



# Museum Of Art

Rem Koolhaas

Minkeun Sim / Jaechang Ko / Changsuk Han

INTRODUCTION

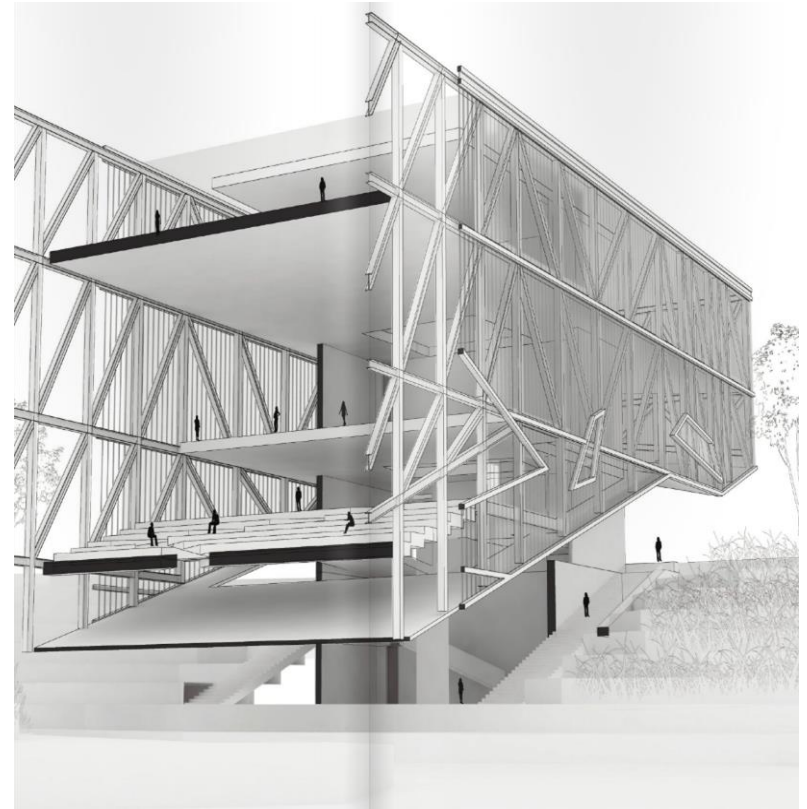
STRUCTURE FEATURES

FOUNDATION SYSTEM

LOADING ANALYSIS

LATERAL LOAD BEHAVIOR

MATERIALS



## **PART 1 INTRODUCTION**

- General Information
- Design Concept
- Building Layout

## General Information



## General Information

Location: Seoul National University, Seoul, South Korea  
Completed: 2005

Floor count: Ground 3 story & Basement 3 story  
Floor area: 4,486.47 m<sup>2</sup>  
Building area: 2,775.56 m<sup>2</sup>  
Building height: 17.575 M

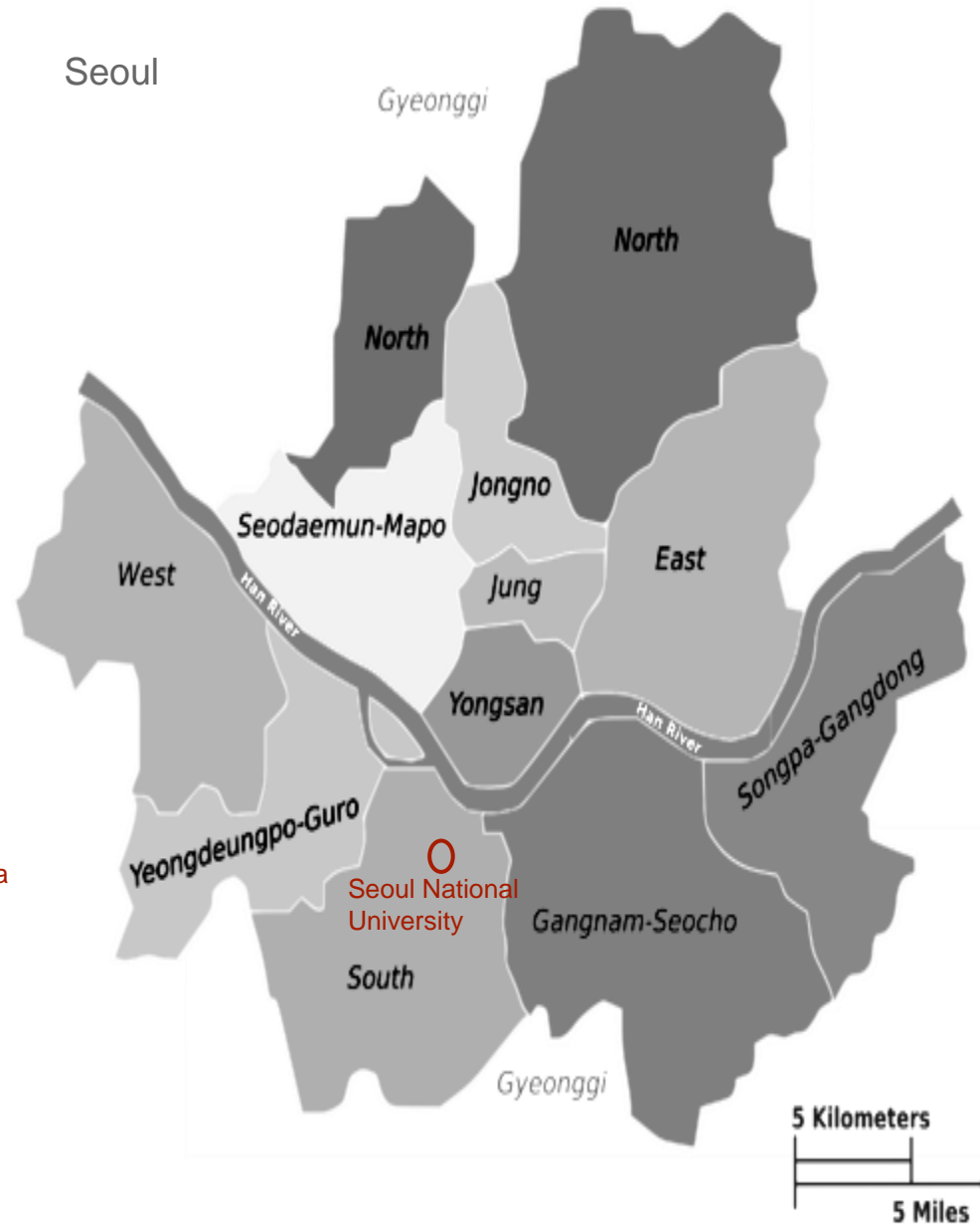
Architect: Rem Koolhaas  
Engineer: Samsung Engineering



# General Information

## The Site

- Seoul National University, Seoul, South Korea



# General Information

## The Site

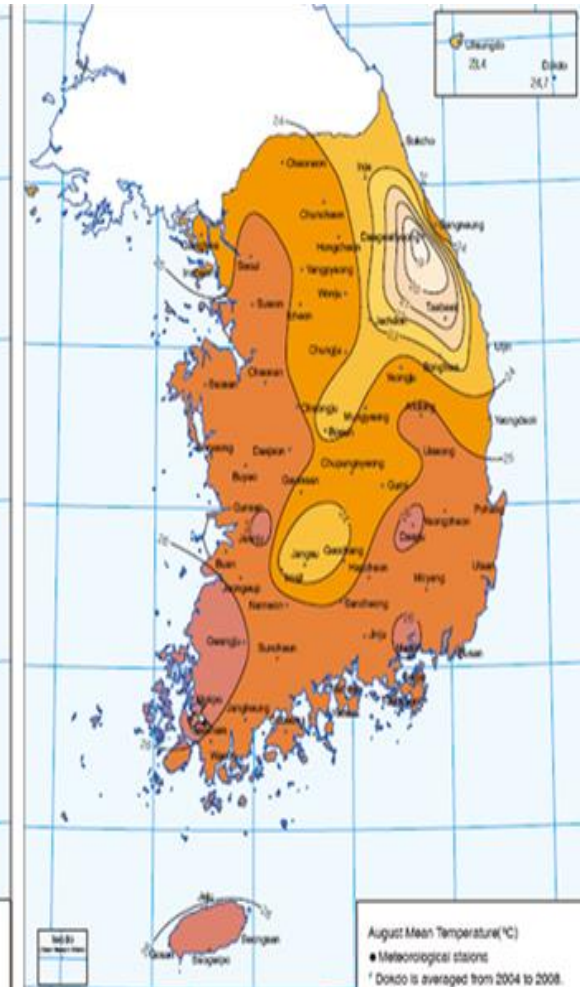
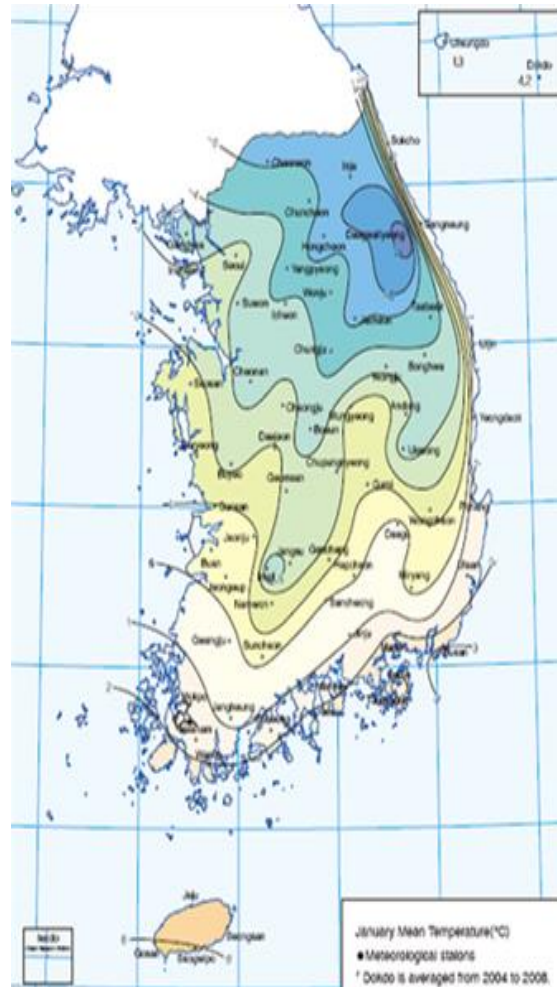
- Seoul National University, Seoul, South Korea



# Site Analysis

## Climate

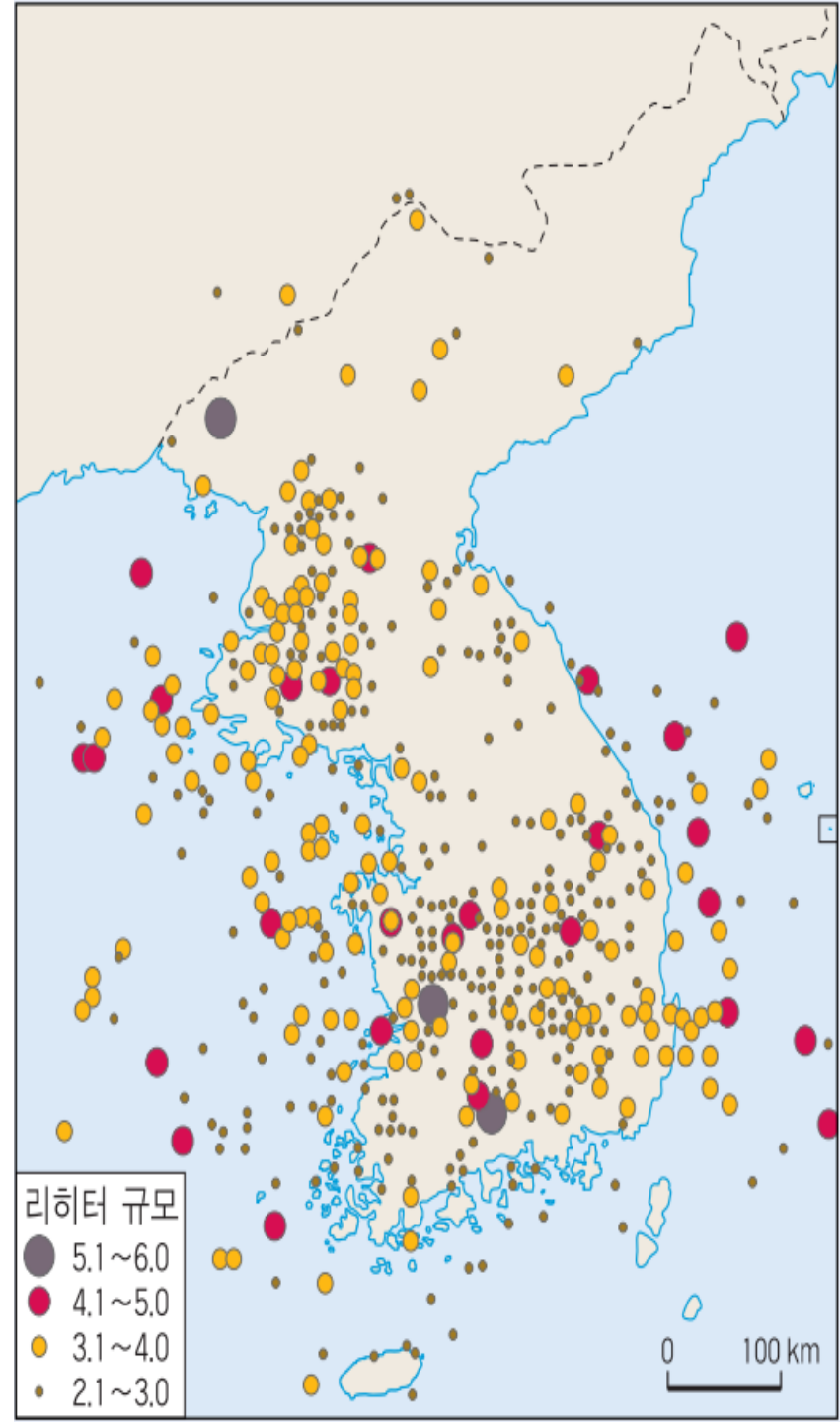
- Part of the East Asian monsoonal region
- Four distinct seasons
- Winter: long, cold, and dry (Avg. 23°F)
- Summer: short, hot, and humid (Avg. 77°F)
- Spring & Autumn: pleasant and short



## Site Analysis

### Earthquake

- The occurrence of earthquake during 30 years (1981 - 2012)
- Non-strong earthquake
- Low dangerousness of earthquakes
- Seismic forces can be considered less than other lateral forces on the site.

