STRUCTURAL CASE STUDY

WYLY THEATER

Anthony Antunez
Hayley Field
Michael Irving
Ziyang Li
Eric Liao
Juan Rodriguez

PROJECT OVERVIEW

Firm: REX + OMA

Location: Dallas, Texas

Client: Dallas Theater Center

Partners: Rem Koolhaas, Joshua Prince-Ramus

Executive Architect: Kendall/Heaton Associates

Structure: Magnusson Klemenic Associates

Mechanical: Transsolar / Cosentini / Plus Group

Theater Design: Theatre Projects Consultants

Project Year: 2009

Project Area: 82,882.11 square feet

Building Type: Mid-rise

Building Usage: Theater

Seats: 575

Site Usage: Performance, Gathering Space

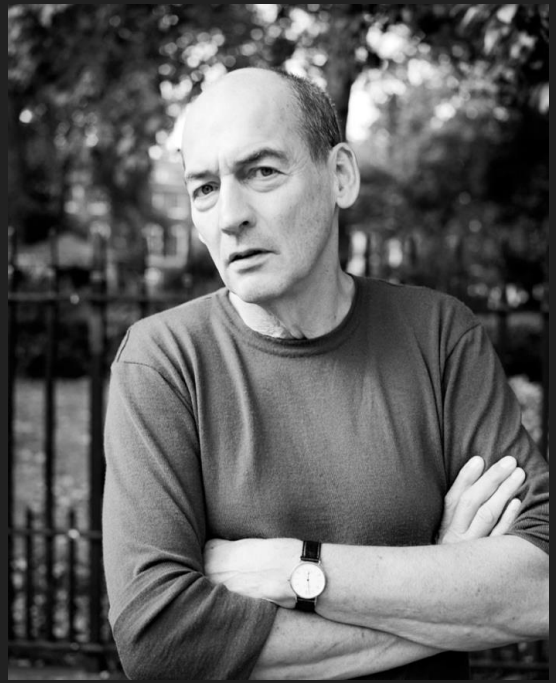
Height: 151 feet

Floors: 10

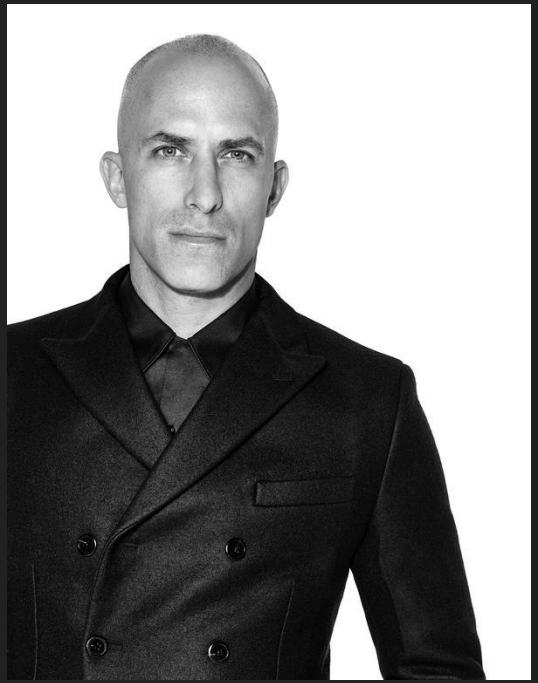
Awards: 2011 AIA Honor Award

ARCHITECTS

Rem Koolhaas, OMA

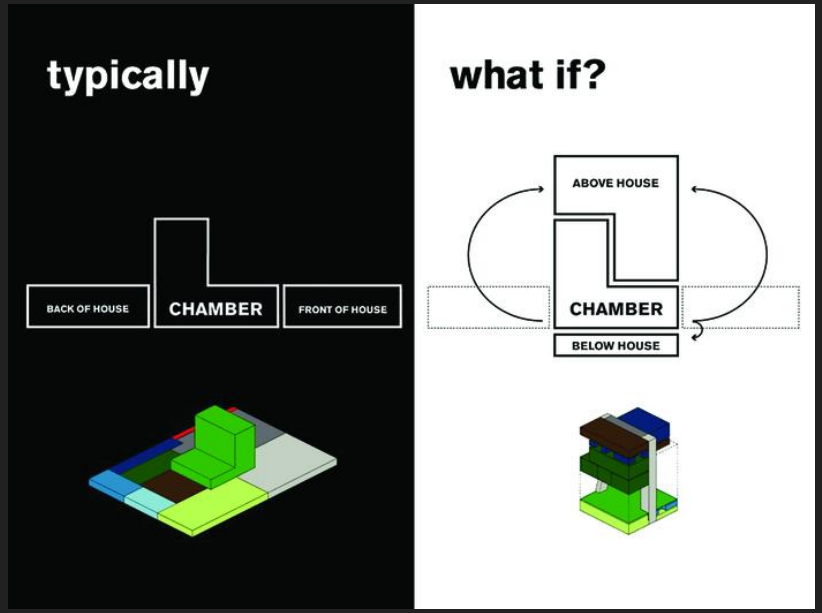


Joshua Prince-Ramus, REX



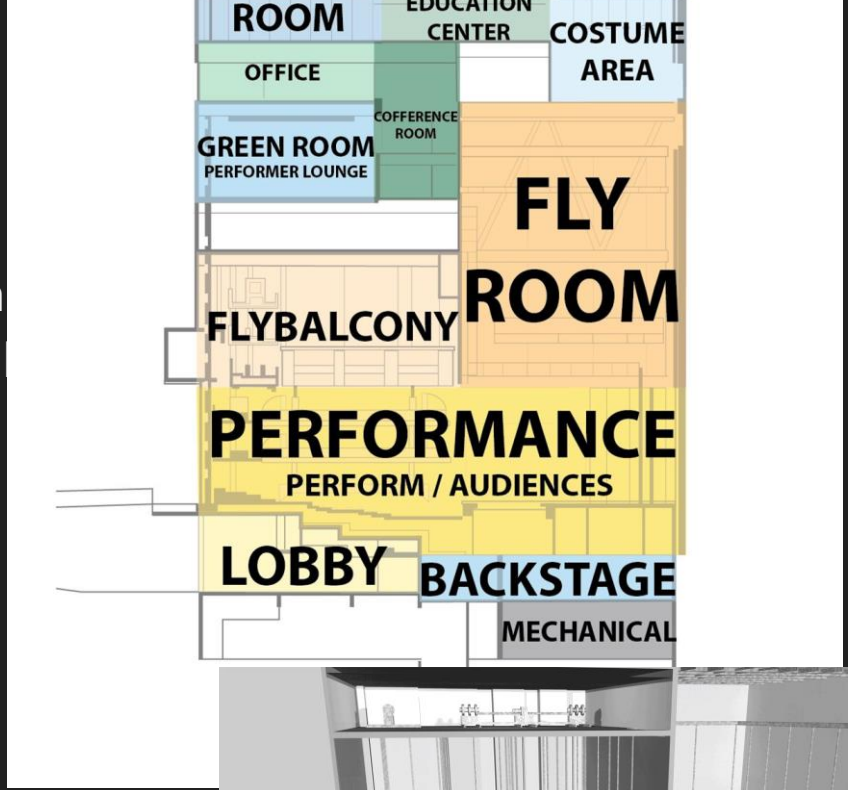
DESIGN CONCEPT

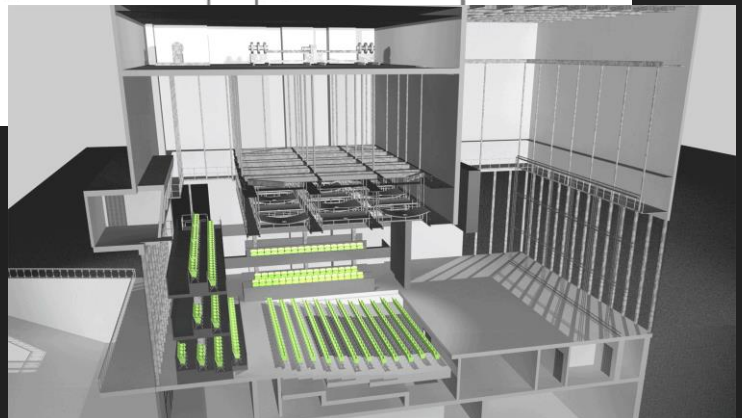
- Instead of following the traditional format of a theater, where the front and back of the house flank the main auditorium, they decided to stack them vertically. By doing this we are able to add more public space to it.
- By stacking the different components of the theater, the architects liberated the performance chamber's entire perimeter and allowed performers to mix fantasy and reality when they desired.
- In addition to the architects wishing to flip the idea of the theater on its head, they wanted the Wyly to stand its ground in size when compared to its next door neighbors: Norman Foster's Winspear Opera House and I. M. Pei's Meyerson Symphony Center.
- "I hate the traditional theater profile of the door, auditorium, back of house, and front of house. Instead, we chose to pile the front-of-house and back-of-house functions on top of and below the auditorium, making for a smaller footprint overall."
  - Rem Koolhas



