

The Towers at the City College of New York



Robin Scaramastro - Structural Option - Advisor: Dr. Memari

Senior Thesis Final Presentation – Spring 2007

Presentation Overview

Introduction

Existing Structural System

Problem Statement

Proposed Solution

Structural Depth

- Gravity System
- Lateral System
- Foundations

Mechanical Breadth

- LEED Points

Construction Breadth

- Cost Impact
- Schedule Impact

Conclusion



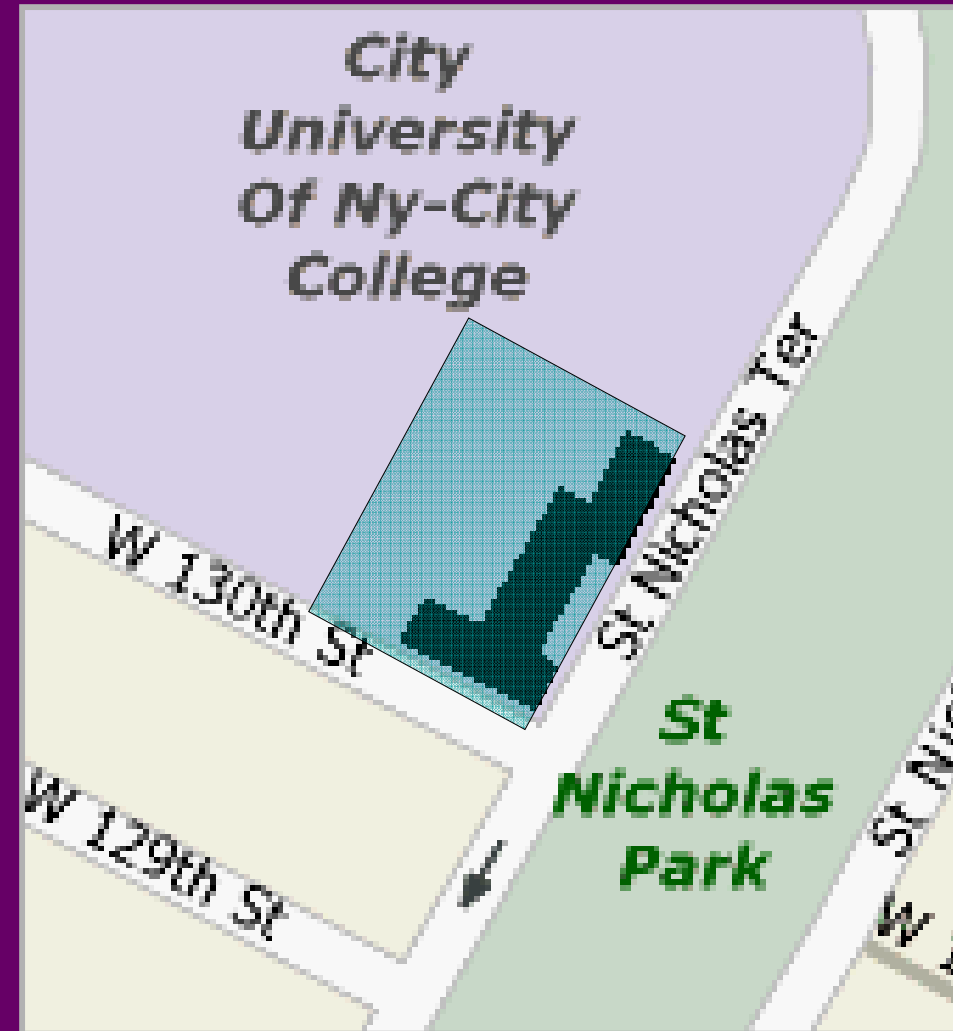
Introduction

Building Information:

- 181,000 SF dormitory for CCNY students and faculty
- 6, 8, and 10 stories
- Located at 130th St. and St. Nicholas Terrace, New York
- Project Cost : \$59 million

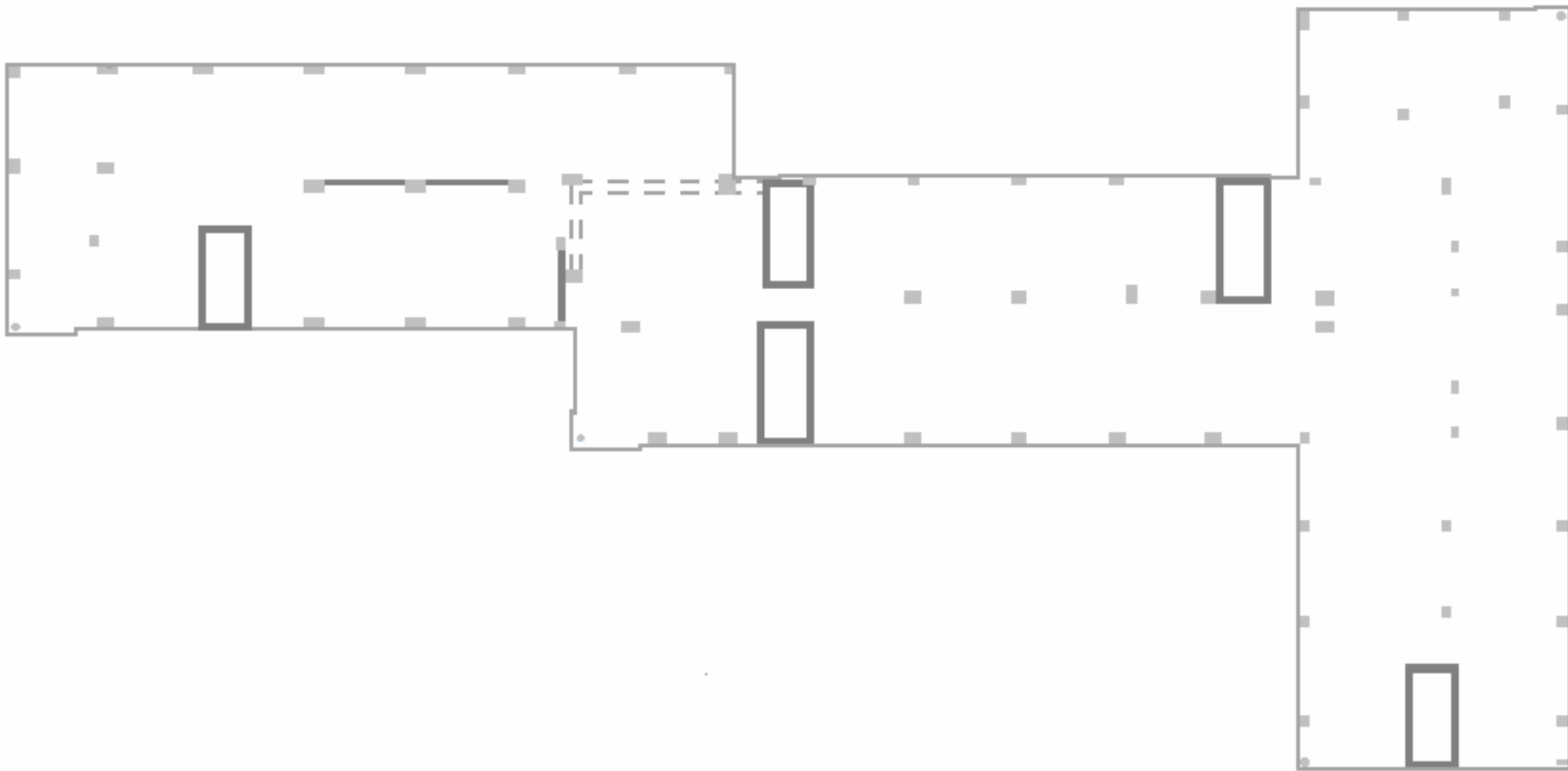
Codes Used in Design:

- The Building Code of the City of New York
 - ASCE7-05
 - UBC 97



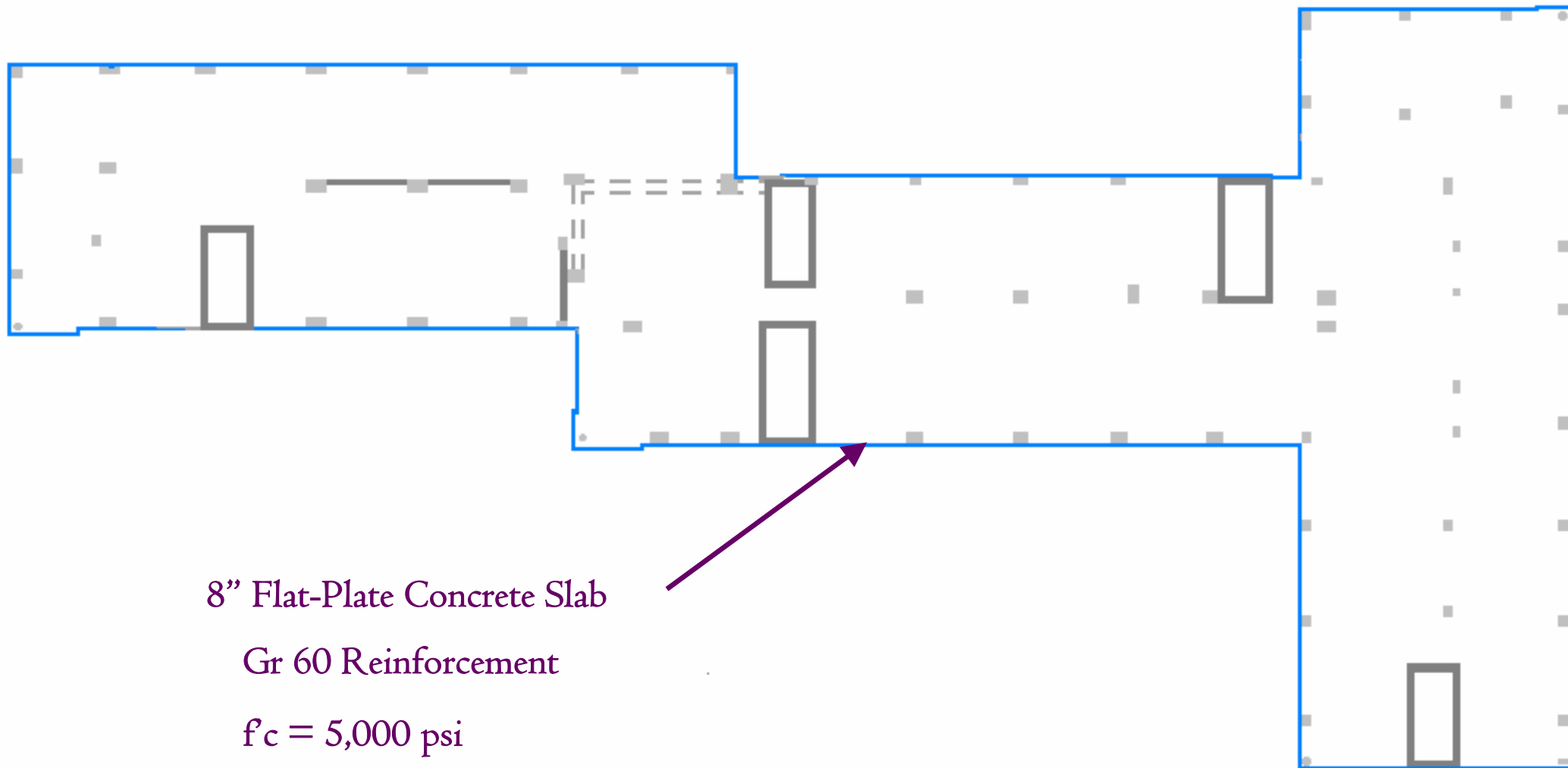
Existing Structural System

Structural Framing – Cast in place concrete



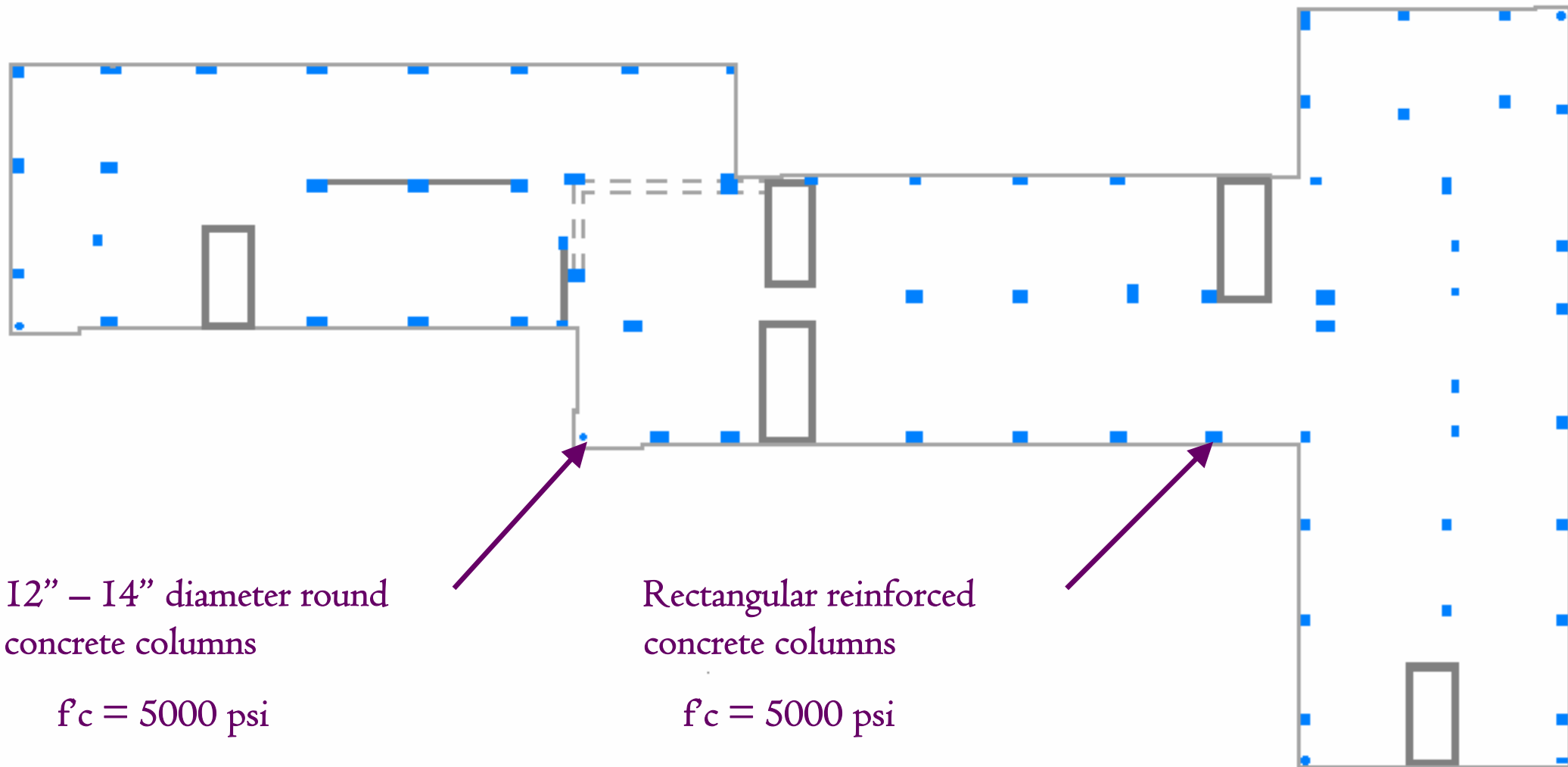
Existing Structural System

Structural Framing



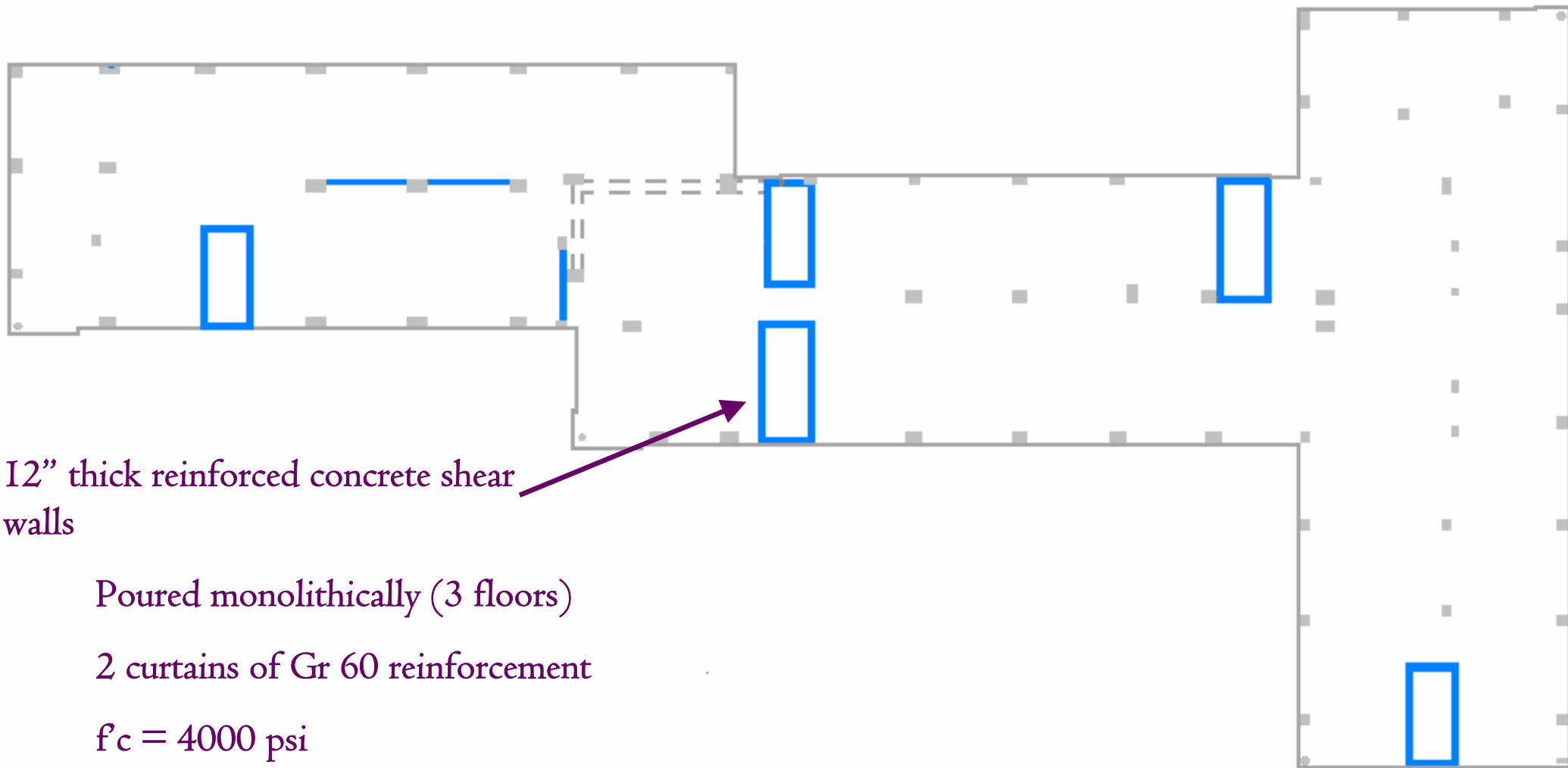
