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**GRIND**  
**CITY**





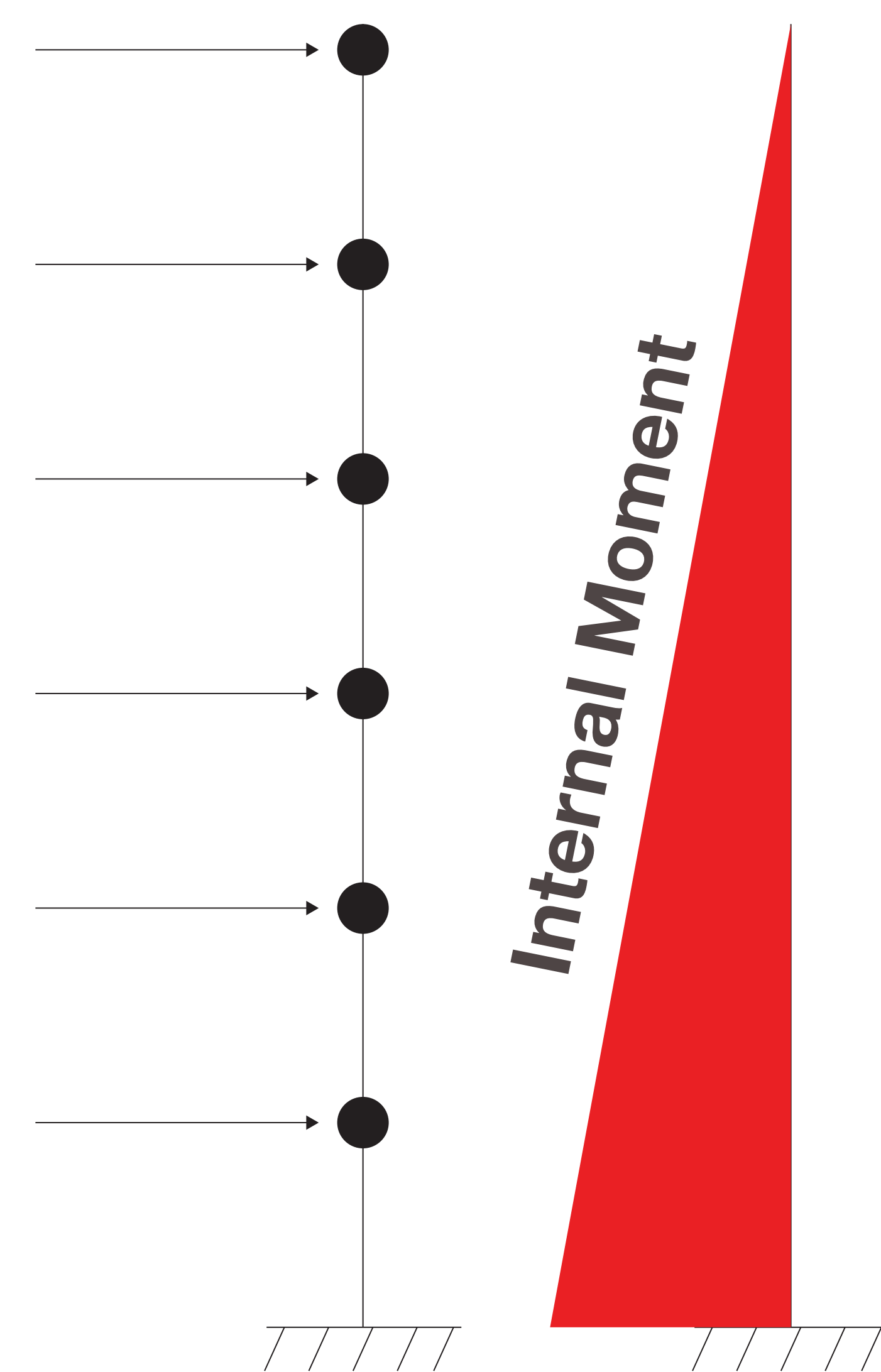
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## Seismic Load Mechanism

Earthquake forces originate from the fictitious force due to the ground acceleration and the mass source of the building.

It acts as a lateral load and the building behaves much like a cantilever beam.



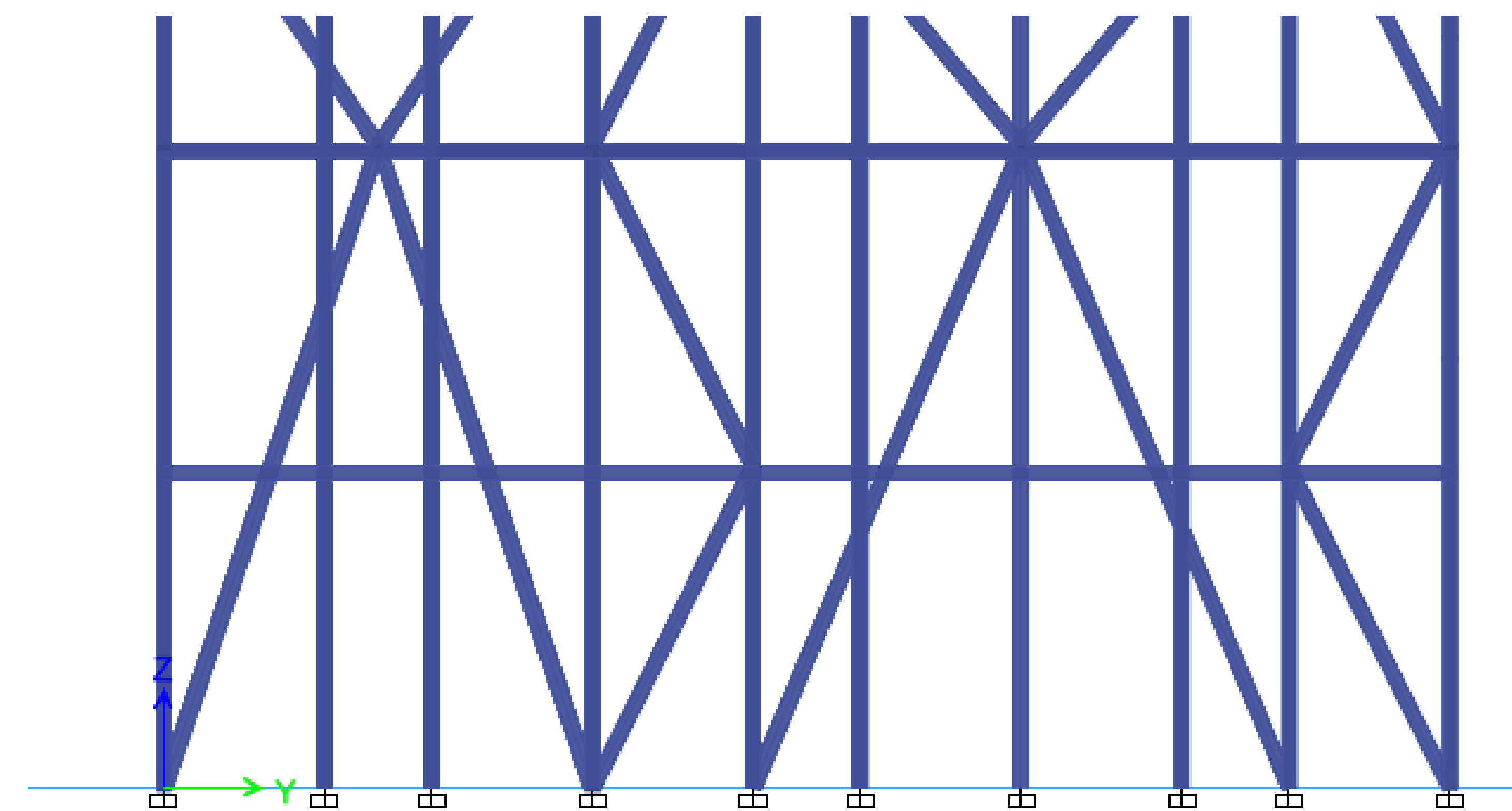
**Figure 1.** Illustration of Seismic Load

