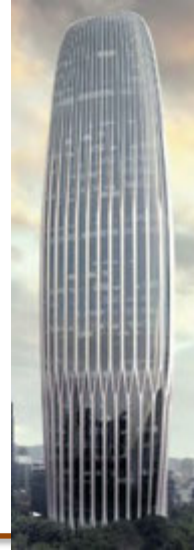


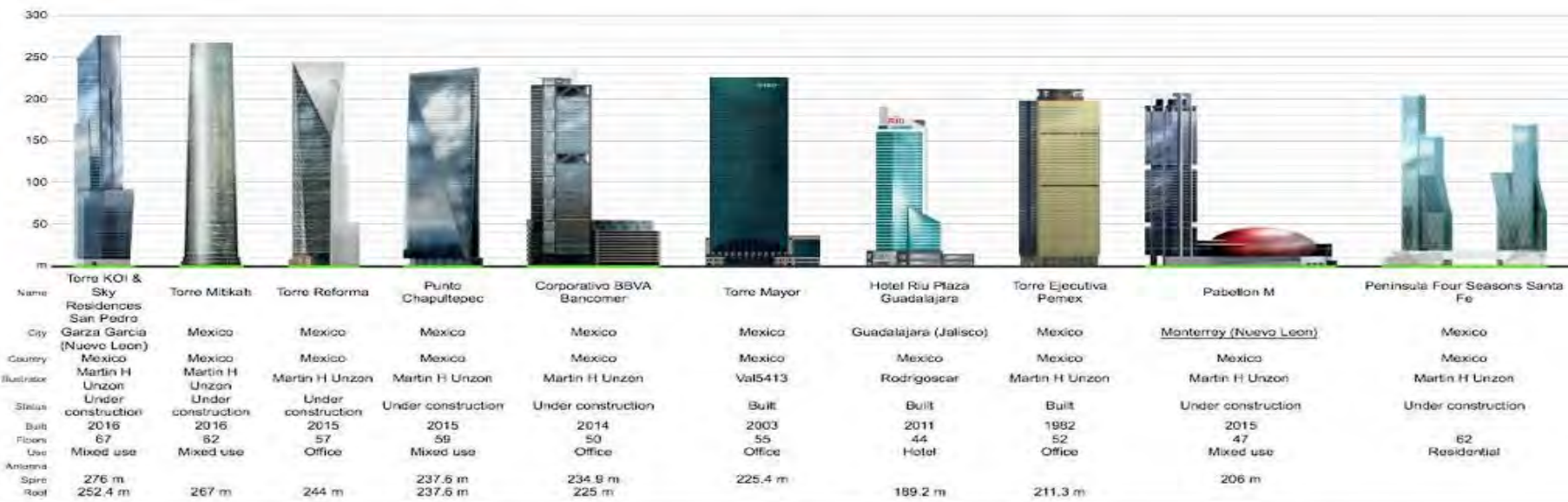


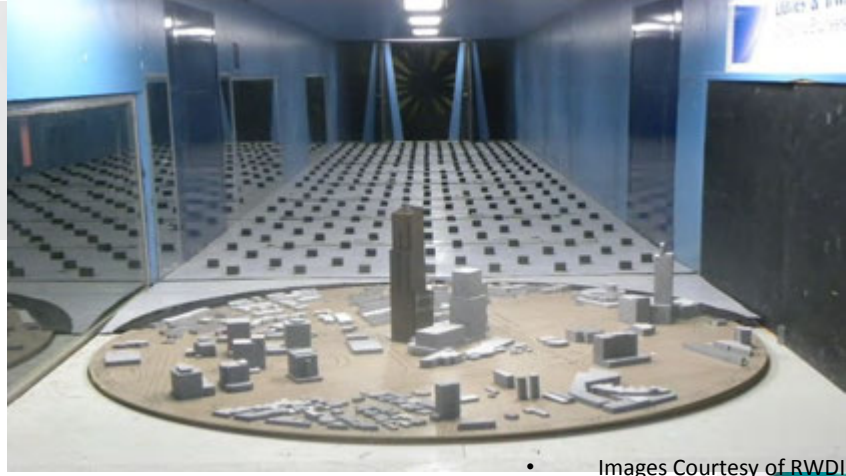
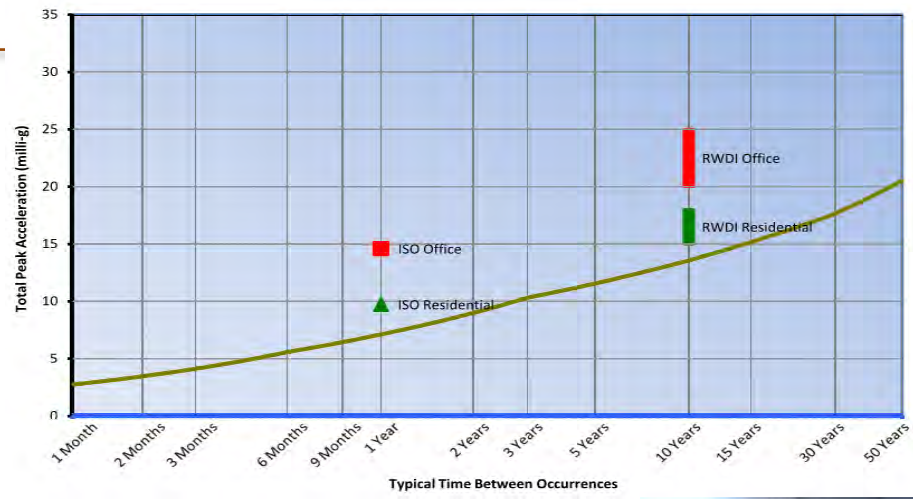
El evento del Cemento, el Concreto y los Prefabricados



Consideraciones de los concretos en el diseño del edificio más alto de Latinoamérica

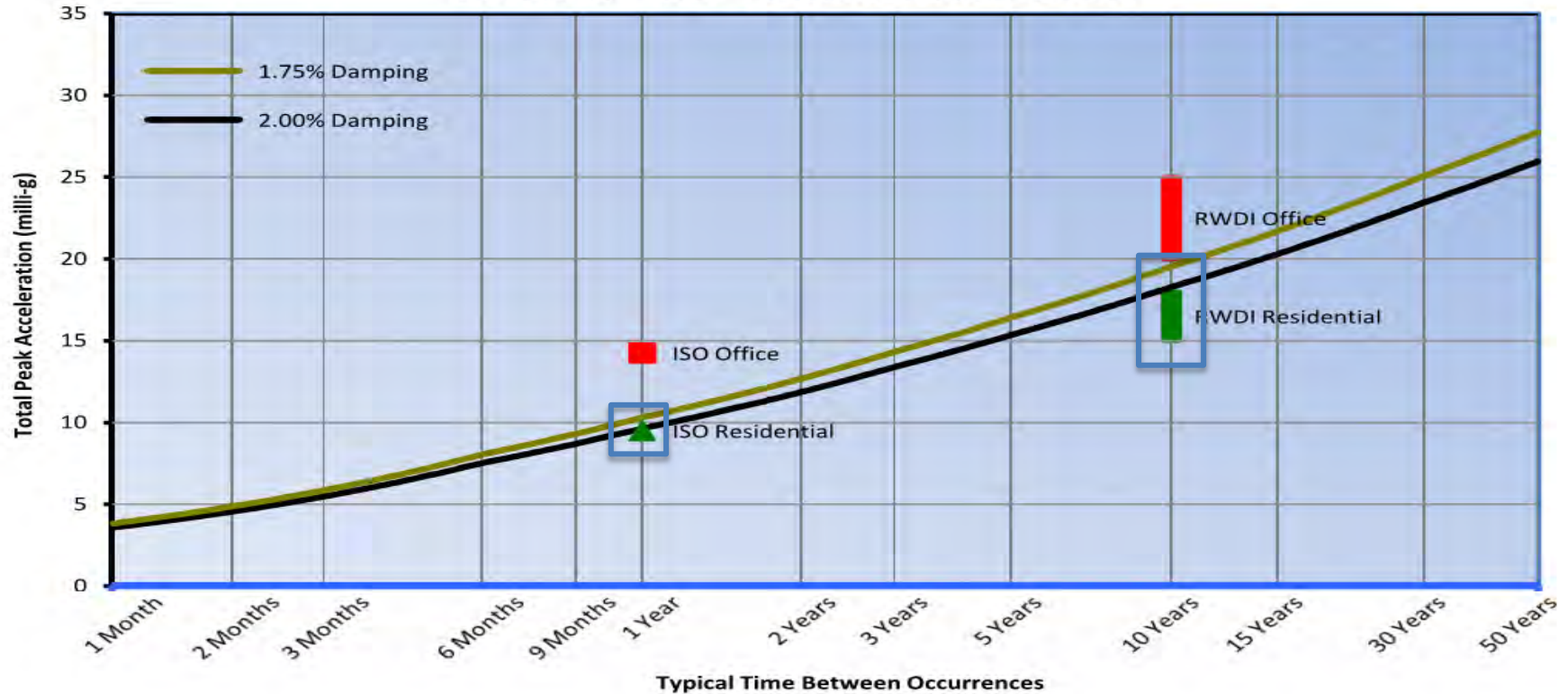
Dr. Roberto Stark
Stark + Ortiz, S.C.
MEXICO





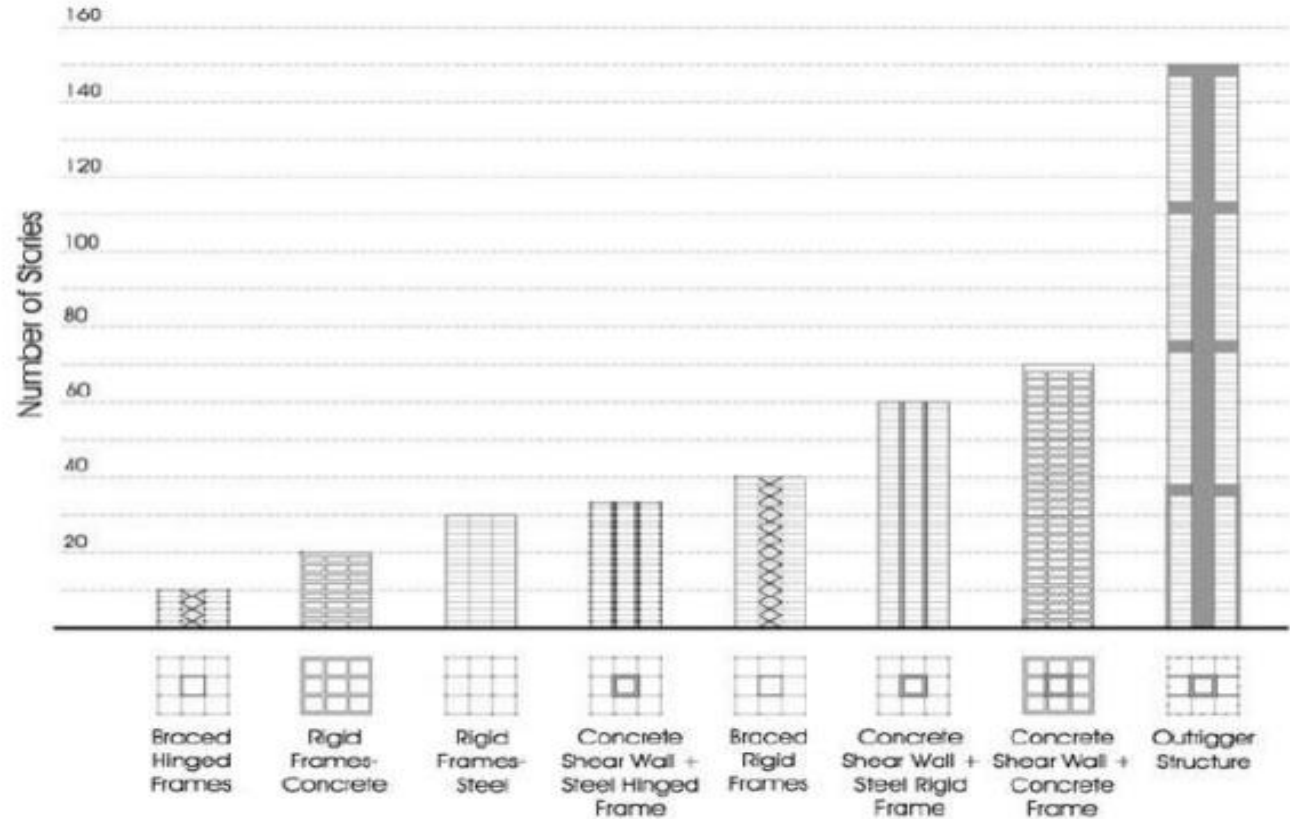
Aceleración Pico Máxima por Viento

LEVEL 57 - TOP RESIDENTIAL FLOOR



• Images Courtesy of RWDI

Sistemas Estructurales

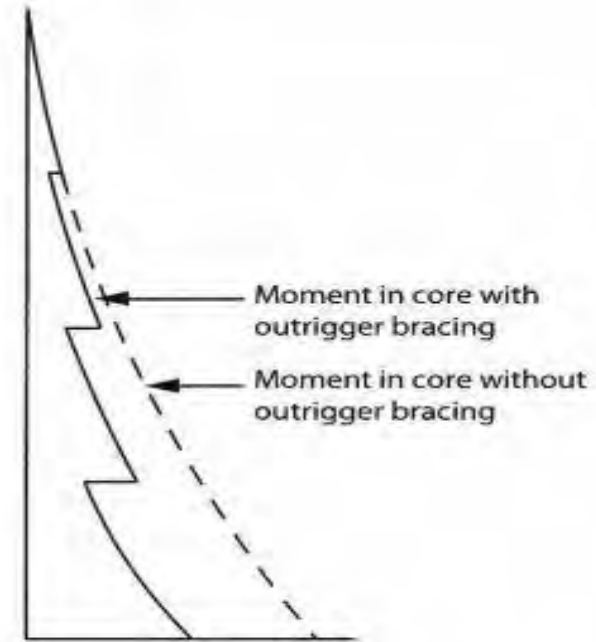
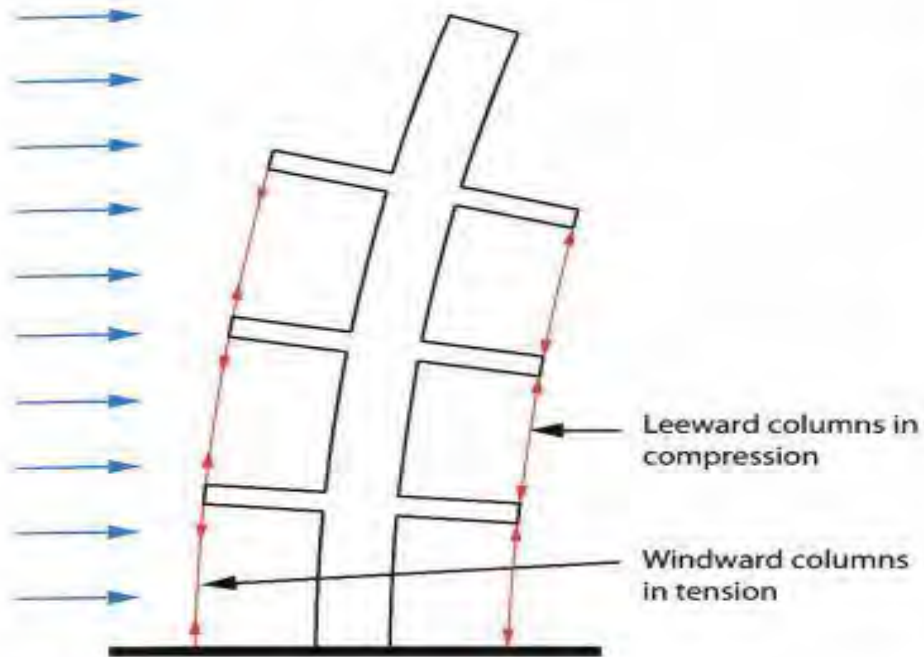


- Source <https://www.slideshare.net/reachkarthiksuresh/structural-systems-in-high-rise-buildings>

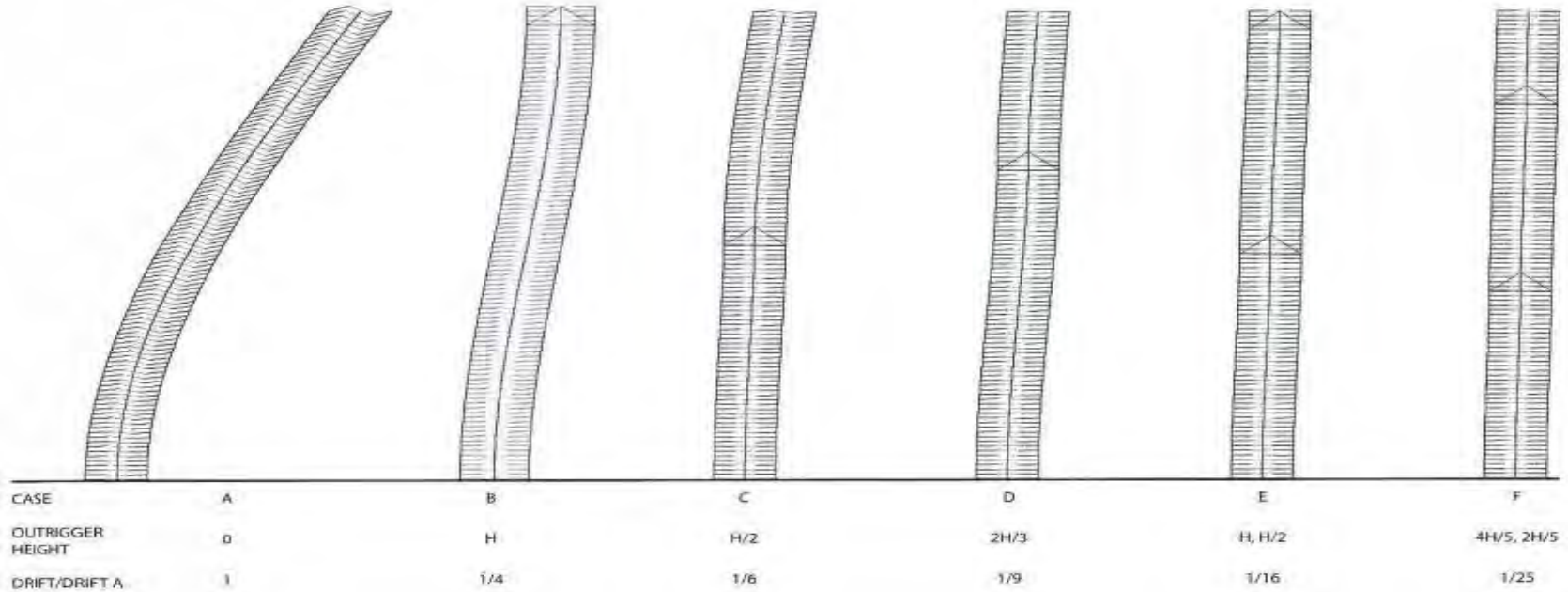
Diferentes usos de outriggers



Uso de Outriggers en Edificios

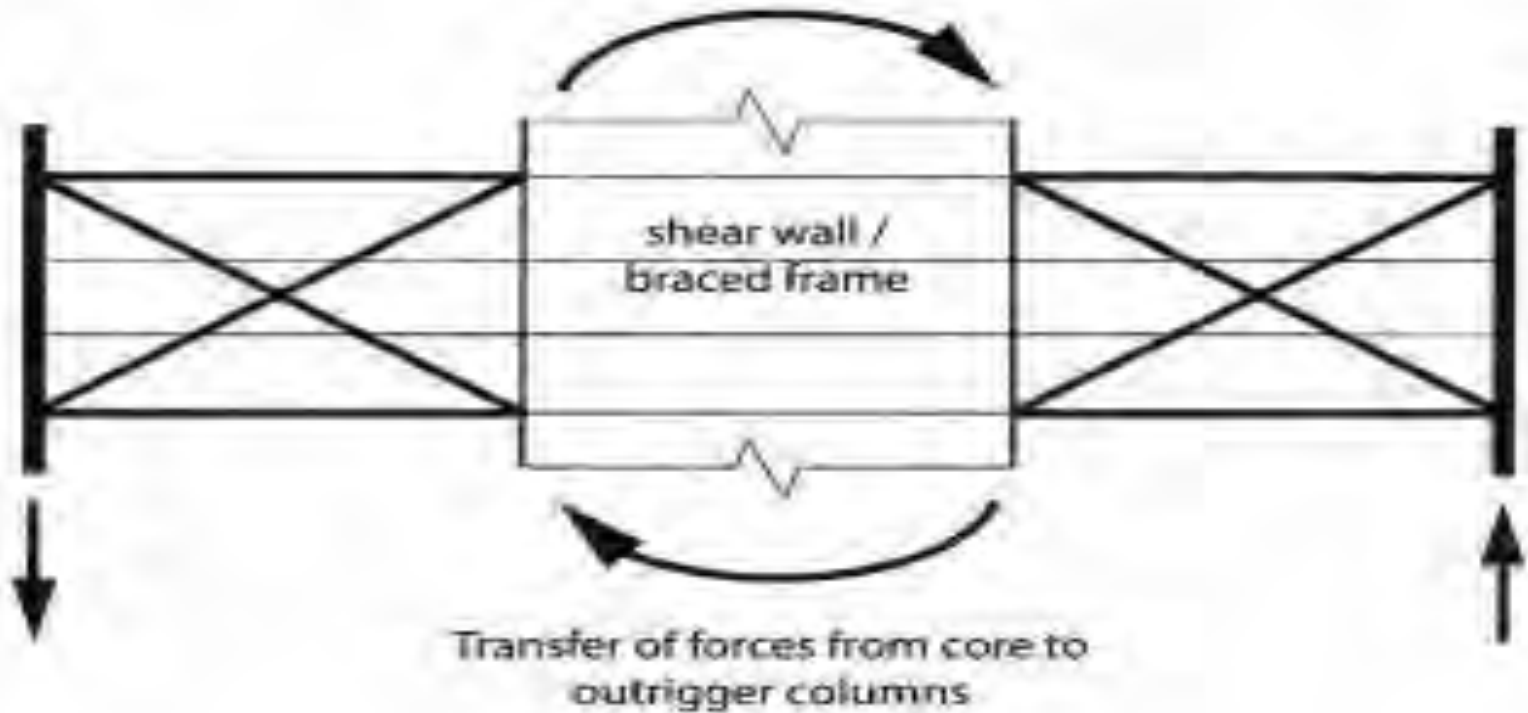


Beneficios y Retos



- Source: Outrigger Design for High-Rise Buildings 2nd Edition, CTBUH 2016

Outrigger Directo



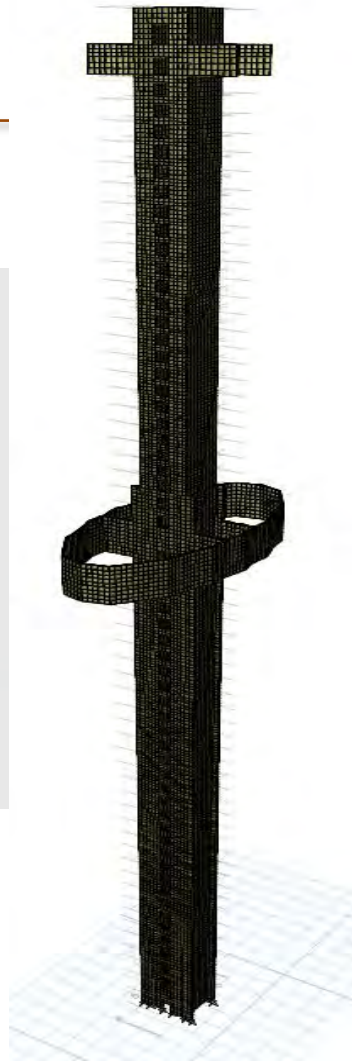
- Source: Belt Trusses and Basements as “Virtual” Outriggers for Tall Buildings, Nair 1998

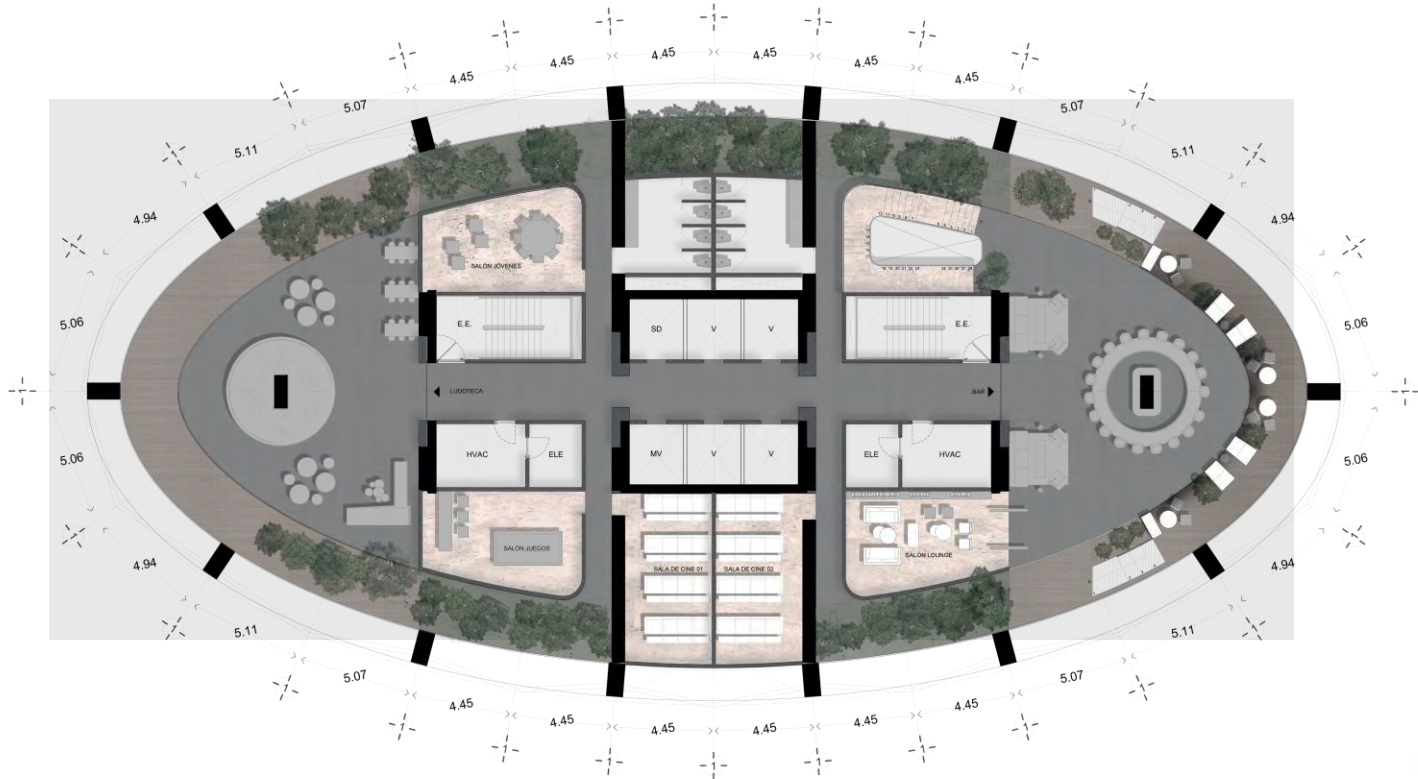


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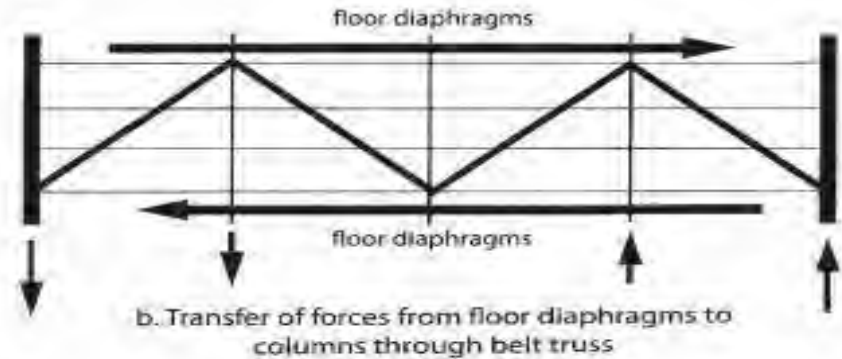
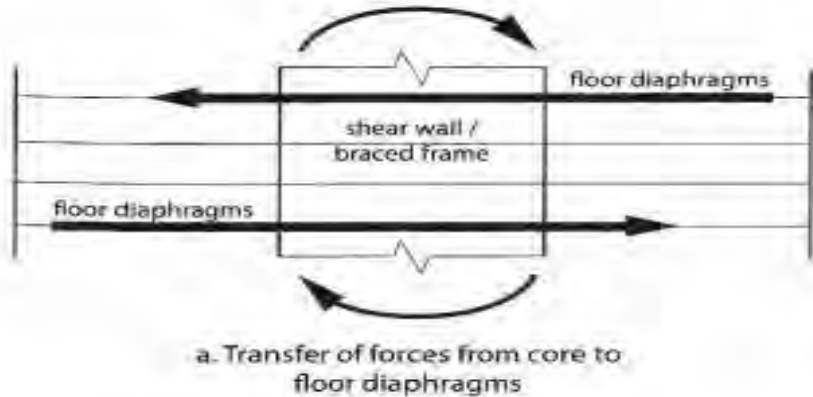
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Amenidades PB

