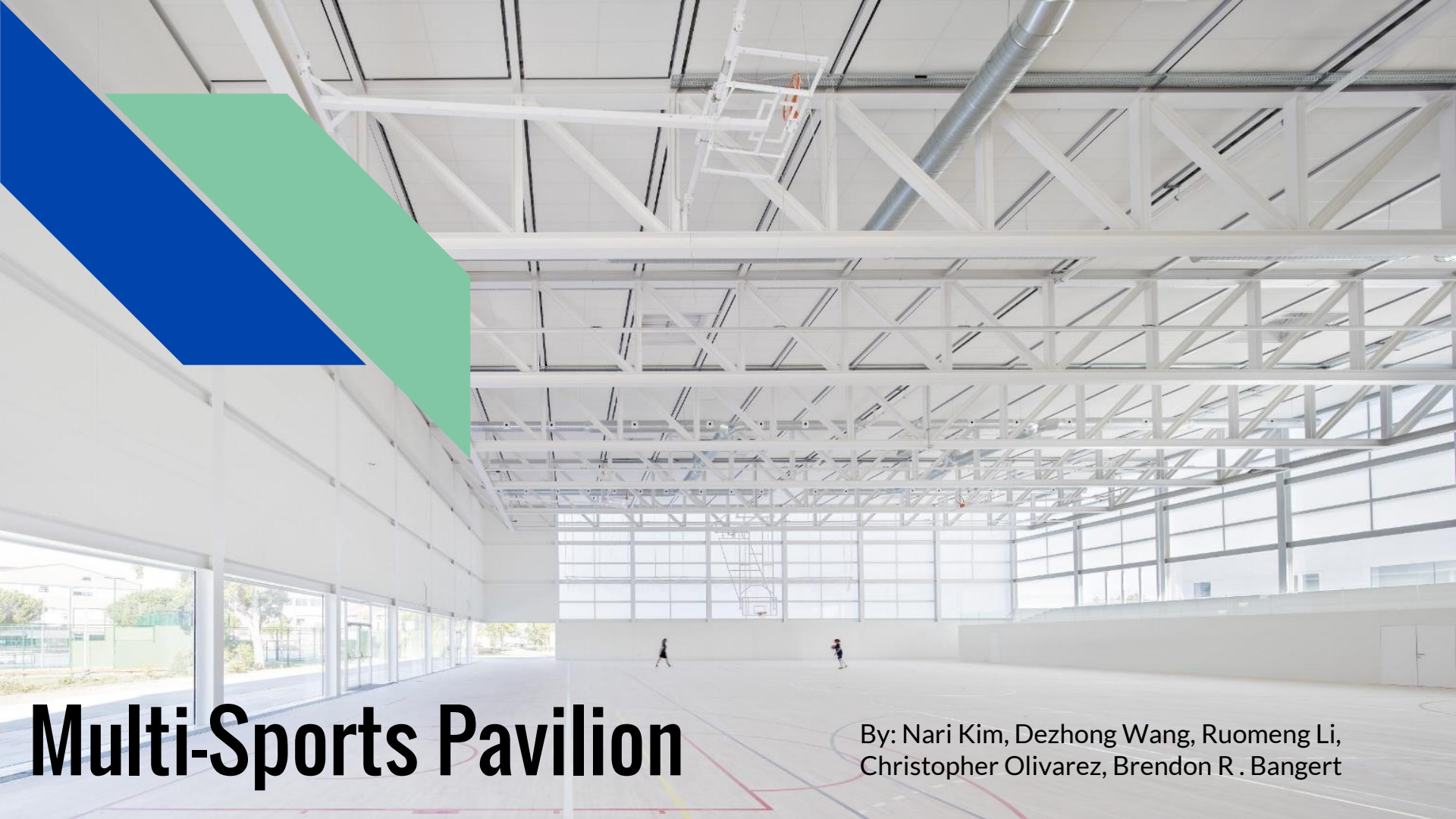


Multi-Sports Pavilion

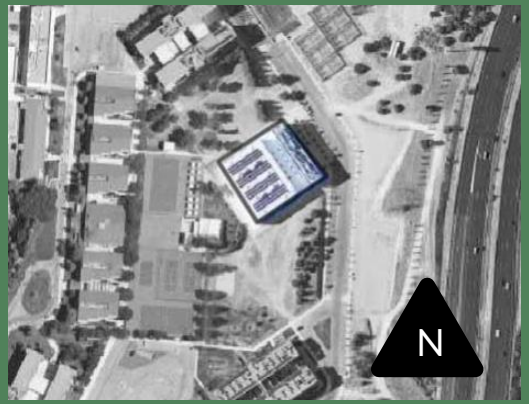
By: Nari Kim, Dezhong Wang, Ruomeng Li,
Christopher Olivarez, Brendon R . Bangert

Introduction | Context

- Madrid, Spain
- University Francisco de Vitoria
- Multisports pavilion :
  - 9,000 sq meters (96,875 Sq feet)
  - Completed in 2017 (Started in 2012)
  - Gymnasium & Pool
  - Office Spaces
- Designed by: Alberto Campo Baeza
- Structure by: Andres Rubio Moran

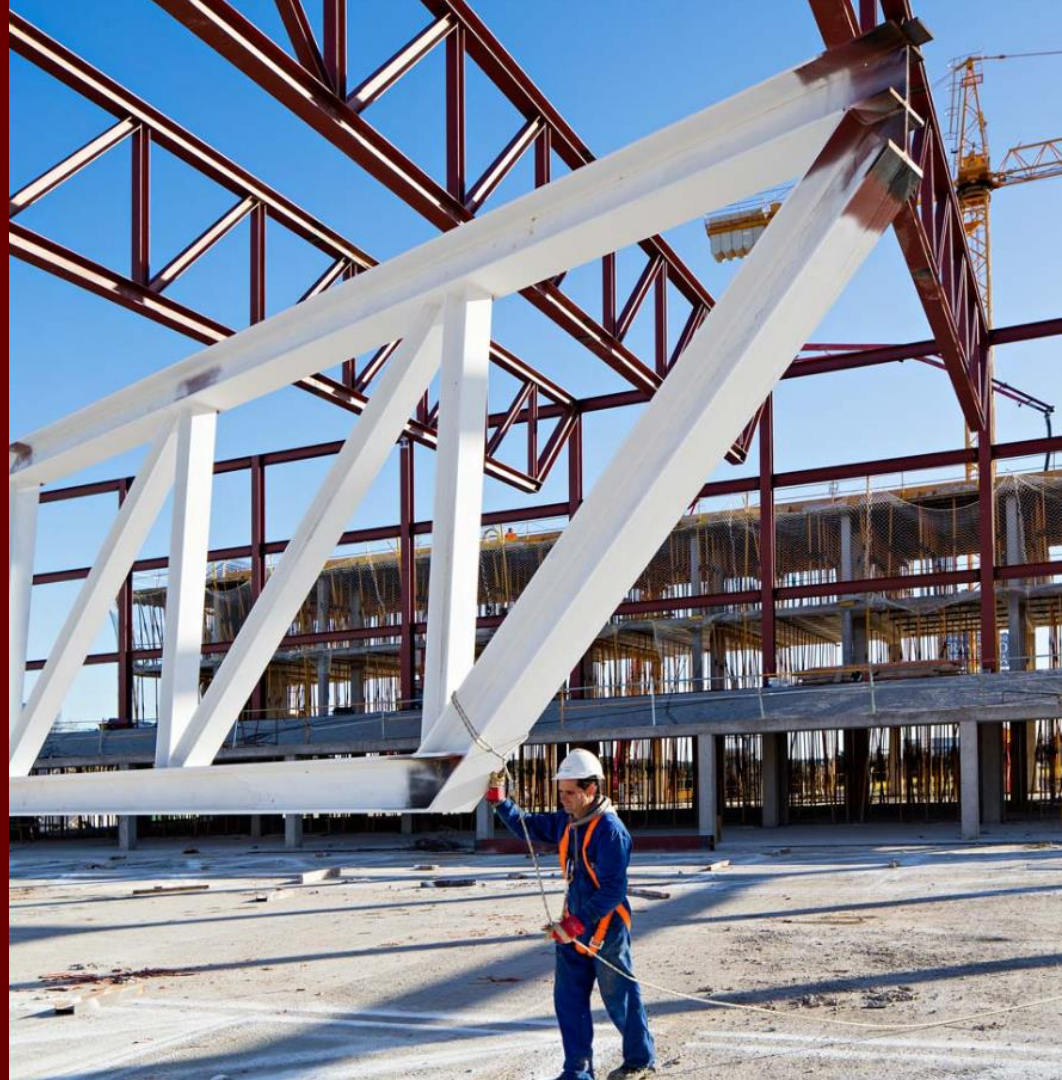
Background

- Simple Program
- Multi-purpose
- Volumetrically constrained to existing conditions
- Interconnected patio spaced between two “Clean buildings”
- Heavy focus on functionality



