





RENAISSANCE  
SCHAUMBURG



ERIC YANOVICH

STRUCTURAL OPTION

SCHAUMBURG HOTEL AND  
CONVENTION CENTER

SCHAUMBURG, ILLINOIS

# PRESENTATION OUTLINE

- BACKGROUND PROJECT INFORMATION
- EXISTING STRUCTURAL SYSTEM
- DESIGN GOALS
- PROPOSAL AND SOLUTION OVERVIEW
- CONSTRUCTION IMPACTS AND CONSIDERATIONS
- OVERALL CONCLUSIONS AND RECOMMENDATIONS

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## OMISSION OF PRESENTATION

- LIGHTING BREADTH (TYPICAL GUEST SUITE)



# PROJECT INFORMATION

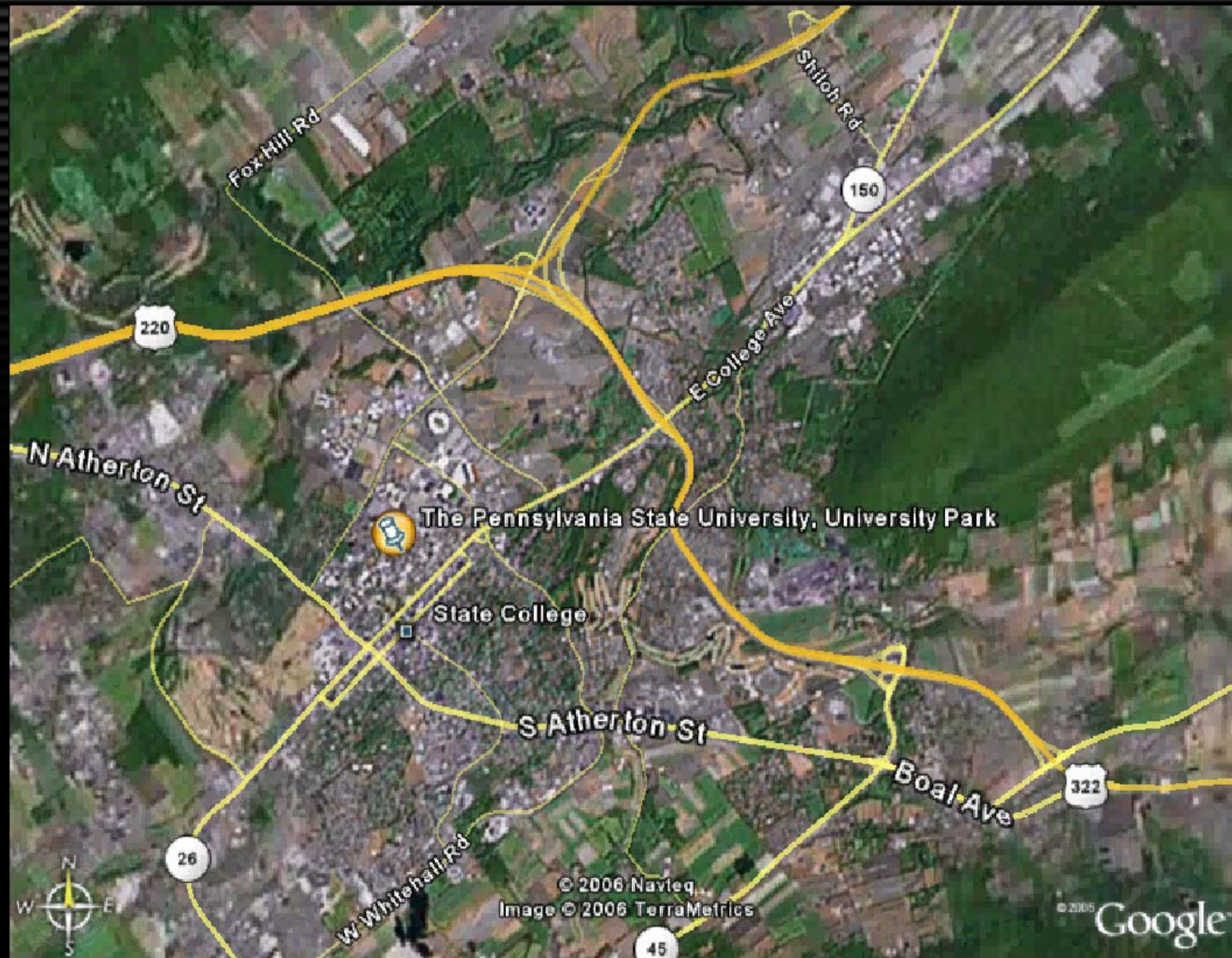
## GENERAL INFORMATION

- 1551 THOREAU DRIVE  
SCHAUMBURG, ILLINOIS
- 17 STORY HOTEL WITH 500 GUEST SUITES  
COVERING OVER 436,000 SF
- PROJECT TOTAL = \$207 MILLION  
HOTEL STRUCTURE = \$99 MILLION
- 5 STORY ATRIUM, RESTAURANT, AND 4 STAR ACCOMMODATIONS
- DESIGN PARTNERS
  - ARCHITECTS: JOHN PORTMAN AND ASSOC. & DANIEL P. COFFEY AND ASSOC.
  - STRUCTURAL ENGINEER: HALVORSON PARTNERS





# BUILDING LOCATION





# BUILDING SITE



# DESIGN CODES



- INTERNATIONAL CODE COUNCIL
  - 2003 INTERNATIONAL BUILDING CODE
  - 2003 INTERNATIONAL FIRE CODE



- AMERICAN INSTITUTE OF STEEL CONSTRUCTION
  - 3<sup>RD</sup> EDITION MANUAL OF STEEL CONSTRUCTION (LRFD)



- AMERICAN SOCIETY OF CIVIL ENGINEERS
  - MINIMAL DESIGN LOADS FOR BUILDINGS (ASCE 7-02)



- AMERICAN CONCRETE INSTITUTE
  - BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE (ACI 318-02)

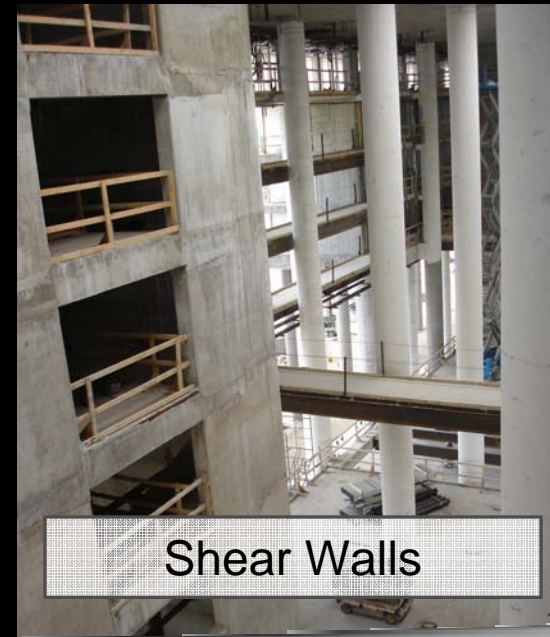


# EXISTING STRUCTURAL SYSTEM

- CAST-IN-PLACE CONCRETE COLUMNS AND BEAMS
- 10" POST-TENSIONED CONCRETE FLAT PLATE SLAB
- CIRCULAR (42" DIA) CONCRETE COLUMNS IN ATRIUM SPACE
- SHEAR WALLS FOR LATERAL FORCE RESISTANCE
- 9'8" TYPICAL STORY HEIGHT



