



MIDAS SQUARE 공학 기술강연

# Structural Design of Lotte World Tower

Jong-Ho Kim | P.E., CEO & Chairman, Chang Minwoo Structural Consultants

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# Chang Minwoo Structural Consultants

## History & Works

- Founded in 1989 by Mr. Jong-Ho Kim (Chairman and CEO)
- Lotte World Tower (123FL, 555m, Seoul, Korea)
- Seoul International Financial Center (55FL, 284m, Seoul, Korea)
- Busan Lotte World II, Phase 1, 2 and 3 (107FL, 494m, Busan, Korea)
- Incheon International Airport Terminal II (Incheon, Korea)



# Chang Minwoo Structural Consultants

## History & Works

Leading the History of Landmarks in Korea !





# Introduction

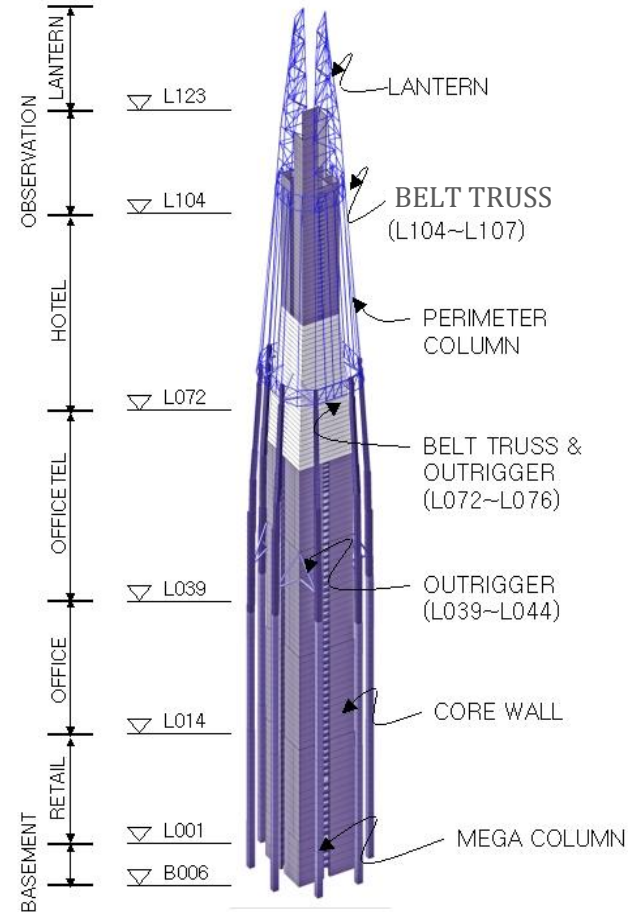
## General Information



Location	Jamsil, Seoul, Korea
Ground Area	87,182.80m <sup>2</sup>
Usage	Office, Hotel, Residence, etc
Structure	Steel, Concrete Structure
Gross Area	328,350m <sup>2</sup>
Construction	2010.11 ~ 2016. 12
Height	555m
Stories	123F, B6F

# Introduction

## Structural System



Lateral Resisting System	Core Wall + Outrigger / Belt Truss + Mega Column	
Core Wall	RC Wall (t=2000~500mm)	
Outrigger	Steel (L39~44, L72~76)	
Belt Truss	Steel (L72~76, L104~107)	
Mega Column	RC Mega Column (3.5 x 3.5m <sup>2</sup> )	
Slab	Office & Officetel	Steel Beam + Deck Slab
	Hotel	Flat Slab
Foundation	Mat Foundation (t=6500mm)	
Material	Concrete: $f_{ck} = 30 \sim 80\text{MPa}$ Rebar: $f_y = 400\sim 600\text{MPa}$ Steel: $f_y = 235\sim 650\text{MPa}$	

# Structural Design

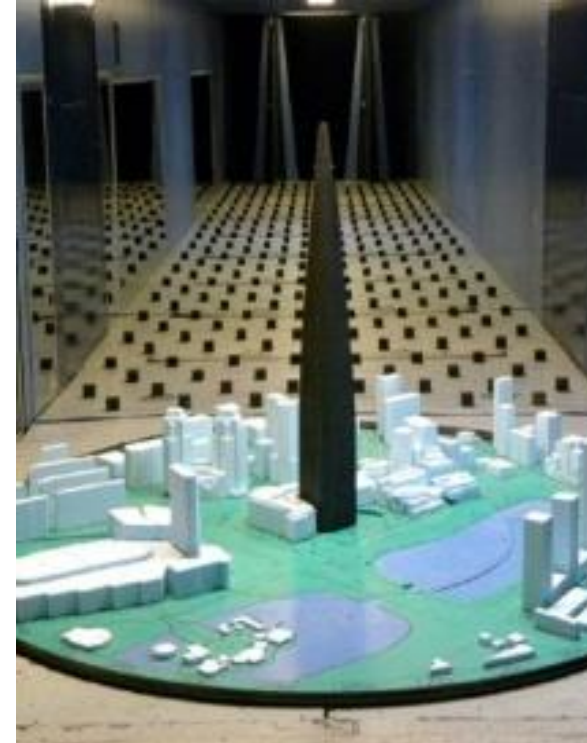
## Lateral Load

### Wind Load

- Code: KBC 2009
- Exposure: B
- Basic Wind Speed:
  - $V=26\text{m/s}$ (for drift check)
  - $V=30\text{m/s}$ (for strength design)

### Seismic Load

- Code: KBC 2009
- Site Coefficient:  $S=0.176$  (Seoul)
- Response Modification Factor: 4.0
- Importance Factor:  $IE=1.5$
- Seismic Design Category: C



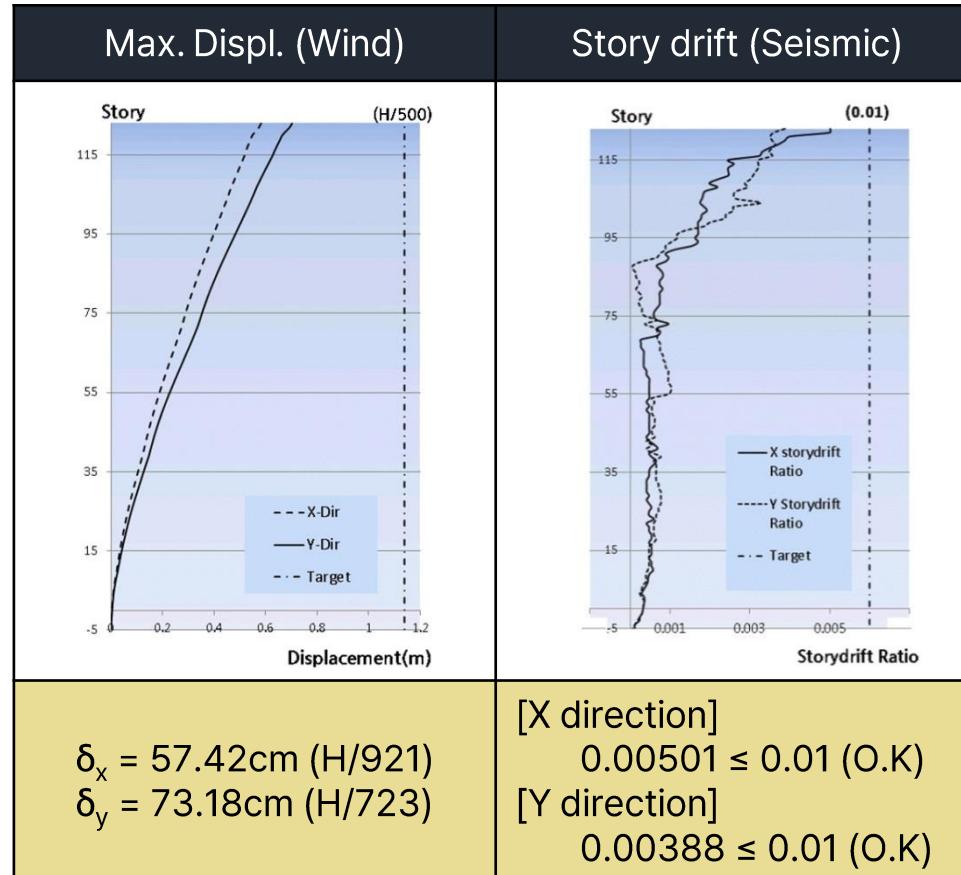
[HFFB Model]



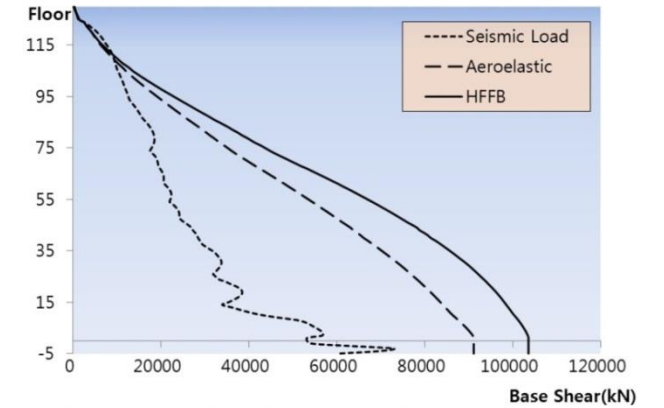
[Aeroelastic Model]