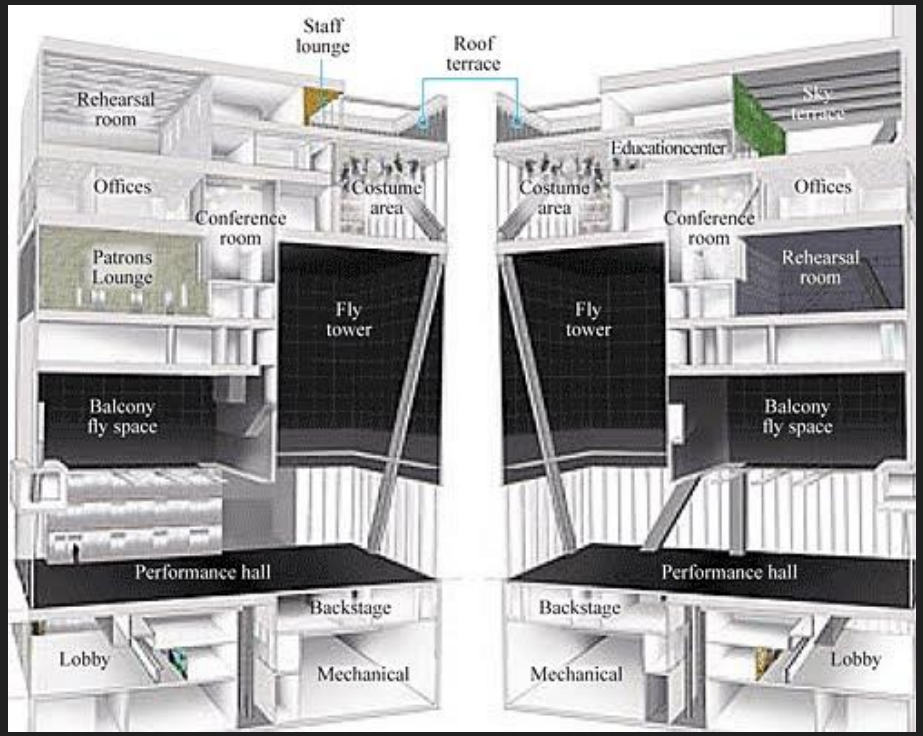
LAYOUT

- The Wyly Theater is a compa
  story building with different
  heights.
- The theater can be set up in
  different ways
  - Proscenium
  - Thrust
  - Arena
  - Traverse
  - Studio theater
  - Bipolar sandwich
  - Flat floor configuration.





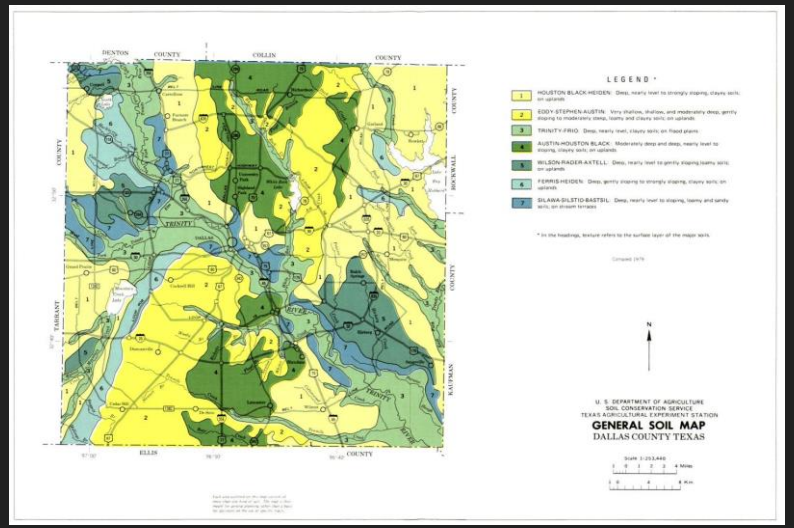
Layout


Staff lounge
Roof terrace
Rehearsal room
Offices
Conference room
Costume area
Patrons Lounge
Fly tower
Balcony fly space
Performance hall
Backstage
Lobby
Mechanical
Educationcenter
Costume area
Offices
Conference room
Rehearsal room
Fly tower
Balcony fly space
Performance hall
Backstage
Mechanical
Lobby

SOIL

Clay Soil

- Highly expansive and extremely absorbent
- Common in the North Texas Area
- The soil consists of tiny packed particles that are dense and can be difficult to work with.

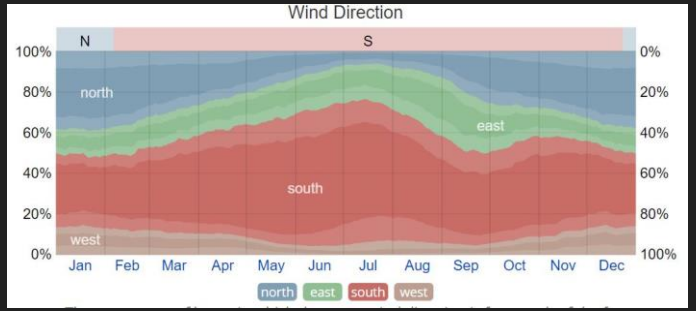


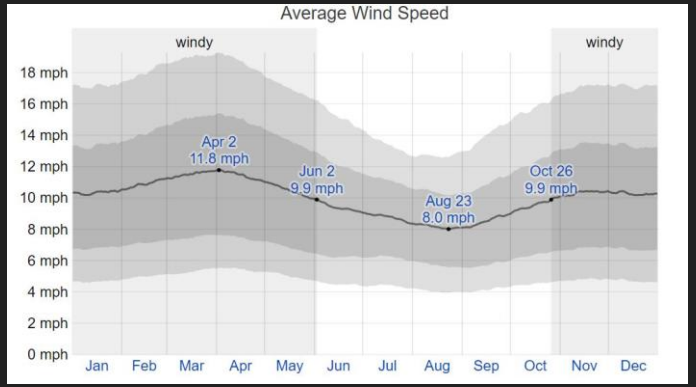
FOUNDATION

- Lowest floor
  - Two stories deep surrounded by three concrete retaining walls with ramp leading down to the entrance
- Concrete drilled pier foundation
  - 40ft deep