Existing Structural System

Structural Framing



Existing Structural System

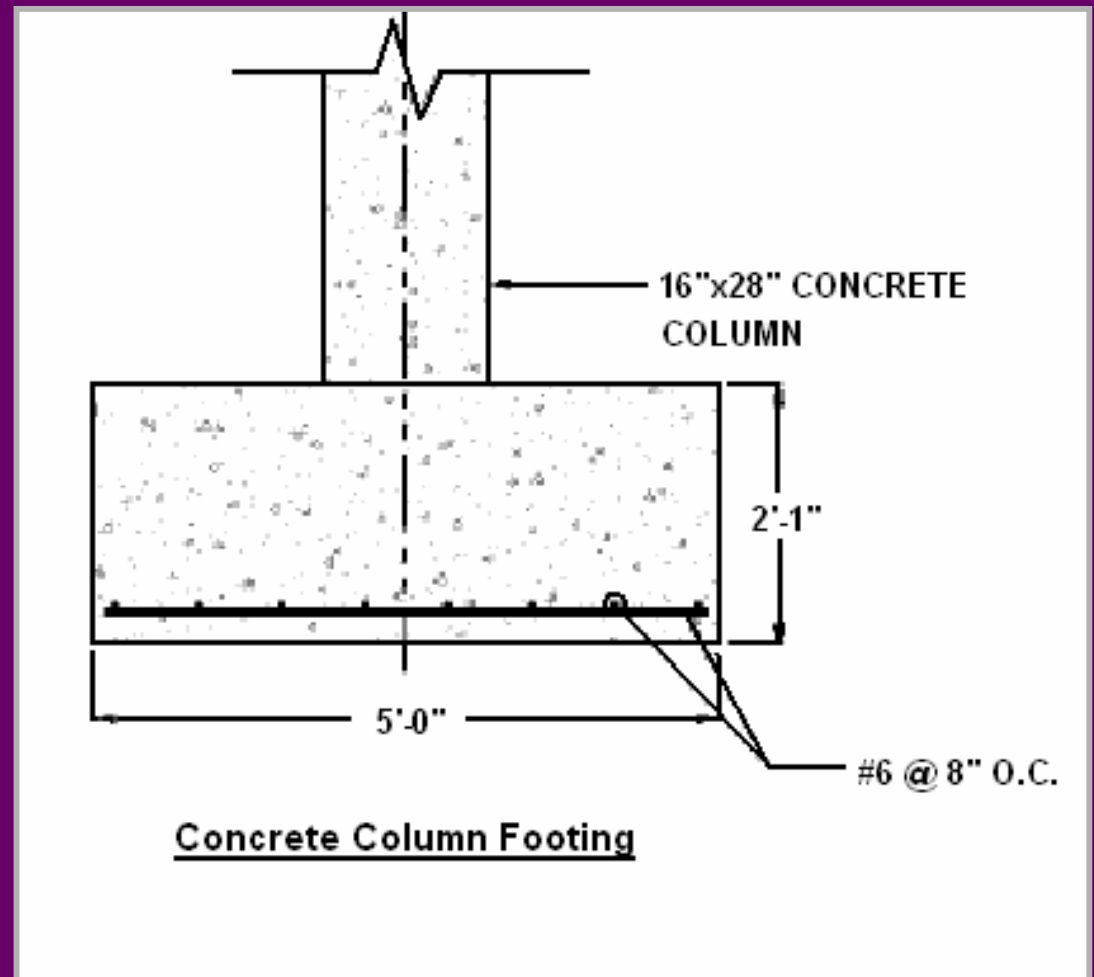
Structural Framing



Existing Structural System

Foundations

- Bearing pressure of 40,000 psf
- Typical spread footings for columns and grade beams
- Mat slabs used for shear walls