Main Structural System

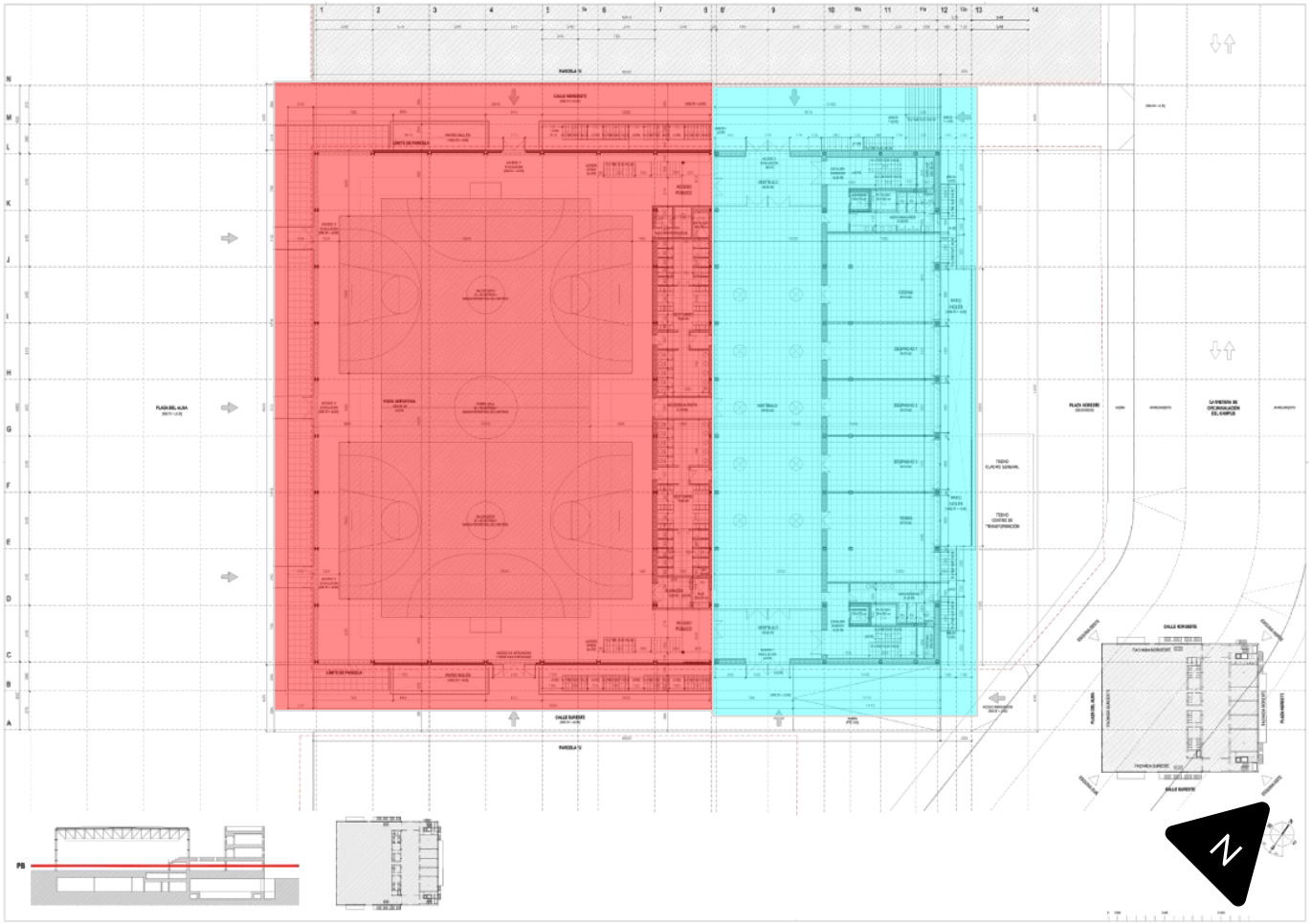
- Rigid diaphragm system in accordance european building code standards.
- HEB Steel Flange Beams compose the gymnasium
- Cast in place concrete compiles the rigid frame of the office area.
- Precast Concrete Fiberglass panels installed as shear components on both diaphragms.



Overall Plan

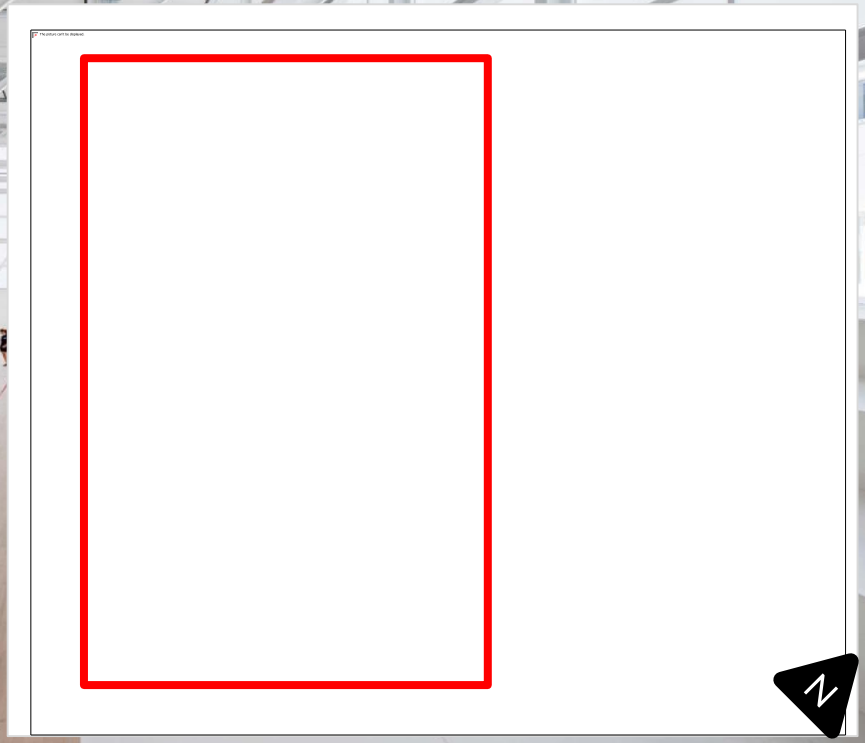
Ground Floor Plan

Gym composes more than half of the projected building footprint.



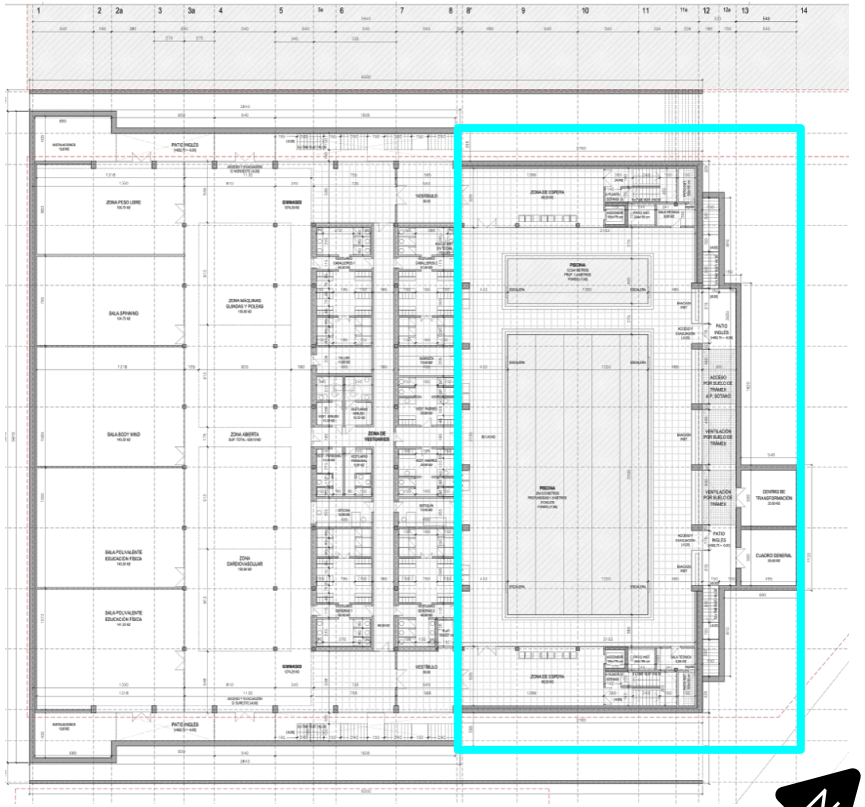
Gymnasium Background

- Multi-sports court area w/ seating
- Office spaces and locker rooms below
- Glazing, shear walls, column system
- Framed System
- 9 Structural Trusses
- Reinforced Fiberglass Concrete
- 2237.93 Meters Sq (24,088 Ft sq)
    - Length 58.60 Meters (192.25 feet)
    - Width 38.190 Meters (125 feet)
    - Height 11.95 Meters (39.20 feet)