# Structural Design

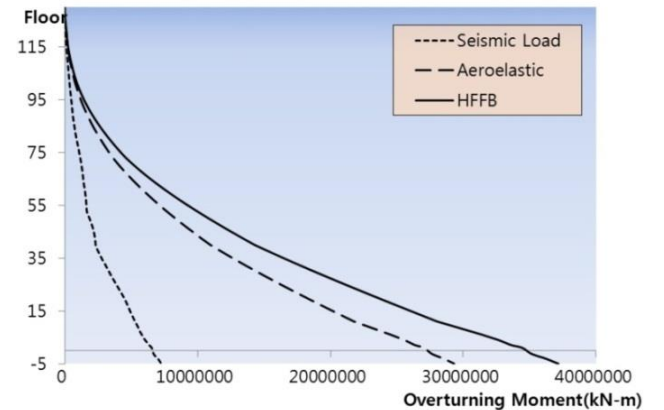
## Max. Displacement & Story Drift



## Base Shear



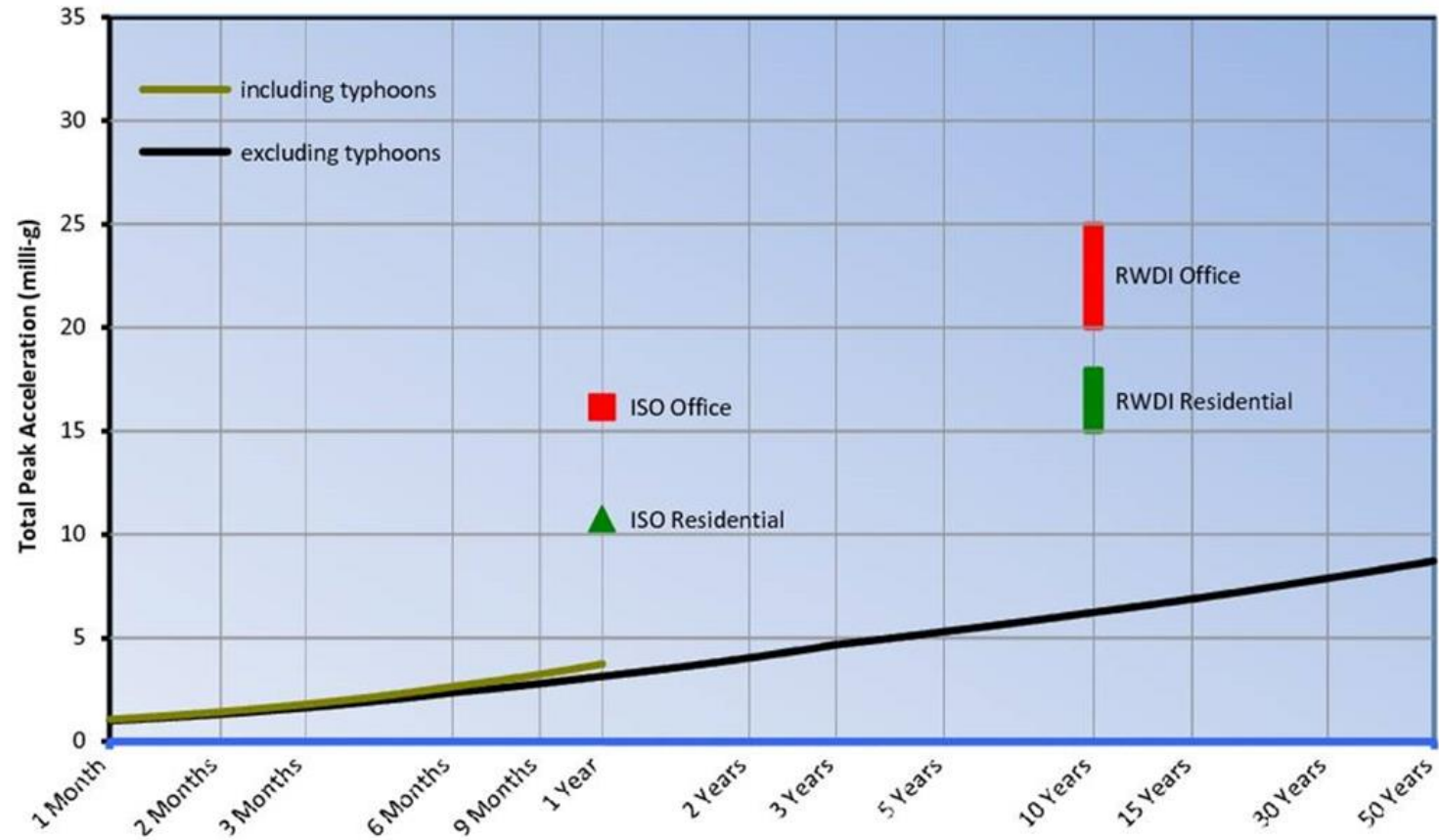
## Overtuning





# Structural Design

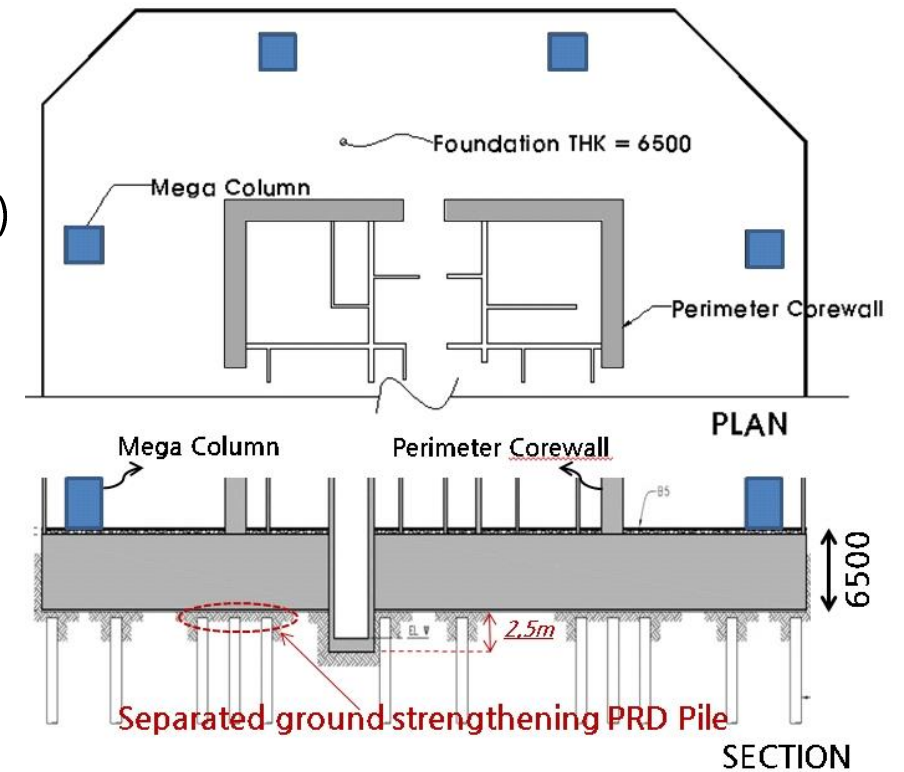
## Response Acceleration for Wind Load



# Structural Design

## Foundation

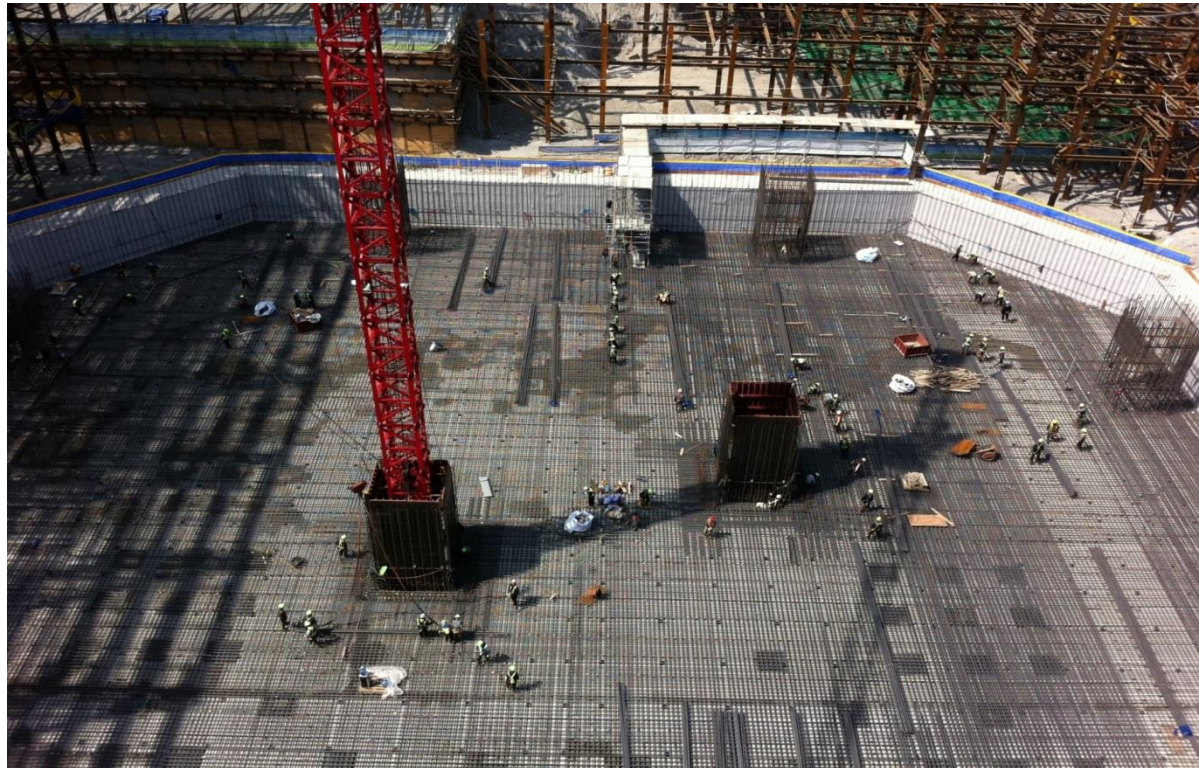
- Size : 72m X 72m X 6.5m
- Allowable Bearing : 3,000 kPa
- Reaction : 2,590kPa < 3,000kPa (O.K)
- $f_{ck} = 50\text{MPa}$   
(Low heat- High Flexible Concrete)
- $\Phi 1,000$  PRD Foundation Reinforcing :  
To minimize settlement under core walls and mega columns



# Structural Design

## Foundation

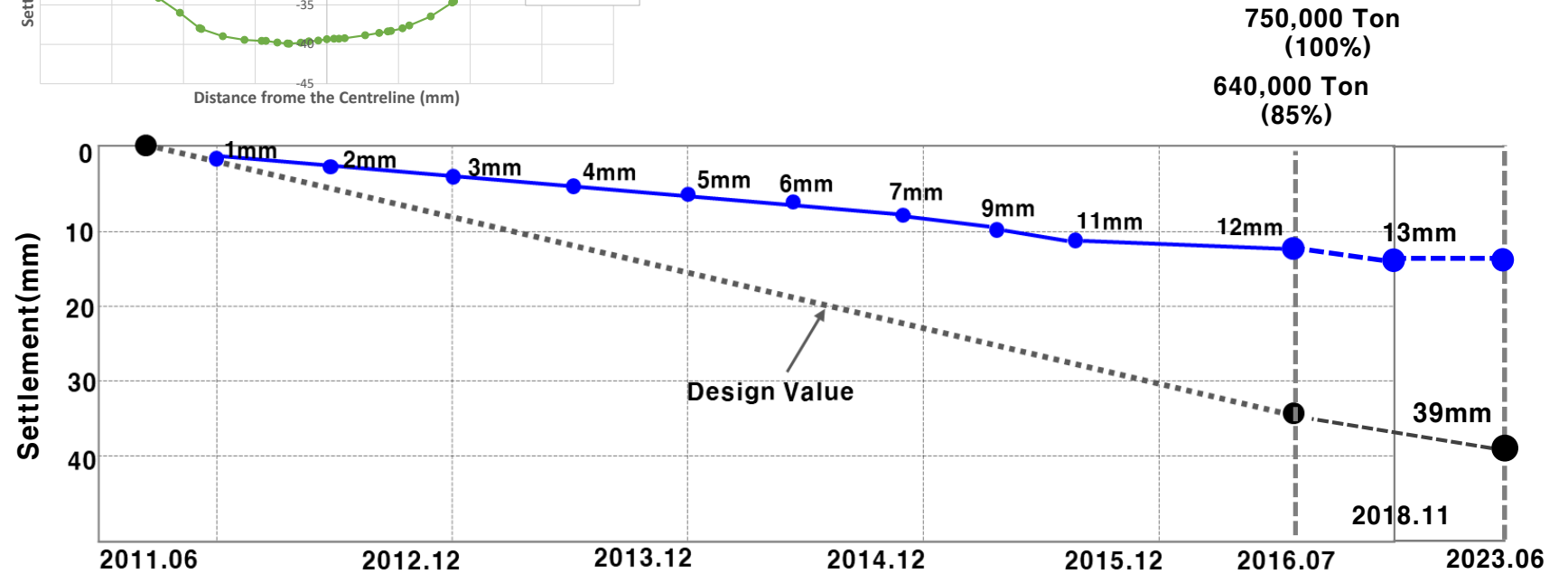
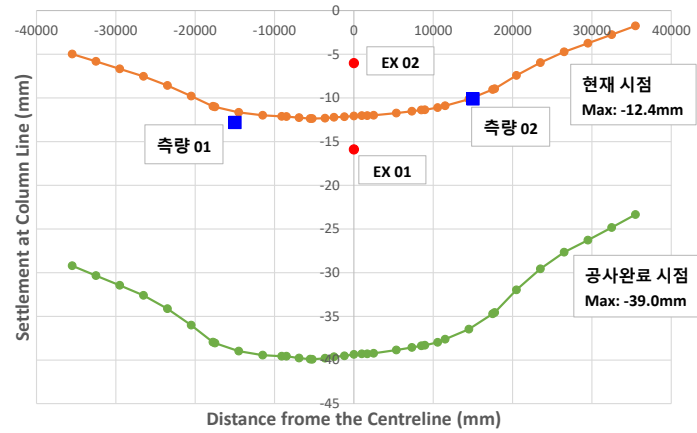
- Rebar 4,200ton
- Concrete 3,400m<sup>3</sup>
- Continuous Placing for 32 hours



