William J. Clinton Presidential Center

Little Rock, AR

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[1]

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Introduction

PROJECT NAME:	William J. Clinton Presidential Center
LOCATION:	Little Rock, Arkansas
COST:	$160 million
ARCHITECT:	Polshek Partnership Architects, LLP, NYC
STRUCT'L:	Leslie E. Robertson Associates, RLLP, NYC
PROJECT DESIGN BEGAN:	1999
CONSTRUCTION BEGAN:	2002
DATE OPENED:	July 28, 2004

Background

- Building serves as a library and museum
- President Clinton wanted to convey openness and accessibility
- Architects wanted the building to resemble the six nearby bridges
- Mostly made out of glass and structural steel

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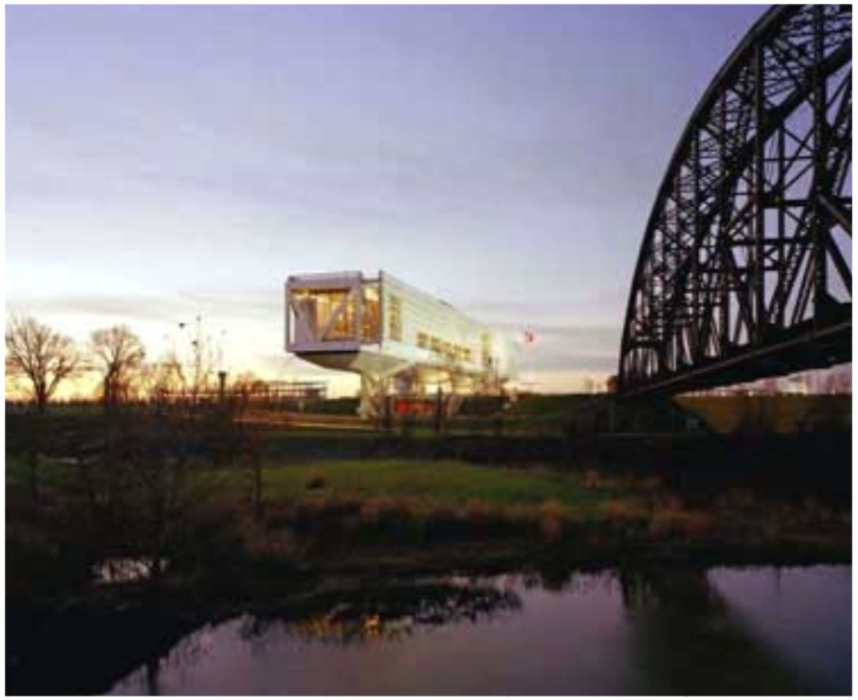

[3]

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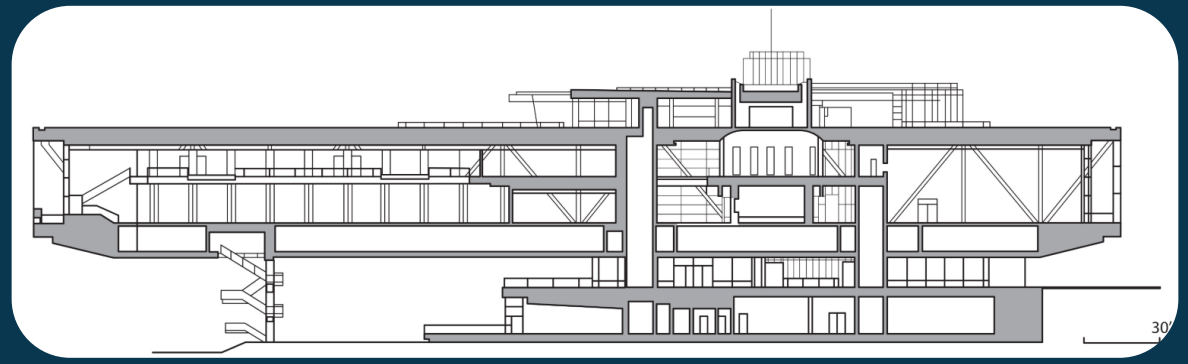
Dimensions

- Five-story structure
- Main 420 ft. long body of structure supported by 37 ft. deep trusses that cantilever 90 ft. towards river
- Trusses spaced 46 ft. apart
- 165,000 sf



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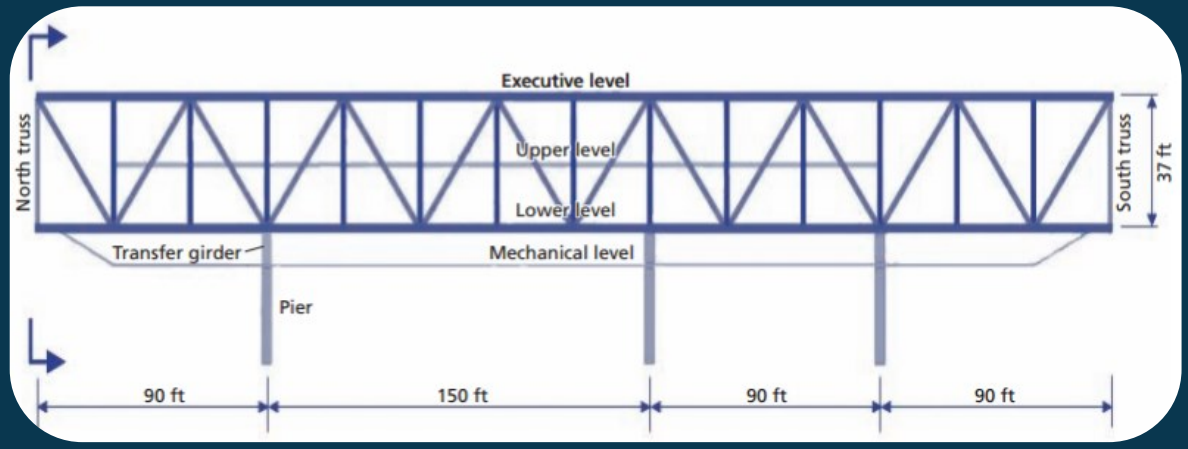

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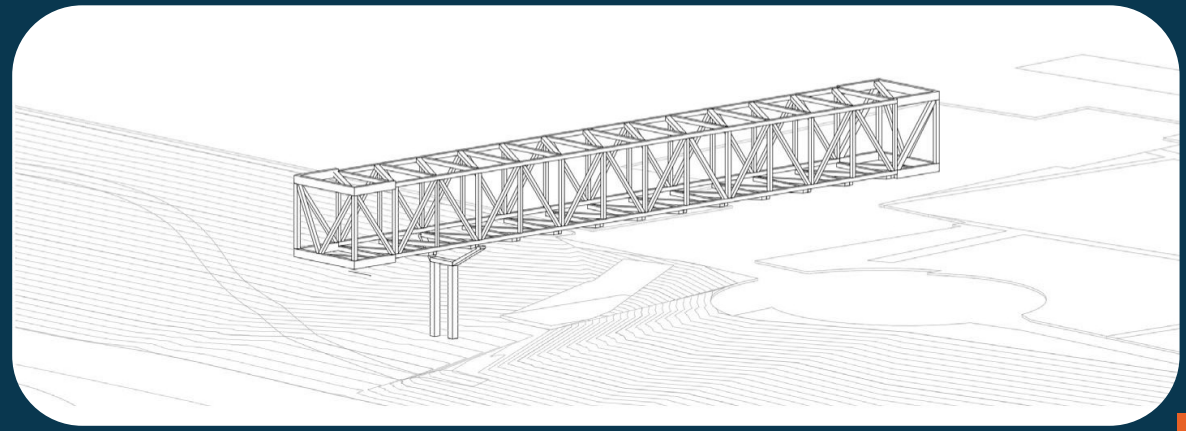

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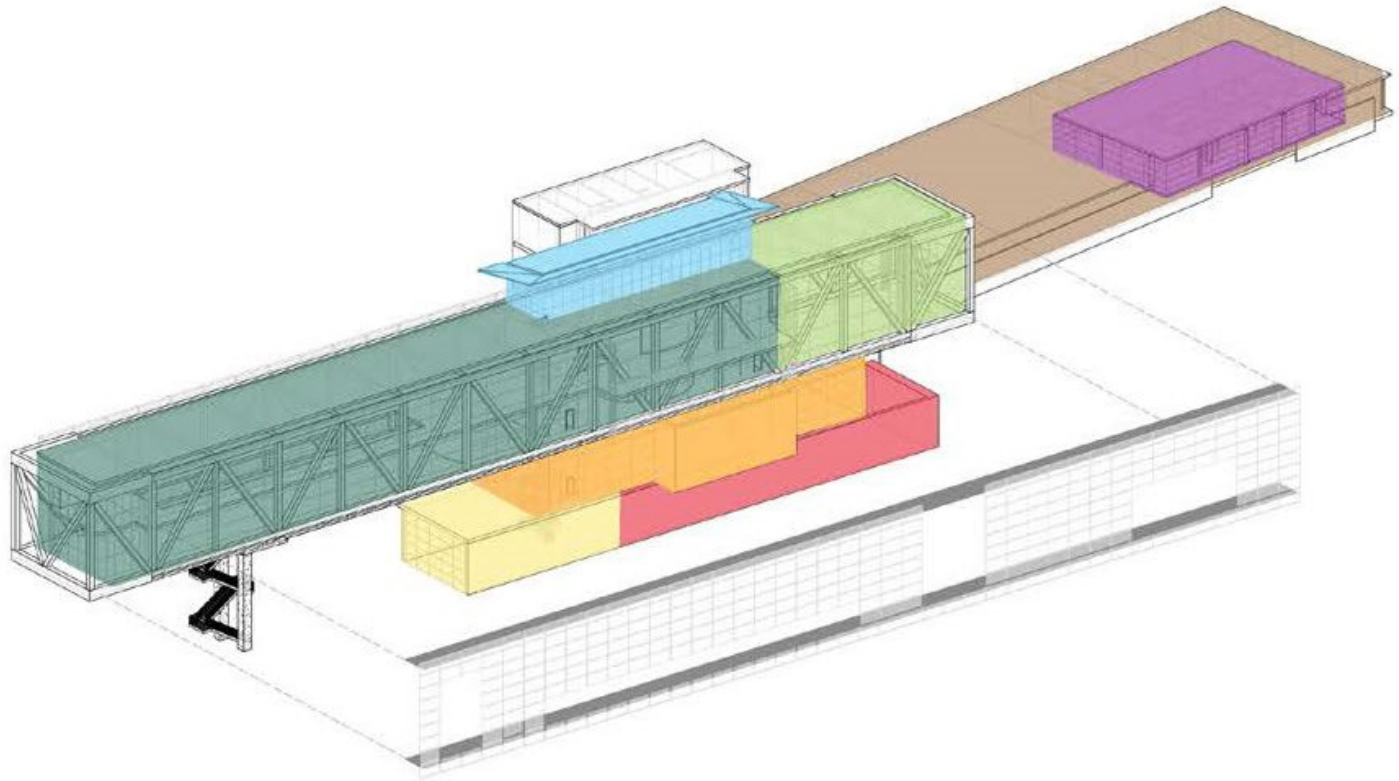
Apartment
Exhibition/ Gallery
Great Hall
Cafe
Lobby
Archives
Offices
Plan Area: 24,000 ft²
Building Area: 153,700 ft²
Building Footprint: 44,139 ft²