Outrigger Indirecto o Virtual



- Source: Belt Trusses and Basements as "Virtual" Outriggers for Tall Buildings, Nair 1998



Concreto de la Localidad

Ultimo tercio $f'_c = 50 \text{ Mpa}$

Tercio medio $f'_c = 60 \text{ Mpa}$

Tercio inferior $f'_c = 70 \text{ Mpa}$



FICHA TÉCNICA

Cemento Hidráulico

Especificaciones de producto:

- **Tipo de cemento: NMX C 414 CPO 40, ASTM C 150 Tipo I**
- f'_c 7 días: 33.0 N/mm^2 (ASTM C 150 Min. 19 N/mm^2)
- f'_c 28 días: 44.9 N/mm^2 (ASTM C 150 No aplica)
- Pérdida por ignición: 2.2% (ASTM C 150 Máx. 3.0%)
- Expansión en autoclave: 0.033% (ASTM C 150 Max. 0.80%)
- Tiempo de fraguado inicial: 163 min (ASTM C 150 No menos de 45 min)
- Tiempo de fraguado final: 295 min (ASTM C 150 No más de 375 min)
- **Calor de hidratación 7 días: 384.04 (91.8) kJ/kg(cal/gr) (ASTM C 150 No aplica)**
- **Calor de hidratación 28 días: 392.39 (93.8) kJ/kg(cal/gr) (ASTM C 150 No aplica)**

Módulo de Elasticidad

	Concretos Cd. De Monterrey				
	f'c				
	Unidad	400	500	600	700
Cemento	kg/m ³	430	525	550	700
Grava	kg/m ³	920	950	980	1000
Arena	kg/m ³	870	750	700	530
Agua	kg/m ³	175	180	180	190
Ad 1	l/m ³	1.2	1.4	1.5	1.5
Ad 2	l/m ³	3.5	3.8	4.0	6.0
Masa Unitaria	kg/m ³	2400	2410	2416	2428
Módulo elástico	kg/m ³	330,000	355,000	370,000	395,000
Contracción por secado	Millonésimas	900	800	800	700

• Image Courtesy of Cemex

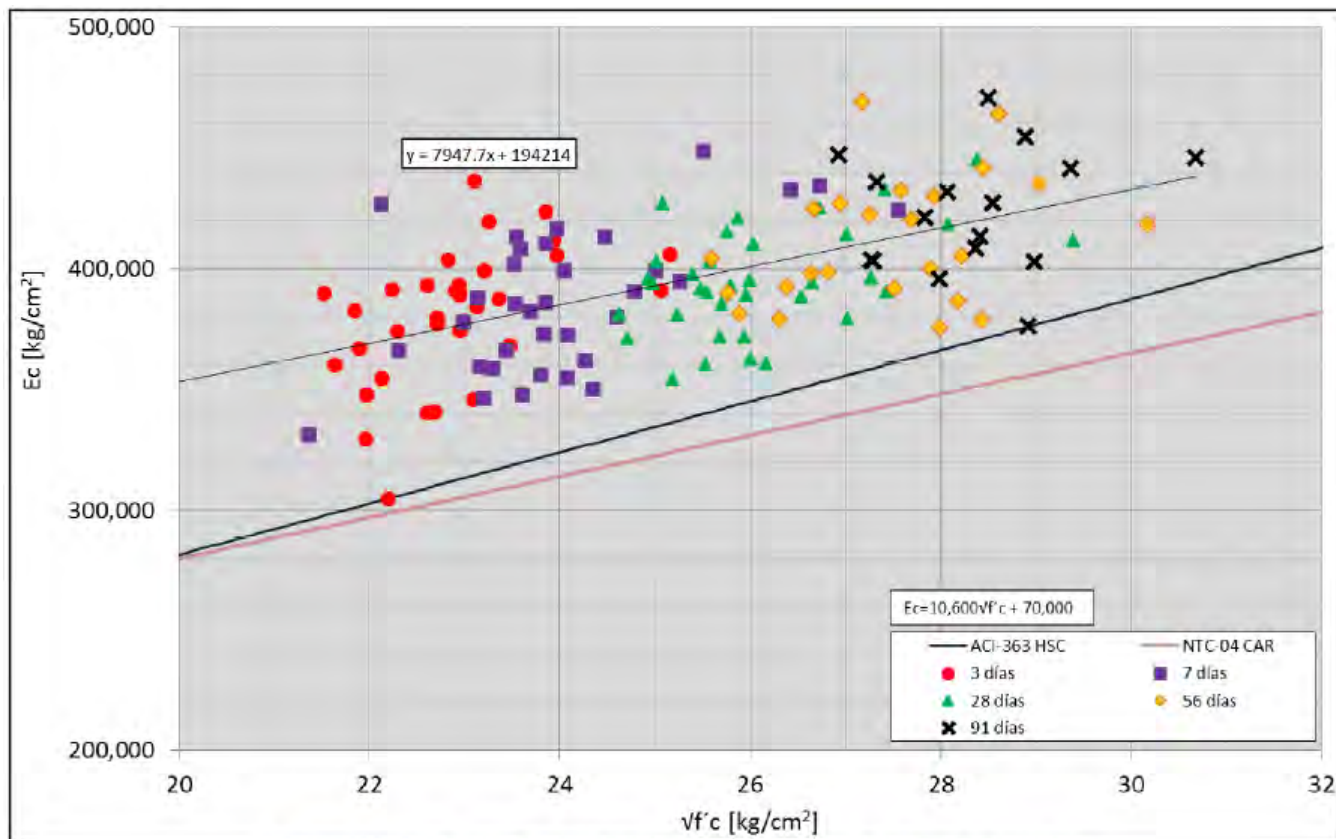
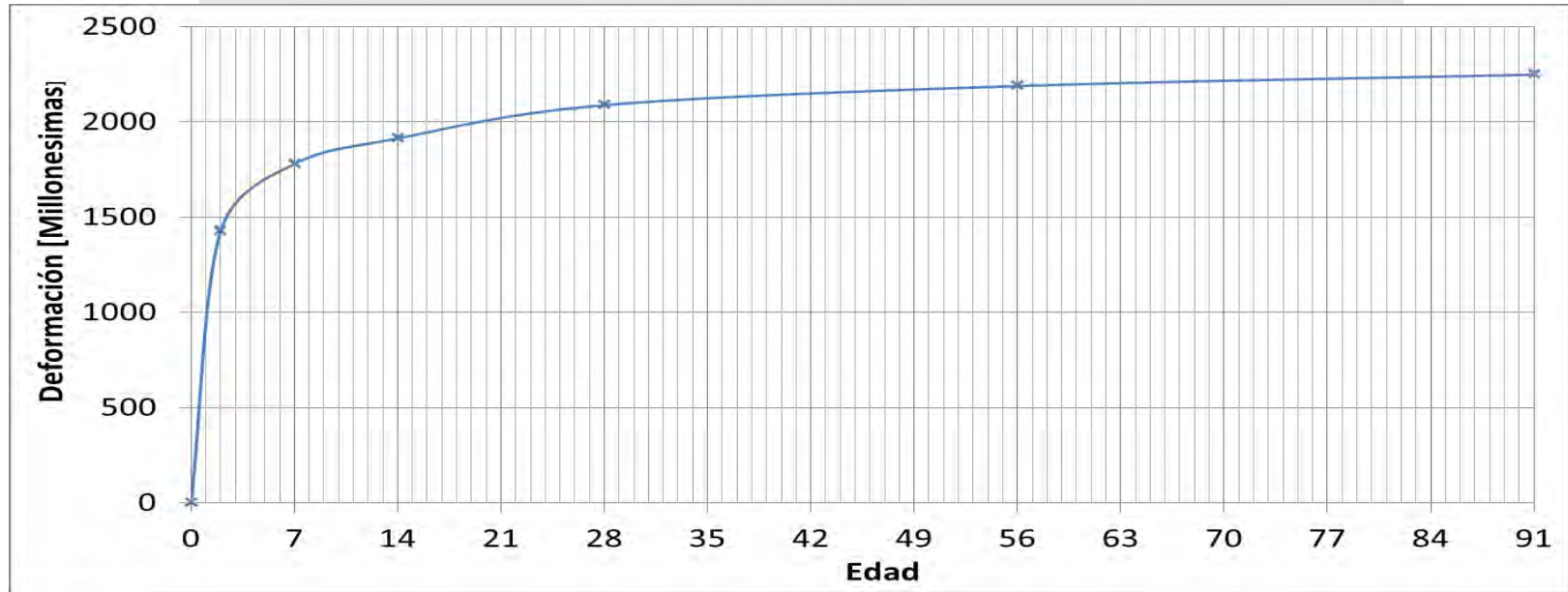


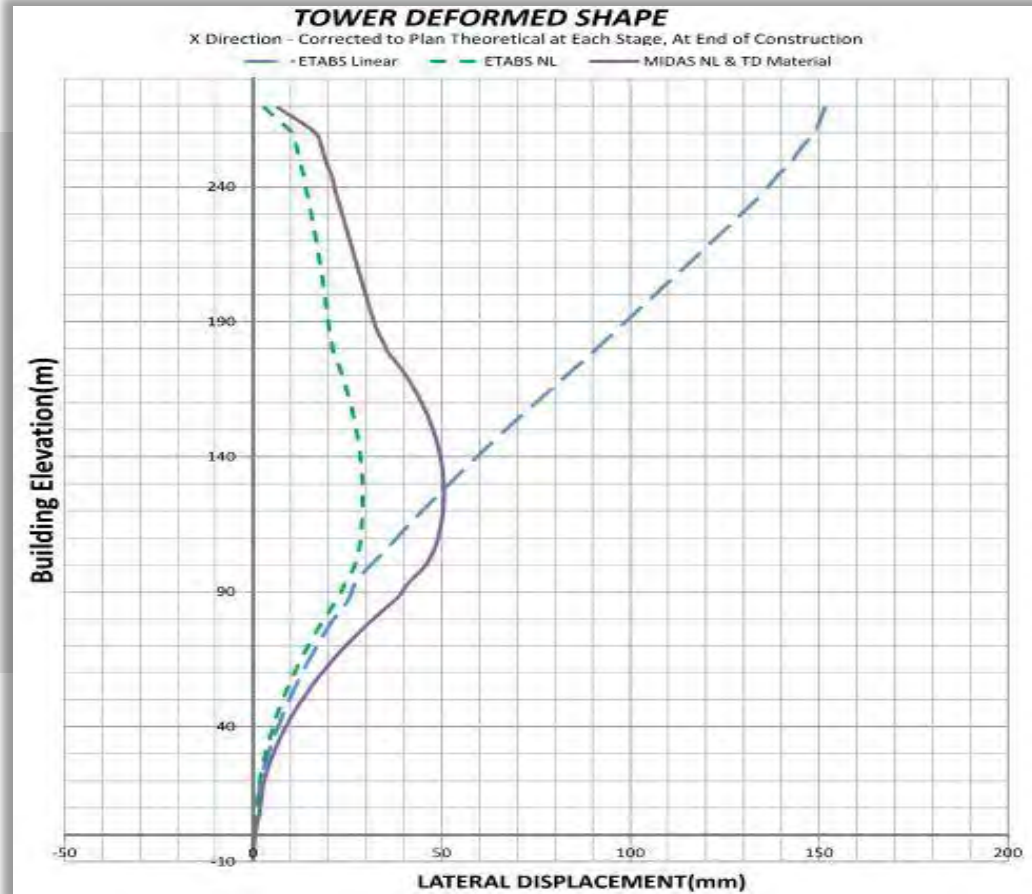
Figura 7. Módulos de elasticidad de los concretos suministrados

Flujo Plástico y Contracción

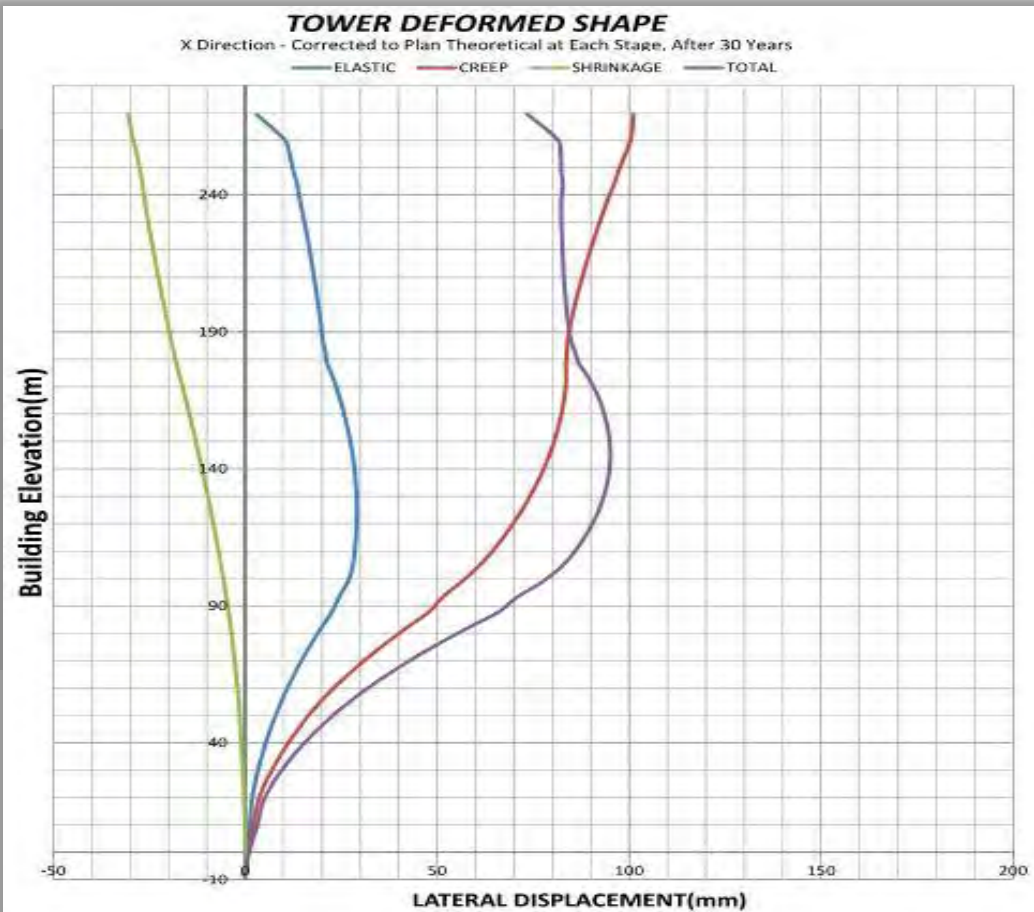


• Image Courtesy of Cemex

Deformación Lateral de la Estructura por Contracción del Concreto

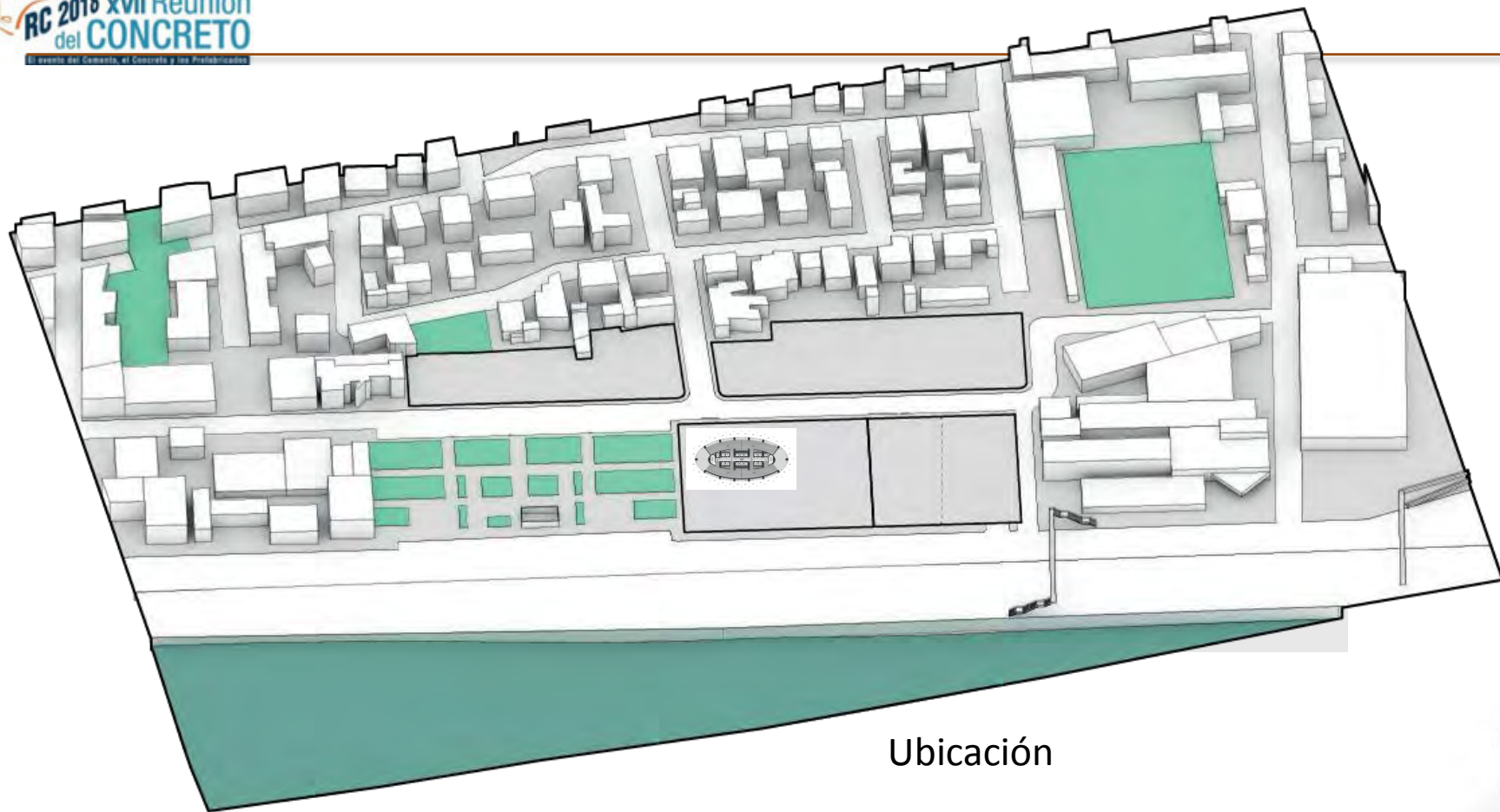


Desplazamiento Lateral Debido a Deformación Vertical









Ubicación

Piso Mecánico

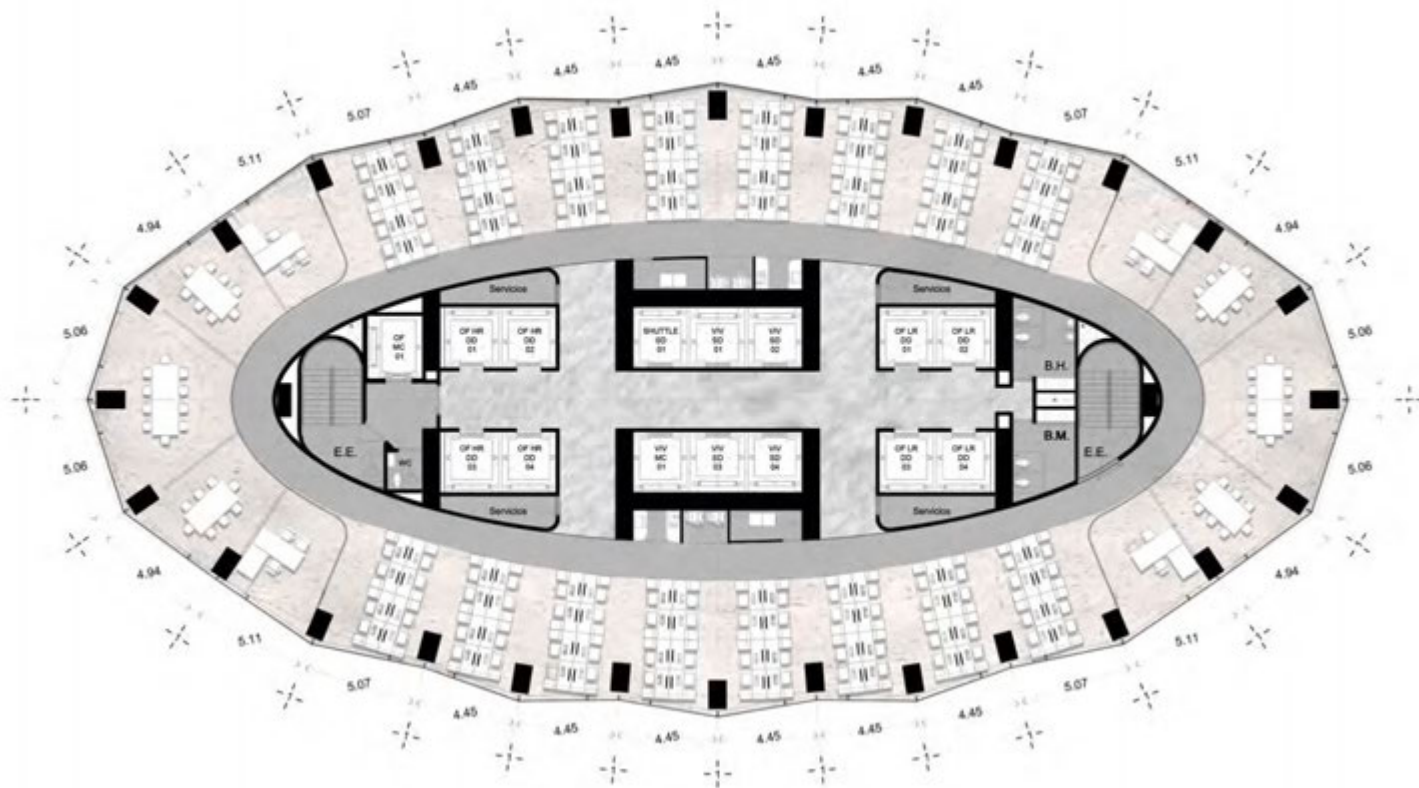
Amenidades
Piso Mecánico

VIVIENDAS

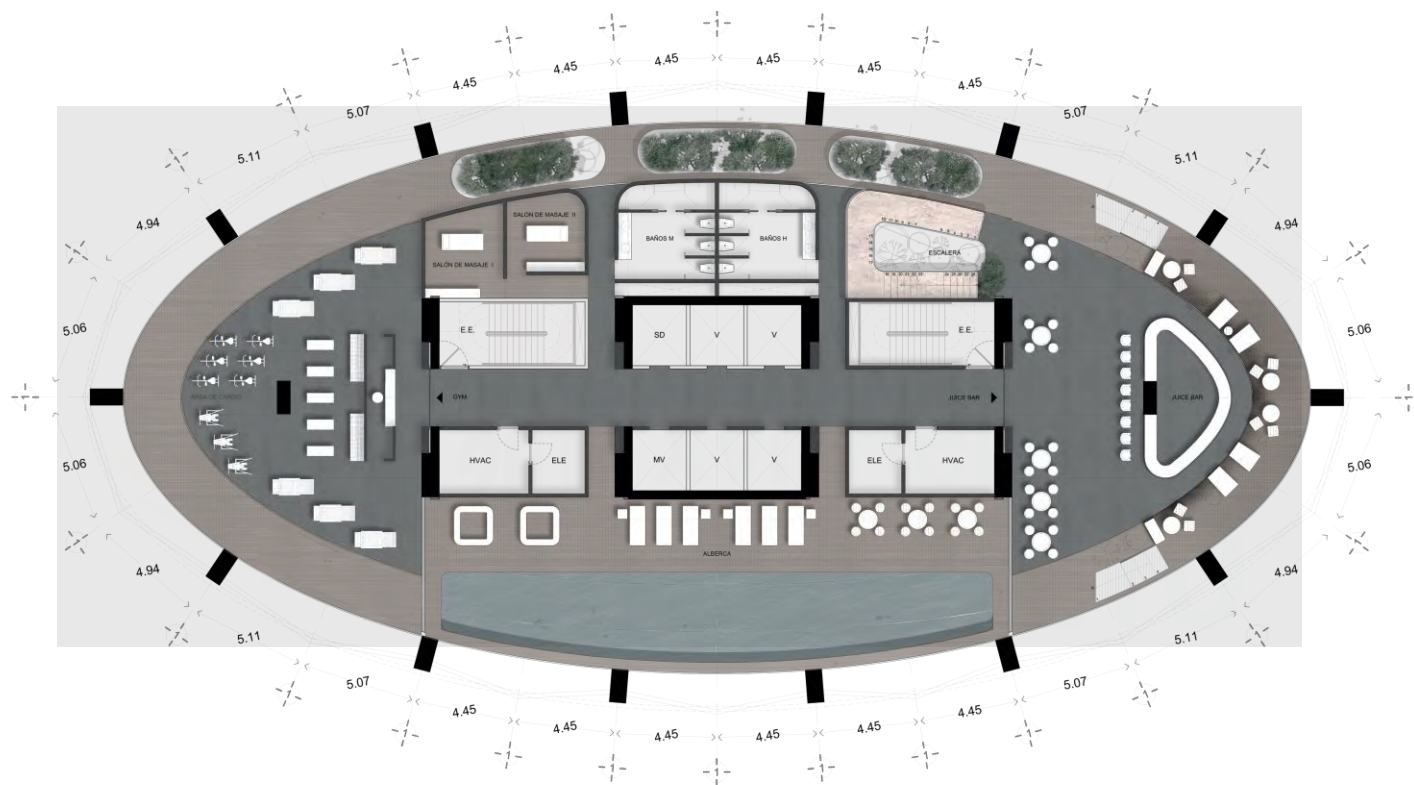
OFICINAS



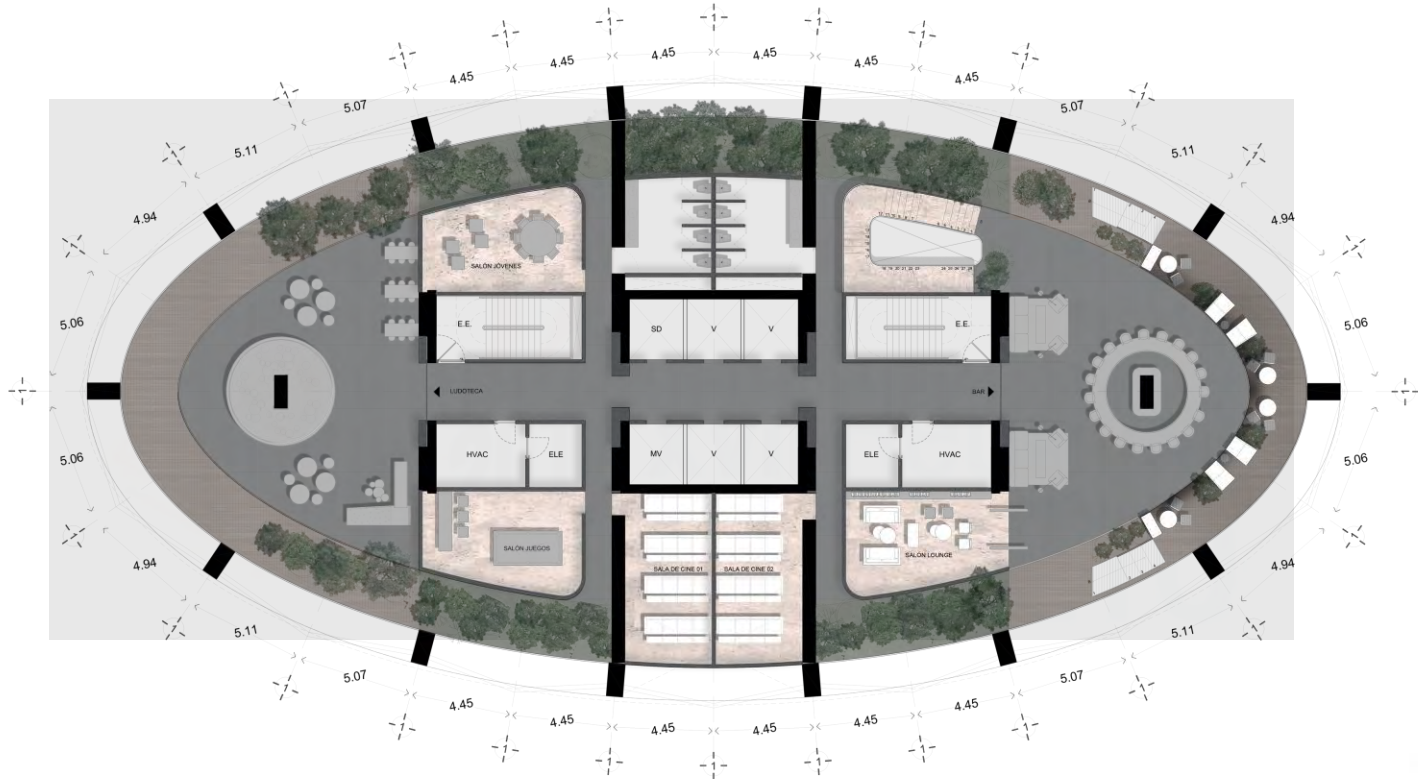




Nivel Oficinas



Amenidades PA



Amenidades PB



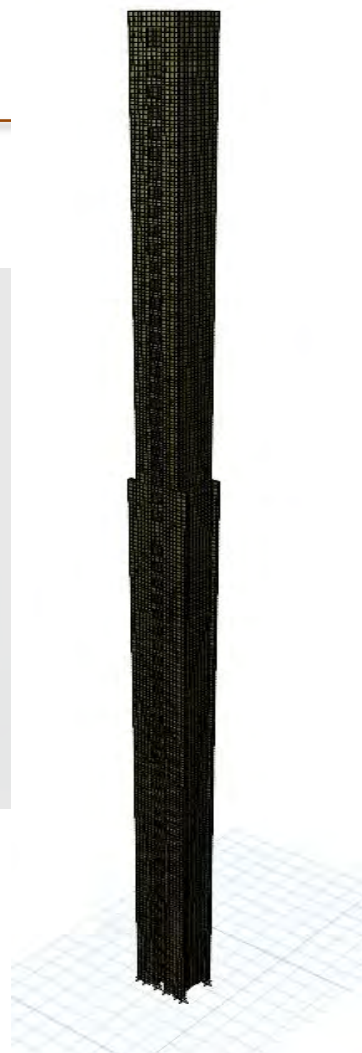
Nivel Vivienda

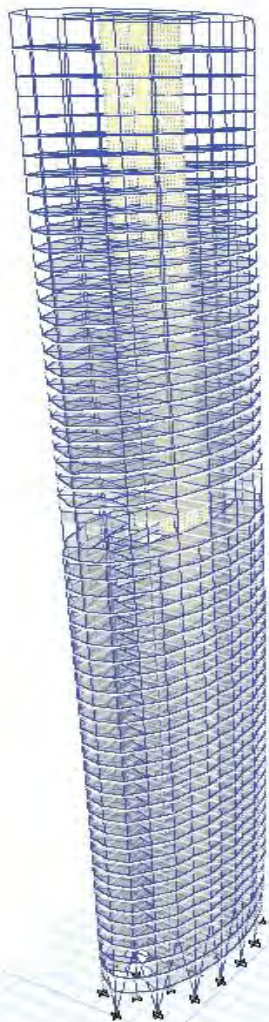


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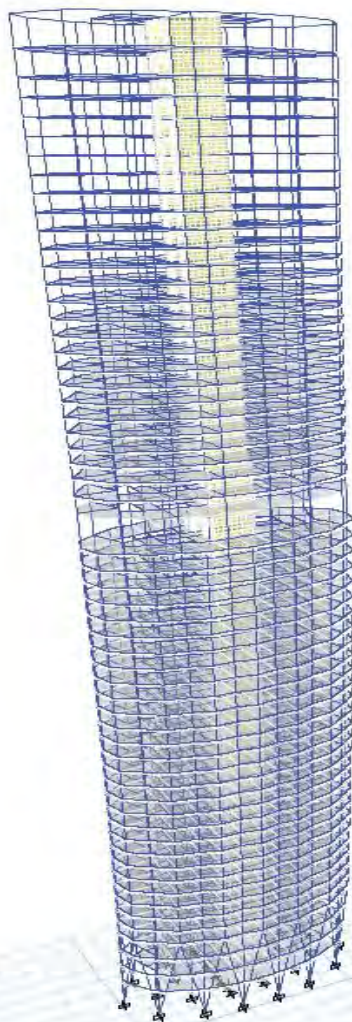