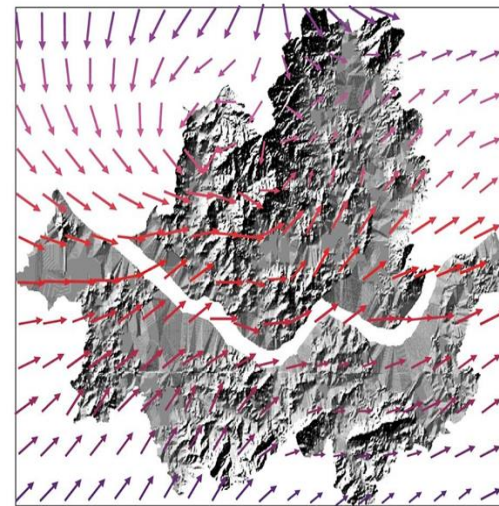


# Site Analysis

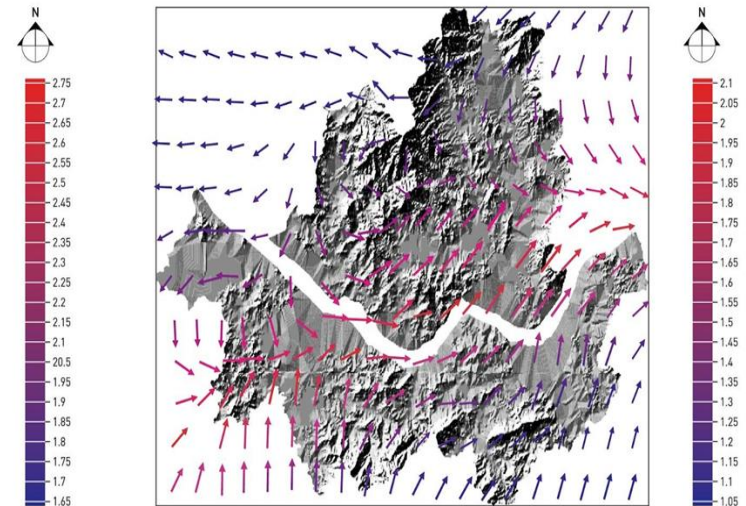
## Seasonal Wind Loads

- Wind directions
- Wind Speeds
- Dynamic Changes

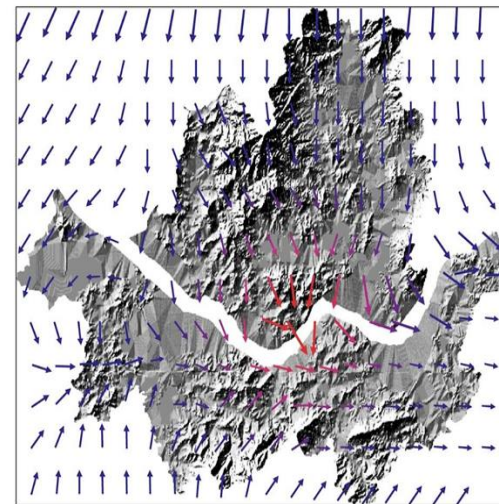
Seasonal Wind Field



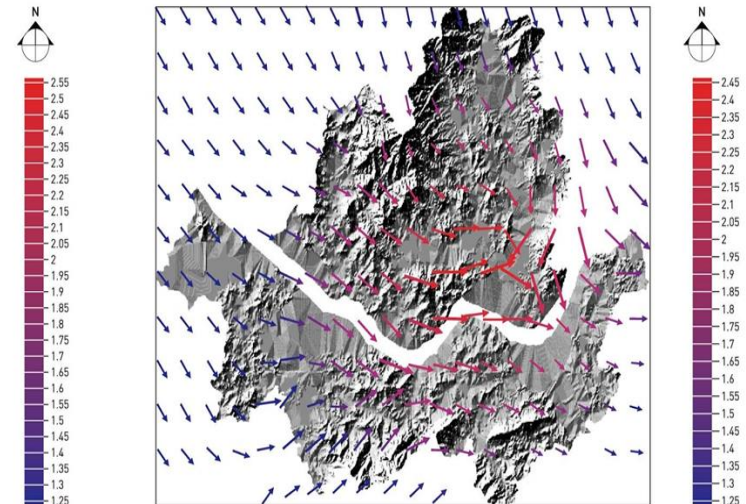
봄 | Spring



여름 | Summer



가을 | Autumn



겨울 | Winter

# Site Analysis

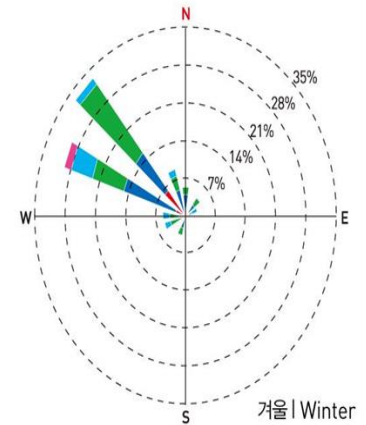
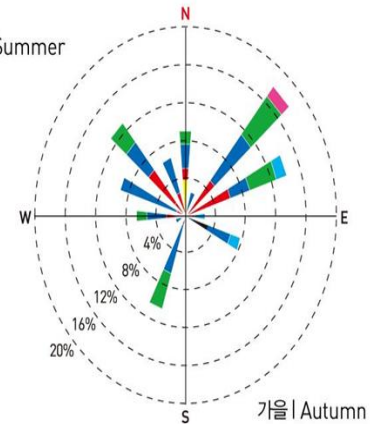
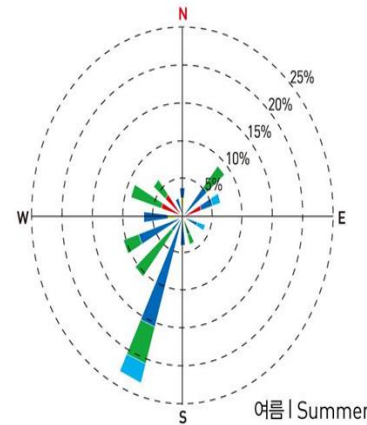
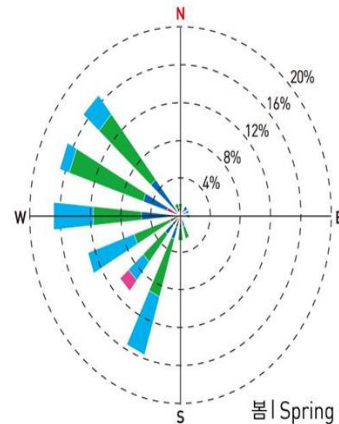
## Wind Load (Seoul)

- Seasonal Wind Analysis
- Southwester (summer)
- Strong Northwester (winter)
- Strong Northeaster (autumn)
- High consideration of lateral loading for structural design.

바람속도 (m/s)  
Wind Speed (m/s)

- >=3.0
- 2.5~3.0
- 2.0~2.5
- 1.5~2.0
- 1.0~1.5
- 0.5~1.0
- 0.0~0.5

무풍 | Calms: 0.00%

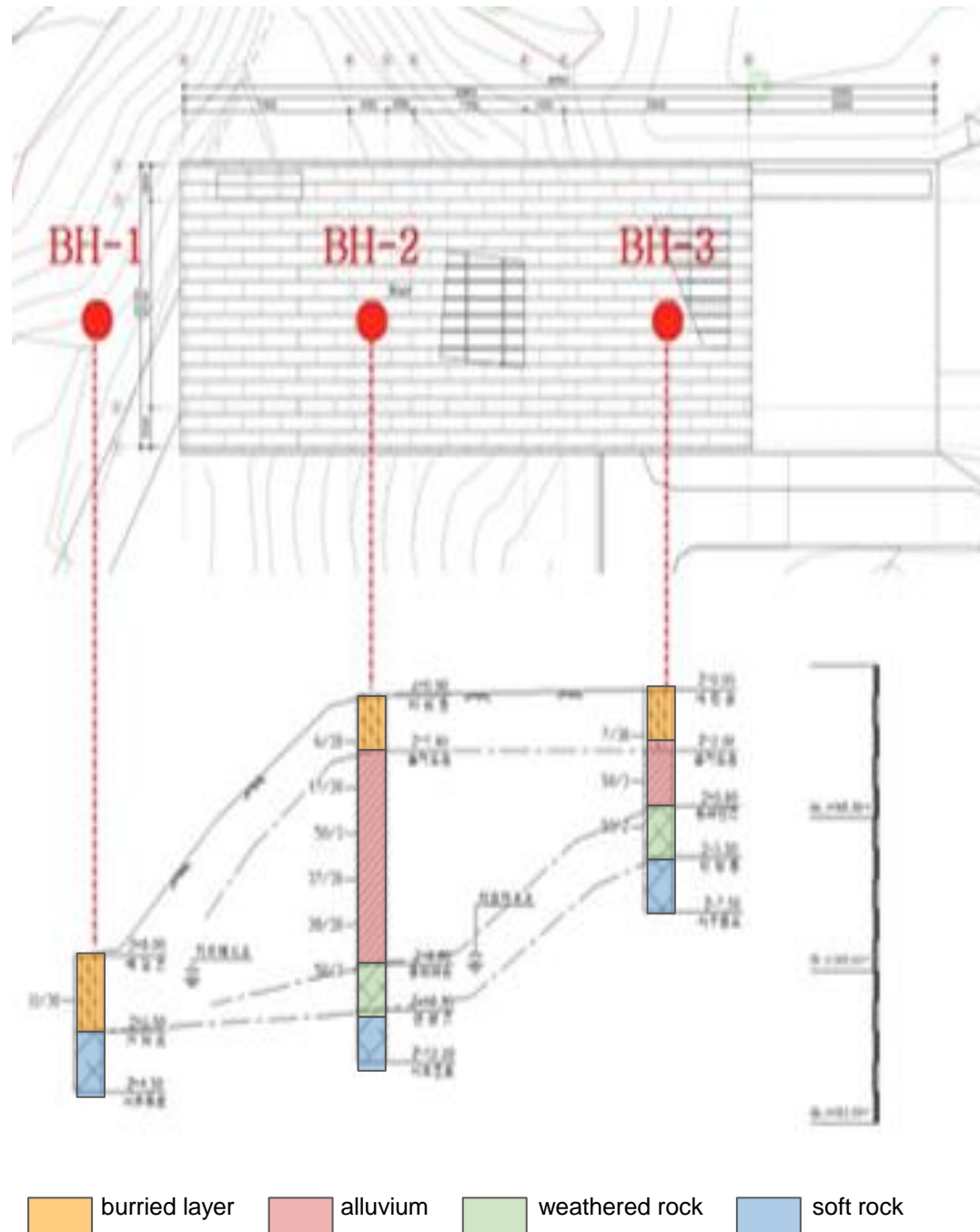


# Site Analysis

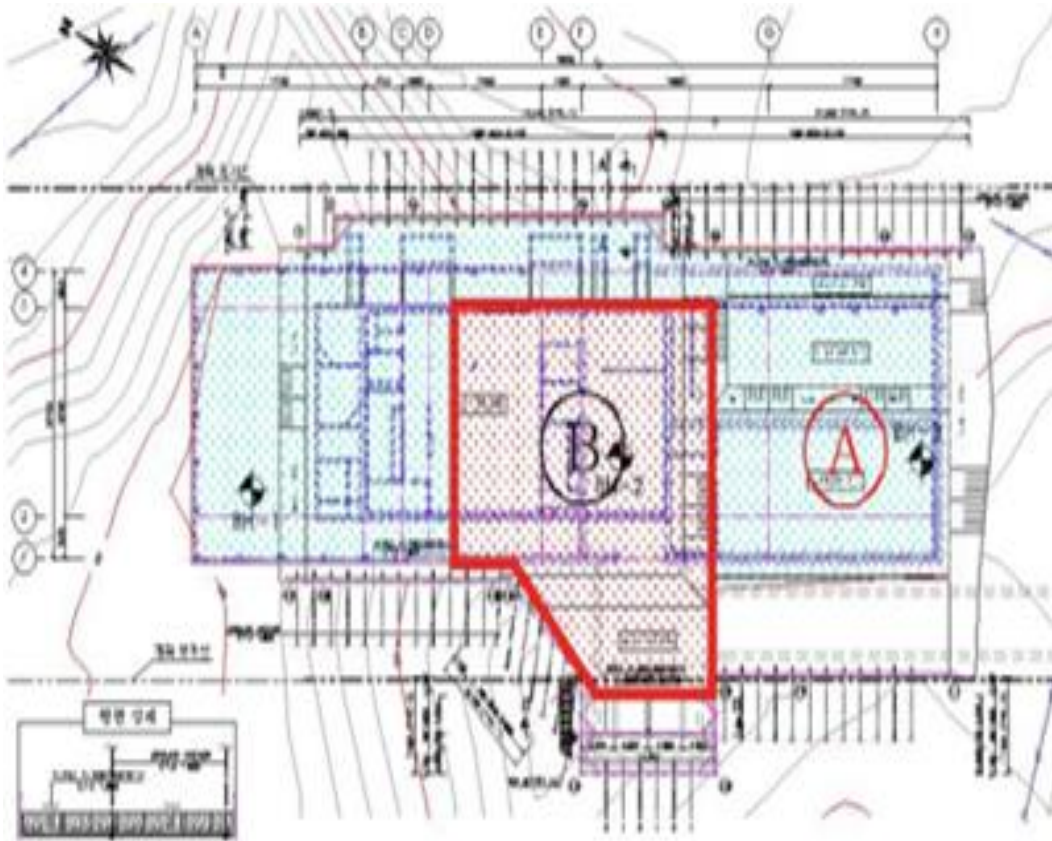
## Soil Condition

- Boring tests were required on three points (BH-1, BH-2, BH-3) of slopes to check soil condition.
- BH-3: Manager Offices, Storages Area
- BH-2: Vertical core that support cantilevers of both sides.

Types	Depth
Burried layer	0 ~ 1.8m
Alluvium	1.8 ~ 8.8m
Weathered rock	8.8 ~ 10.3m
Soft rock	10.3 ~ 12m



# Earthworks



## PART 'A'



- Back filling after placing B1 floor slab concrete

## PART 'B'



- Back filling, soil stabilization
- and then, placing mat foundation

# Earthworks Process



Excavation



Driving H-pile



Installing wood lagging 1



Installing wood lagging 2



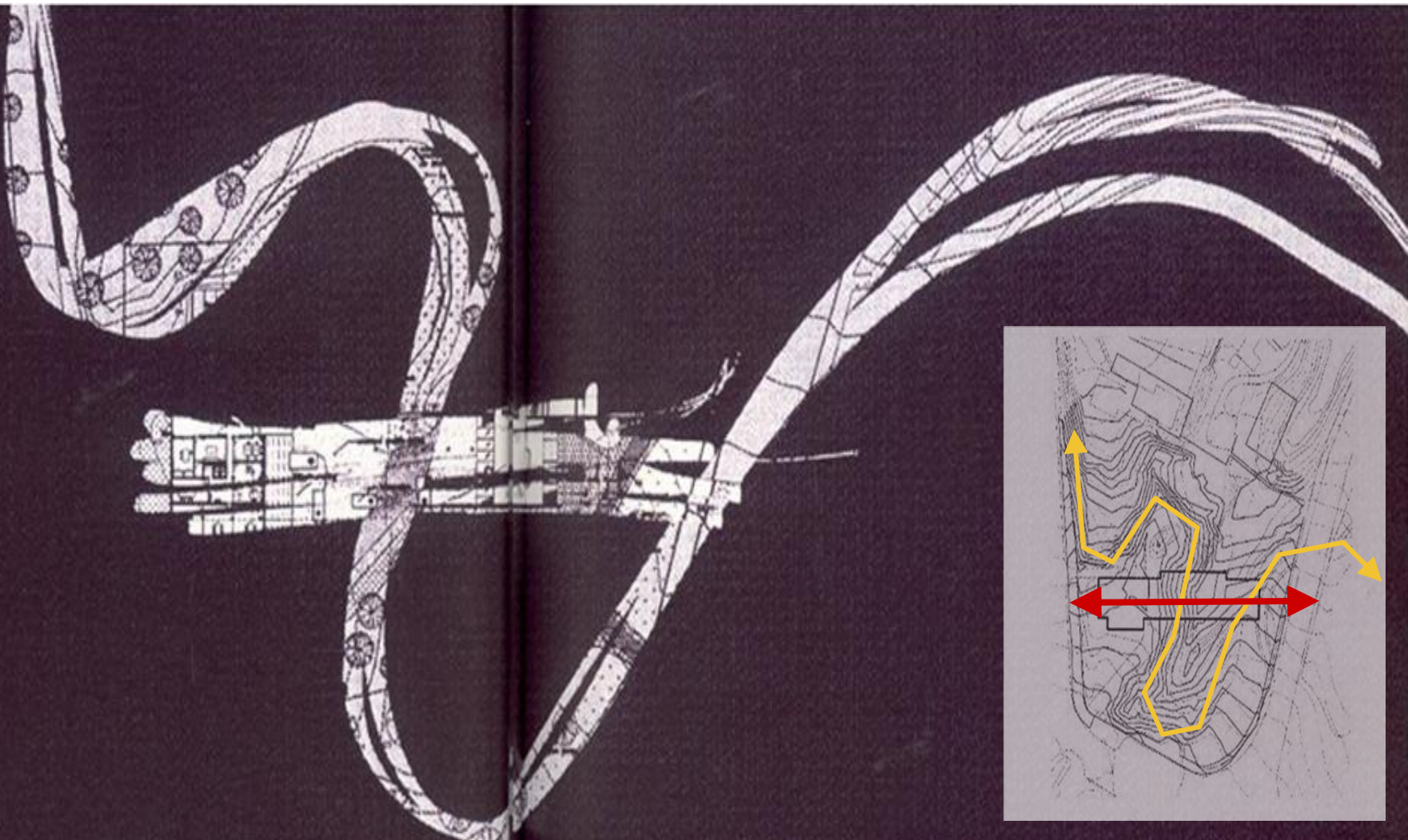
Driving pipes for drainage



Earth-anchor system

## Design Concept

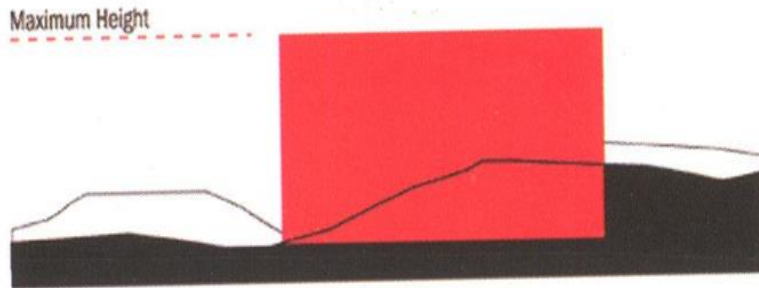
The design concept of the Seoul National University Museum is to connect the university with the local community.