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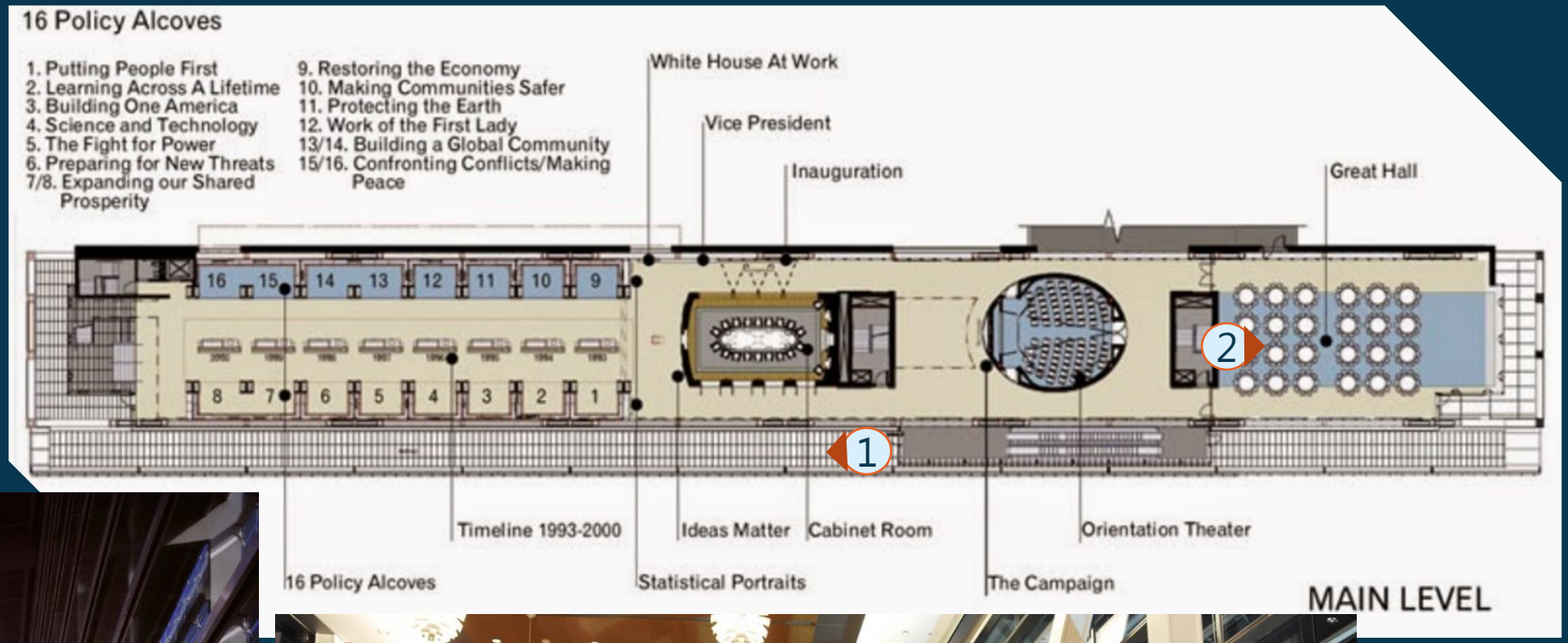
[3]


16 Policy Alcoves
1. Putting People First
2. Learning Across A Lifetime
3. Building One America
4. Science and Technology
5. The Fight for Power
6. Preparing for New Threats
7/8. Expanding our Shared Prosperity
9. Restoring the Economy
10. Making Communities Safer
11. Protecting the Earth
12. Work of the First Lady
13/14. Building a Global Community
15/16. Confronting Conflicts/Making Peace
White House At Work
Vice President
Inauguration
Great Hall
16 15 14 13 12 11 10 9
8 7 6 5 4 3 2 1
1
2
Timeline 1993-2000
Ideas Matter
Cabinet Room
Orientation Theater
16 Policy Alcoves
Statistical Portraits
The Campaign
MAIN LEVEL

[3]


1


2

[2]

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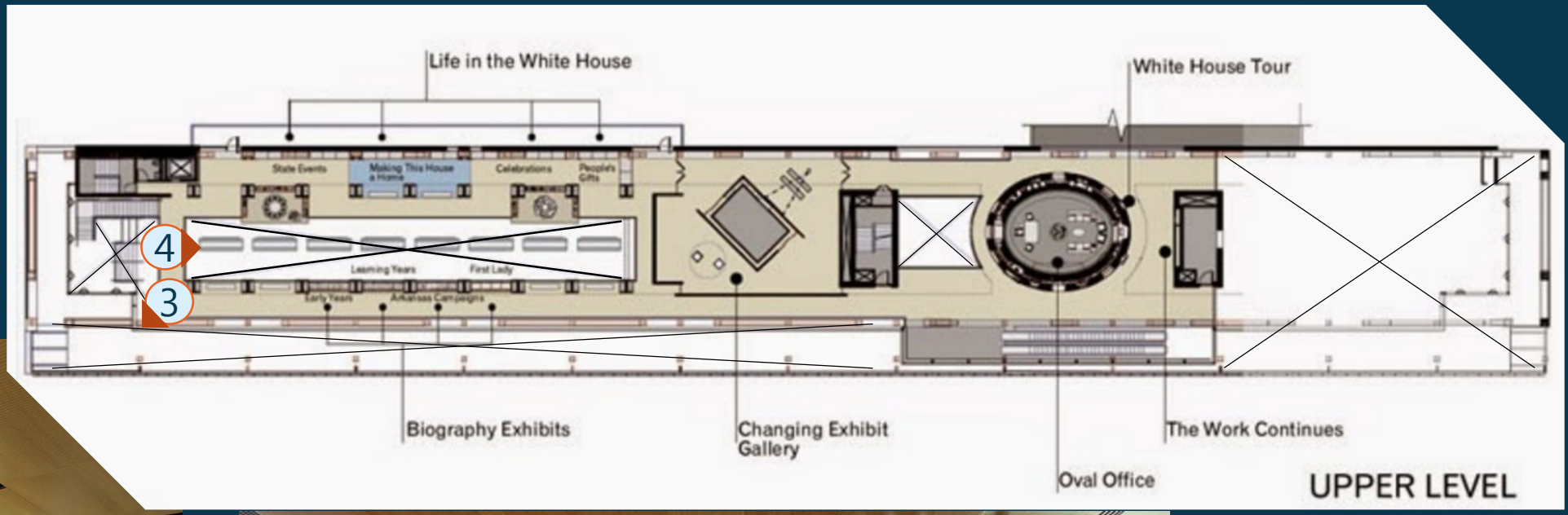
Life in the White House
White House Tour
State Events
Making This House a Home
Celebrations
People's Gifts
4
3
Learning Years
First Lady
Early Years
Arkansas Campaigns
Biography Exhibits
Changing Exhibit Gallery
Oval Office
The Work Continues
UPPER LEVEL

[1]