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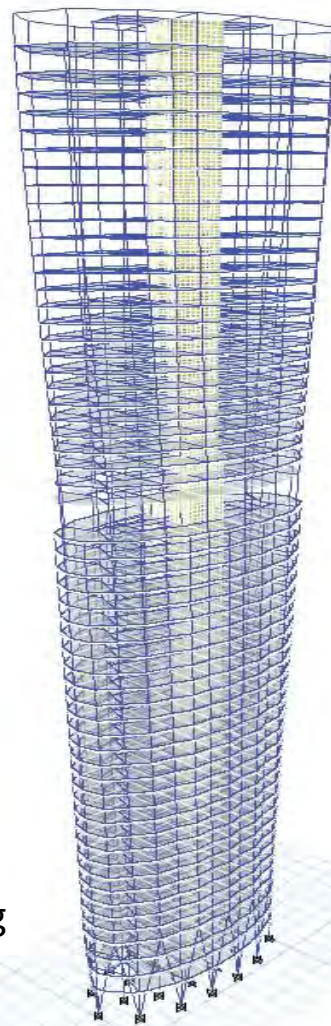




T1=7.93 seg

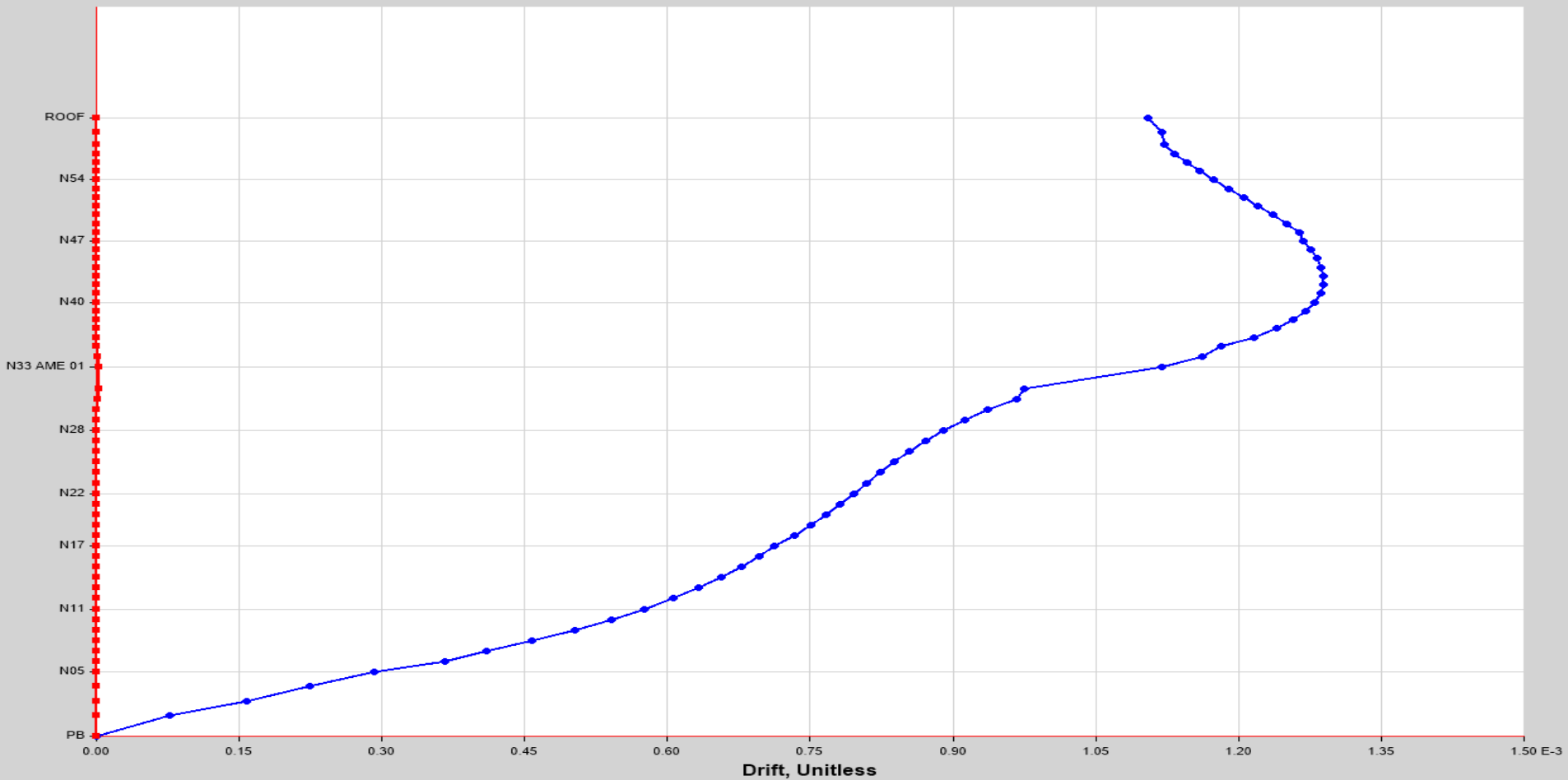


T2=6.31 seg



T3=3.55 seg

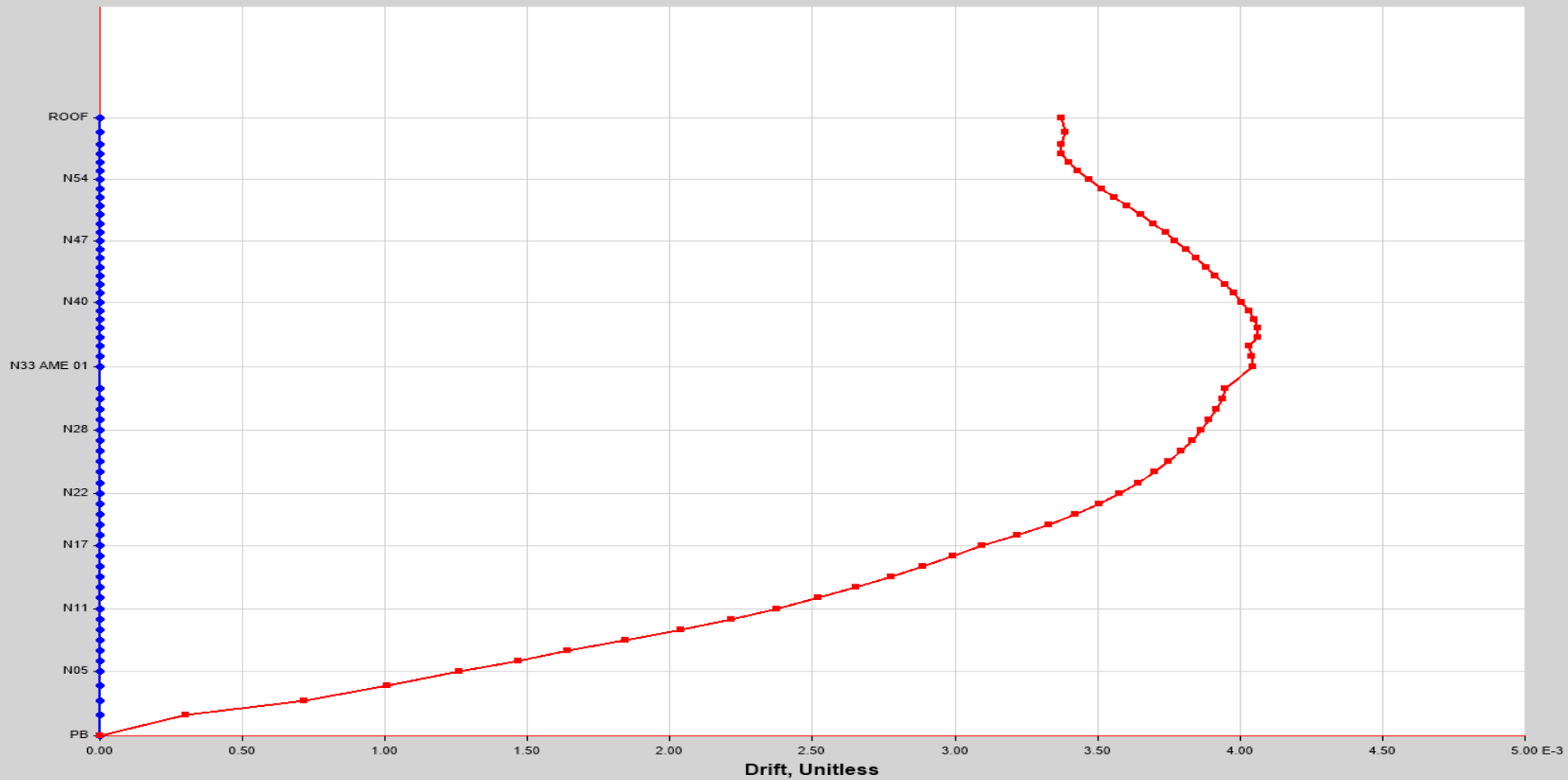
Maximum Story Drifts



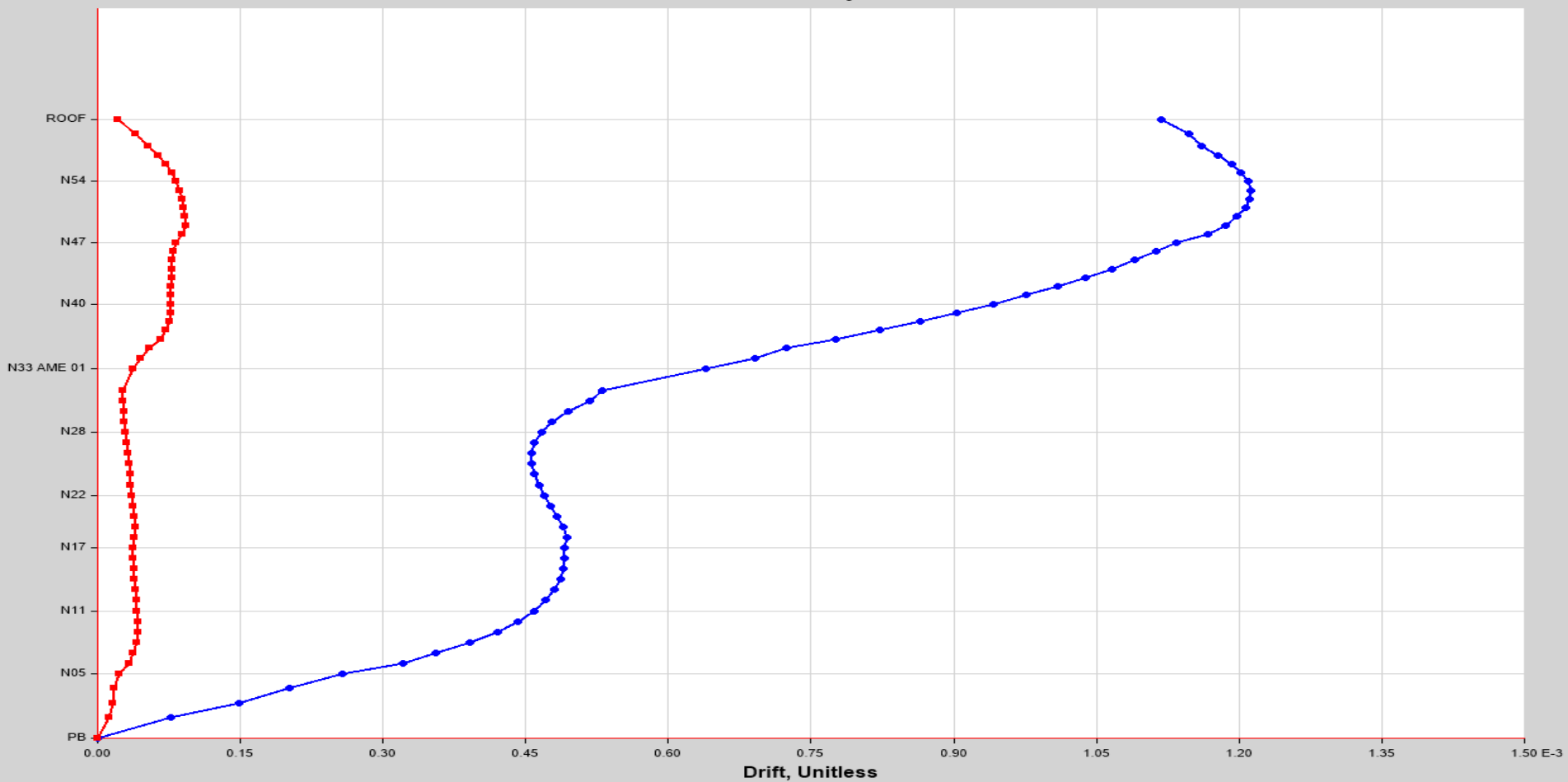
Desplazamientos Relativos de Entrepiso – Viento X



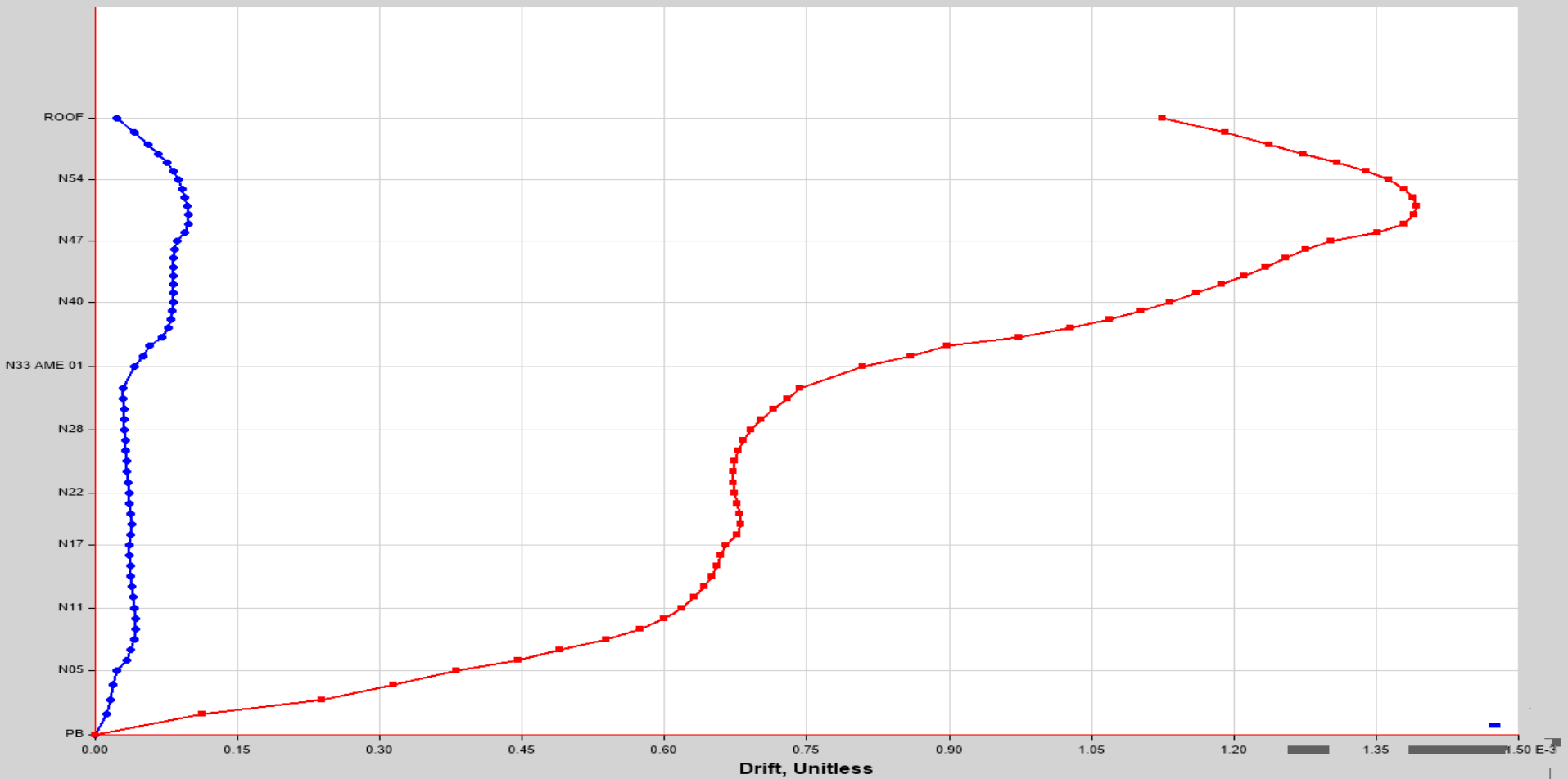
Maximum Story Drifts



Desplazamientos Relativos de Entrepiso – Viento Y



Desplazamientos Relativos de Entrepiso – Sismo X



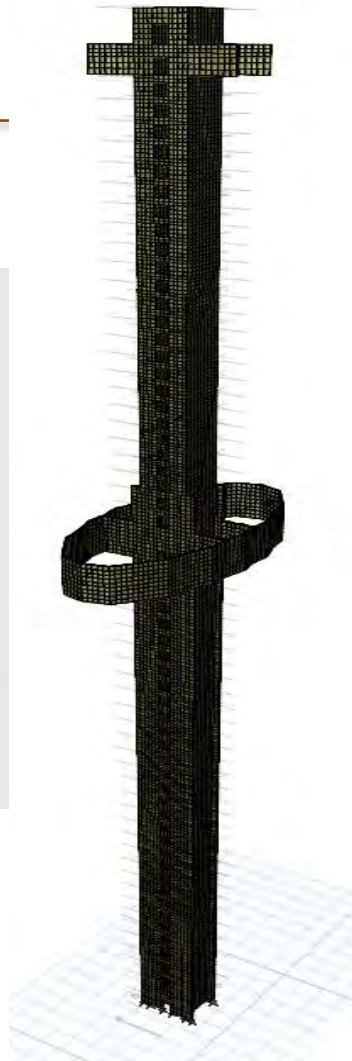
Desplazamientos Relativos de Entrepiso – Sismo Y

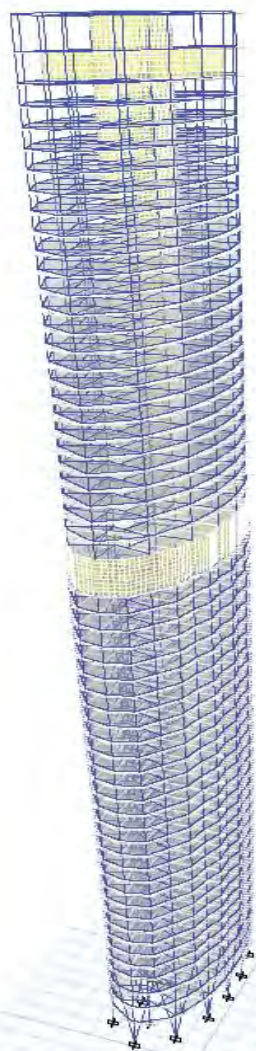


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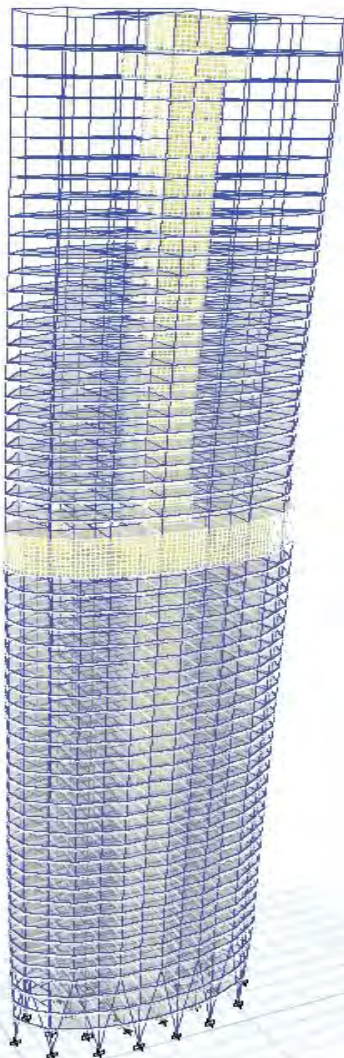


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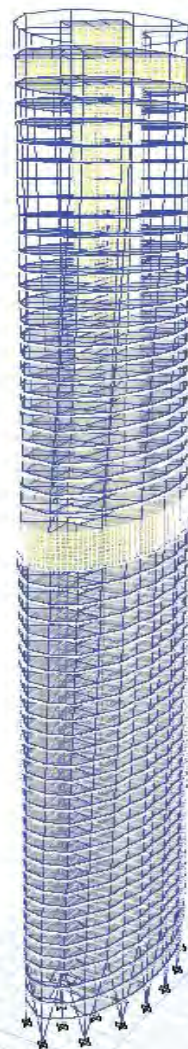




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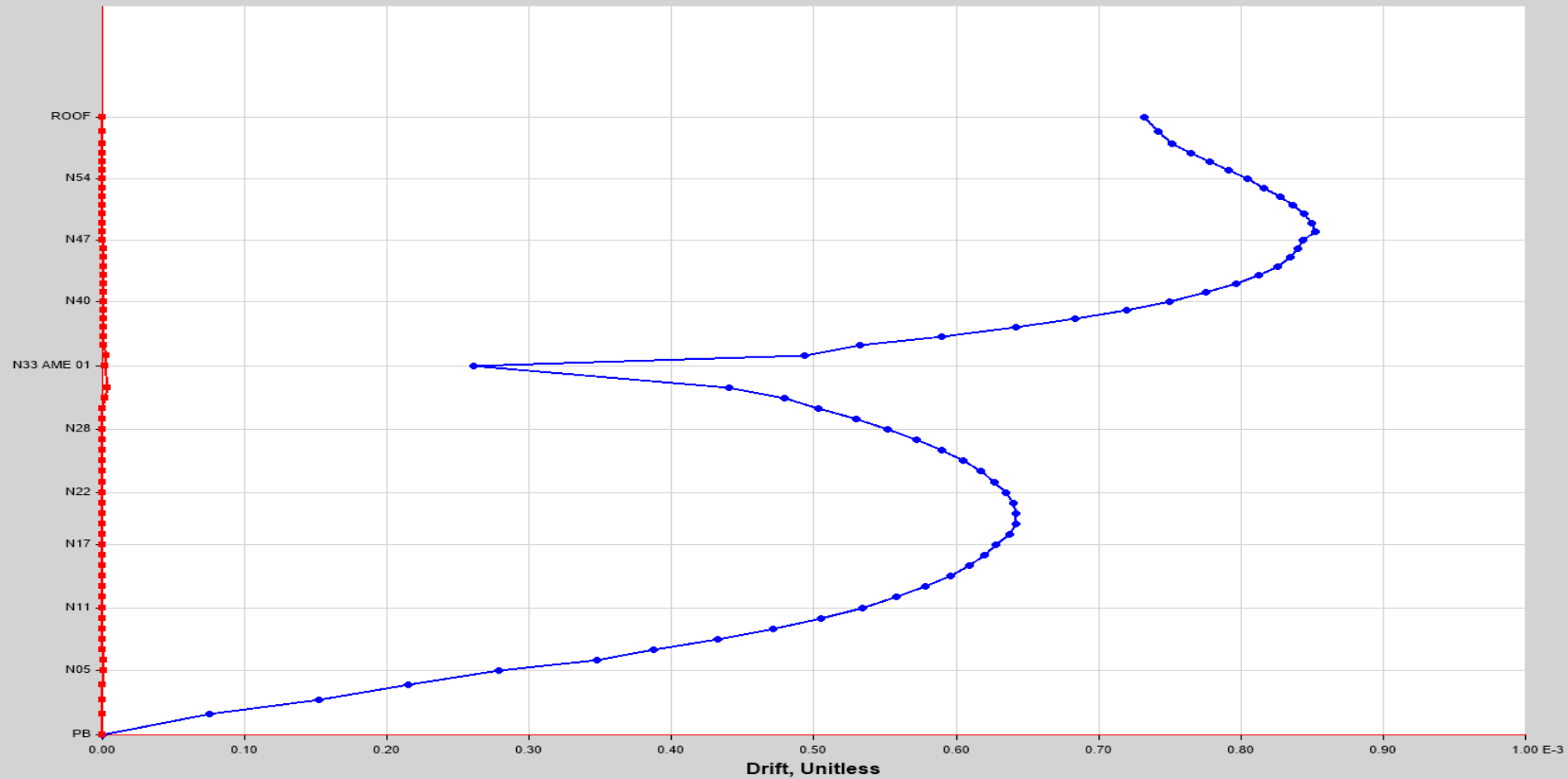