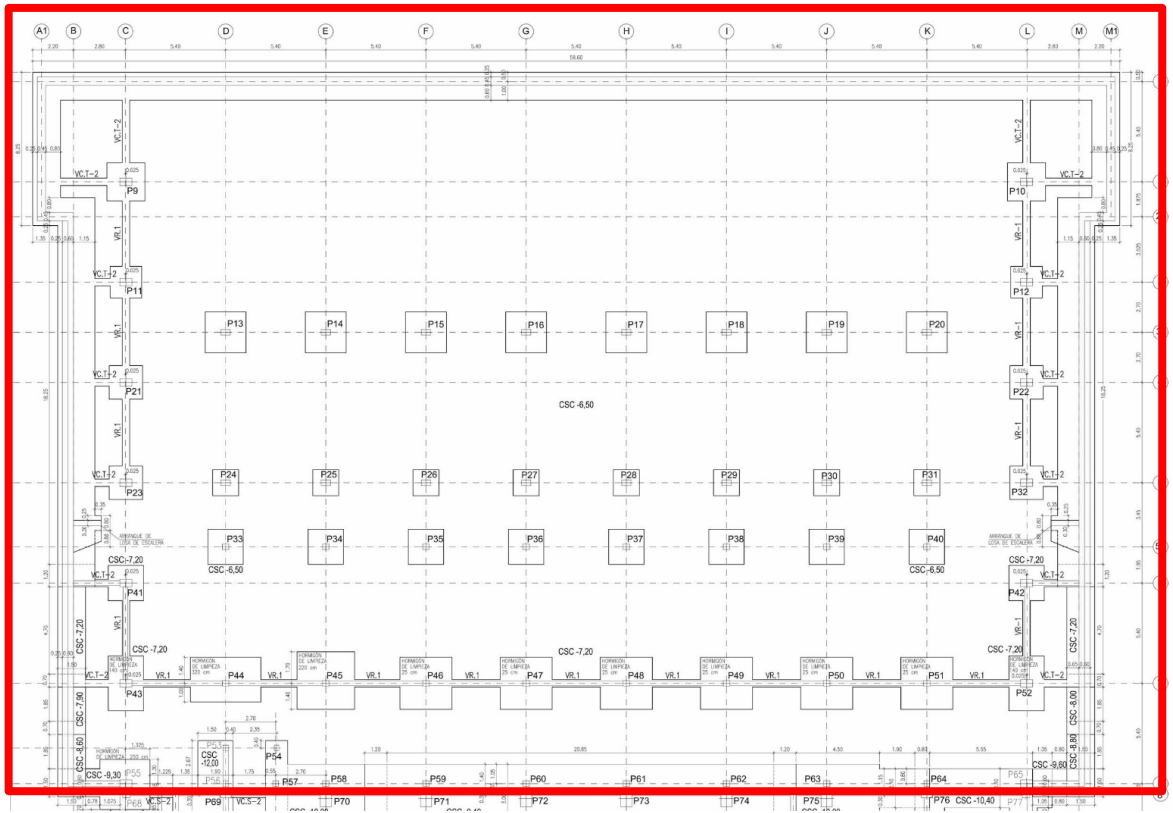
Egress and “Offices”

- Offices, fitness rooms, and pool.
- Reinforced Concrete Framing
- Glazing, shear walls, column system
- Cast in place columns
- 524.88 Meters Sq * (5 Stories) (5,649 Ft Sq)
    - Length 10.28 Meters (192.25 feet)
    - Width 47.6 Meters (125 feet)
    - Height 10.28 Meters (39.20 feet)



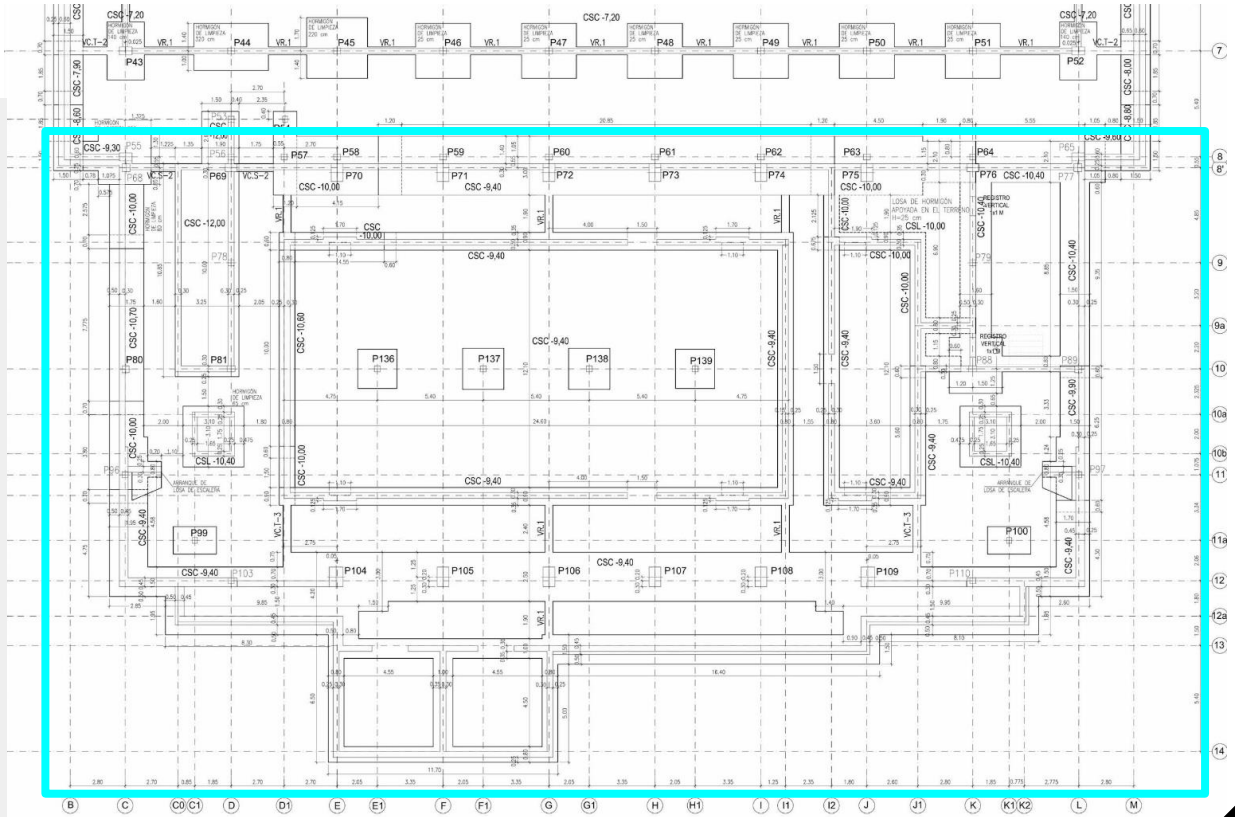
Gymnasium Foundation

- Isolation footings
- Shear wall footings
- 600mm exterior wall fiberglass concrete walls.



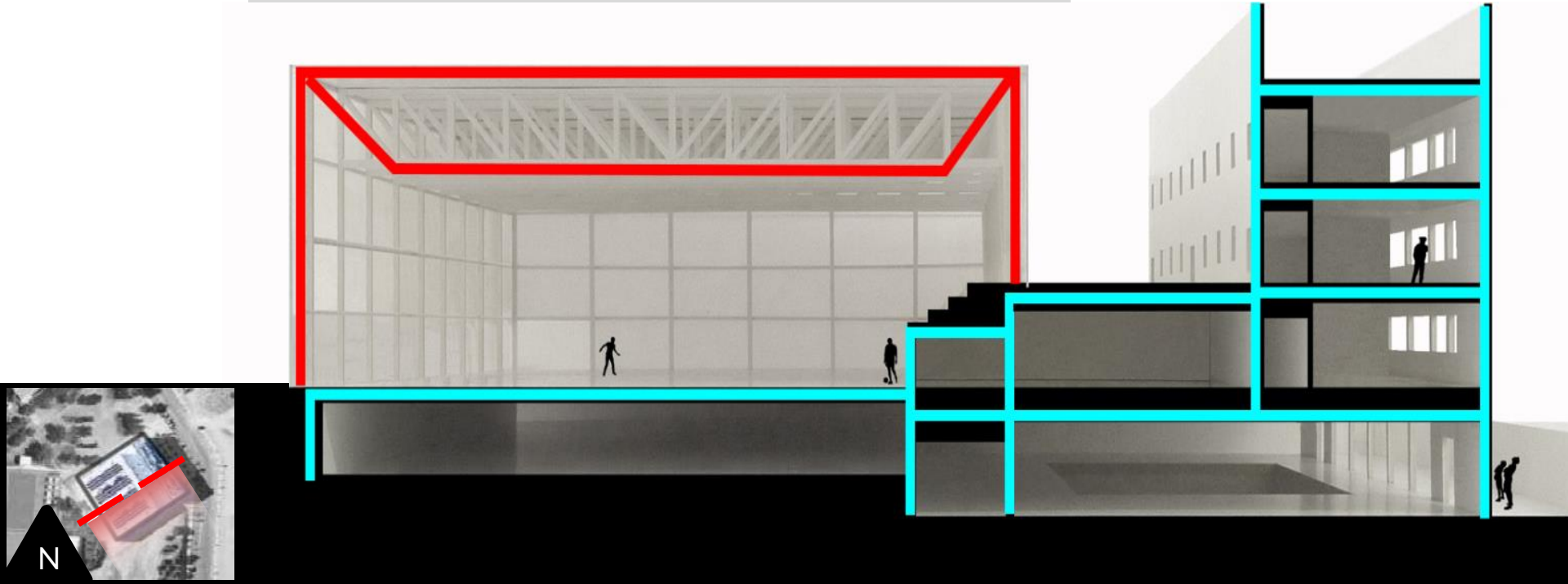
Office Foundation

- Consistent material usage from 5th floor to foundation plan.
- Isolated footings, and wall cast columns integral to project serviceability.