Problem Statement

Large concrete columns in floor to ceiling corner windows



(c) ROBERT K CHIN
TENEMENTCITY.COM

Problem Statement

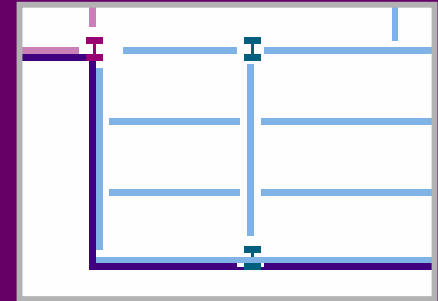
Irregular grid



Si

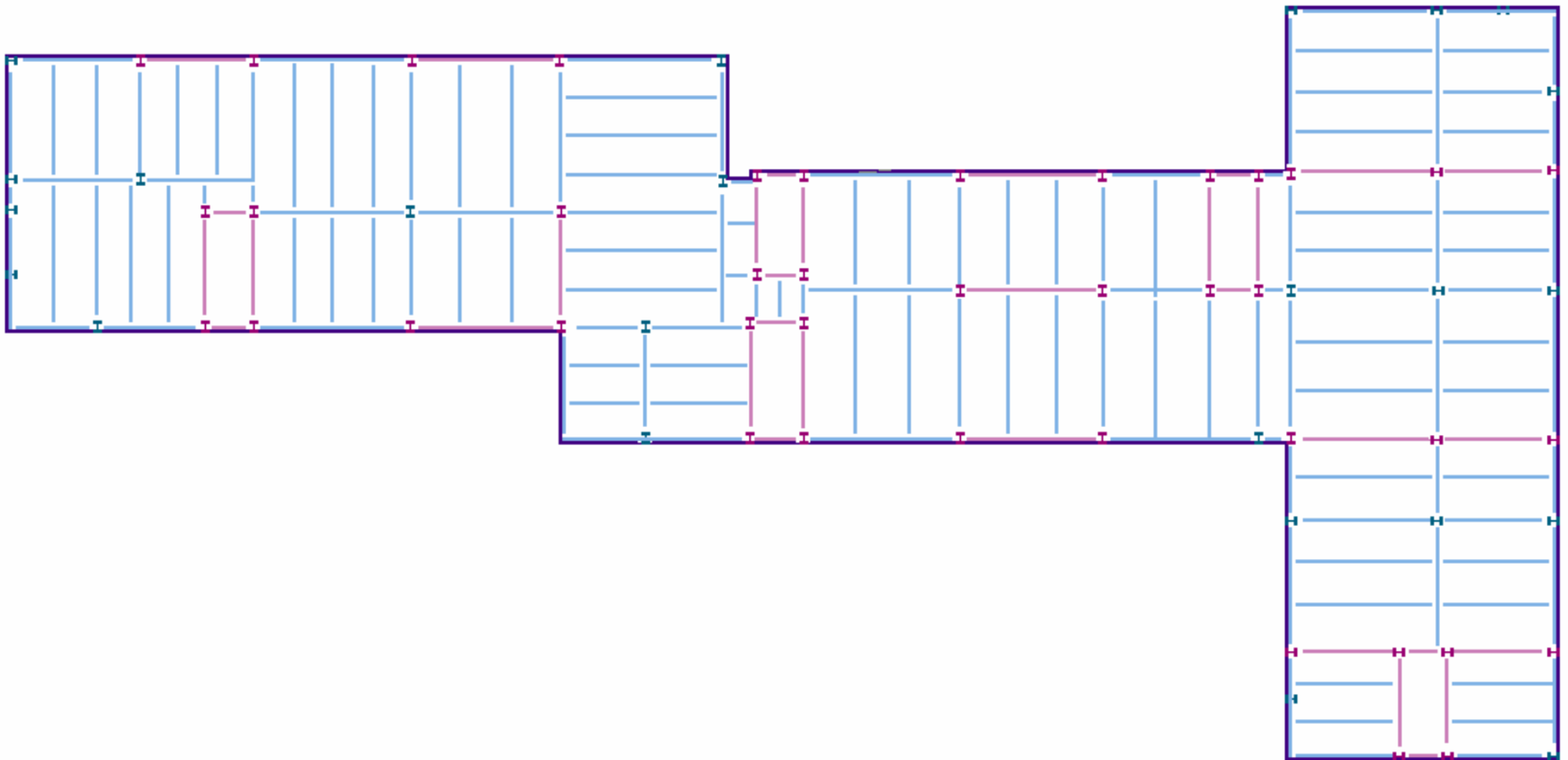
Proposal

- Apply a steel structure
 - cantilever building corners to eliminate columns in windows
 - create a regular grid system
 - reduce the number of columns
 - create less impact on floor plan