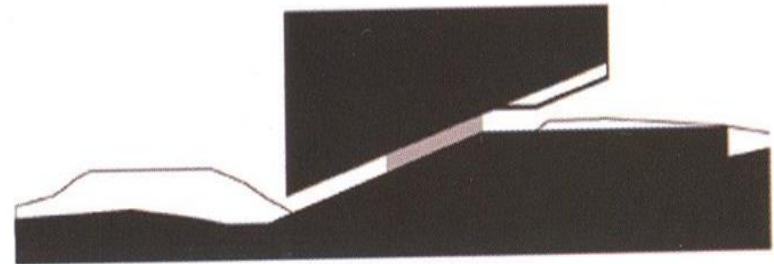
# Design Concept

## Design Process

**Program Mass**



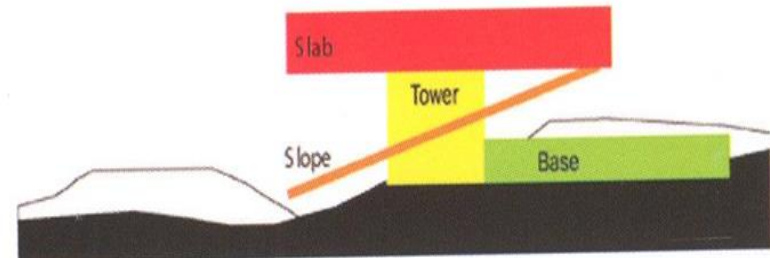
**Monolith**



**Slice**



**Parts**

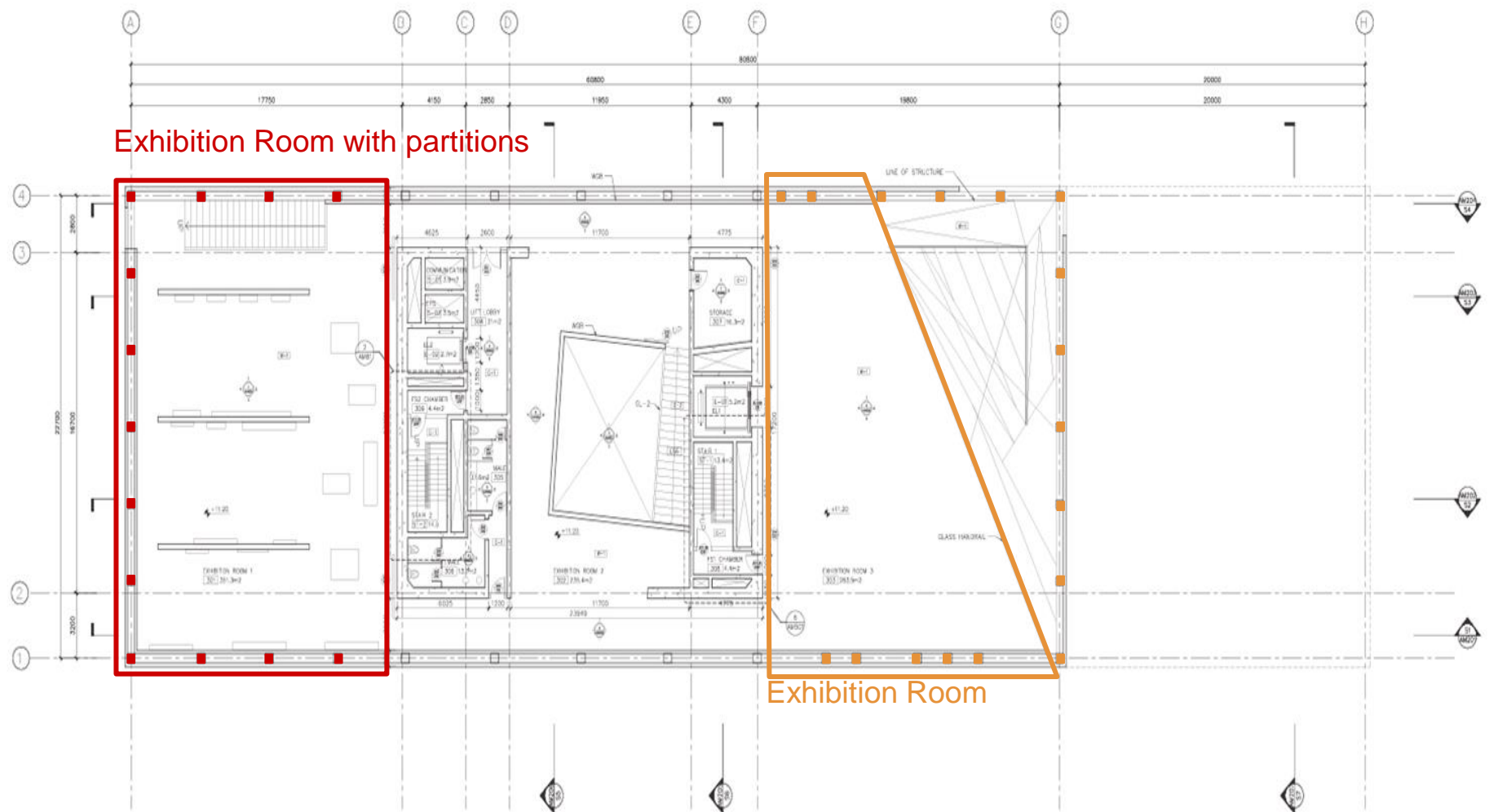


# Building Layout

MOA's program



Third Floor Plan



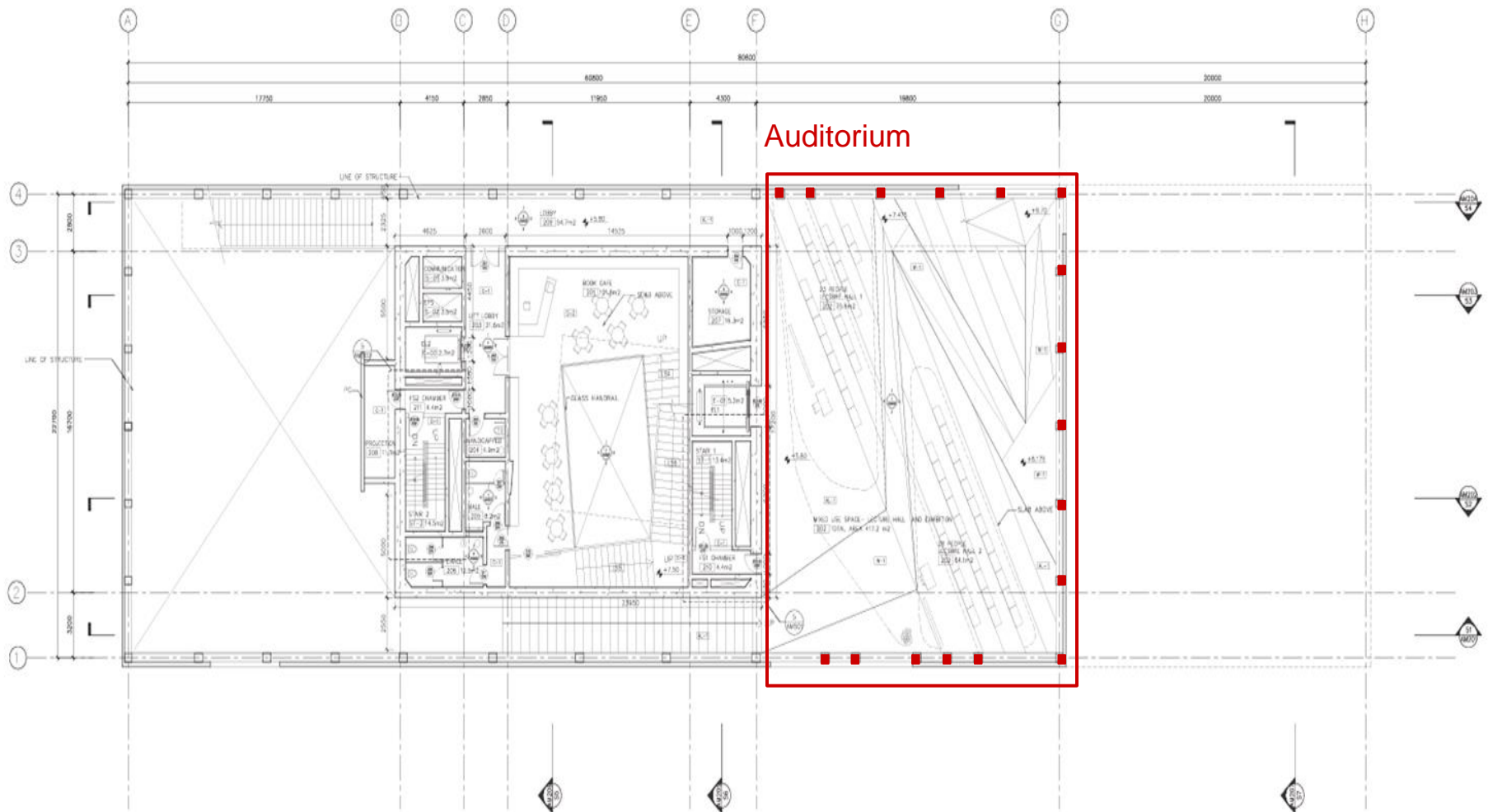
Exhibition Room with partitions

Exhibition Room



No walls and no columns inside. It allows to provide diverse exhibition spaces and display plans by using partitions.

## Second Floor Plan



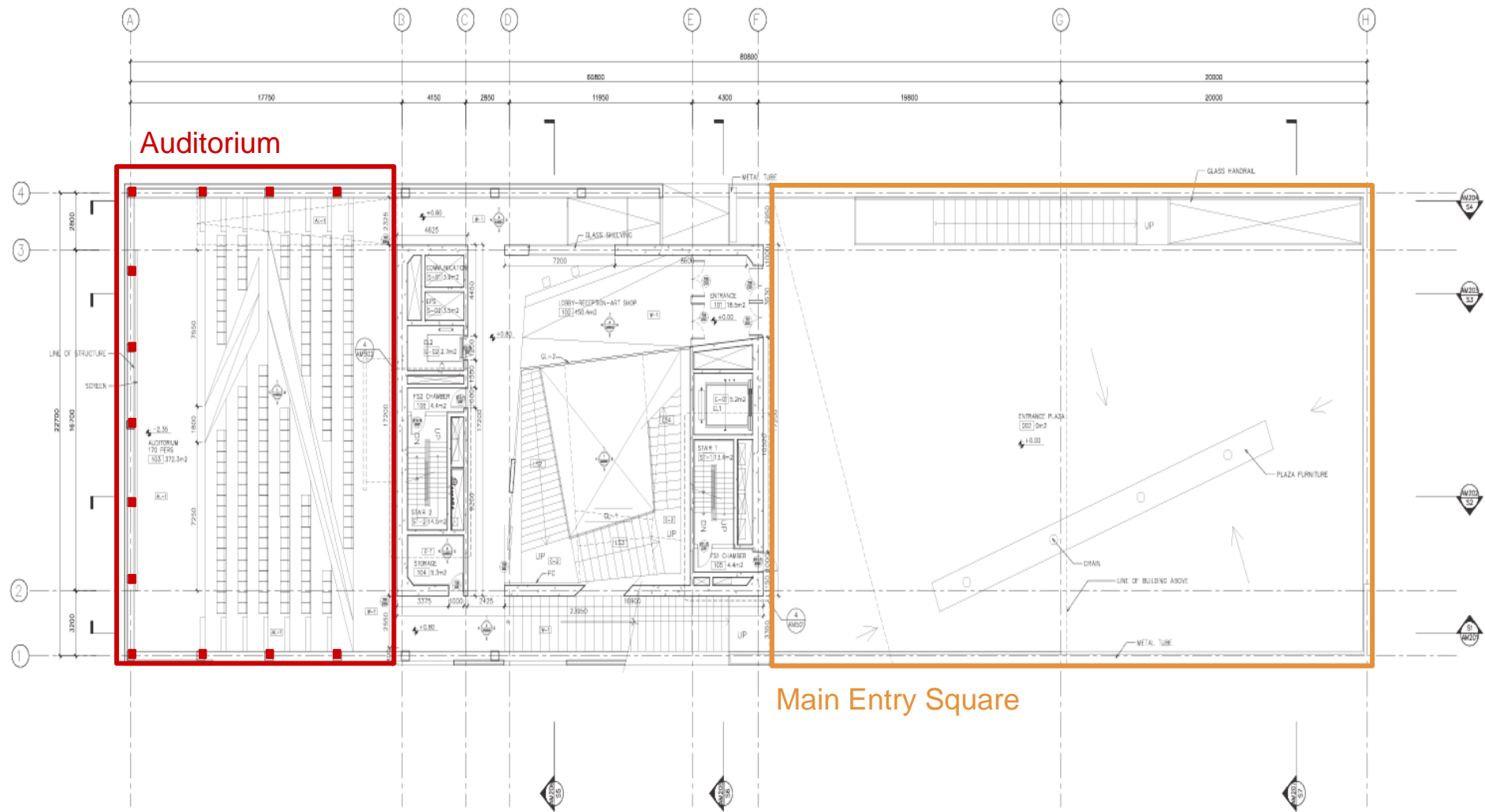


Auditorium



The special structures provide long span space for the auditorium. Thus, audiences can enjoy lectures or performances without interruptions of structures.

Ground Floor Plan



Auditorium

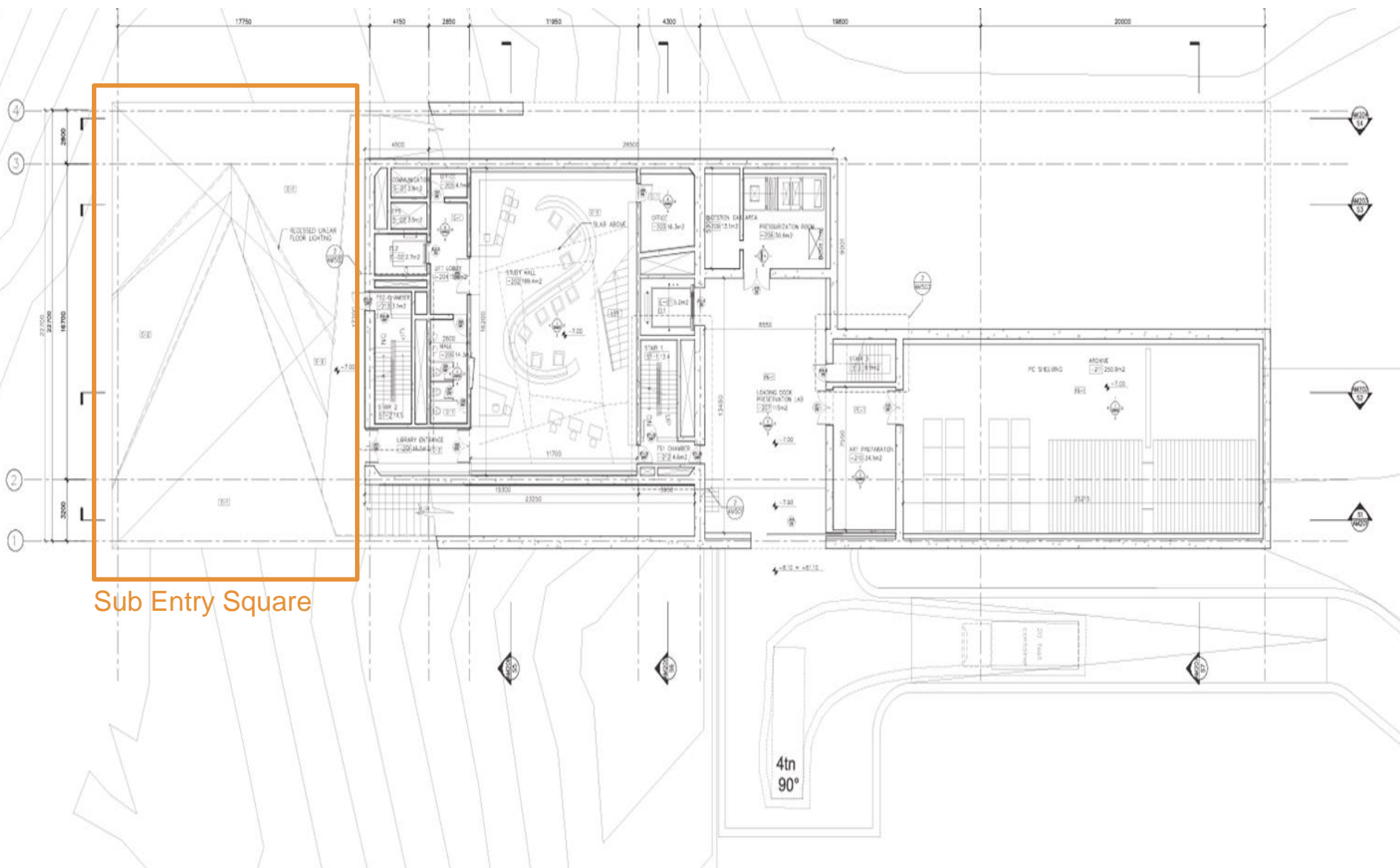


## Main Entry Square

The mass restructured in this way is floating in the air, supported by its concrete core and cantilevered steel frame. It has the special building's feature and provides the spectacular entry square.



## Basement Level







This architectural section drawing illustrates a building's internal structure and room layout. A red rectangular box highlights a central vertical core and structural wall, which serves as a key structural element. The drawing includes various rooms such as Exhibition Room 2, Research Room, Reception Room, and a Staircase. It also shows a large staircase on the right side. The drawing is annotated with dimensions, room names, and structural details. A red label at the bottom identifies the highlighted area as the 'Vertical Core & Structural Wall'.

