Hotel | Northeast U.S.

Jordan Rutherford | Structural Option

Faculty Advisor | Dr. Thomas Boothby

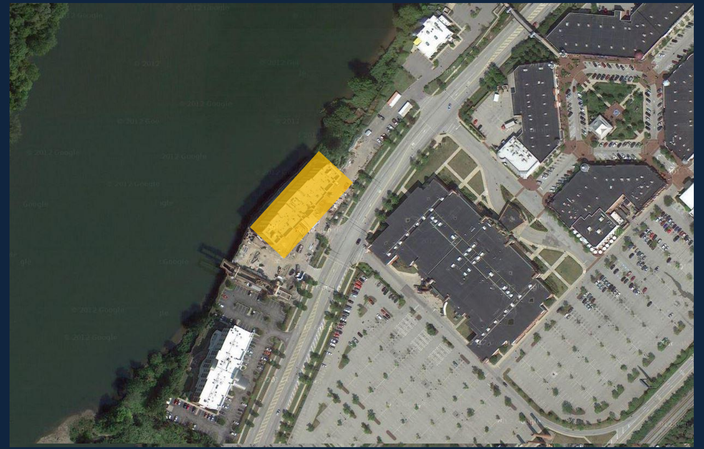
AE Senior Thesis | April 8, 2013

HOTEL N.E.U.S.

BUILDING INFORMATION

- Located in the Northeast United States
- 5 stories above grade
- 113 rooms
- 75,209 ft^2
  - 63’ x 257’
- Maximum Height: 60’-8”
- Construction Cost: $9.2 million
- October 2011 – November 2012

SITE



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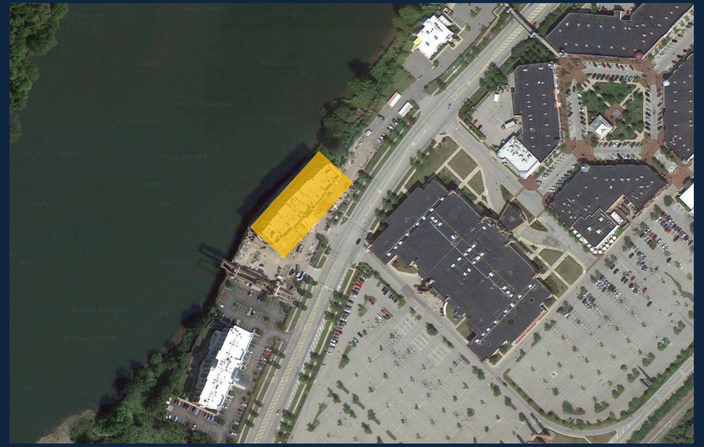
Project Team

- Construction Manager | Continental Real Estate
- Architect | Meyer and Associates
- MEP | Prater Engineering Associates
- Fire Protection | Prater Engineering Associates
- Civil Engineer | Civil and Environmental Consultants, Inc.
- Landscape Arch. | Civil and Environmental Consultants, Inc.
- Structural Engineer | Atlantic Engineering Services

Site



HOTEL N.E.U.S.

ARCHITECTURE

ELEVATIONS

- Synthetic Stucco (EIFS)
- Brick
- Cornices
- Arches

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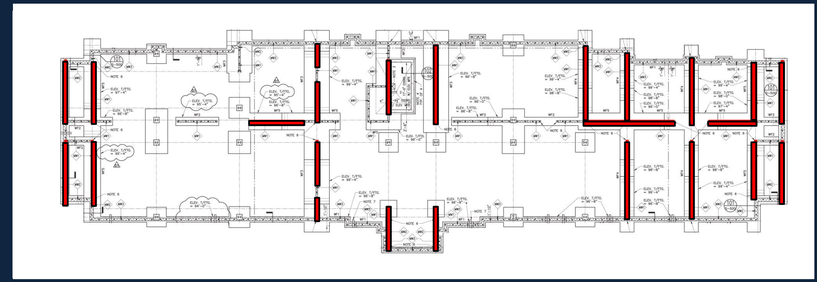
EXISTING STRUCTURE

FLOOR PLANS

- Foundation | Spread and Strip Footings
- Floor | Slab on grade
  | 8” Hollowcore precast Plank
- Framing | Steel Beams and Columns
  | Masonry Bearing Walls
- Lateral System | Masonry Shear Walls