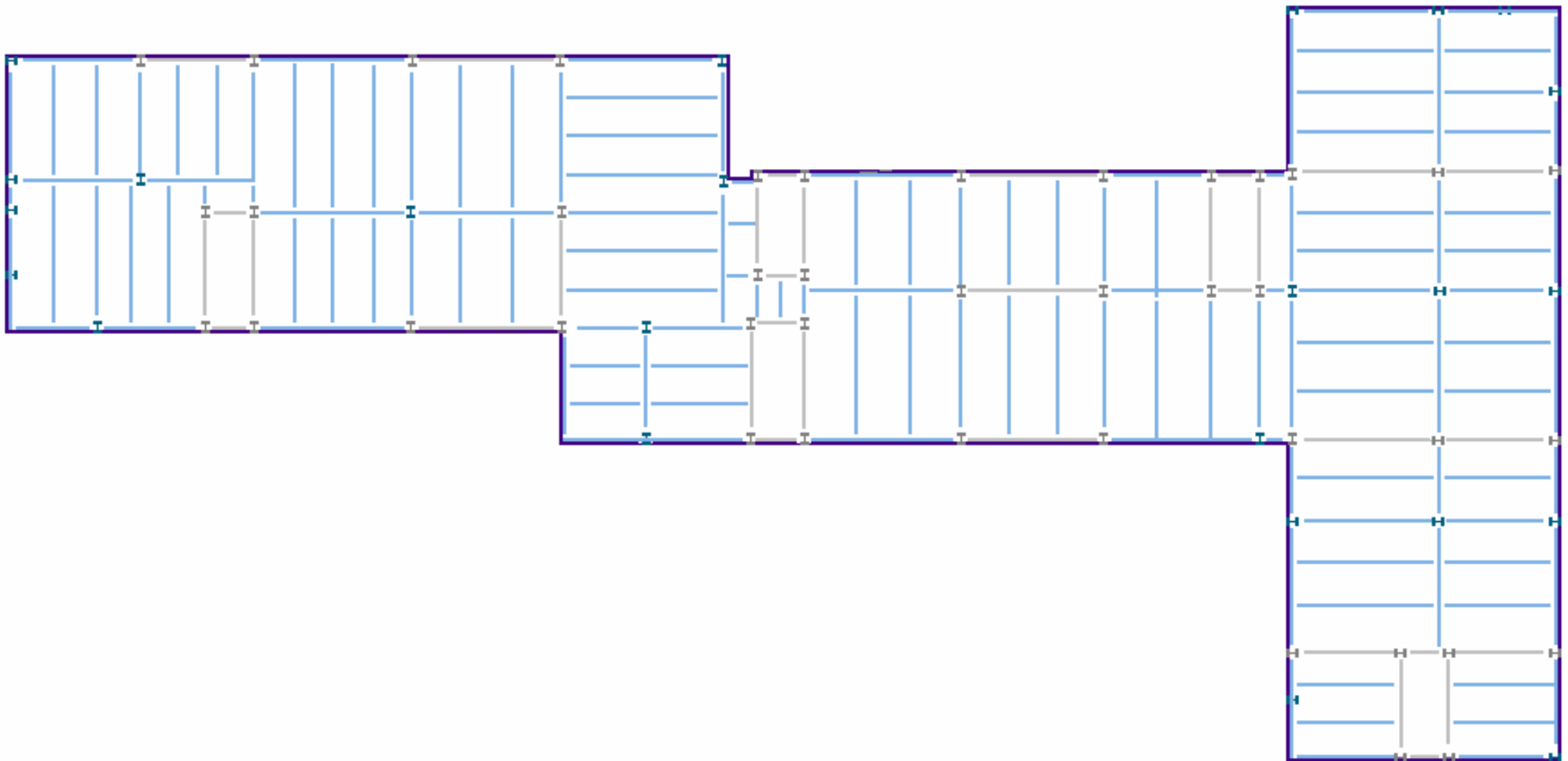
Structural Depth

Building redesigned in steel



Structural Depth

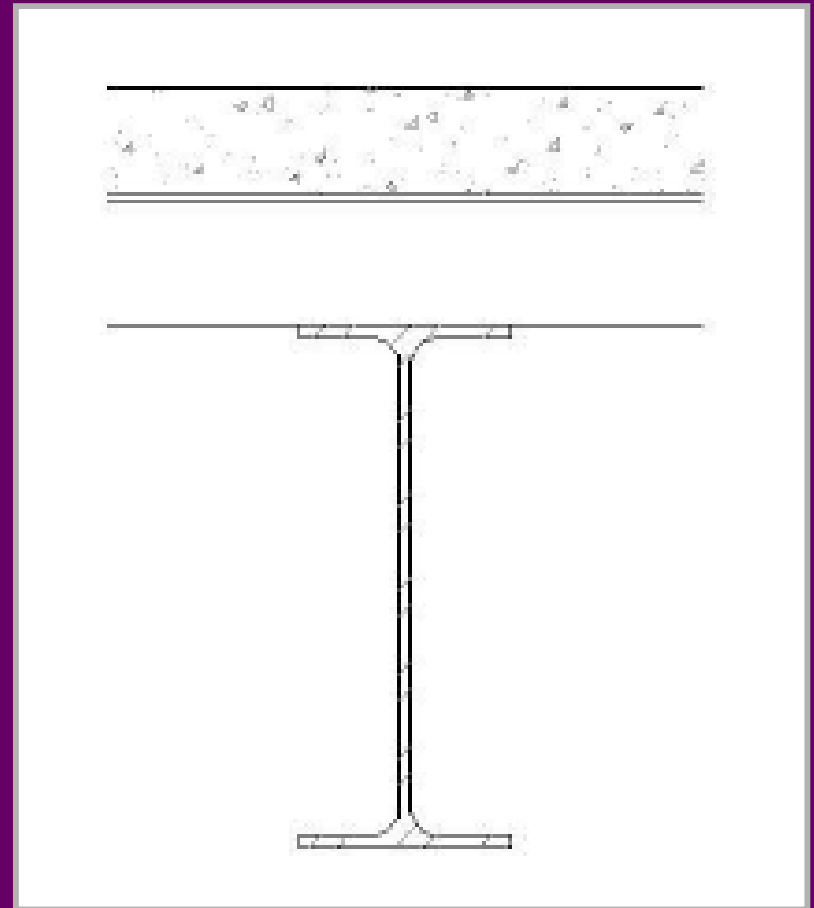
Gravity System



Structural Depth

Gravity System

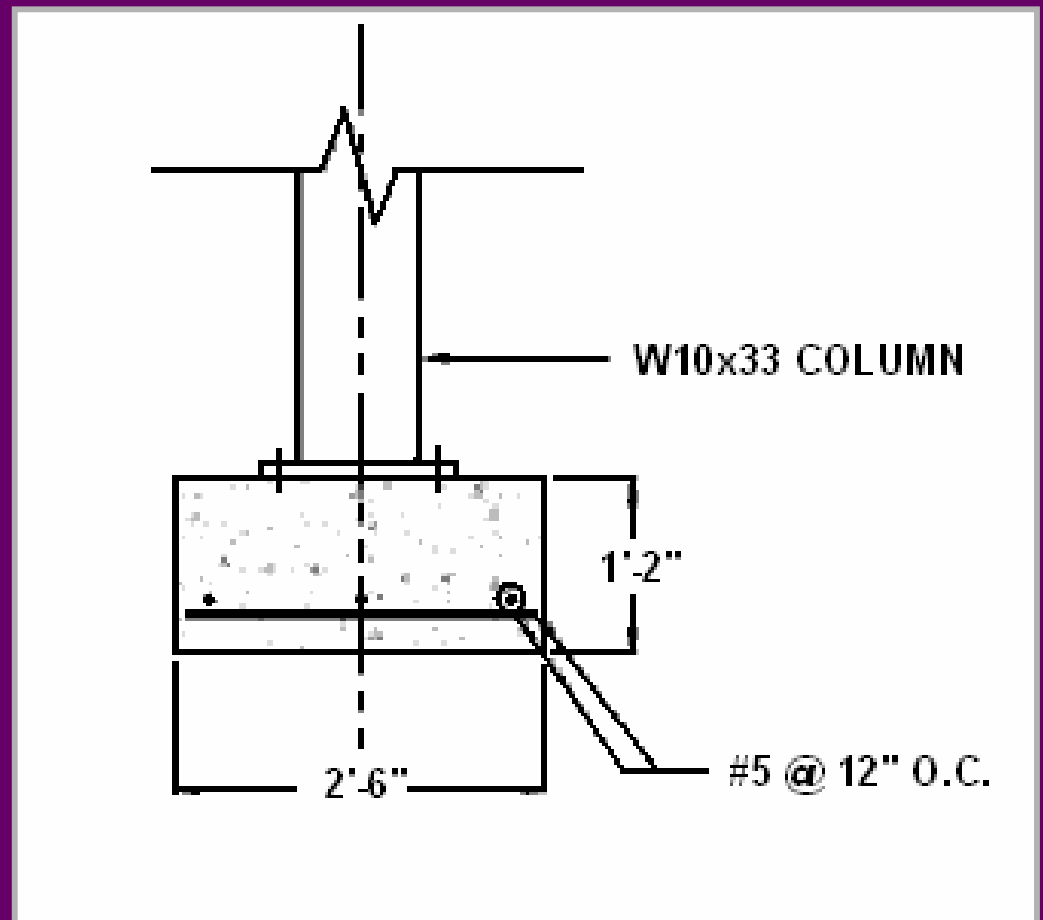
- 2" Composite metal deck with 2 ½" concrete slab
- W10 and W12 composite infill beams with shear studs
- W14 – W21 girders
- W10 gravity columns
 - Fireproofing provided by gypsum board



Structural Depth

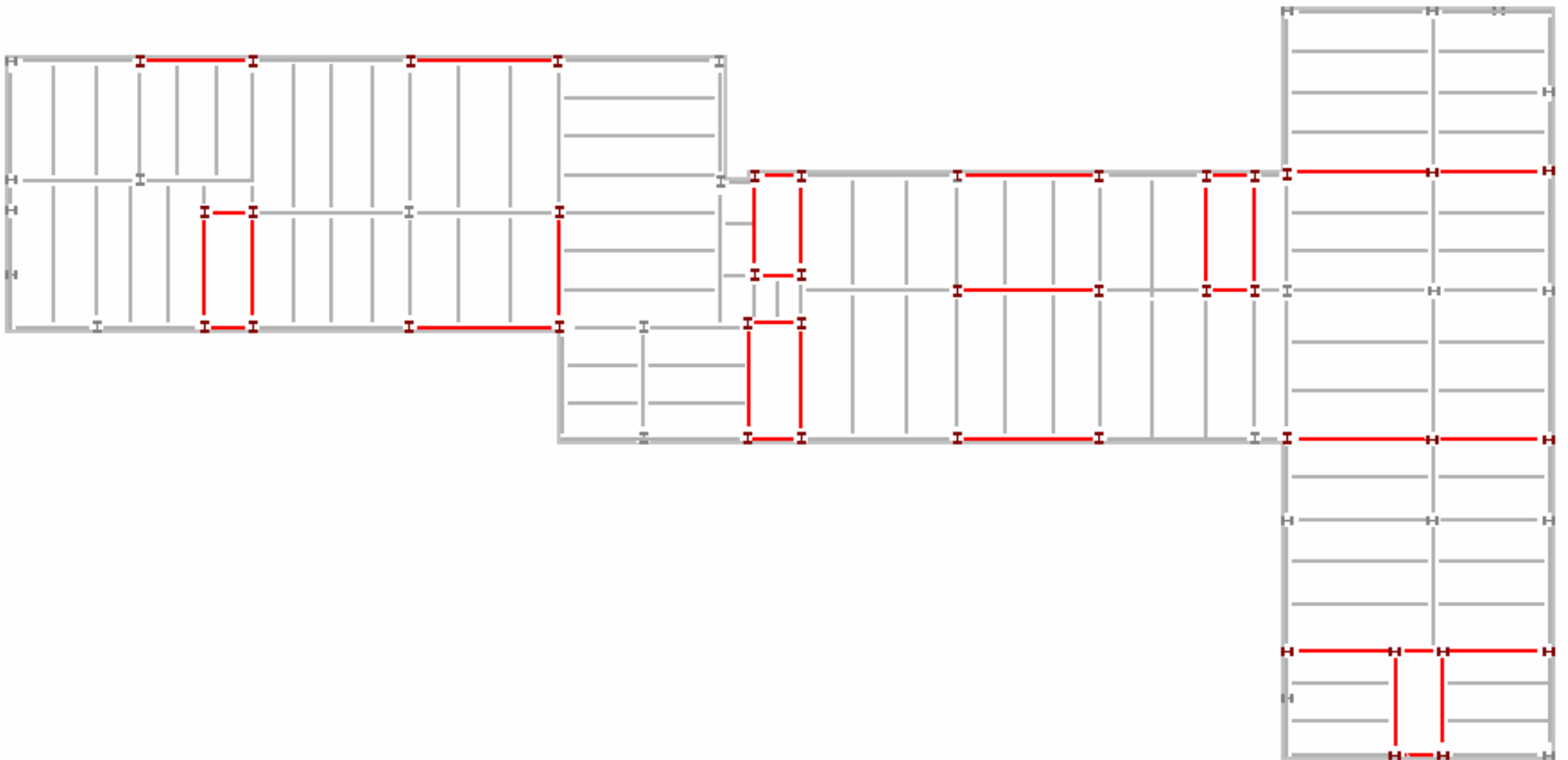
Typical Foundation

- Spread footings like used in existing structure
- less concrete needed for gravity column foundations