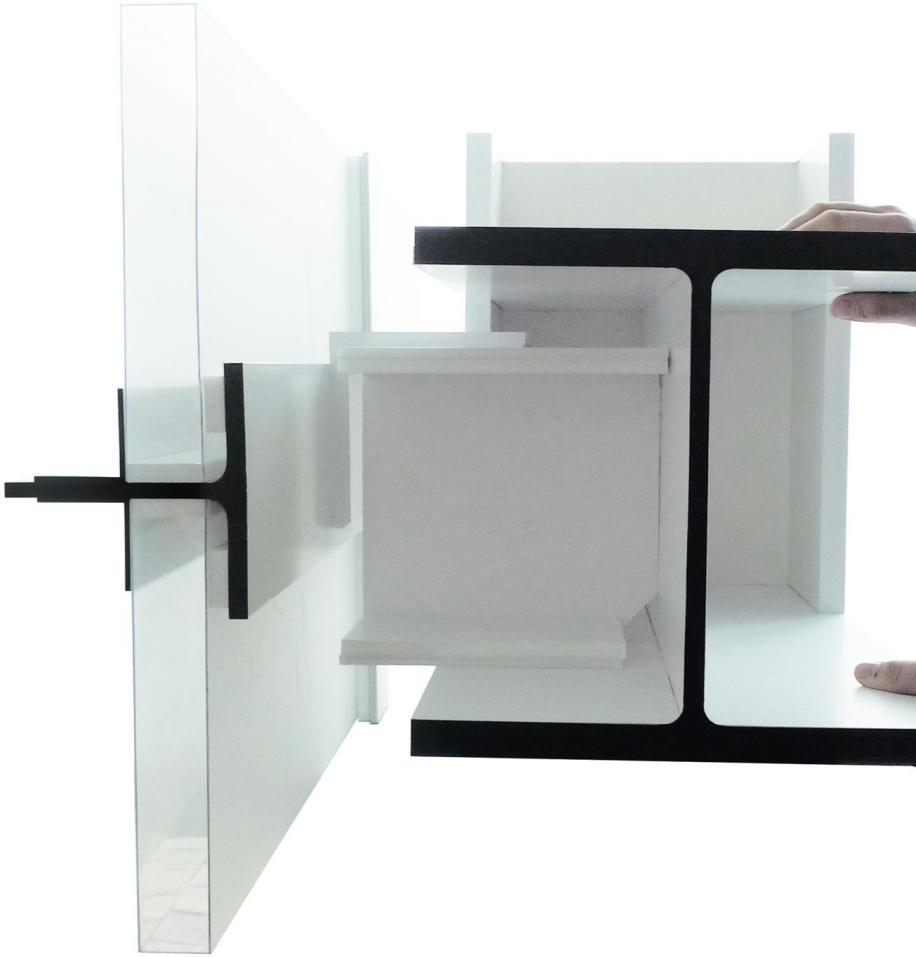
Visual Analysis

- Steel Framing vs. reinforced concrete diaphragm structures.



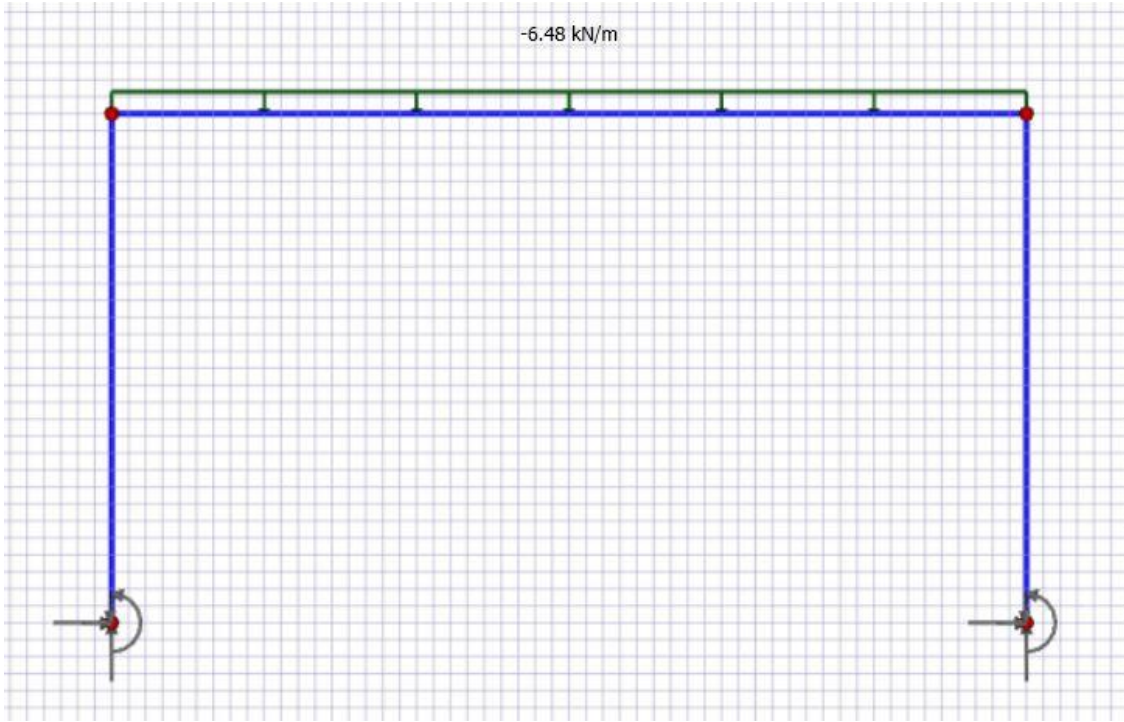
Connection Points

- Pin-connection points
- HEB double chord truss system.
- Rigid framing system
- Foundation connection via baseplates.
- Welded/Bolted Connections



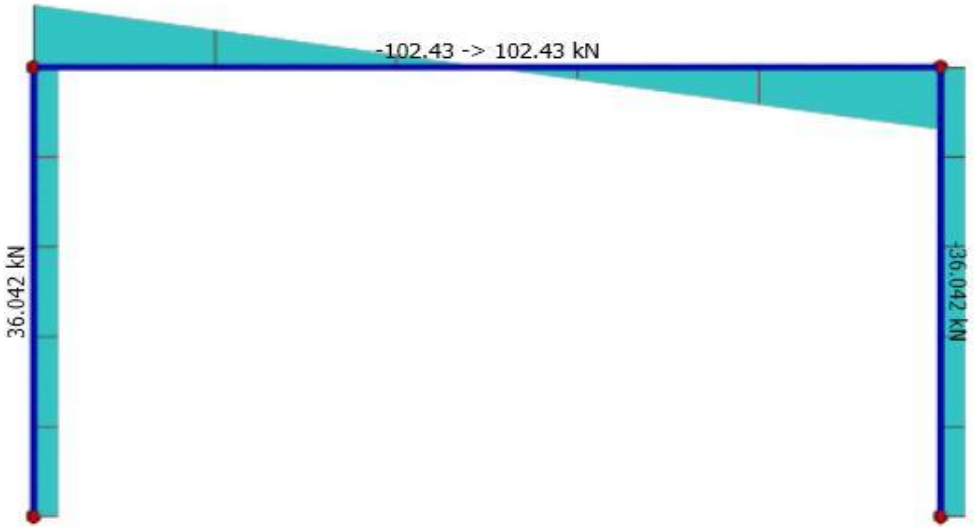
Loading Diagram: Concrete

- Entire office portion : reinforced concrete systems
- Bear uniformly distributed flooring and roof systems.
- Columns vary in size: (30x35 / 60x90)
- Beams vary in size: typical beams (25x60) / deep beams (40x240)