## Reinforced Lobby Structure

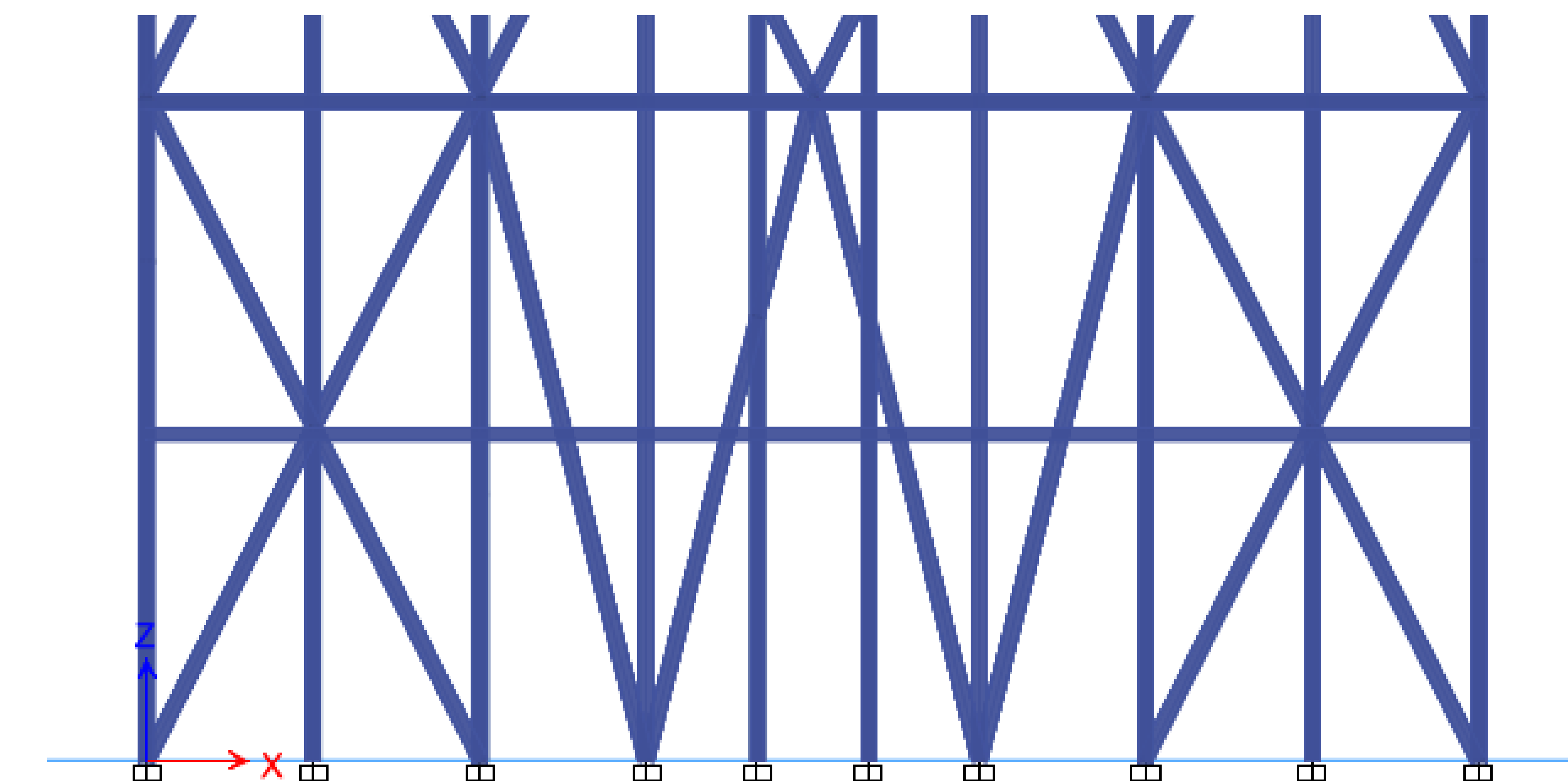
By doubling the member length, its critical buckling force is decreased by four times.

The internal compression force imposed on the bottom floor are immensely greater.

GRIND CITY has added additional bracing and rigid wall members to withstand this force.



**Figure 2.a** North-South Facade



**Figure 2.b** East-West Facade

## Horizontal In-plan Bracing due to Structural Irregularity

The T-shape of the floor plan can be systematic because of its structural irregularity. If we consider a line in Y-Y direction in the middle of the structure, the center of diaphragm does not lie in the middle of that line.

Due to the earthquake, the floor behaves like a cross section of the beam under torsion and the corners are exposed to more risk.

GRIND CITY features an in-plan bracing at the corners to reinforces these weaknesses.

