Technical Report 4

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Structural Option
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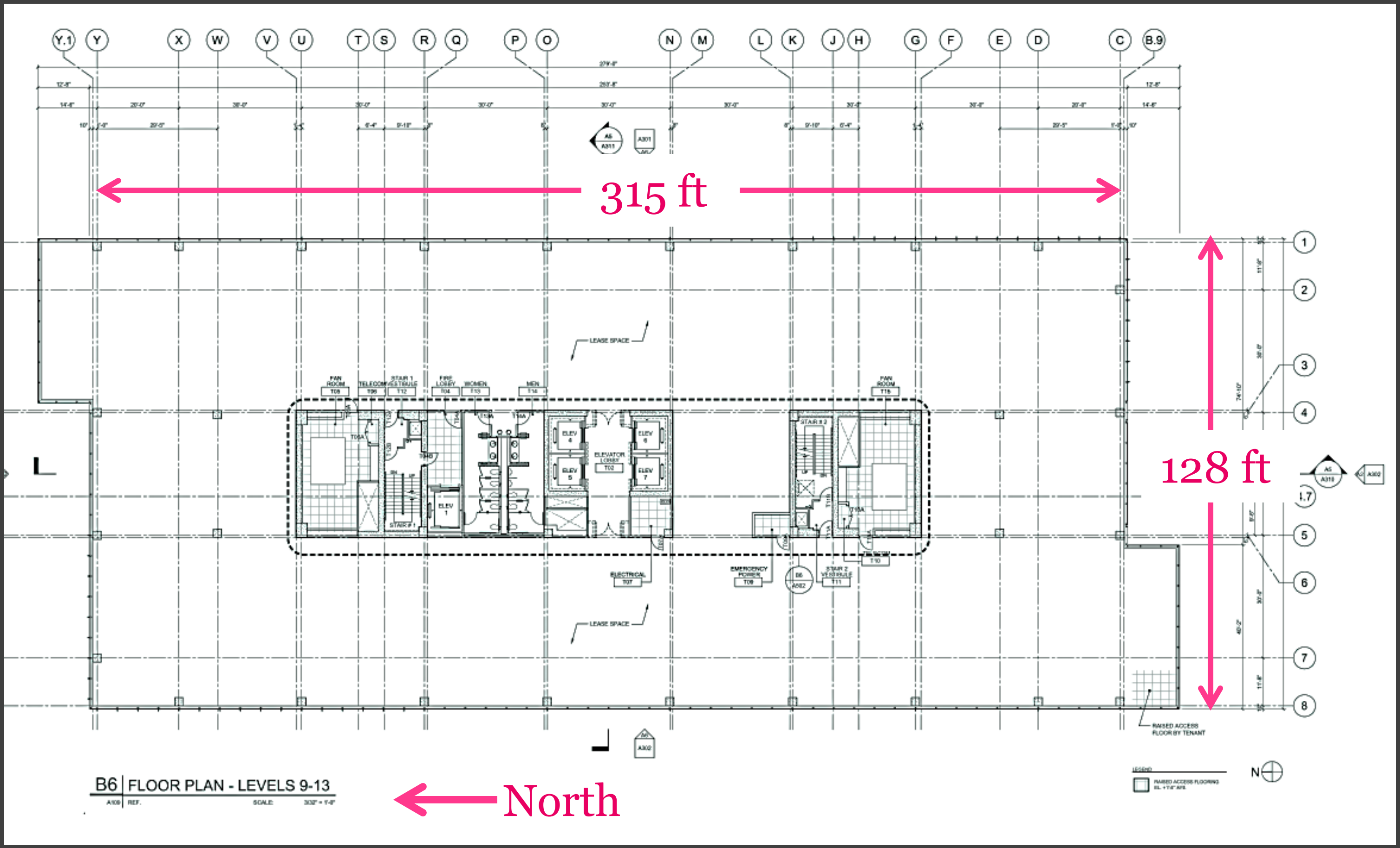
LA JOLLA COMMONS
PHASE II OFFICE TOWER

General Building Information

- La Jolla Commons Phase II Office Tower
- Height | 198’ 8” (13 stories)
- Square Footage | 462,301 GSF
- Location | San Diego, California
  - Seismic Design Category D
- Office Building
  - Multi-tenant capabilities
  - First Class A NetZero Office Building in the USA
- Special Features
  - Underfloor Air Distribution System
  - 15 foot cantilevers at both ends