Circular Atrium Columns



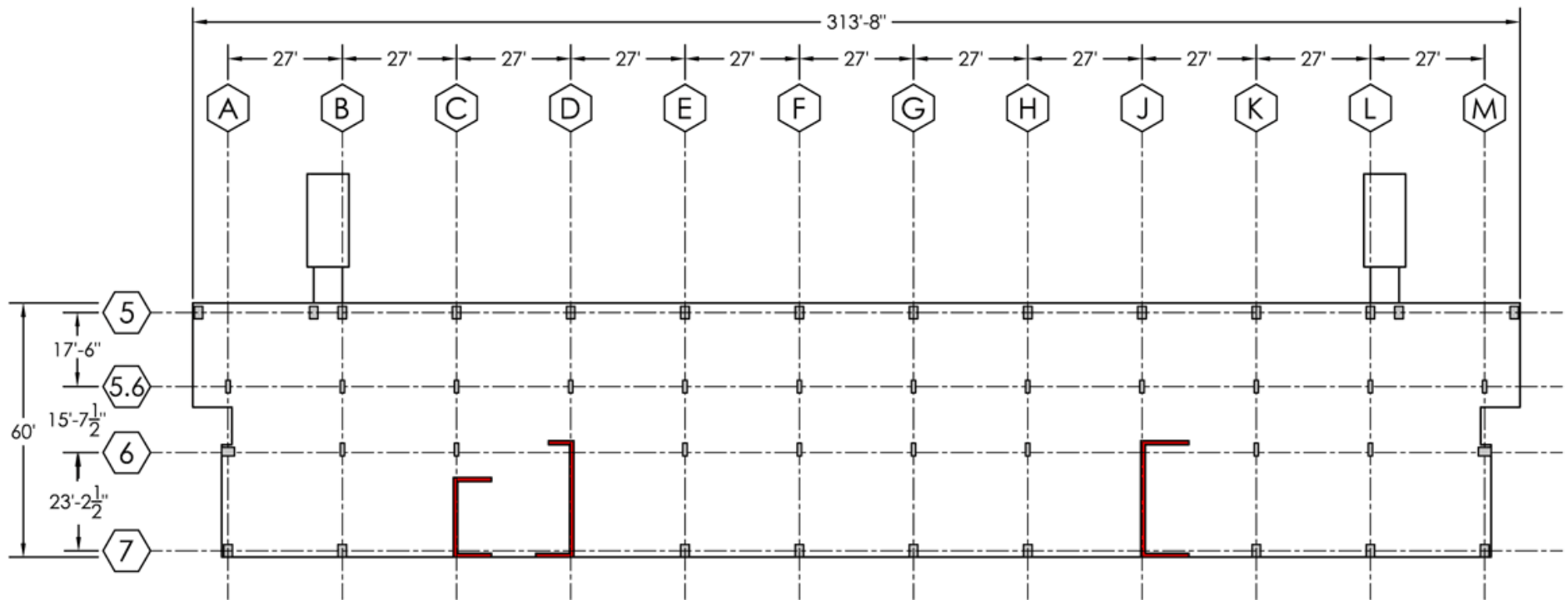
Shear Walls





# LATERAL SYSTEM

- 11"-18" THICK SHEAR WALLS
- 6-8KSI CONCRETE
- 9 WALLS CREATING 3 C-SHAPED ELEMENTS



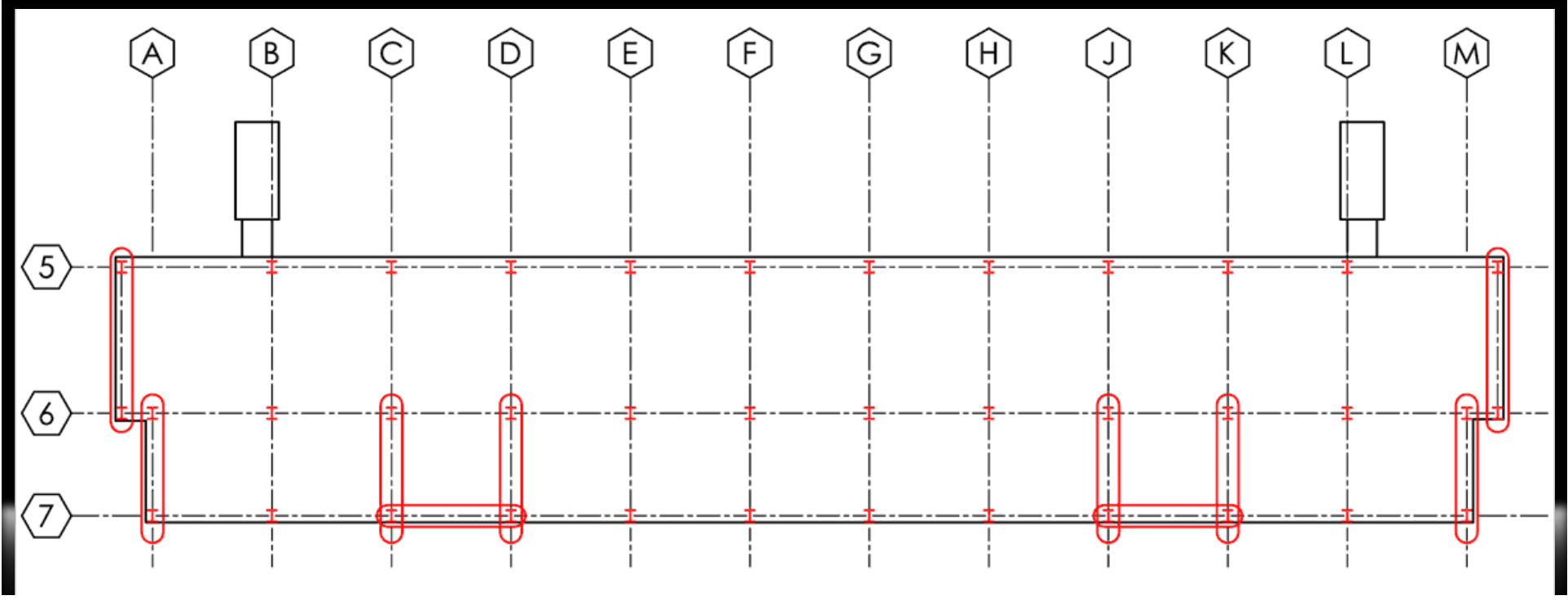
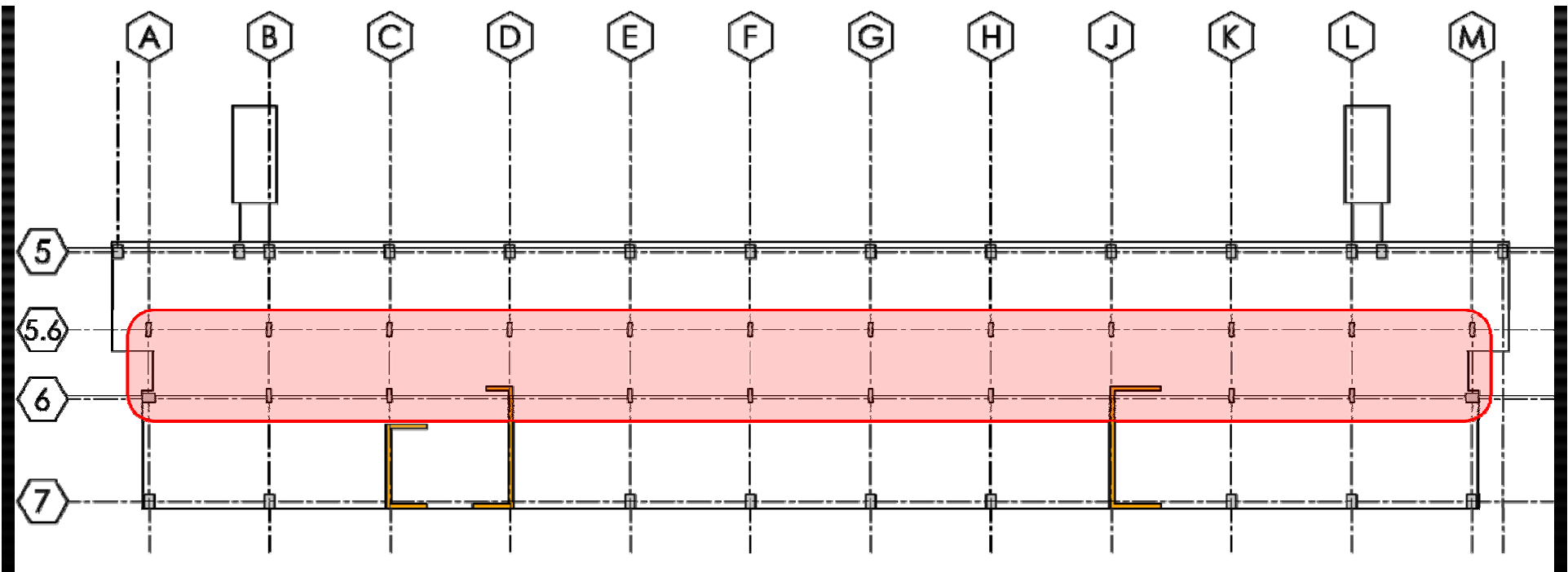
# DESIGN GOALS