## Vertical Core & Structural Wall



**Vertical Core (stairs)**  
**Core Structural Wall**

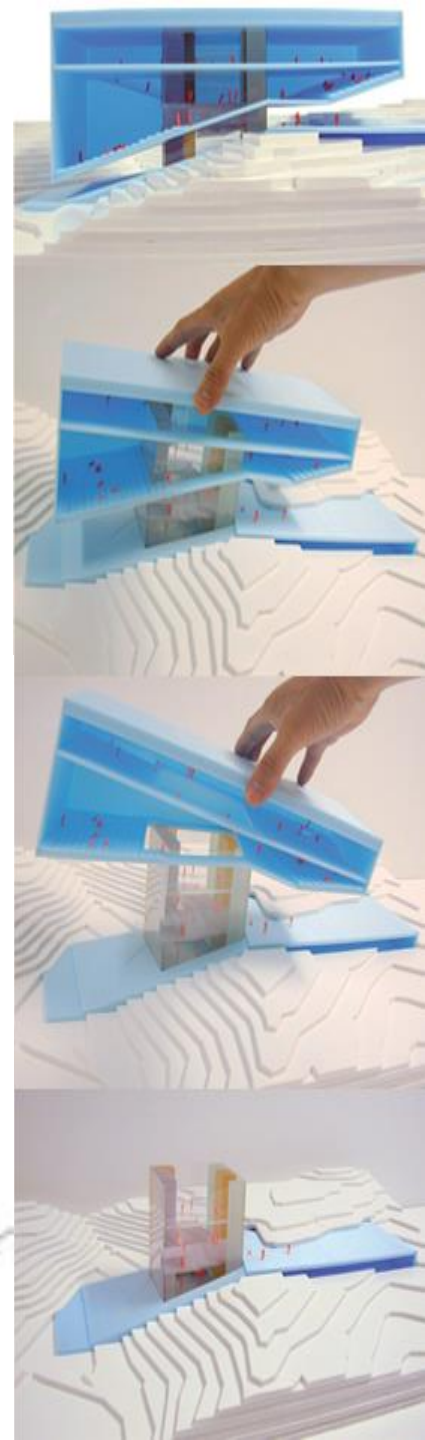
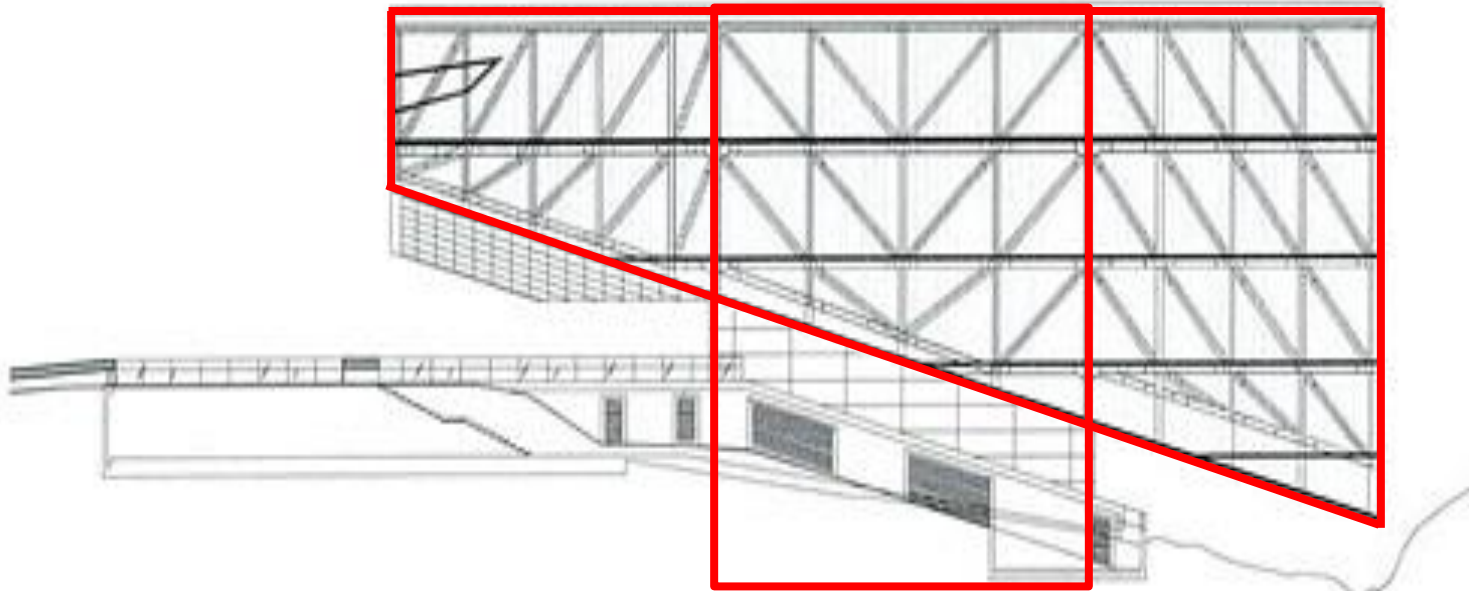


## **PART 2 STRUCTURE FEATURES**

- Structure Component
- Structure Principle
- Structure Progress

# Structure Component

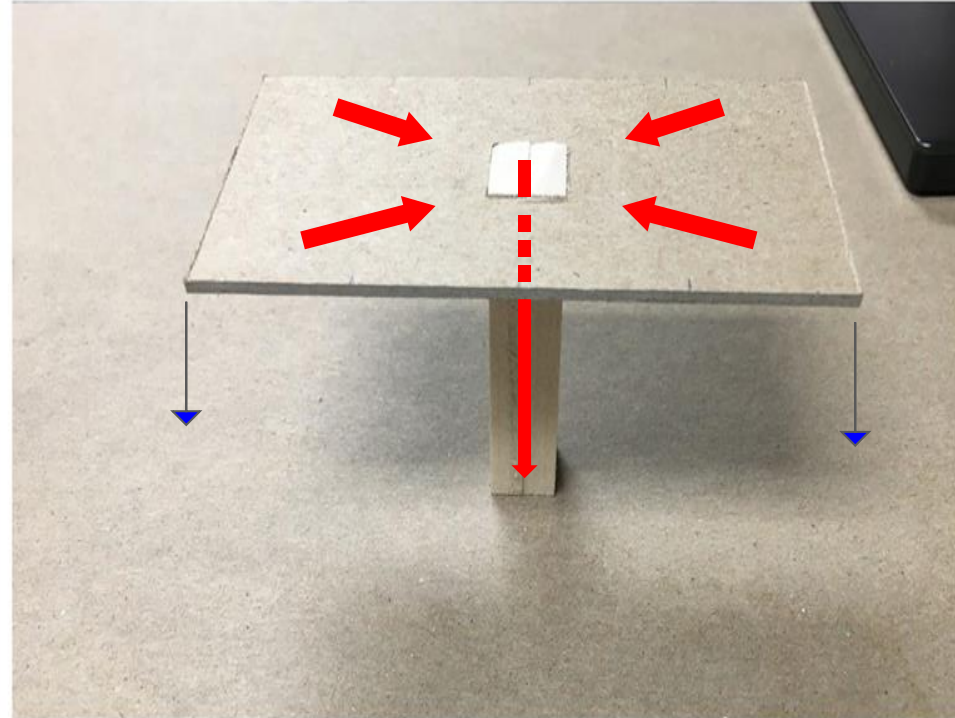
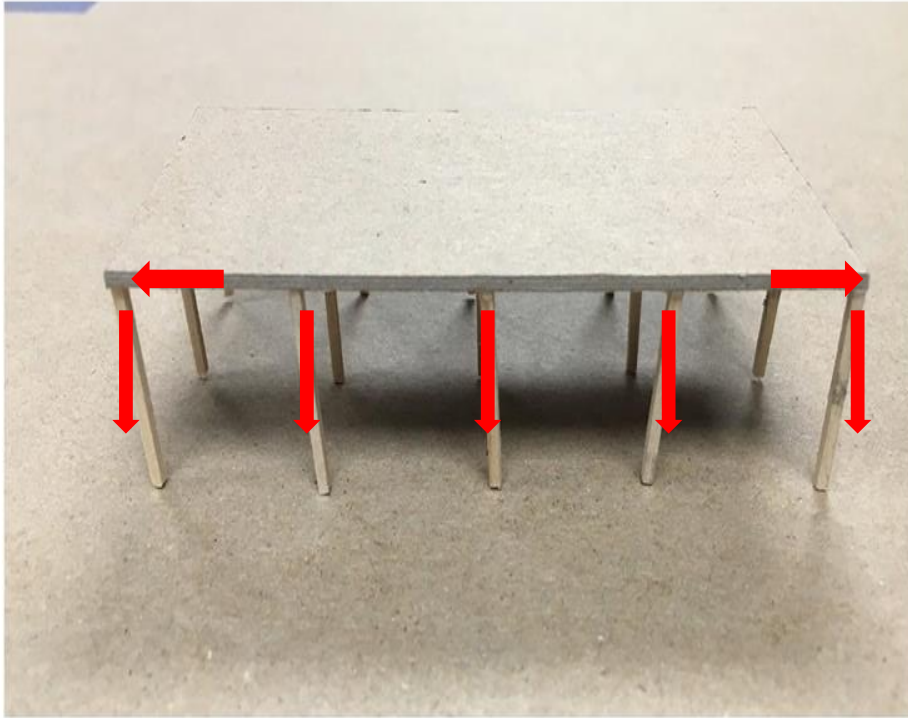
- Steel Frame Trusses
- Reinforced Concrete



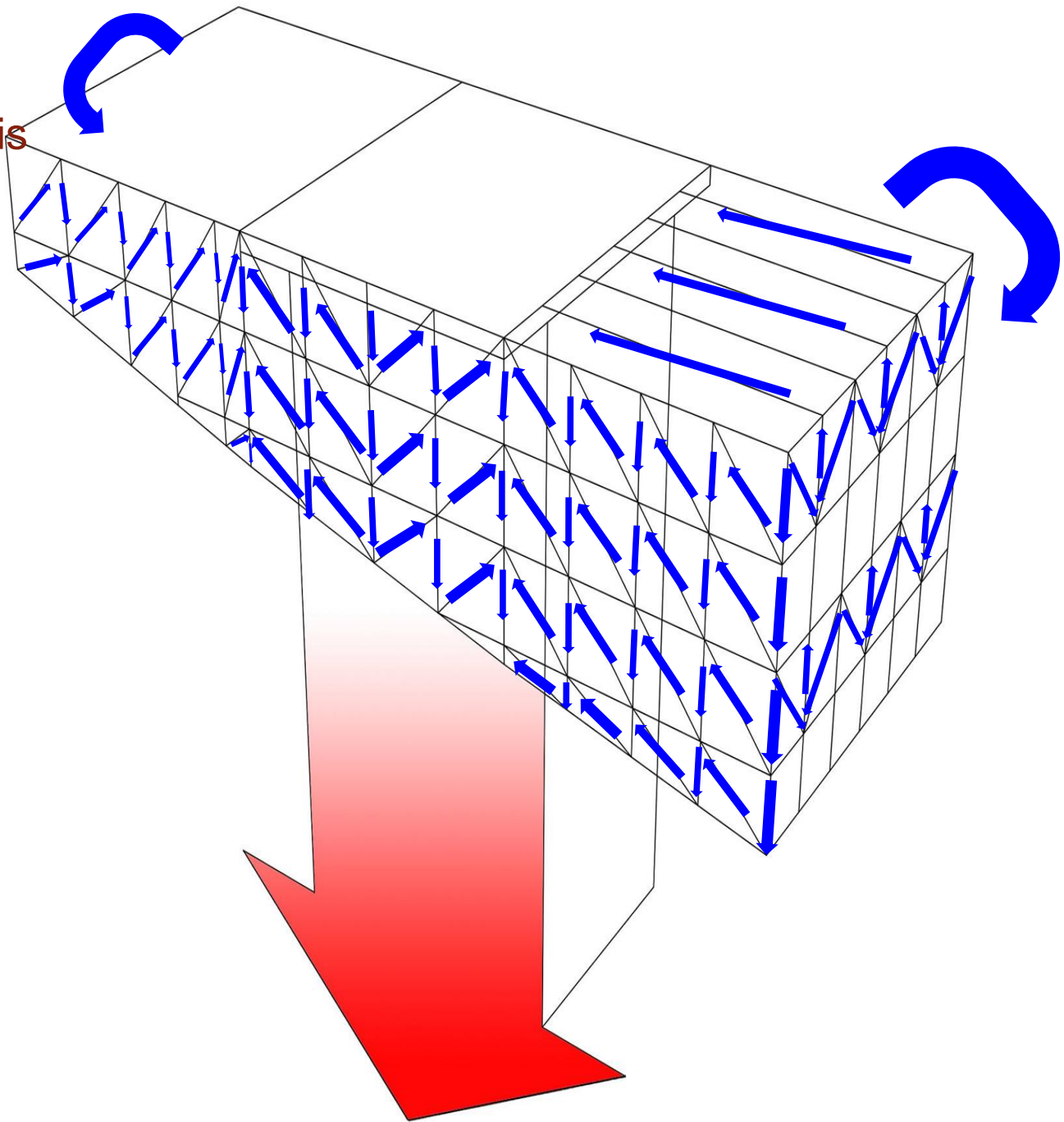
## Structure Principle



## Structure Principle

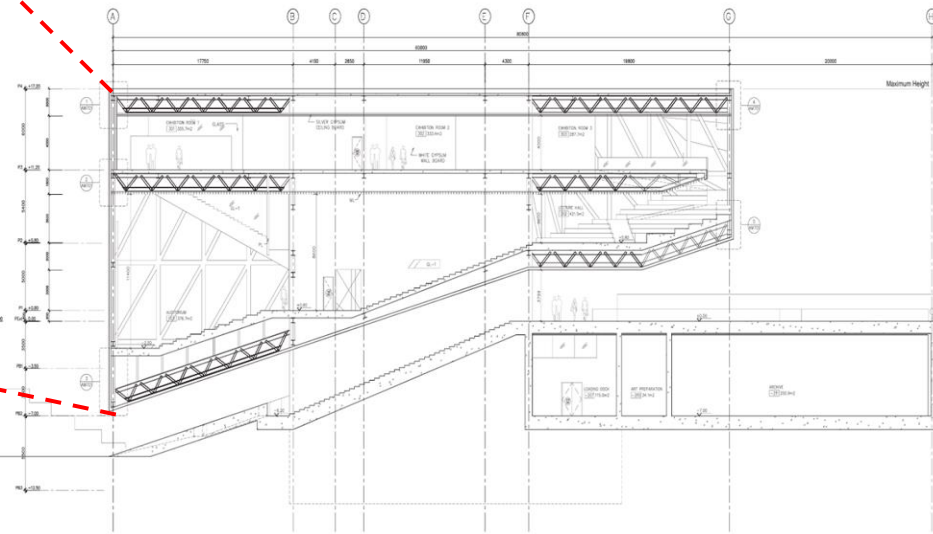
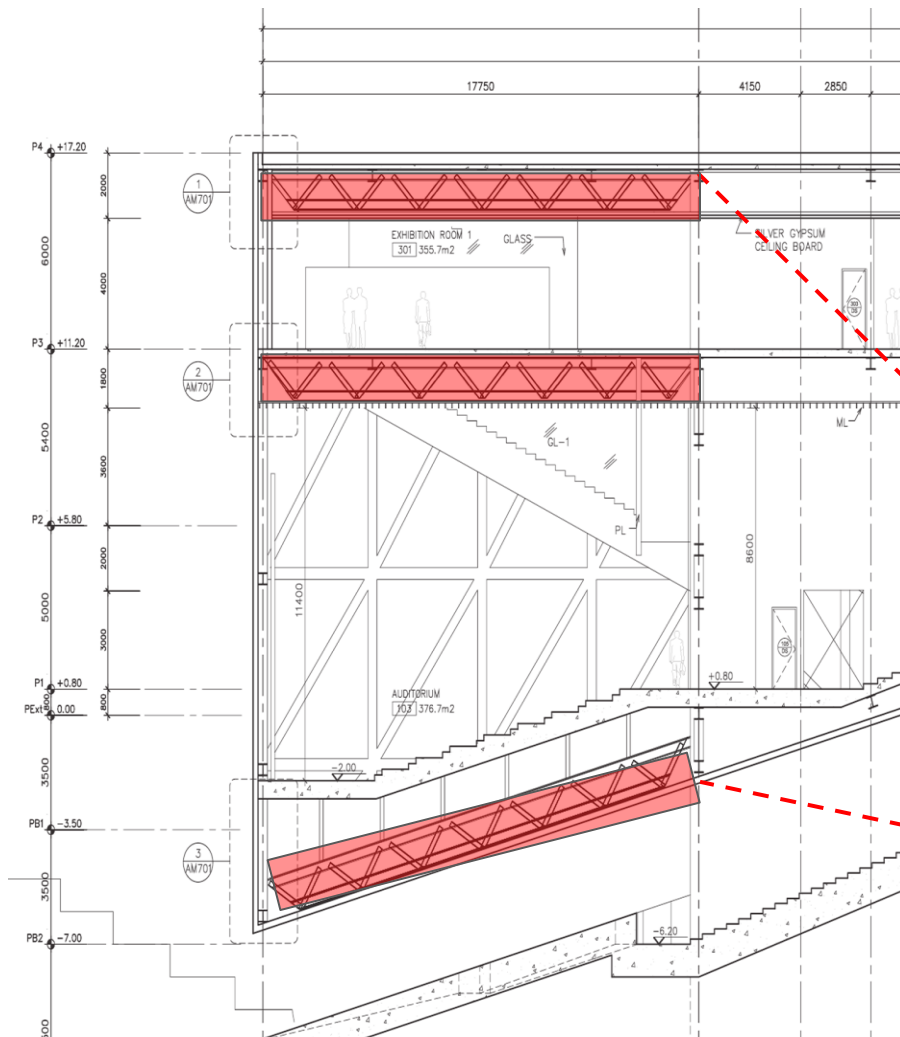