Typical Floor Plan

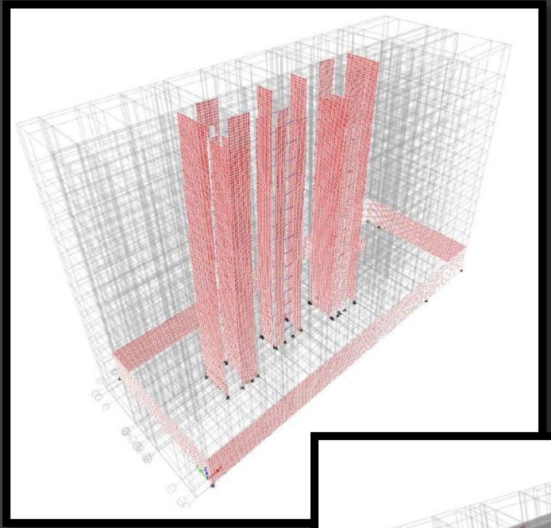


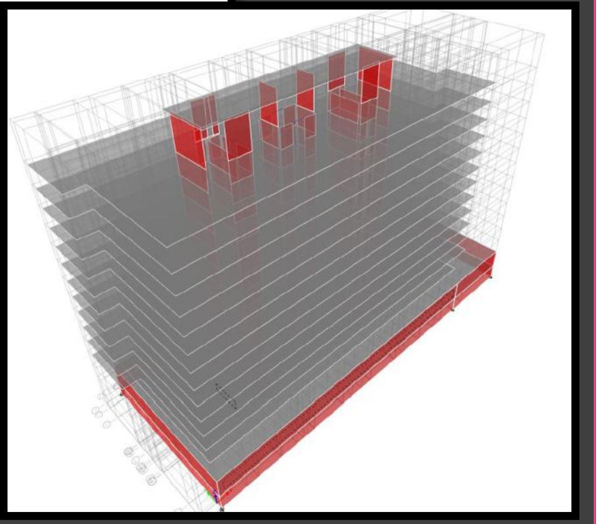
Existing Structural System

- Mild reinforced, cast-in-place concrete structure
- Mat Foundation
  - Thickness ranges from 3 ft to 6.5 ft
- Gravity System
  - Two-way, flat plate, reinforced concrete slab supported by a rectangular grid of concrete columns
  - Slab camber
  - Spandrel beam around slab edge
- Lateral System
  - Specially reinforced concrete shear walls
  - Collector beams in NS direction - levels below grade
- Special Features
  - 15 foot cantilevers at the North and South ends
  - Steel framed mechanical penthouse

ETABS Model

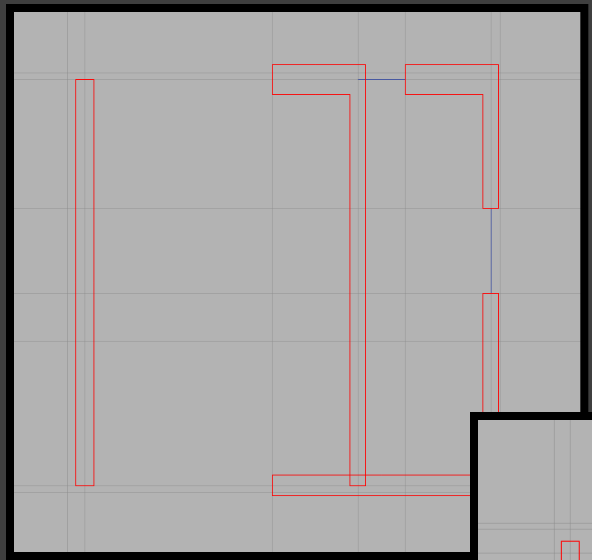
- Elements Included in Lateral Model
  - Concrete Shear-Walls
  - Coupling Beams
  - Foundation Walls
- Elements Excluded from Model
  - Edge Beam
  - Concrete Columns
  - Gravity Concrete Beams
- Rigid Diaphragm Assumed
- Base Conditions Assumed:
  - All shear walls were FIXED at the base
- All concrete elements modeled as “cracked”
  - Stiffness reduction of 65%



