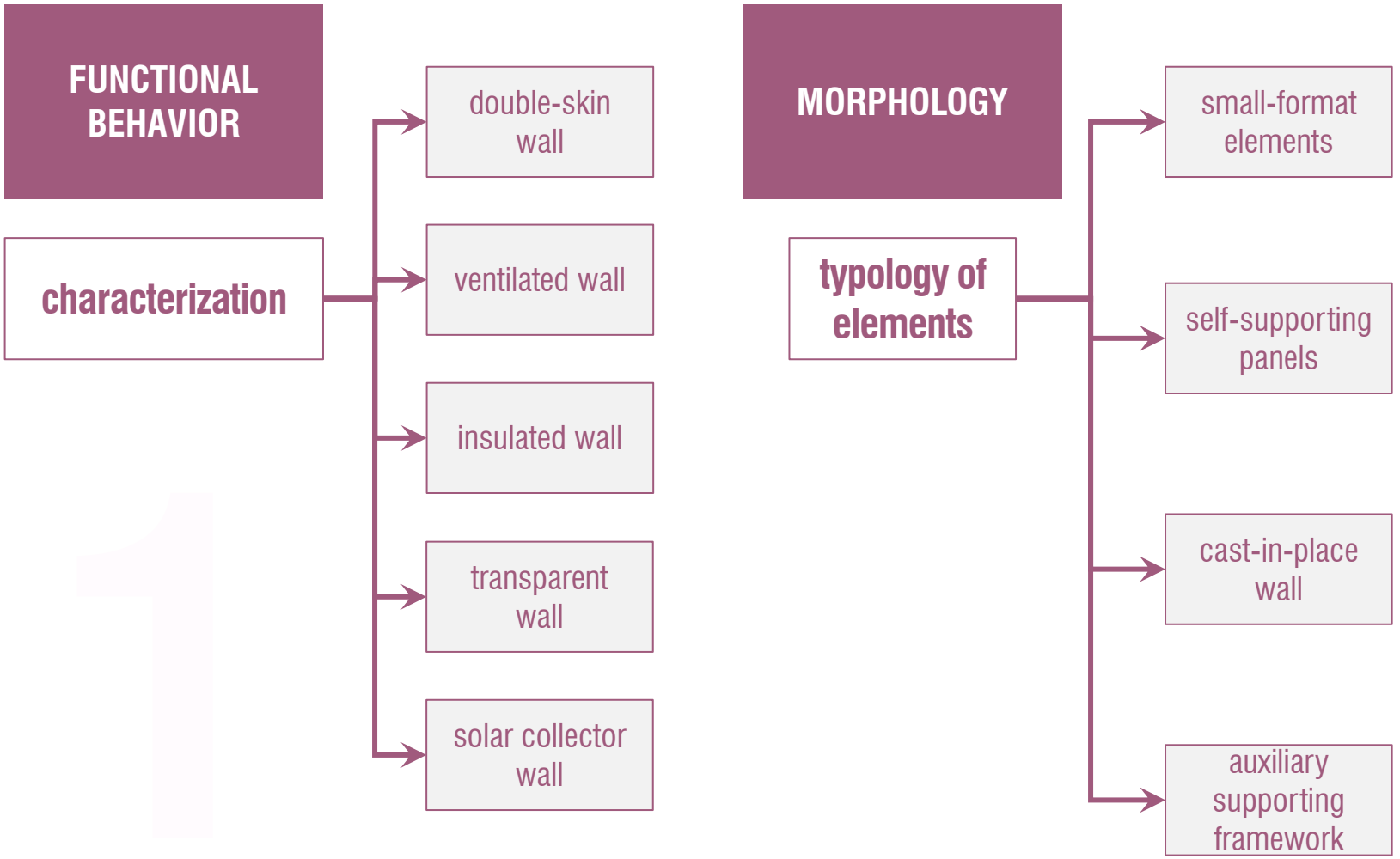


Functional schemes





Functional schemes

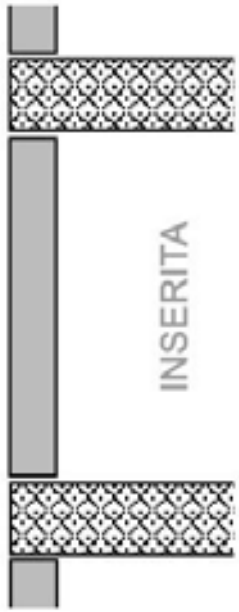


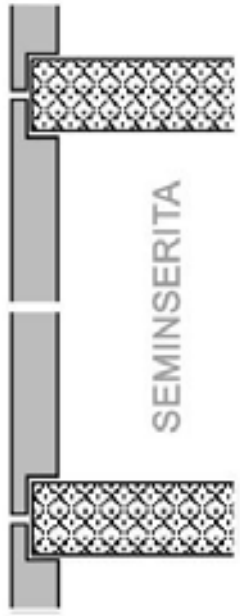