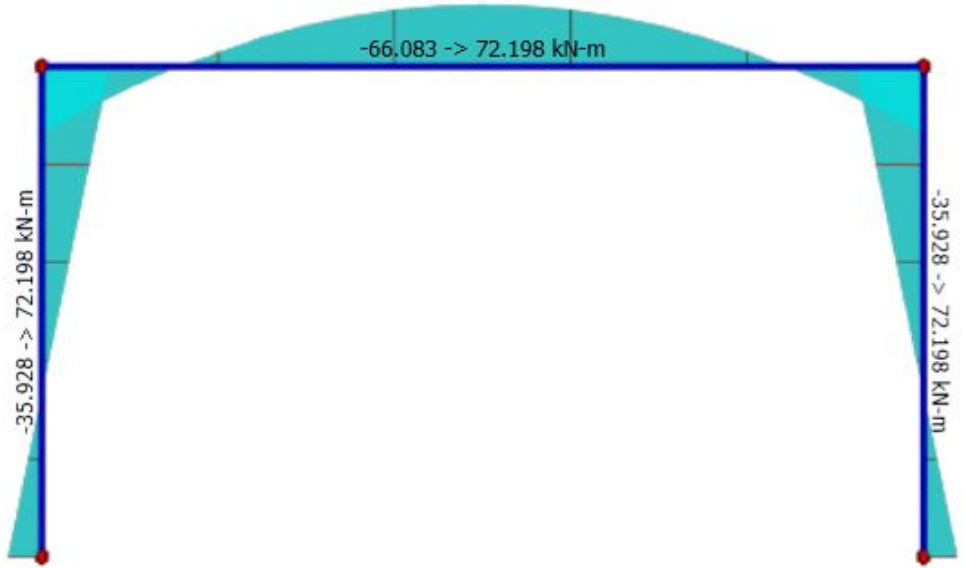
Shear Diagram: Concrete

- Shear loading results for a typical uniformly distributed beam.



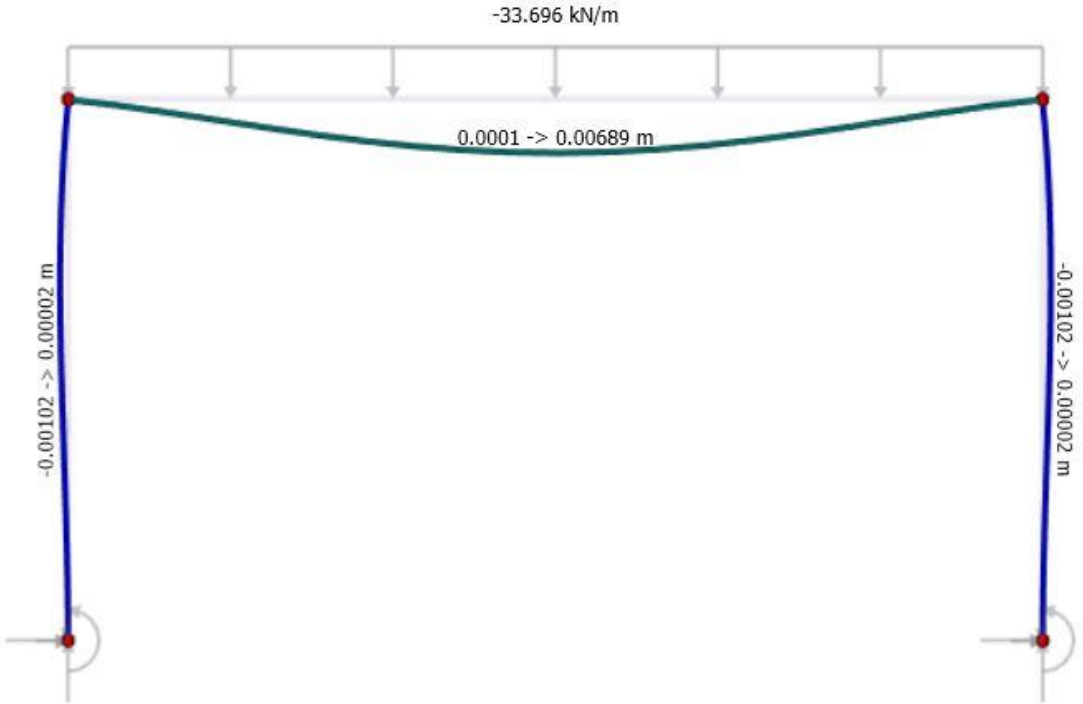
Moment Diagram: Concrete

- Bending moment follows suite, with grid spacing, and load placements.



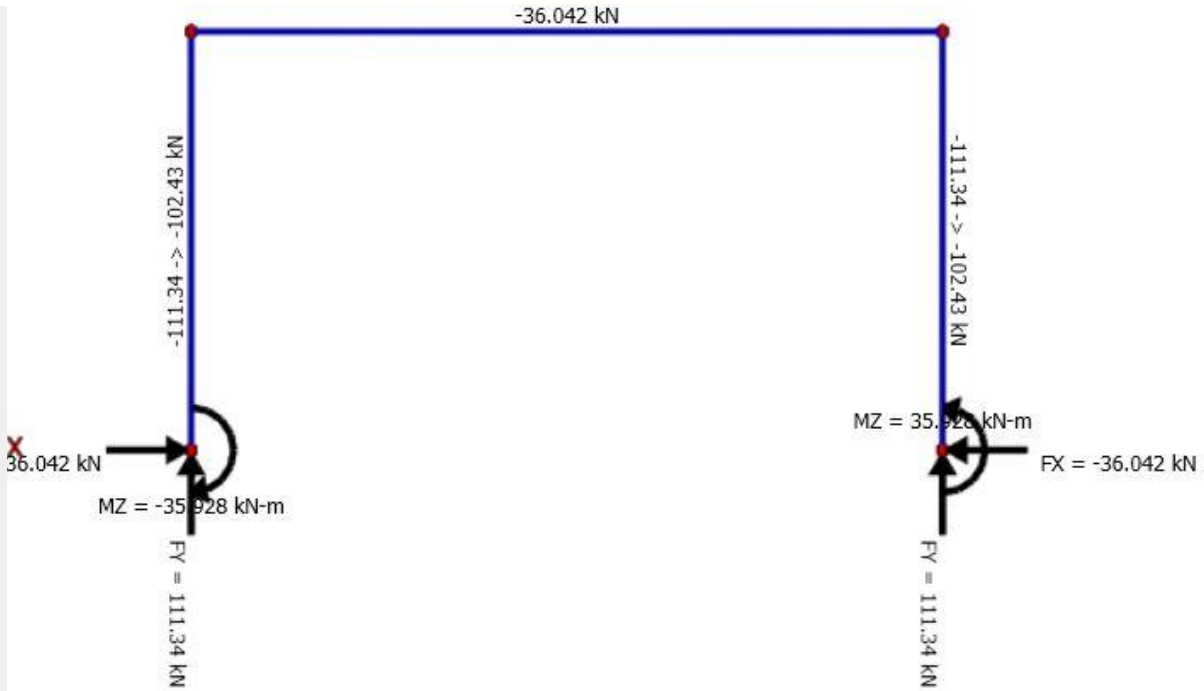
Deflection Diagram: Concrete

- Exterior and interior shear, and stability components utilized to reinforce entire office portion superstructure.



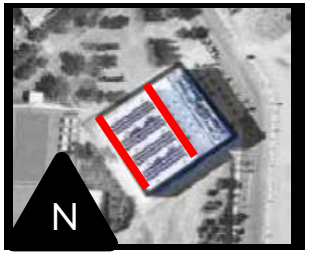
Axial Reaction Diagram: Concrete

- Rigid connections
- Fixed supports

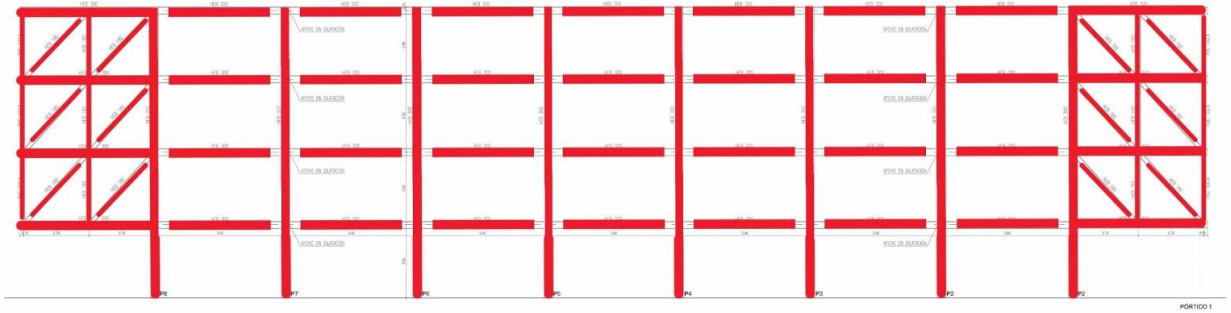


Framing System Long Sides

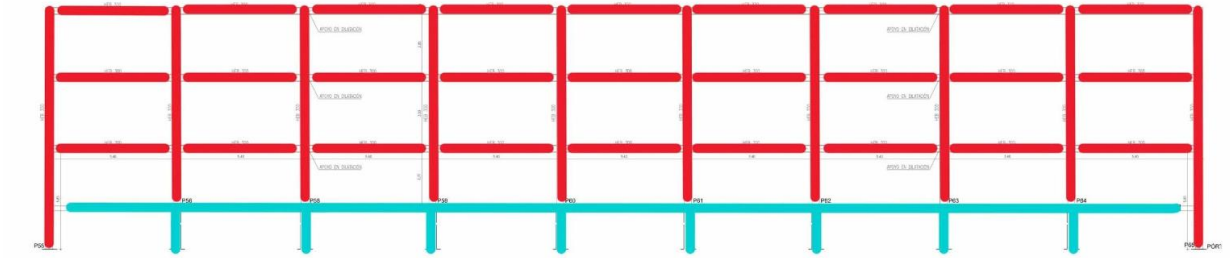
- HEB 300 Beams and Girders compose primary framing system
- Diagonal and Lateral Bracing cantilevered, HEB 180 Beams
- Pinned System