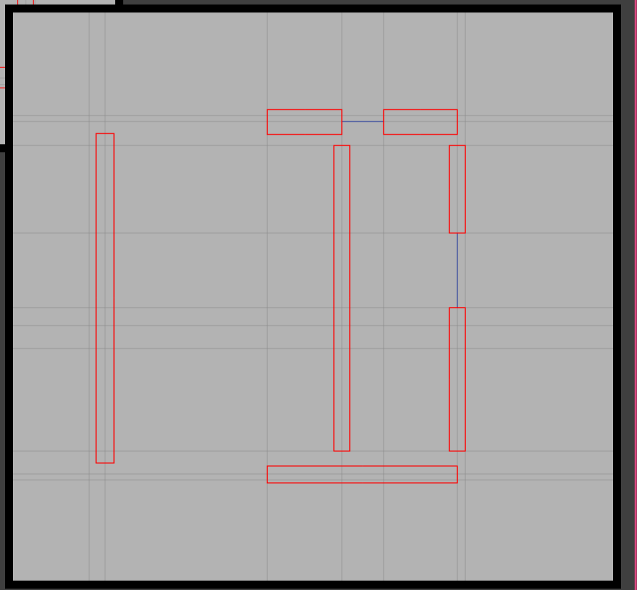


ETABS Model

- Challenges:
  - Shear wall intersection
  - Unverifiable distribution of torsional forces
- Decisions:
  - Disconnected Shear Walls
  - Kept Coupling Beams
  - Reassigned Diaphragms Individually
- Consequences & Benefits:
  - Drift values were significantly increased
  - Failure for Seismic Drift requirements
  - Forces Distributed Correctly
  - Verifiable Model



Original Model



Final Model

Irregularities Considered

- Plan Type 1B– Extreme Torsional Irregularity
  - Compared Maximum and Average Deflections for Each story
  - Found to exist under load case EY - EYT
  - Torsional moment for Seismic Load was adjusted for a new Torsional Amplification Factor – Ax = 1.24
- No other irregularities were found to exist

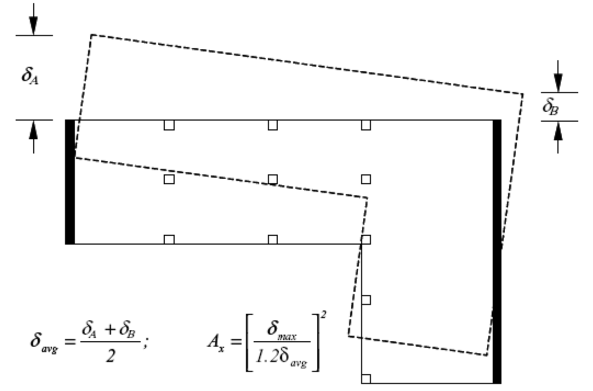


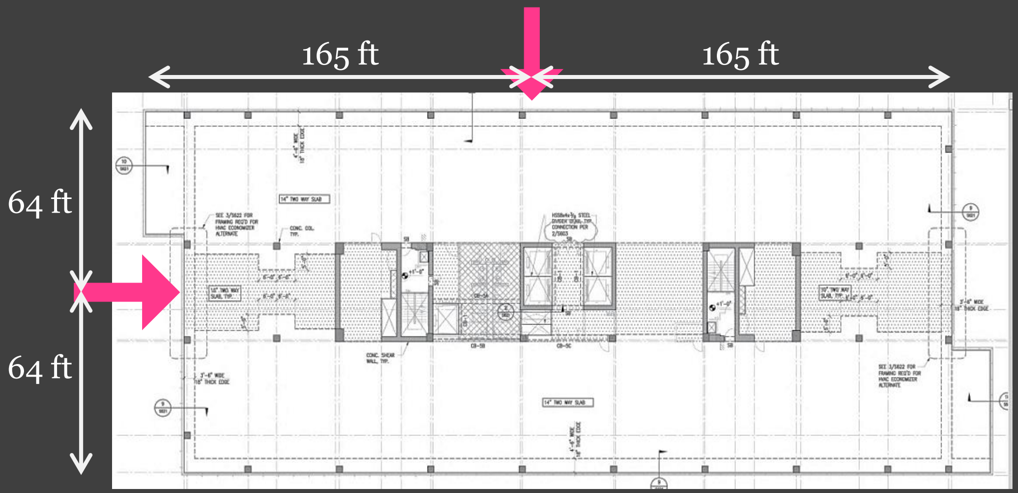
FIGURE 12.8-1 TORSIONAL AMPLIFICATION FACTOR, A_x