Functional schemes

RELATION STRUCTURE-ENVELOPE

characterization

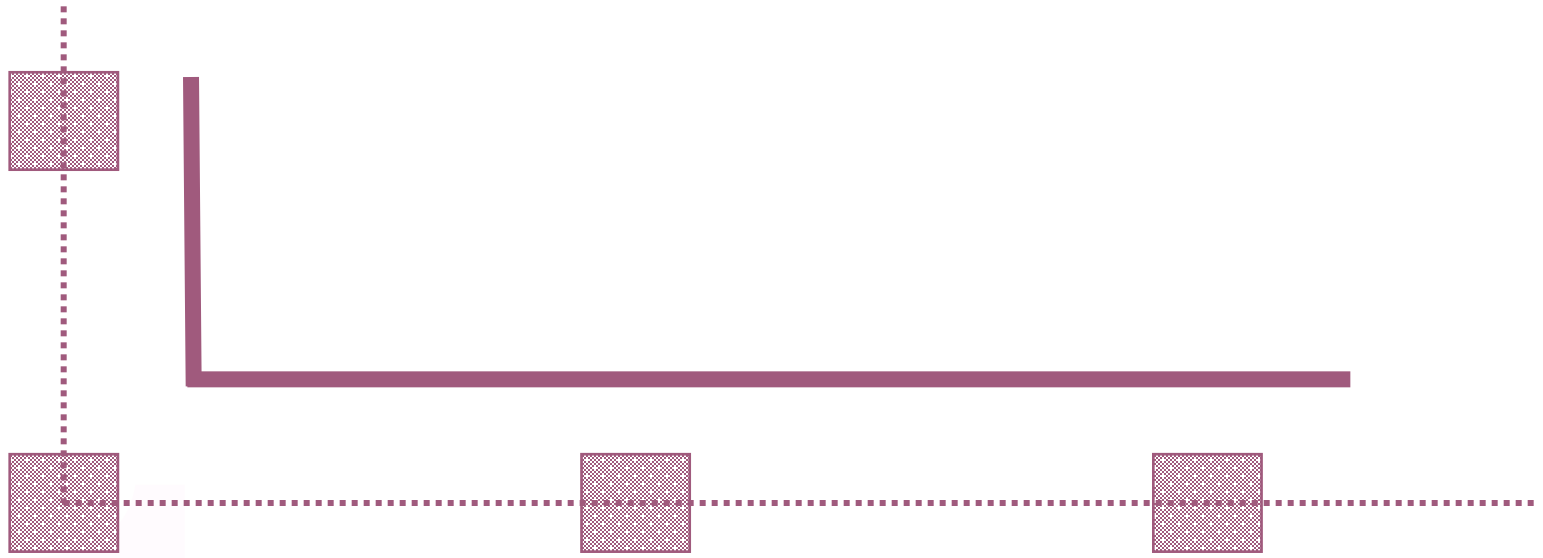
- Infill wall
- Semi-curtain wall
- Curtain wall