T2=5.21 seg



T3=3.45 seg

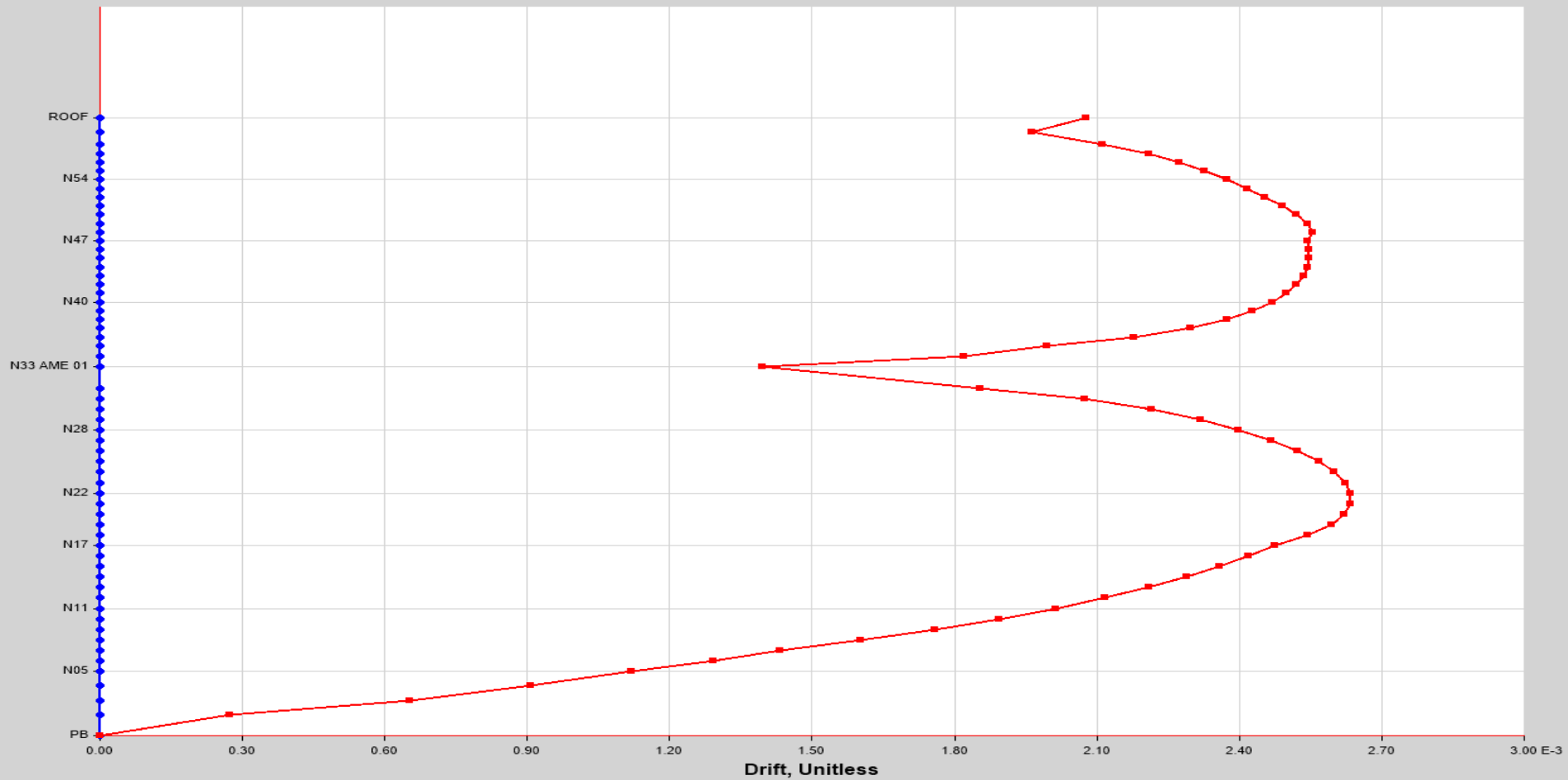
Maximum Story Drifts



Desplazamientos Relativos de Entrepiso – Viento X

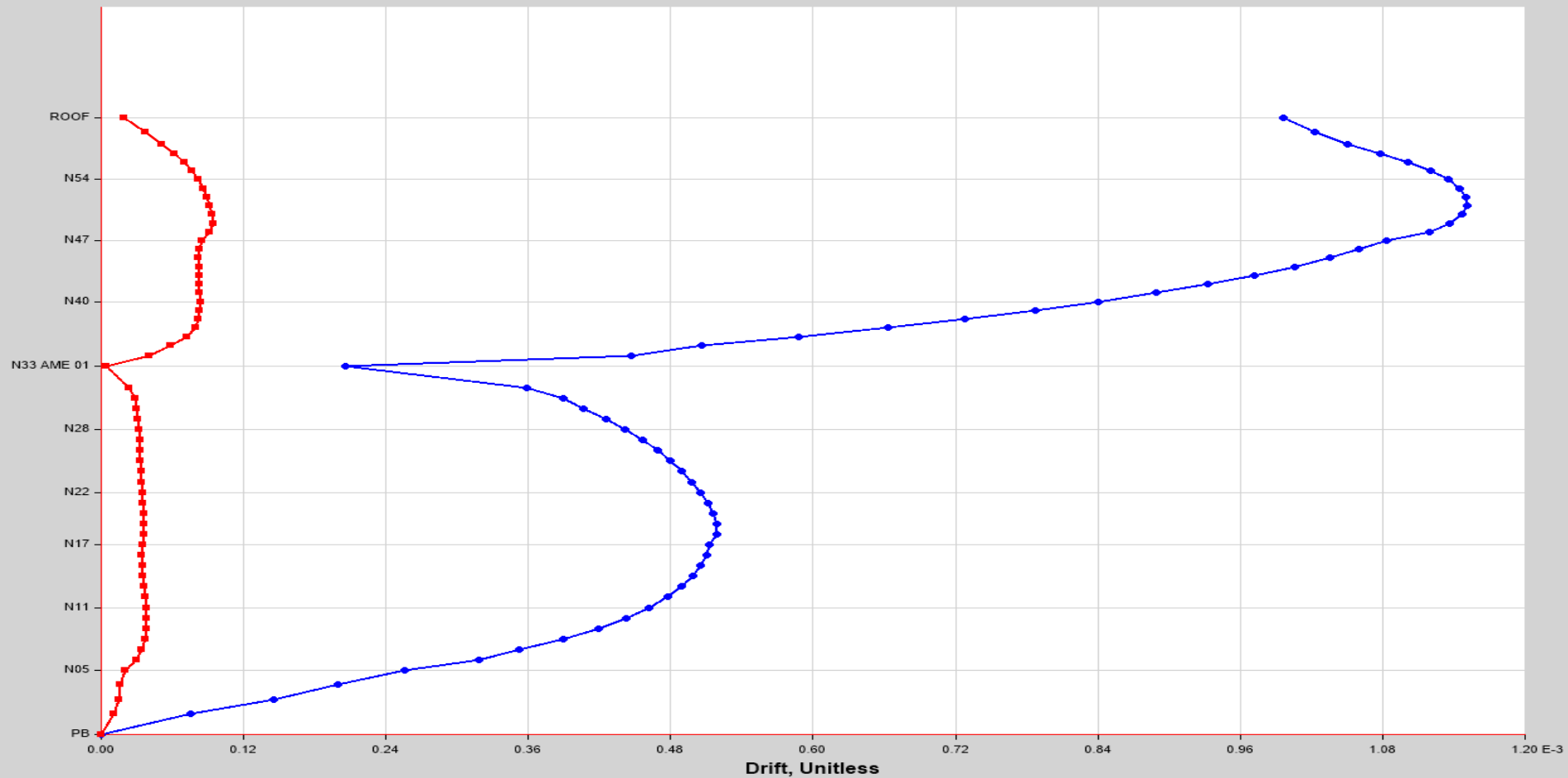


Maximum Story Drifts



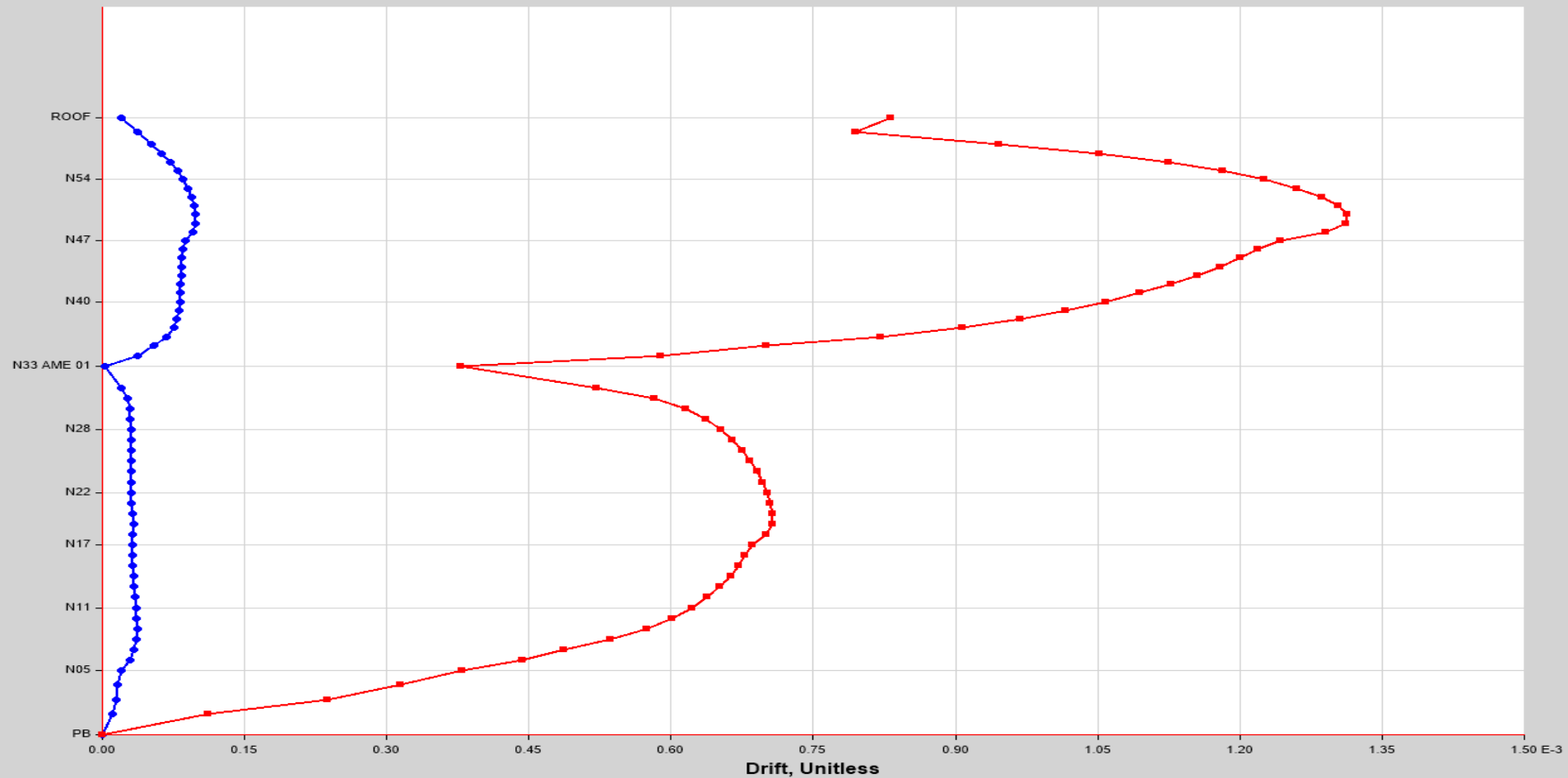
Desplazamientos Relativos de Entrepiso – Viento Y

Maximum Story Drifts

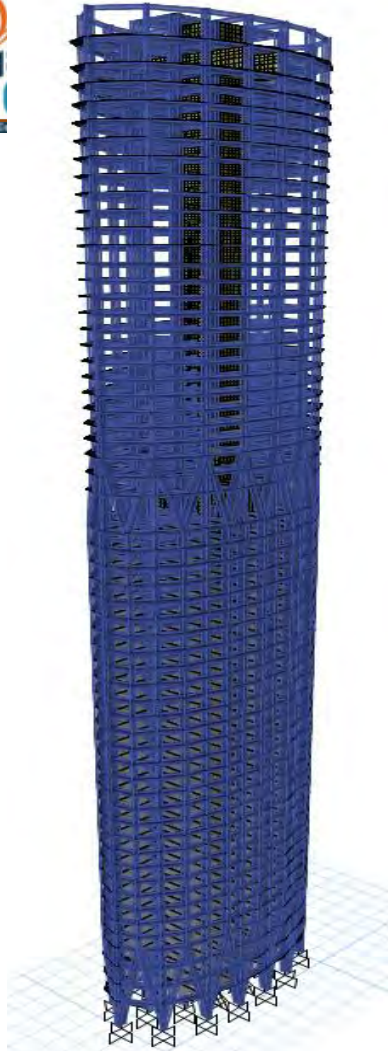


Desplazamientos Relativos de Entrepiso – Sismo X





Desplazamientos Relativos de Entrepiso – Sismo Y

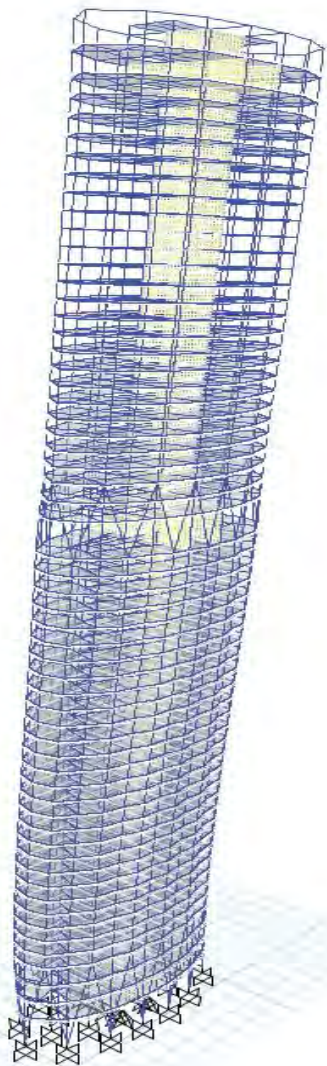


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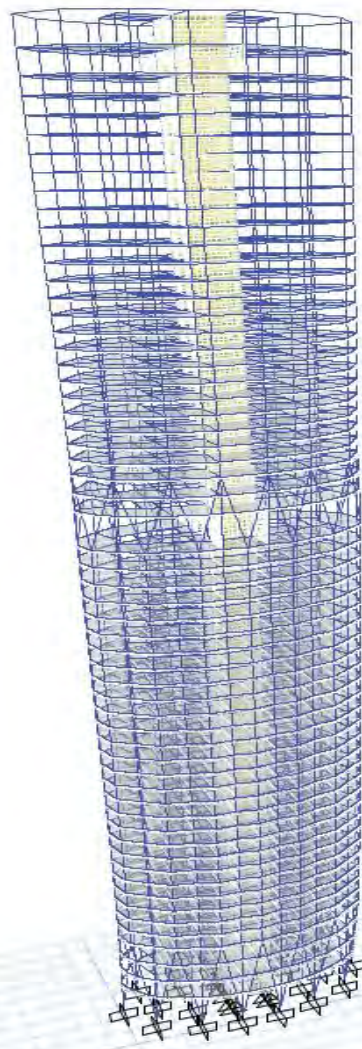


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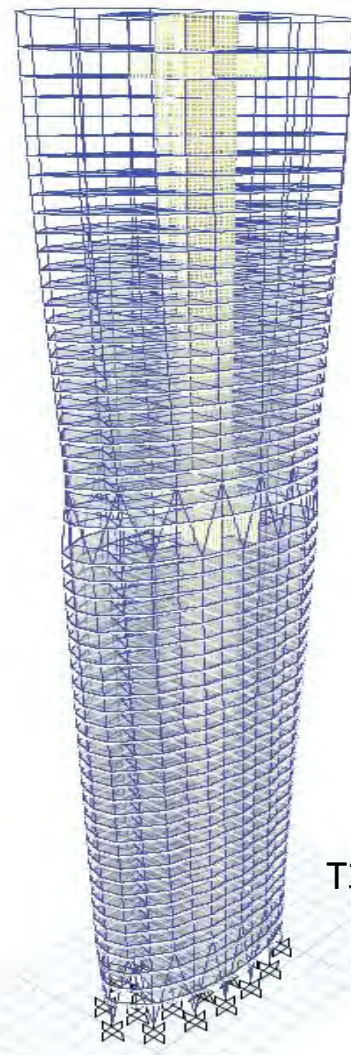




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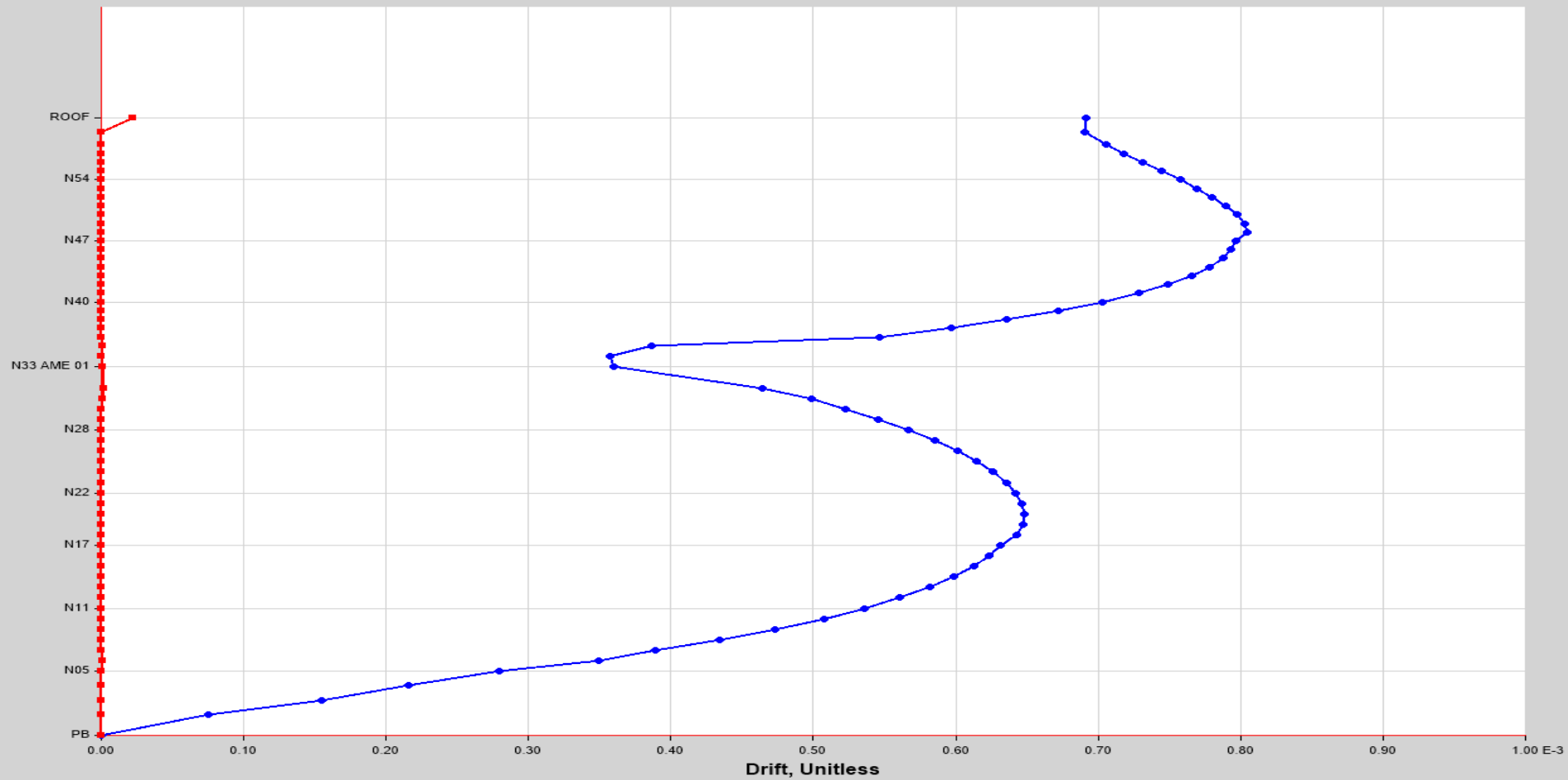


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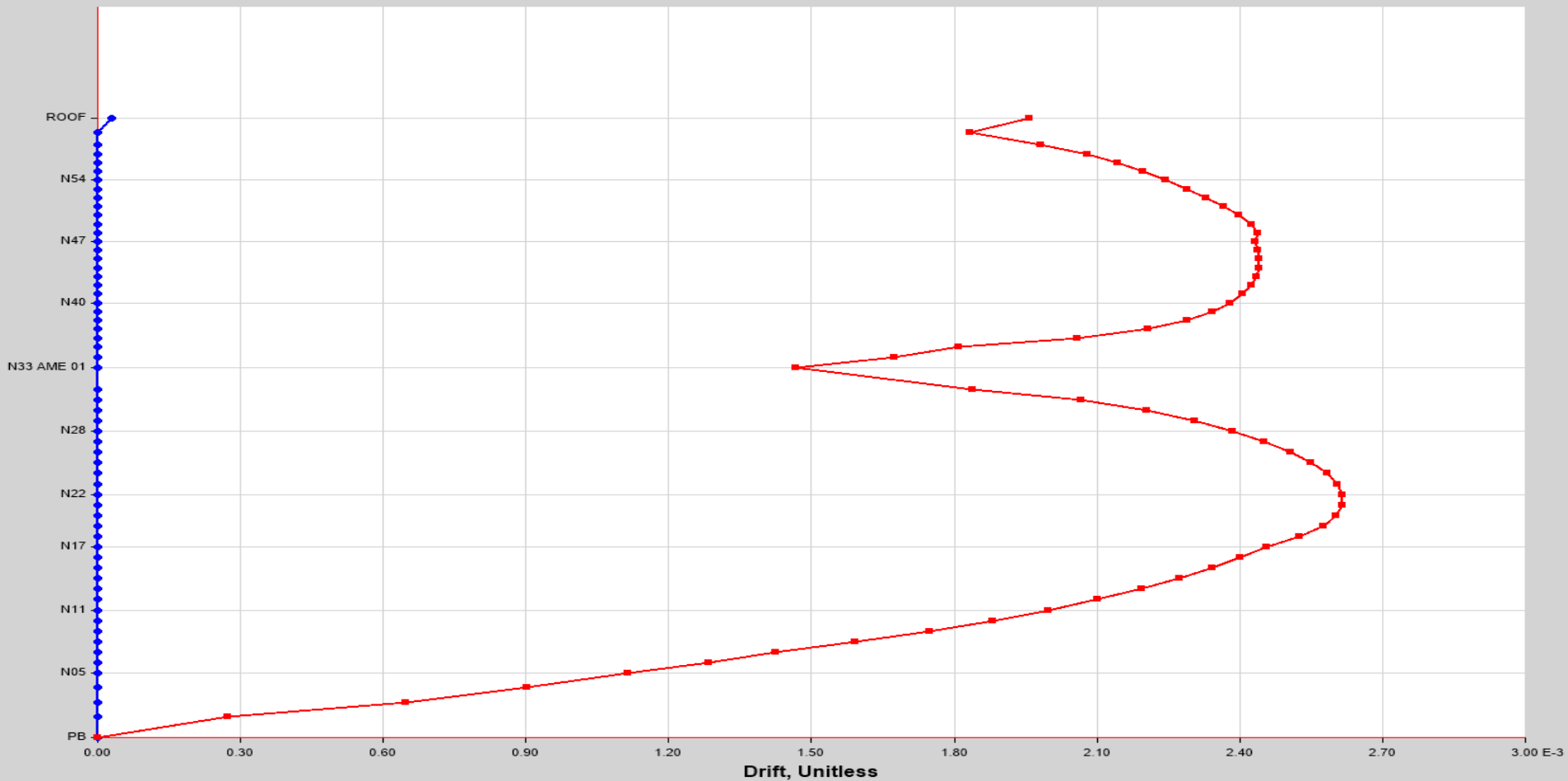
T3=3.42 seg

Maximum Story Drifts



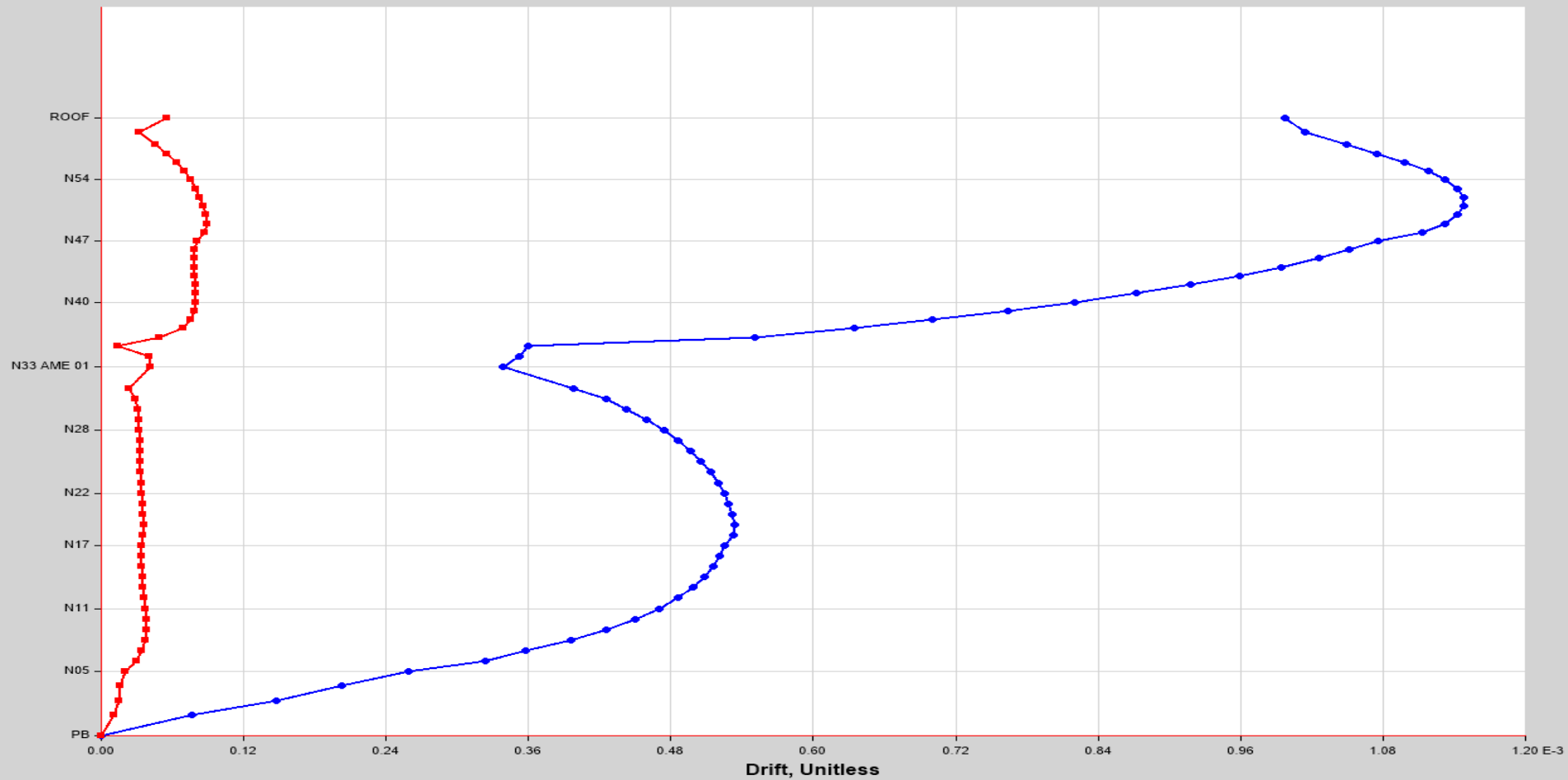
Desplazamientos Relativos de Entrepiso – Viento X





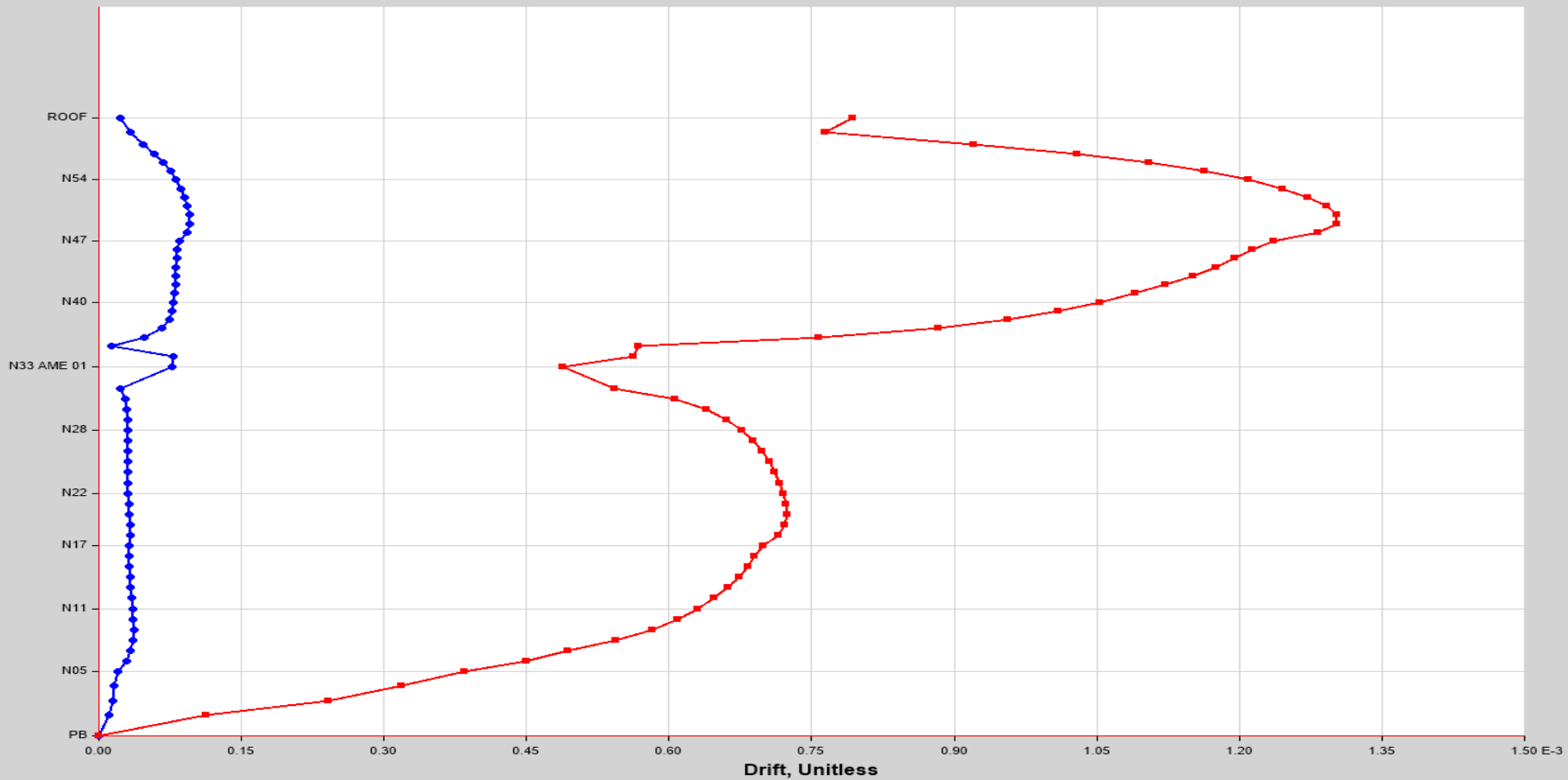
Desplazamientos Relativos de Entrepiso – Viento Y