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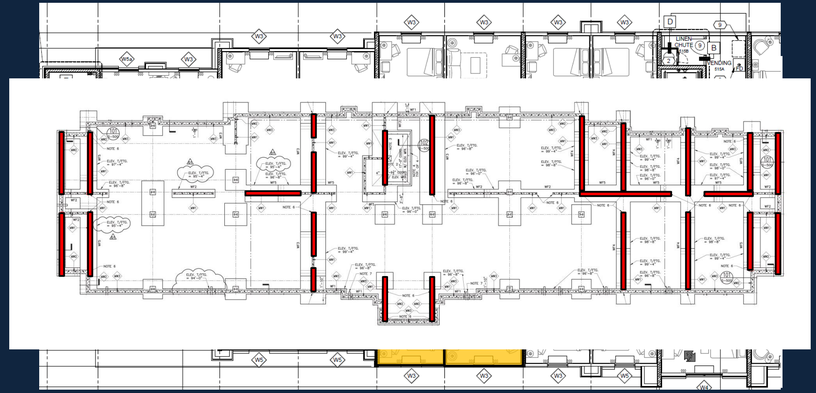
PROBLEM STATEMENT

- Steel / Masonry System
- Open spaces on ground level
- Room sizes
- Lateral Elements layout



Hotel N.E.U.S.

Building Overview

Existing Building

Problem Statement

Proposed Solution

Redesign

Conclusion

Proposed Solution/Goals

- Steel Gravity and Lateral System
- Maintain floor plan and room sizes
- Maintain window and door placement
- Lateral Layout

MAE Requirements

- AE 530- Computer Modeling of Building Structures
- AE 534- Steel Connections
- AE 537- Building Performance Failures and Forensic Techniques
- AE 542- Building Enclosures Science Design

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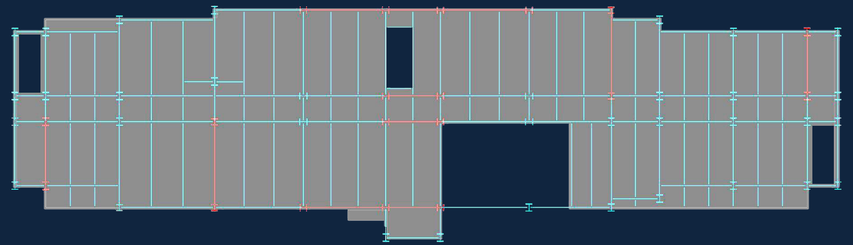
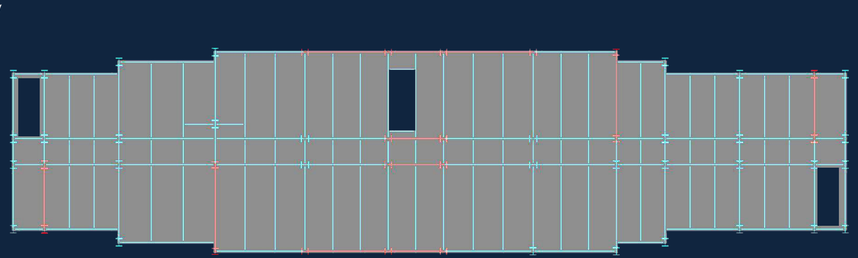
GRAVITY





- Concrete on Composite Metal Deck
  - 5.5” total thickness
  - 3” flutes

- Typical Beam: W14x22 (14) and W16x26 (16)
- Typical Girder: W18x40 (16)
- Typical Column: W10x33