FORCES OF NATURE

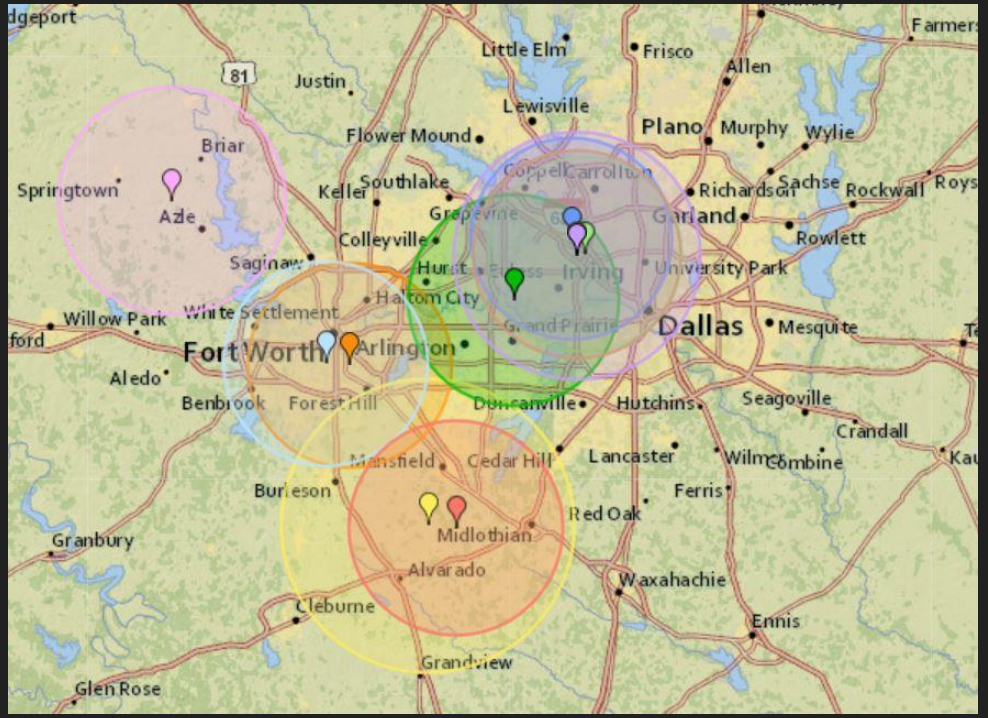
- Primarily sees wind forces
  - Highest Average wind speed - 11.8 mph
  - Lowest Average wind speed - 8 mph
- Has potential of seismic activity
  - Last seismic activity recorded in May 2018
    - 3.5 magnitude
  - This is combated by using a rigid frame





SEISMIC DATA

- 4 months ago 2.3 magnitude, 5 km depth
  Fort Worth, Texas, United States
- 6 months ago 3.5 magnitude, 5 km depth
  Venus, Texas, United States
- 10 months ago 1.7 magnitude, 6 km depth
  Irving, Texas, United States
- about a year ago 2.5 magnitude, 6 km depth
  Irving, Texas, United States
- about a year ago 2.1 magnitude, 4 km depth
  Farmers Branch, Texas, United States
- about a year ago 3.1 magnitude, 5 km depth
  Irving, Texas, United States
- about a year ago 2.8 magnitude, 3 km depth
  Azle, Texas, United States
- 2 years ago 2.3 magnitude, 5 km depth
  Fort Worth, Texas, United States
- 2 years ago 2.4 magnitude, 7 km depth
  Irving, Texas, United States
- 2 years ago 2.6 magnitude, 5 km depth
  Venus, Texas, United States



STRUCTURAL SYSTEM

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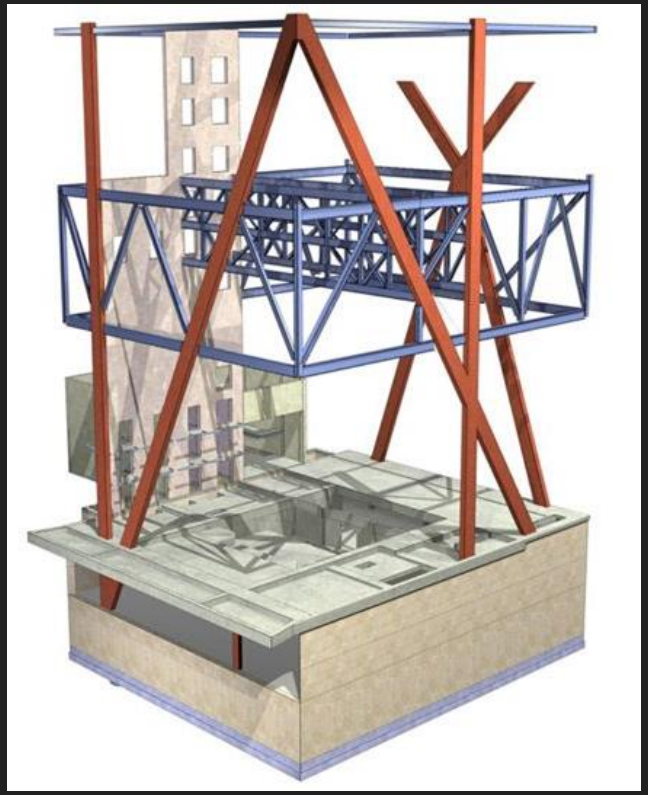
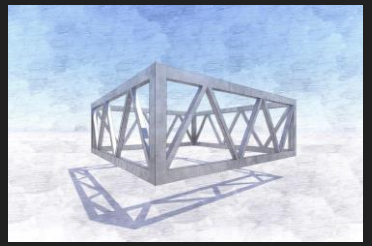