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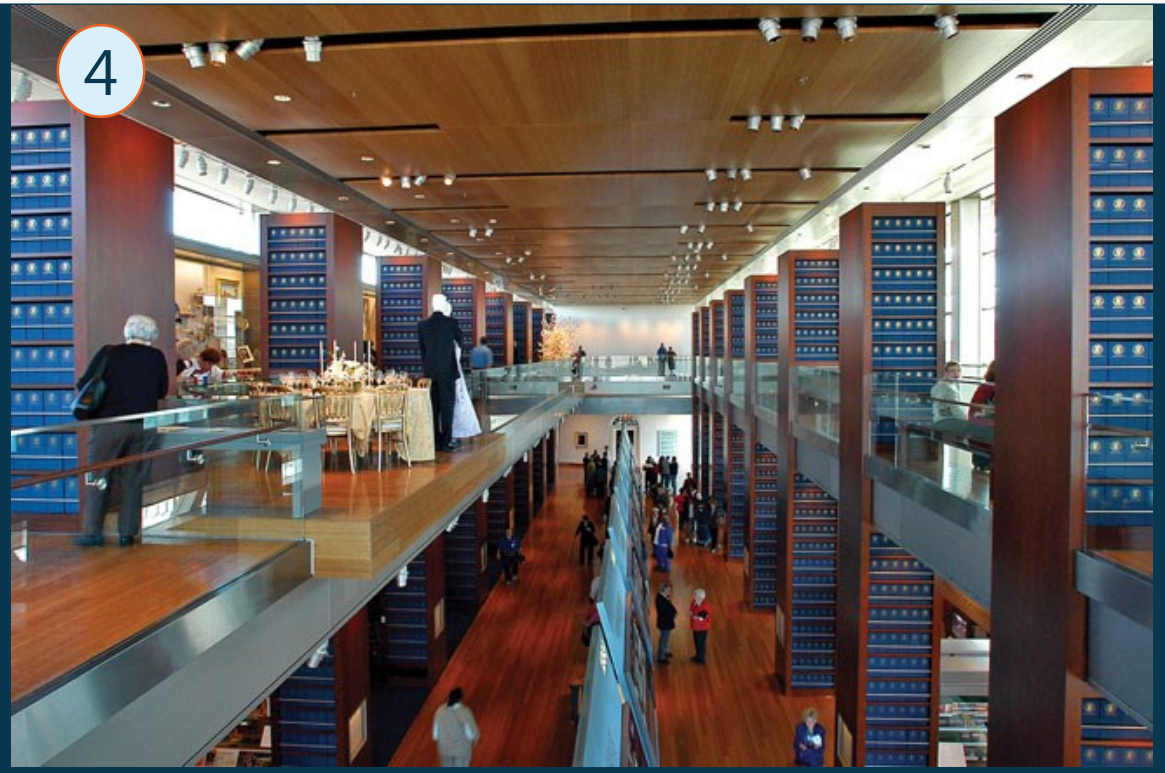
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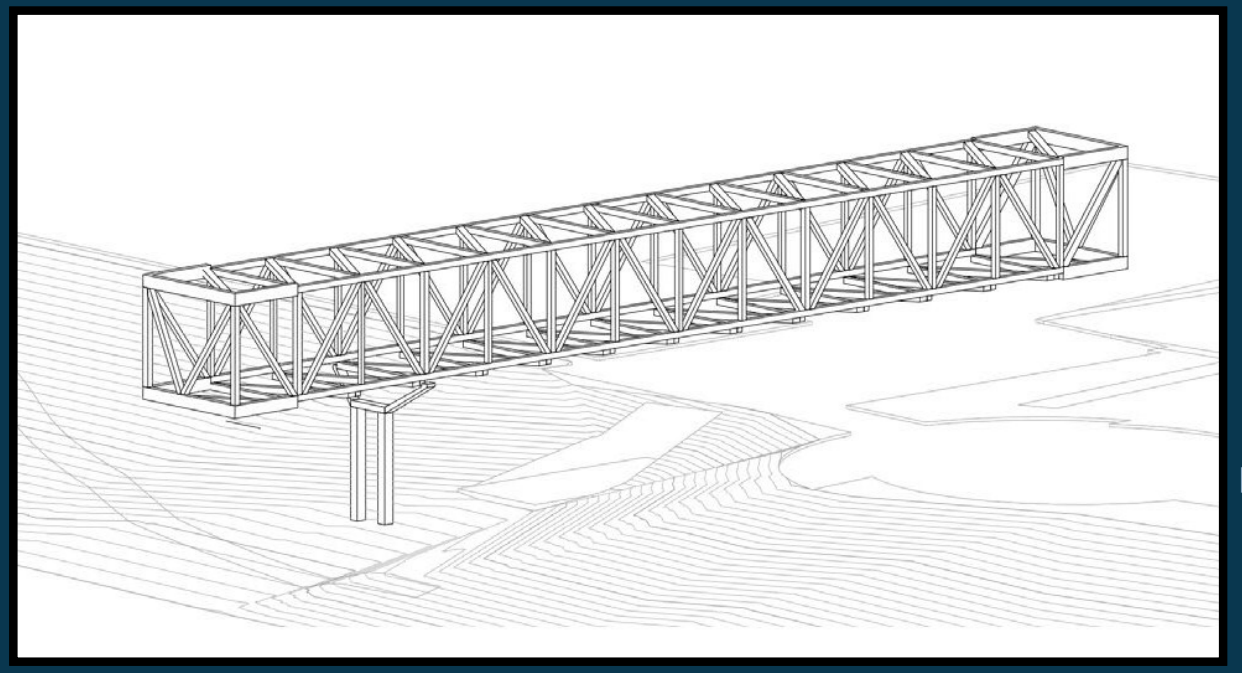
[2]

Gravity System

- Pair of deep trusses make up the structural frame in the 420 ft. direction
  - Supported at three locations
  - Cantilevers 90 ft. on both ends
- Horizontal trusses span the width at the top and bottom chords of the deep truss
  - Bolted in the field to top flanges and floor beams



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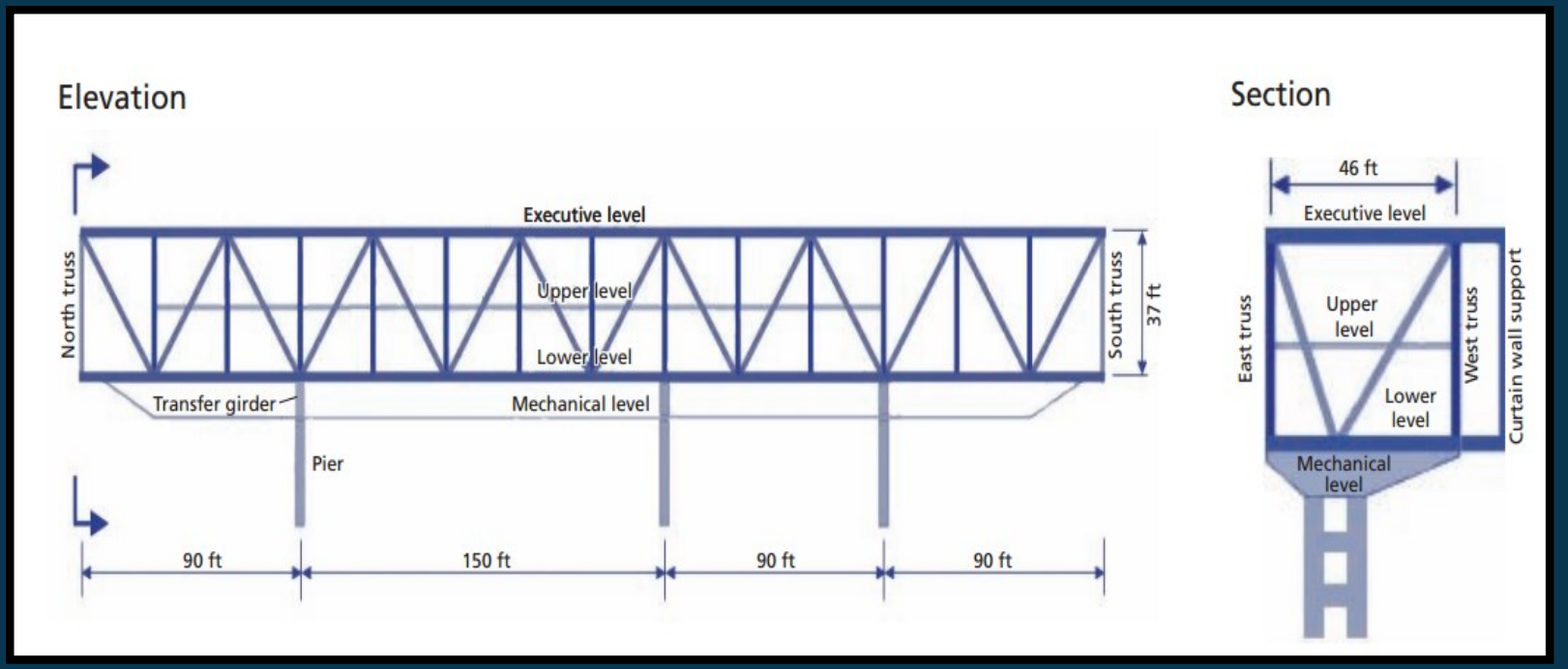