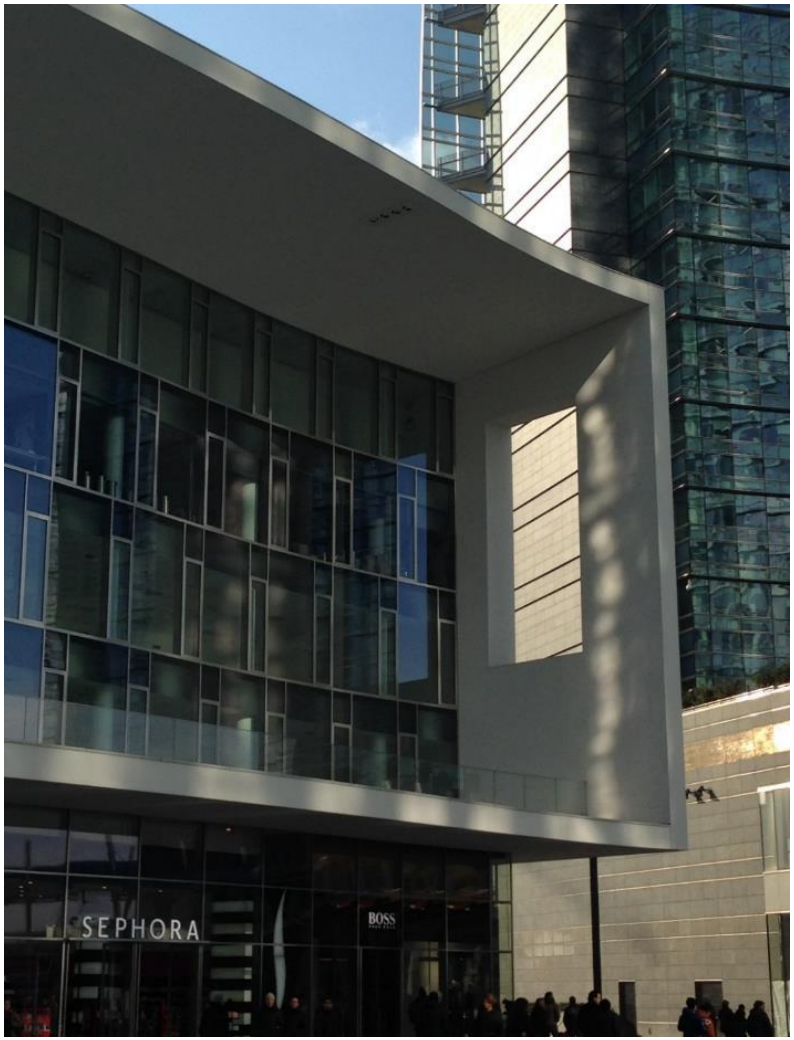
Functional schemes



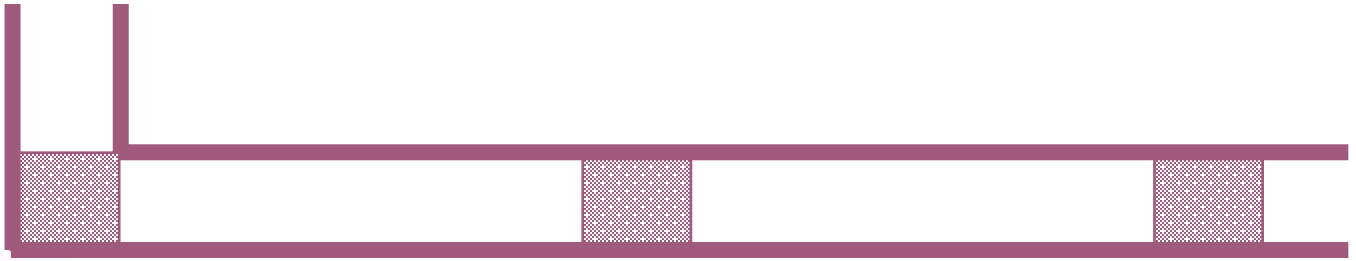
INFILL WALL

Functional schemes





Functional schemes

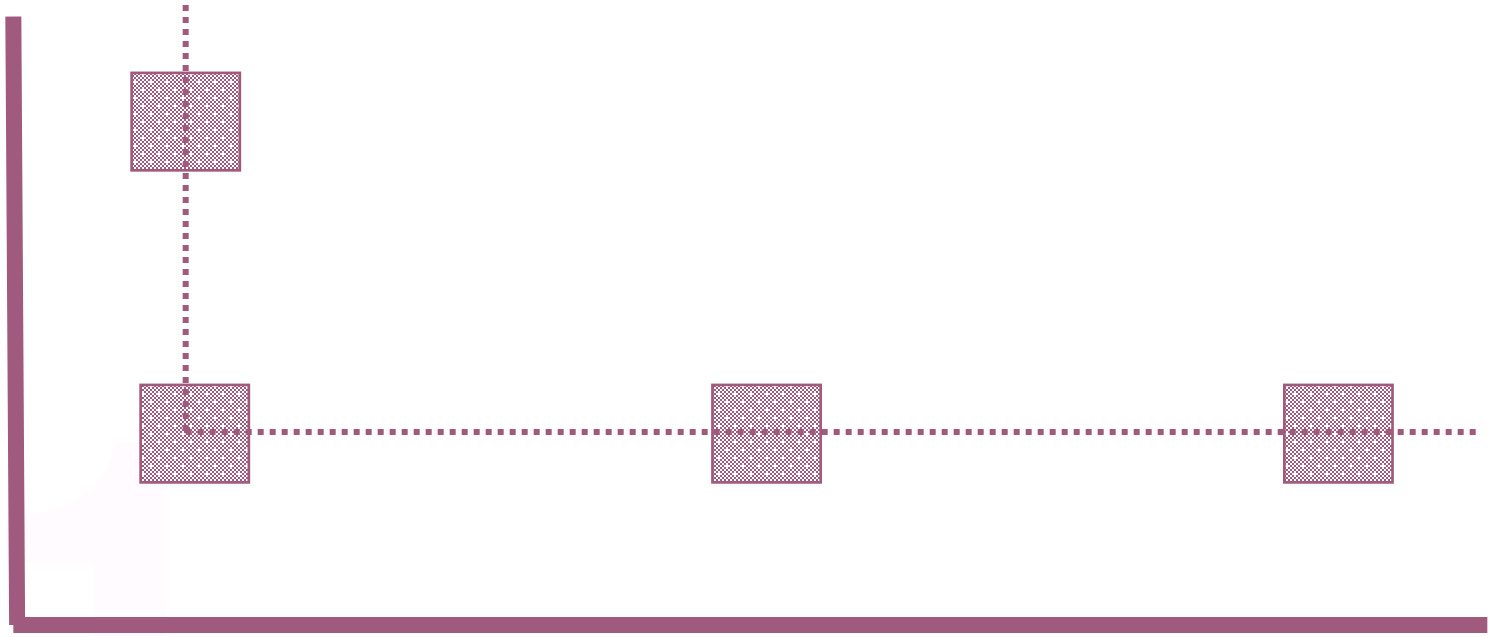


SEMI-CURTAIN WALL

Functional schemes