Reinforced Concrete Columns

- Battered and Vertical
- 6 members
- 18in x 4ft
- Largest 166ft

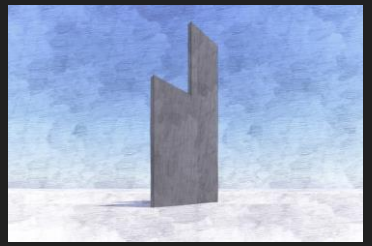
Steel Belt Truss

- 32ft in depth



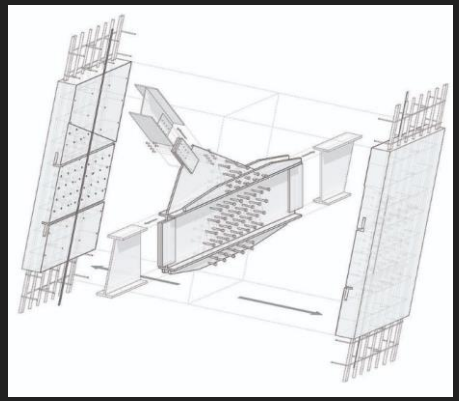
Reinforced Concrete Shear Wall

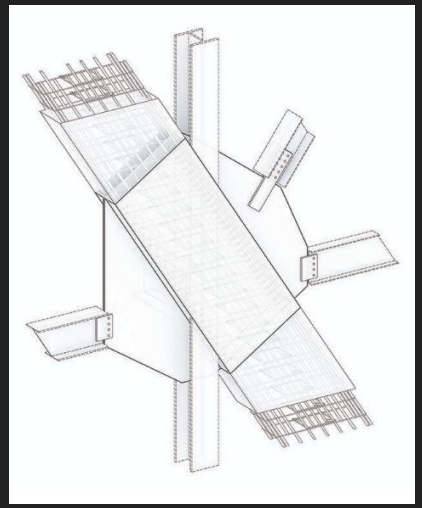
- 135ft in height
- 85ft in width



NODAL POINT CONNECTIONS

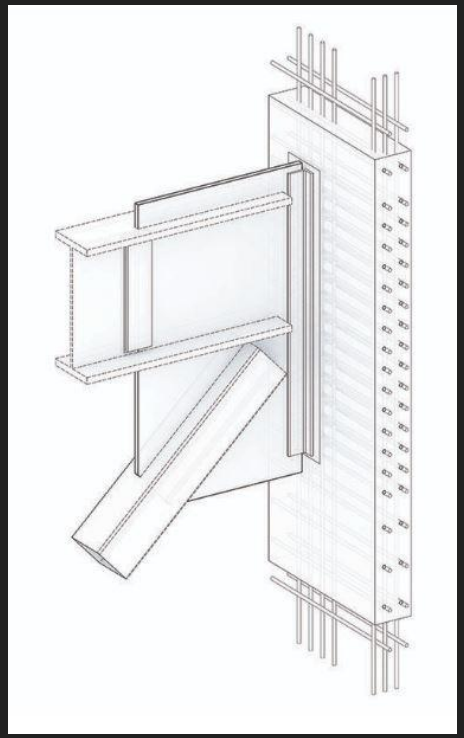
- Custom steel members cast in the concrete.
- Steel members connected in nodal points.
- Bolt holes in steel to bolt steel members going into joint.
- Critical alignment.





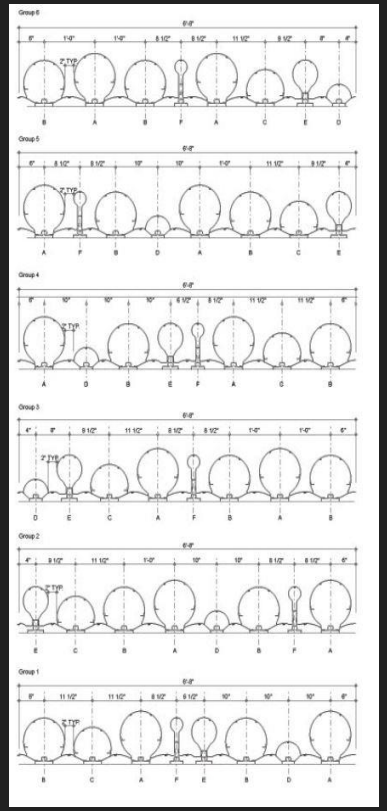
SHEAR WALL CONNECTIONS

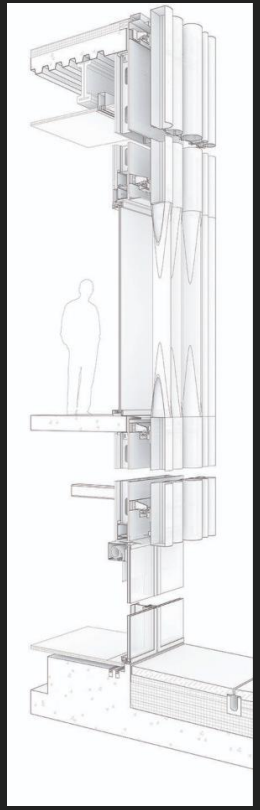
- Steel members welded to an angle that is embedded in shear wall.
- Steel frame acts as a wind bracing.