West Sides

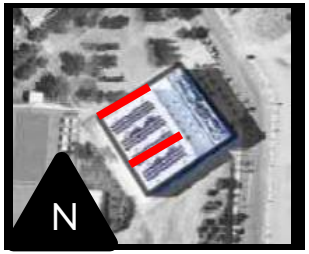


East Sides

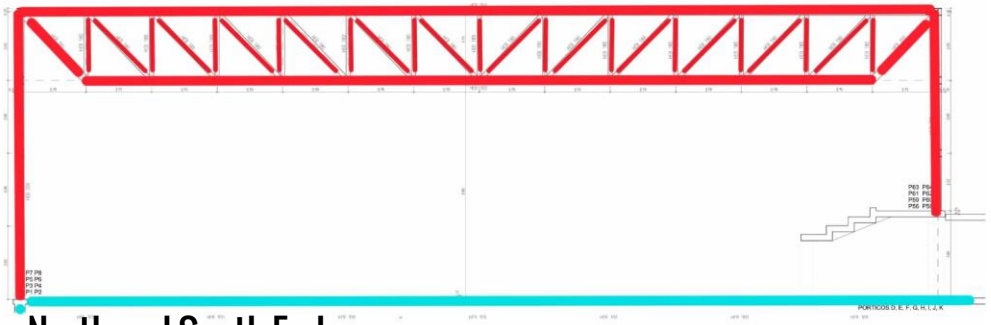


Framing System Short Sides

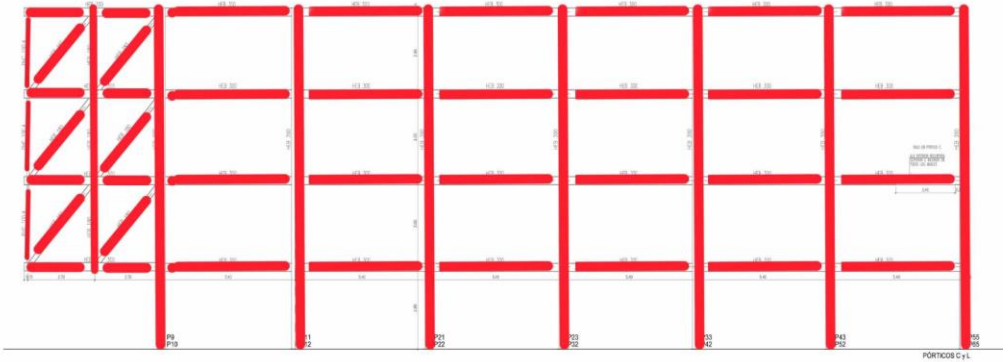
- HEB 180 Truss systems projected across roofing system.
- Diaphragm system is HEB 300 Beams and Girders.
- End Conditions, use HEB 180, and HEB 300s



Section Cut

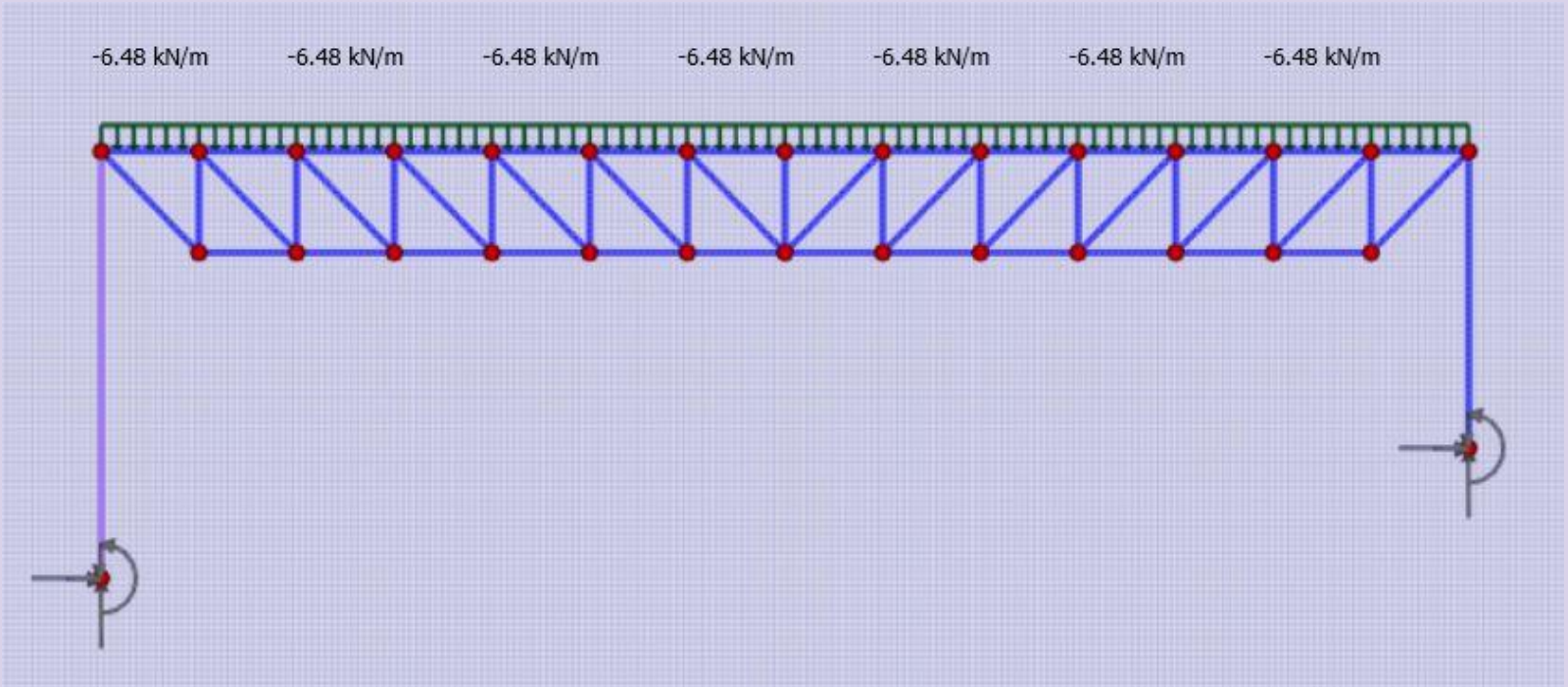


North and South Ends



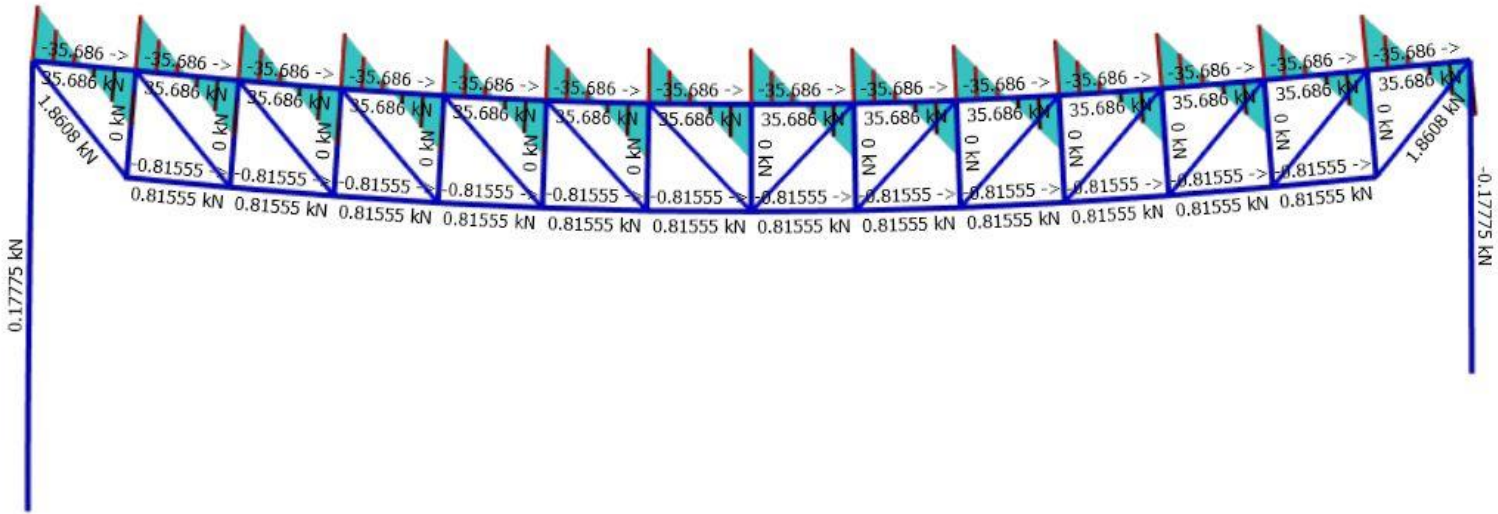
Loading Diagram: Truss

- Uniformly distributed load roof system, applied across entire roof, and distributed to both shear wall systems.