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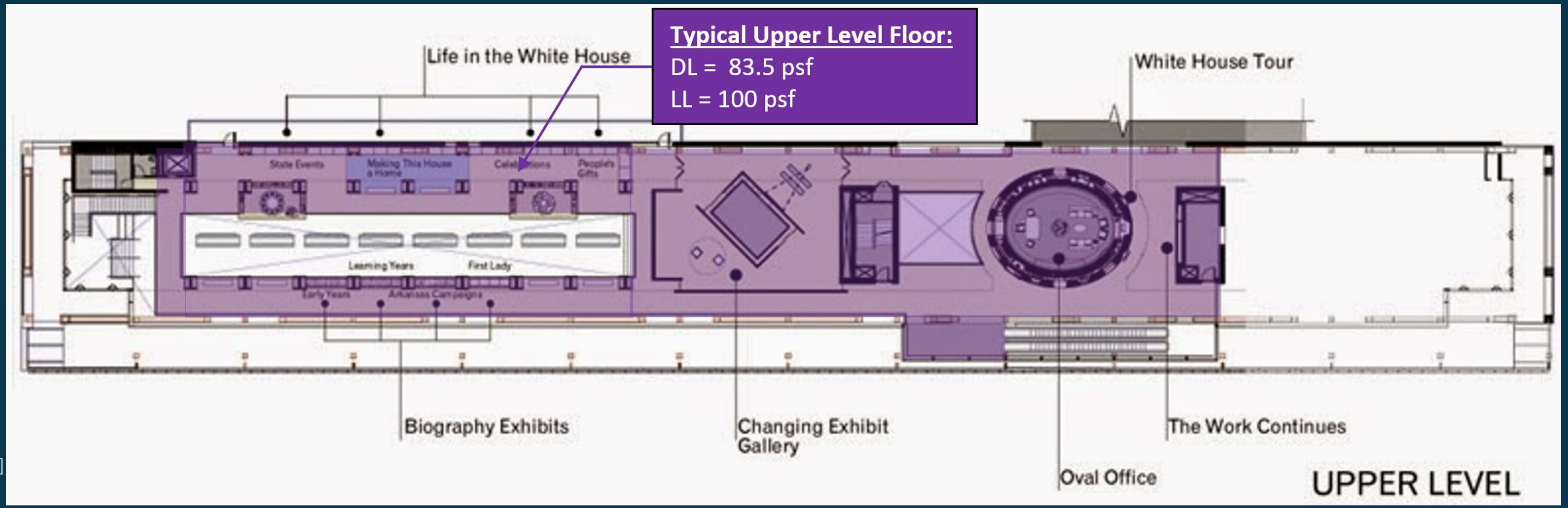
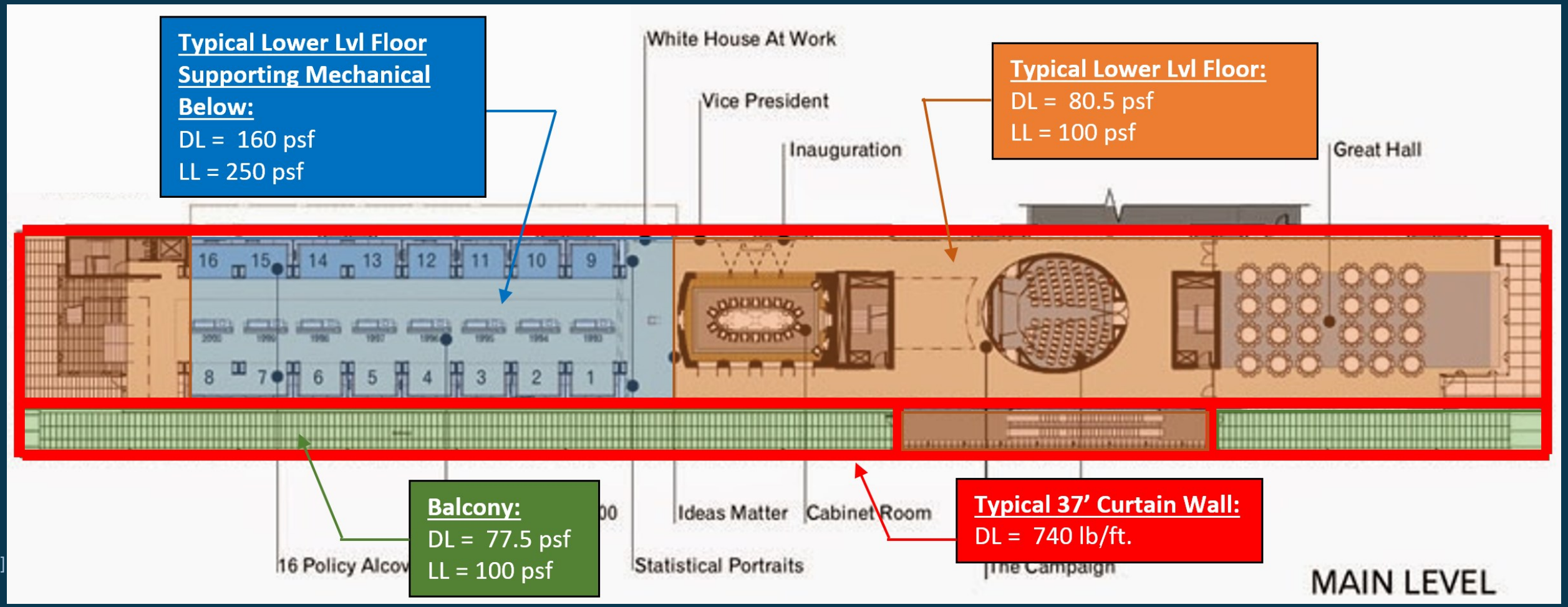


[3]

Typical Upper Level Floor			
5” Conc. Slab, Normal Weight.....	67.5	psf	
Deck.....	2	psf	
Flooring.....	3	psf	
Ceiling.....	3	psf	
Floor Collateral.....	5	psf	
Floor Sprinklers.....	3	psf	
Total Dead Load.....	**83.5**	**psf**	
Live Load.....	**100**	**psf**	(reducible)



[3]

Typical Lower Level Floor			
5" Conc. Slab, Normal Weight.....	67.5	psf	
Deck.....	2	psf	
Flooring.....	3	psf	
Floor Collateral.....	5	psf	
Floor Sprinklers.....	3	psf	
Total Dead Load.....	**80.5**	**psf**	
Live Load.....	**100**	**psf**	(reducible)

Typical Mechanical Level Floor			
5" Conc. Slab, Normal Weight.....	67.5	psf	
Deck.....	2	psf	
Flooring.....	3	psf	
Insulation.....	2	psf	
Soffit.....	5	psf	
Total Dead Load.....	**79.5**	**psf**	
Live Load.....	**150**	**psf**	(reducible)

Balcony			
5" Conc. Slab, Normal Weight.....	67.5	psf	
Deck.....	2	psf	
Flooring.....	3	psf	
Soffit.....	5	psf	
Total Dead Load.....	**77.5**	**psf**	
Live Load.....	**100**	**psf**	(reducible)

Other Loading Plans Not Shown

Typical Penthouse Roof

Roofing ……..	10	psf	
Roof Deck……..	2	psf	
Insulation……	2	psf	
Ceiling……	3	psf	
Roof Collateral……...	5	psf	
Sprinklers……	3	psf	
**Total Dead Load…….. **	**25**	**psf**	
**Live Load…….. **	**20**	**psf**	(unreducible)

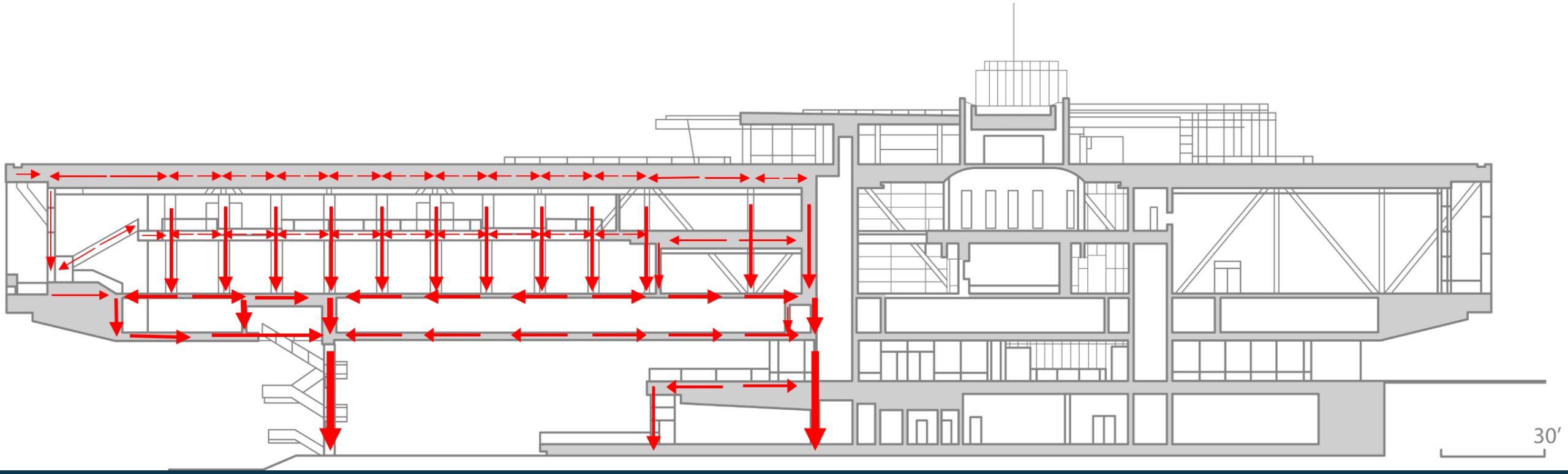
Typical Roof Garden

Soil, 1 ft. thick……	120	psf	
5” Conc. Slab, Normal Weight ……..…	67.5	psf	
Deck……..	2	psf	
Insulation……	2	psf	
Ceiling……	3	psf	
Roof Collateral……...	5	psf	
Sprinklers……	3	psf	
**Total Dead Load…….. **	**202.5**	**psf**	
**Live Load (1 ft. thick soil)…..…….. **	**120**	**psf**	(unreducible)

Typical Executive Level Floor

5” Conc. Slab, Normal Weight.....	67.5	psf	
Deck……	2	psf	
Flooring……..	3	psf	
Ceiling……	3	psf	
Floor Collateral……..	5	psf	
Floor Sprinklers……	3	psf	
**Total Dead Load…….. **	**83.5**	**psf**	
**Live Load…….. **	**100**	**psf**	(reducible)