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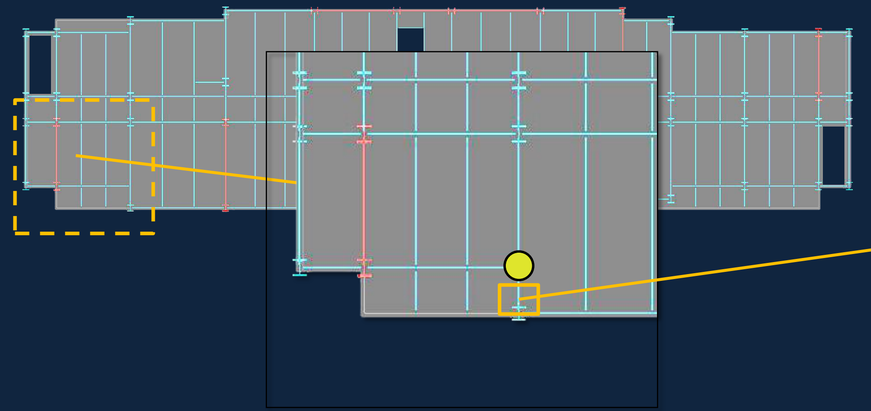
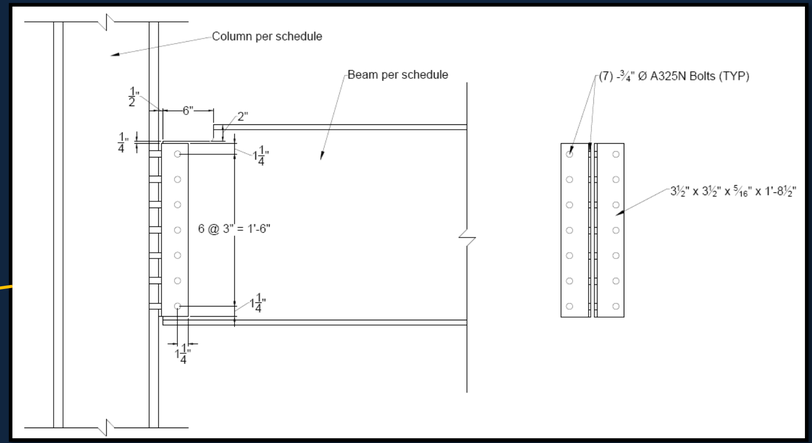
GRAVITY

CONNECTION

- Building Overview
- Existing Building
- Problem Statement
- Proposed Solution
- **Redesign | Gravity**
- Conclusion





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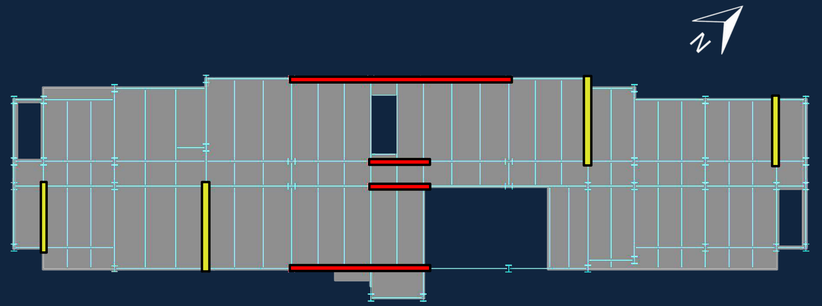
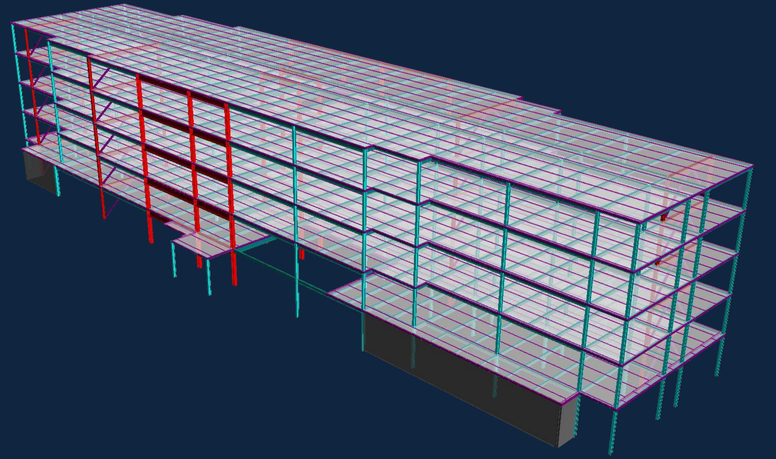
LATERAL



Braced Frame

Moment Frame



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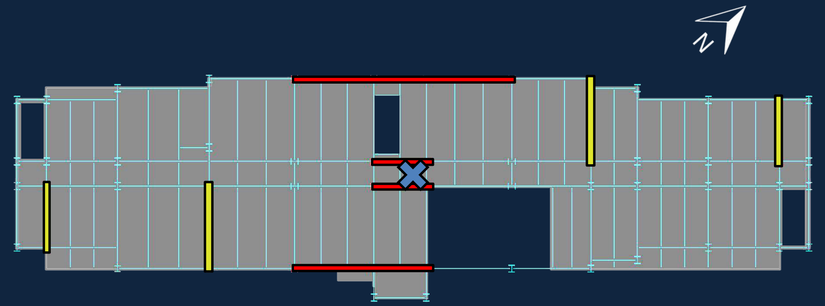
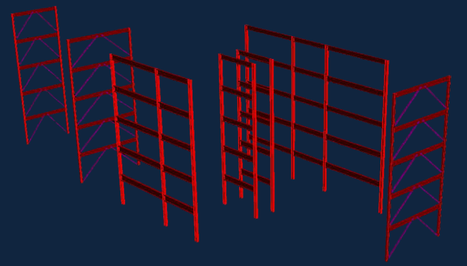
LATERAL