# Structural Design

## Foundation

### ◆ Settlement



# Structural Design

## Underground Level

- B06 ~ B01
- RC Beam + RC Slab
- Max. Effective Span = 17m

Mega Column  
(3500X3500)

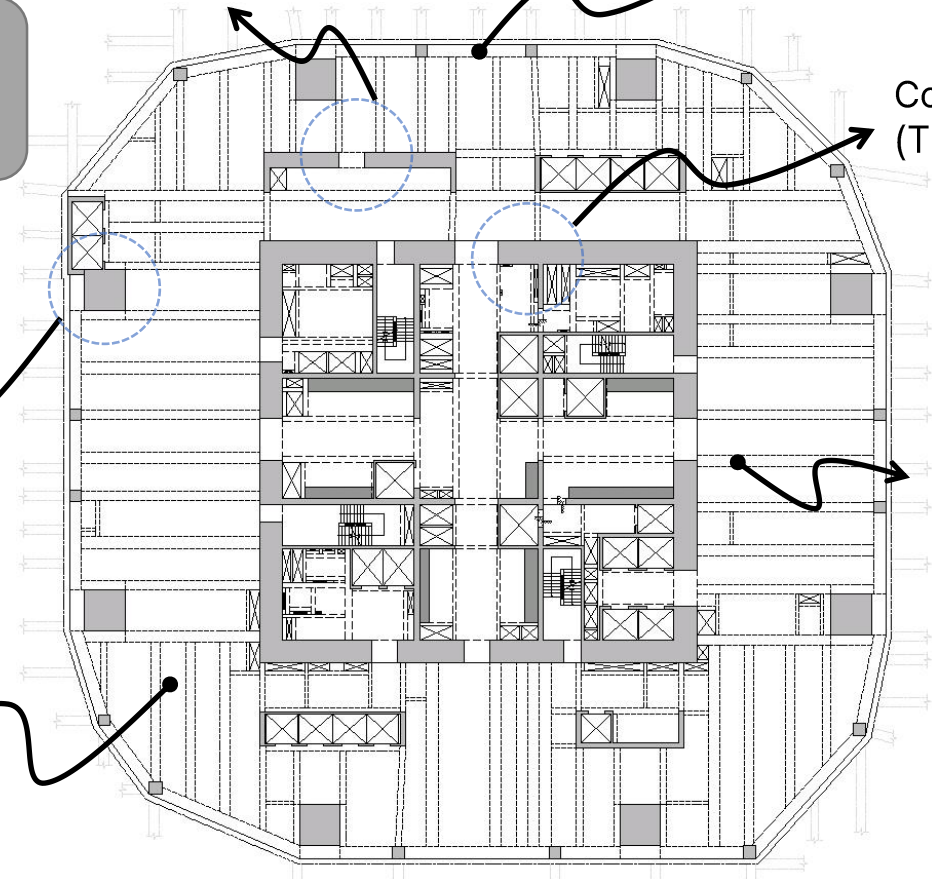
RC Slab  
(THK. = 150)

Shuttle Elev. Wall  
(THK. = 1600)

Perimeter Girder  
(1000X1000)

Core Wall  
(THK. = 2000)

RC Beam  
(1000X900)





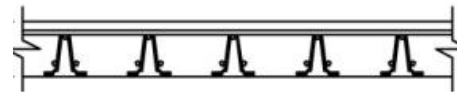
# Structural Design

## Office Level

- L013 ~ L038
- Steel Beam + Deck Slab
- Story Height = 4500mm
- Max. Effective Span = 17m

Mega Column  
(3200X3200~2800X2800)

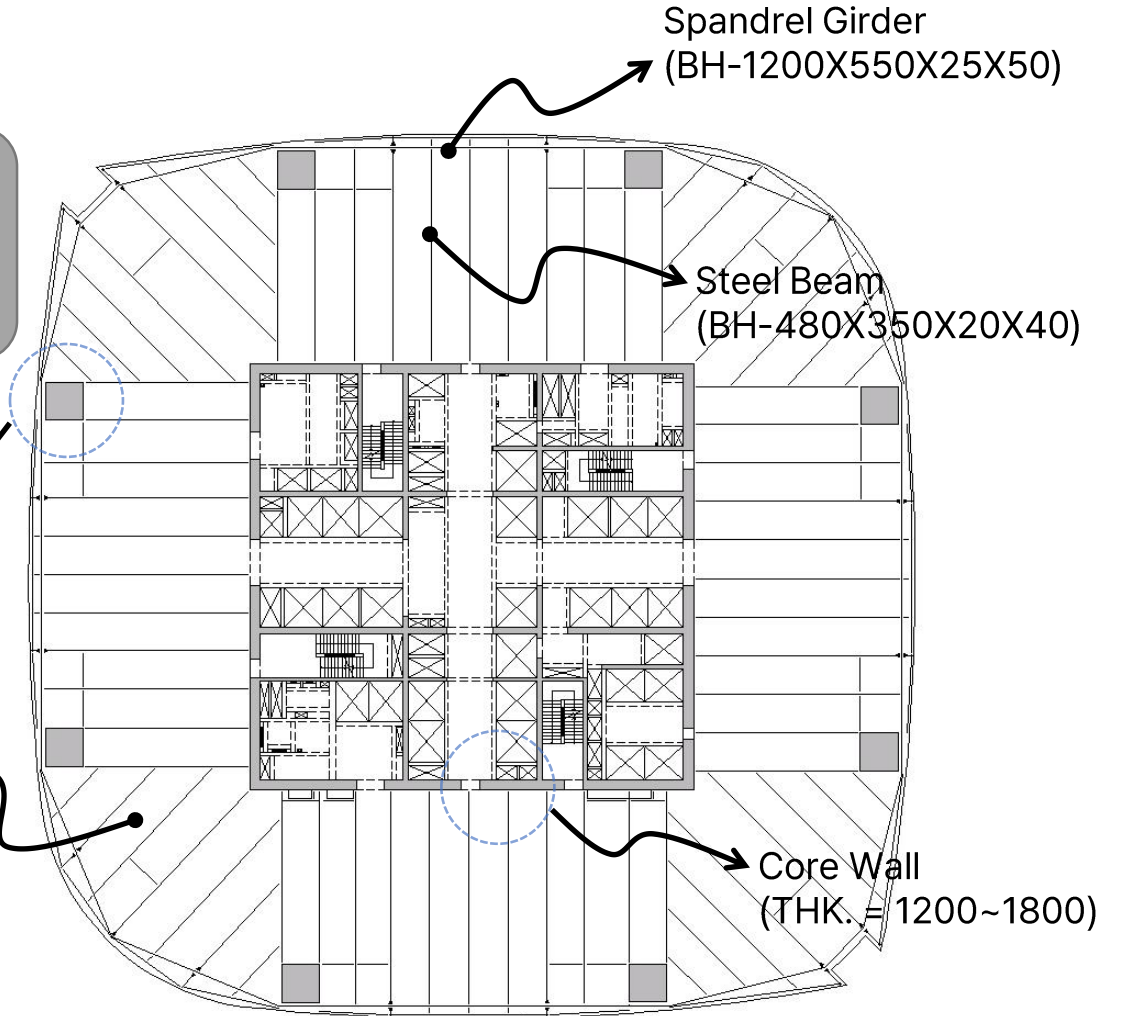
Deck Slab  
(THK. = 130)



Spandrel Girder  
(BH-1200X550X25X50)

Steel Beam  
(BH-480X350X20X40)

Core Wall  
(THK. = 1200~1800)



# Structural Design

## Office Level



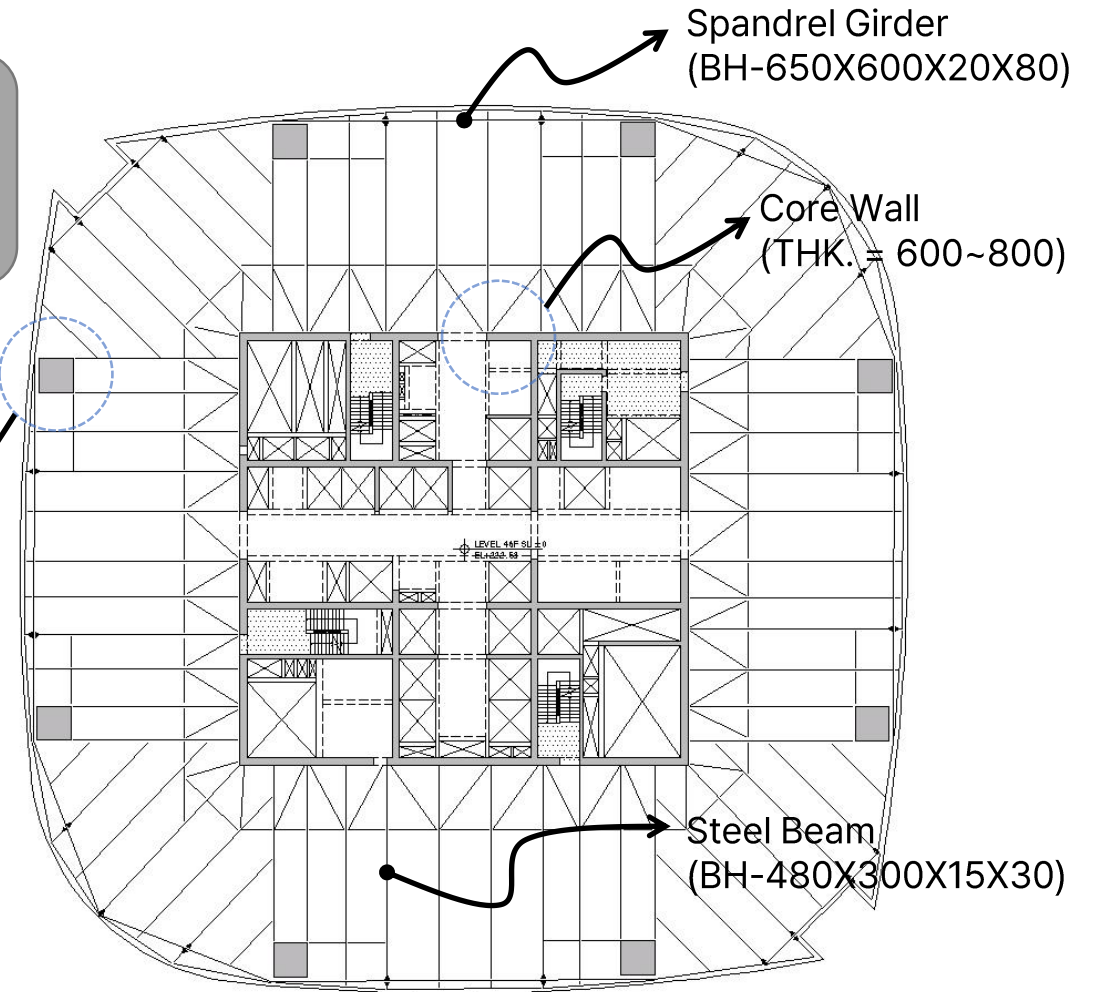
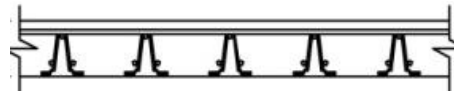
# Structural Design