Gravity Load Tracing



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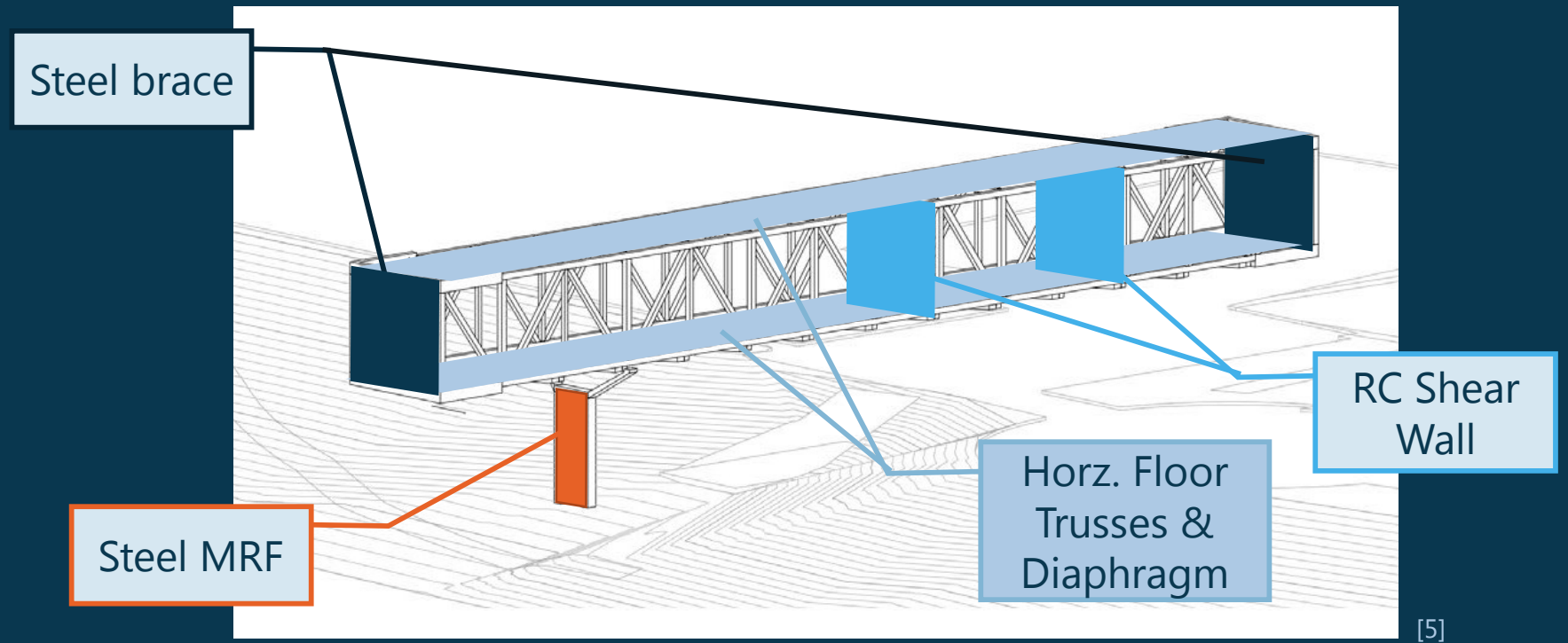
Lateral System

- Shear walls, horizontal floor trusses and reinforced concrete floor diaphragms make up the lateral load resisting system
  - Shear walls located at outer perimeter of the building's stair towers
- Floor diaphragms help distribute the lateral load
- Horizontal trusses act like drag member and collectors, transferring the lateral loads to shear walls
  - Deliver lateral wind and seismic forces to the building's shear walls



[5]

Wind Loads

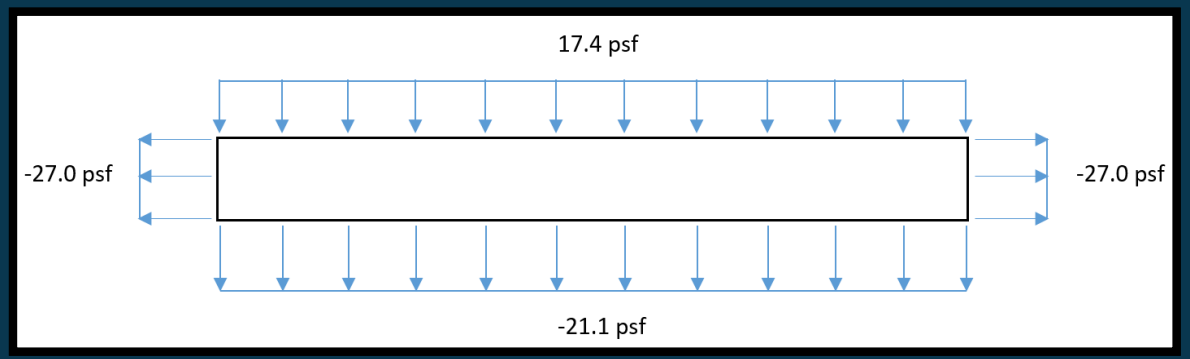
Basic Wind Speed	115 mph
Wind Exposure Category	C
Wind Importance Factor, I	1.0
Internal Pressure Coefficient, C_{pi}	+/- 0.18
Gust Effect Factor, G	0.85
Mean Roof Height, h	74 ft.
Wind Directionality Factor, K_d	0.85
Topographic Factor, K_{zt}	1.0
Velocity Pressure Exposure Coefficient, K_h	1.21 (at mean roof height)

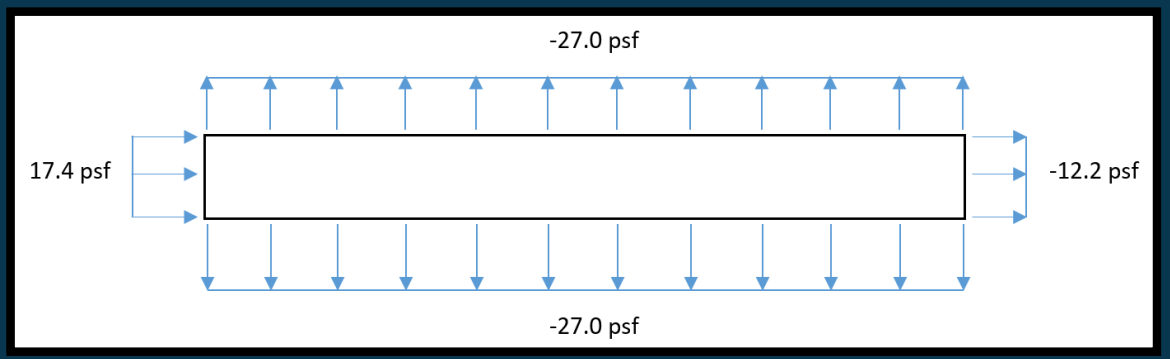
Wind Load in the Short Direction (L/B = 0.11)

Wall	C_p	$q_h G C_p$	$q_h G C_{pi}$
		(psf)	*(psf)*
Windward	0.80	23.7	±6.26
Leeward	-0.50	-14.8	±6.26
Side	-0.70	-20.7	±6.26

Wind Load in the Long Direction (L/B = 9.1)

Wall	C_p	$q_h G C_p$	$q_h G C_{pi}$
		(psf)	*(psf)*
Windward	0.80	23.7	±6.26
Leeward	-0.20	-5.92	±6.26
Side	-0.70	-20.7	±6.26