CENTER OF RIGIDITY

- Building Overview
- Existing Building
- Problem Statement
- Proposed Solution
- **Redesign | Lateral**
- Conclusion



Braced Frame
Moment Frame



Center of Rigidity Comparison				
Level	X		Y	
	New	Old	New	Old
5	123.59	161.57	2.28	-5.05
4	123.64	160.71	1.72	-4.5
3	123.68	159.13	1.95	-3.51
2	123.7	156.28	2.09	-1.72
1	123.69	151.16	2.71	1.37
*For the Y direction, 0 is centerline				

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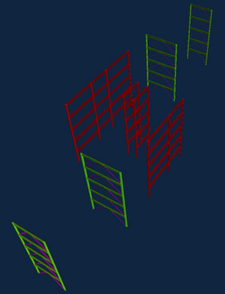
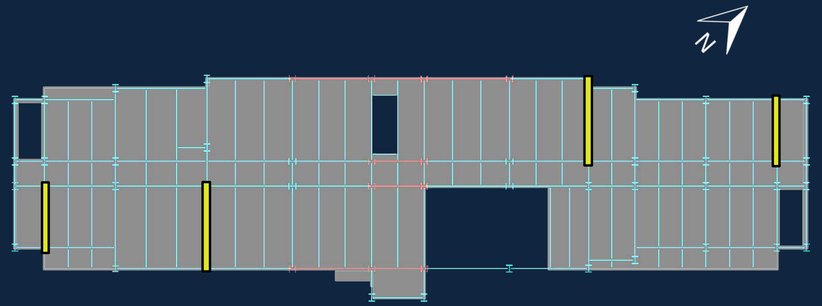
LATERAL

BRACED FRAMES





- Replace shear walls in short direction
  - One brace spans swimming area
- R = 3.25

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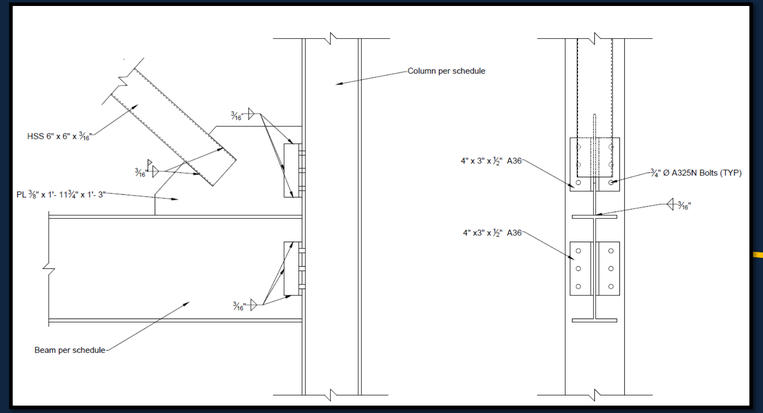
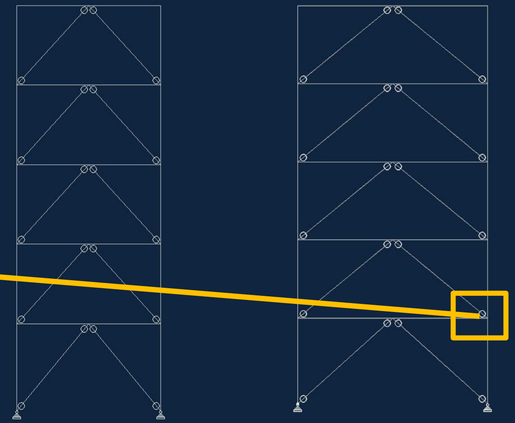
BRACED CONNECTION

BRACED FRAMES

- Building Overview
- Existing Building
- Problem Statement
- Proposed Solution
- **Redesign | Lateral**
- Conclusion