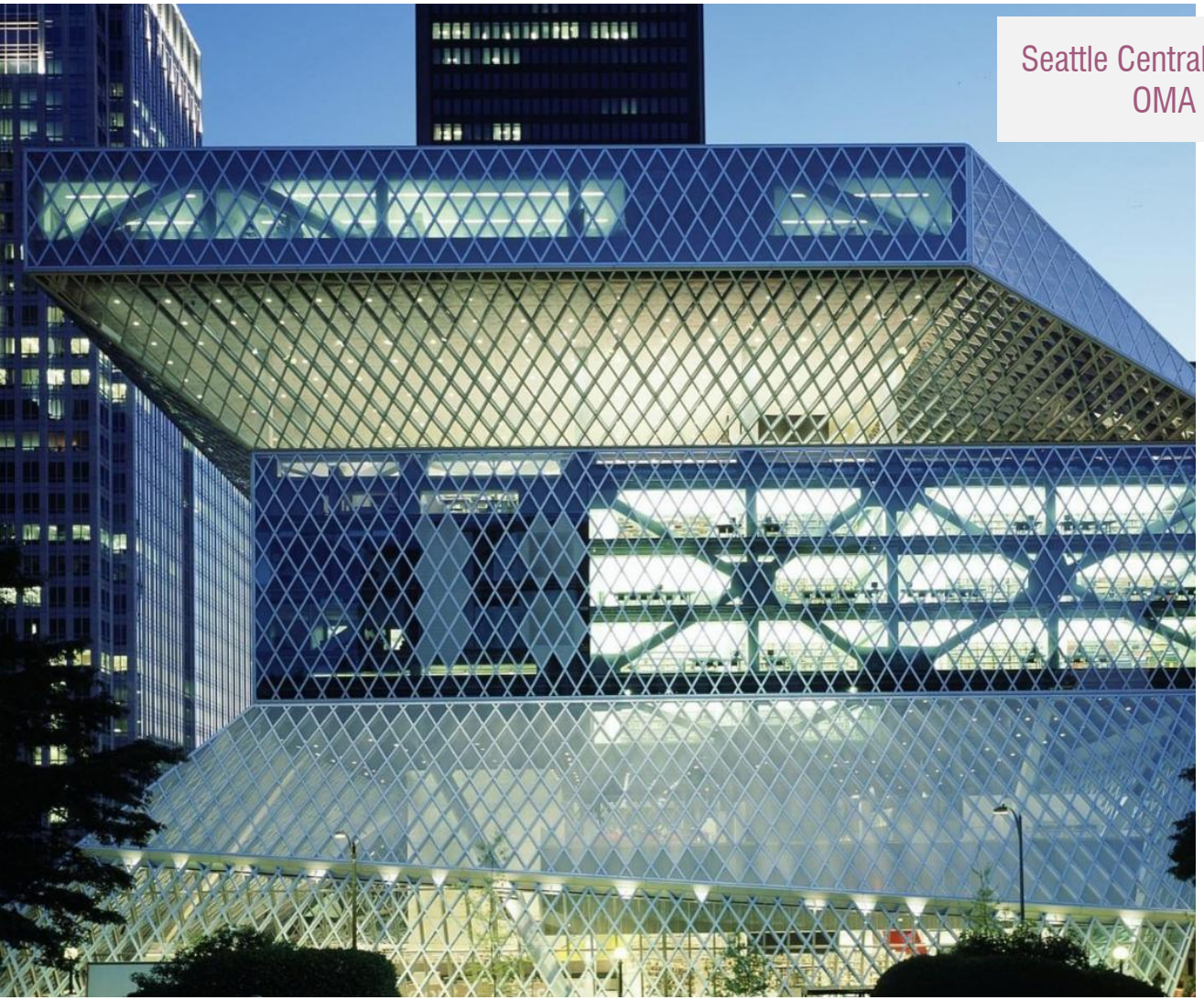


Functional schemes

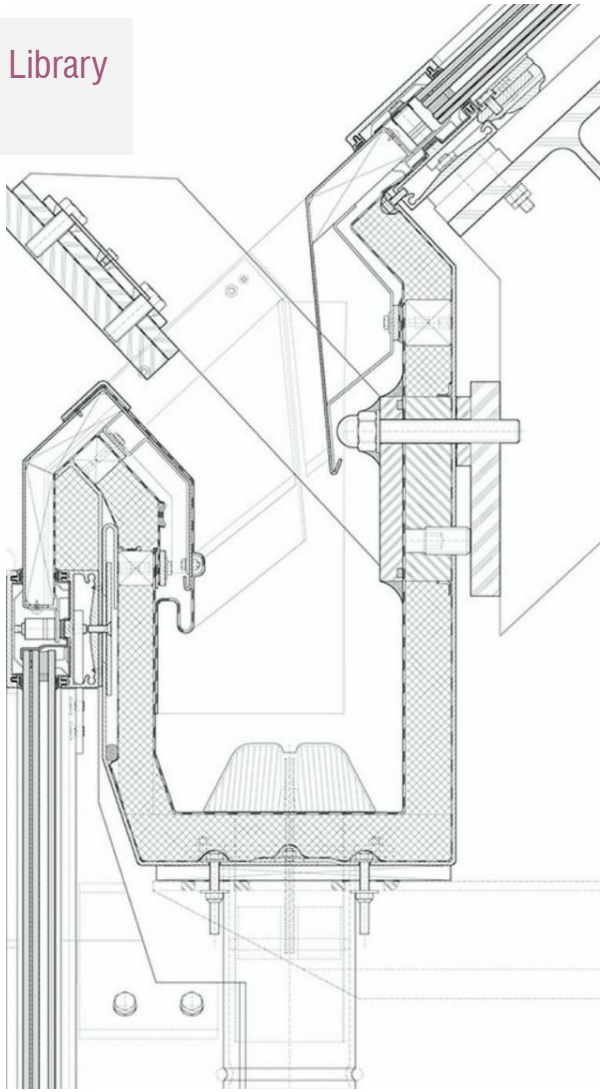


CURTAIN WALL

Functional schemes



Seattle Central Library
OMA



Functional schemes

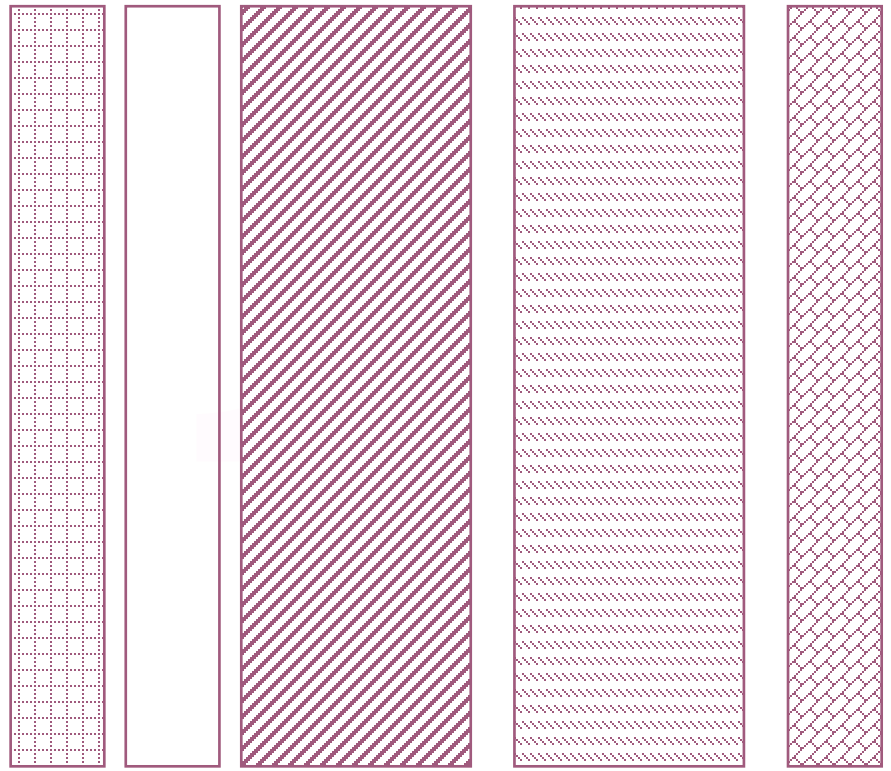
Wood & Copper Sculpture in Hamburg (D)
Busch & Takasaki Architekten





Functional layers

Exploded view showing the assembly of the vertical building envelope components



EXTERNAL CLADDING	protection against weathering aesthetic appearance
COMPLETION LAYERS (non-structural)	thermal insulation shock-resistance
Load bearing **WALL**	load-bearing capacity deformation control fire resistance weight-to-load ratio thermal insulation
SERVICE CAVITY	management facility integration
INTERNAL CLADDING	acoustic insulation fire resistance