## CONVERSION OF THE CONCRETE FRAME TO STEEL

### CONSIDERATIONS AND PROJECT SCOPE

- REMOVAL OF A ROW OF COLUMNS
- TIME/COST SAVINGS
- REPLACEMENT OF POST-TENSIONED SLAB SYSTEM WITH COMPOSITE SLAB
- ANALYSIS OF BRACED FRAME PERFORMANCE





# DESIGN GOALS

## CONVERSION OF THE CONCRETE FRAME TO STEEL

### ADVANTAGES

- ADDITIONAL COLUMN-FREE SPACE
  - TIME SAVINGS IN ERECTION
- LESS SPECIALIZED CONSTRUCTION

### CONCERNS

- LATERAL SYSTEM COMPATIBILITY
- LATERAL SYSTEM PERFORMANCE
- INCREASED STORY HEIGHT (17")

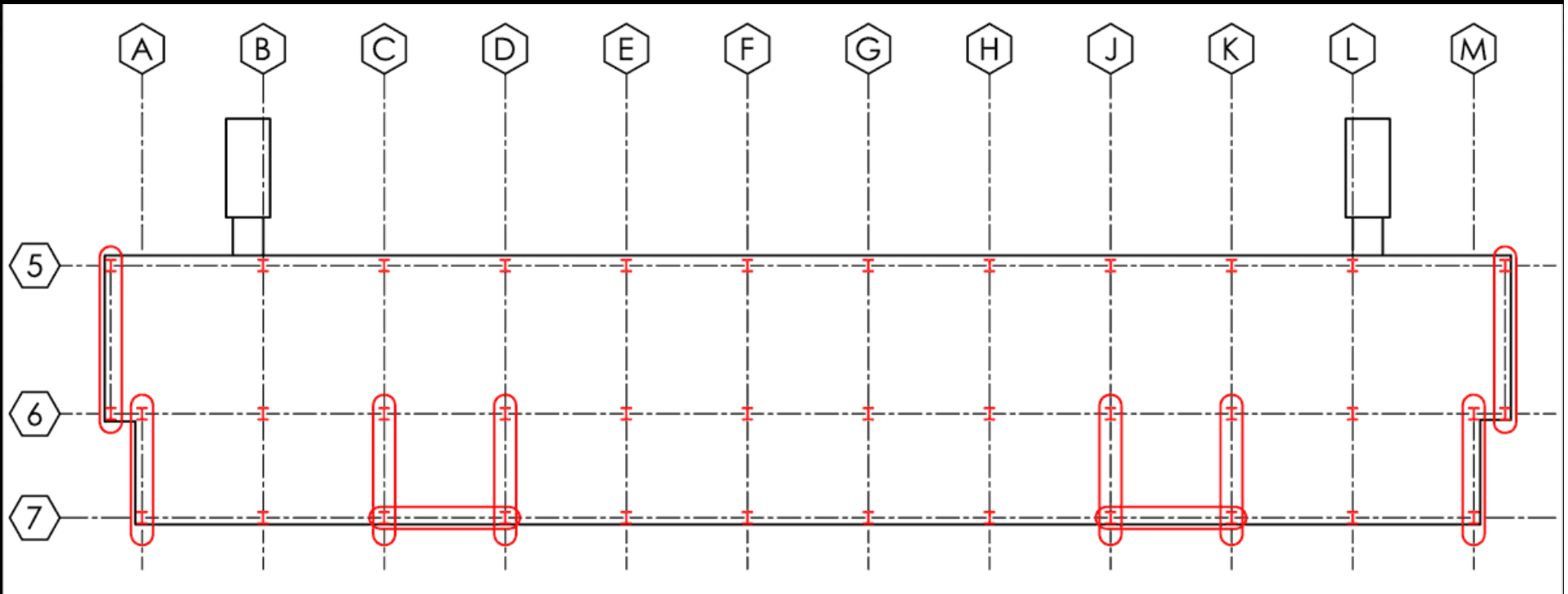