Maximum Story Drifts



Desplazamientos Relativos de Entrepiso – Sismo X





Desplazamientos Relativos de Entrepiso – Sismo Y

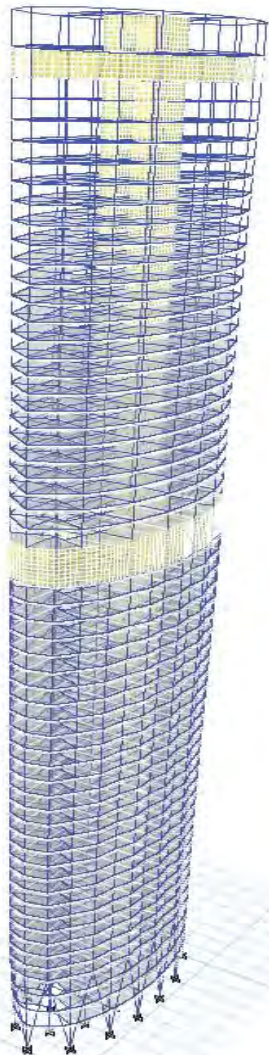


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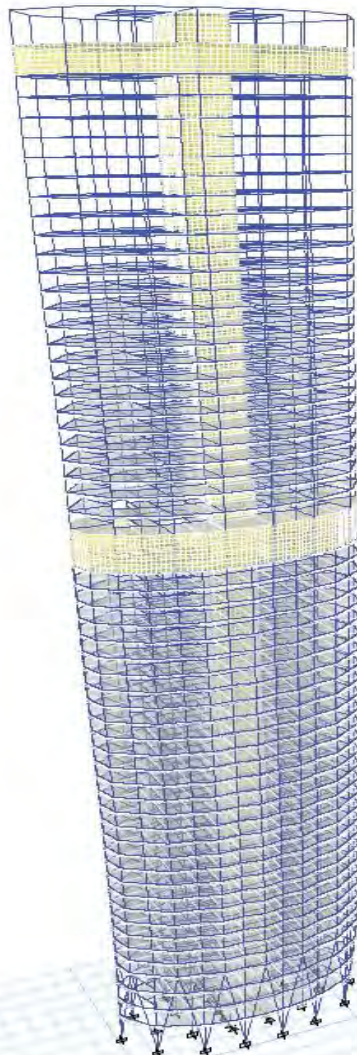


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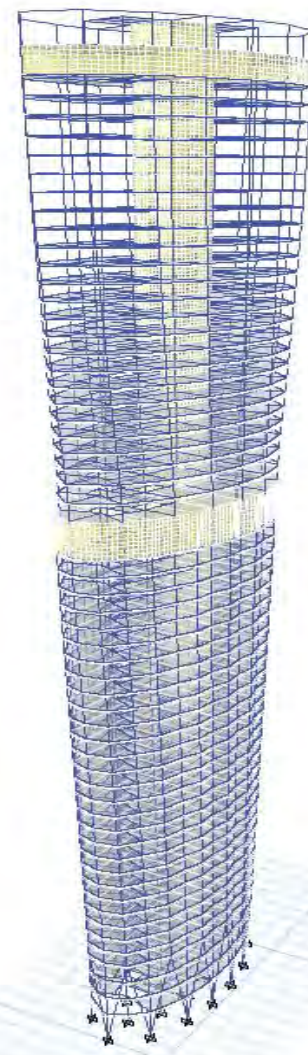




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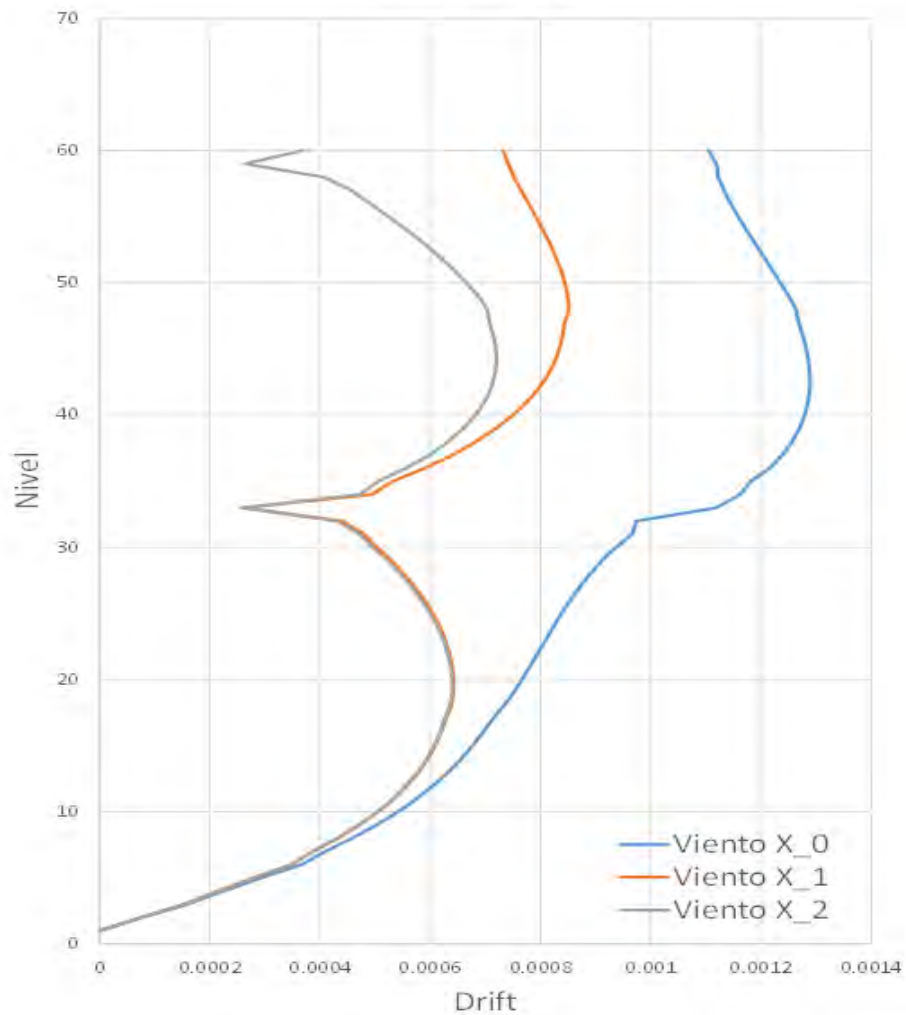


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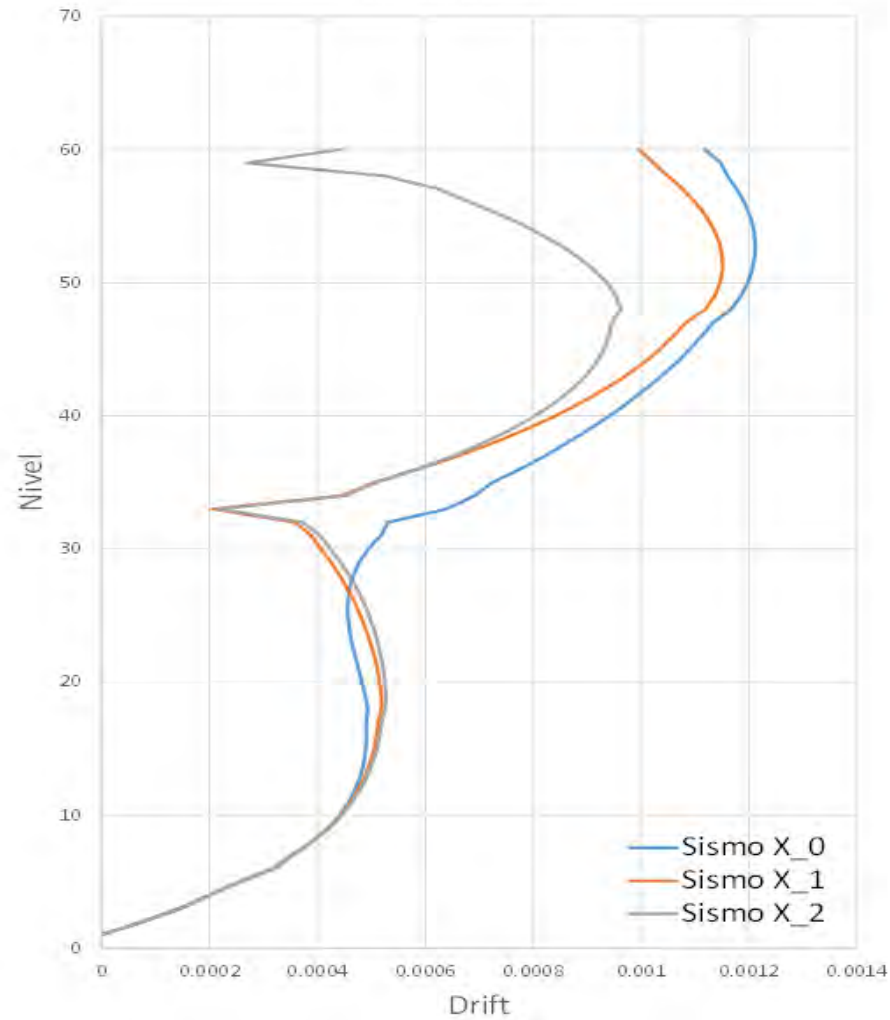


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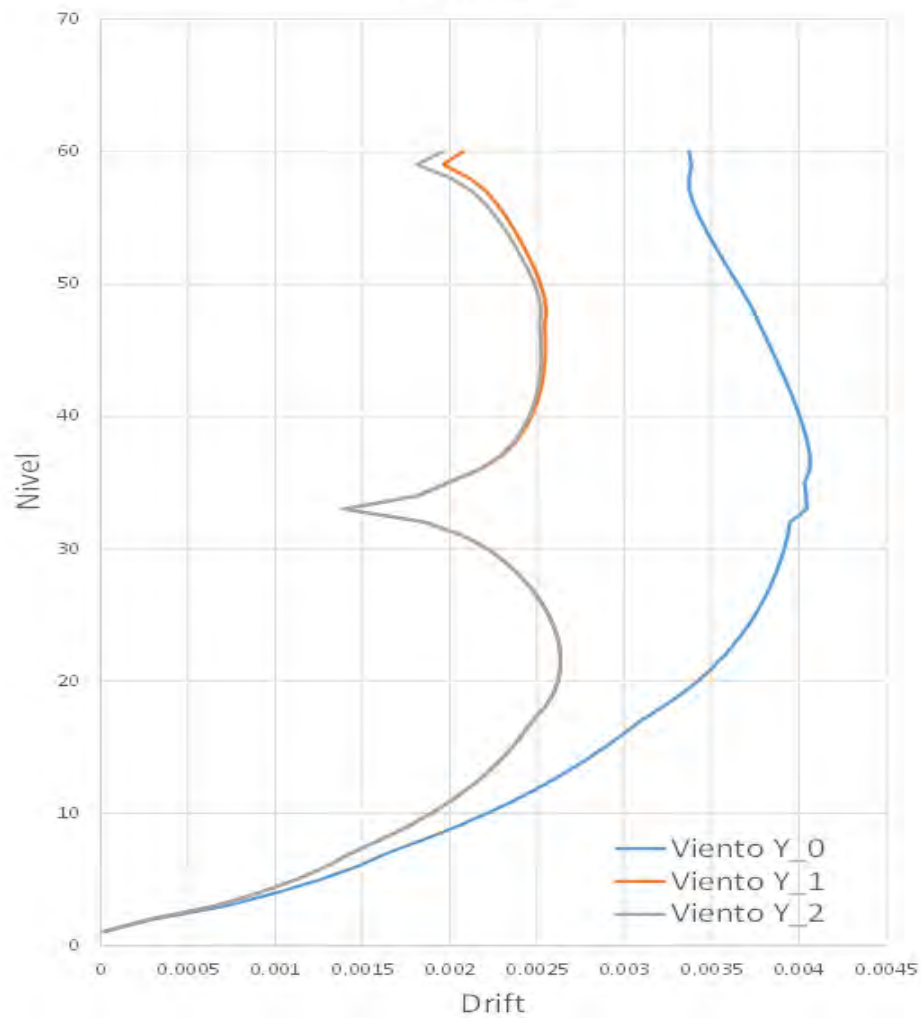
Drifts Viento X