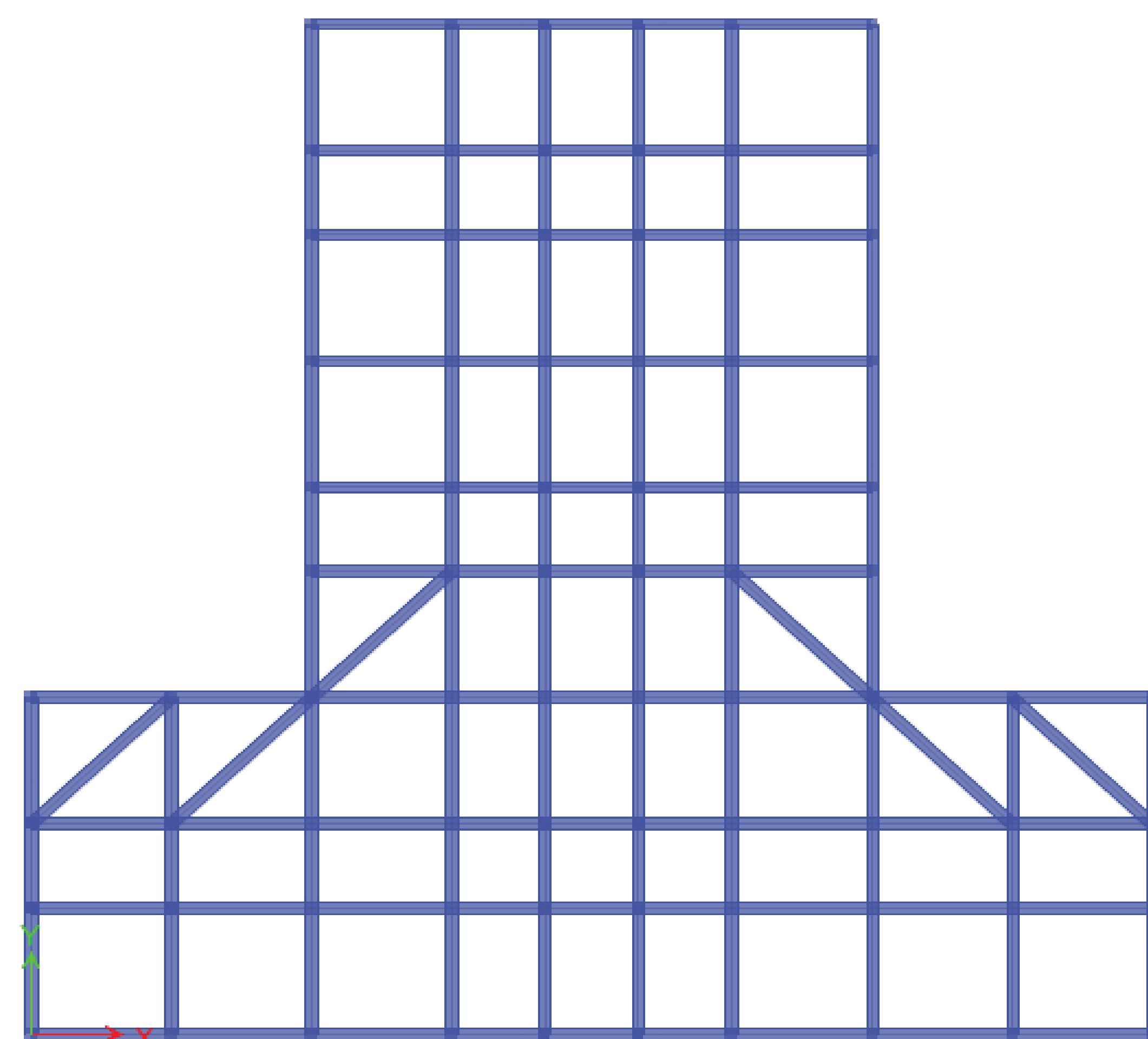
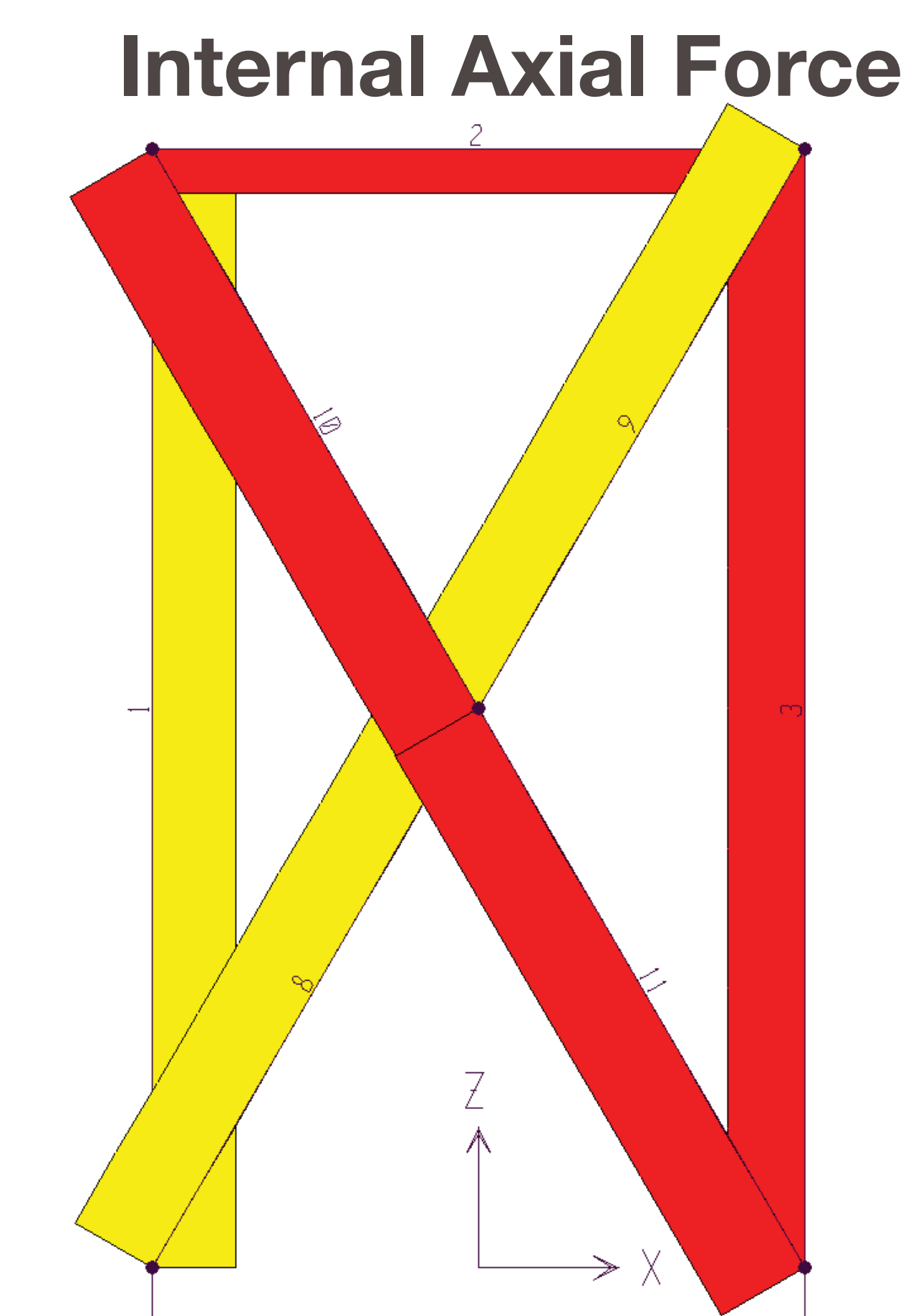