Load Analysis



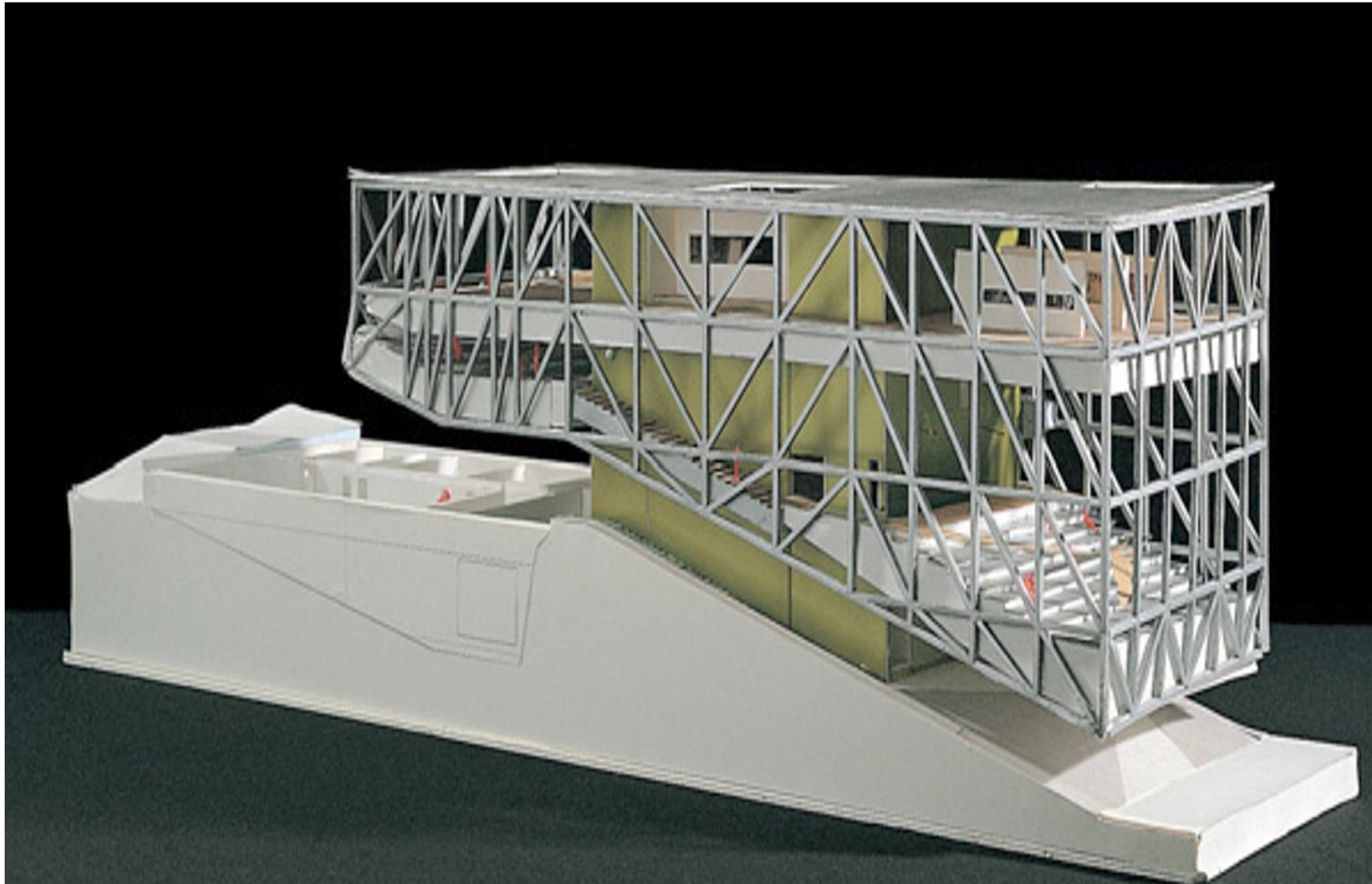
# Truss Slaves

- Replace Simple Truss with Plate Girder
- Improving workability
- Plate Girder makes simple progress as well as reduce welding in construction area



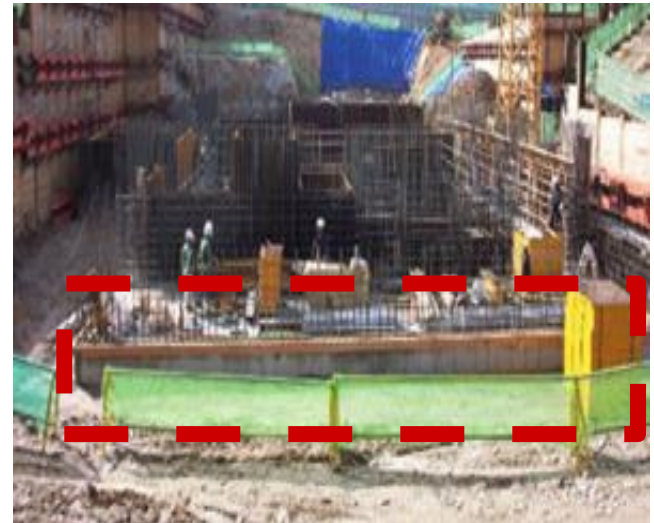
Sección longitudinal S1 / Longitudinal section S1

## Structure Component



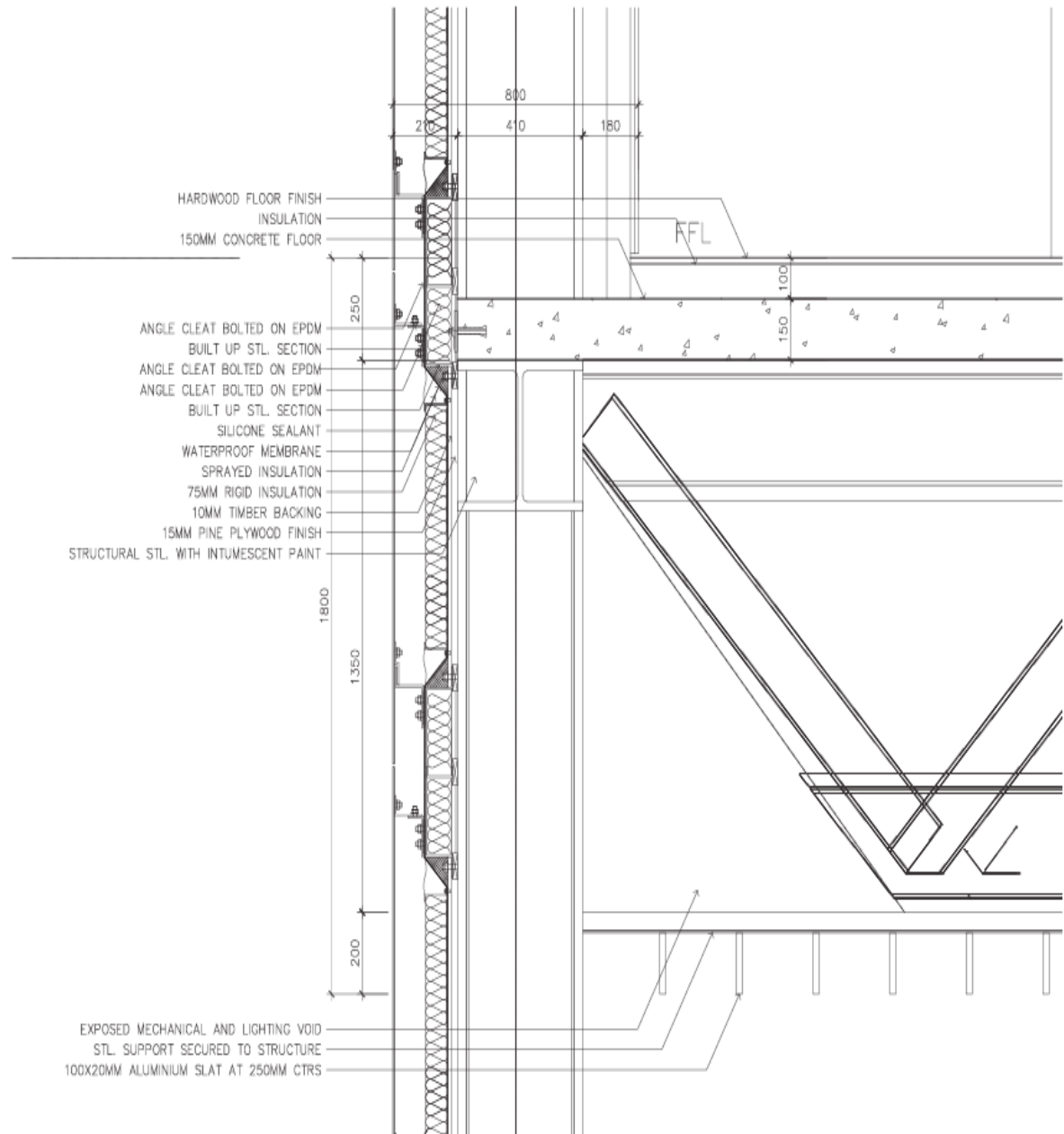
## Foundation Type - Mat Foundation

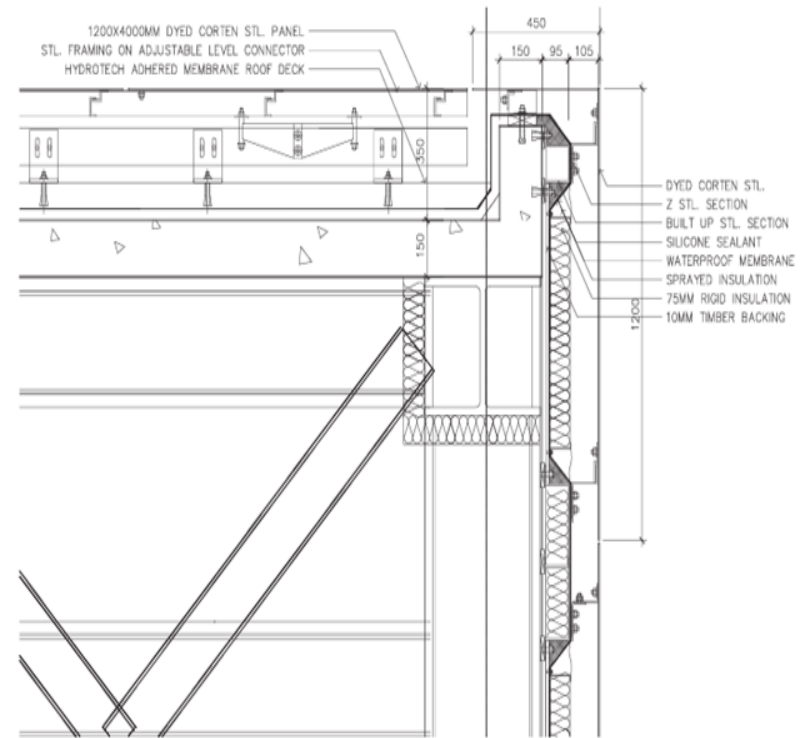
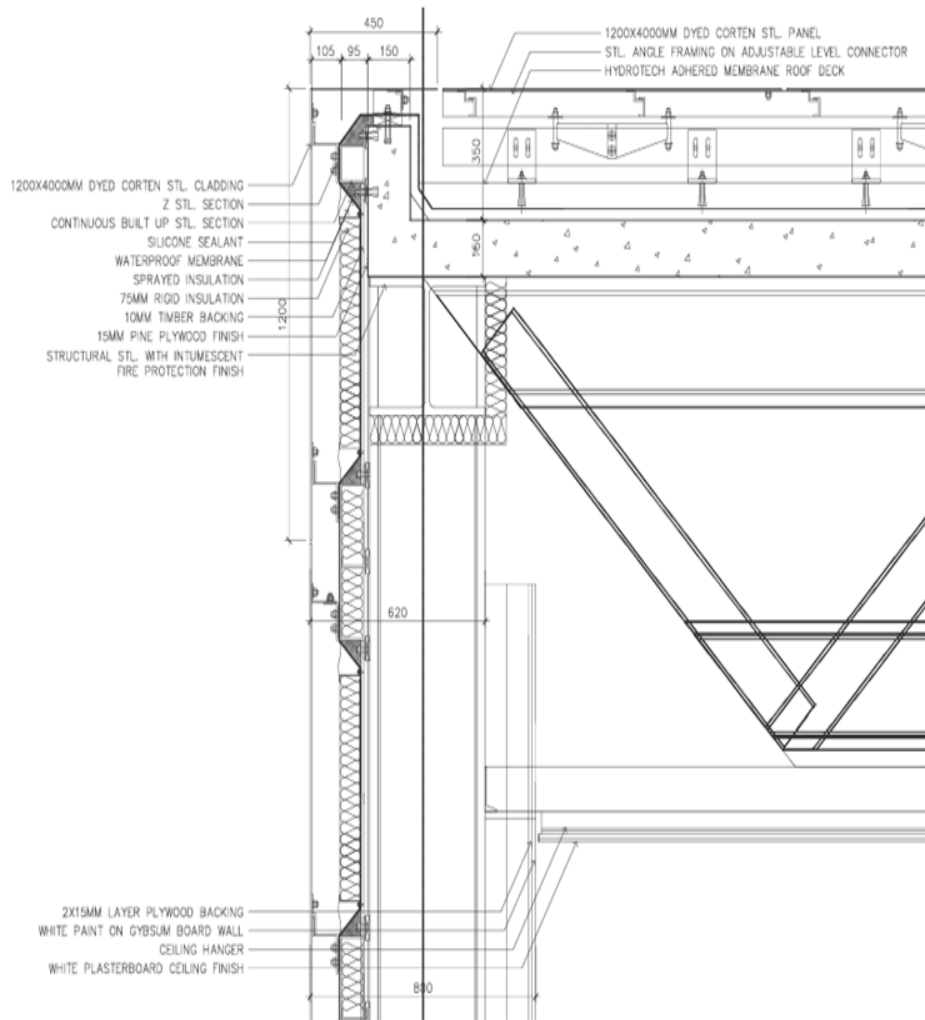
- Shallow foundation.
- Mat foundations are used **to distribute heavy column and wall loads** across the entire building area, to lower the contact pressure compared to conventional spread footings.
- It can be constructed near **the ground surface, or at the bottom of basements**.
- In high-rise buildings, mat foundations can be several meters thick, with extensive reinforcing to ensure relatively uniform load transfer.



# Structure Component

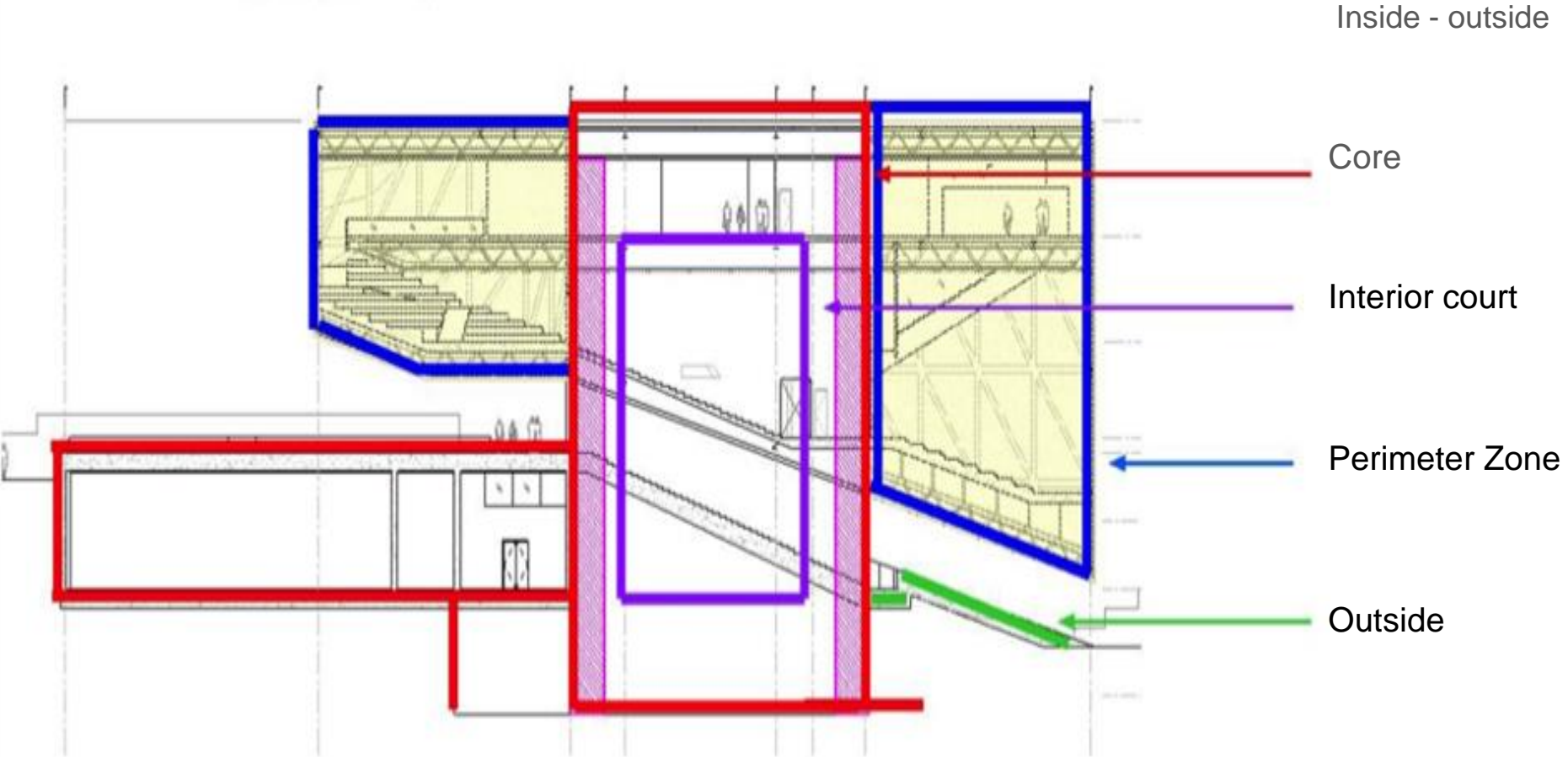
- Steel Frame Trusses
- Reinforced Concrete





# Structure Progress

Architectural drawing showing the structure progress of a building, illustrating the relationship between the interior and exterior spaces.