Structural Depth

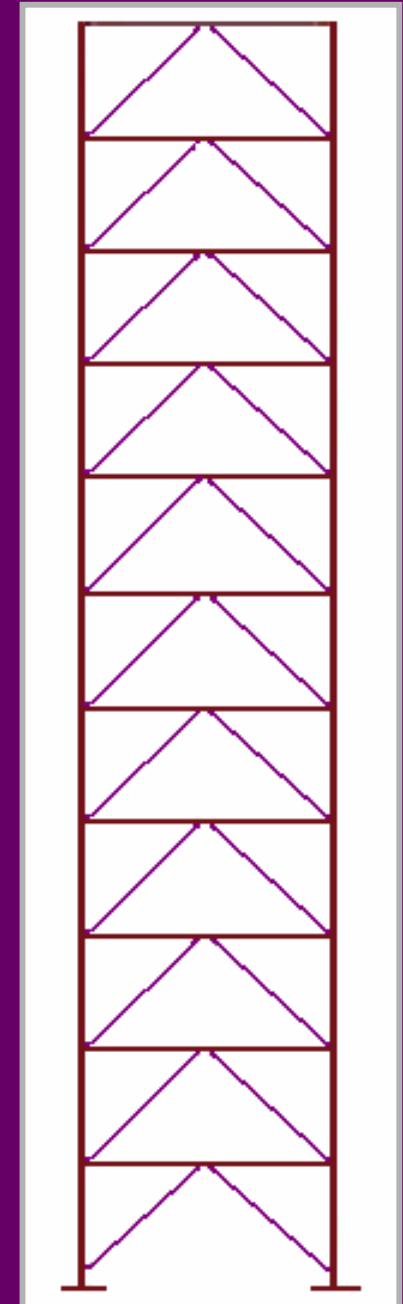
Lateral System



Structural Depth

Lateral System

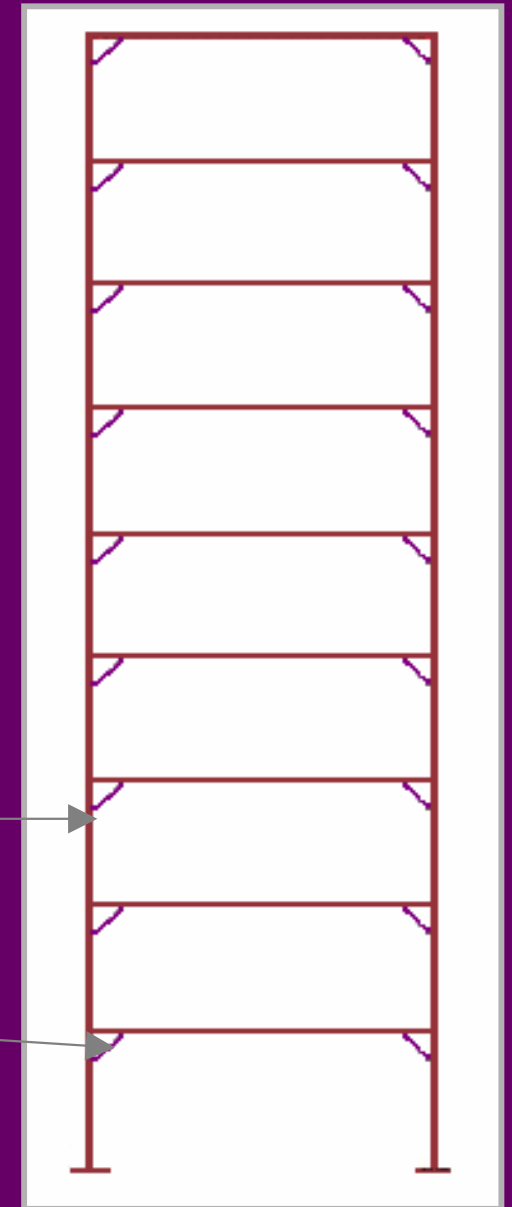
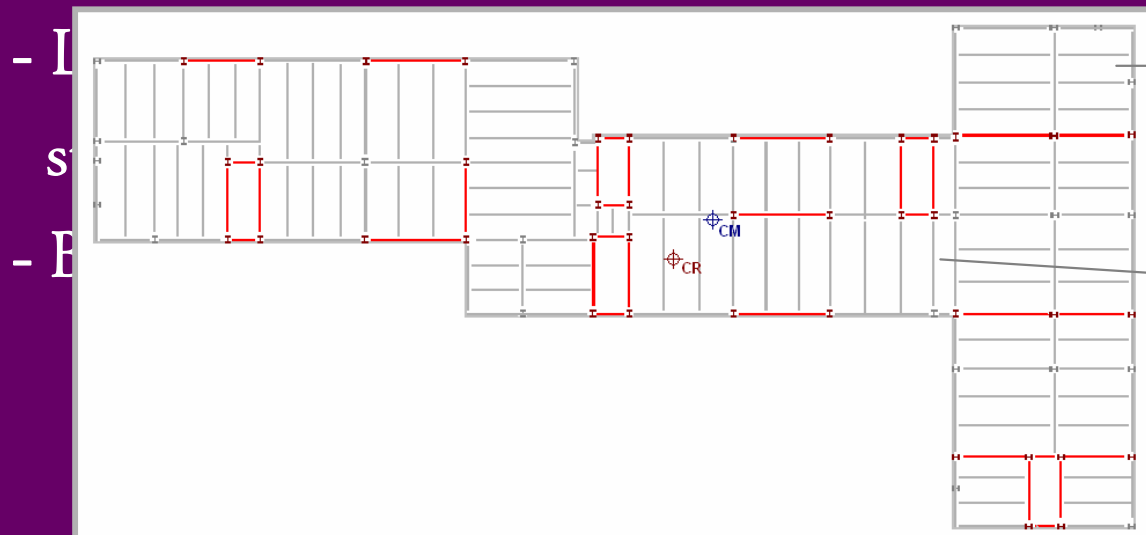
- Braced frames implemented in stair cores



Structural Depth

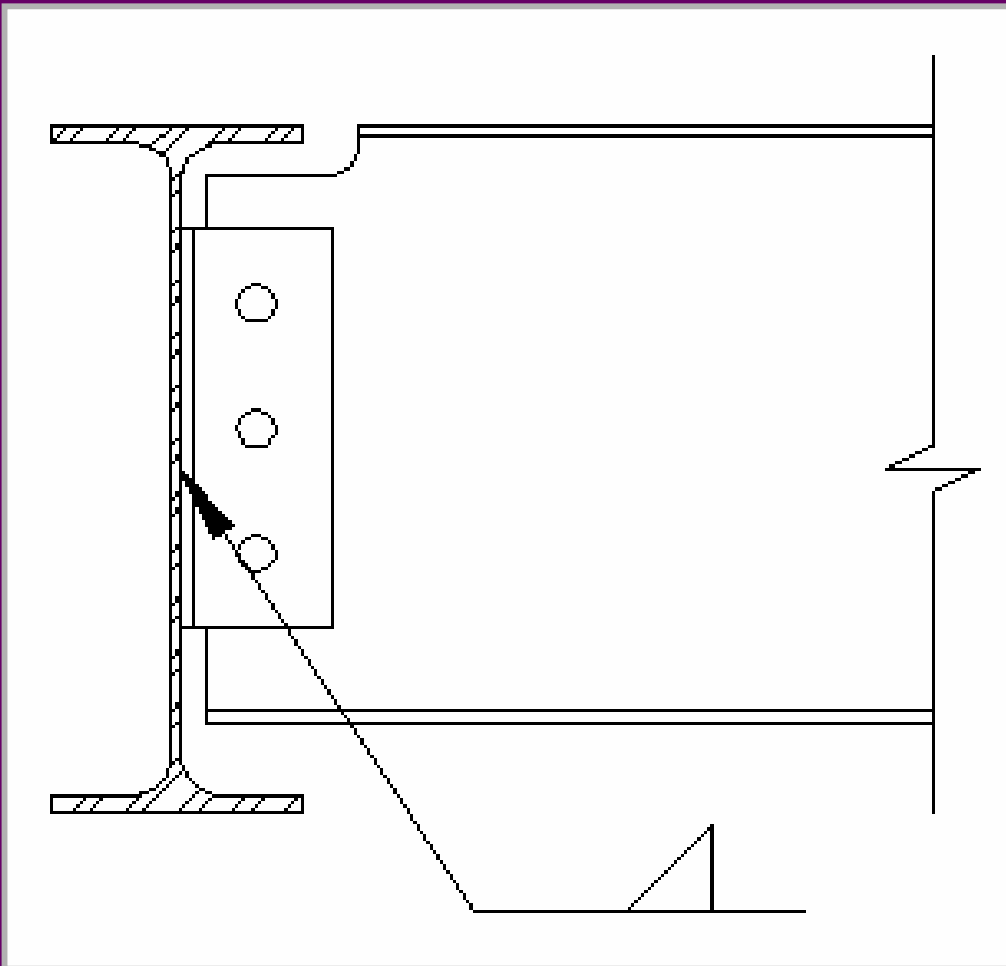
Lateral System

- Braced frames implemented in stair cores
- Moment frames with steel angle kickers used elsewhere
- Placed to reduce eccentricity and torsional moment