Figure 3. Typical Floor Plan

## Structural Bracing Topology Optimization

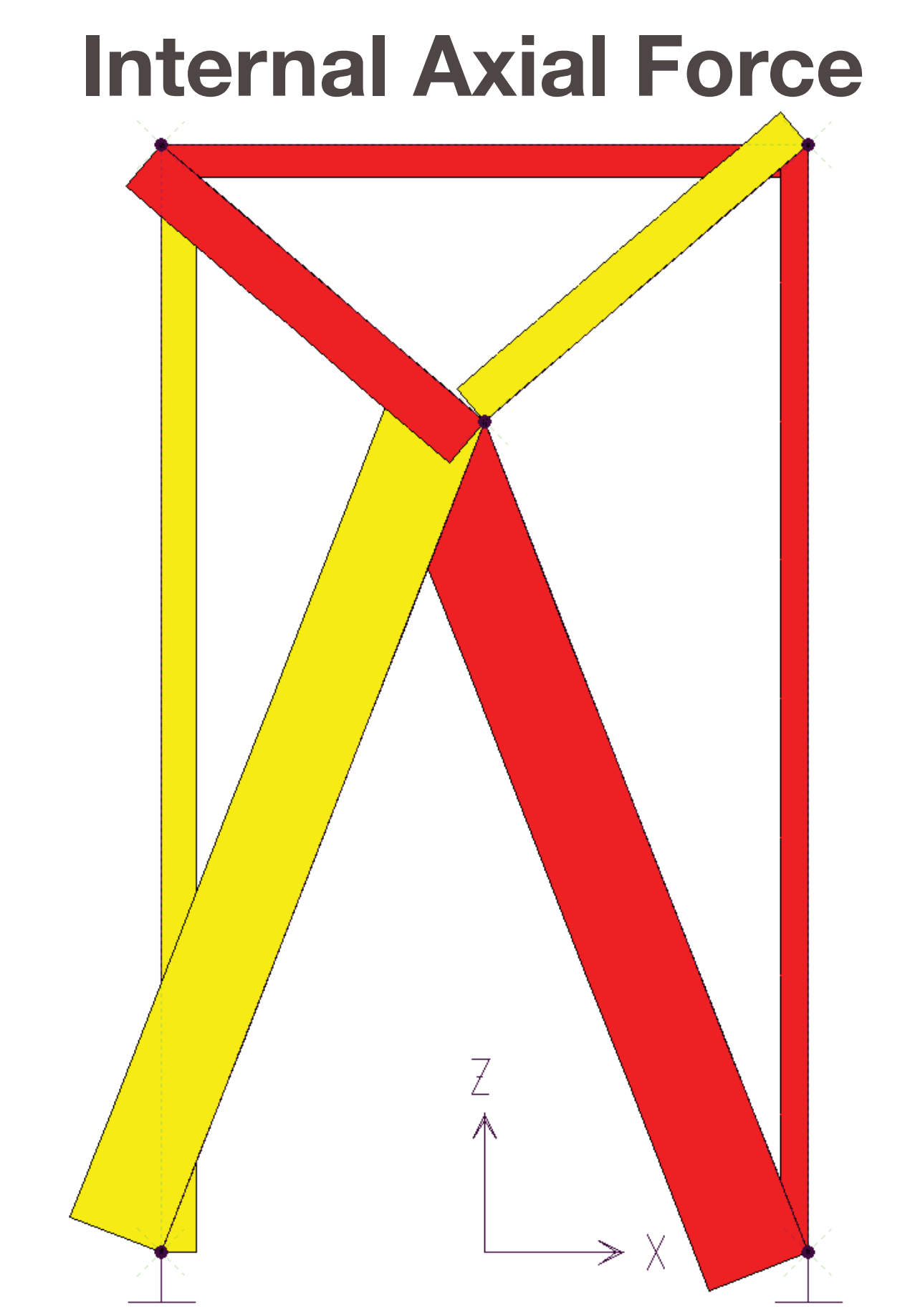
Unlike the conventional X bracing design, GRIND CITY utilizes the Super Braces which yield a better strength-to-weight ratio (SWR).

Compared to the X bracing, Super Braces put less compression force on the outer column which is the most critical member due to its longer length.