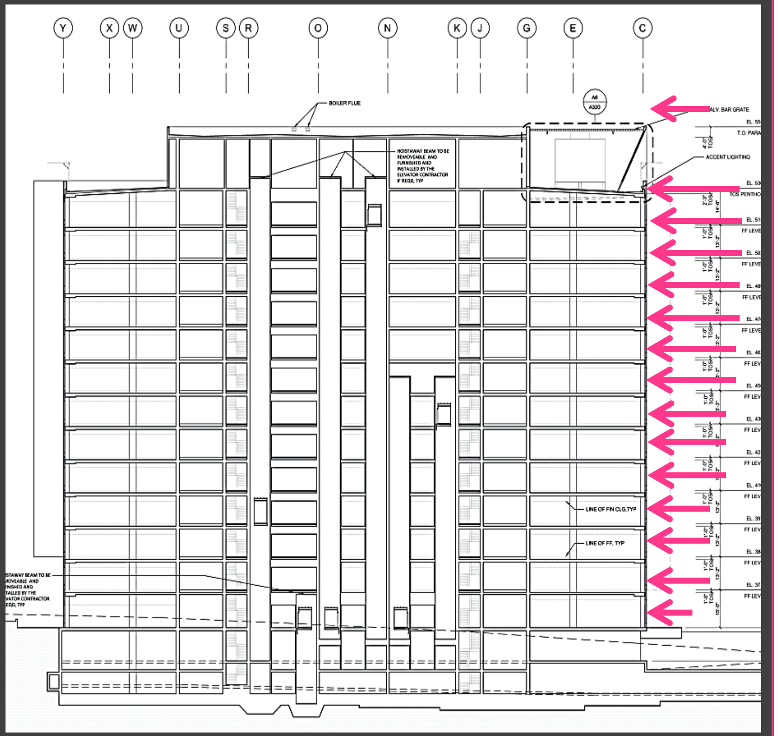
TABLE 12.3-1 HORIZONTAL STRUCTURAL IRREGULARITIES

	Irregularity Type and Description	Reference Section	Seismic Design Category Application
1a.	**Torsional Irregularity** is defined to exist where the maximum story drift, computed including accidental torsion, at one end of the structure transverse to an axis is more than 1.2 times the average of the story drifts at the two ends of the structure. Torsional irregularity requirements in the reference sections apply only to structures in which the diaphragms are rigid or semirigid.	12.3.3.4 12.8.4.3 12.7.3 12.12.1 Table 12.6-1 Section 16.2.2	D, E, and F C, D, E, and F B, C, D, E, and F C, D, E, and F D, E, and F B, C, D, E, and F
1b.	**Extreme Torsional Irregularity** is defined to exist where the maximum story drift, computed including accidental torsion, at one end of the structure transverse to an axis is more than 1.4 times the average of the story drifts at the two ends of the structure. Extreme torsional irregularity requirements in the reference sections apply only to structures in which the diaphragms are rigid or semirigid.	12.3.3.1 12.3.3.4 12.7.3 12.8.4.3 12.12.1 Table 12.6-1 Section 16.2.2	E and F D B, C, and D C and D C and D D B, C, and D

Wind | Distribution of Forces

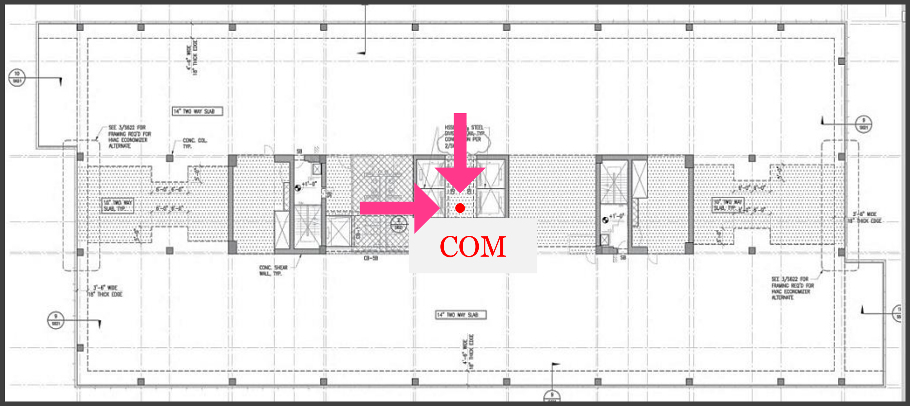
- Wind Vertical Distribution of Forces
  - Pressures were converted into point loads at each level using the tributary area of each story
- Wind Horizontal Distribution of Forces
  - Point load placed at the center of pressure
- All 4 ASCE 7-05 Wind Load Cases Included in Analysis