# STRUCTURAL PROPOSAL

## CONVERSION OF THE CONCRETE FRAME TO STEEL

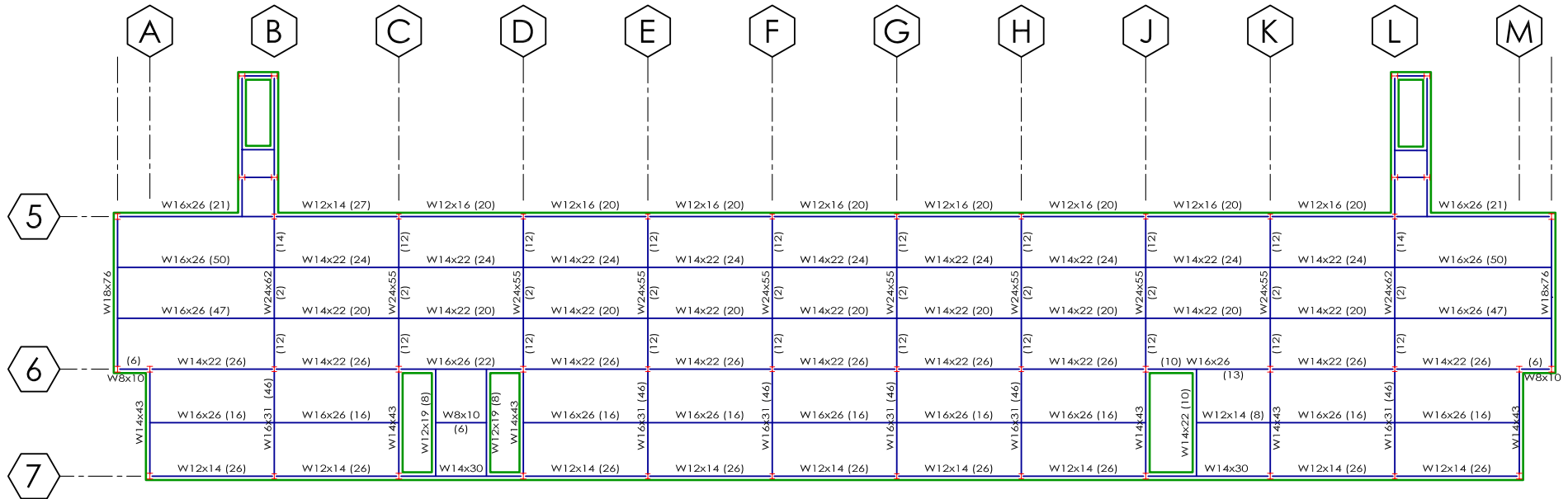
•NOTE FRAME LAYOUT



# STRUCTURAL PROPOSAL

## GRAVITY SYSTEM

- TYPICAL BEAM SIZES RANGE FROM W12X311 TO W24X55 WHEN PART OF THE BRACED FRAMES



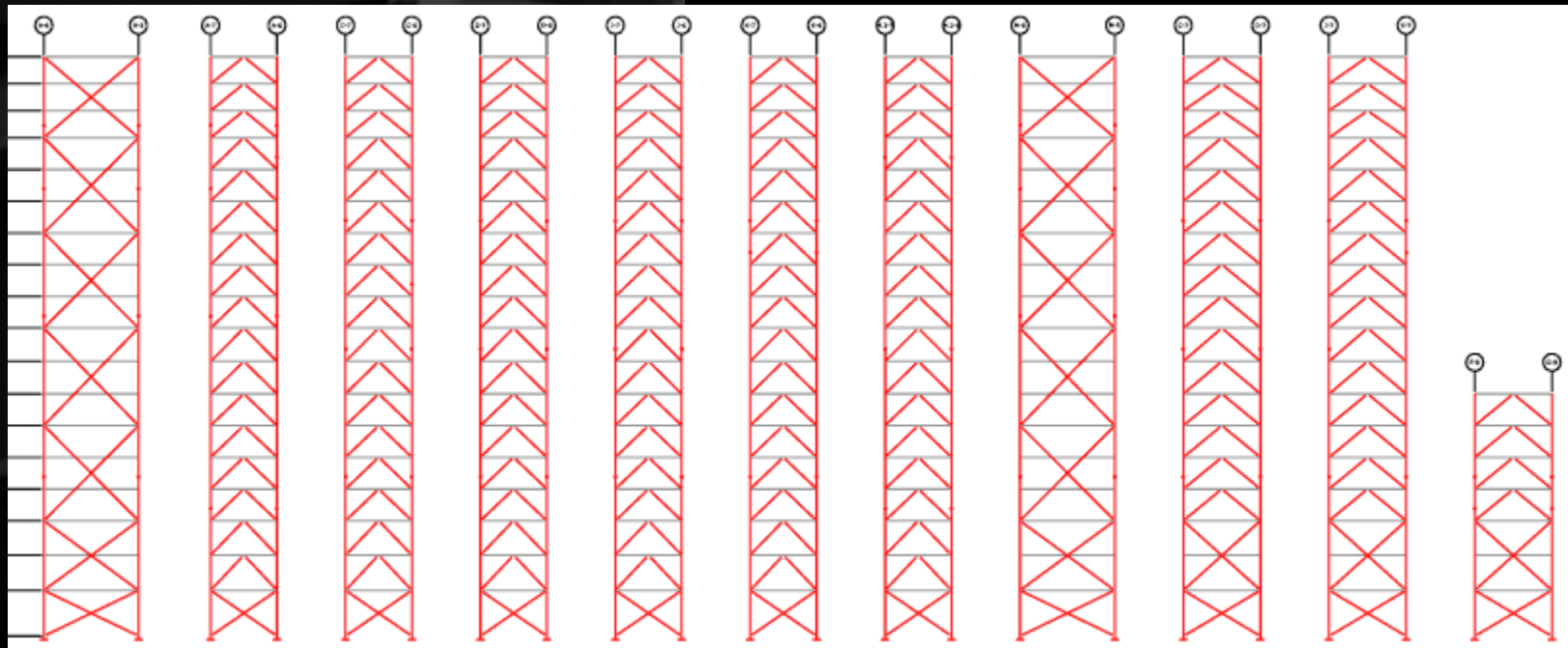
Please See Appendix B of the Final Report for Complete Beam/Girder Sizes



# STRUCTURAL PROPOSAL

## LATERAL SYSTEM

- TYPICAL COLUMN SIZES RANGE FROM W14X311 AT THE BASE TO W14X90 ON UPPER LEVELS
- BRACE MEMBER AVERAGE IN SIZE TO W12X45 FOR MOST OF THE FRAMES\*