SWR = 156

Figure 4.a. X Bracing



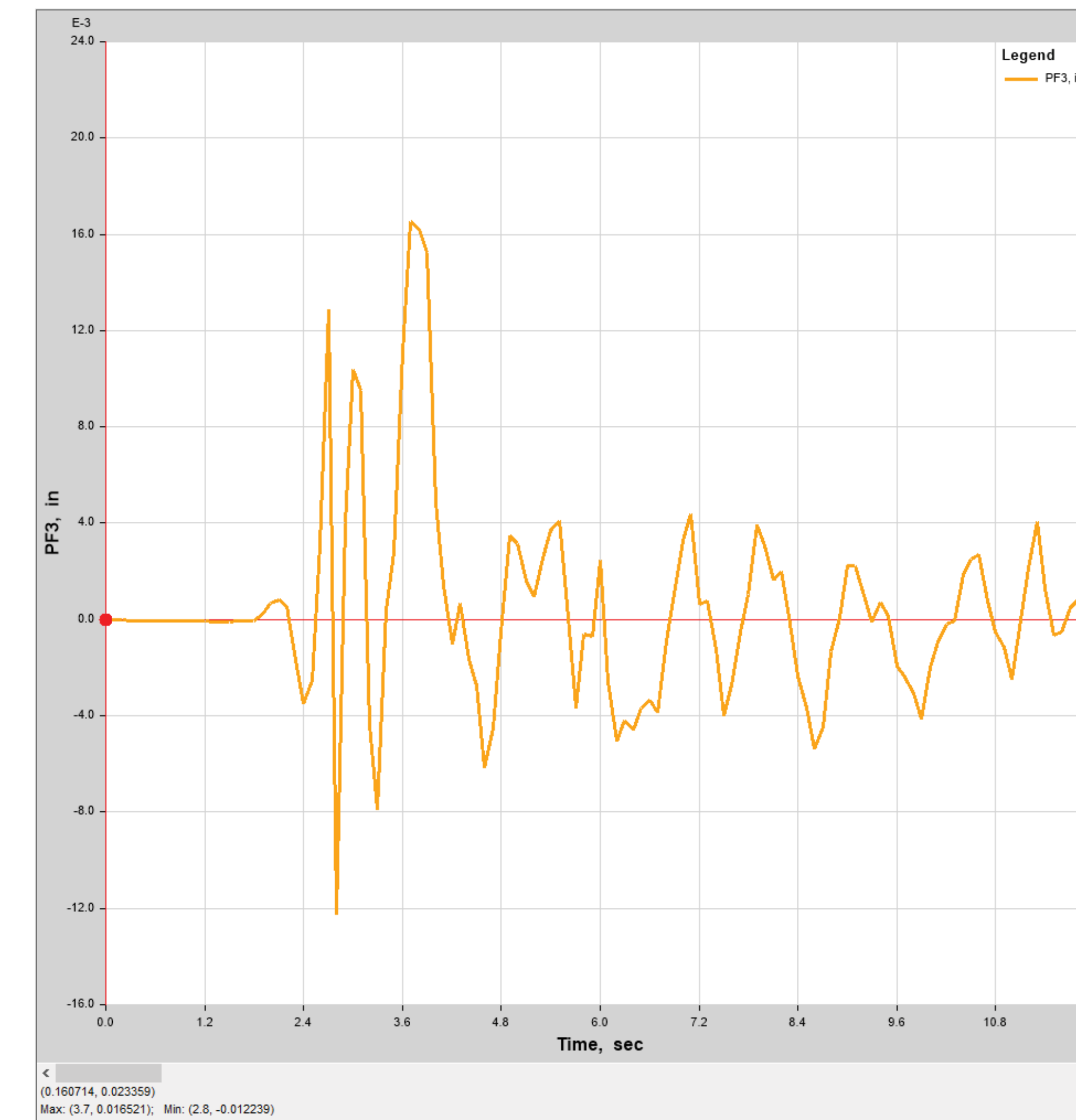
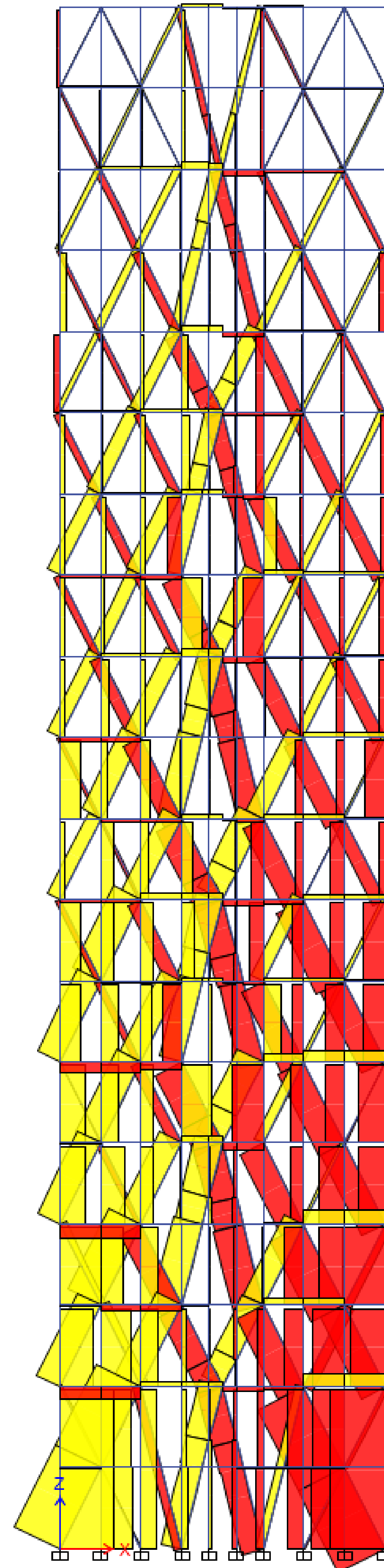
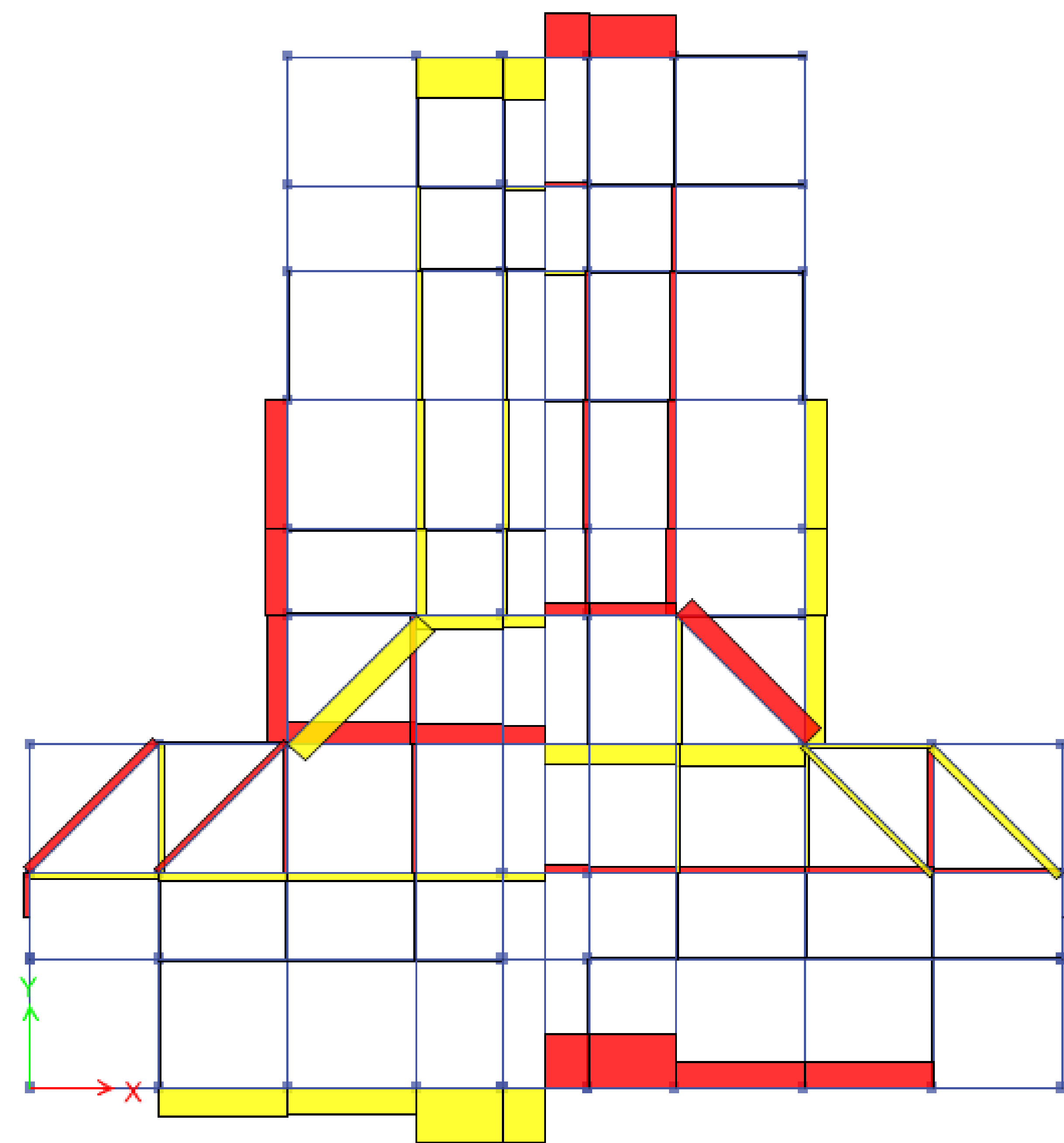
SWR = 337