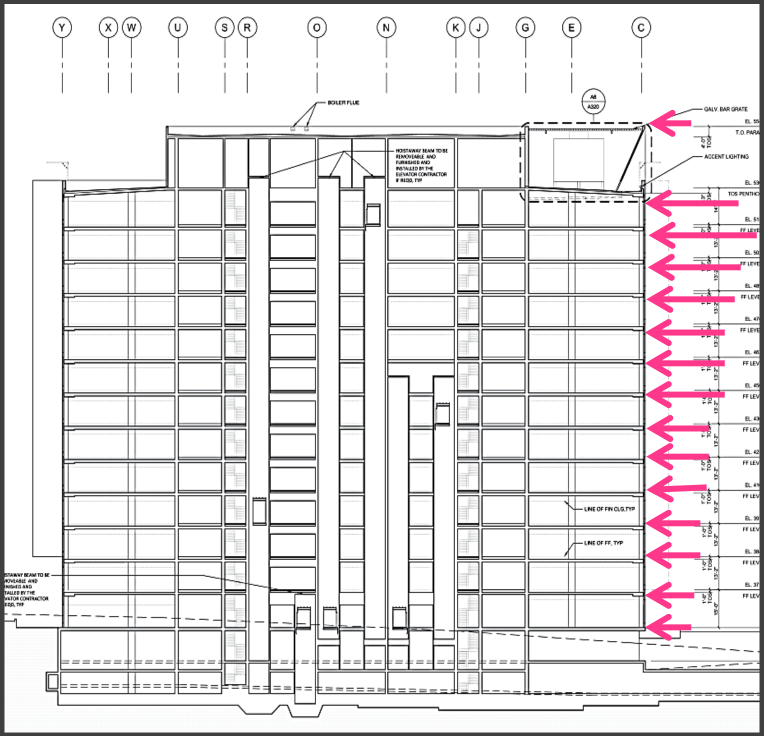




Seismic | Distribution of Forces

- Seismic Horizontal Distribution of Forces
  - Point load placed at the center of mass
- Seismic Vertical Distribution of Forces
  - Forces generated at center of mass of each story
- Seismic forces considered in each direction along with accidental torsional moments