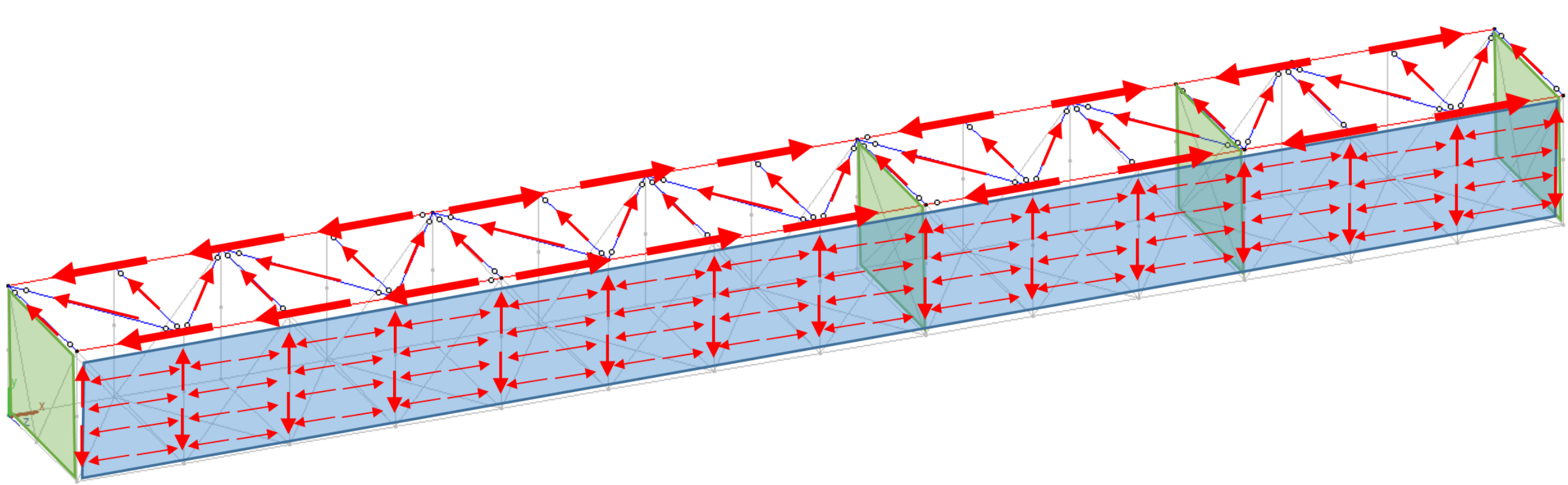




Seismic Loads

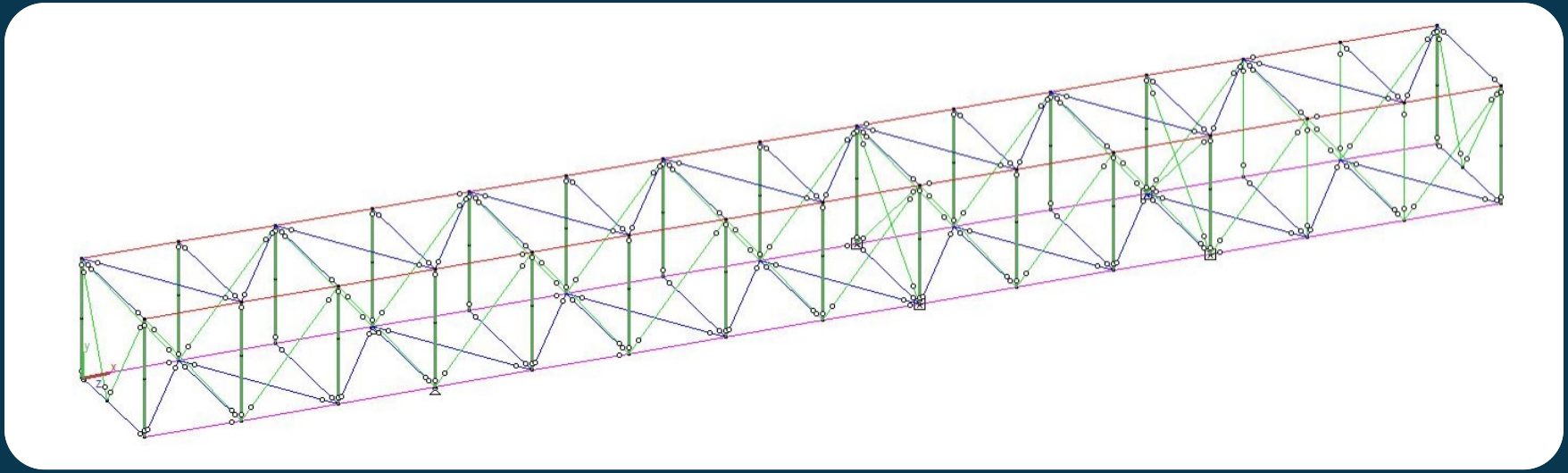
Spectral Response Coeff., S_{DS}	0.399
Spectral Response Coeff., S_{D1}	0.234
Site Class	D (assumed)
Seismic Design Category (Short Period)	C
Seismic Design Category (Long Period)	D
Approximate Period Parameter C_t	0.02
Approximate Period Parameter x	0.75
Structural Height, h_n	74 ft.
Upper Limit Coeff., C_u	1.466
Approx. Period Upper Limit, $C_u T_a$	0.740 s
Fundamental Period (minimum), T	0.505 s
Period T_0	0.117 s
Short Period T_S	0.586 s
Long Period T_L	12 s
Analysis Procedure	Equivalent Lateral Force Method (ASCE 7-10, Section 12.8)
Response Modification Coeff., R	5
Overstrength Factor, Ω_0	2.5
Deflection Amplification Factor, C_d	4.5
Importance Factor, I_e	1.0
Seismic Response Coeff., C_s	0.0798
Seismic Weight, W	10,000 k

Wind Load Tracing



Structural Analysis

- Supports modeled as pin and rollers, restrained for out of plane translations at the base
- Moment releases on member ends, identifying locations of simple connections
- Shear walls modeled with two X-braced frames
- Top and bottom chords modeled as continuous, with the proper splice locations

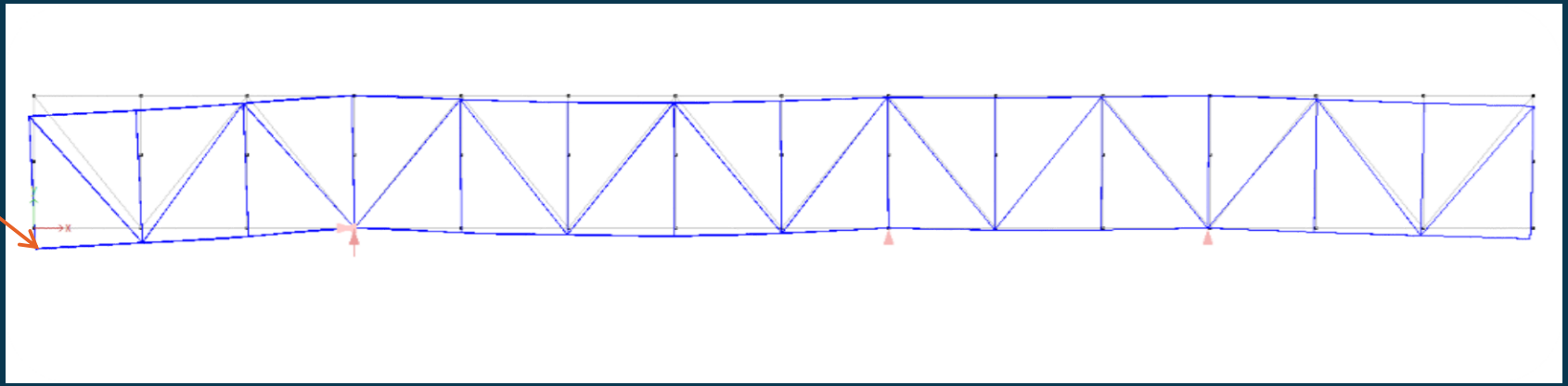


Structural Analysis

- Performed the structural analysis in Multiframe
- LRFD load combinations considered:
  - 1.4D
  - 1.2D+1.6L+0.5Lr
  - 1.2D+1.6Lr+L
  - 1.2D+1.6Lr+0.5W
  - 1.2D+1.0W+L+0.5Lr
  - 1.2D+1.0L
  - 0.9D+1.0W

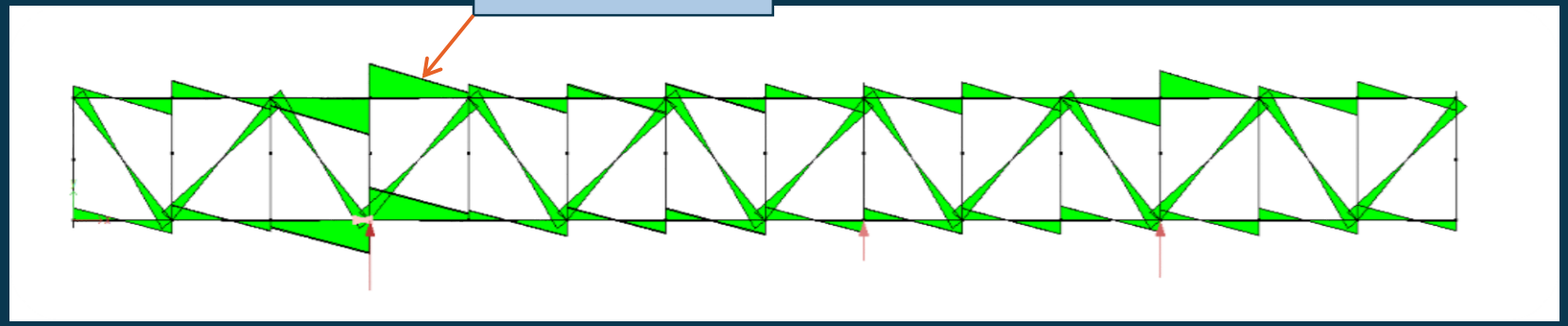
- Typical Dead Loads
  - Self-weight
  - P~35-100k
- Typical Live Loads
  - P~27-150k
- Typical Wind Loads
  - P~11-22k

Δ max = 0.4”

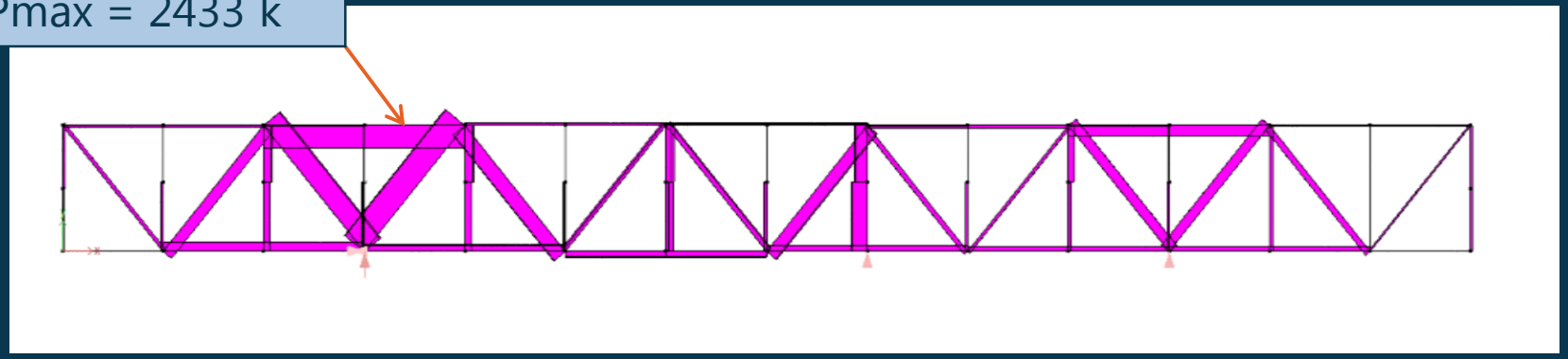


Structural Analysis (Gravity)