WALLS

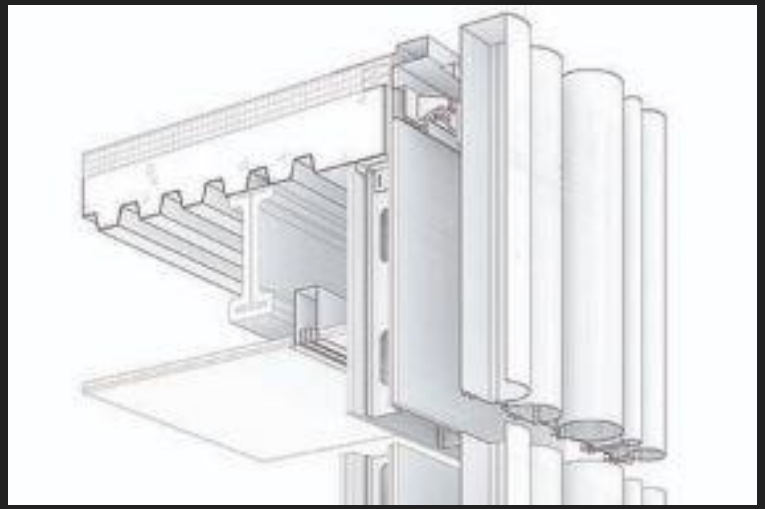
- Theatre walls are all glass.
- Aluminum Tubes were made in Argentina
- Meant to look like drapes
- Composed 466 anodized aluminum tubes
- Walls are suspended from the ceiling above.

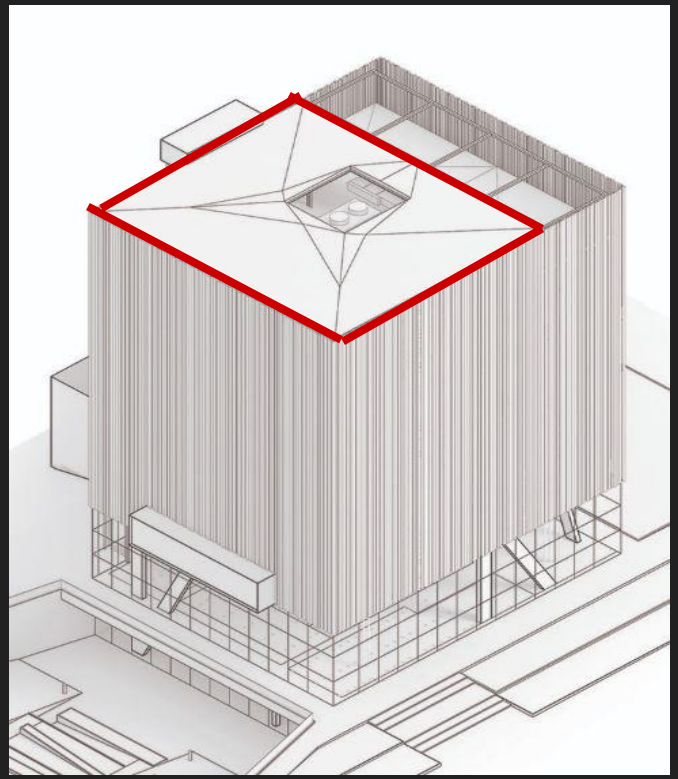




ROOF

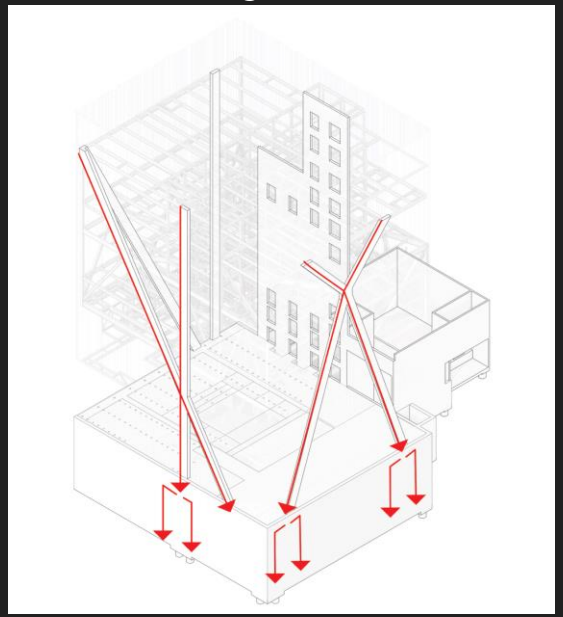
- Acts as a tension element.
- Consists of metal decking for concrete slabs
- Supported with I-beams