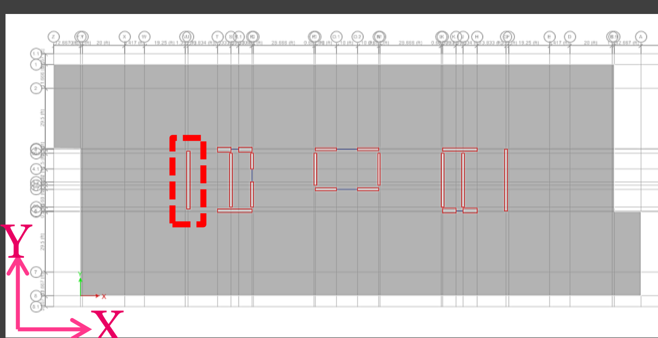


Animation | EX + EXT

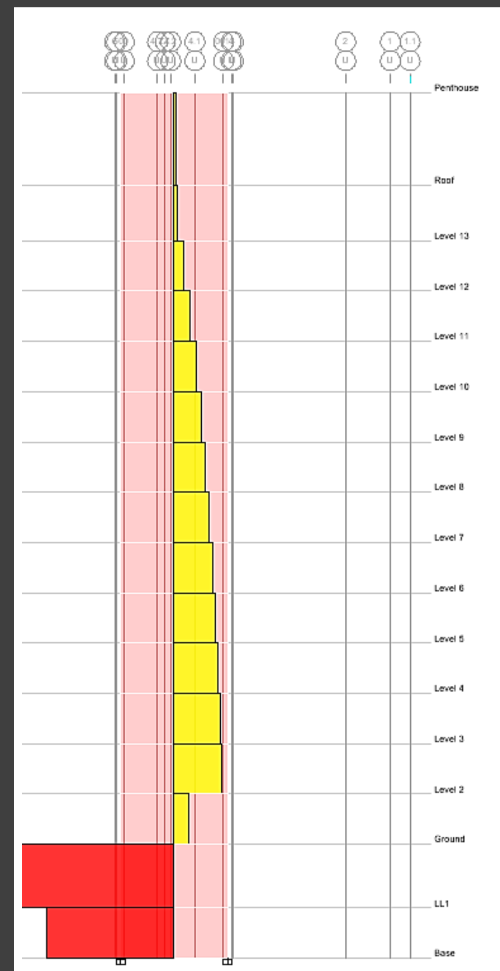
Animation | EY + EYT

Shear and Moment Diagram| Shear Wall U

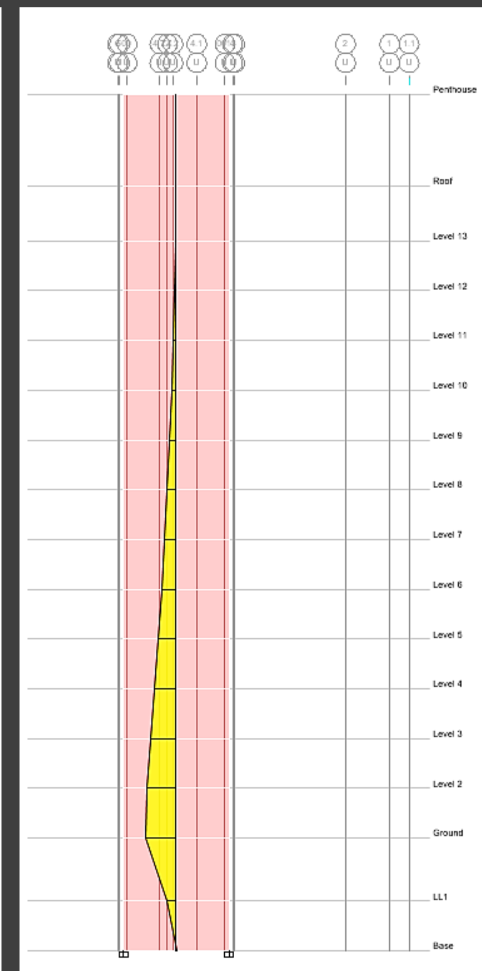
- Shear Diagram
  - Shown for EY + EYT
  - Shear reversal at foundation walls
  - Increasing shear
  - At ground = 1876 kip
  - At Base = 5009 kip
- Moment Diagram
  - Shown for EY + EYT
  - Moment at Ground = 198774 ft-kip
  - Base Moment = 5287 ft-kip