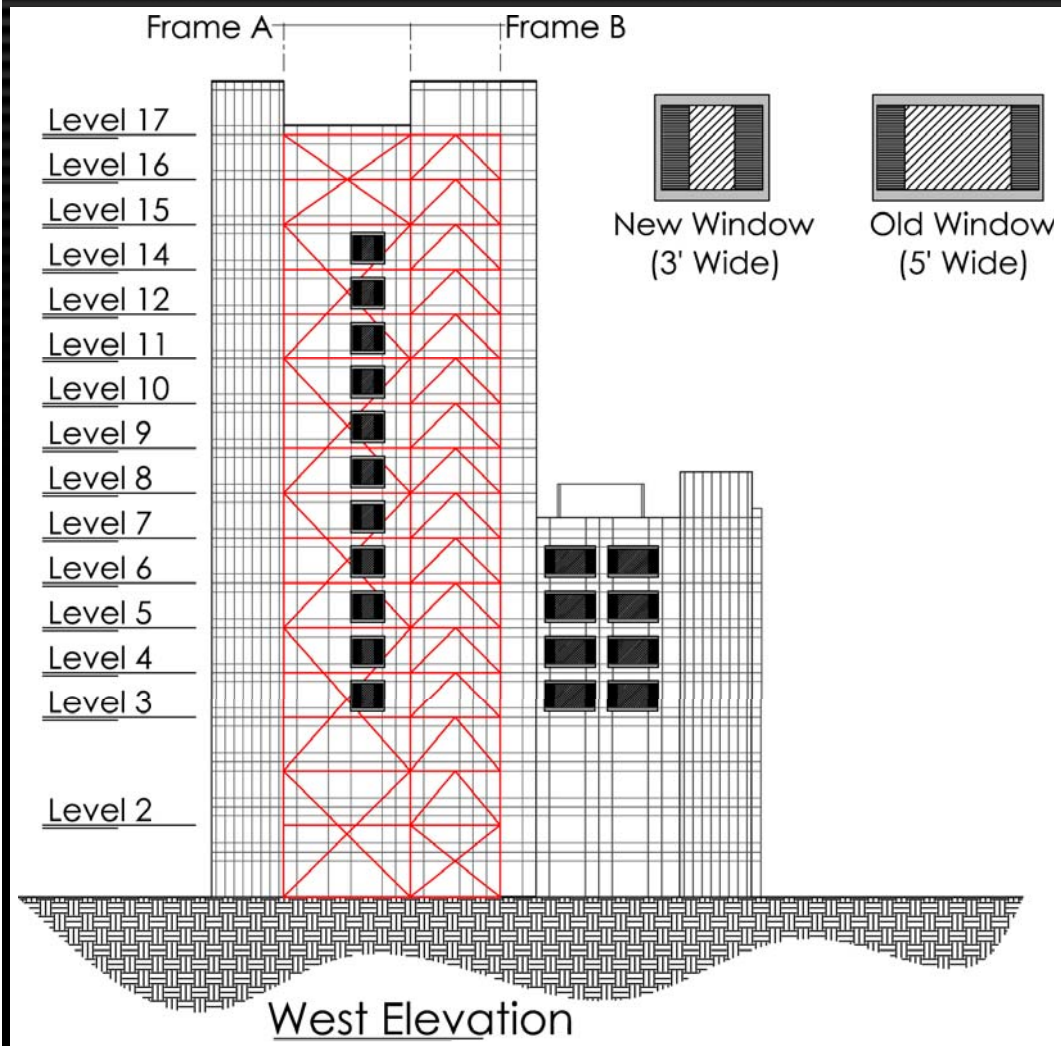


\*Please see Appendix B for per member sizes



# STRUCTURAL PROPOSAL

## CONCERNS OF SYSTEM CHANGES



- TYPICAL WINDOW SIZES LOCATED IN THE CORRIDOR





# STRUCTURAL PROPOSAL

## PROPOSAL SUMMARY

- DEFLECTIONS INCLUDING THE ORIGINAL SHEAR-WALL SYSTEM WERE WELL OUTSIDE THE  $L/480$  PER STORY DRIFT LIMIT
- THE BRACED FRAMES REDUCE THE OVERALL DRIFT TO 5.1" RESULTING IN A PER STORY DRIFT OF  $L/470$
- THE ORIGINAL SYSTEM HAD A DEFLECTION EQUAL TO 4.4" ( $L/510$ )



# CONSTRUCTION IMPACTS

- WHAT IS THE ECONOMICAL IMPACT?

## Systems Comparison

System	Total Cost
Current	\$8,486,680.32
Proposed	\$7,136,813.04

## Result of proposed switch

Savings	\$1,349,867.28
% Difference	15.91%

Per Square Foot	Total Cost
Current	\$19.4659 /sq.ft.
Proposed	\$16.3697 /sq.ft.

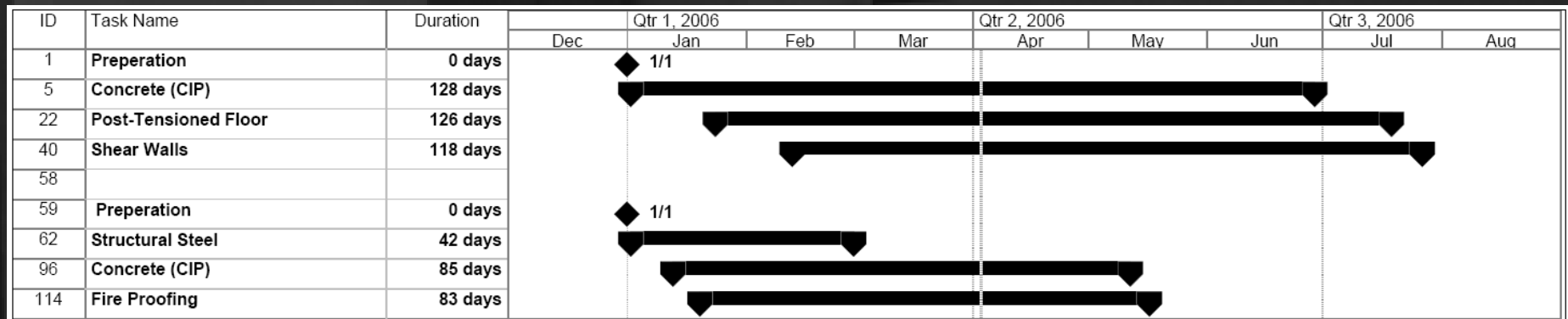
Total square footage
435977.7



# CONSTRUCTION IMPACTS

- WHAT IS THE SCHEDULING IMPACT?

» CONSIDERING THE ON-SITE CONSTRUCTION TIMES TO BE THE SAME, EACH PROJECT'S TIMELINE CAN BE SEEN BELOW



Project Schedule Comparison		Days
Steel Duration		97
Concrete Duration		148
	Difference	51 days
		10 weeks



# FINAL CONCLUSIONS & RECOMMENDATIONS

- COMPARABLE DRIFT OF THE PROPOSED STRUCTURE VS. THE CURRENT DESIGN
  - MORE LAYOUT FLEXIBILITY
  - COST SAVINGS OF ALMOST 16%
  - SCHEDULE TIME SAVING OF 10 WEEKS

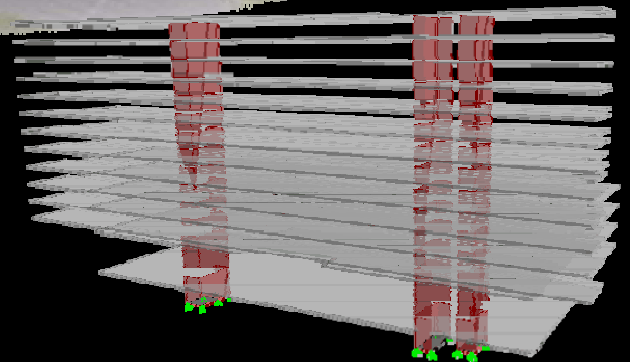
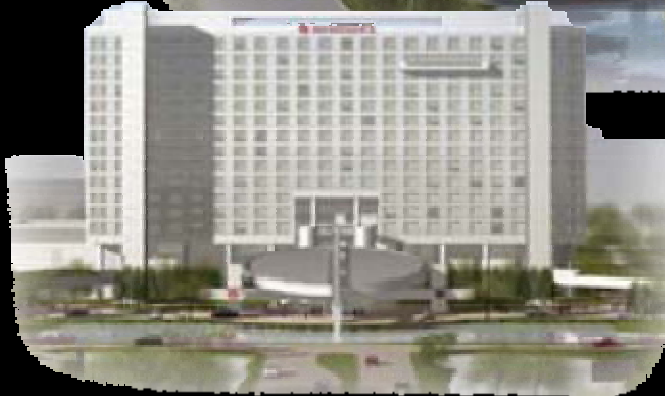
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PERSONAL RECOMMENDATION:  
PROPOSED STEEL STRUCTURE WITH BRACED FRAMES