# Structure Progress



Interior court



Core



Perimeter Zone



Outside

# Structure Progress

## Bent Jack-Down Construction Procedure

- Installation members
- Jack up (A: +25mm /G: 40mm)
- Measure dimension after jack down
- Concrete Placement
- Measure dimension
- Remove supports

Structure Inspection



Pieces Conveyance



Level up



Measure dimension



# Structure Progress



Support



Floor Girder



Transfer Girder



Cantilever Truss



Floor Girder



Transfer Girder



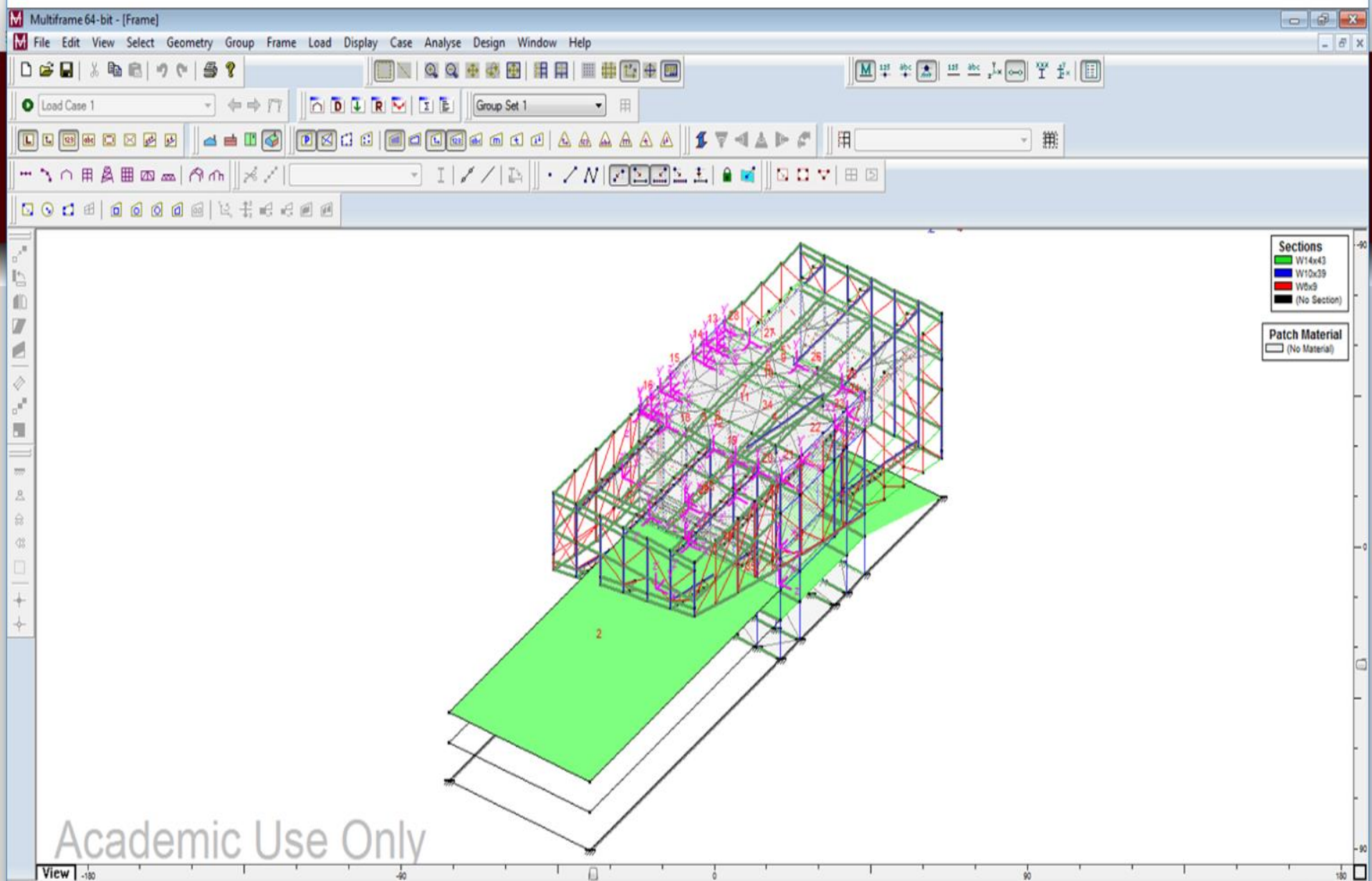
Welding



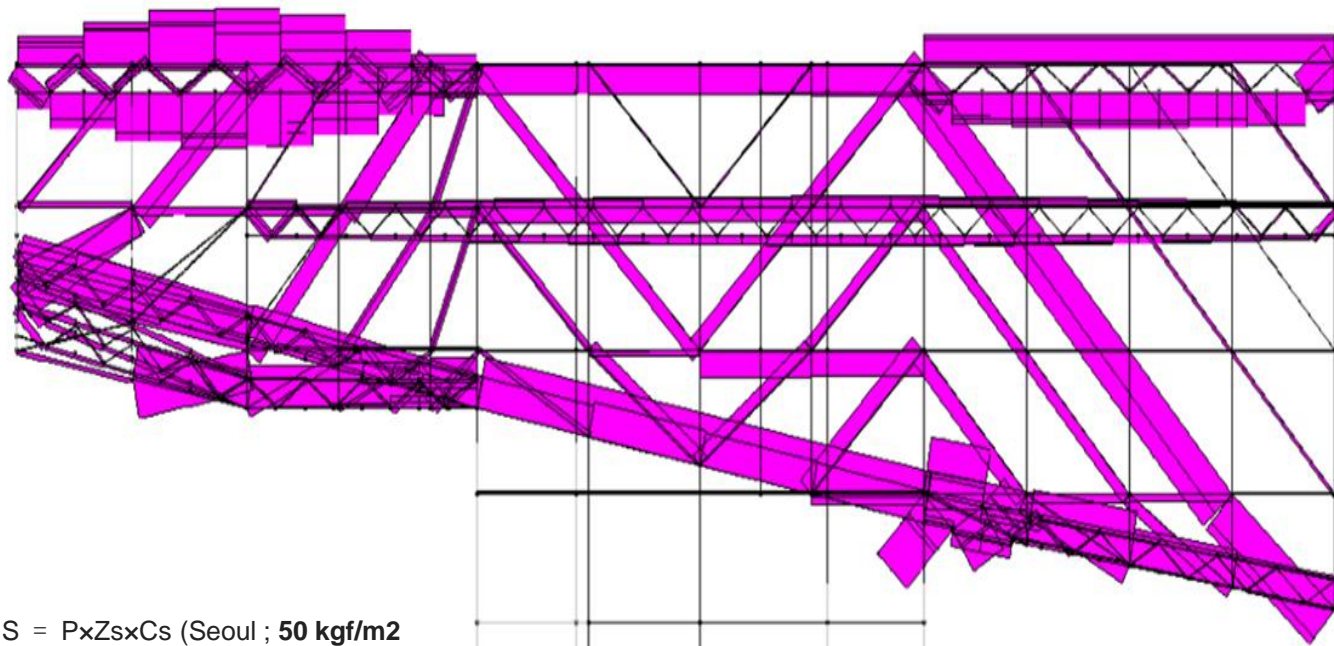
Completion

## **PART 3 LOADING ANALYSIS**

- Gravity Loads
- Lateral Loads
- Multi-frame Analysis



## Multi-frame Analysis: Gravity Loads



Snow Load :  $S = P \times Z_s \times C_s$  (Seoul ; **50 kgf/m<sup>2</sup>**)

Live Load : Office, Public space : **500kgf/m<sup>2</sup>**

Dead Load : CON+STEEL Slab = 1cm thick >> 80kg/m<sup>2</sup>

25cm >> 2500kg/m<sup>2</sup>

$60.6 \times 23 = 1393.8 \text{ m}^2$

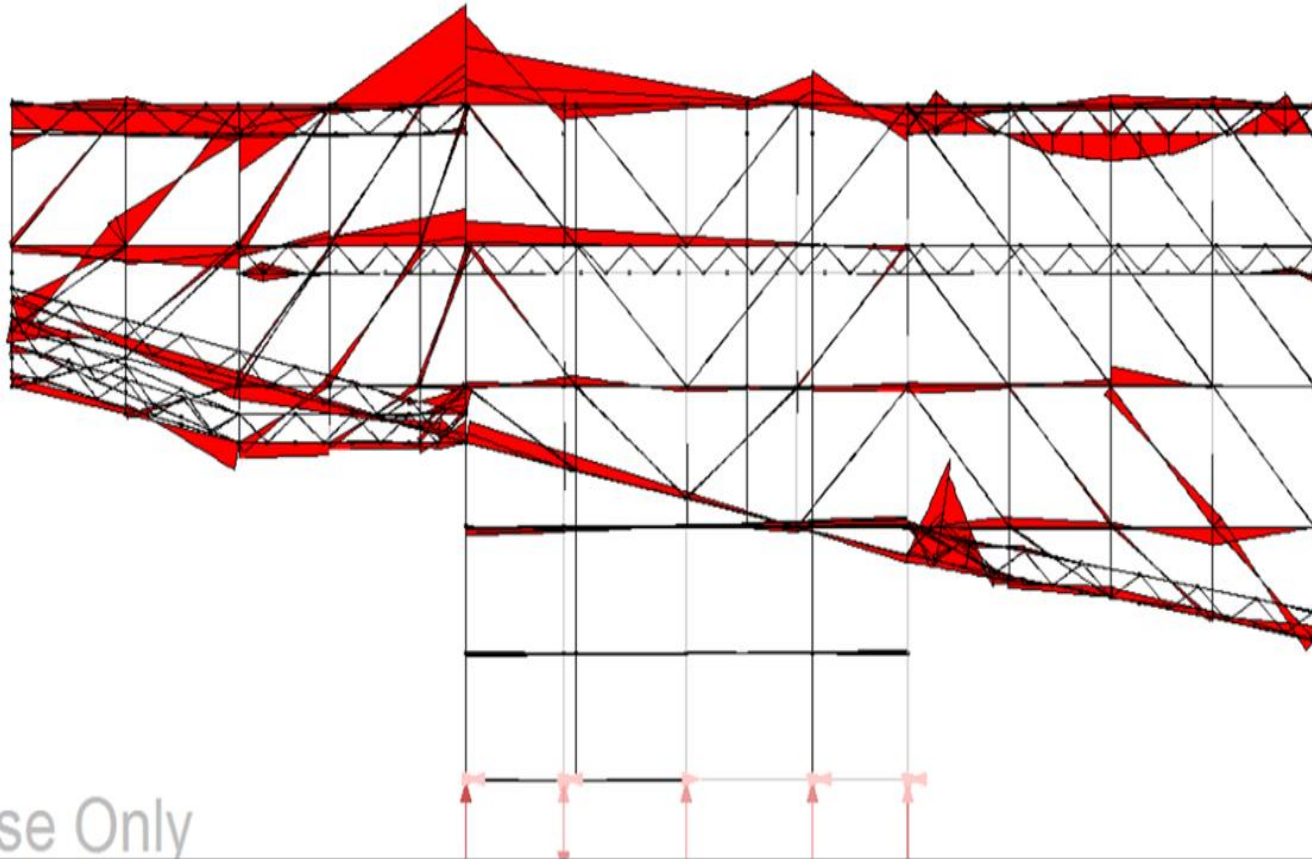
$1393.8 \times 2500 = 3,484,500 \text{ kg} = 3,484.5 \text{ ton}$

2story + rooftop = **10,453 ton**

View  
ready

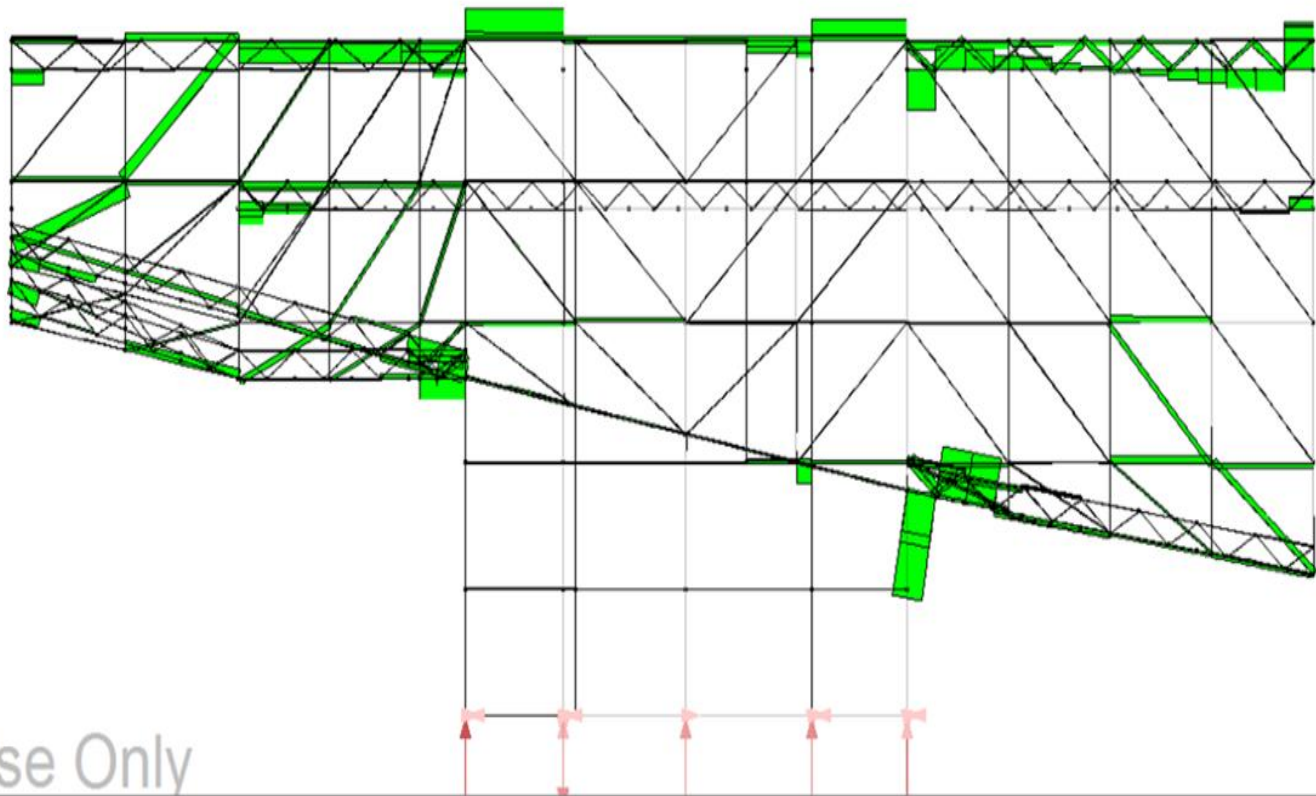
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# Multi-frame Analysis: Gravity Loads



Academic Use Only

## Multi-frame Analysis: Gravity Loads



Academic Use Only

View Static Case: Load Case 1 Vy (tonne)

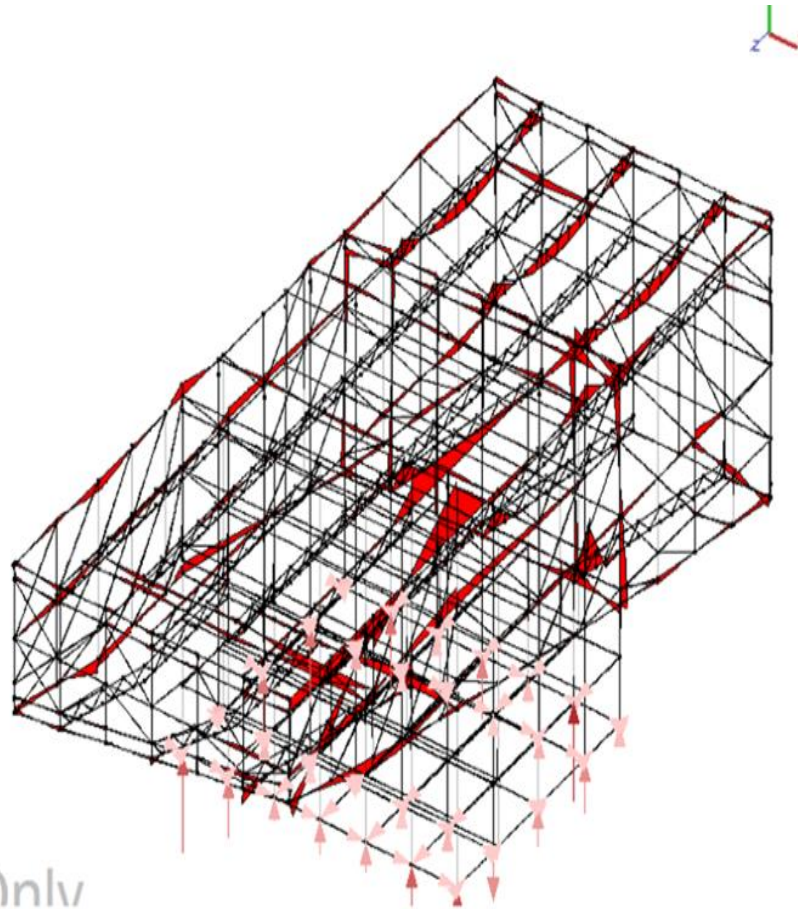
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12:31 PM  
11/29/2015