Vmax = 32 k

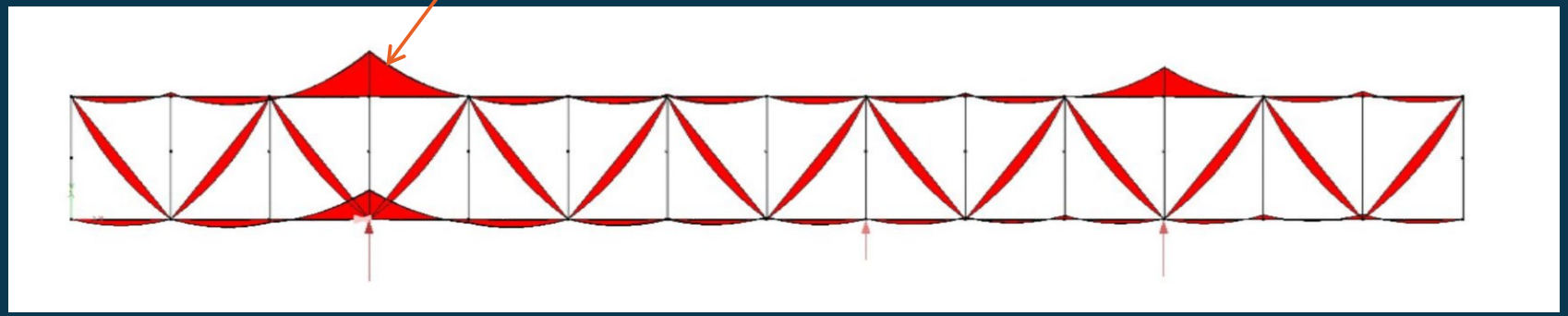


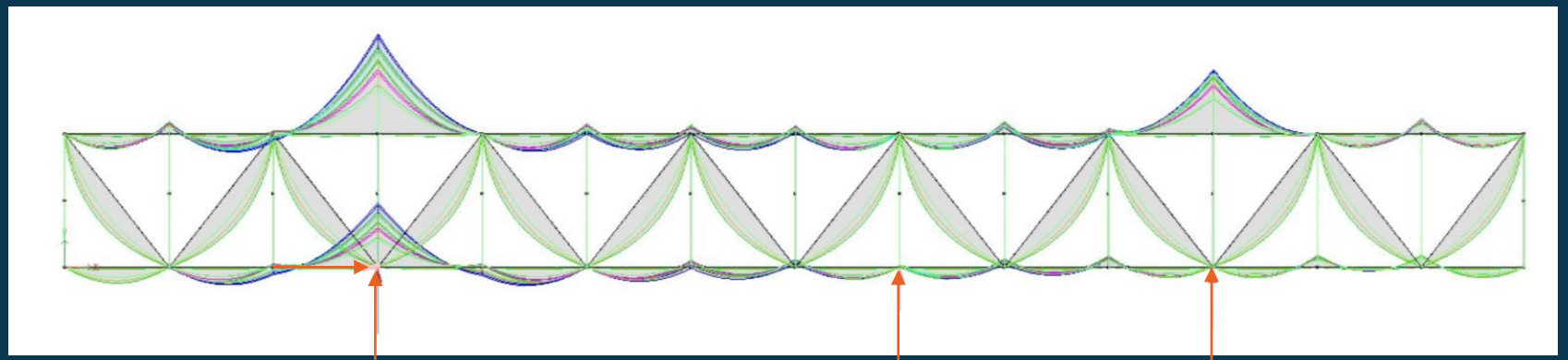
Pmax = 2433 k



Structural Analysis

Mmax = 598 k-ft



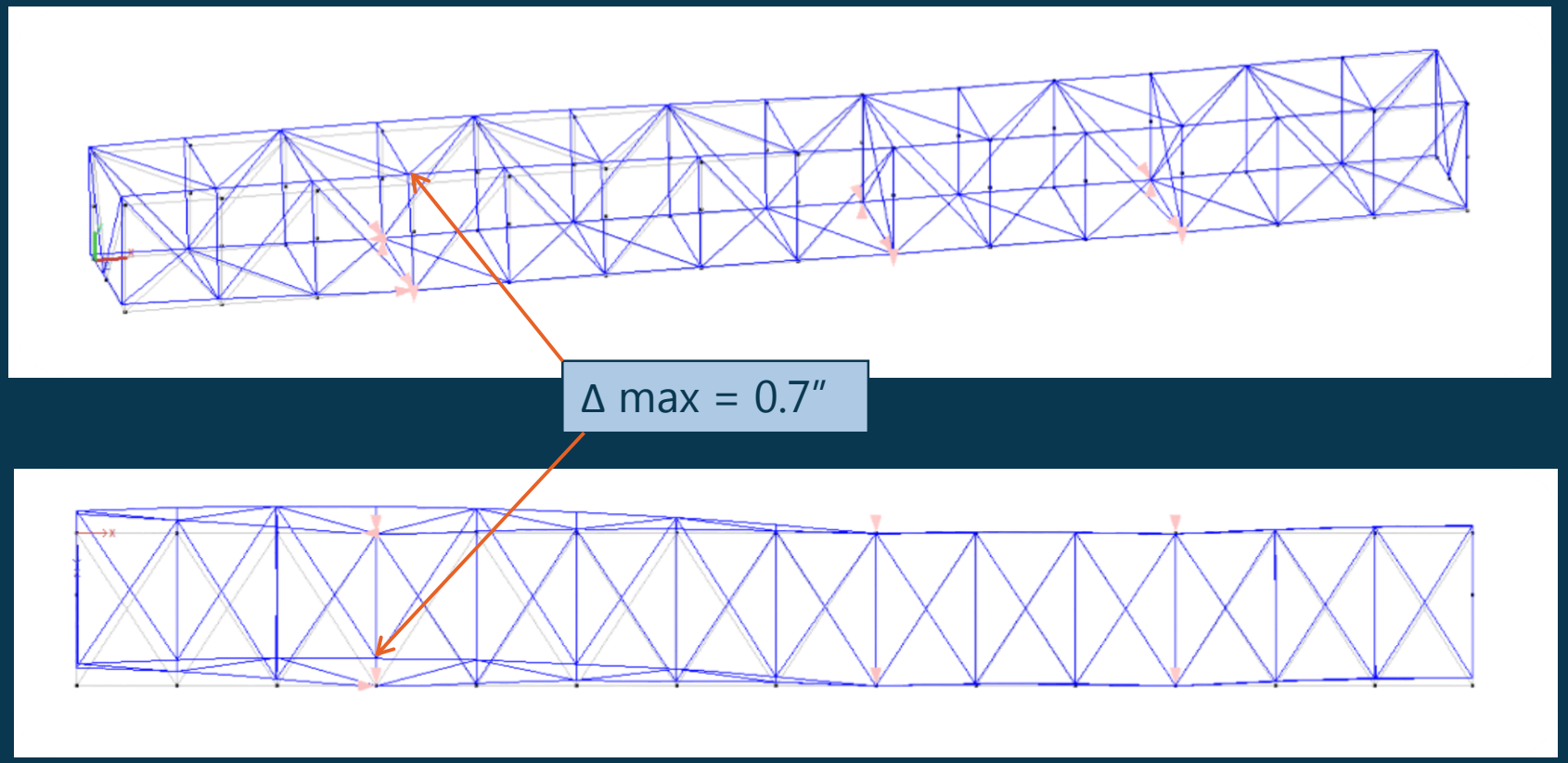


Rx,max = 235 k
Ry,max = 4455 k

Ry,max = 1591 k

Ry,max = 2753 k

Structural Analysis (Lateral)



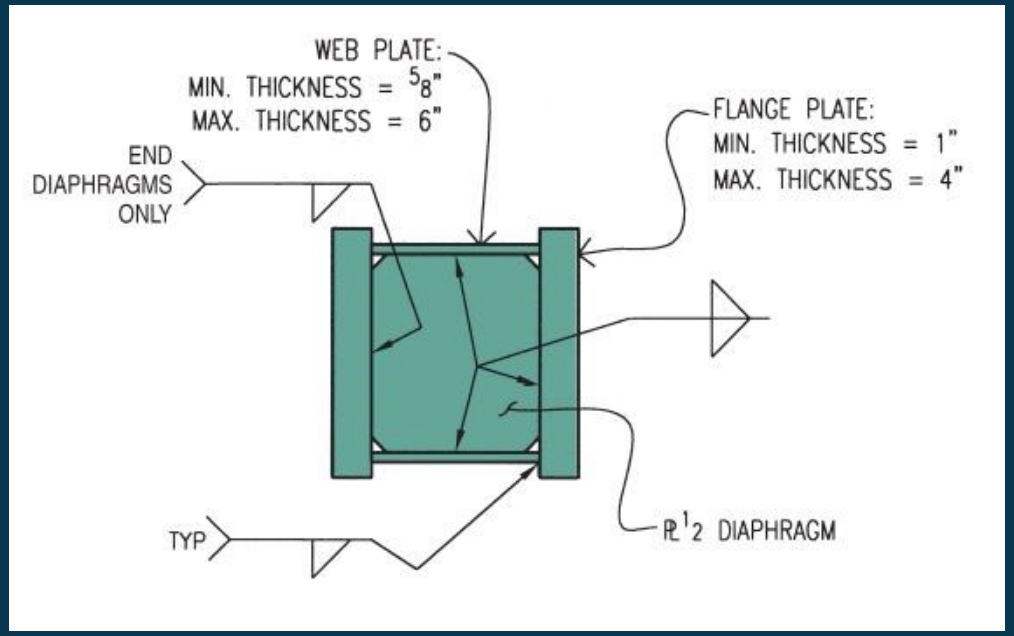
Structural Design

Member	Section
Bottom chords of trusses	Built up steel boxes 26″D x 16″ W
Architecturally exposed diagonals	Built up steel boxes 16″D x 16″ W