Shear

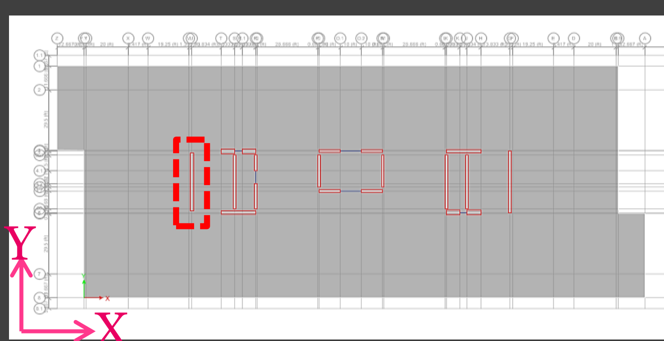


Moment

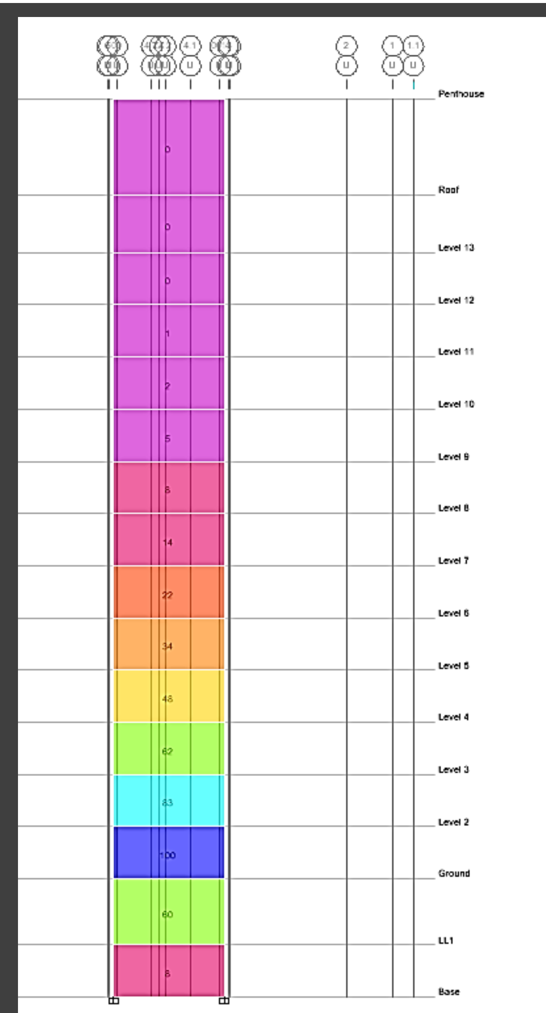


Member Utilization Diagram| Shear Wall U

- Member Utilization Ratios
  - Show which walls are working the hardest
  - Upper levels – working the least
  - Lower levels above grade – working the most
  - Below Grade – working less due to foundation walls
  - Shown for Load Case EY



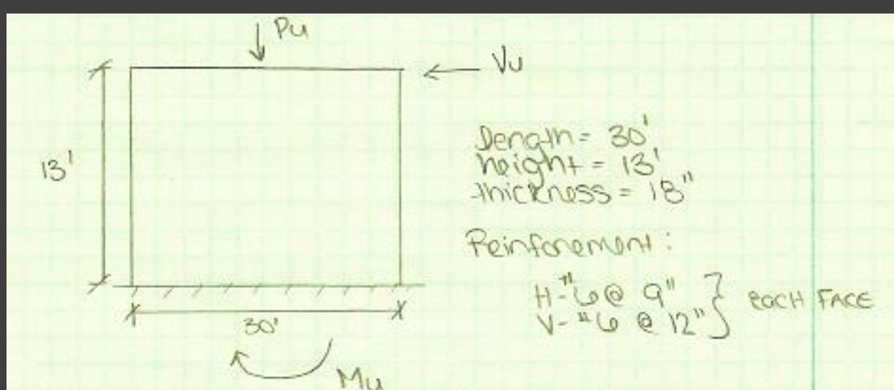
0-7
7-14
14-21
21-35
49-56
77-84
84-91
91-100

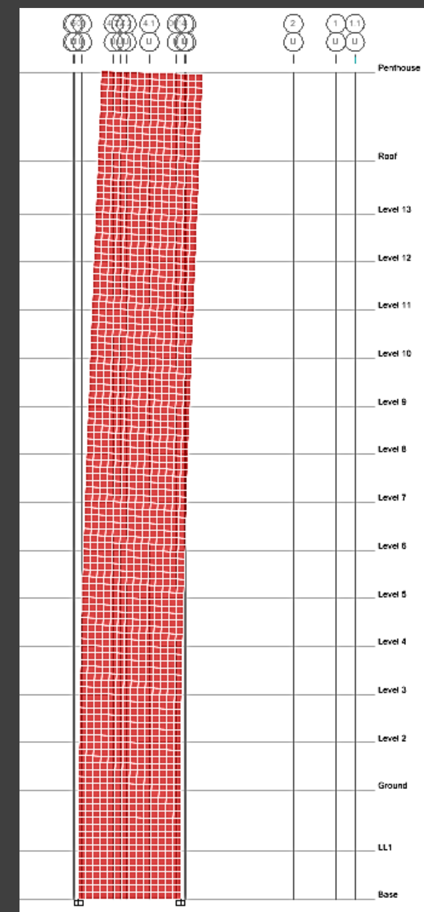


Is the Lateral System Acceptable?

- Serviceability
  - Wind – L/400 Industry Standard
  - Seismic – Code required Allowable Story Drift 0.020hsx
    However, walls were disconnected! Actual deflections would be much less!
- Strength Considerations
  - Building Overturning – Factor of Safety of 5 (EY + EYT)
  - Shear Wall Strength – Adequate for Loads Applied, meets requirements of special reinforced shear walls

Controlling Load Combination: *1.2D + 1.0E + L + 0.2S*





Any Questions?

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