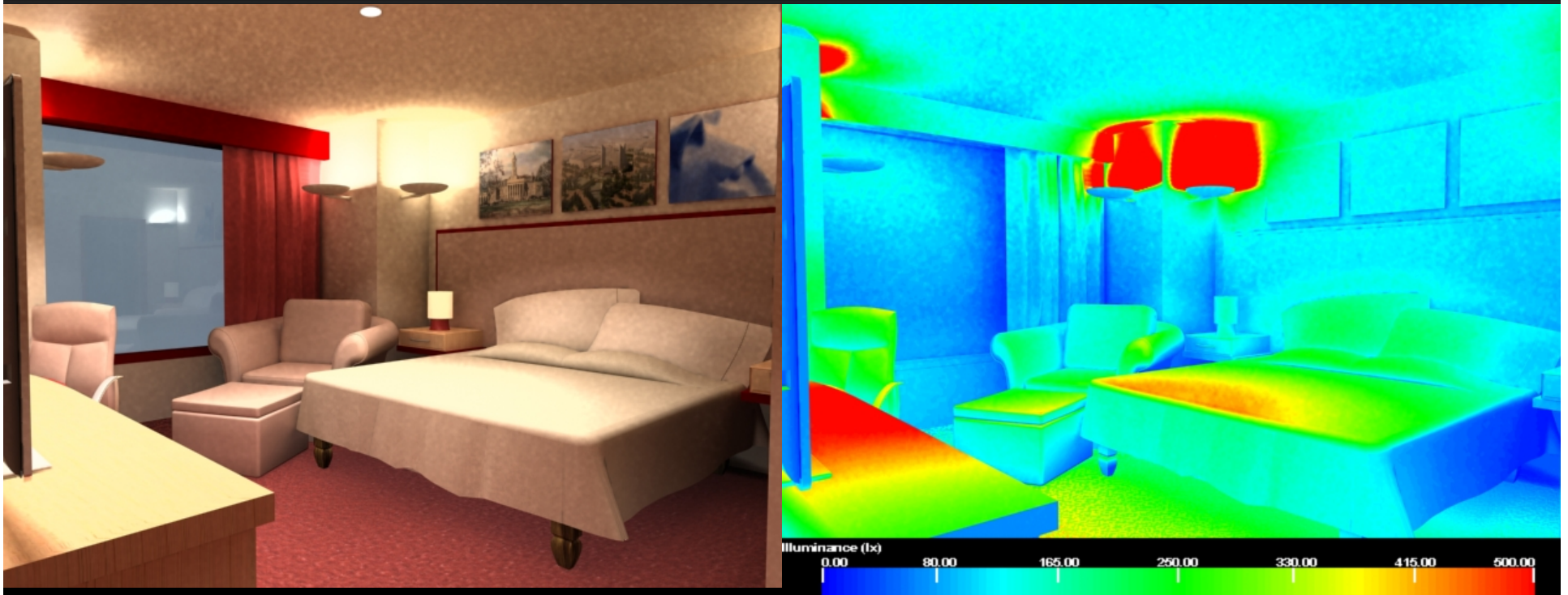


# QUESTIONS / ANSWERS



# LIGHTING BREADTH

- WHAT DOES THIS STRUCTURE FRAME?

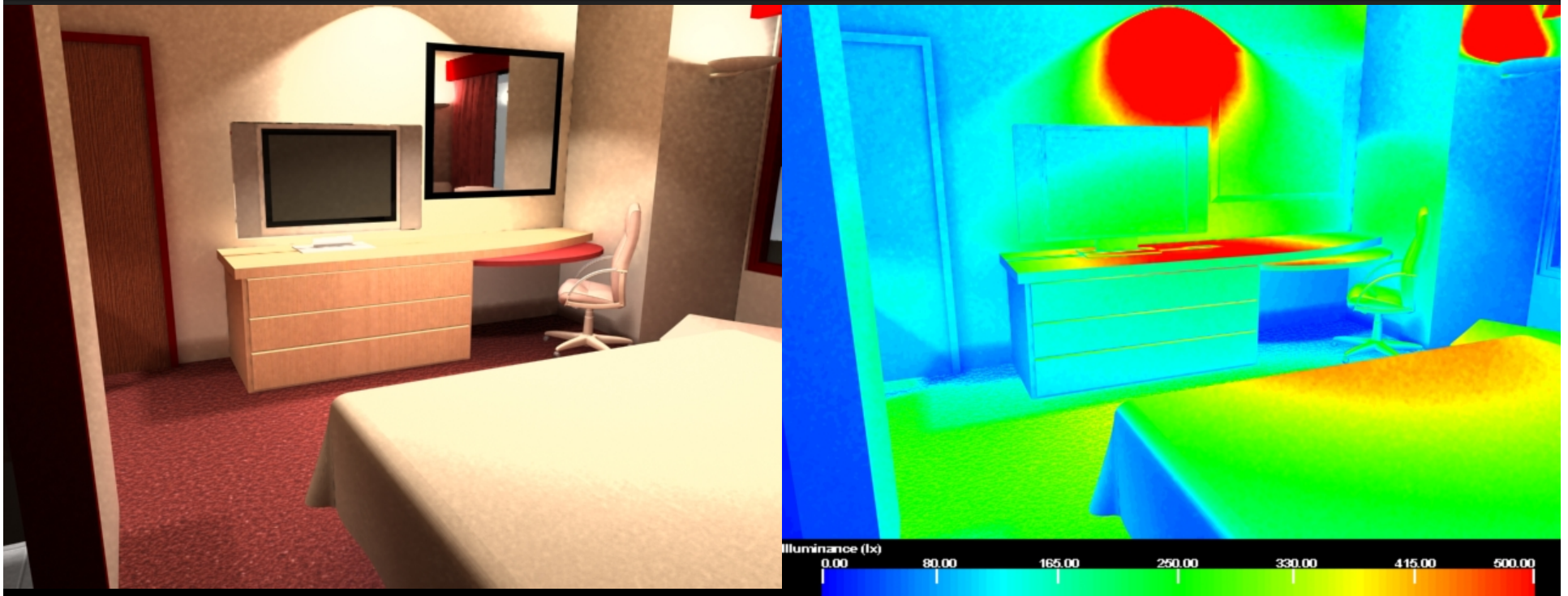


OVER-TIME

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# LIGHTING BREADTH

- WHAT DOES THIS STRUCTURE FRAME?