- Chord and diagonals have same width due to architectural concerns, but also provided a simple family of connection details, practical for construction
- Built up members made out of ASTM A572 GR50 steel

Structural Design

- Truss consists of:
  - 30 vertical members
  - 32 diagonal members
  - 36 chord members
  - 36 nodes
- Truss members are built-up box sections
  - Ranging in length form 28 to 125 ft.
  - Required very high standards of dimensional control
  - Required full length fillet welds



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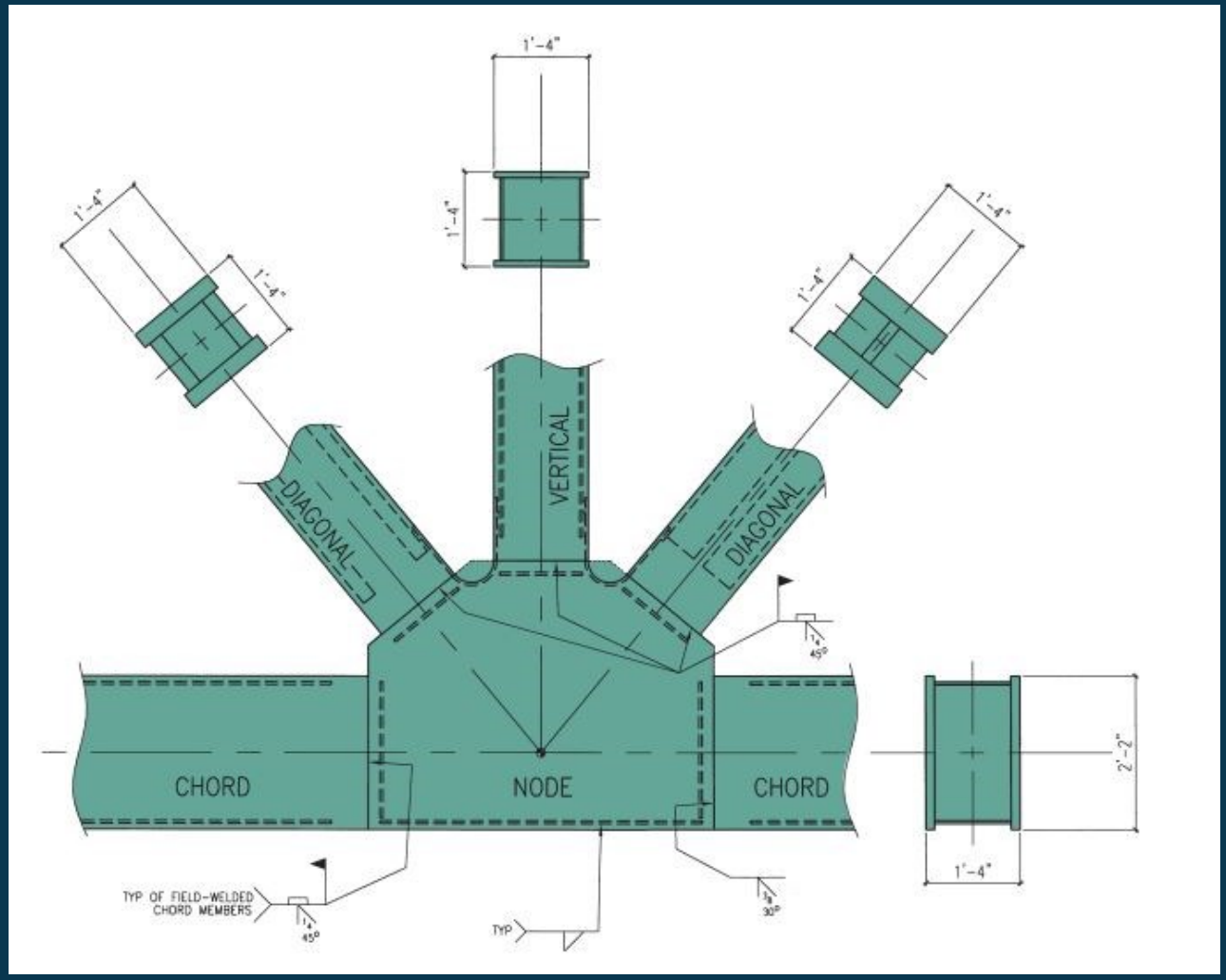
Structural Design

- Truss was connected on site with groove welds



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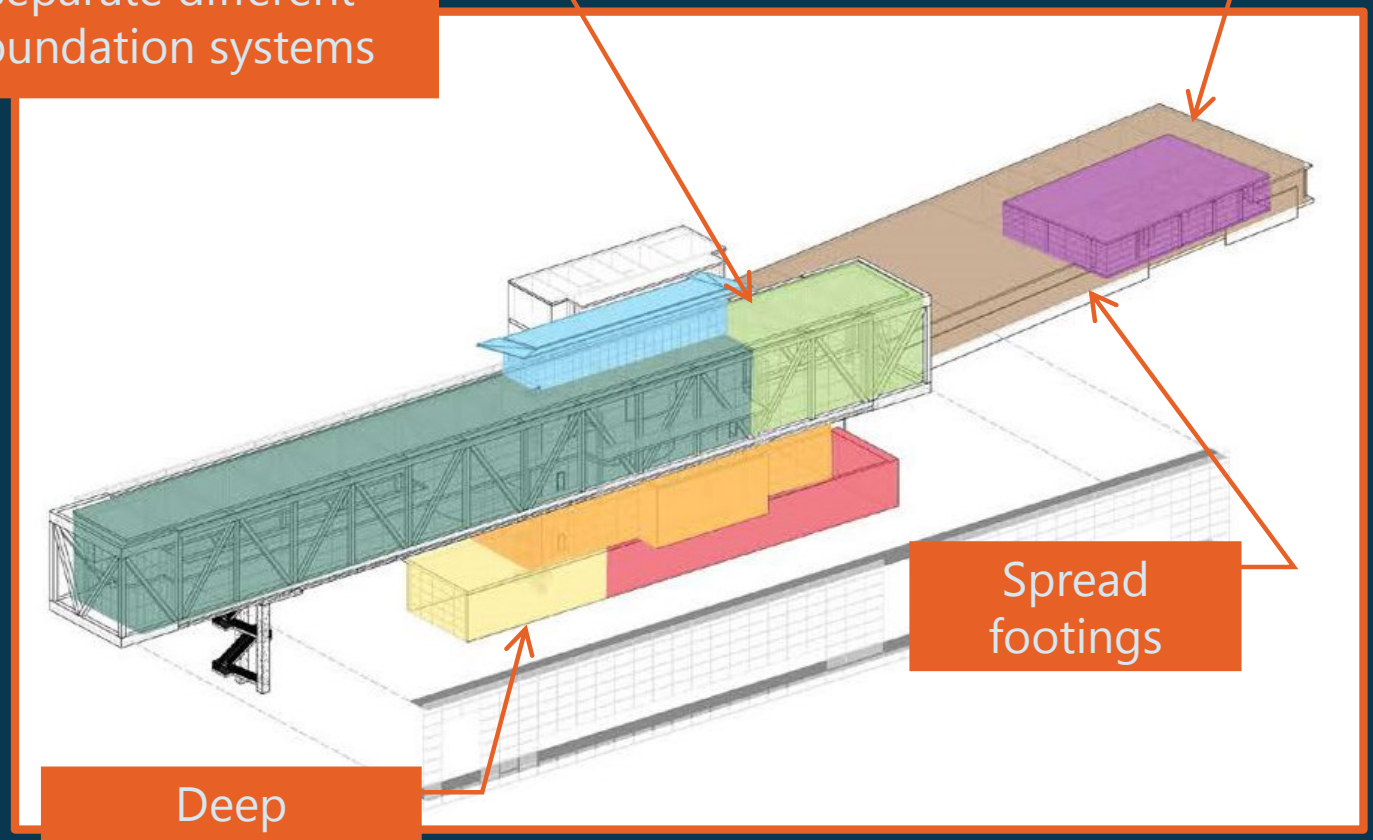
Foundations

- Expansive clay was undercut and backfilled with engineered fill
- The foundation for the museum/library was separated from the archive building with expansion joint
- Museum/library building contains deep foundation design per the recommendation of the geotechnical engineers
- Archive building contains concrete spread footings



[5]

Foundation Design

- Several 60 to 80 ft. long drilled shaft caissons
- Diameters ranged from 30 to 42 in.
- Embedded 20 ft. into bedrock shale
- Designed to resist overturning forces and to deliver lateral loads to the bedrock

Sources

[1] D. A. Sesil and O. Güleç, "Commanding Presence," Civil Engineering Magazine, vol. 75, no. 3, pp. 42-49, March 2005.

[2] The Clinton Foundation, "The Clinton Presidential Center," [Online]. Available: https://www.clintonfoundation.org/clinton-presidential-center. [Accessed 28 March 2017].

[3] J. Hill, "A Daily Dose of Architecture: Clinton Library," 21 February 2005. [Online]. Available: http://archidose.blogspot.com/2005/02/clinton-library.html. [Accessed 28 March 2017].

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[6] C. Rautenberg, "Making the Essential Connections on "A Bridge to the 21st Century"," *Welding Innovation,* vol. XX, no. 1, 2003.

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