# Multi-frame Analysis: Gravity Loads



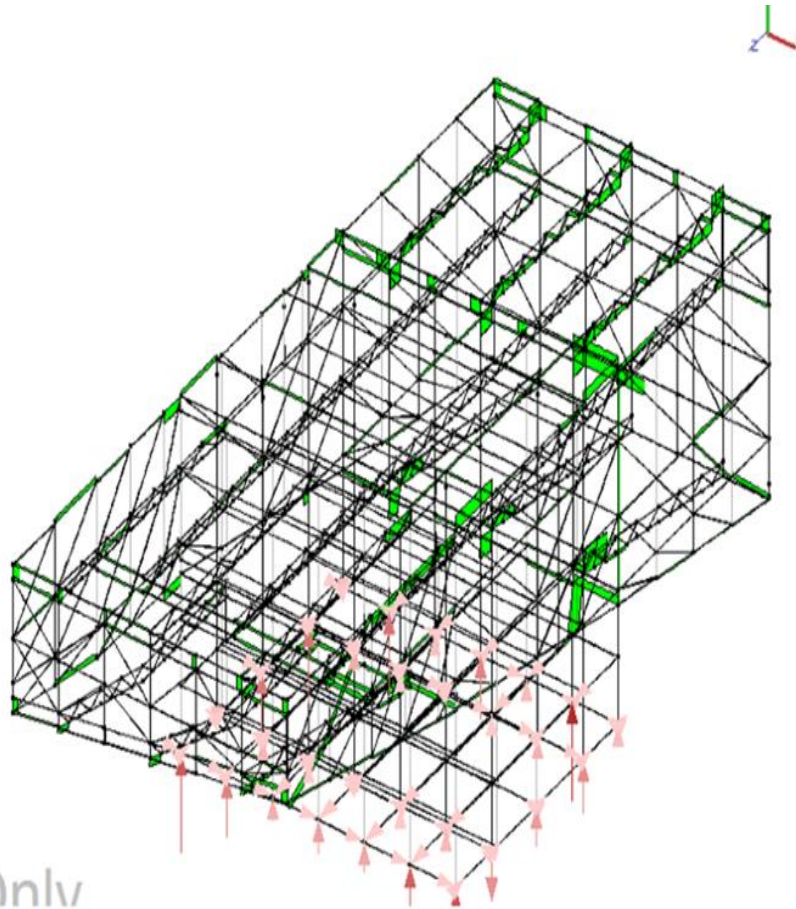
Academic Use Only

Static Case: Load Case 1 Mz' (t-m)

View | -180 -90 0 90 180

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# Multi-frame Analysis: Gravity Loads



Academic Use Only

Static Case: Load Case 1 Vy (tonne)

View | -180 -90 0 90 180

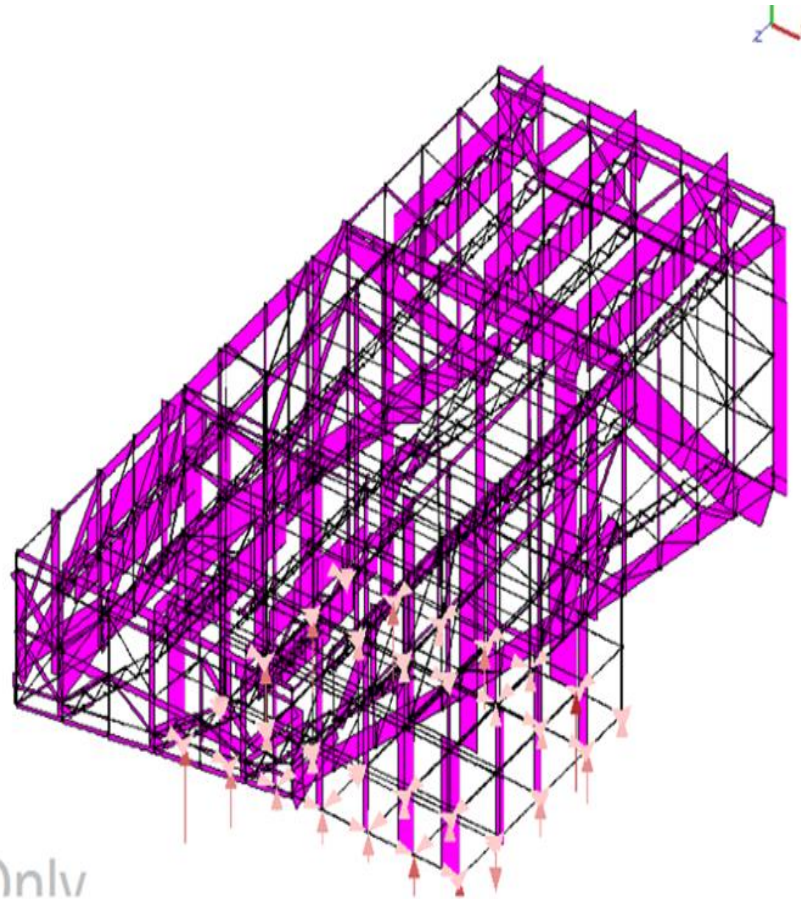
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# Multi-frame Analysis: Gravity Loads



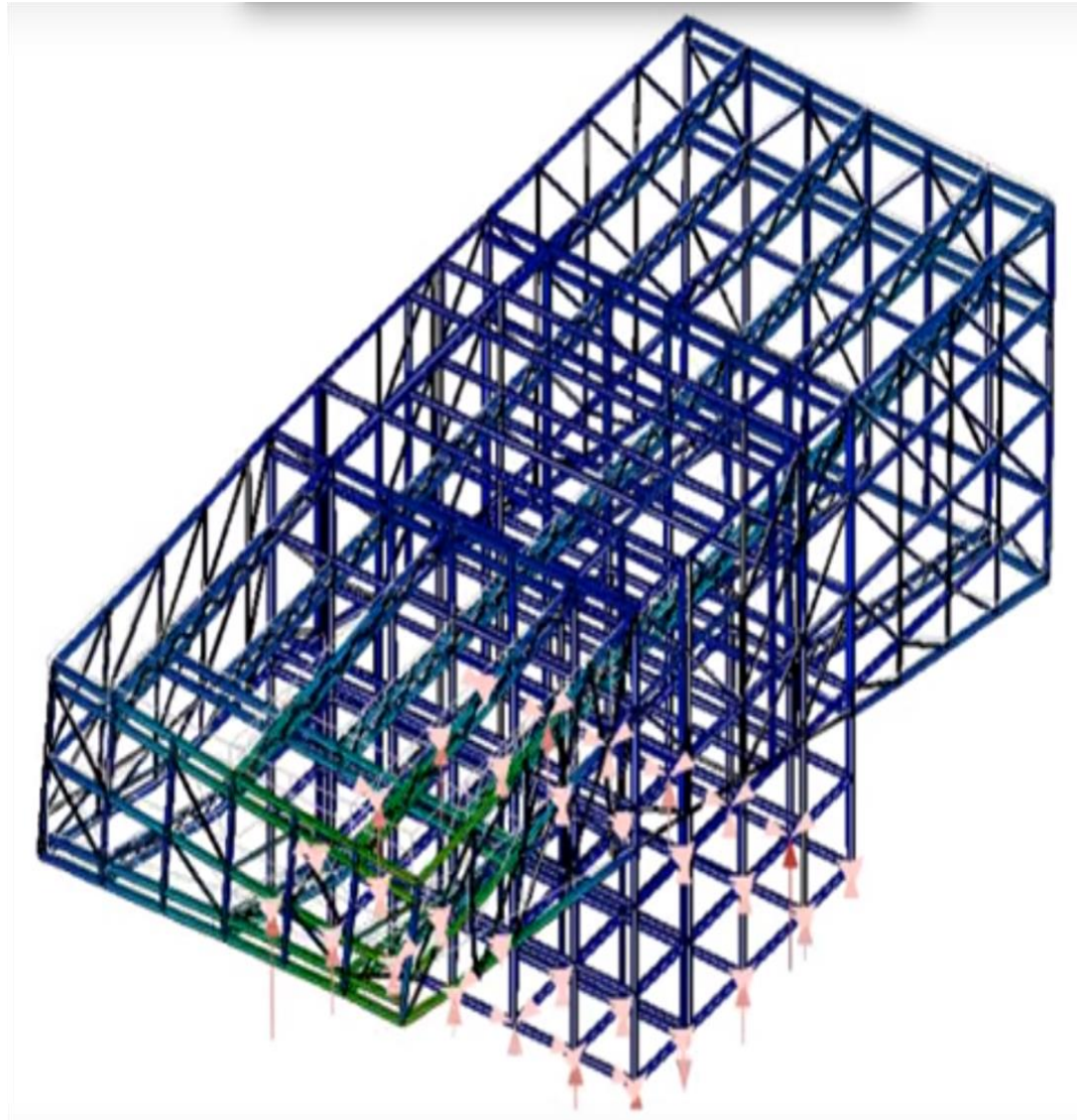
Academic Use Only

Static Case: Load Case 1 Px' (tonne)

View | -180 -90 0 90 180

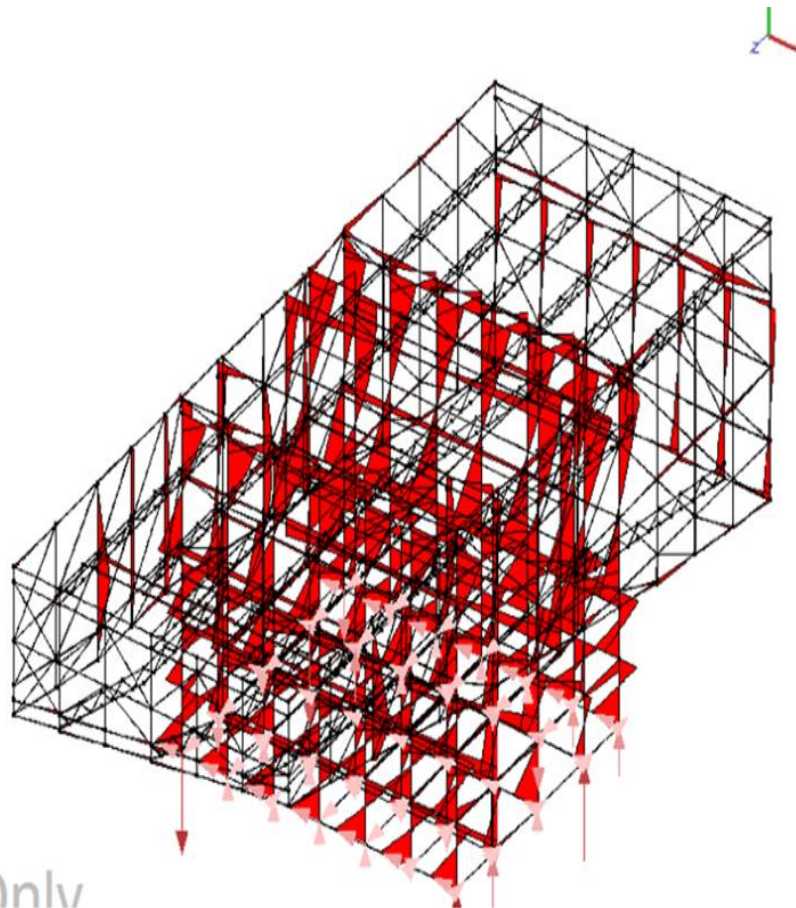
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## Multi-frame Analysis: Gravity Loads



## Multi-frame Analysis: Lateral Loads (Wind)

Wind Load :  
Average : 2.5m/s  
Maximum : Hurricane 'Maemi' = 60m/s



Academic Use Only

Static Case: Wind 1 Mz' (l-m)

View -180

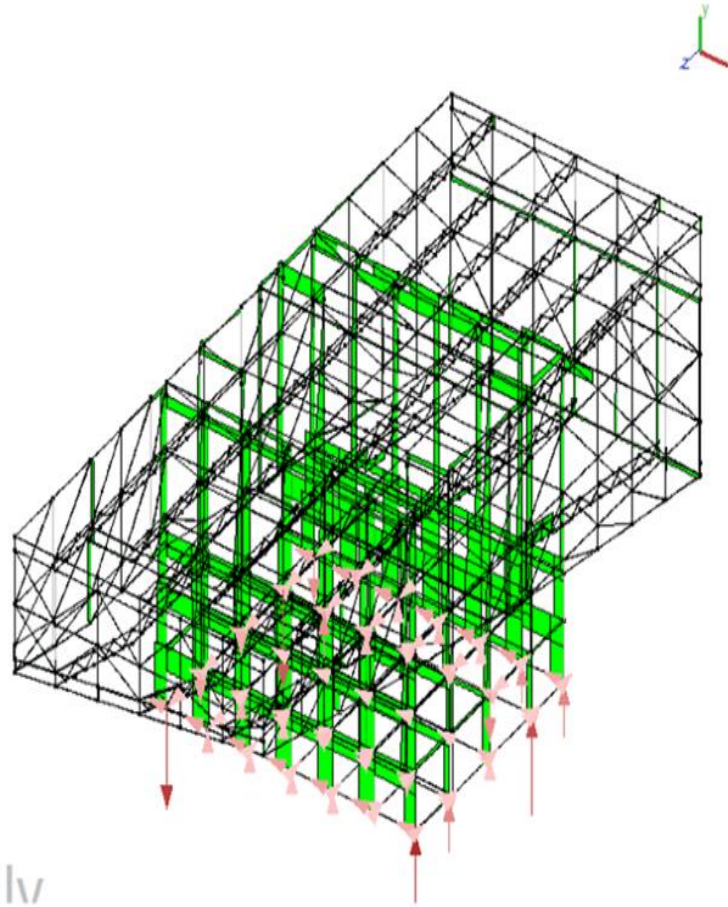
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## Multi-frame Analysis: Lateral Loads (Wind)



Academic Use Only

Static Case: Wind 1 Vy (tonne)

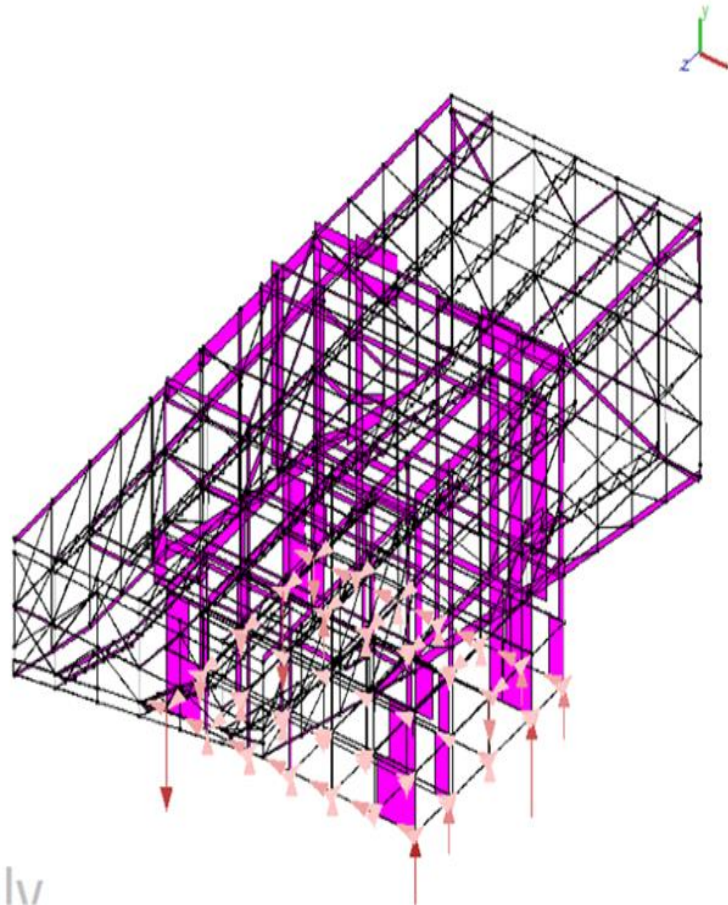
View

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## Multi-frame Analysis: Lateral Loads (Wind)



Academic Use Only

Static Case: Wind 1 Px' (tonne)