## Officetel Level

- L044 ~ L071
- Steel Beam + Deck Slab
- Story Height = 3900mm
- Max. Effective Span = 15m

Mega Column  
(2800X2800~2000X2000)

Deck Slab  
(THK. = 150)





# Structural Design

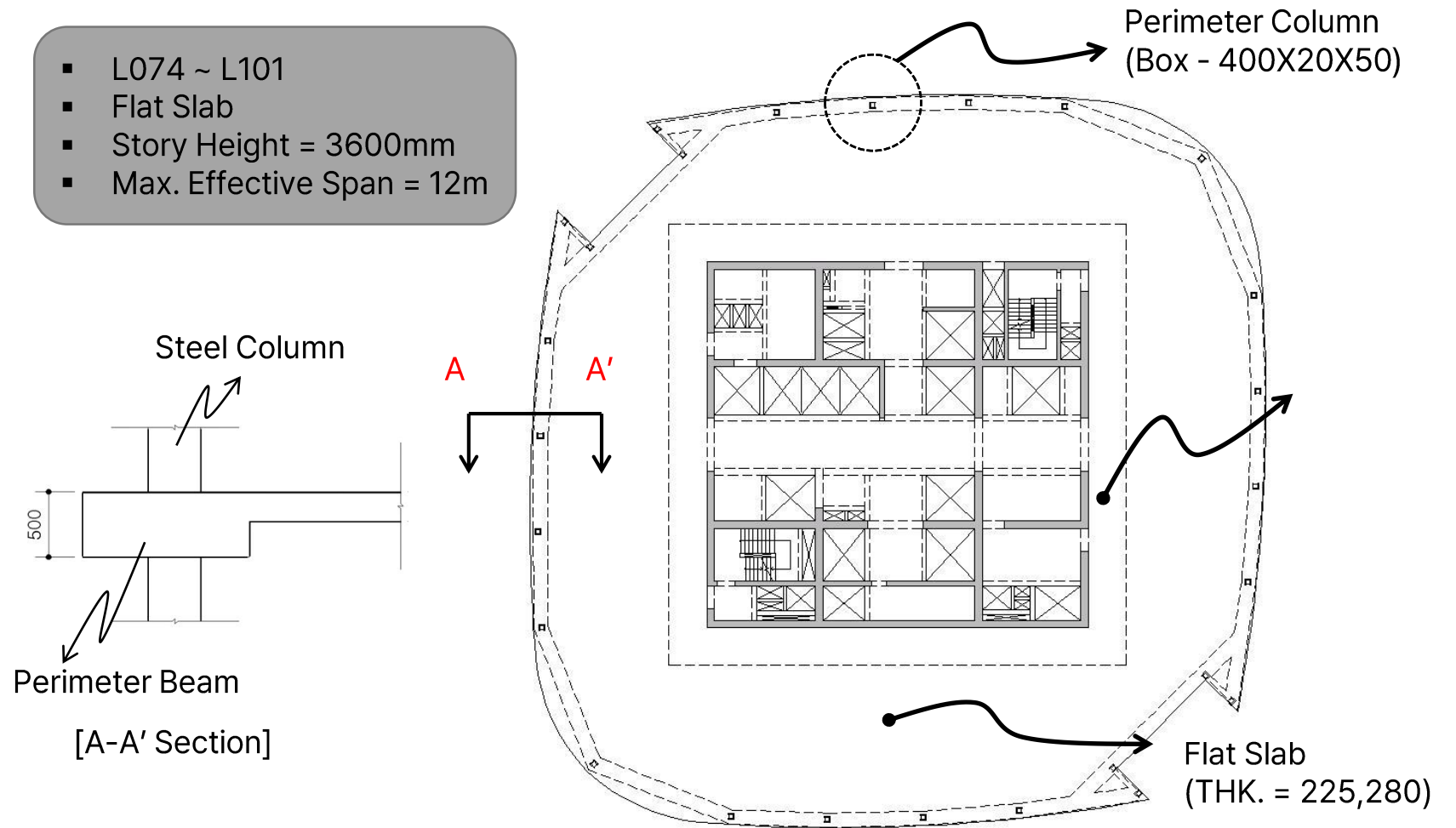
## Officetel Level



# Structural Design

## Hotel Level

- L074 ~ L101
- Flat Slab
- Story Height = 3600mm
- Max. Effective Span = 12m





# Structural Design

## Hotel Level



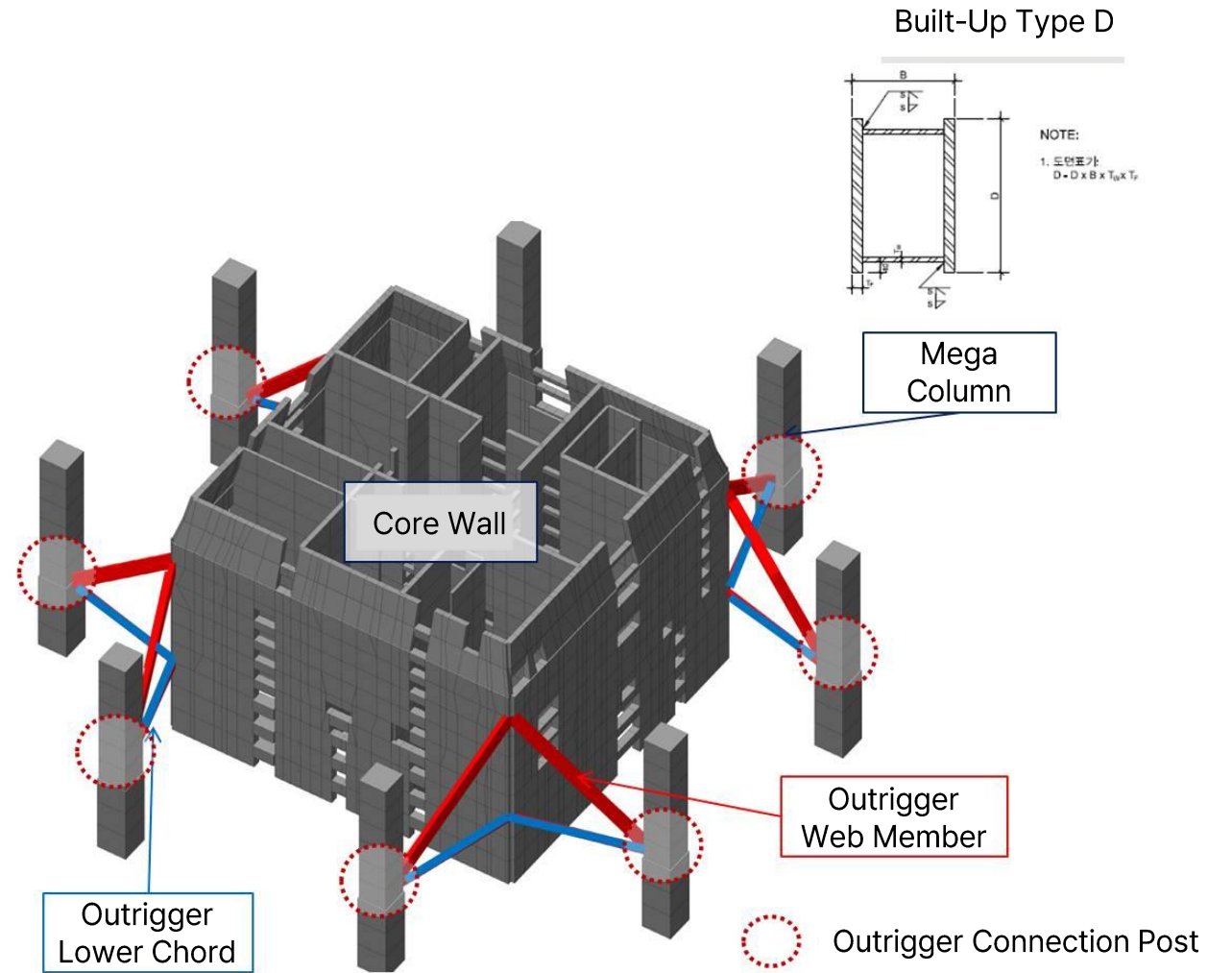
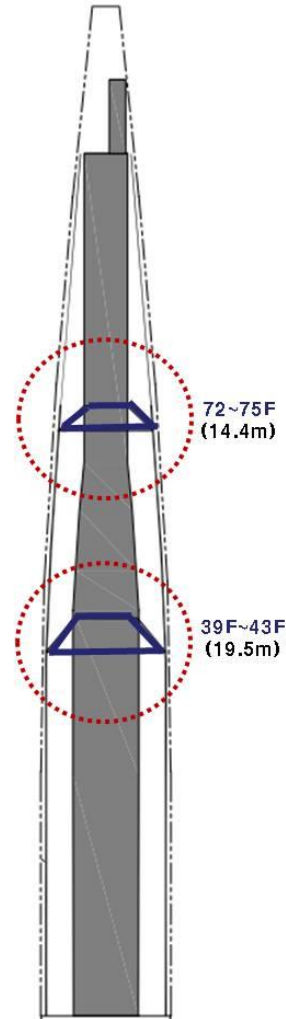
# Structural Design

## Lateral Resisting System

	Decision	ALT. 1	ALT. 2	ALT. 3	ALT. 4
Location					
Outrigger	2 sets	3 sets	2 sets	3 sets	3 sets
Belt Truss	2 sets	6 sets	6 sets	5 sets	2 sets
Outrigger + Belt Truss Lateral Load Share	28.5%	30.2%	30.2%	29.9%	28.5%