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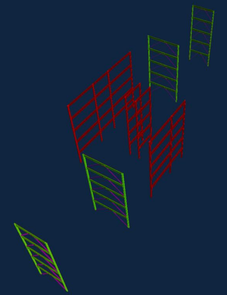
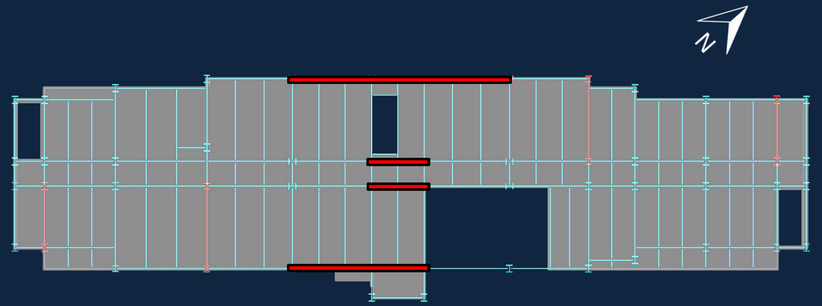
LATERAL

MOMENT FRAMES

- Building Overview
- Existing Building
- Problem Statement
- Proposed Solution
- **Redesign | Lateral**
- Conclusion





- Allows for window and door openings
- Pinned Base
- R = 3

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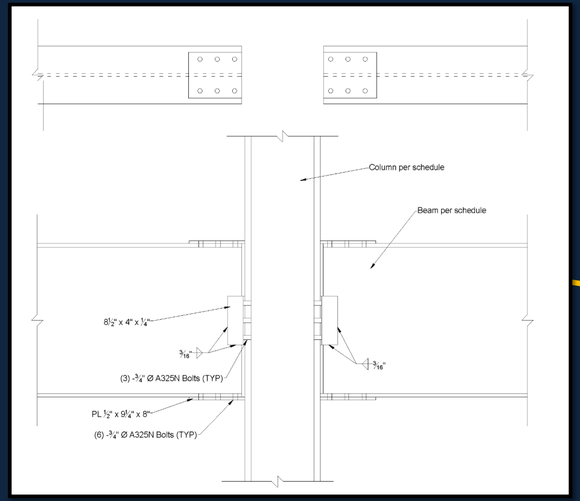
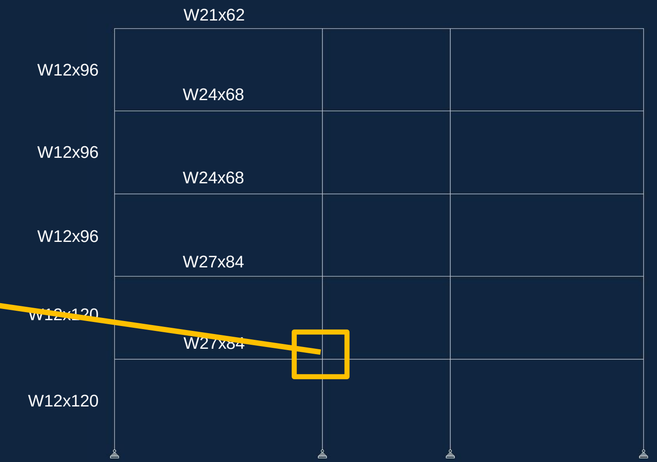
MOMENT CONNECTION

MOMENT FRAMES





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ARCHITECTURE

EXISTING STYLES

- Building Overview
- Existing Building
- Problem Statement
- Proposed Solution
- **Redesign | Arch.**
- Conclusion

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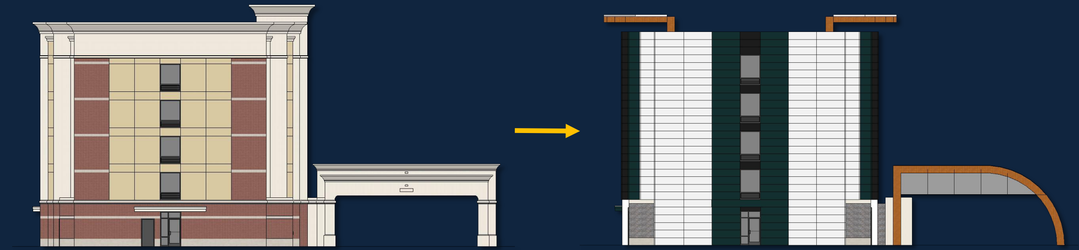
ARCHITECTURE

ELEVATIONS



HOTEL N.E.U.S.