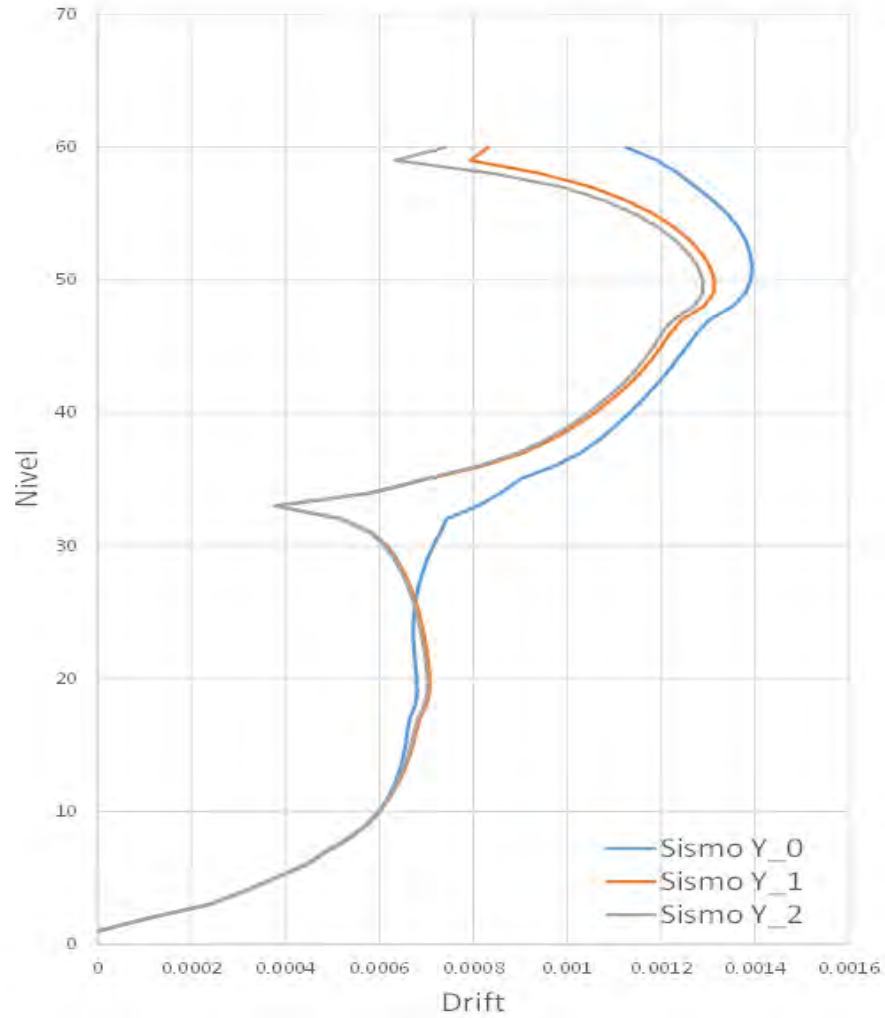
Drifts Sismo X



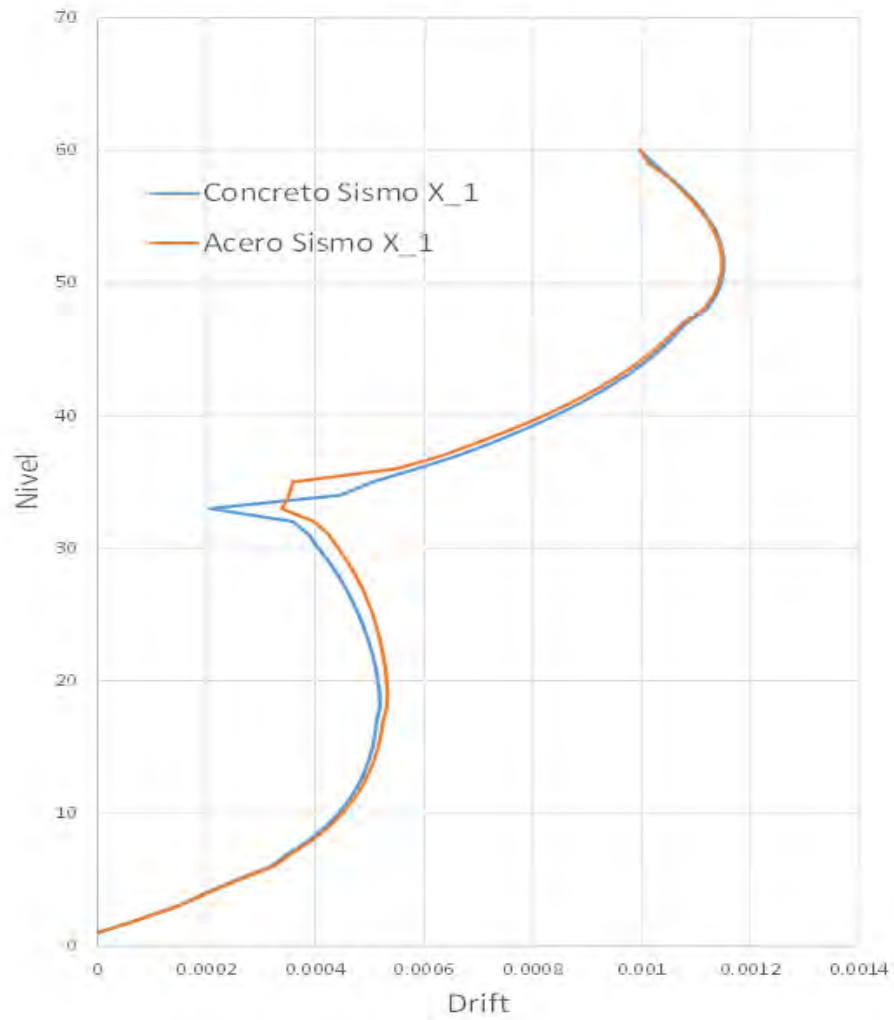
Drift Viento Y



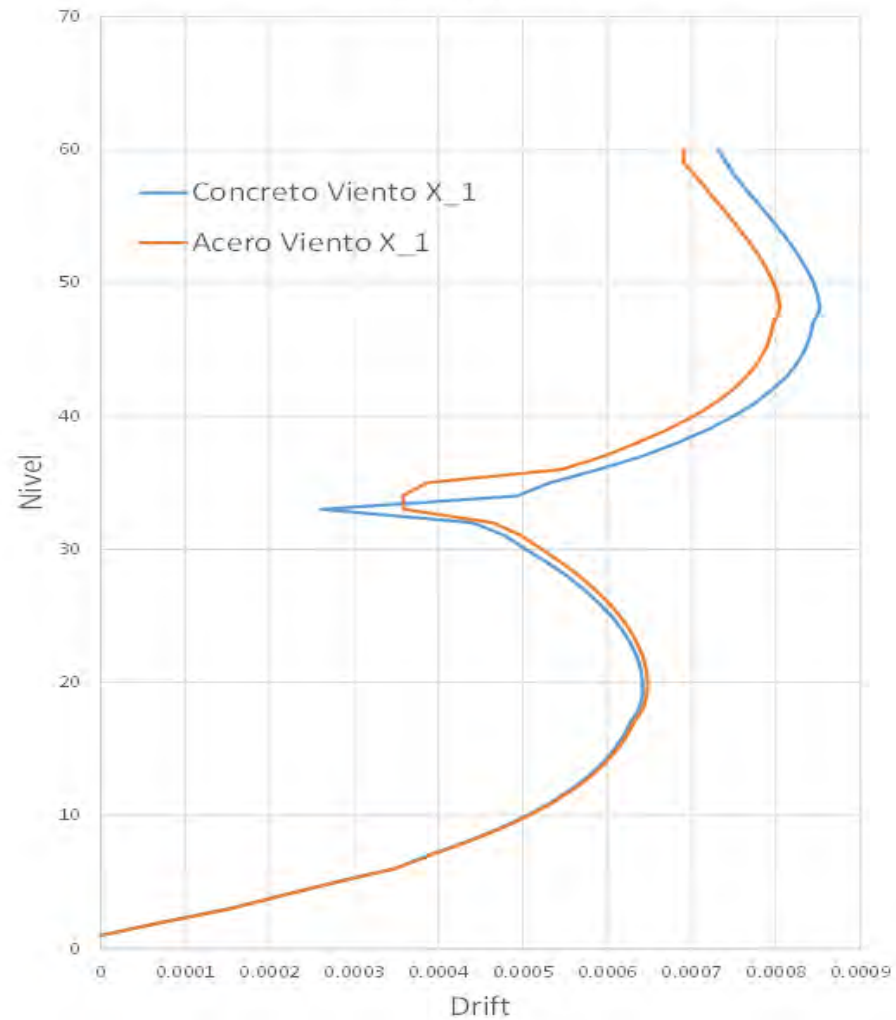
Drift Sismo Y



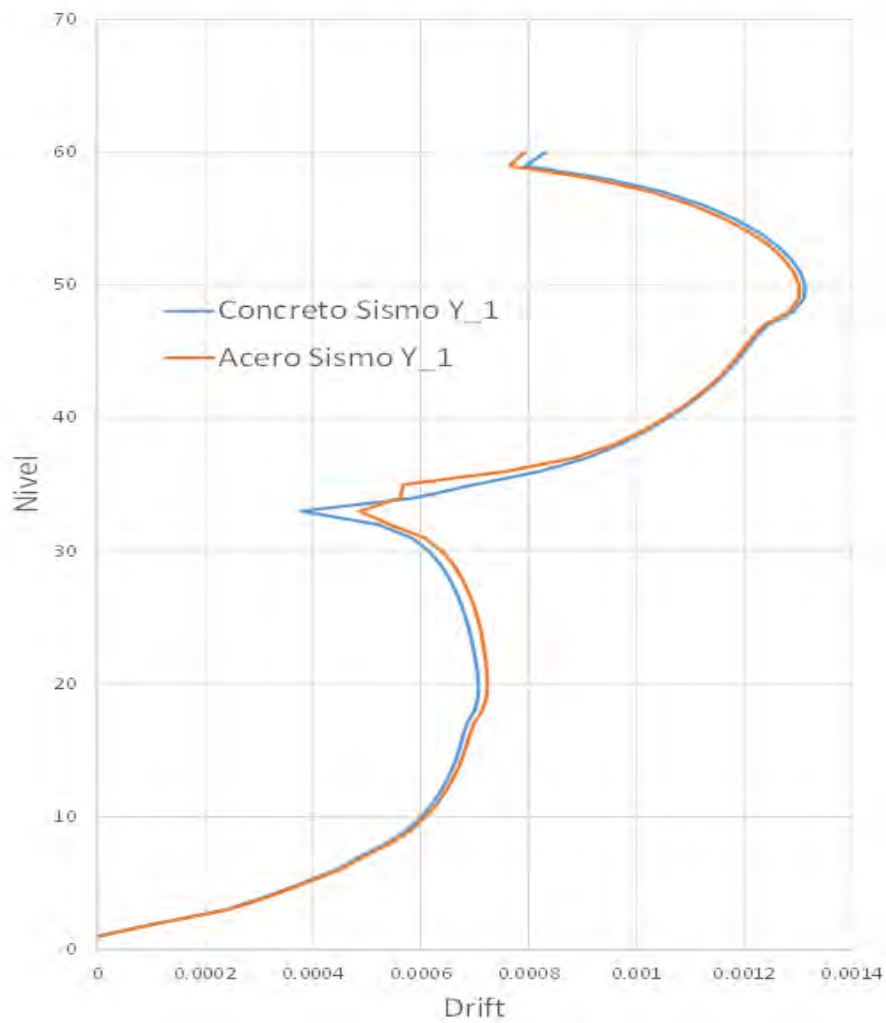
Drifts Sismo X



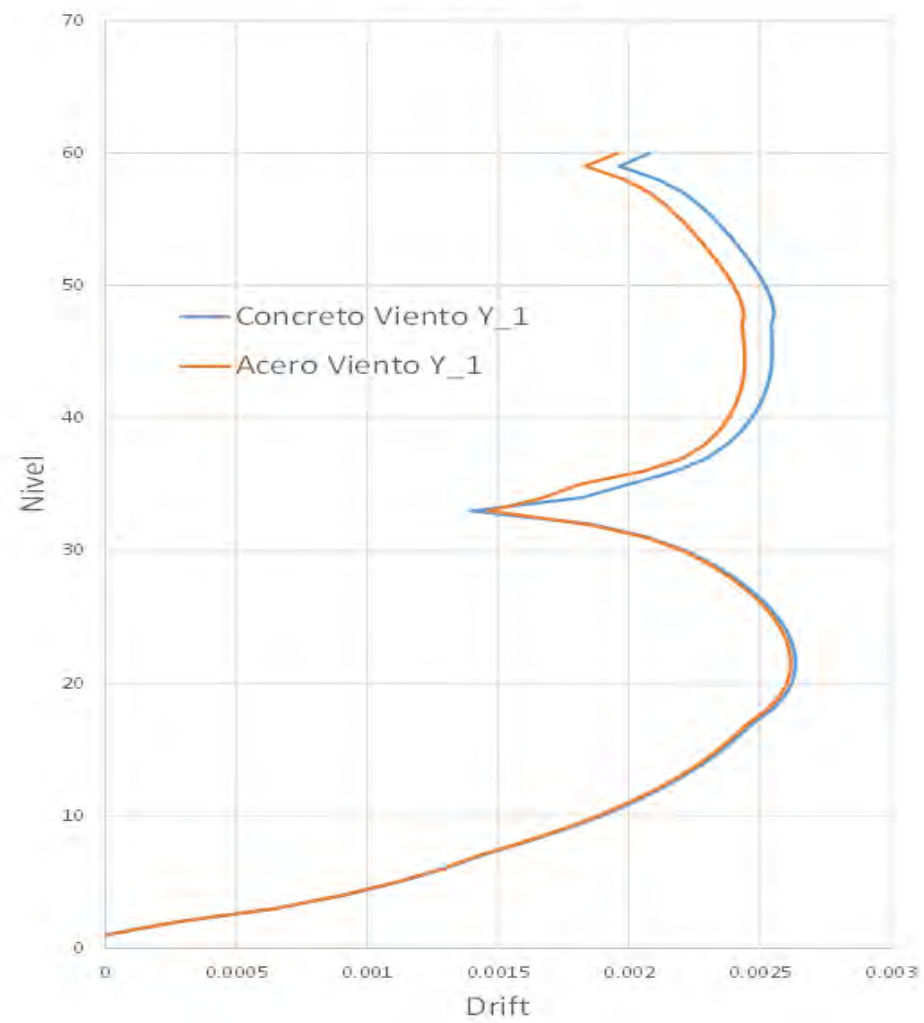
Drifts Viento X



Drift Sismo Y



Drift Viento Y

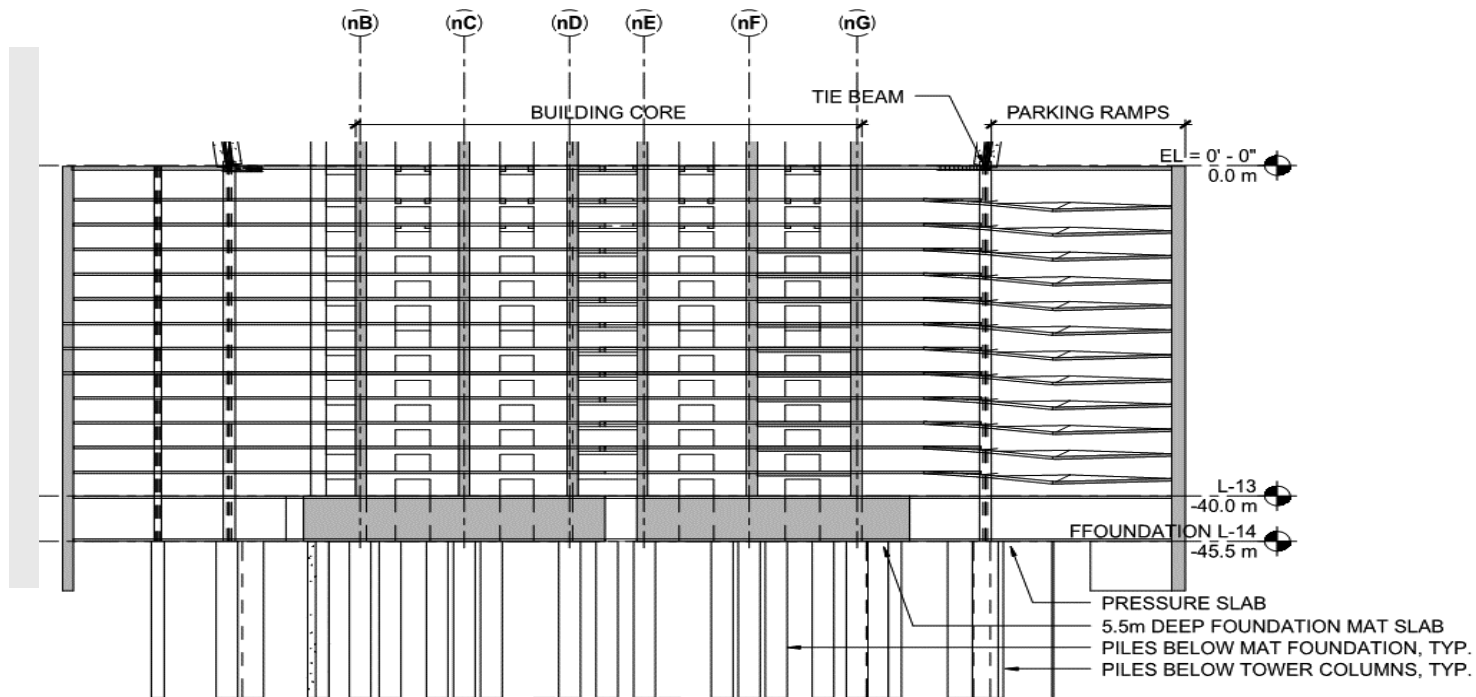


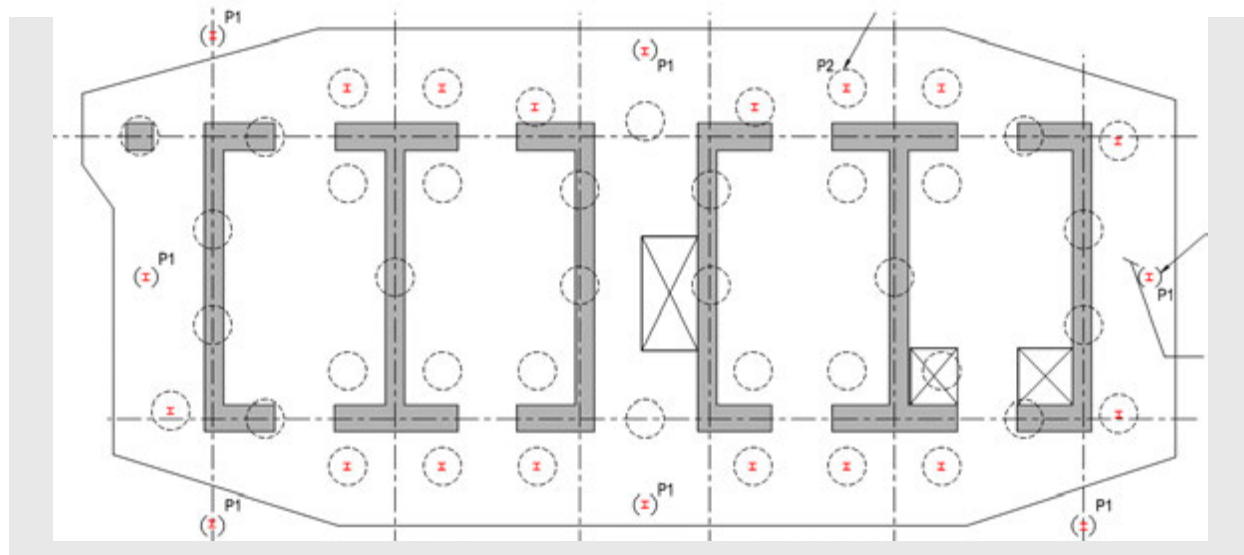


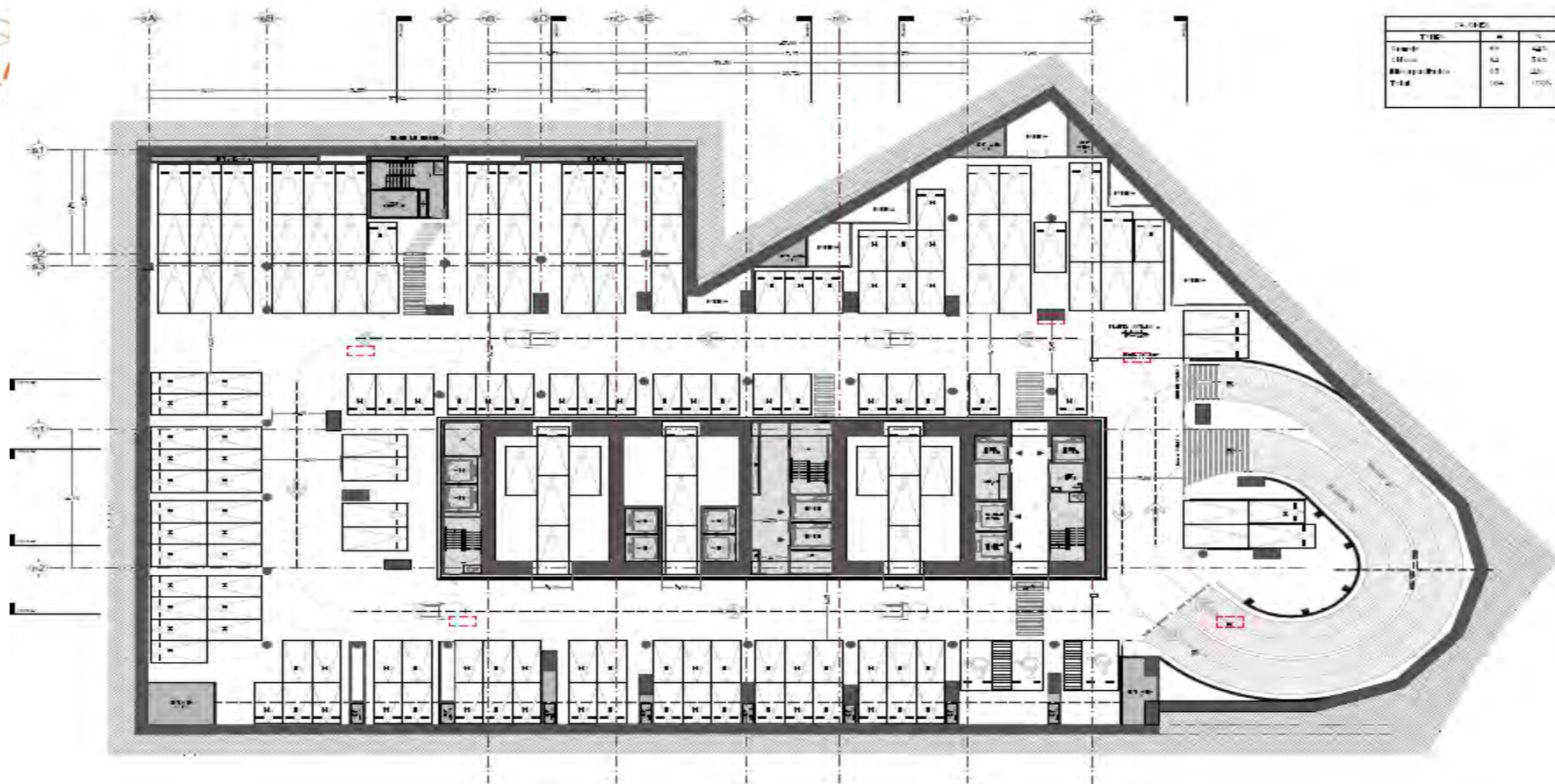
AMSD



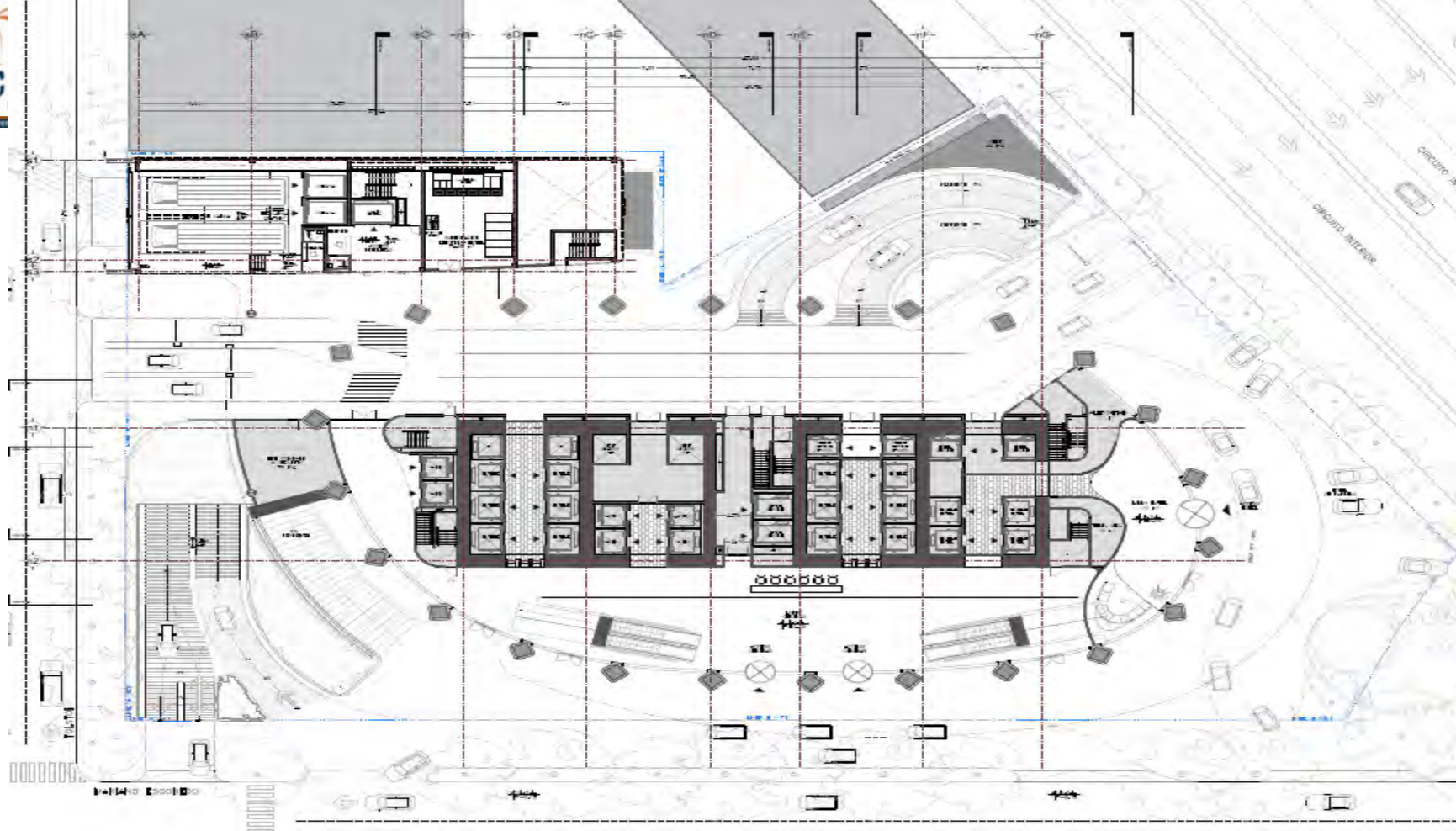




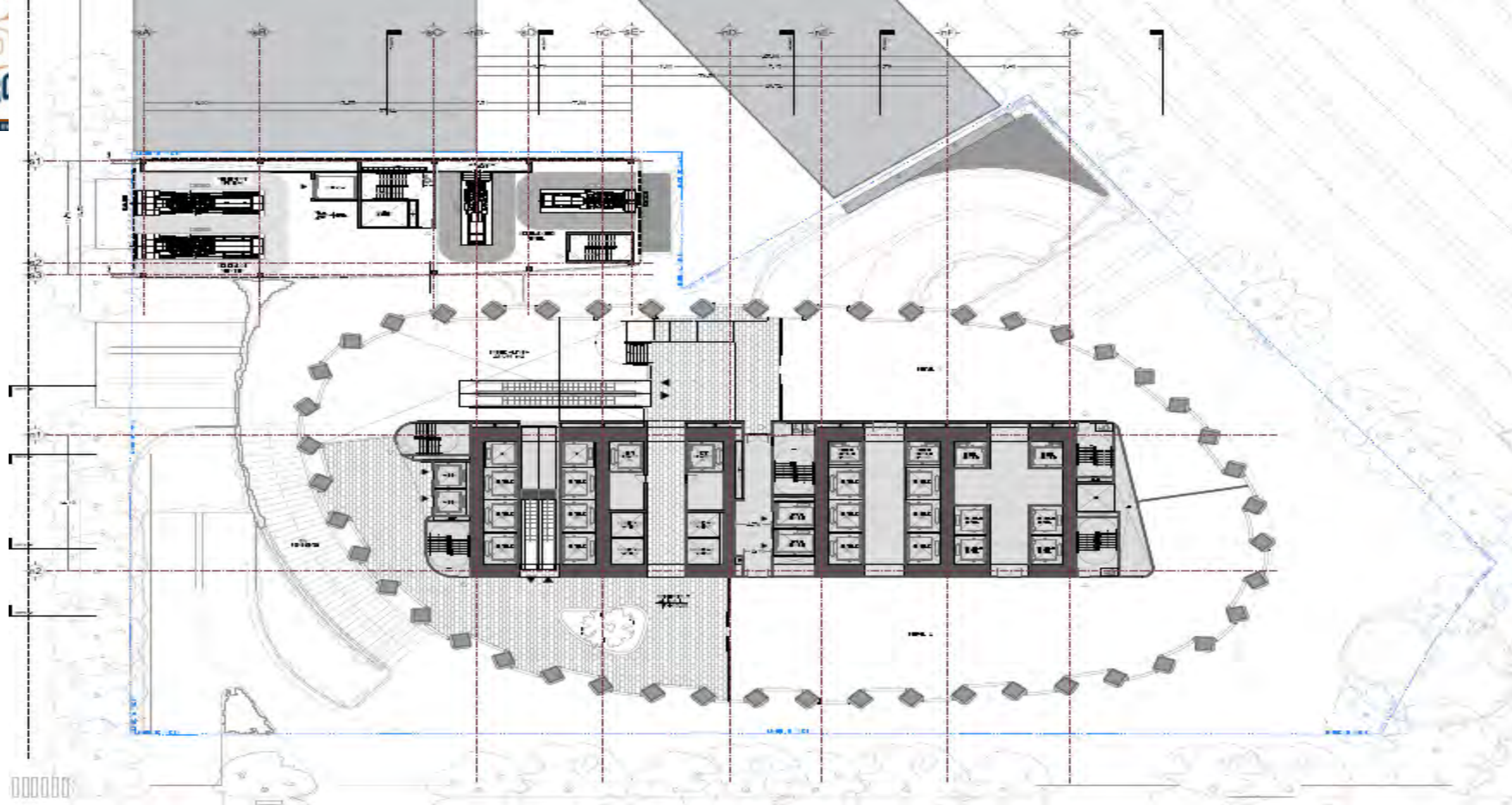




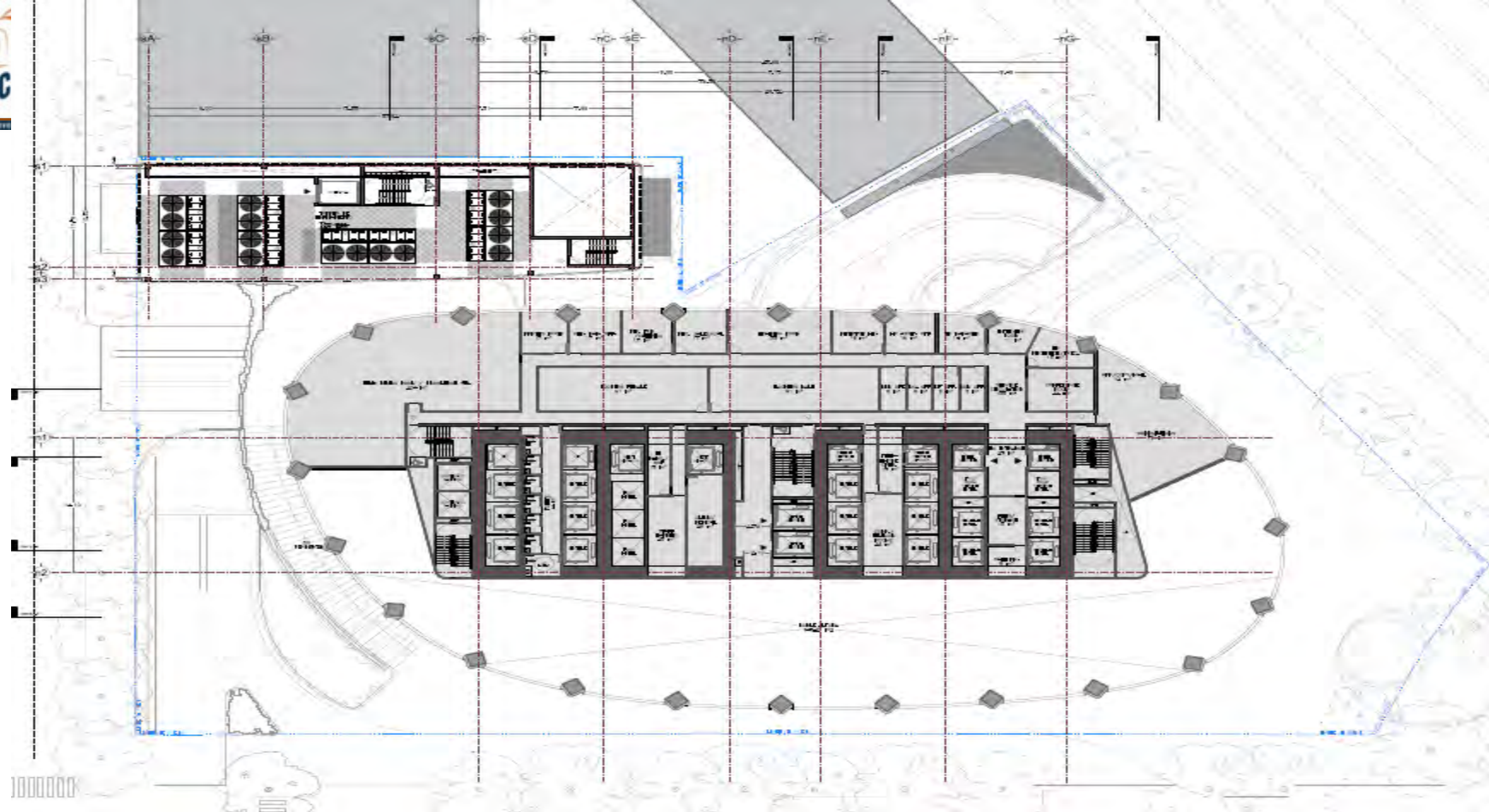
Planta Sótano 4



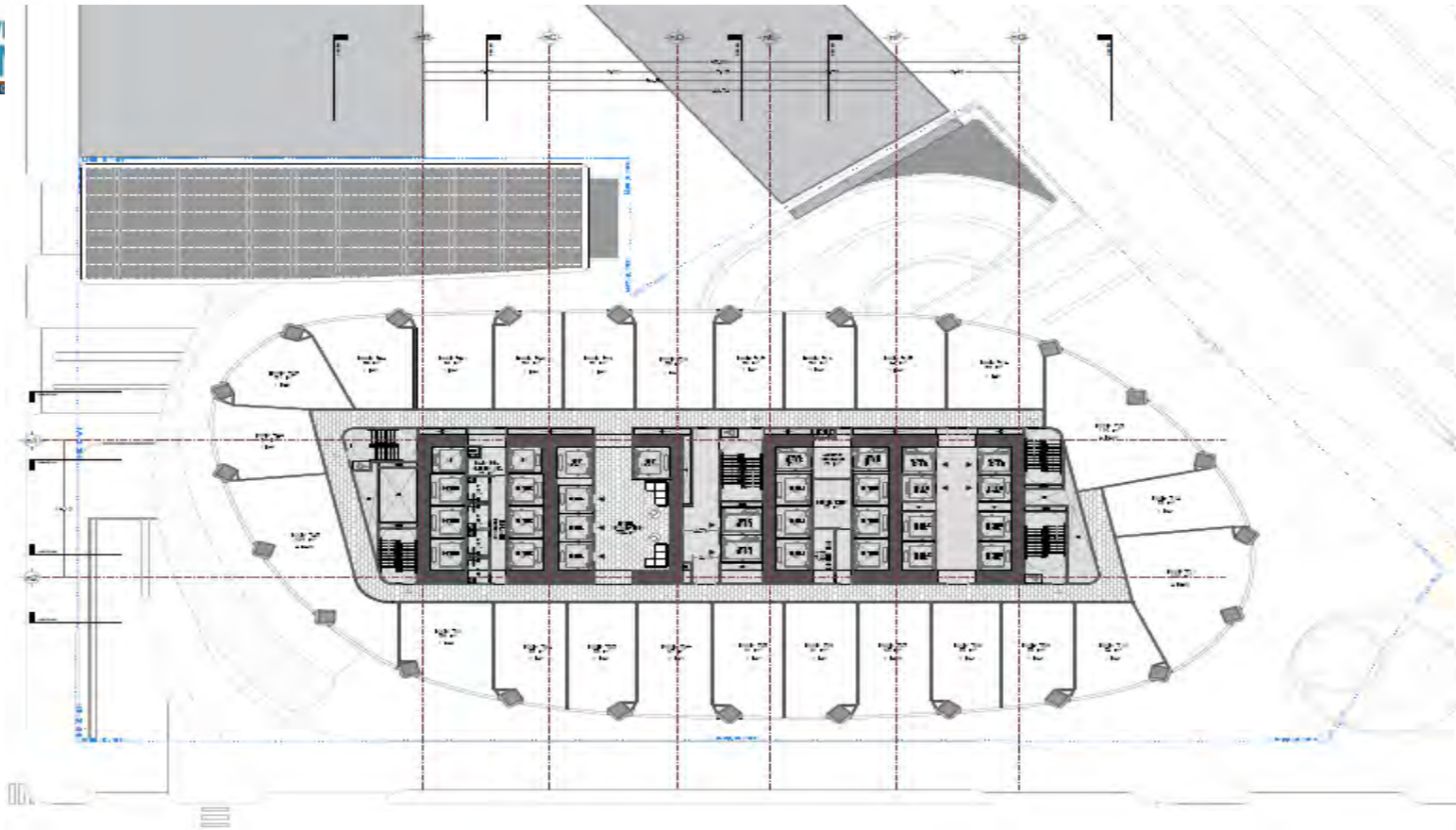
Planta Lobby



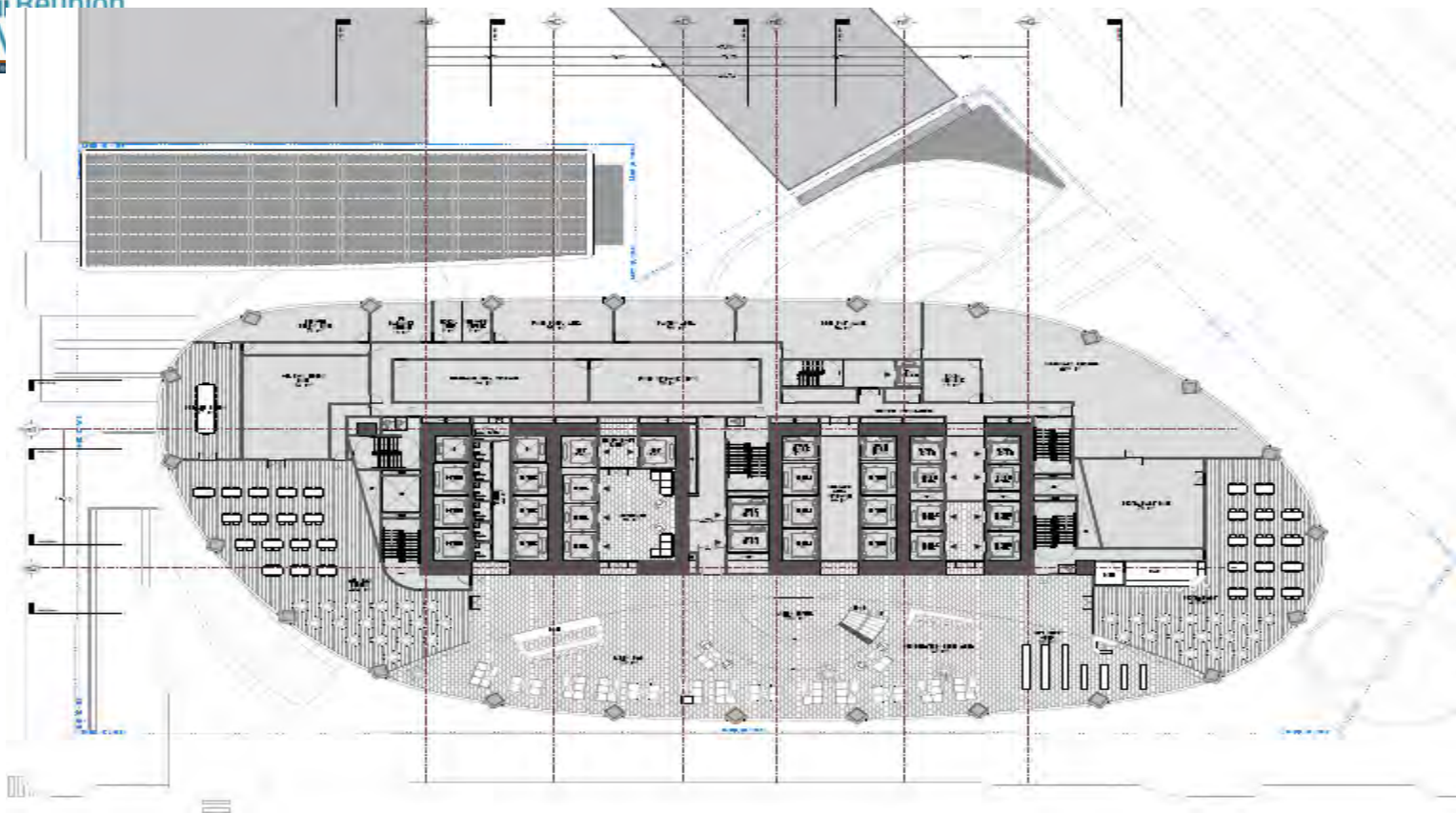
Planta Comercio 1



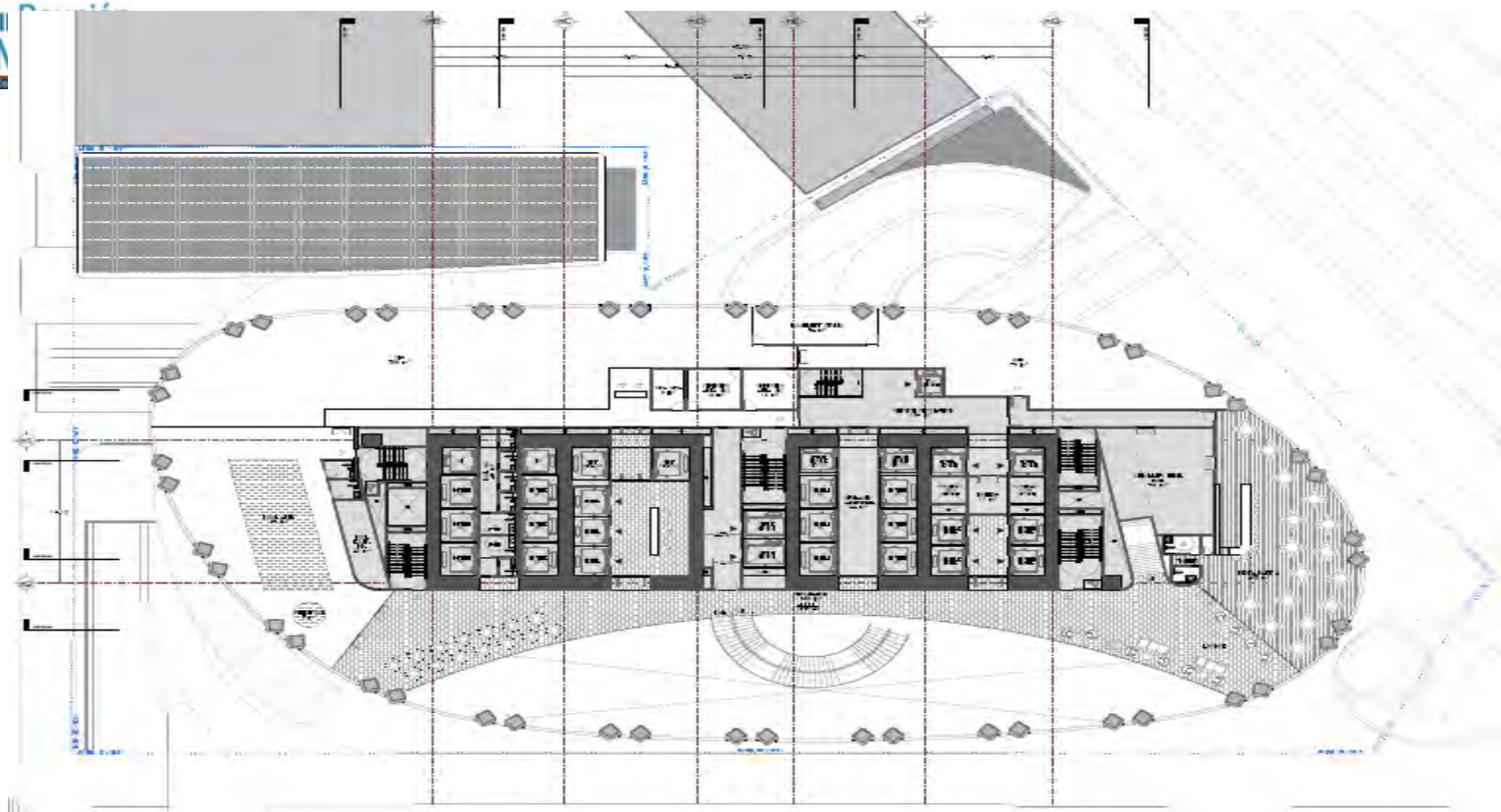
Planta Comercio 3



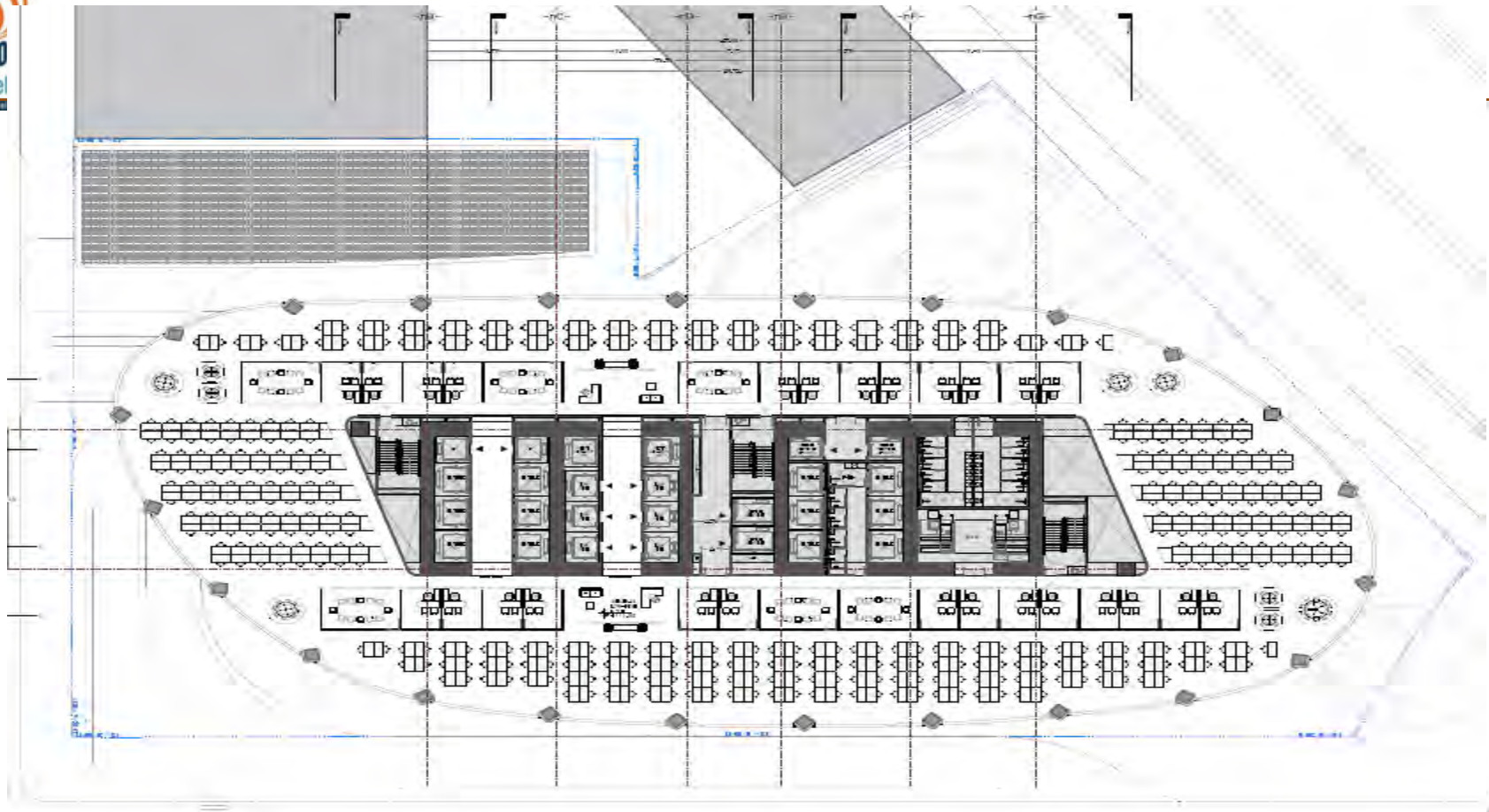
Planta Hotel Nivel 10



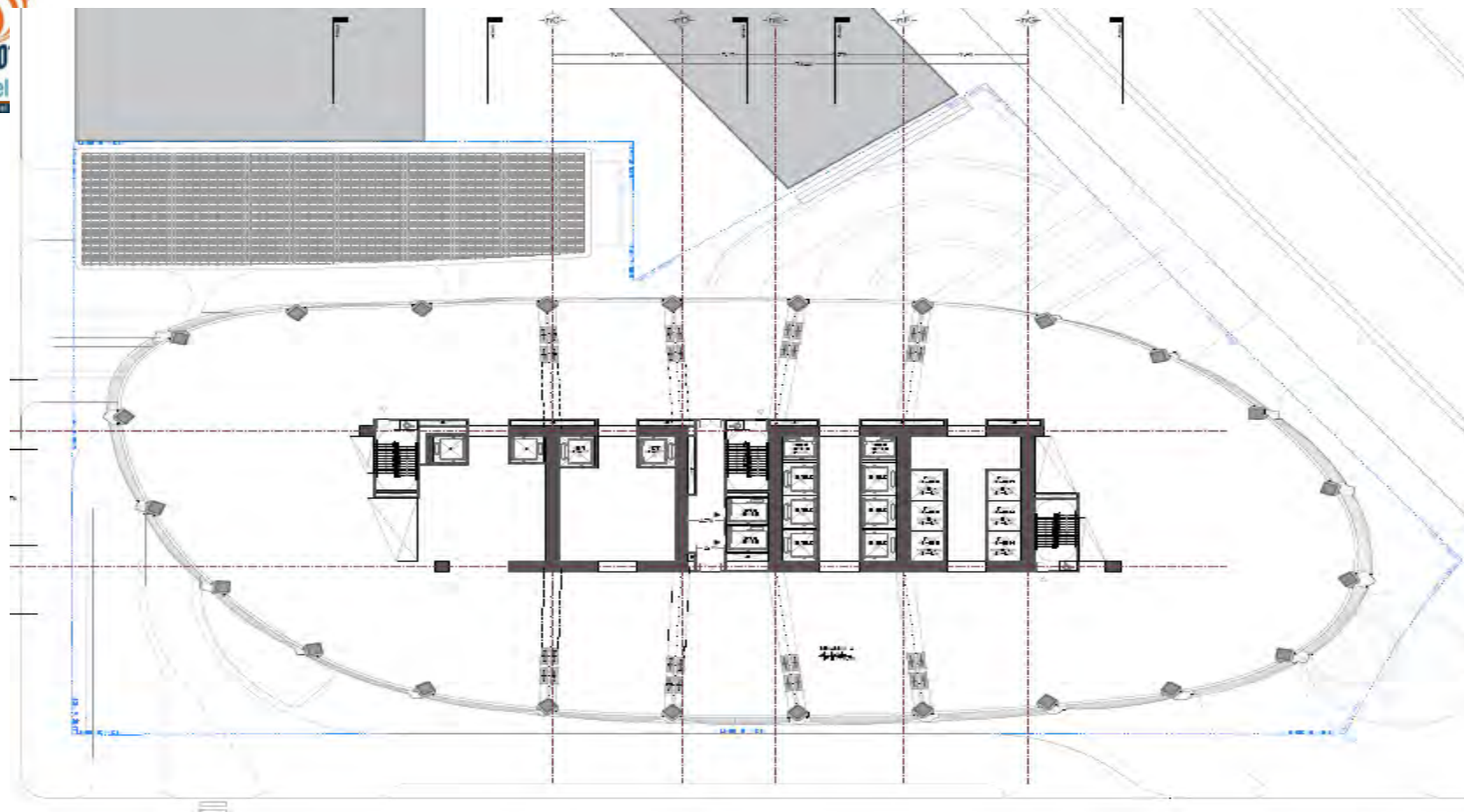
Planta Hotel Nivel 16