# Structural Design

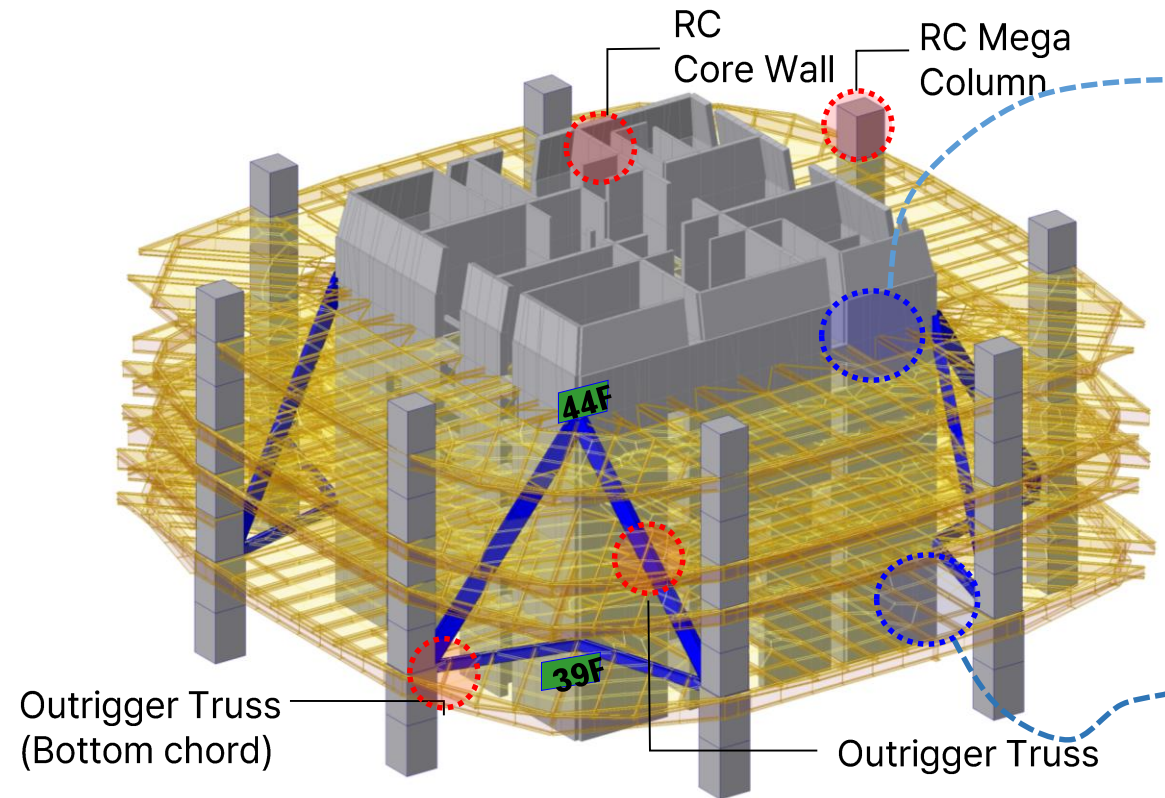
## Outrigger Truss





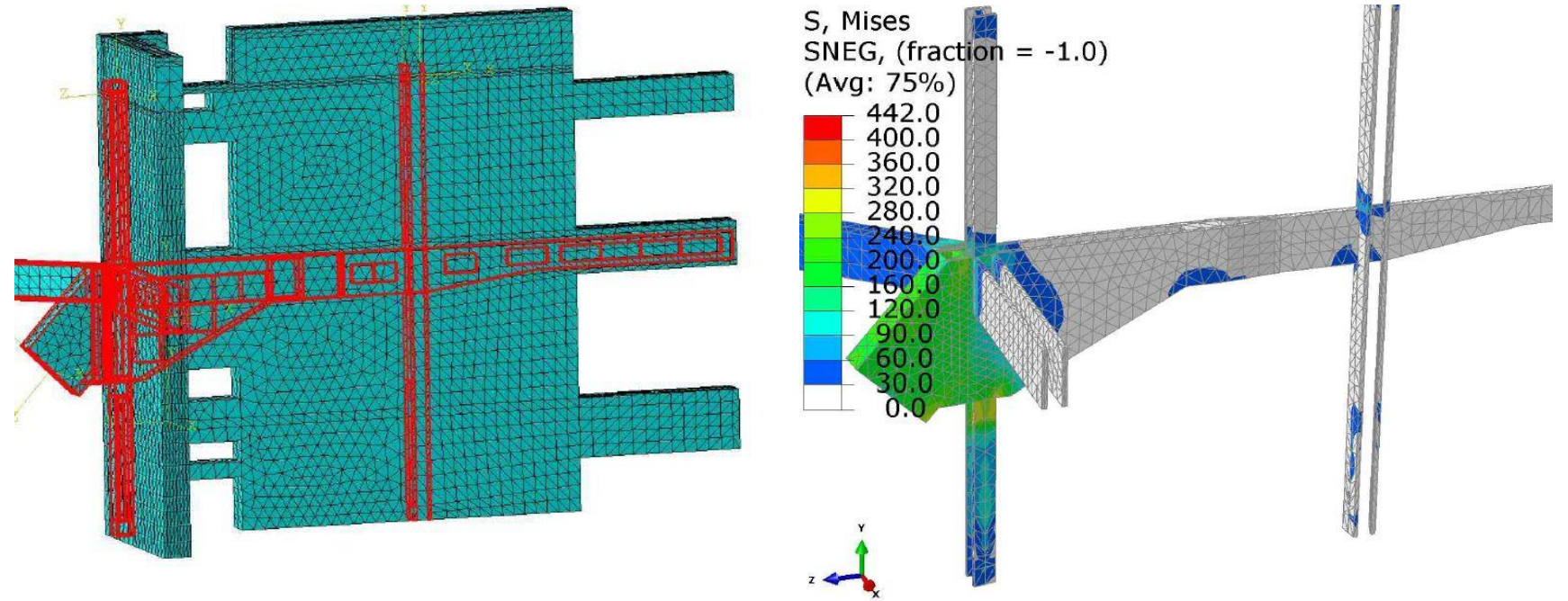
# Structural Design

## Outrigger Truss



# Structural Design

## Outrigger Truss

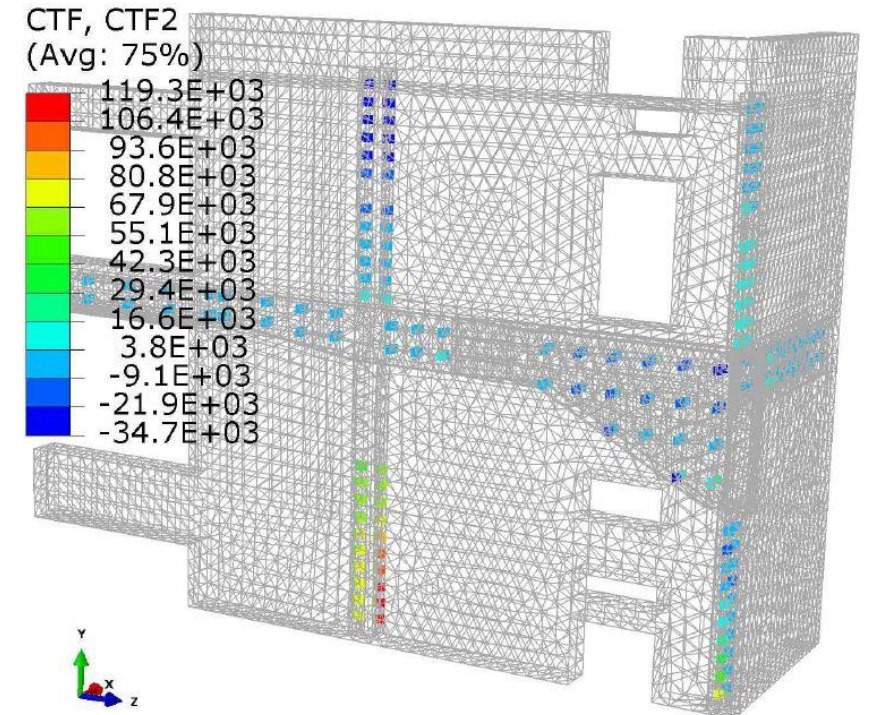
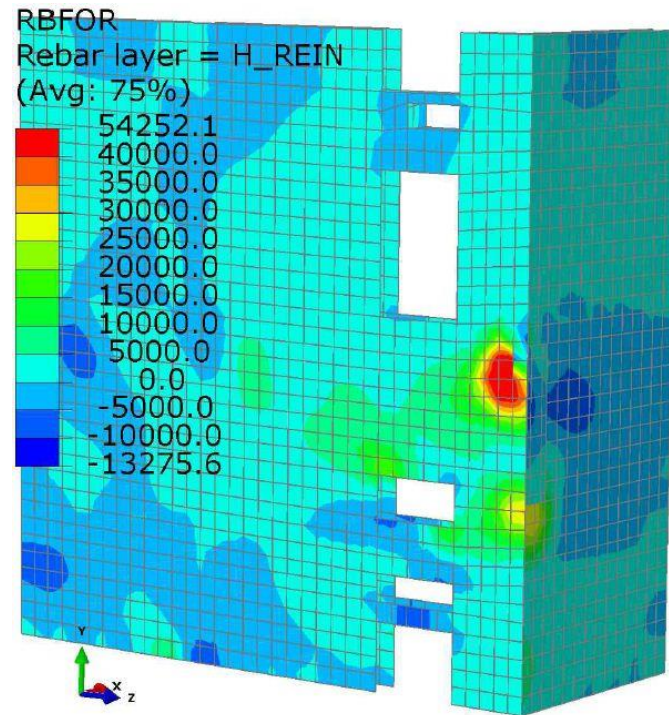


[ FE Analysis ]



# Structural Design

## Outrigger Truss



[ FE Analysis ]