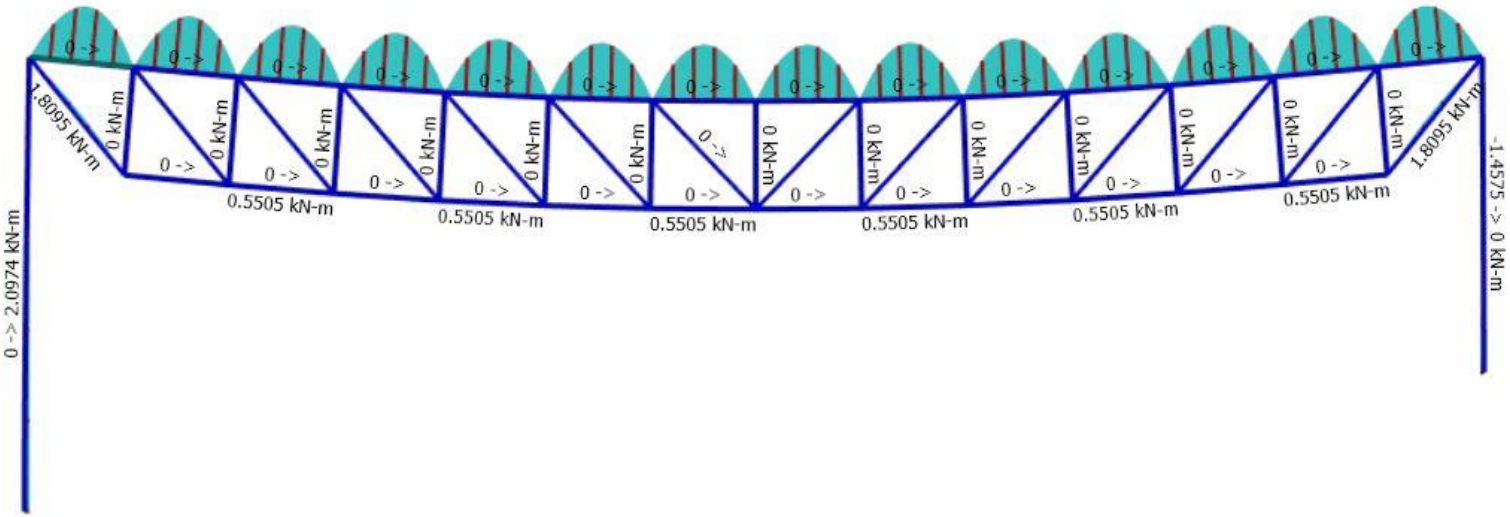
Shear Diagram: Truss

- HEB 180 webbing between double chords composed of HEB 300 spatial truss system.



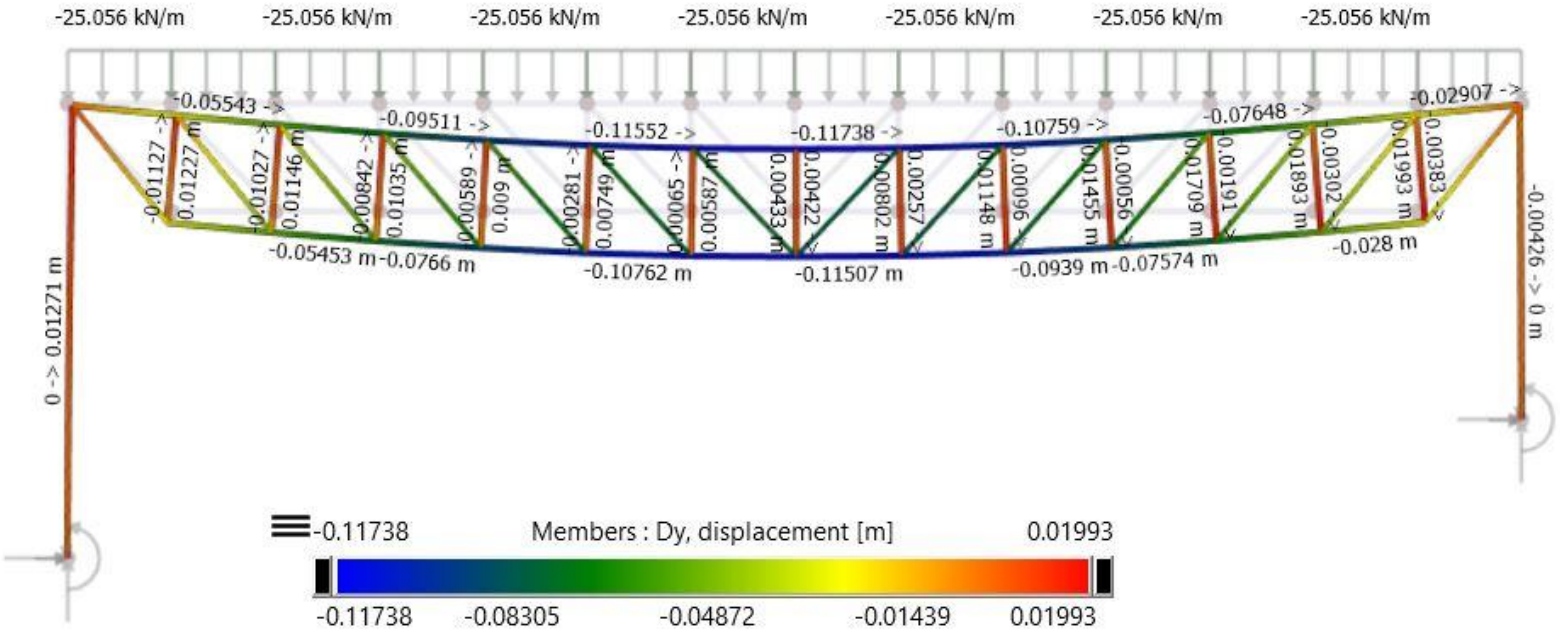
Moment Diagram: Truss

- Bending possibly reduced with pretension stressing, and braced systems.



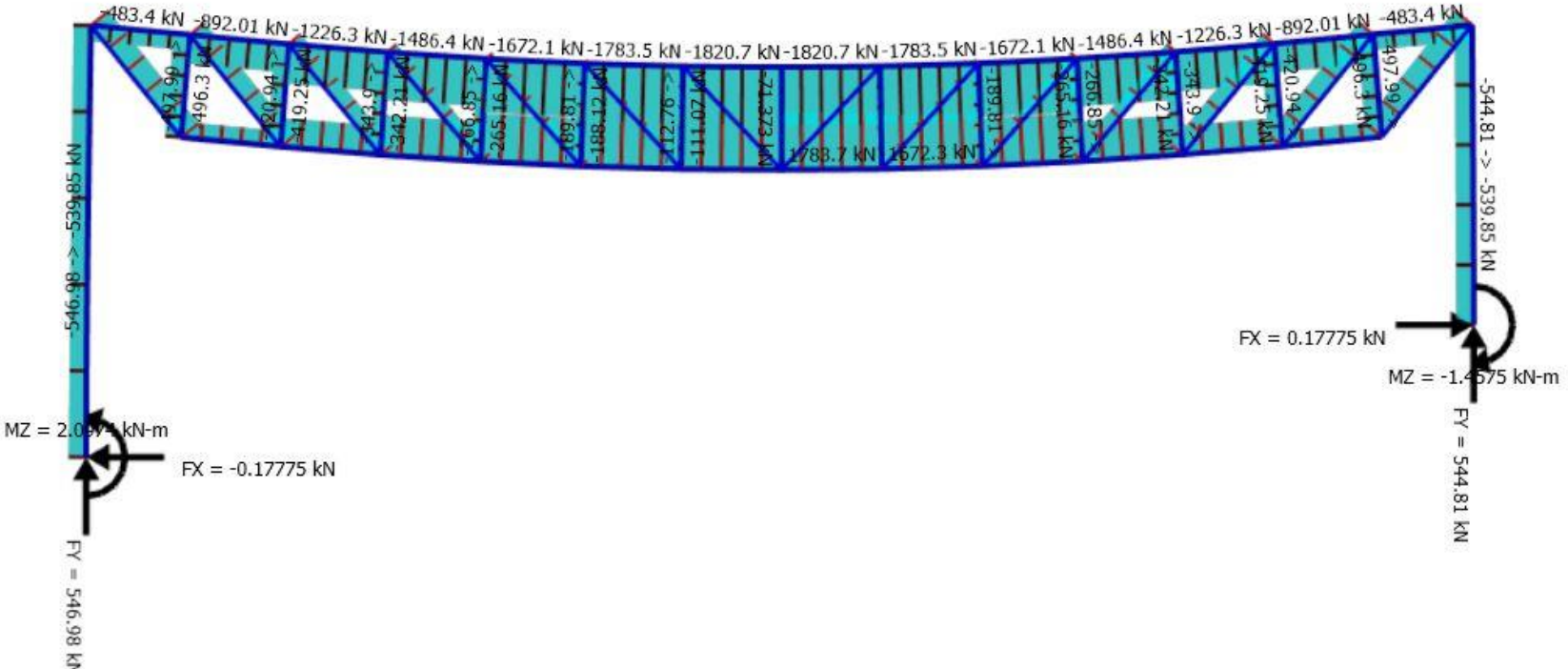
Deflection Diagram: Truss

- Left side wall projects straight to concrete floor column base plates, while right side component, projects forces into reinforced concrete framing system.