ARCHITECTURE

- Metl Span Architectural Insulated Panels
  - Grey, Green, and White
- Grey Brick along base
- Roof Awning
- Entryway
  - Tinted Structural Glass

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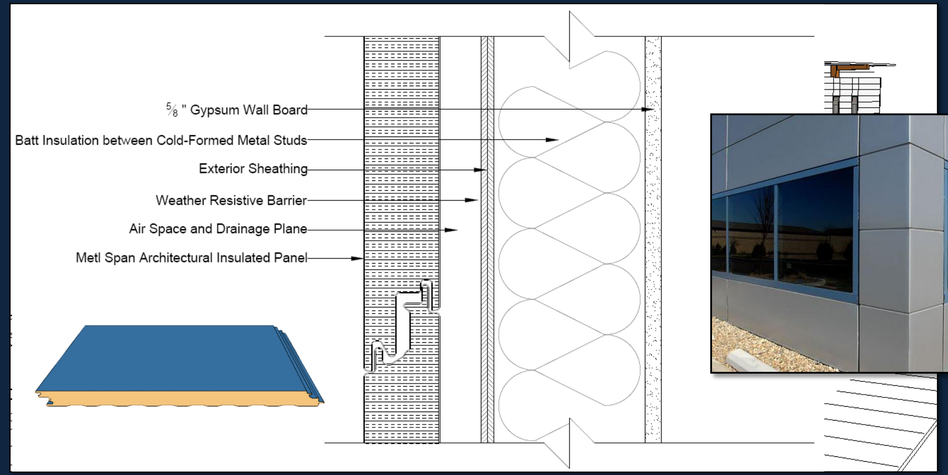
ENCLOSURE



HOTEL N.E.U.S.

SUMMARY

- Gravity system changed from precast plank and masonry walls to composite steel
- Lateral system changed from masonry shear walls
  - Short direction- Braced frames
  - Long direction- Moment frames
- Façade changed from EIFS to metal panels

GOALS

- Maintain floor plan and room sizes ✓
- Locate Braces within partitions ✓
- Limit drift for moment frames ✓
- Keep C.O.R. close to center of building ✓
- Redesign architecture ✓
- Redesign enclosure ✓