# Structural Design

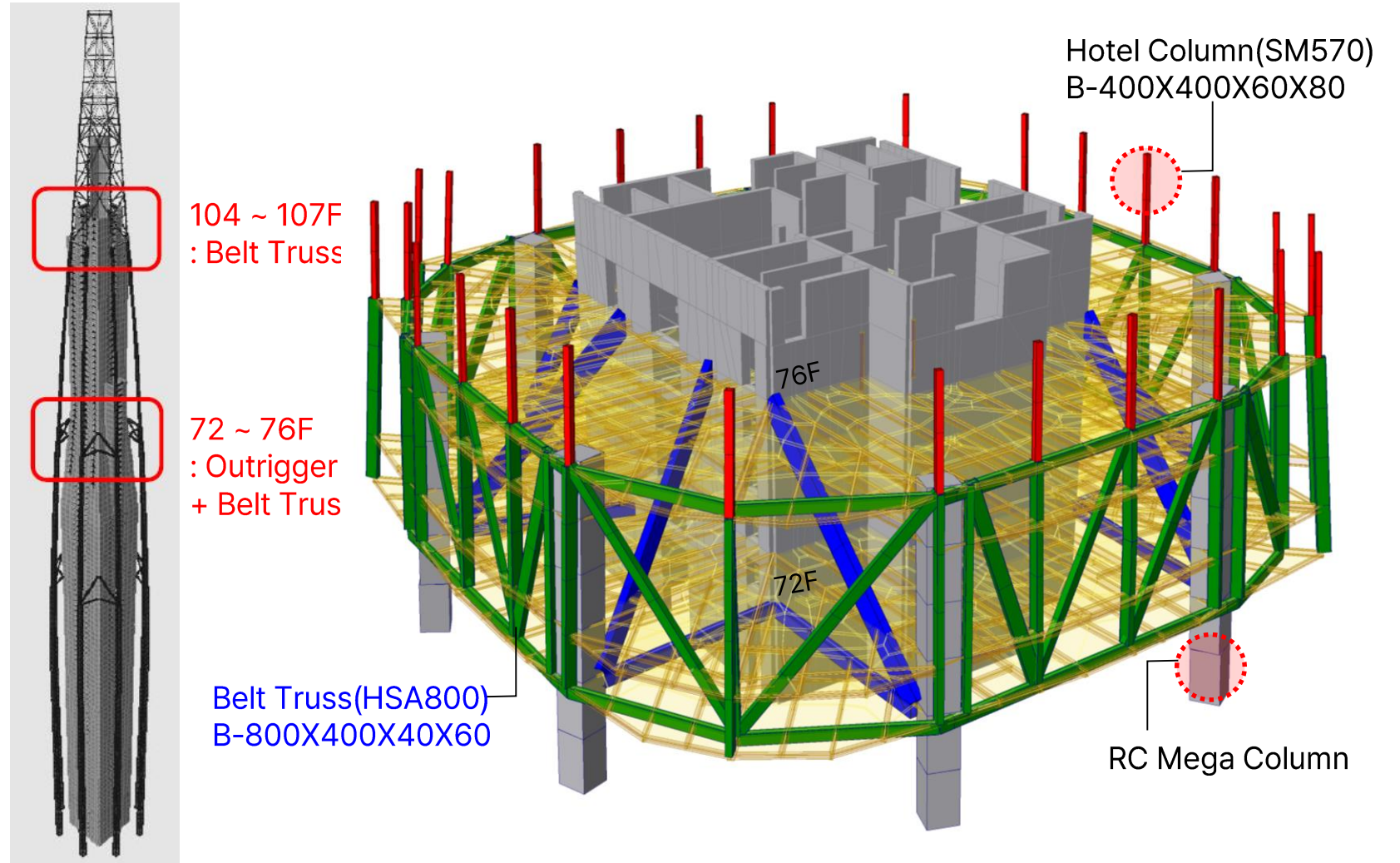
## Mega Column





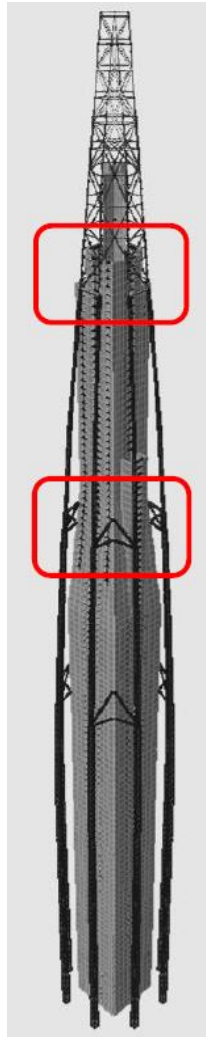
# Structural Design

## Belt Truss



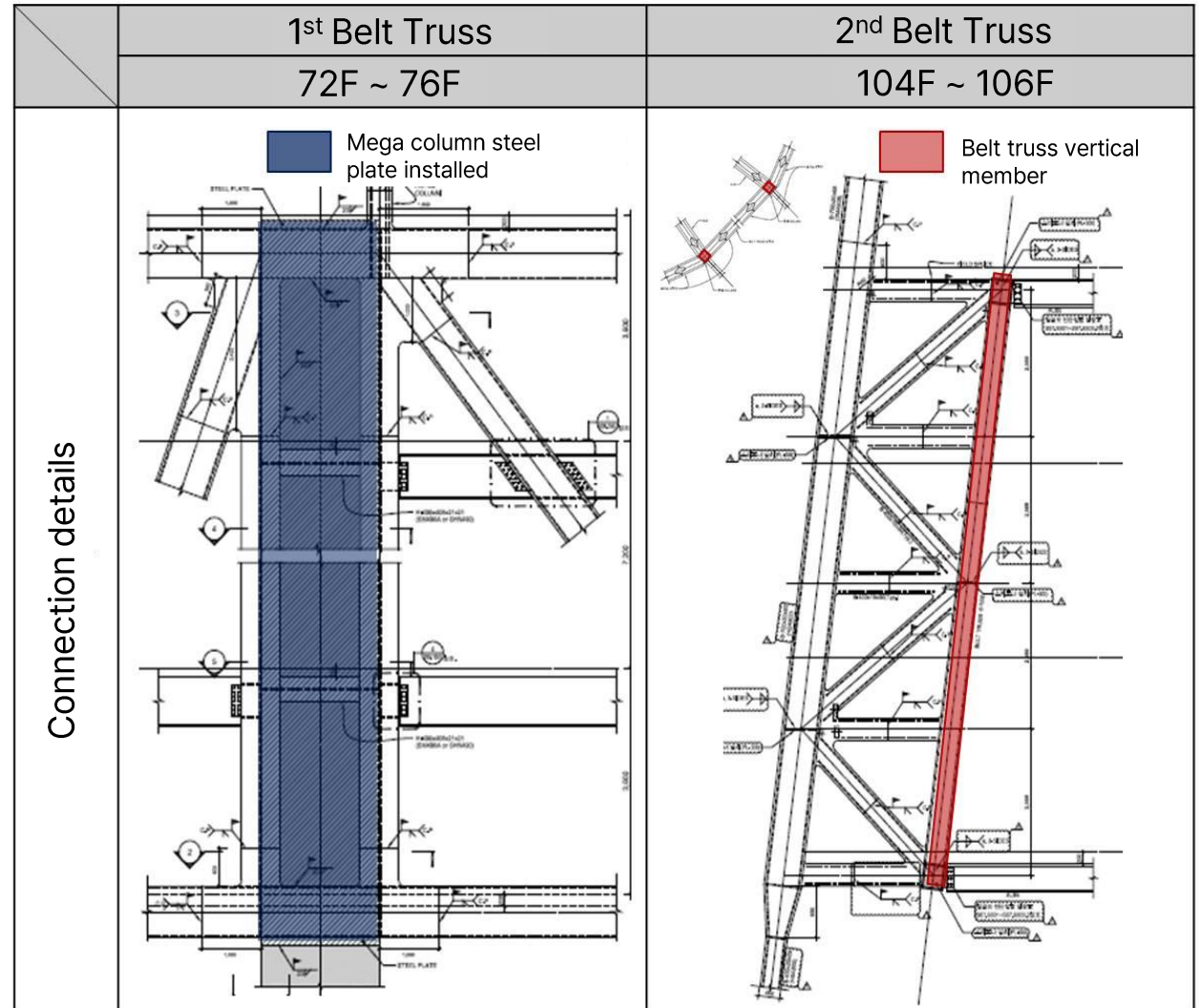
# Structural Design

## Belt Truss



104 ~ 107F  
: Belt Truss

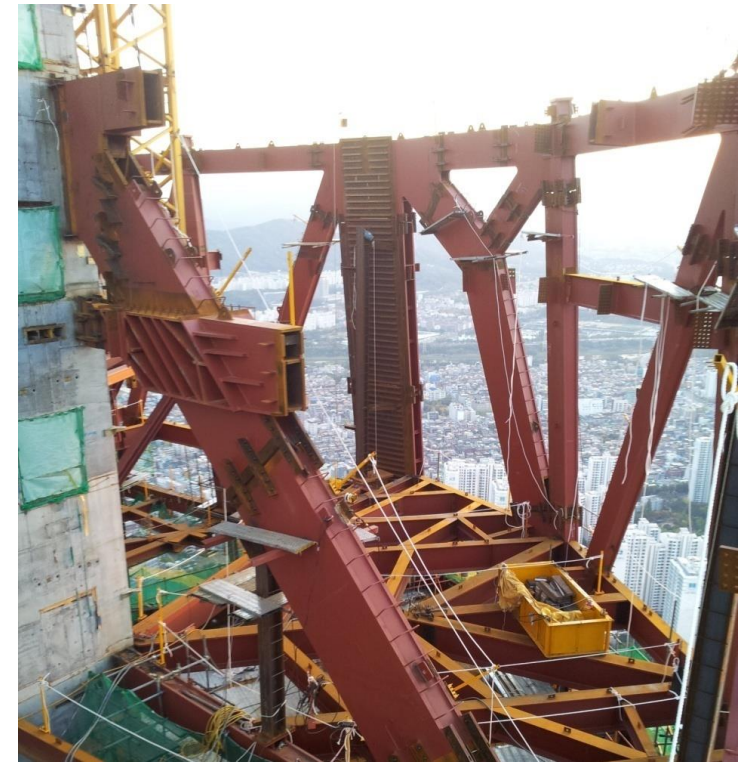
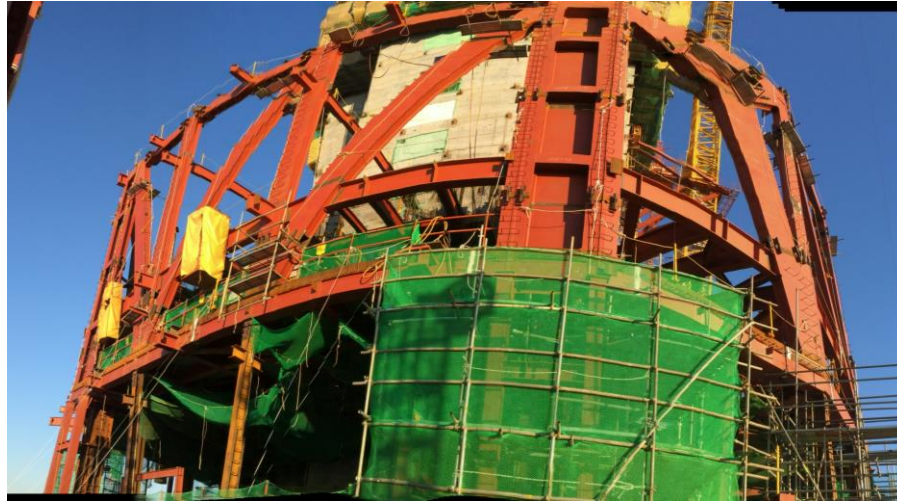
72 ~ 76F  
: Outrigger  
+ Belt Truss