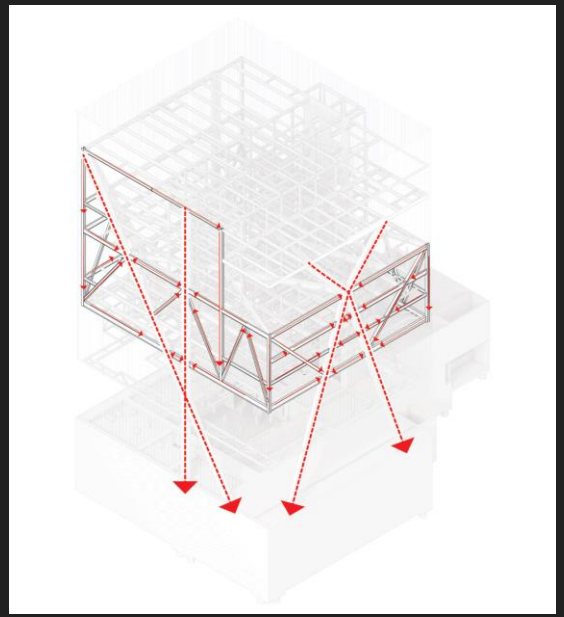


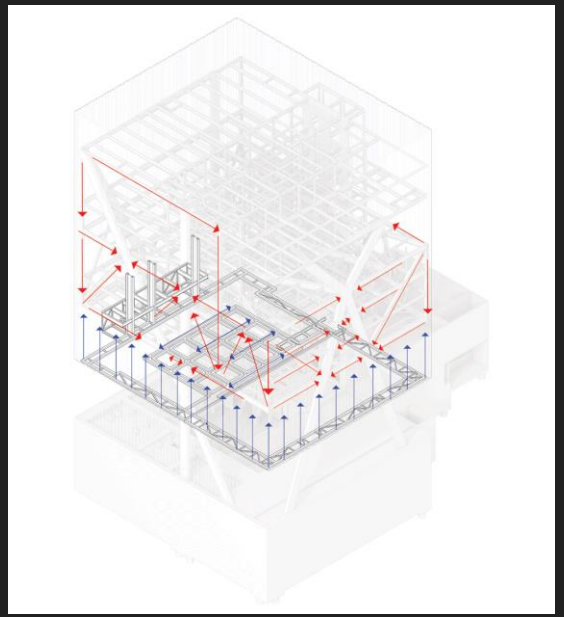


STRUCTURAL ANALYSIS

Load tracing

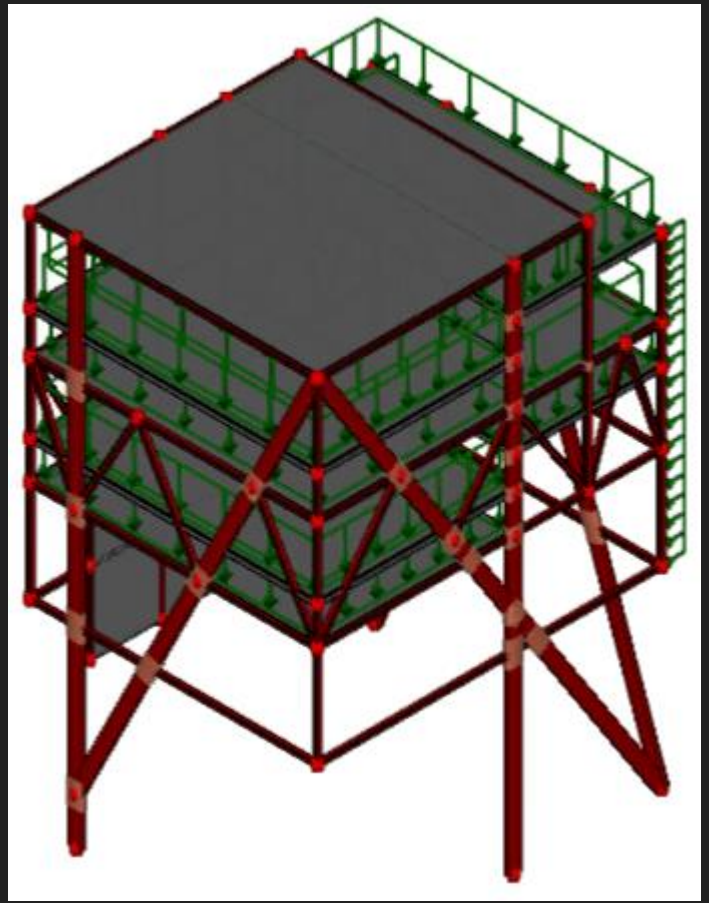






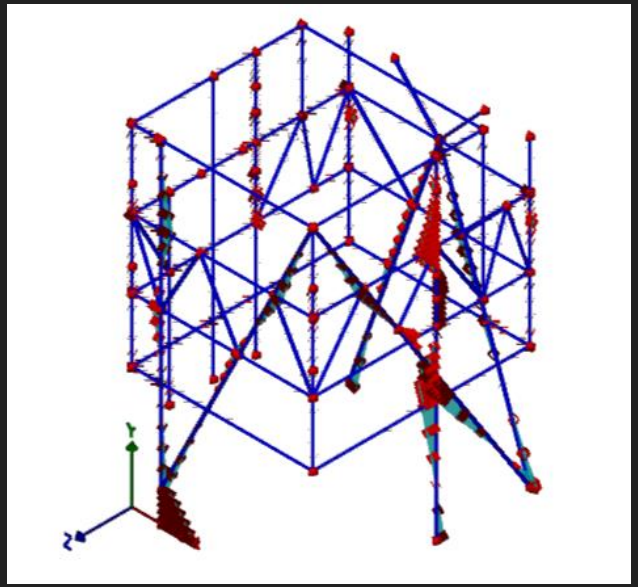
STRUCTURAL ANALYSIS

- Uniform distributed occupancy live load of 100 psf on all floors
- An additional 50 psf snow load is added on the roof
- Wind load of 30 psf on the South side