Axial Diagram: Truss

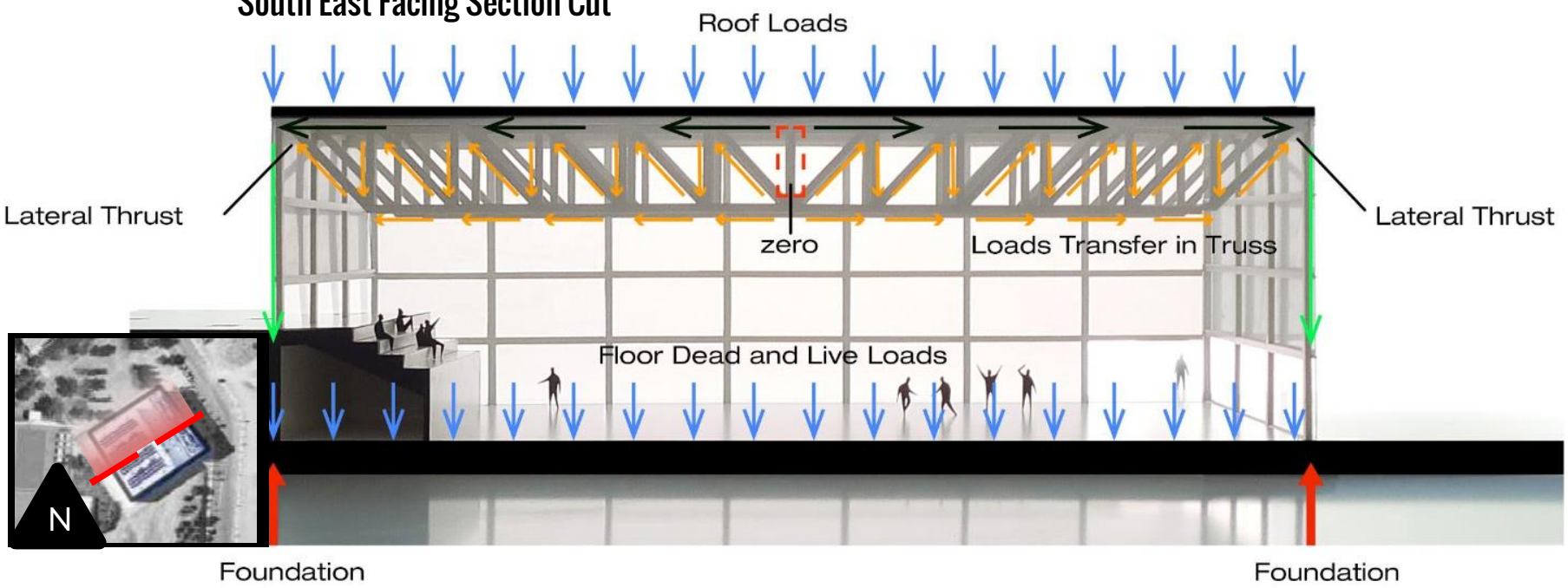
- 9 Spatial truss systems are braced bi-laterally.



Load Tracing System

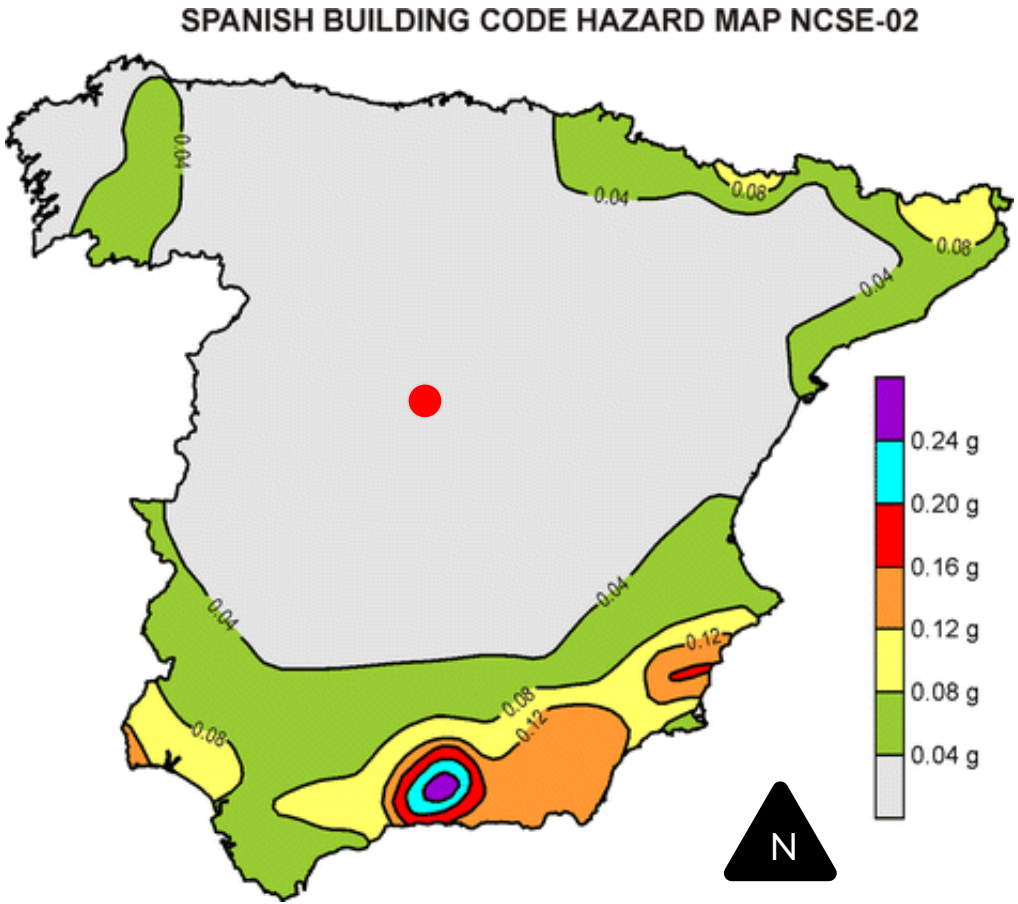
- Exterior members are primary point of transfer from roof loading to foundation

South East Facing Section Cut



Location Impacts

- NCSE-02, peak ground acceleration provided via the g chart, with higher values being at a higher risk.
- Winds procured from the west and southwest direction. And could create possibly vortex shedding



Summary

- General background information regarding site context
  - Wind patterns
  - Seismic hazard overview
- Components of the structural system
- Floor plan
  - location of structural components
  - Orientation and distribution of of the space in relation to structural components
  - Foundation
- Visual Analysis
  - Material factor
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Axial Reaction Diagram: Concrete

- https://www.flickr.com/photos/campobaeza/34042352774 = Background Photo
- https://www.google.com/maps/place/Francisco+de+Vitoria+University+-+Madrid/@40.4403665,-3.8368576,766m/data=!3m2!1e3!4b1!4m5!3m4!1s0xd4185d02f8a6fe5:0x703d6f7e39d3e3aa!8m2!3d40.4403665!4d-3.8346689 - Google Maps References
- https://archello.com/brand/andres-rubio-moran - Background Photo Slide 3 (Truss placement))
- https://p-upload.facebook.com/deportesUFV/?ref=page_internal - Interior photo video pull
- https://www.campobaeza.com/sports-pavilion-university/ - All remaining photos, documents, and diagrams
- https://www.archdaily.com/875503/multi-sport-pavilion-and-classroom-complex-alberto-campo-baeza - Research Pool
- Earthquake Code Permanent Commission of Spain (2002) Norma de Construccio´n Sismorresistente: Parte General y Edificacio´n, NCSE-02. Ministry of Public Works of Spain, Madrid in SpanishMezcua, J., Rueda, J. & García Blanco, R.M. Nat Hazards (2011) 59: 1087. https://doi.org/10.1007/s11069-011-9819-3 - Earthquake information
- https://www.windfinder.com/forecast/madrid - Wind loading information