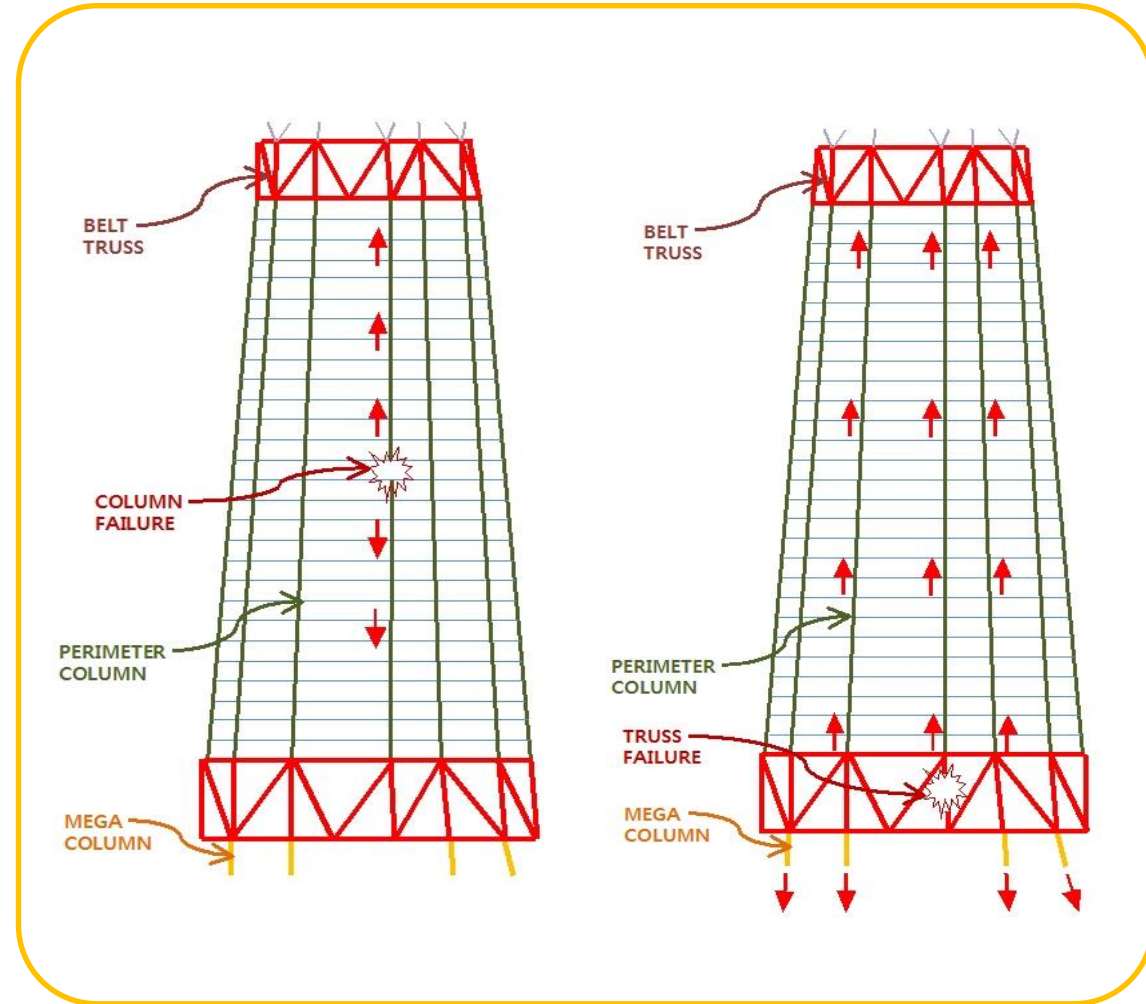
# Structural Design

## Belt Truss



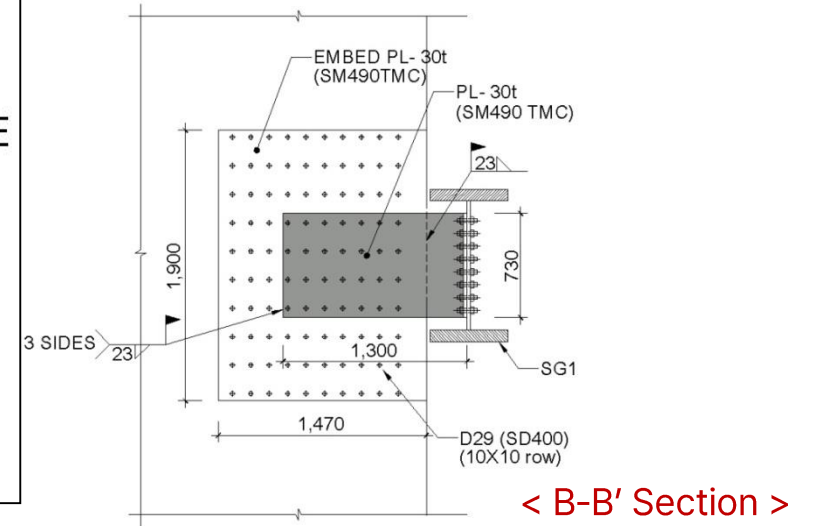
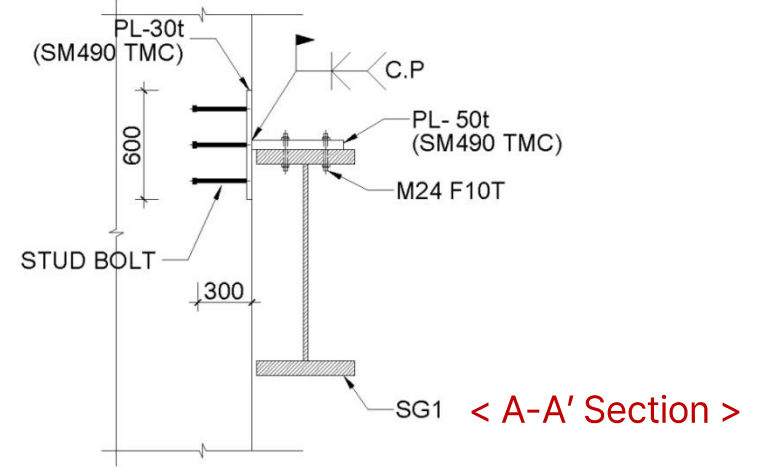
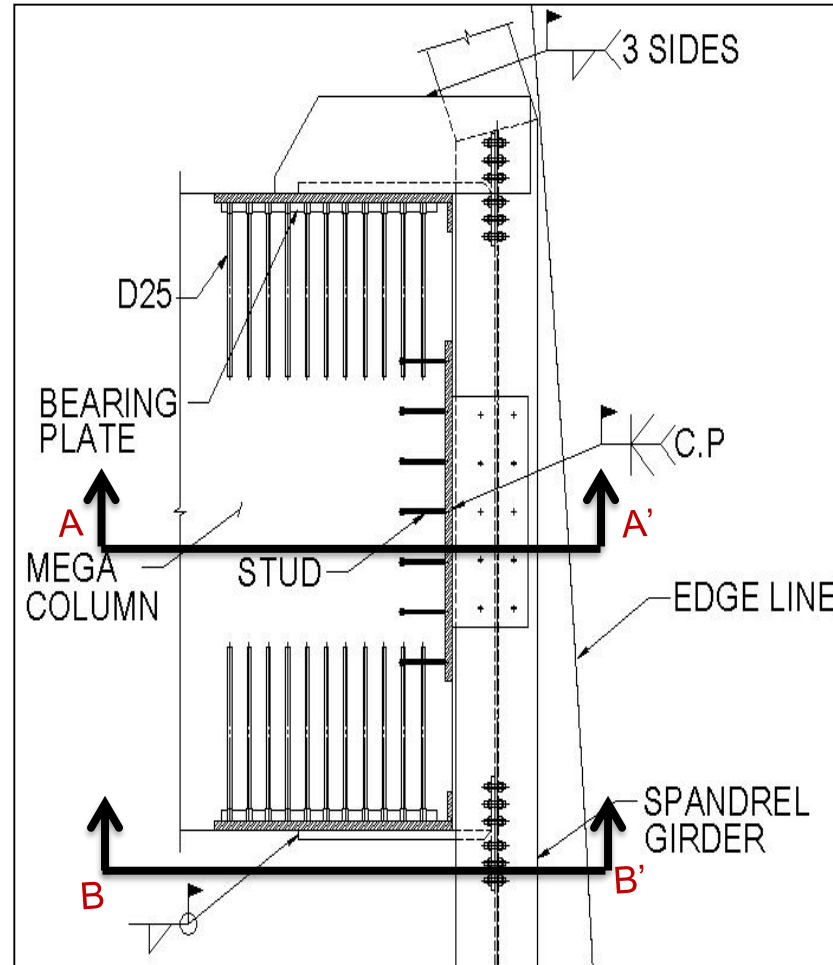
# Structural Design