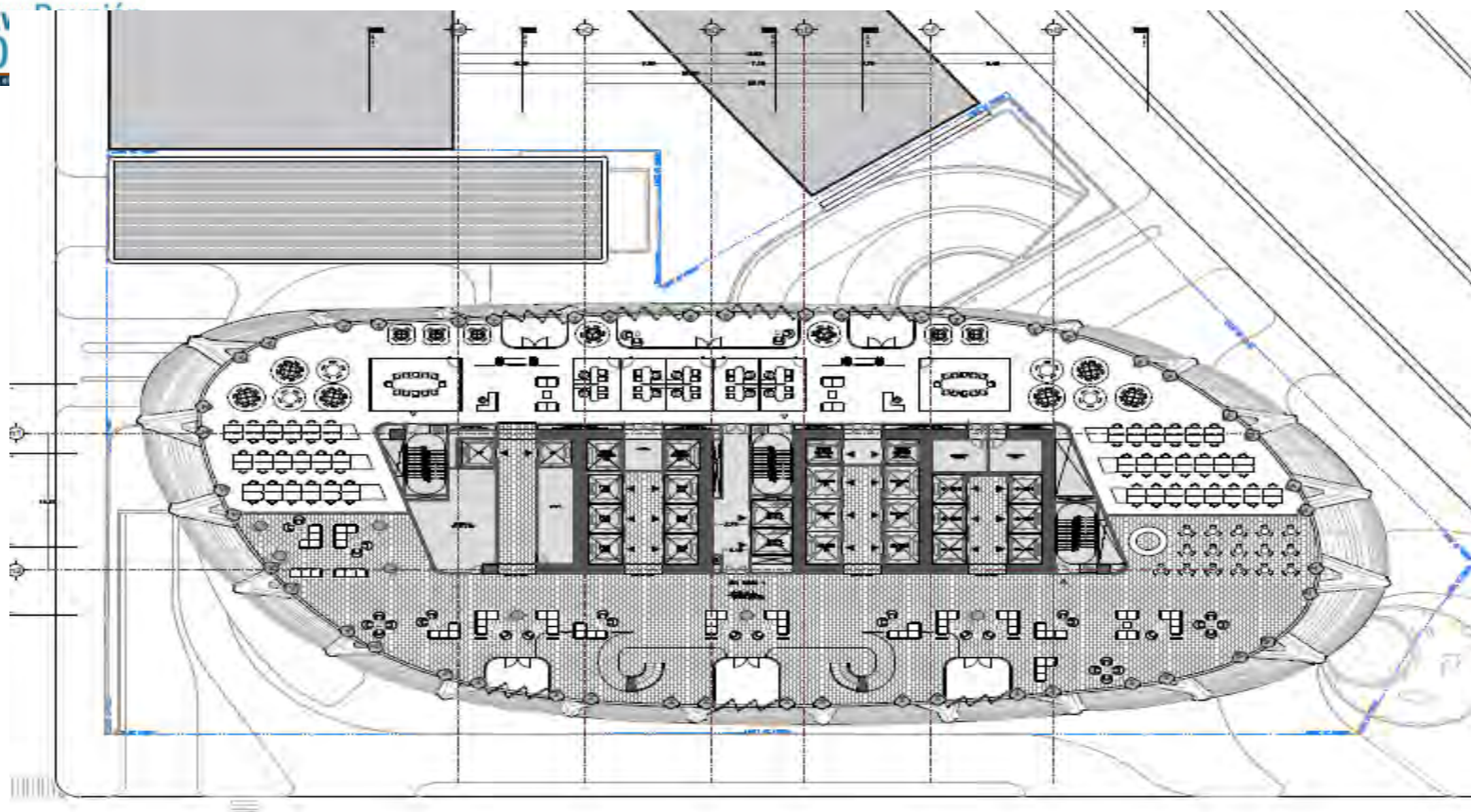
Planta Hotel Nivel 17



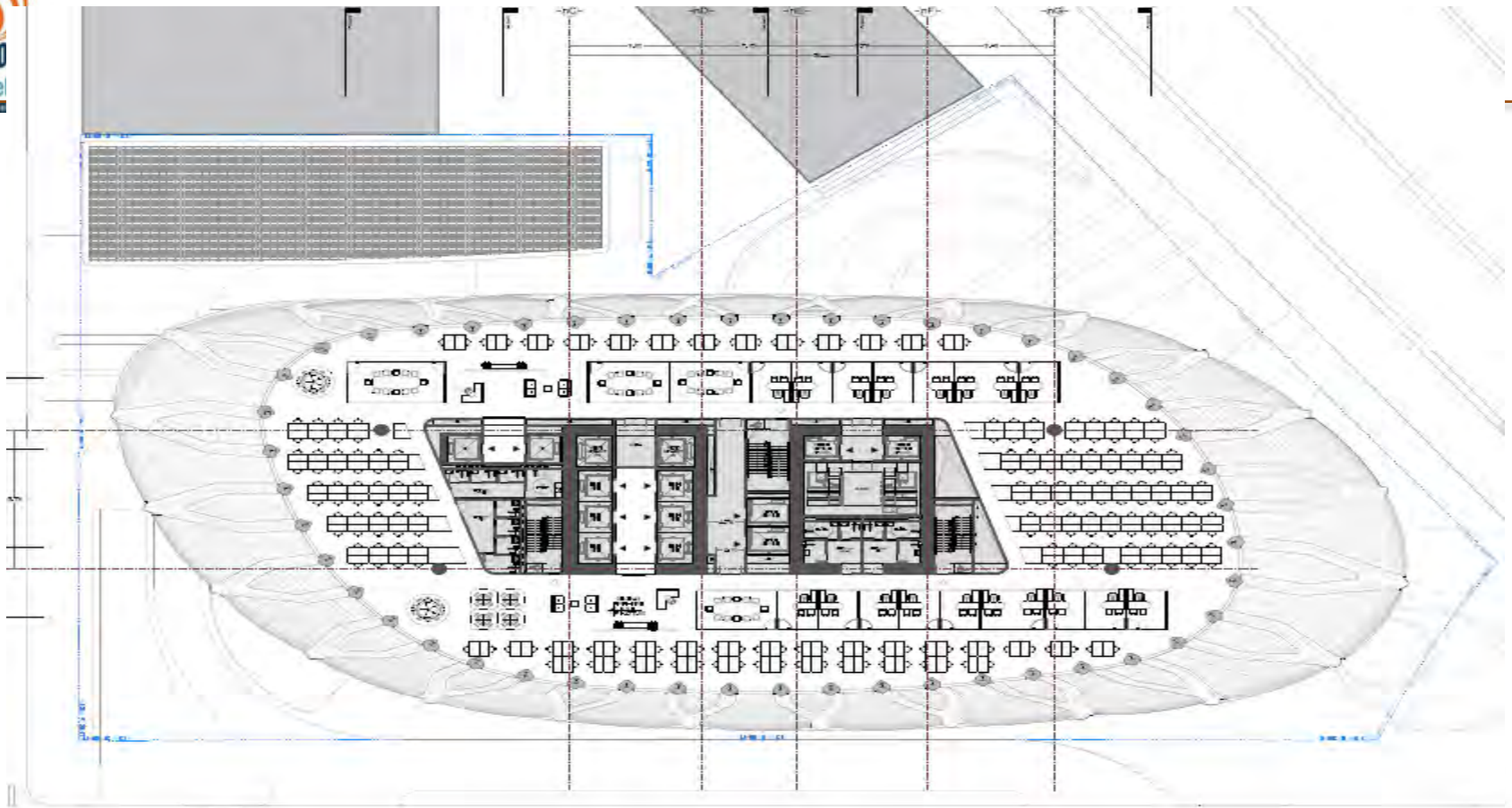
Planta Oficina Low Nivel 25



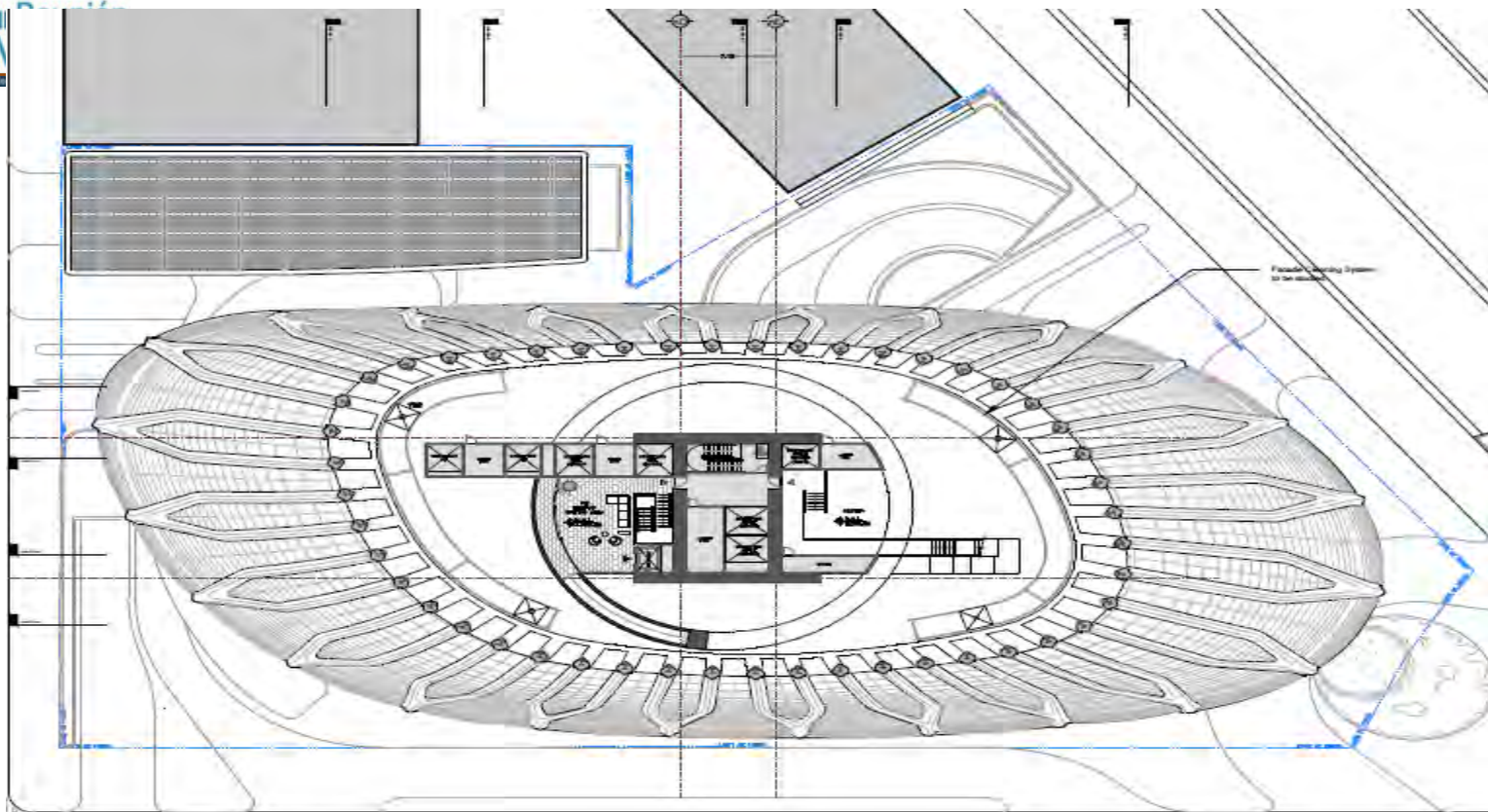
Planta Mecánico Nivel 40



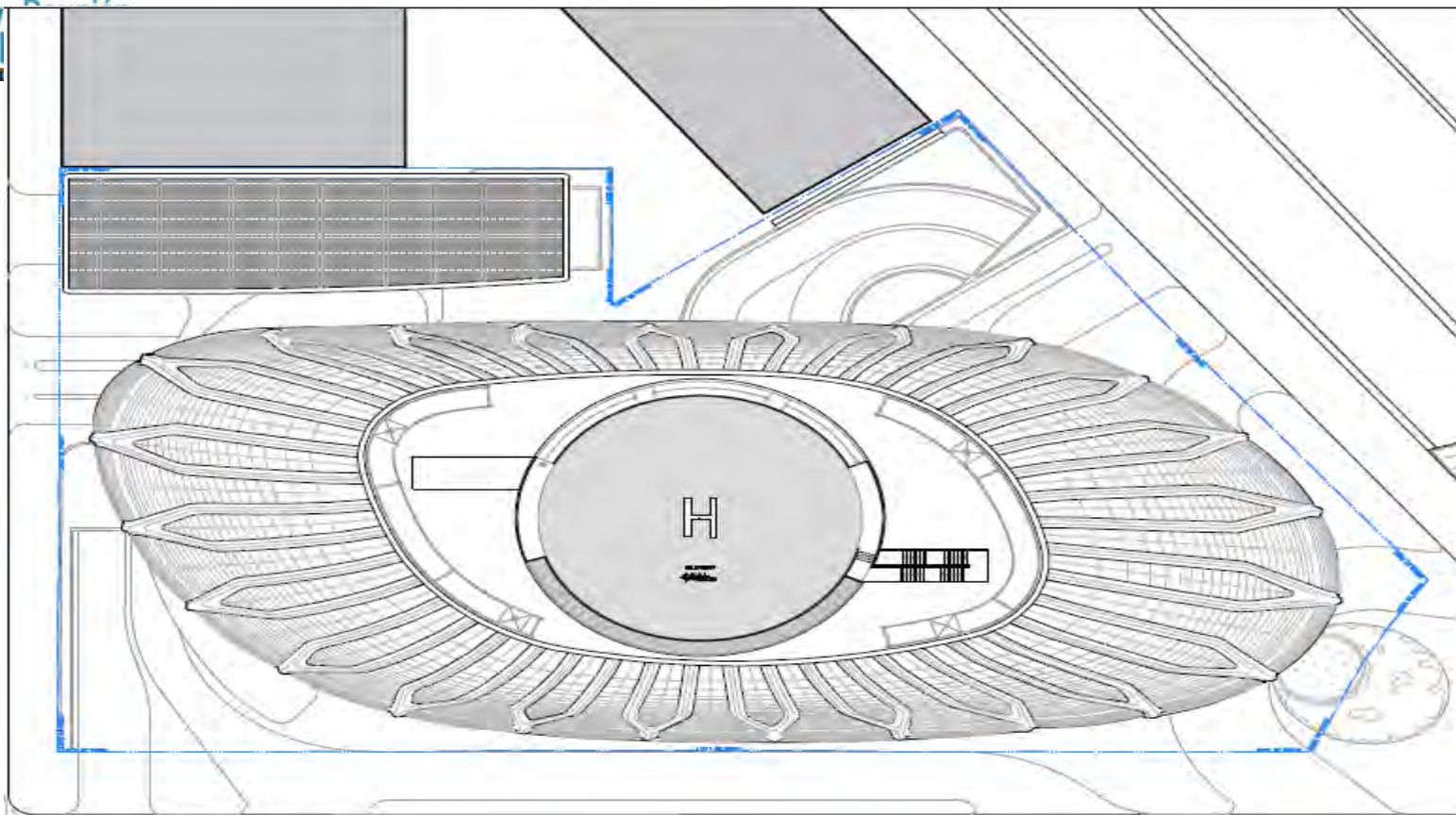
Planta Sky Lobby Nivel 50



Planta Oficinas High Nivel 60



Planta Azotea Nivel 65



Planta Helipuerto Nivel 66



STEEL COLUMNS ABOVE
BELT TRUSS

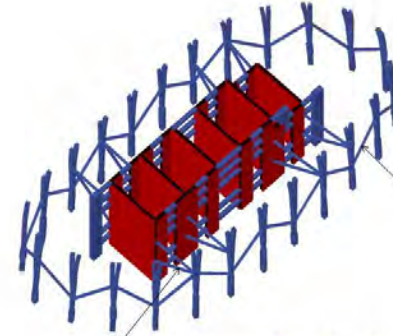
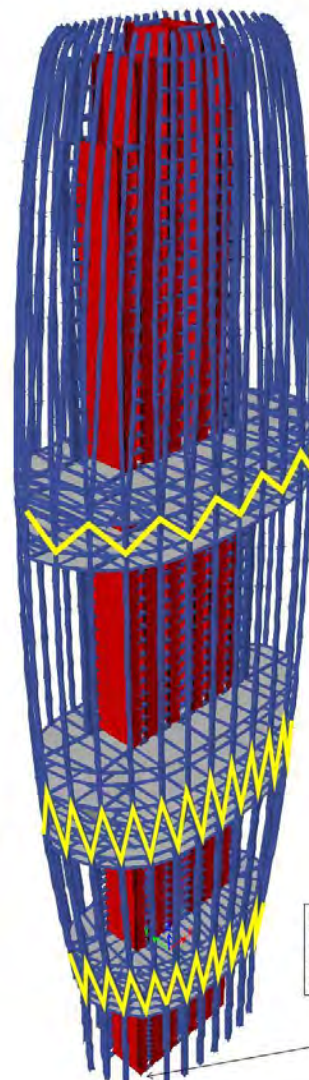


1M X 1M COMPOSITE
COLUMNS



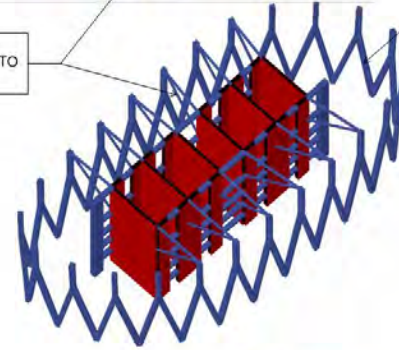
1.5M X 1.5M COMPOSITE
COLUMNS



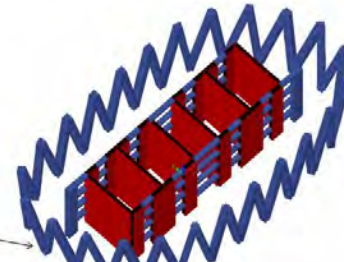


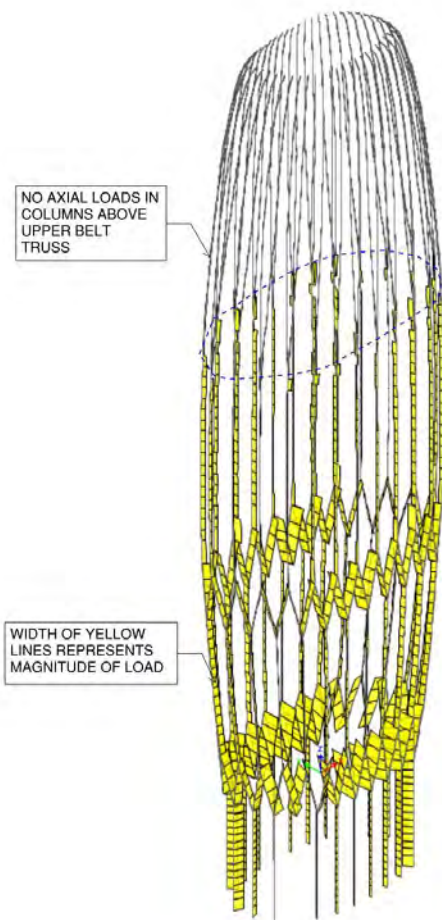
BELT TRUSS TO
DISTRIBUTE
LATERAL LOADS
AMONG COLUMNS

OUTRIGGERS
CONNECT CORE TO
COLUMNS

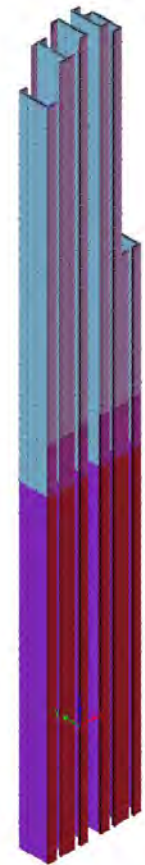


BELT TRUSS ENABLES
TRANSFER OF
COLUMNS BELOW
GRADE AT PARKING
LEVELS

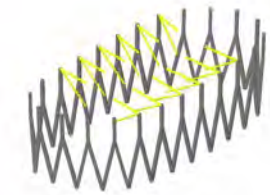
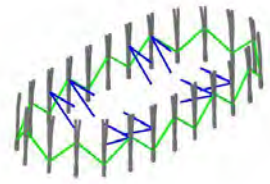