OVER-TIME

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# LIGHTING BREADTH

## Illuminance Levels to Reach

Area	fc	lux
Floor	10-20	100-200
Desk	50	500
Shower	20	200
Face level in bathroom	50	500
Architectural Elements	30-50	300-500

Type	#	Wattage/fixture	Ballast	Location
Erco	3	33W		Mirror (bath)
Erco	1	68W		Downlights
Erco	2	34W		Wall wash
Erco	4	34W		Single Down

## Total Room Wattage

371W

## As-Rendered Illuminance Levels

Area	Approx.		Outcome
	fc	lux	
Floor	20	200	Sufficient
Desk	50	500	Sufficient
Architectural Elements	40-50	400-500	Sufficient





# CONSTRUCTION IMPACTS

Concrete System			
ID	Objective	Duration	Predecessor
1	Preparation	0 days	
2	Procure Steel	0 days	
3	Procure Concrete	0 days	
4	Misc. Preparation (site work)	0 days	
5	Concrete (CIP)	128 days	
6	Columns Floors 1-3	8 days	
7	Beams Floors 1-3	8 days	6
8	Columns Floors 4-5	8 days	7
9	Beams Floors 4-5	8 days	8
10	Columns Floors 6-7	8 days	9
11	Beams Floors 6-7	8 days	10
12	Columns Floors 8-9	8 days	11
13	Beams Floors 8-9	8 days	12
14	Columns Floors 10-11	8 days	13
15	Beams Floors 10-11	8 days	14
16	Columns Floors 12-14	8 days	15
17	Beams Floors 12-14	8 days	16
18	Columns Floors 15-16	8 days	17
19	Beams Floors 15-16	8 days	18
20	Columns Floors M1-M2	8 days	19
21	Beams Floors M1-M2	8 days	20
22	Post-Tensioned Floor	126 days	
23	Floor 1	14 days	7
24	Floor 2	14 days	7
25	Floor 3	14 days	7
26	Floor 4	14 days	9
27	Floor 5	14 days	9
28	Floor 6	14 days	11
29	Floor 7	14 days	11
30	Floor 8	14 days	13
31	Floor 9	14 days	13
32	Floor 10	14 days	15
33	Floor 11	14 days	15
34	Floor 12	14 days	17
35	Floor 14	14 days	17
36	Floor 15	14 days	19
37	Floor 16	14 days	19
38	Mech 1	14 days	21
39	Mech 2	14 days	21
40	Shear Walls	118 days	
41	Floor 1	3 days	23
42	Floor 2	3 days	24,41
43	Floor 3	3 days	25,42
44	Floor 4	3 days	26,43
45	Floor 5	3 days	27,44
46	Floor 6	3 days	28,45
47	Floor 7	3 days	29,46
48	Floor 8	3 days	30,47
49	Floor 9	3 days	31,48
50	Floor 10	3 days	32,49
51	Floor 11	3 days	33,50
52	Floor 12	3 days	34,51
53	Floor 14	3 days	35,52
54	Floor 15	3 days	36,53
55	Floor 16	3 days	37,54
56	Mech 1	3 days	38,55
57	Mech 2	3 days	39,56
<b>Total Duration</b>		<b>148 days</b>	

Steel System			
ID	Objective	Duration	Predecessor
1	Preparation	0 days	
2	Concrete/Steel Procurement	0 days	
3	Site Prep / Site Work	0 days	
4	Structural Steel	3 days	
5	Columns Floors 1-3	3 days	
6	Beams Floors 1-3	3 days	5
7	Columns Floors 4-5	3 days	6
8	Beams Floors 4-5	3 days	7
9	Columns Floors 6-7	2 days	8
10	Beams Floors 6-7	2 days	9
11	Columns Floors 8-9	2 days	10
12	Beams Floors 8-9	2 days	11
13	Columns Floors 10-11	2 days	12
14	Beams Floors 10-11	2 days	13
15	Columns Floors 12-14	2 days	14
16	Beams Floors 12-14	2 days	15
17	Columns Floors 15-16	2 days	16
18	Beams Floors 15-16	2 days	17
19	Columns Floors M1-M2	3 days	18
20	Beams Floors M1-M2	3 days	19
21	Metal Deck Floor 1	2 days	6
22	Metal Deck Floor 2	2 days	6,21
23	Metal Deck Floor 3	2 days	6,22
24	Metal Deck Floor 4	2 days	8,23
25	Metal Deck Floor 5	2 days	8,24
26	Metal Deck Floor 6	2 days	10,25
27	Metal Deck Floor 7	2 days	10,26
28	Metal Deck Floor 8	2 days	12,27
29	Metal Deck Floor 9	2 days	12,28
30	Metal Deck Floor 10	2 days	14,29
31	Metal Deck Floor 11	2 days	14,30
32	Metal Deck Floor 12	2 days	16,31
33	Metal Deck Floor 14	2 days	16,32
34	Metal Deck Floor 15	2 days	18,33
35	Metal Deck Floor 16	2 days	18,34
36	Metal Deck M1	2 days	20,35
37	Metal Deck M2	2 days	20,36
38	Concrete (CIP)	85 days	
39	Floor 1	5 days	7,21
40	Floor 2	5 days	7,22,39
41	Floor 3	5 days	7,23,40
42	Floor 4	5 days	9,24,41
43	Floor 5	5 days	9,25,42
44	Floor 6	5 days	11,26,43
45	Floor 7	5 days	11,27,44
46	Floor 8	5 days	13,28,45
47	Floor 9	5 days	13,29,46
48	Floor 10	5 days	15,30,47
49	Floor 11	5 days	15,31,48
50	Floor 12	5 days	17,32,49
51	Floor 14	5 days	17,33,50
52	Floor 15	5 days	19,34,51
53	Floor 16	5 days	19,35,52
54	Mech 1	5 days	20,36,53
55	Mech 2	5 days	20,37,54

Fire Proofing		
ID	Objective	Duration
56	Fire Proofing	83 days
57	Floor 1	3 days
59	Floor 3	3 days
60	Floor 4	3 days
61	Floor 5	3 days
62	Floor 6	3 days
63	Floor 7	3 days
64	Floor 8	3 days
65	Floor 9	3 days
66	Floor 10	3 days
67	Floor 11	3 days
68	Floor 12	3 days
69	Floor 14	3 days
70	Floor 15	3 days
71	Floor 16	3 days
72	Mech 1	3 days
73	Mech 2	3 days
<b>Total Duration</b>		<b>97 Days</b>