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ACKNOWLEDGEMENTS

Atlantic Engineering Services:
Cam Baker
John Schneider

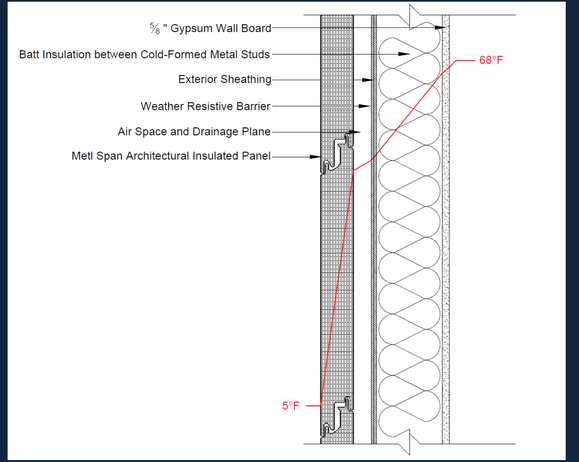
AE Department Faculty

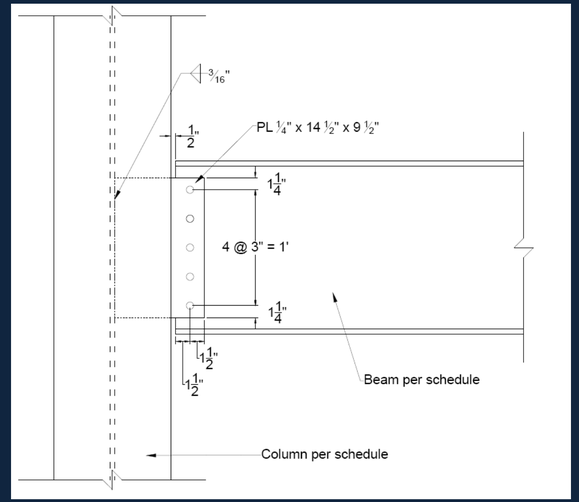
Dr. Thomas Boothby

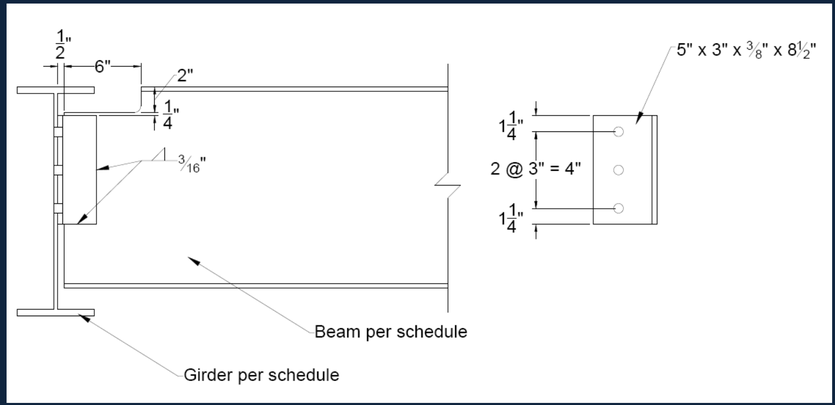
My family, friends, girlfriend, and God

THANK YOU

Seismic Load Data		
Occupancy Category	-	II
Site Class	-	D
Seismic Load Importance Factor	I_e	1
Site Class Coefficient	S_s	0.125
	S_1	0.049
Spectral Response Coefficient	F_a	1.6
	F_v	2.4
	S_{DS}	0.1333
	S_{D1}	0.0784
Seismic Design Category	-	B
Long Period Transition Period	T_L	12
Response Modification Factor	R	3.25
Fundamental Period (N-S)	Ta	0.930
Response Modification Factor	R	3
Fundamental Period (E-W)	Ta	1.900







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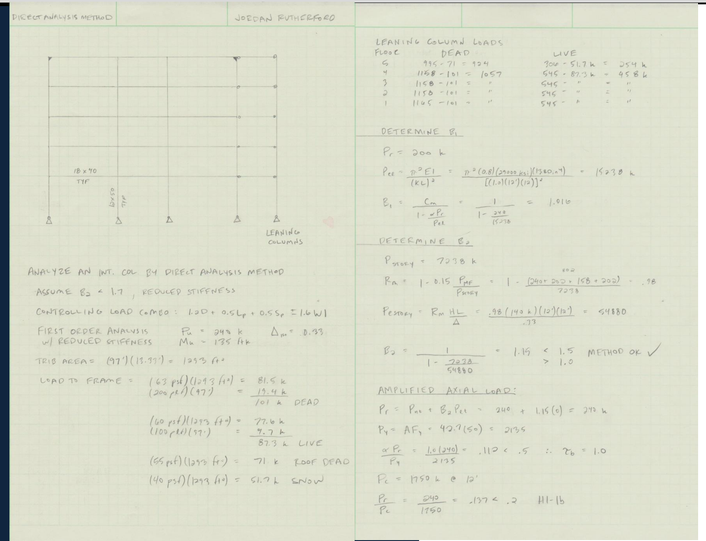
APPENDIX

LATERAL AND DRIFTS



Wind Drift and Displacement

Floor	Displacement		Drift		Allowable Displacement (in)
	X direction (in)	Y direction (in)	X direction (in)	Y direction (in)	
5	0.54924	0.63710	0.04477	0.10257	1.68
4	0.50447	0.53453	0.05847	0.12077	1.35
3	0.44600	0.41376	0.07073	0.13321	1.02
2	0.37527	0.28055	0.08812	0.13653	0.69
1	0.28715	0.14402	0.28715	0.14402	0.36

Seismic Drift and Displacement

Floor	Displacement						Drift		Allowable Drift (in)
	X direction (in)	Cd	Total	Y direction (in)	Cd	Total	X direction (in)	Y direction (in)	
5	1.19952	3.00	3.59856	0.5272	3.25	1.7134	0.31155	0.29055	2.64
4	1.09567	3.00	3.28701	0.4378	3.25	1.4229	0.44022	0.36442	2.64
3	0.94893	3.00	2.84679	0.3257	3.25	1.0584	0.52104	0.39868	2.64
2	0.77525	3.00	2.32575	0.2030	3.25	0.6598	0.58308	0.37931	2.64
1	0.58089	3.00	1.74267	0.0863	3.25	0.2804	1.74267	0.28044	2.88