View | -100 -90 0 90 180

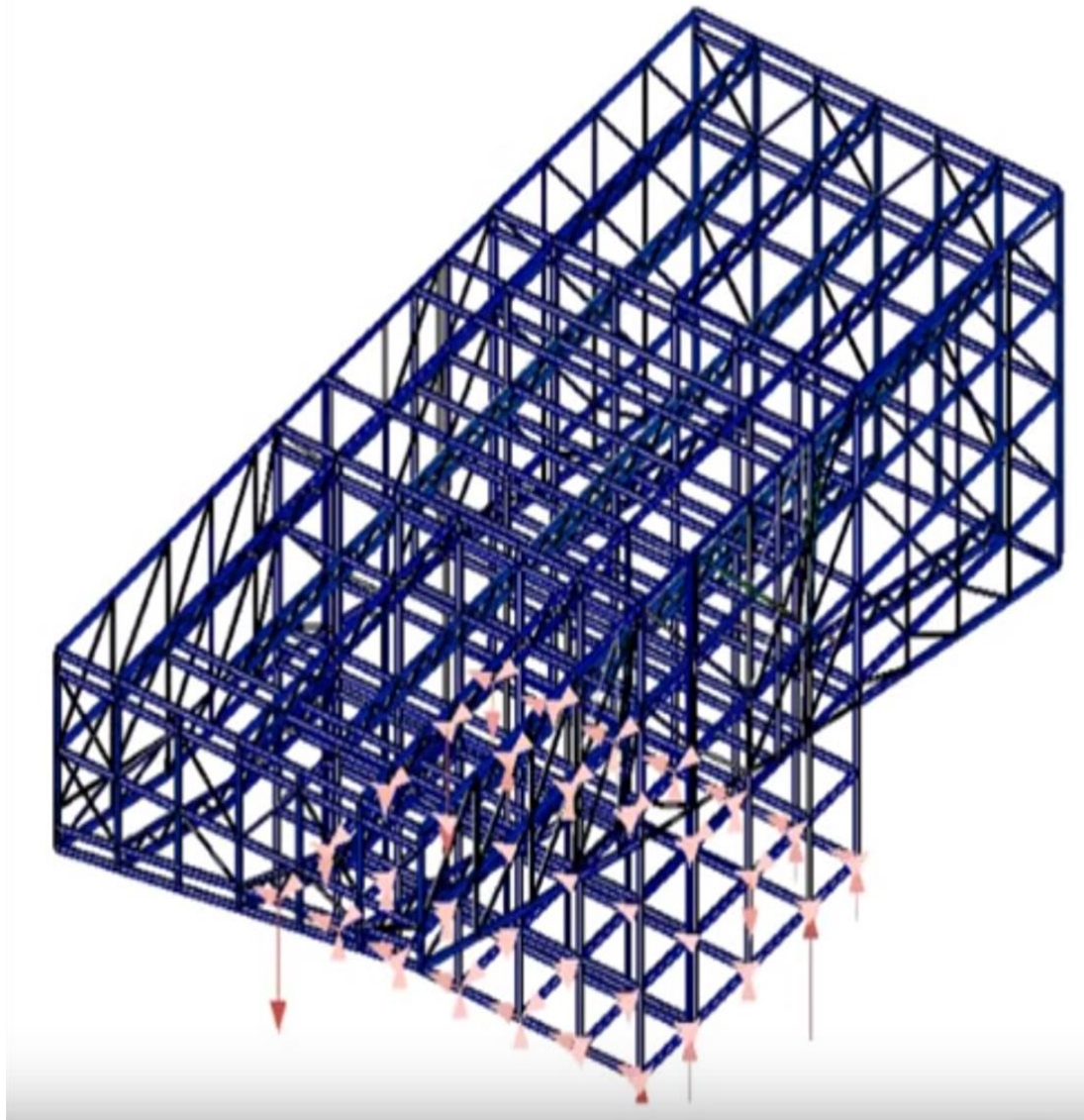
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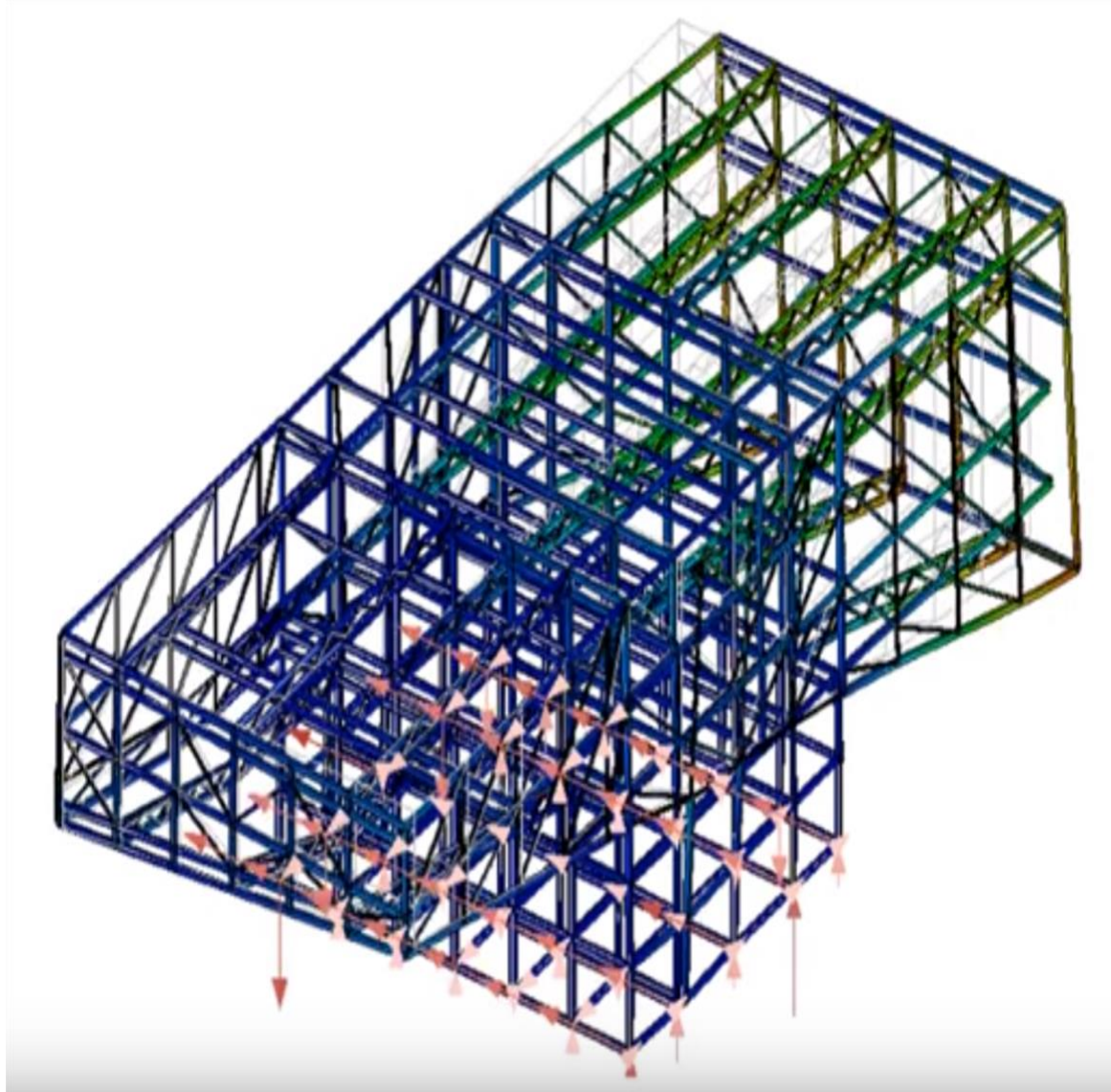
## **PART 4 LATERAL LOAD BEHAVIOR**

- Wind Load Behavior
- Seismic Load Behavior

## Multi-frame Analysis: Wind Load Behavior



## Multi-frame Analysis: Seismic Load Behavior



Seismic :  
Maximum limit law : 5

In this case  
Maximum Richter : 9

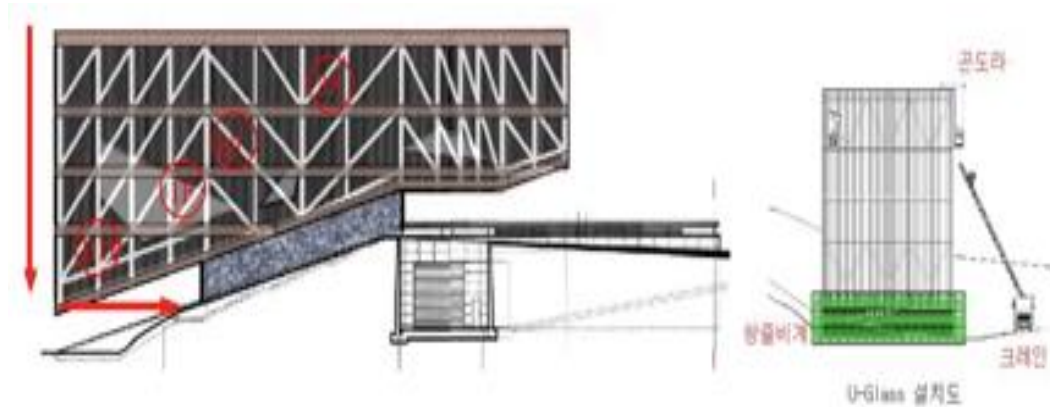
## **PART 5 Materials**

- Exterior Materials
- Interior Materials

# Exterior Materials

## U-profiled glass

- During installing U-Glass, use two cranes(for AL. Frame, for U-Glass) for upper parts and use one crane for down parts
- Install from up to down, North to South



구분	층	4월		5월		6월		비고
		20	30	10	20	30	10	
AL Frame 설치	3F							4/20 1차분 AL Frame 항공운수
	2F							
	B1, 1F							
U-Glass 설치	3F							4/30 U-Glass 반입예정
	2F							
	B1, 1F							
Joint 코킹설치	3F							
	2F							
	B1, 1F							
옥상 AL Copping								
하단 AL Sheet								

# Exterior Materials

## U-profiled glass

- Higher thermal efficiency than double glazing
- High light scattering efficiency - good lighting effects

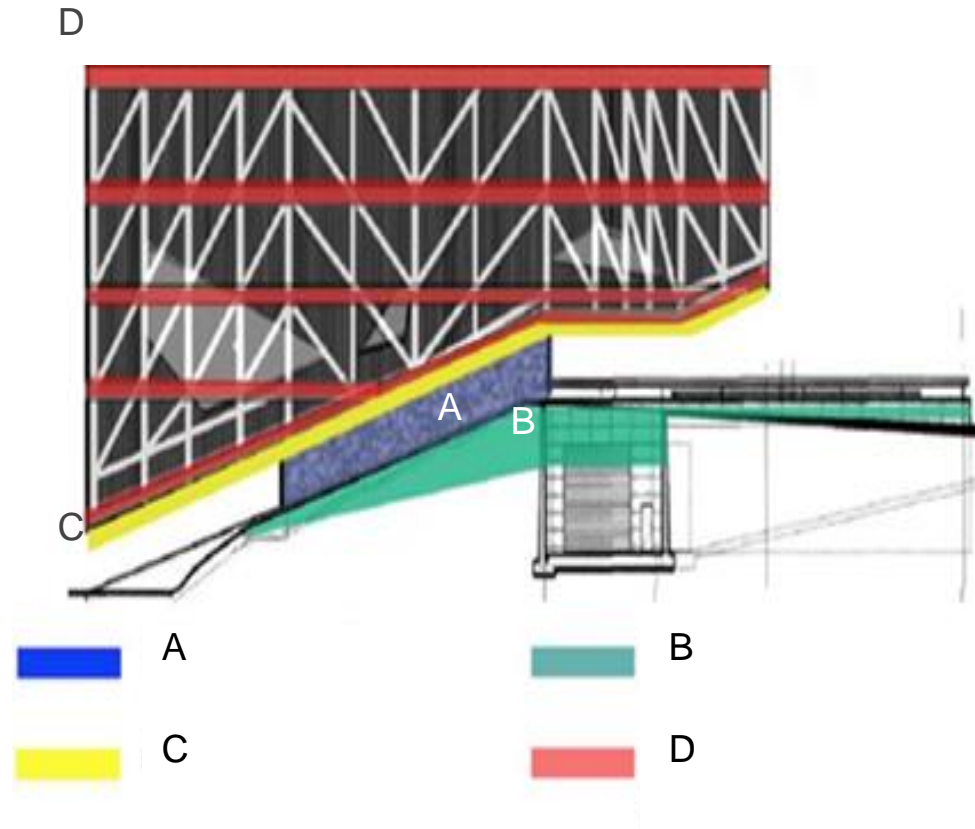




# Exterior Materials

## AL. Panel

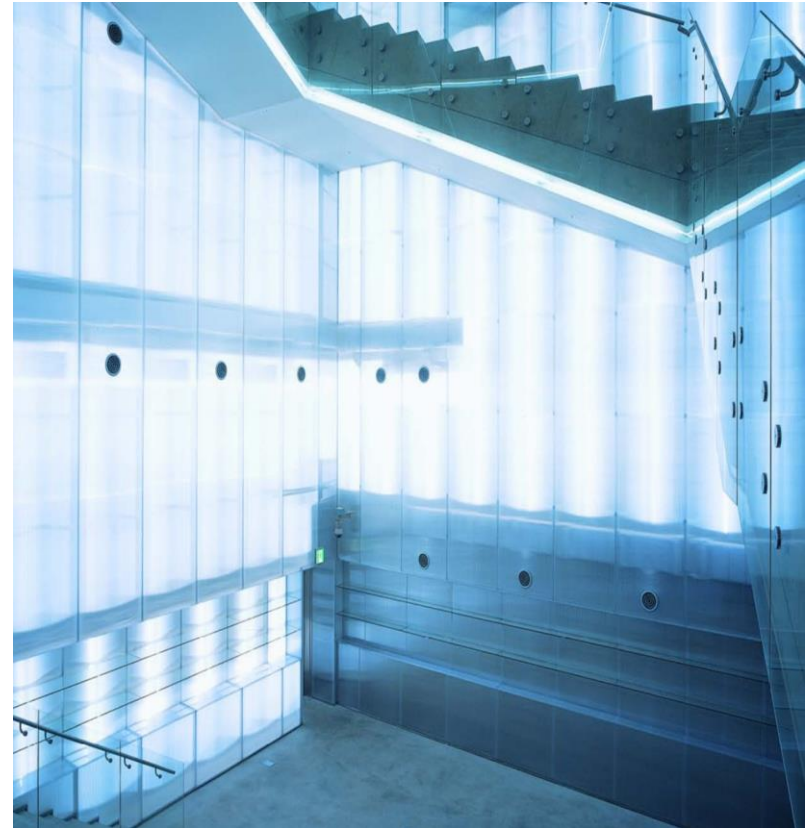
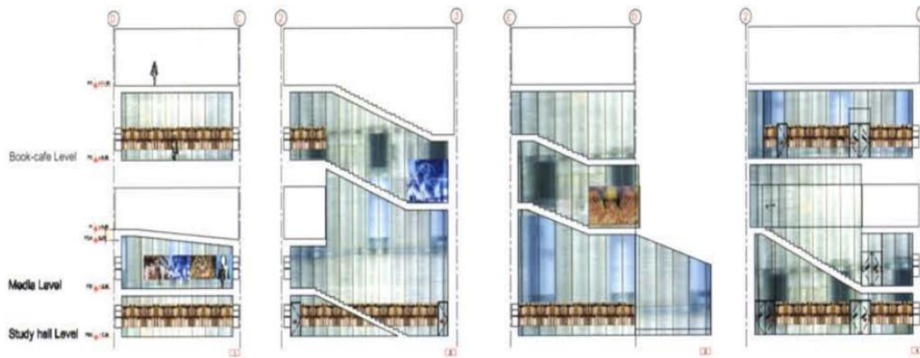
- Use AL. Panel instead of outside insulation system
- protect from outside air through painting film.
- Installing AL.Panel on outside of core wall, lower parts of cantilever, exposed slab and parapet.



# Interior Materials

## Danpalon Panel

- Double Panel System: High Insulation, soundproof, anti-sweating
- provide good interior and duct spaces.
- light weight materials: lower building load



## Connection Description

### Danpalon

- Danpalon can diffuse artificial lighting that seems to luminous materials
- Through visual effect, interior spaces look like wider spaces.



# Citations of bibliographic sources

Video : <https://www.youtube.com/watch?v=phKDiZM9R48>

Drawing : <http://compo3t.blogspot.com/2014/11/museu-dart-de-seul-moa.html>

Image & Diagram : <http://artchist.blogspot.com/2015/10/seoul-national-university-museum-by-oma.html?view=flipcard&m=1>

Photoes : [http://www.spaceinvading.com/entry/project\\_id/Seoul\\_National\\_University\\_Museum200903111236834205](http://www.spaceinvading.com/entry/project_id/Seoul_National_University_Museum200903111236834205)

[https://www.flickr.com/photos/guen\\_k/sets/72157618208636409/](https://www.flickr.com/photos/guen_k/sets/72157618208636409/)

[http://issuu.com/alvaroarias/docs/portfolio\\_aad](http://issuu.com/alvaroarias/docs/portfolio_aad) (p.85)

Book:

Koolhaas, R. (2007). Seoul National University Museum of Art 2005. In *AMOMA Rem Koolhaas II: 1996/2007 : Teoría y práctica = theory and practice*. (1st ed., pp. 278-303). Madrid: El Croquis.

**THANK YOU**