# CONSTRUCTION IMPACTS

Concrete System Cost Calculations								
<b>Beams - *includes reinforcing/concrete/placement</b>								
Type	Amount			RS Means	Daily Output	Work Days	Unit Cost	Total Cost
	Volume (CY)			Section			\$	\$
6ksi	1618.49			03310-240	15.6	103.62	\$ 935.50	\$ 1,514,092.86
5ksi	1409.62			03310-240	15.6	90.24	\$ 872.50	\$ 1,229,891.15
<b>Columns - *includes reinforcing/concrete/placement</b>								
Type	Amount			RS Means	Daily Output	Work Days	Unit Cost	Total Cost
	Volume (CY)			Section			\$	\$
8ksi	2266.35			03310-240	27.1	83.75	\$ 1,199.00	\$ 2,717,348.51
6ksi	456.42			03310-240	12.6	36.31	\$ 1,086.00	\$ 495,671.85
<b>Post Tensioned Floor System - *Concrete Cost/Time Includes Material and Placement</b>								
Type	Amount			RS Means	Daily Output	Work Days	Unit Cost	Total Cost
	Floor	# Similar	Area	Section			\$	\$
10" Slab*	9-17	9	18338.4 sq.ft.	03310-220 and 240	140.0	14.55	\$ 100.45	\$ 511,692.30
10" Slab*	7-8	2	26315.2 sq.ft.	03310-220 and 240	140.0	4.64	\$ 100.45	\$ 163,170.48
10" Slab*	3-6	4	36457.5 sq.ft.	03310-220 and 240	140.0	12.86	\$ 100.45	\$ 452,118.01
10" Slab*	2	1	36014.2 sq.ft.	03310-220 and 240	140.0	3.18	\$ 100.45	\$ 111,655.14
10" Slab*	1	1	36457.5 sq.ft.	03310-220 and 240	140.0	3.21	\$ 100.45	\$ 113,029.50
	Floor	# Similar	Weight	Section			\$	\$
Tendons	9-17	9	7.34 ton	03230-600	1,650.0	8.89	\$ 2.50	\$ 330,091.20
Tendons	7-8	2	10.53 ton	03230-600	1,650.0	12.76	\$ 2.50	\$ 105,260.80
Tendons	3-6	4	14.58 ton	03230-600	1,650.0	17.68	\$ 2.50	\$ 291,660.00
Tendons	2	1	14.41 ton	03230-600	1,650.0	17.46	\$ 2.50	\$ 72,028.40
Tendons	1	1	14.58 ton	03230-600	1,650.0	17.68	\$ 2.50	\$ 72,915.00
<b>Shear Walls</b>								
Type	Amount			RS Means	Daily Output	Work Days	Unit Cost	Total Cost
	Height	Length <sub>s</sub>	Number	Section			\$	\$
Largest	24'	119.73'	2	03310-220 and 700	1,375.0	4.18	\$ 102.45	\$ 24,532.68
Average	10.3'	119.73'	13	03310-220 and 700	1,375.0	11.66	\$ 102.45	\$ 159,462.40
Smallest	8'	119.73'	3	03310-220 and 700	1,375.0	2.09	\$ 1.99	\$ 714.79
Wall Reinforcement	Ton			Section			\$	\$
#3-7	32.9			03210-600	3.0	10.97	\$ 1,165.00	\$ 38,328.50
#8-18	77.95			03210-600	4.0	19.49	\$ 1,065.00	\$ 83,016.75
							<b>Summary</b>	<b>Total Cost</b>
								<b>\$ 8,486,680.32</b>



# CONSTRUCTION IMPACTS

## Steel System Cost Calculations

Beams								
Type	Amount			RS Means Section	Daily Output	Work Days	Unit Cost \$	Total Cost \$
	#	Length (ft)	Weight (ton)					
Beams	1937	50471.23	657.761	05120-680	13.9	47.32	\$ 2,384.00	\$ 1,568,102.22
Studs		41265		05090-860	1,040.0	39.68	\$ 1.37	\$ 56,533.05
Columns								
Type	Amount			RS Means Section	Daily Output	Work Days	Unit Cost \$	Total Cost \$
	#	Length (ft)	Weight (ton)					
Columns	189	4092.9	424.1085	05120-680	13.9	30.51	\$ 2,384.00	\$ 1,011,074.66
Braced Frames								
Type	Amount			RS Means Section	Daily Output	Work Days	Unit Cost \$	Total Cost \$
	#	Length (ft)	Weight (ton)					
Framing	324	6421.2	282.55375	05120-680	13.9	98.39	\$ 2,384.00	\$ 673,608.14
Composite Slab-on-Metal Deck - *Concrete Cost/Time Includes Material and Placement								
Type	Amount			RS Means Section	Daily Output	Work Days	Unit Cost \$	Total Cost \$
	Floor	# Similar	Area					
4" Slab*	9-17	9	18338.4 sq.ft.	03310-220 and 240	140.0	14.55	\$ 102.45	\$ 521,880.30
4" Slab*	7-8	2	26315.2 sq.ft.	03310-220 and 240	140.0	4.64	\$ 102.45	\$ 166,419.27
4" Slab*	3-6	4	36457.5 sq.ft.	03310-220 and 240	140.0	12.86	\$ 102.45	\$ 461,119.86
4" Slab*	2	1	36014.2 sq.ft.	03310-220 and 240	140.0	3.18	\$ 102.45	\$ 113,878.23
4" Slab*	1	1	36457.5 sq.ft.	03310-220 and 240	140.0	3.21	\$ 102.45	\$ 115,279.97
Decking	9-17	9	18338.4 sq.ft.	05310-300	1,350.0	12.23	\$ 2.88	\$ 475,331.33
Decking	7-8	2	26315.2 sq.ft.	05310-300	1,350.0	3.90	\$ 2.88	\$ 151,575.55
Decking	3-6	4	36457.5 sq.ft.	05310-300	1,359.0	10.73	\$ 2.88	\$ 419,990.40
Decking	2	1	36014.2 sq.ft.	05310-300	1,350.0	2.67	\$ 2.88	\$ 103,720.90
Decking	1	1	36457.5 sq.ft.	05310-300	1,359.0	2.68	\$ 2.88	\$ 104,997.60
Slab Reinforcing								
Type	Height	Amount	Area	RS Means Section	Daily Output	Work Days	Unit Cost \$	Total Cost \$
	Floor	#	C.S.F.					
6x6-W1.4xW1.4	9-17	9	183.384	03220-200	31.0	53.24	\$ 36.70	\$ 60,571.74
6x6-W1.4xW1.4	7-8	2	263.152	03220-200	31.0	16.98	\$ 36.70	\$ 19,315.36
6x6-W1.4xW1.4	3-6	4	364.575	03220-200	31.0	47.04	\$ 36.70	\$ 53,519.61
6x6-W1.4xW1.4	2	1	360.142	03220-200	31.0	11.62	\$ 36.70	\$ 13,217.21
6x6-W1.4xW1.4	1	1	364.575	03220-200	31.0	11.76	\$ 36.70	\$ 13,379.90
Fire Proofing								
Type	Height	Area (ft <sup>2</sup> )		RS Means Section	Daily Output	Work Days	Unit Cost \$	Total Cost \$
	Floor							
Decking	ALL	435,977.70		07812-600	1,250.0	38.75	\$ 1.45	\$ 632,167.67
Beams	ALL	34,704.42		07812-600	1,500.0	2.57	\$ 1.13	\$ 39,215.99
Columns	ALL	36,076.43		07812-600	1,100.0	3.64	\$ 2.09	\$ 75,399.74
Bracing	ALL	137,088.20		07812-600	1,100.0	13.85	\$ 2.09	\$ 286,514.34
							<b>Summary</b>	<b>Total Cost</b>
								<b>\$ 7,136,813.04</b>