Figure 4.b. Super Bracing

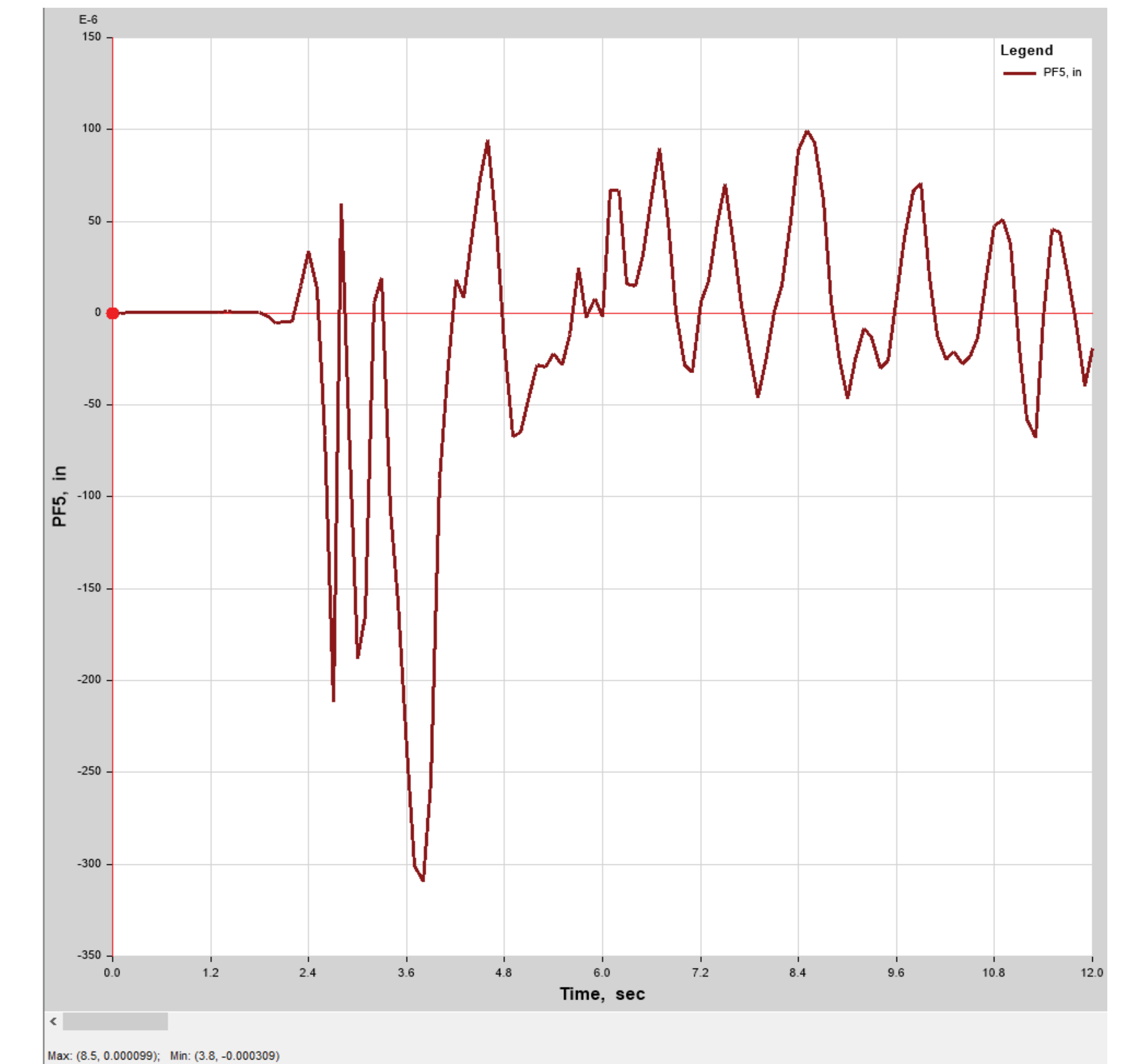




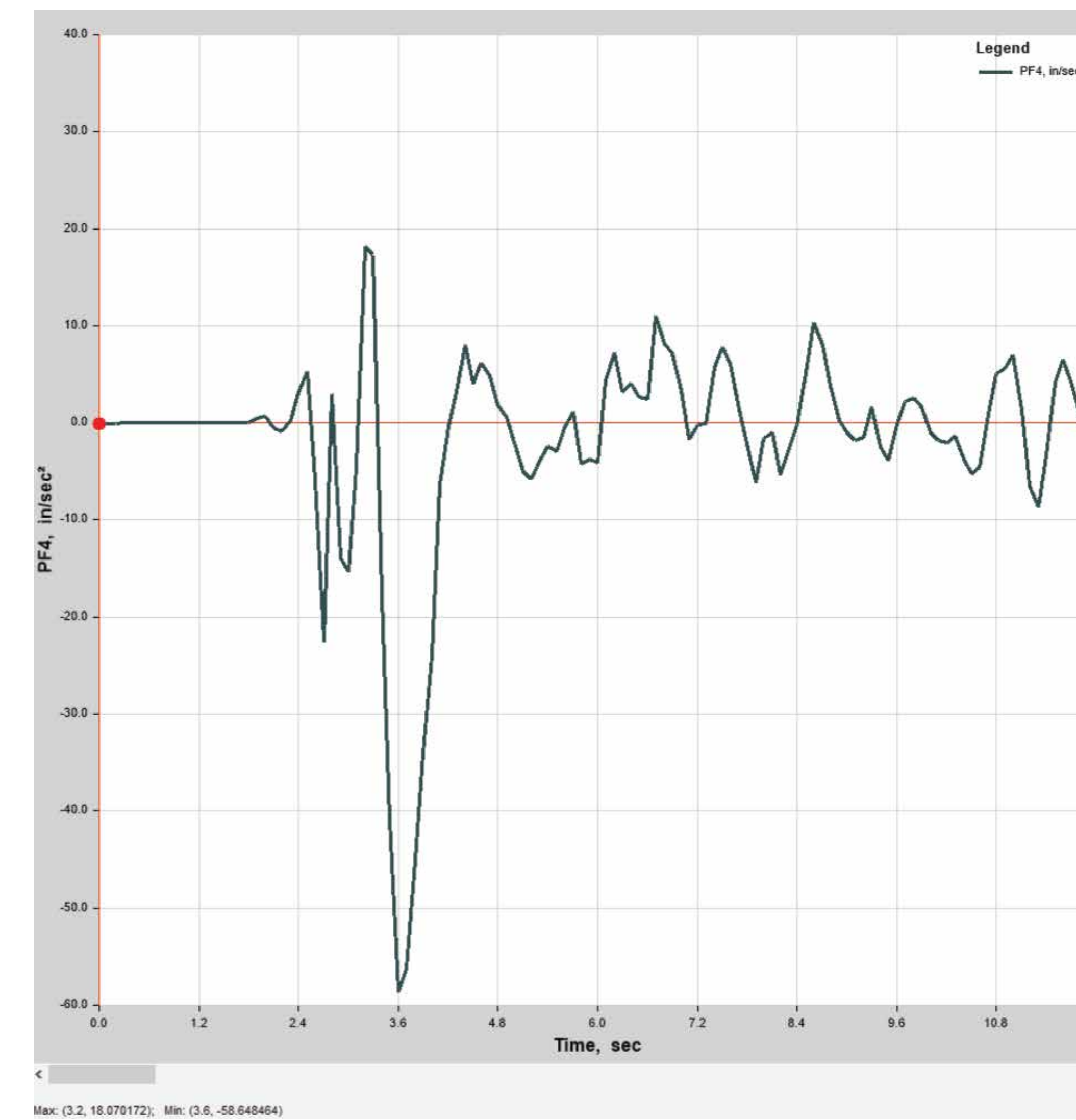
# STRUCTURAL BEHAVIOR



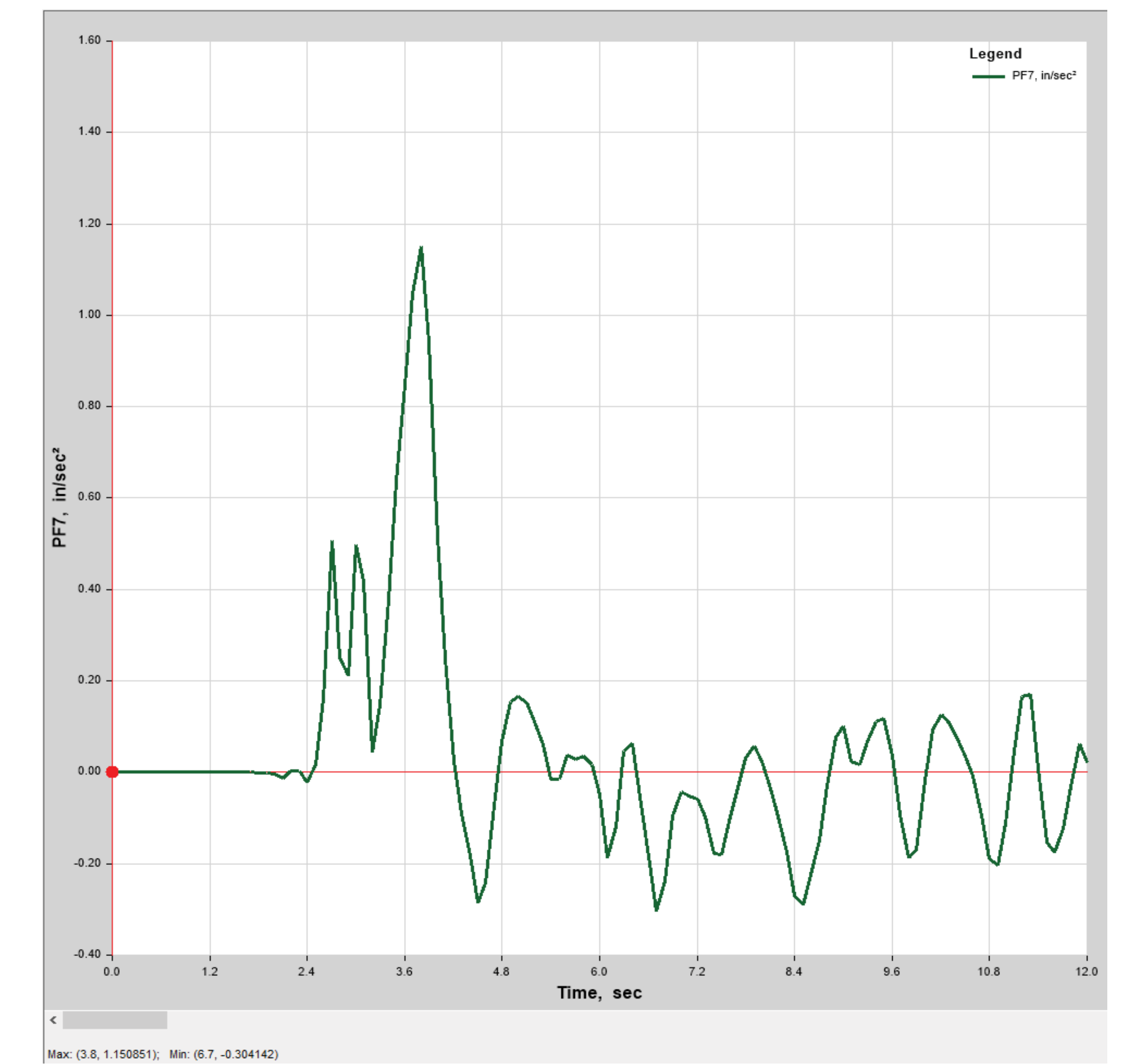
X-X Peak Roof Displacement: 0.0165 in.



Y-Y Roof Displacement: 0.0003 in.



X-X Roof Acceleration: 58.65 in/sec<sup>2</sup>



Y-Y Roof Acceleration: 1.151 in/sec<sup>2</sup>



# ARCHITECTURE DESIGN

GRIND CITY incorporates a very intricate design, with a sleek and bold manner of showing. The super bracing not only provides a key structural property but provides the structure a burst of character. Since this structure's shape is so unique, we brainstormed to create an innovative design that has never been seen before.

The exterior skeleton of our structure will incorporate some environmentally friendly green plants. These are ideal for the eco-friendly environmental design, in a city that prides itself on urban sustainability.

GRIND CITY will fit well into Greenest City Action Plan for Vancouver, because of its character, eco-friendly features, expensive taste, and adaptation to the surrounding environment and healthy atmosphere.

- ▶ **18** stories high totaling up to **57** inches tall
- ▶ Provides **1600** square inches of rentable floor area
- ▶ Aesthetically pleasing design of outer bracing system
- ▶ Lobby floor height doubled for retail space