Structural Depth

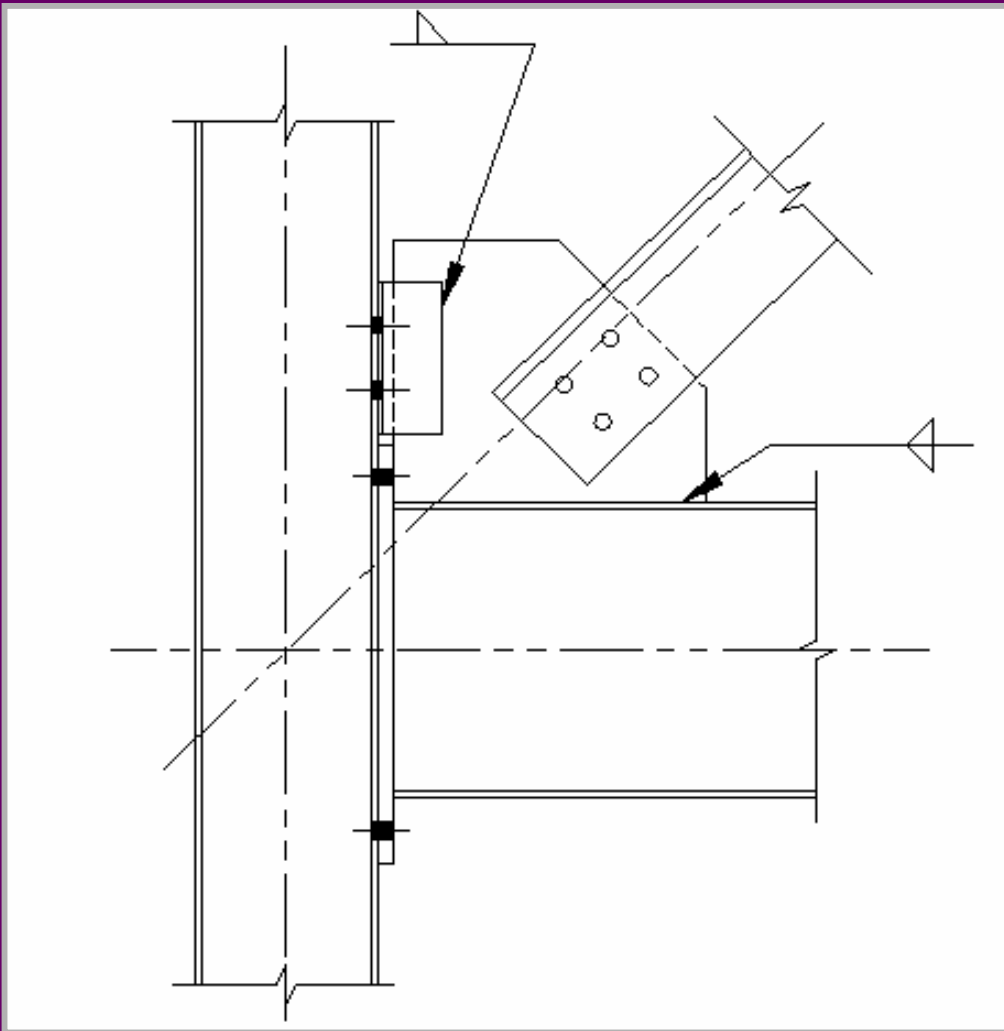
Typical Connections



Shear
Connection
- Single Angle

Structural Depth

Typical Connections



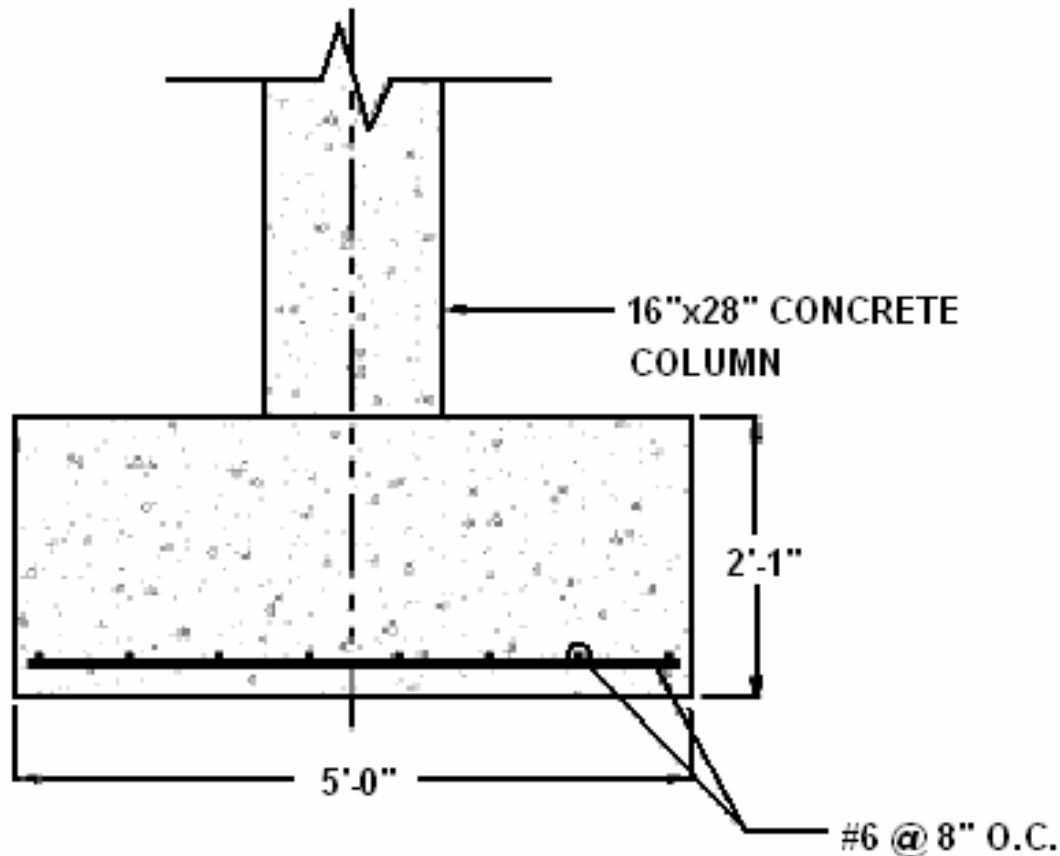
Bracing
Connection

Structural Depth

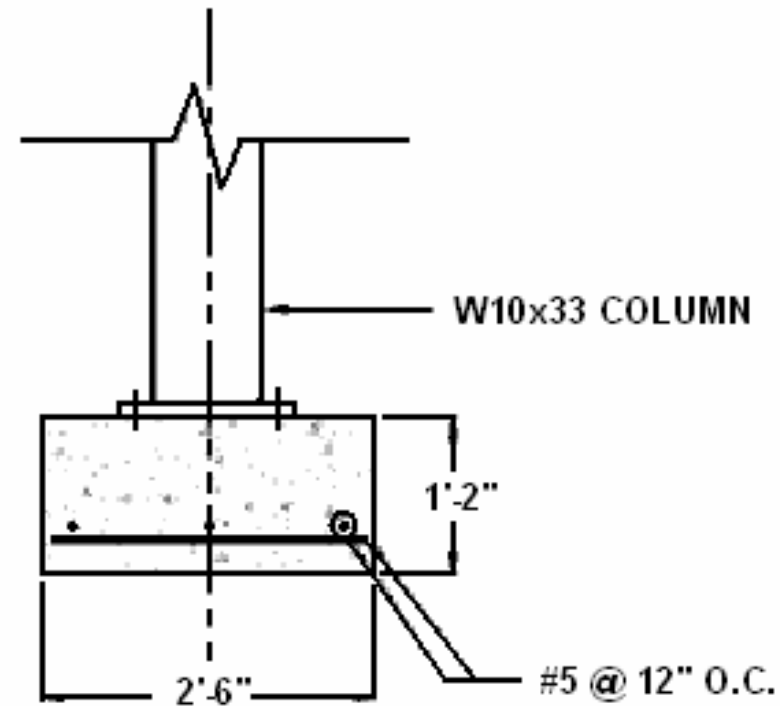
Impact on Foundations

- Reduction of dead load from self weight

II - 169/1 1-16



Concrete Column Footing



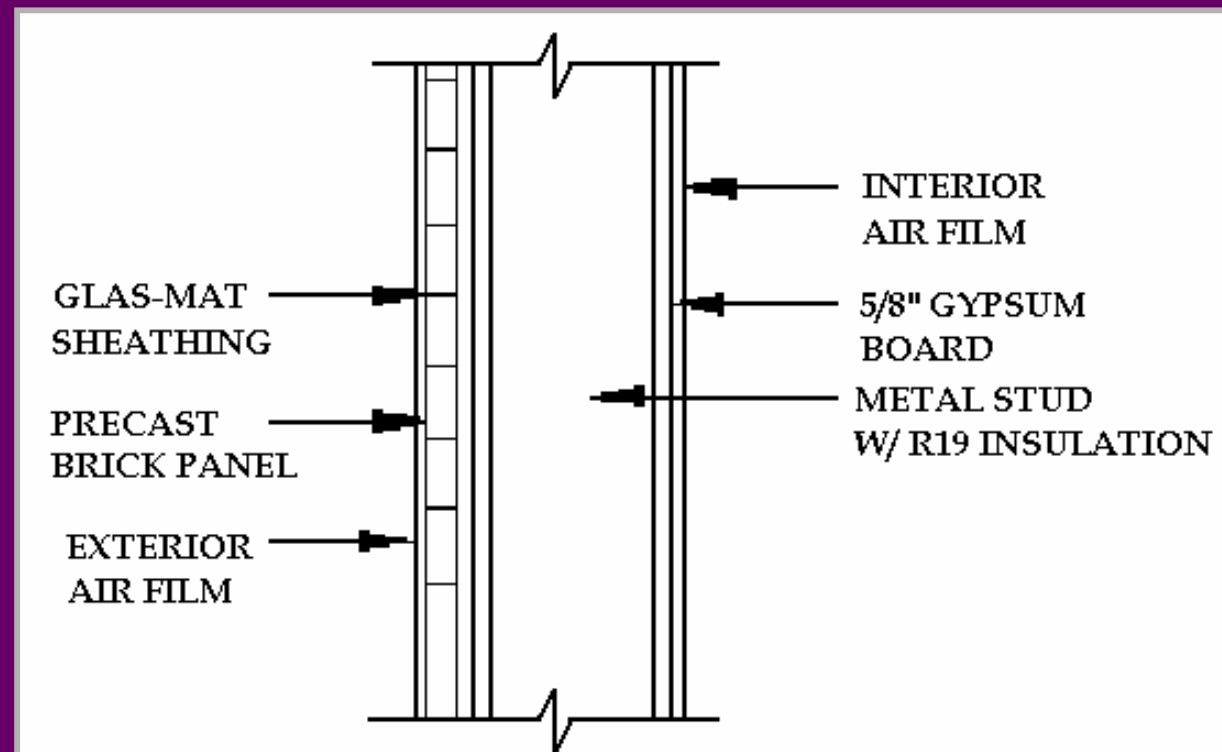
Steel Column Footing

Mechanical Breadth

- LEED Certification
 - 26 possible points can be earned
 - sustainable site
 - water efficiency
 - material selection
 - indoor air quality