SEISMIC LOAD IN COLUMNS



CONCRETE CORE



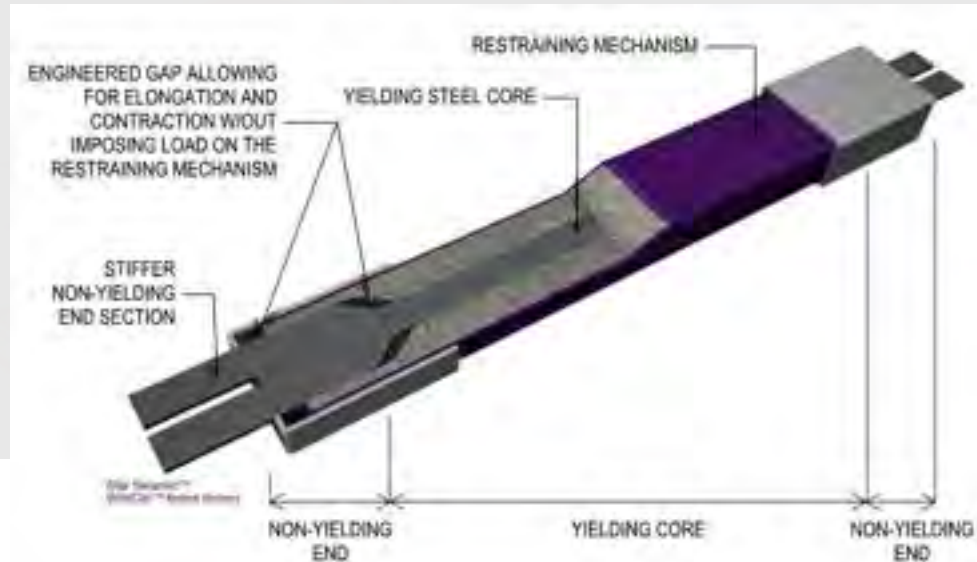
STEEL BUCKLING RESTRAINED BRACE
OUTRIGGERS AND BELT TRUSSES

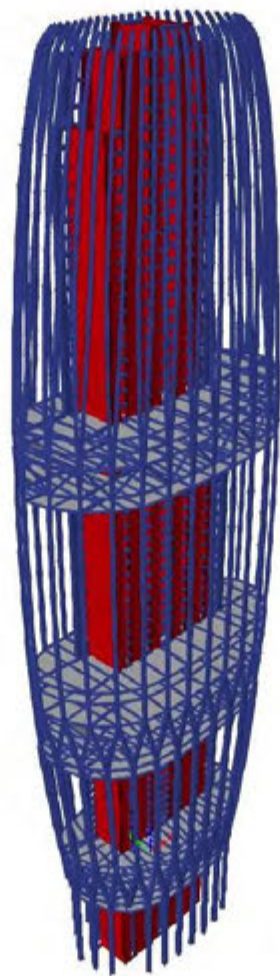


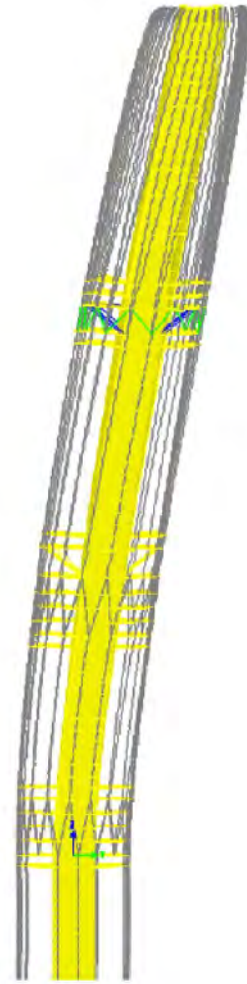
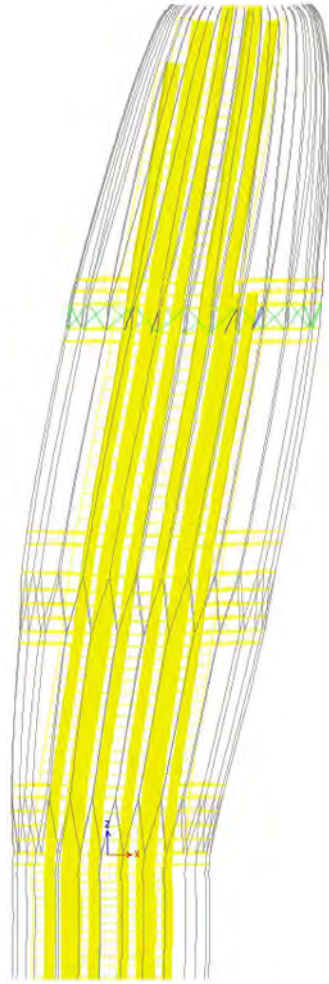
COMPOSITE COLUMNS

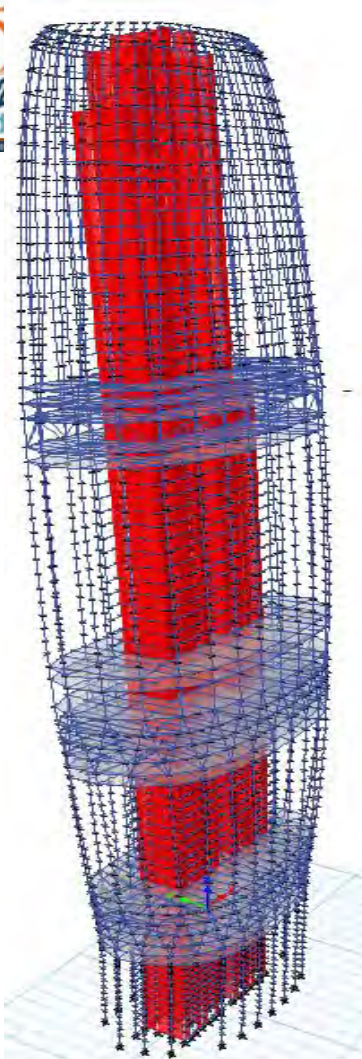
$$+ \quad + \quad =$$

Contraventeo Pandeo Restringido

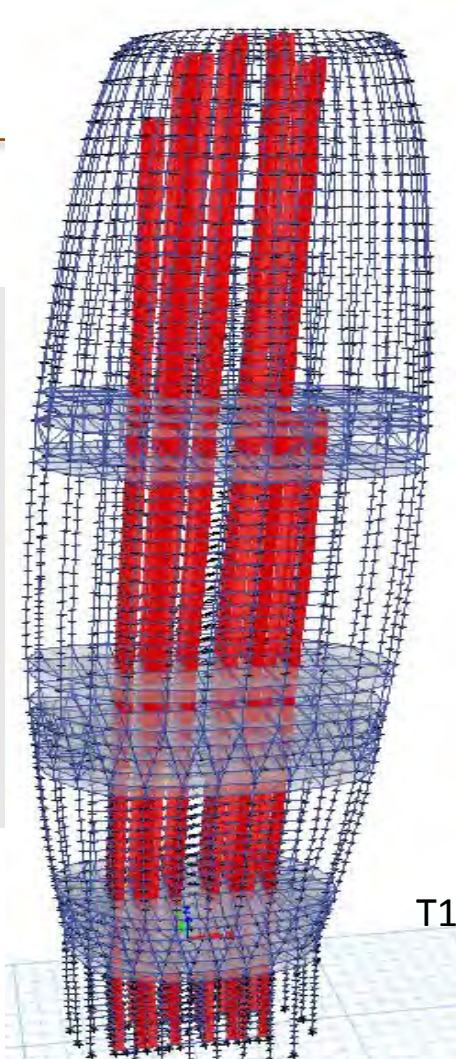




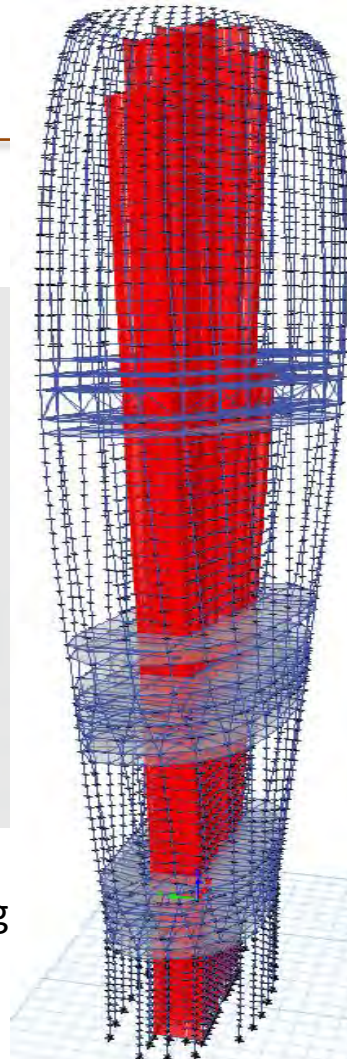




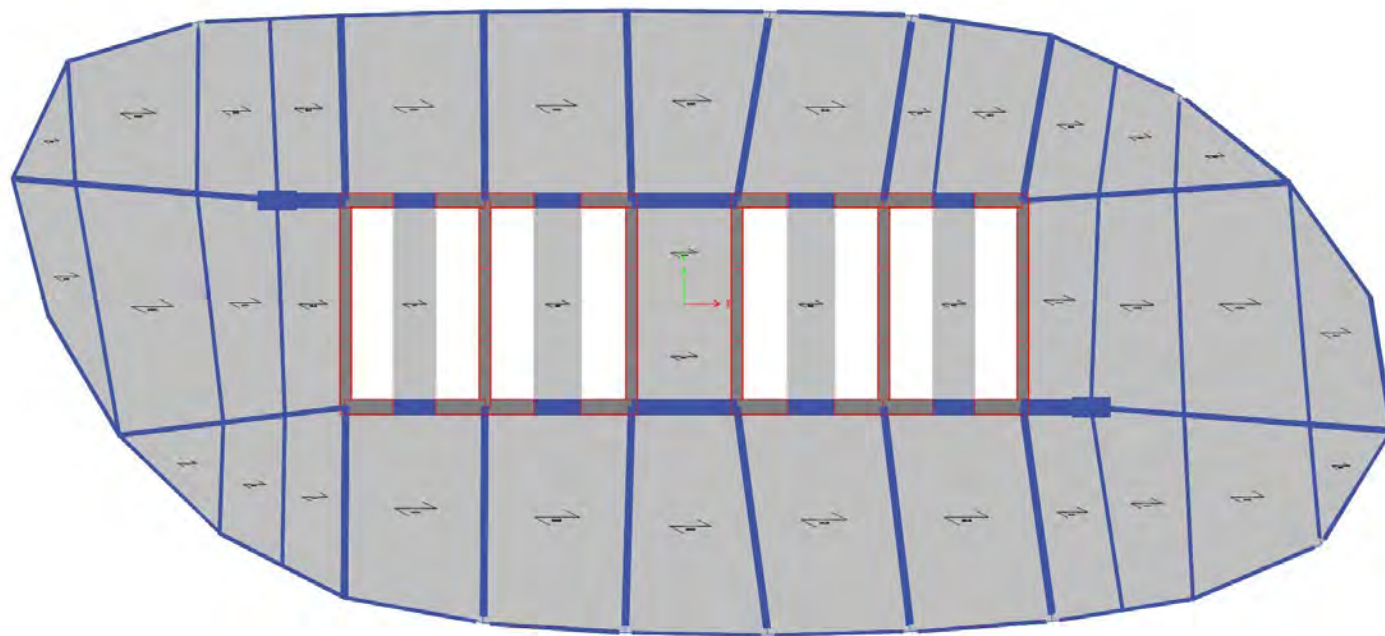
T1=8.25 seg



T1=7.09 seg



T1=4.61 seg

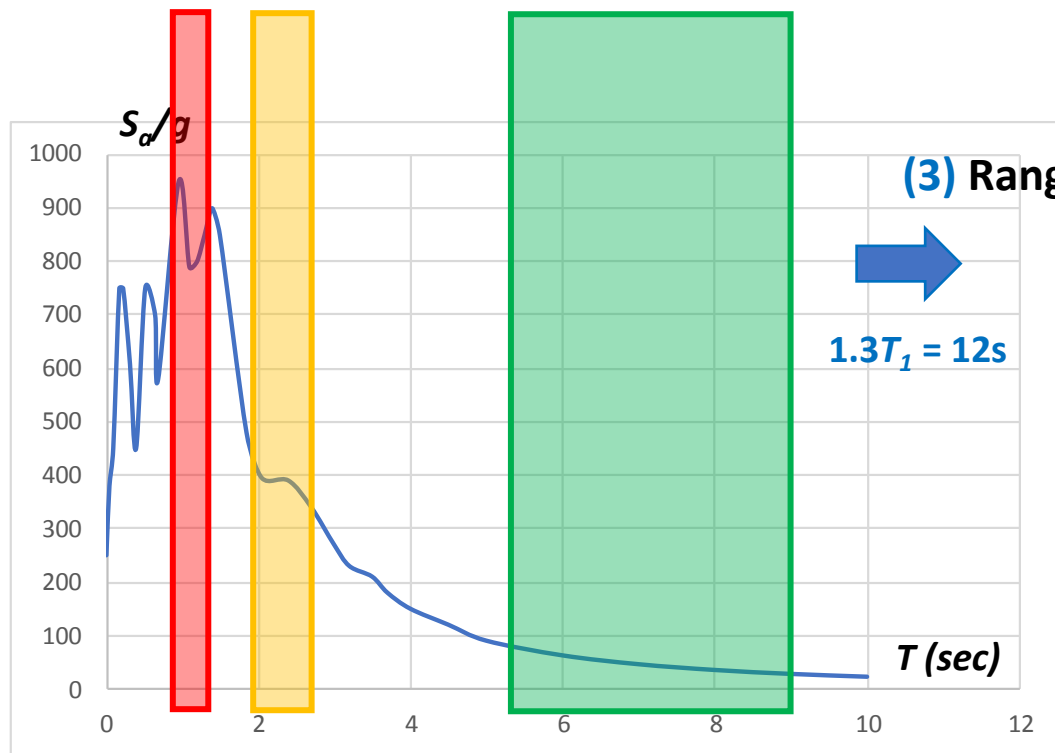


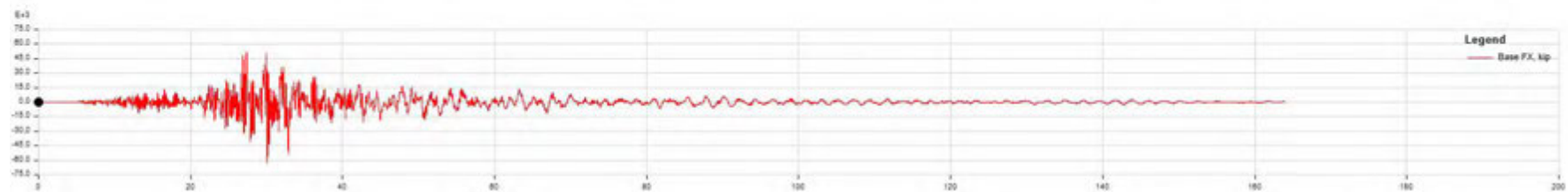
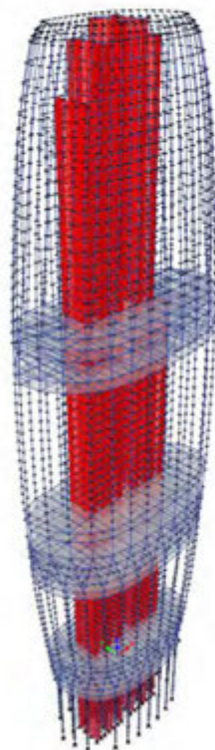
Planta Nivel 25

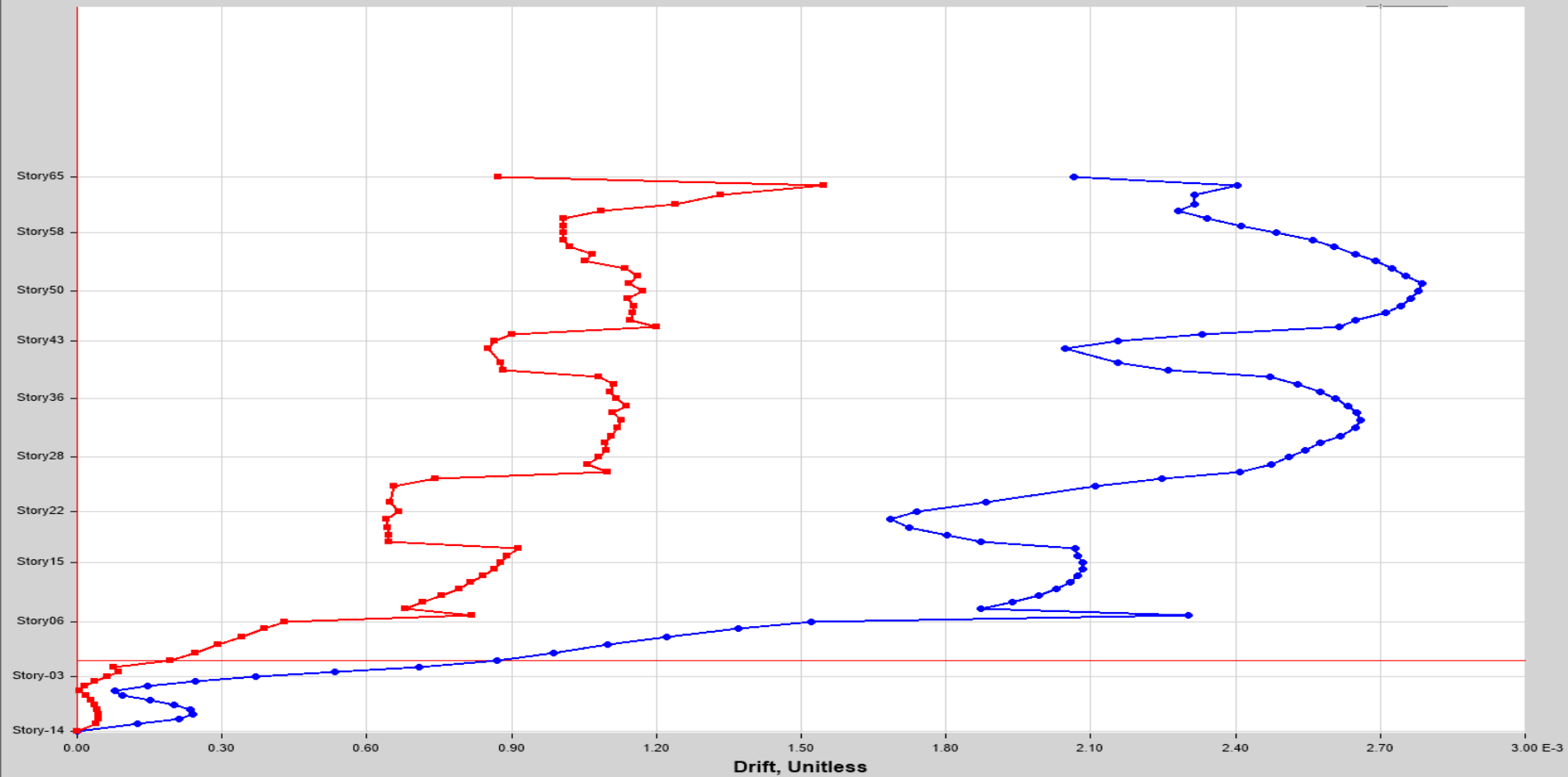
Tercer Modo

Segundo Modo

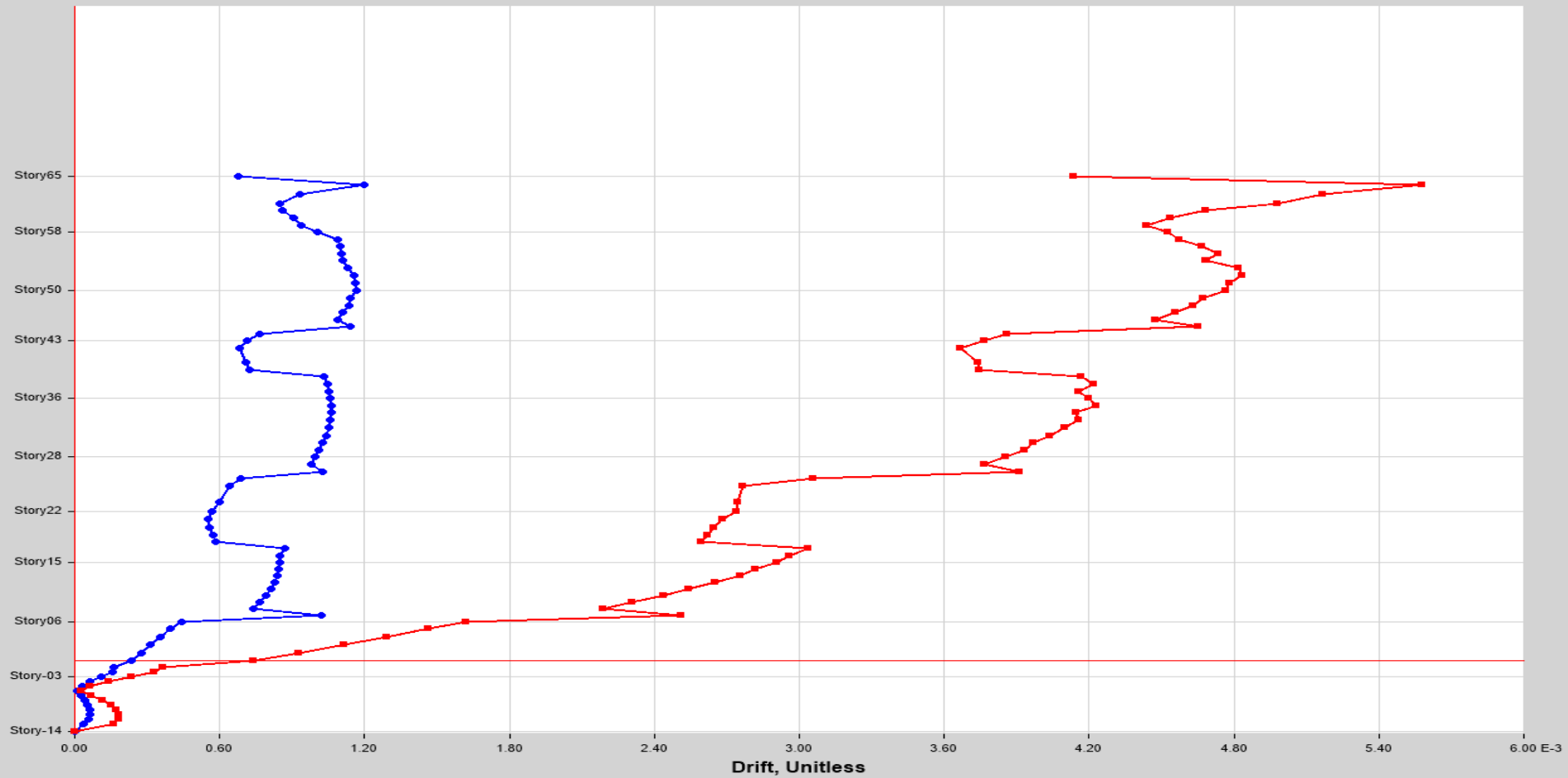
Primer Modo





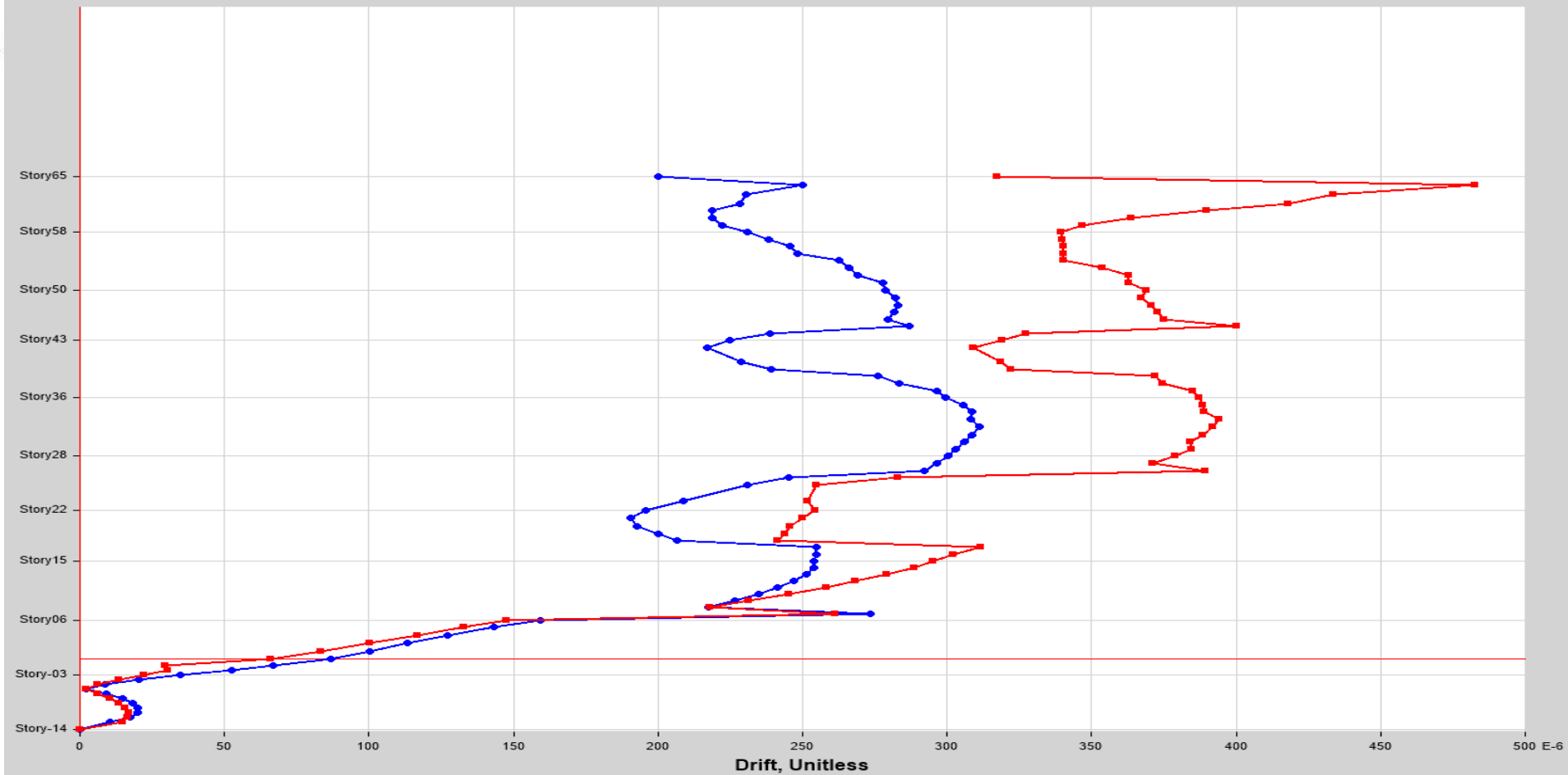


Desplazamientos Relativos de Entrepiso – Sismo X

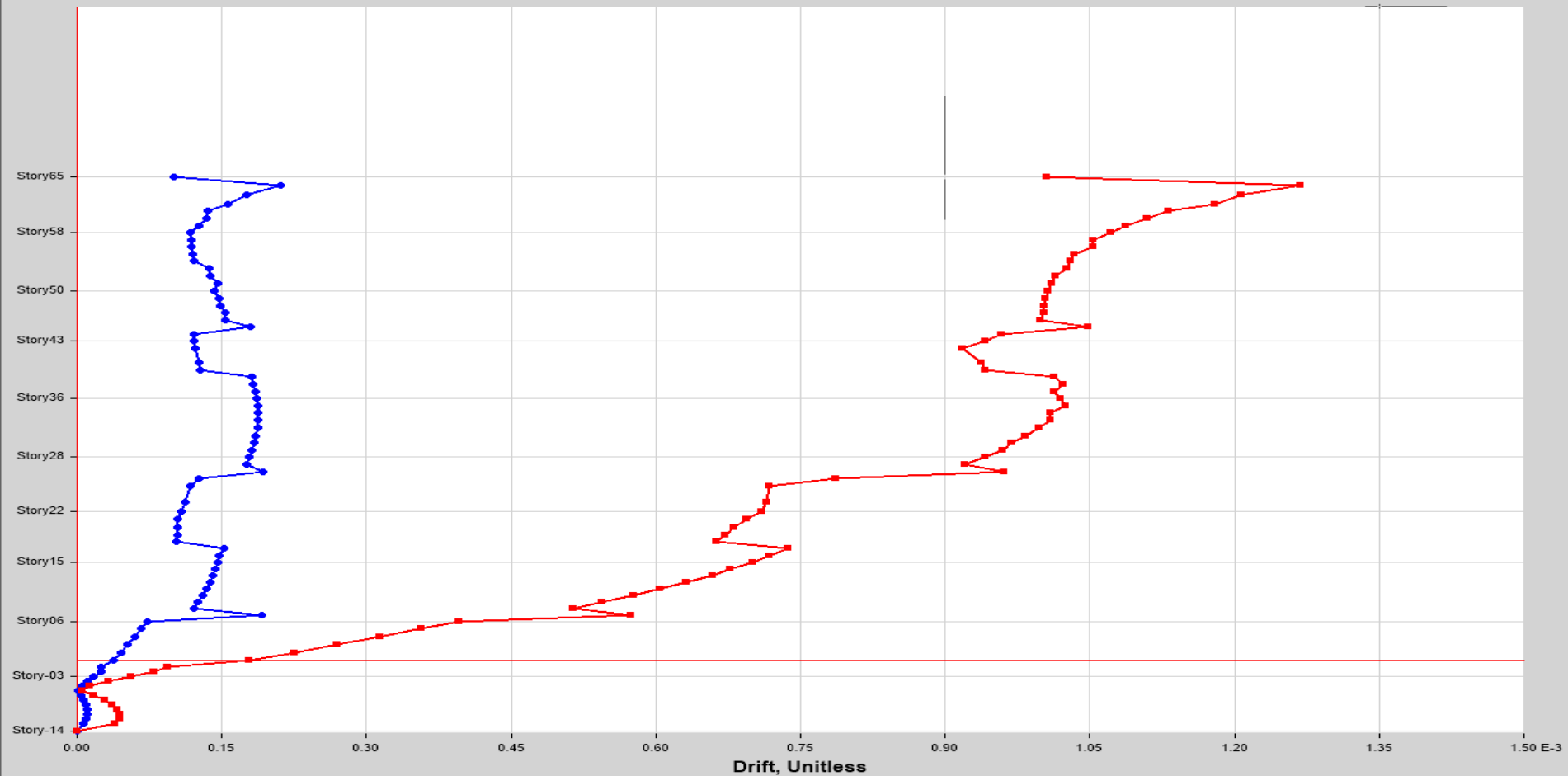


Desplazamientos Relativos de Entrepiso – Sismo Y

Drifts for Diaphragm D_Rigid



Desplazamientos Relativos de Entrepiso – Viento X



Desplazamientos Relativos de Entrepiso – Viento Y