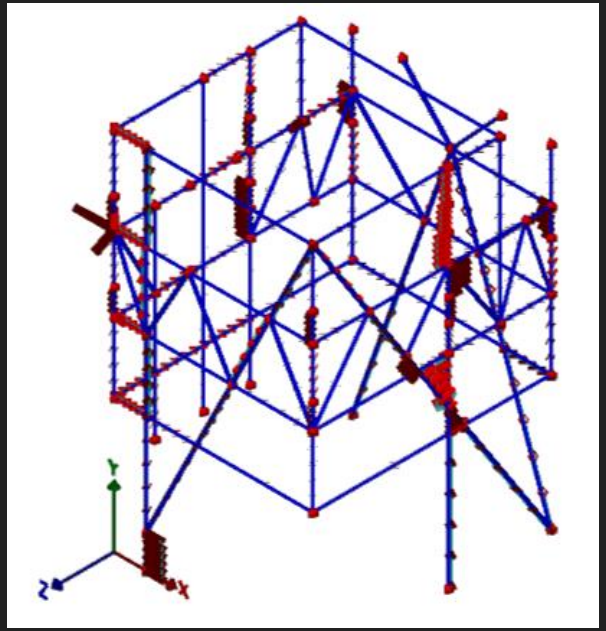
STRUCTURAL ANALYSIS

Moment: the largest bending moment occurs at the foundation of the mega-column.



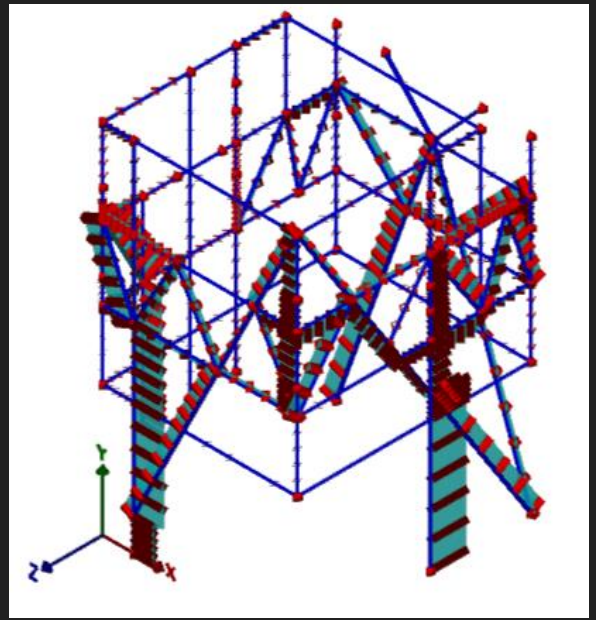
STRUCTURAL ANALYSIS

Shear: the largest y-direction shear occurs when two mega-columns meet. If there is no belt truss the shear might be greater



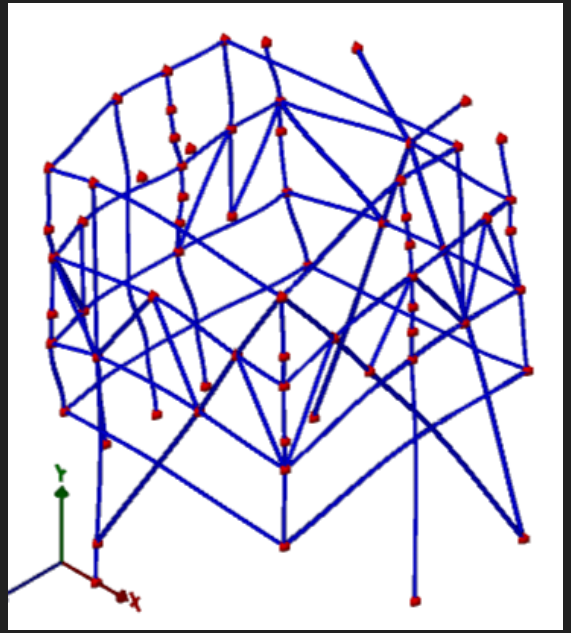
STRUCTURAL ANALYSIS

The axial force: the greatest axial force occurs in the mega-column. The mega-columns bear the majority load, since the most of the load transfer to the mega-columns.



STRUCTURAL ANALYSIS

Deflection: The mega-columns shows a little deflection while the other w-section structural frames shows greater deflection. The mega-columns are steel reinforced concretes that have greater cross sections, which can resist more stress.



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