Museum Of Art
Rem Koolhaas

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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 m²
Building area: 2,775.56 m²
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
Site Analysis

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

<table>
<thead>
<tr>
<th>Types</th>
<th>Depth</th>
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<tbody>
<tr>
<td>Burried layer</td>
<td>0 ~ 1.8m</td>
</tr>
<tr>
<td>Alluvium</td>
<td>1.8 ~ 8.8m</td>
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<tr>
<td>Weathered rock</td>
<td>8.8 ~ 10.3m</td>
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<tr>
<td>Soft rock</td>
<td>10.3 ~ 12m</td>
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</tbody>
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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

Maximum Height

Monolith

Slice

Slice Connection

Parts

Slab

Tower

Slope

Base
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.
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
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.
Section

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
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

- Core
- Interior court
- Perimeter Zone
- Inside - outside
- Outside
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 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: \( 50 \text{ kgf/m}^2 \))
Live Load: Office, Public space: \( 500 \text{ kgf/m}^2 \)
Dead Load: CON+STEEL Slab = 1cm thick >> 80kg/m^2

- 25cm >> 2500kg/m^2
- \( 60.6 \times 23 = 1393.8 \text{ m}^2 \)
- \( 1393.8 \times 2500 = 3,484,500 \text{ kg} = 3,484.5 \text{ ton} \)

2story + rooftop = **10,453 ton**
Multi-frame Analysis: Gravity Loads
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Multi-frame Analysis: Lateral Loads (Wind)

Wind Load:
Average: 2.5 m/s
Maximum: Hurricane ‘Maemi’ = 60 m/s
Multi-frame Analysis: Lateral Loads (Wind)
Multi-frame Analysis: Lateral Loads (Wind)
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
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.
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

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Book:  
THANK YOU