## Belt Truss



# Structural Design

## Spandrel Girder



# Structural Design

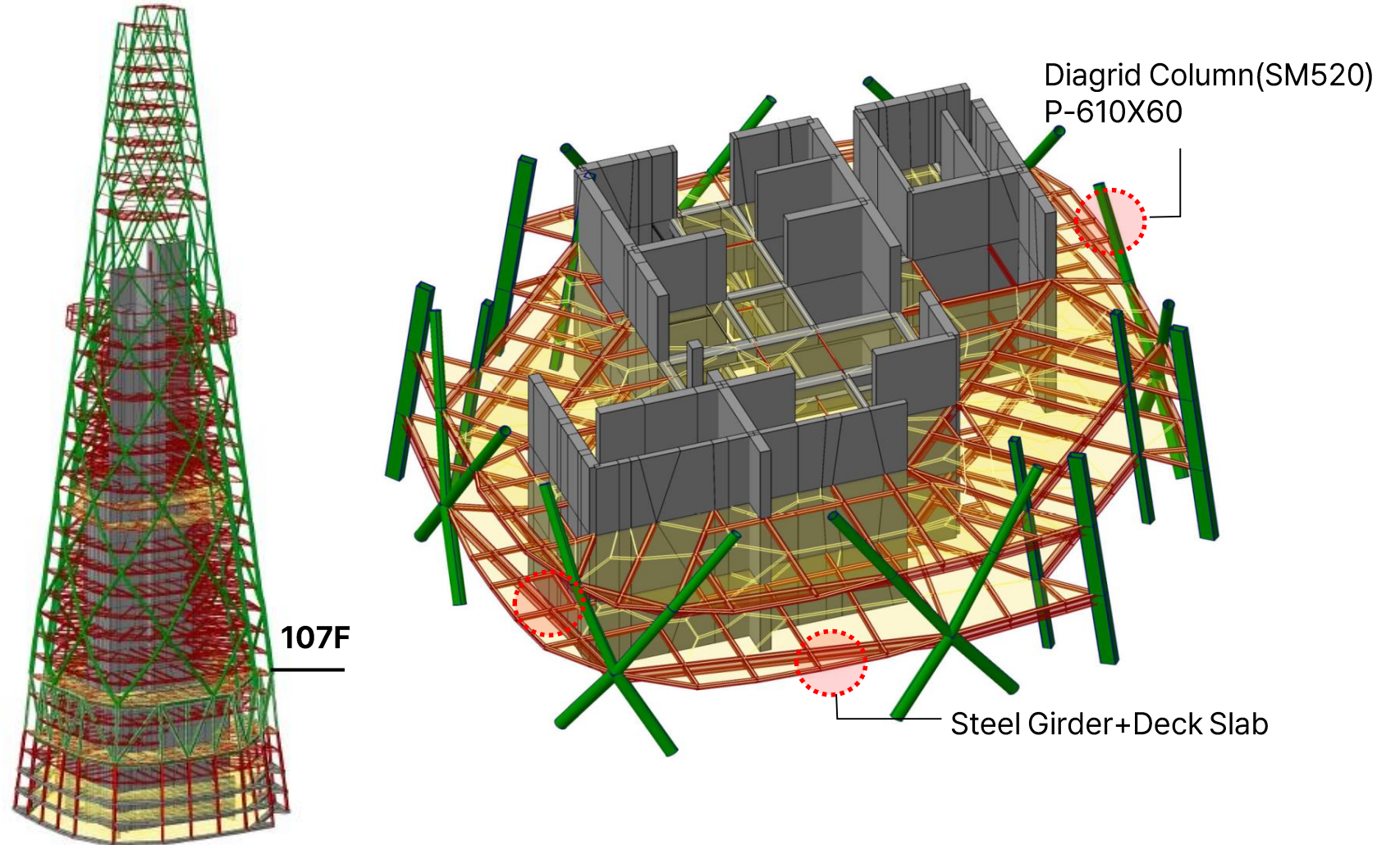
## Spandrel Girder





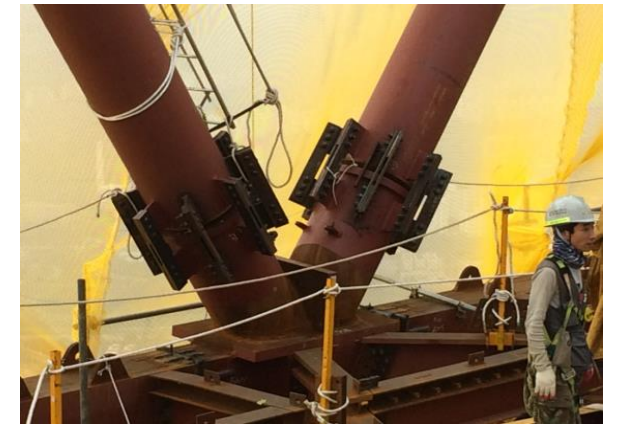
# Structural Design

## Lantern



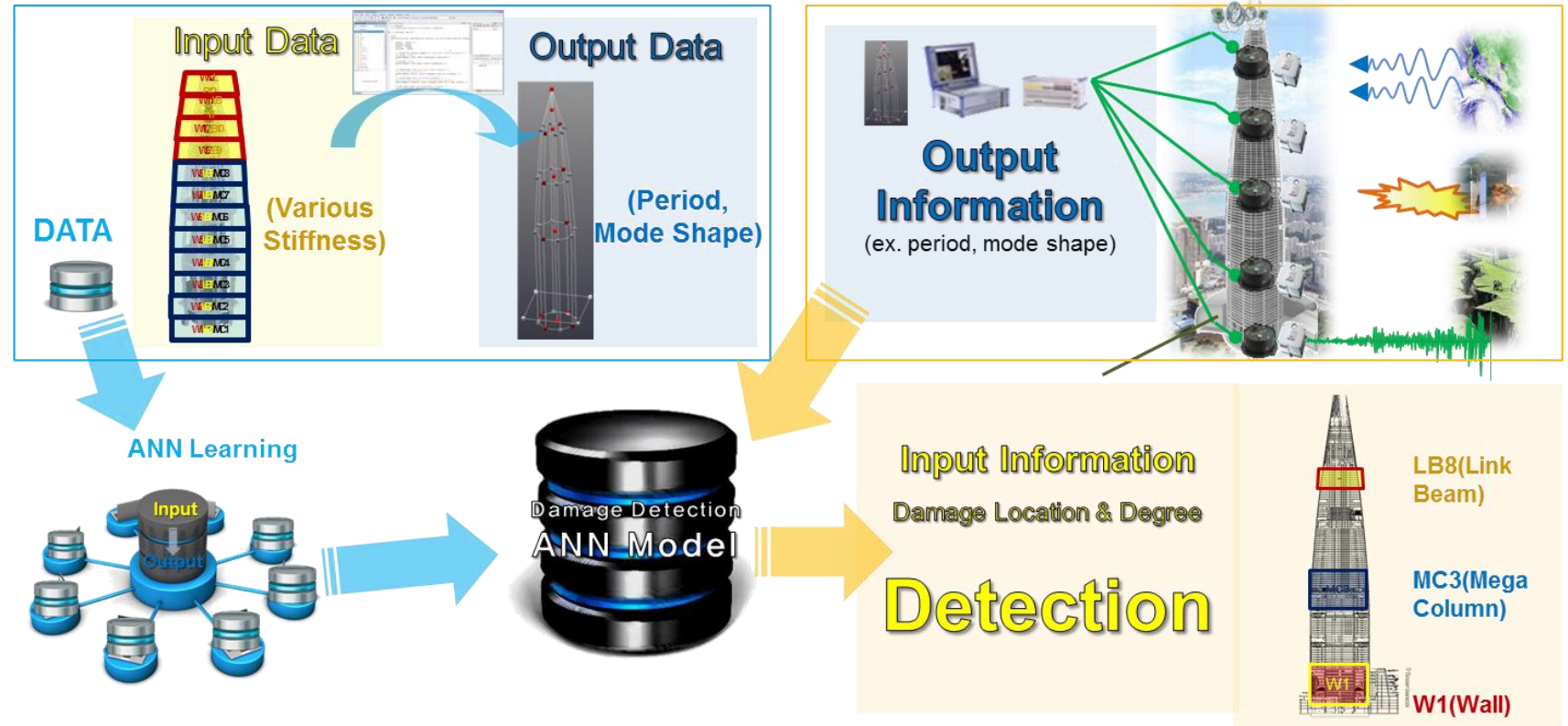
# Structural Design

## Lantern

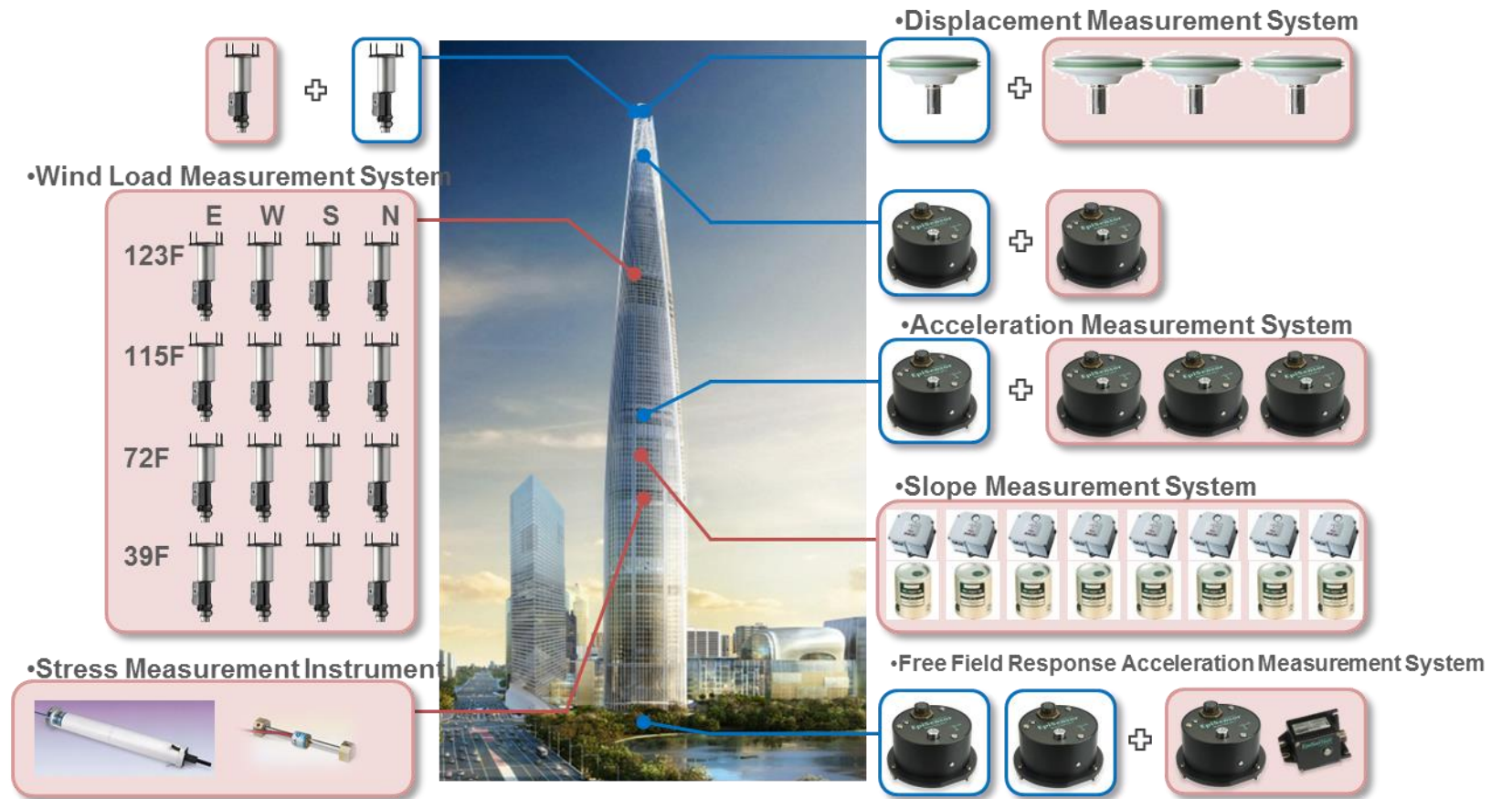




# Structural Health Monitoring System

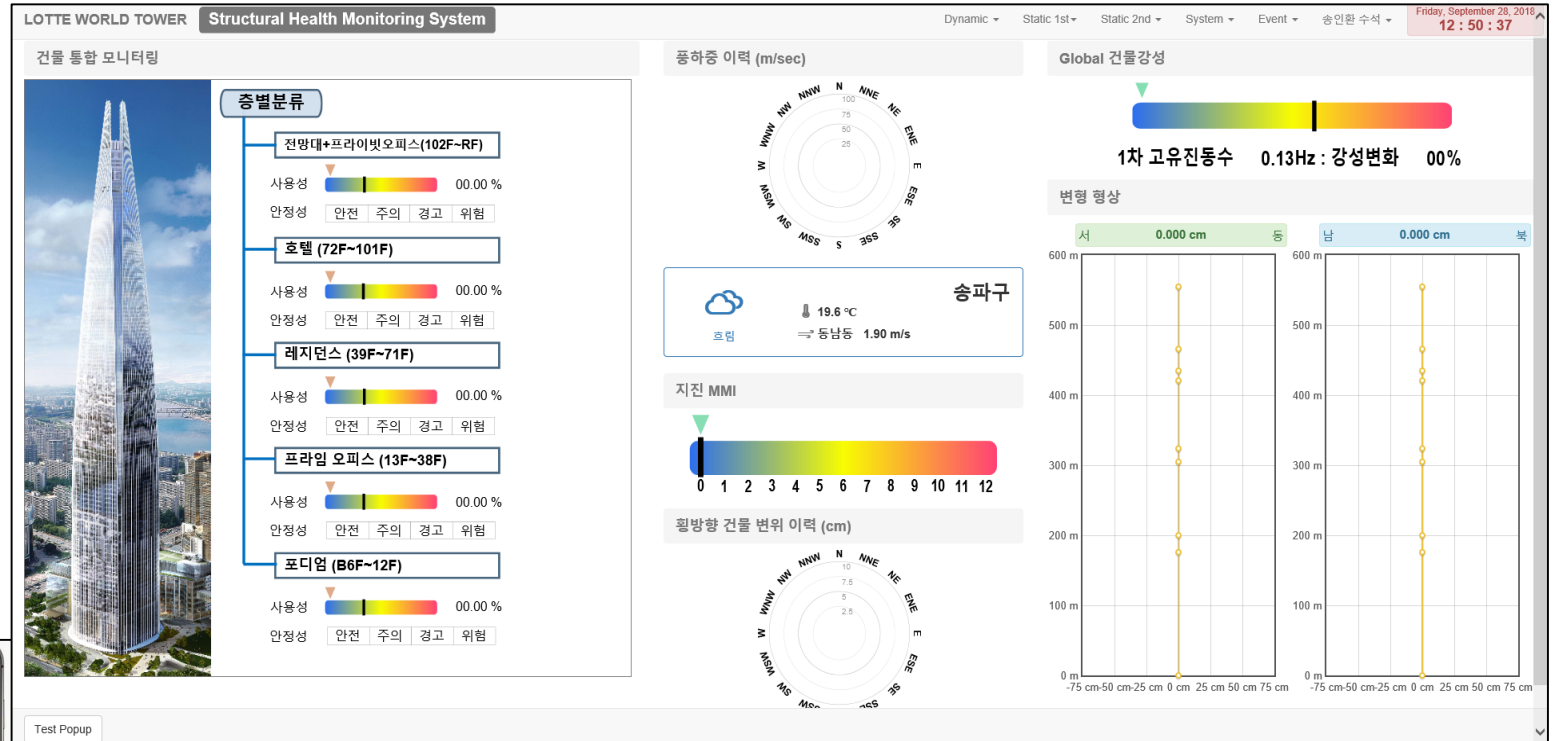


# Structural Health Monitoring System





# Structural Health Monitoring System



**THANK YOU!**