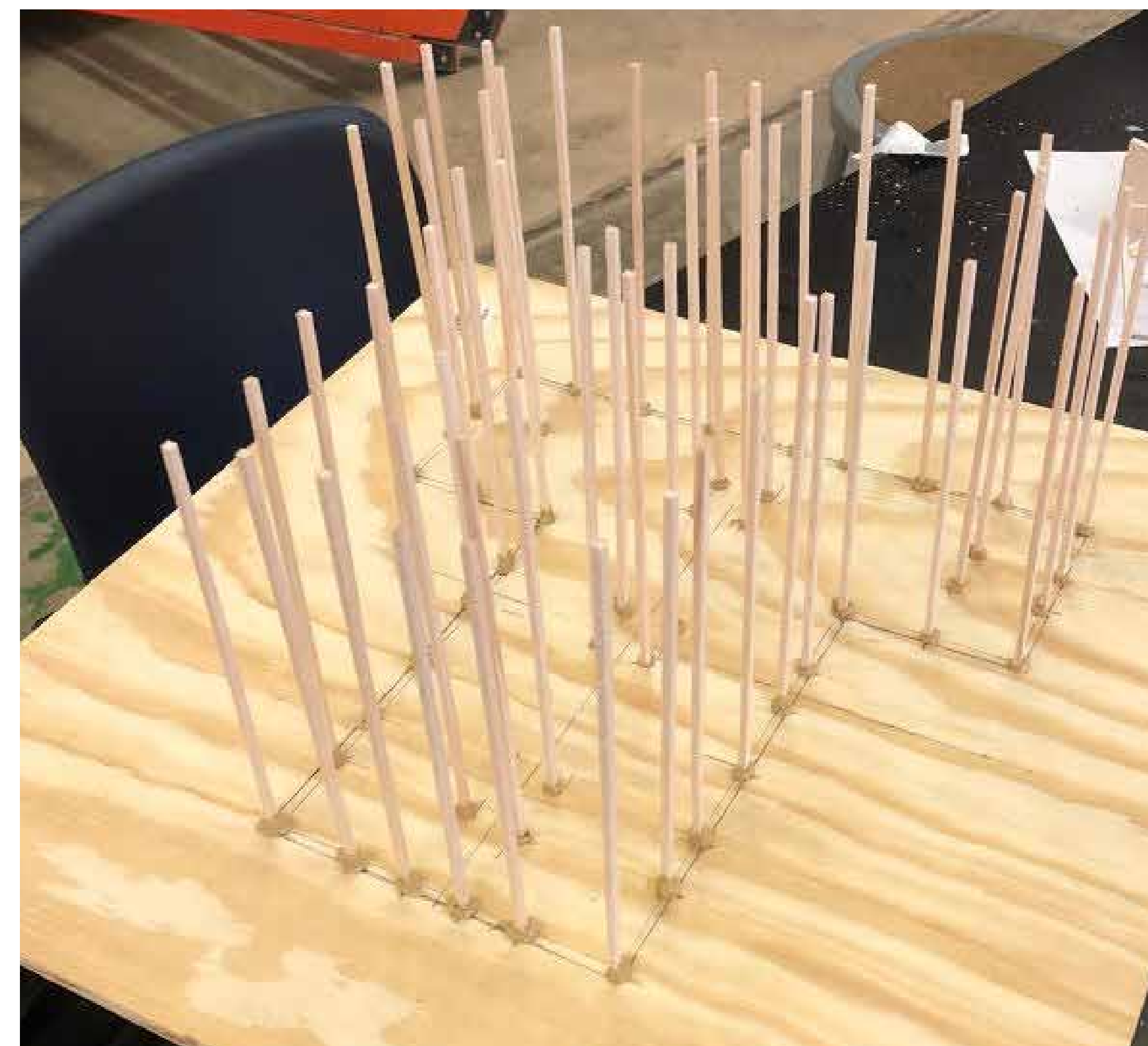
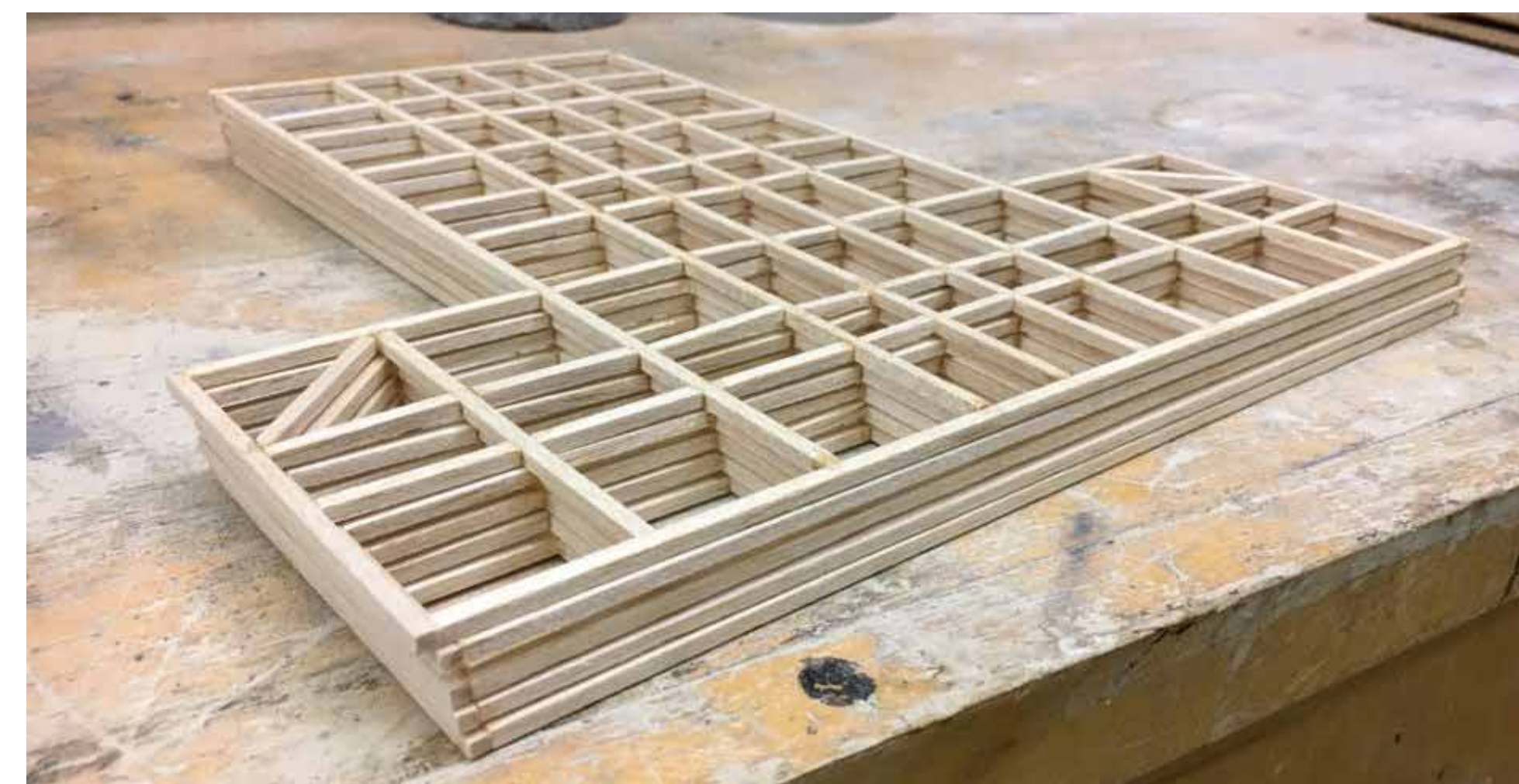
# BUILDING FEATURES

## ECONOMICS

Annual Revenue			
Floors	Total Area	Rental Rate	Revenue
1-2	178 in <sup>2</sup>	\$250	\$44,570
3-9	619 in <sup>2</sup>	\$175	\$108,321
10-15	535 in <sup>2</sup>	\$225	\$120,338
16-18	267 in <sup>2</sup>	\$275	\$73,540
<b>Total Area</b>	<b>1600 in<sup>2</sup></b>		
<b>Total Annual Revenue</b>			<b>\$346,769</b>

Annual Building Cost		
<b>Weight</b>		0.738 lb.
<b>Construction Cost</b>		\$ 7,360,503
<b>Land Cost</b>		\$3,119,878
<b>Annual Building Cost</b>		\$104,804
<b>Annual Seismic Cost</b>	North-South	\$7,133
	East-West	\$ 3,769
<b>Final Annual Building Income</b>	North-South	<b>\$234,832</b>
	East-West	<b>\$238,196</b>

# CONSTRUCTION







# CONCLUSION

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