Investigated the existing building envelope

- R-Value = 23.5
- $Q = 2.42 \text{ BTU/hr}$
(Isf wall area)



Mechanical Breadth

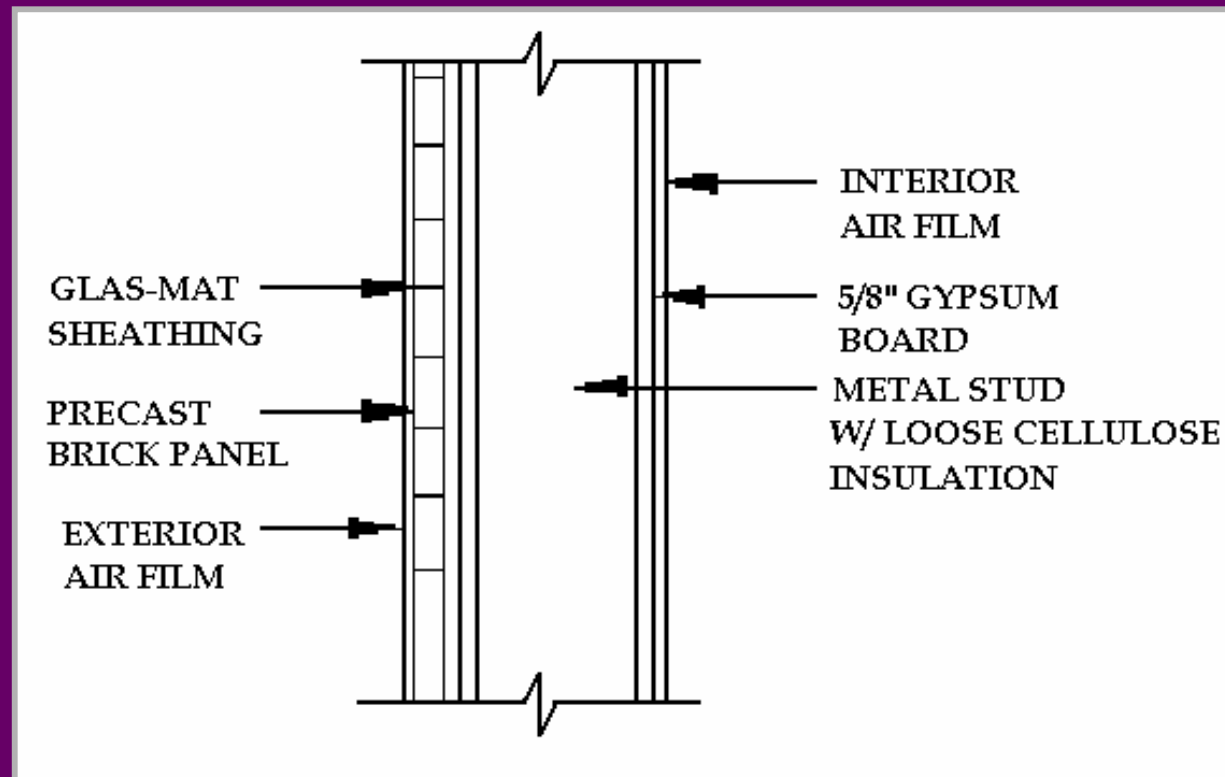
- Proposed building envelope

- R-Value = 27.4

- $Q = 2.09$ BTU/hr

(Isf wall area)

- Heat loss during winter months 14% less than the existing building envelope



Construction Breadth

Concrete Construction Cost and Schedule

- Duration = 140 days (28 weeks)

- Cost = \$5.4 million

Source:
ICE 2000
RS Means

	Total Material Cost	Total Labor Cost	Total Equipment Cost	Total Cost
Column Formwork	\$44,000.00	\$84,480.00	\$0.00	\$128,480.00
Slab Formwork	\$185,000.00	\$355,200.00	\$0.00	\$540,200.00
Beam Formwork	\$3,500.00	\$6,720.00	\$0.00	\$10,220.00
Wall Formwork	\$46,330.00	\$88,953.60	\$0.00	\$135,283.60
Formwork Hardware	\$17,700.00	\$0.00	\$0.00	\$0.00
Formwork Release	\$155,750.00	\$717,696.00	\$0.00	\$873,446.00
Chamfer Strips	\$13,500.00	\$44,434.29	\$0.00	\$57,934.29
Column Reinforcing	\$58,050.00	\$76,540.00	\$0.00	\$134,590.00
Slab Reinforcing	\$488,700.00	\$644,360.00	\$0.00	\$1,133,060.00
Beam Reinforcing	\$5,400.00	\$7,120.00	\$0.00	\$12,520.00
Wall Reinforcing	\$54,000.00	\$71,200.00	\$0.00	\$125,200.00
Column Pour	\$54,000.00	\$13,608.00	\$5,400.00	\$73,008.00
Slab Pour	\$270,000.00	\$68,040.00	\$27,000.00	\$365,040.00
Beam Pour	\$3,600.00	\$907.20	\$360.00	\$4,867.20
Wall Pour	\$84,000.00	\$21,168.00	\$8,400.00	\$113,568.00
Slab Finishing	\$0.00	\$299,012.00	\$0.00	\$299,012.00
Slab Screeds	\$21,720.00	\$100,085.76	\$0.00	\$121,805.76
Shoring	\$1,086,000.00	\$105,840.00	\$0.00	\$1,191,840.00
Crane	\$0.00	\$0.00	\$140,000.00	\$140,000.00
				\$5,460,074.85

Construction Breadth

Steel Construction Cost and Schedule

- Duration = 95 days (19 weeks)
- Cost = \$6.0 million

Source:
ICE 2000
RS Means
Primavera

	Total Material Cost	Total Labor Cost	Total Equipment Cost	Total Cost
Steel Beams	\$210,000.00	\$180,000.00	\$0.00	\$390,000.00
Steel Columns	\$73,500.00	\$63,000.00	\$0.00	\$136,500.00
Steel Angles	\$35,000.00	\$30,000.00	\$0.00	\$65,000.00
Steel Frame	\$1,365,000.00	\$1,170,000.00	\$0.00	\$2,535,000.00
Anchor Bolts	\$456.00	\$1,732.80	\$0.00	\$2,188.80
Base Plates	\$1,425.00	\$2,630.77	\$0.00	\$4,055.77
Grout	\$534.00	\$549.26	\$0.00	\$1,083.26
Shear Studs	\$176,590.00	\$33,552.10	\$0.00	\$210,142.10
Red Oxide	\$20,000.00	\$59,400.00	\$0.00	\$79,400.00
Gypsum Board	\$46,000.00	\$25,300.00	\$0.00	\$71,300.00
Metal Deck	\$905,000.00	\$905,000.00	\$0.00	\$1,810,000.00
WWF Reinforcing	\$16,318.00	\$26,287.90	\$0.00	\$42,605.90
Concrete Slab	\$107,800.00	\$29,635.20	\$11,760.00	\$149,195.20
Slab Finishing	\$0.00	\$299,012.00	\$0.00	\$299,012.00
Slab Screeds	\$21,720.00	\$100,085.76	\$0.00	\$121,805.76
Crane	\$0.00	\$0.00	\$55,800.00	\$55,800.00
				\$5,973,088.79

Conclusion

- Recommend steel for the structure
 - corner columns are eliminated in floor-to-ceiling windows
 - positive impact on floor plan
 - slightly higher construction cost
 - 9 weeks are saved in construction duration
 - steel construction is common in NYC
 - less concrete needed for foundations
 - potential for LEED certification

Acknowledgements

Bruce McKee

(Capstone Development)

Jackie Horowitz

(Turner Construction)

Marc Bowen & Mike Ergler

(Greenman-Pedersen)

Robert Chin

(CCNY Photographer)

THANKS!!!

Delia Nevola

(Goshow Architects)

All AE Faculty

All My Friends and Family

Conclusion

QUESTIONS??



(c) ROBERT K CHIN
TENEMENTCITY.COM

Photos courtesy Robert Chin