PRESENTATION OUTLINE

- Introduction
  - Building History & Statistics
  - Existing Structure
  - Thesis Goals
- Structural Depth
  - ASCE Code Comparison
  - Moment Frames
  - Braced Frames
  - Shear Walls
  - MAE Course Related Study
- Architectural Breadth
- Construction Management Breadth
- Conclusion
PRESENTATION OUTLINE

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- Construction Management Breadth
- Conclusion

INTRODUCTION

Building Statistics

Location: 201 State Street
Erie, PA

Occupancy Type: Hospital/Healthcare

Building Size: 193,616 sq ft


Construction Costs: $50,000,000 +/-

Project Delivery Method: Traditional (Design-Bid-Build)

Project Team:
- Owner: UPMC Hamot
- Architect: Rechtenwald Architects Inc.
- Structural Engineer: Atlantic Engineering Services
- MEP Engineer: CJL Engineering
- Site/Civil Engineer: Urban Engineers Inc.
- General Contractor: Perry Construction Group
### INTRODUCTION

**Building Statistics**

- **Location:** 201 Kobe Street, Erie, PA
- **Occupancy Type:** Hospital/Healthcare
- **Building Size:** 163,616 ft²
- **Construction Dates:** January 2007 – January 2011
- **Construction Costs:** $50,000,000 +/-
- **Project Delivery Method:** Traditional (Design-Bid-Build)
- **Project Team:**
  - **Owner:** UPMC Hamot
  - **Architect:** Rechtenwald Architects Inc.
  - **Structural Engineer:** Atlantic Engineering Services
  - **MEP Engineer:** CJL Engineering
  - **Site/Civil Engineer:** Urban Engineers Inc.
  - **General Contractor:** Perry Construction Group

### Existing Structure

- **Foundations**
  - Strip Footings
  - Spread Footings
- **Floor Construction**
  - 4" concrete on 2" – 20 Gauge Composite Deck
- **Lateral System**
  - N-S Direction
    - Braced Frame along Column Line N
  - E-W Direction
    - Moment Frames along Column Lines 1 and 17
INTRODUCTION

Existing Structure

Foundations
• Strip Footings
• Spread Footings

Floor Construction
• 4" concrete on 2" - 20 Gauge Composite Deck

Lateral System
• N-S Direction
  • Braced Frame along Column Line N
  • Moment Frame along Column Line B

• E-W Direction
  • Moment Frame along Column Lines 1 and 17
INTRODUCTION

Existing Structure

Foundations
- Strip Footings
- Spread Footings

Floor Construction
- 4” concrete on 2” – 20 Gauge Composite Deck

Lateral System
- N-S Direction
  - Braced Frame along Column Line N
- Moment Frame along Column Line B

- E-W Direction
  - Moment Frames along Column Lines 1 and 17

Thesis Goals

Structural Depth
- ASCE 7-05 vs. ASCE 7-10 Load Comparison
- Comparison of Various Lateral Systems
- Analysis impact of the various lateral systems on the buildings architectural interior

Construction Management Breadth
- Detailed Cost and Schedule Analysis of various lateral systems

MAE Course Related Study
- Program a deeper understanding of RAM Structural System
- Design Connections for Moment Frame and Braced Frame Systems
## Structural Depth

### ASCE Code Comparison

#### Snow Loads

<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>ASCE 7-05</th>
<th>ASCE 7-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Snow Load</td>
<td>40 psf</td>
<td>40 psf</td>
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<tr>
<td>Occupancy Category</td>
<td>III</td>
<td>IV</td>
</tr>
<tr>
<td>Importance Factor</td>
<td>1.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Thermal Factor</td>
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<td>1.0</td>
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<tr>
<td>Exposure Factor</td>
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<tr>
<td>Flat Roof Snow Load</td>
<td>24.64</td>
<td>26.88</td>
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#### Live Loads

<table>
<thead>
<tr>
<th>Land Type</th>
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<tr>
<td>Lobbies</td>
<td>100</td>
<td>100</td>
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<tr>
<td>Operating Room/Labs</td>
<td>60</td>
<td>60</td>
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<td>Patient Rooms</td>
<td>40</td>
<td>40</td>
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<tr>
<td>Commissary, above 1st floor</td>
<td>80</td>
<td>85</td>
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<tr>
<td>First Floor Corridors</td>
<td>100</td>
<td>100</td>
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<td>Stairs</td>
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<td>100</td>
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<tr>
<td>Mechanical Space</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Roof</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

### ASCE Code Comparison

- **Occupancy Category III**: Healthcare facilities with a capacity of 50 or more resident patients, but not having surgery or emergency treatment facilities
- **Occupancy Category IV**: Hospitals and other healthcare facilities having surgery or emergency facilities
- **ASCE 7-05**
- **Occupancy Category III**: Buildings and other structures, the failure of which could pose a substantial risk to human life
- **Occupancy Category IV**: Buildings and other structures designated as essential facilities
PRESENTATION OUTLINE

• Introduction
• Building History & Statistics
• Existing Structure
• Thesis Goals
• Structural Depth
• ASCE Code Comparison
• Moment Frames
• Braced Frames
• Shear Walls
• MAE Course Related Study
• Architectural Breadth
• Construction Management Breadth
• Conclusion

UPMC Hamot Women's Hospital
Erie, PA

Justin Kovach

Structural Depth

ASCE Code Comparison

Design Parameter | ASCE 7-05 | ASCE 7-10
--- | --- | ---

**Wind Loads**

<table>
<thead>
<tr>
<th>Design Wind Speed</th>
<th>90 mph</th>
<th>120 mph</th>
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</thead>
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<tr>
<td>Occupancy Category</td>
<td>III</td>
<td>IV</td>
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<tr>
<td>Importance Factor</td>
<td>1.15</td>
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<td>Exposure Category</td>
<td>D</td>
<td>D</td>
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<td>Enclosed</td>
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Load Combination Factor

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<th>ASCE 7-10</th>
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<tbody>
<tr>
<td>N-S</td>
<td>1.6</td>
<td>1.0</td>
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<tr>
<td>E-W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building Weight</td>
<td>11,606 k</td>
<td>11,606 k</td>
</tr>
<tr>
<td>Base Shear N-S</td>
<td>1040.3 k</td>
<td>1688.5 k</td>
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<tr>
<td>Base Shear E-W</td>
<td>435.9 k</td>
<td>733.9 k</td>
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**Earthquake Loads**

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<th>Design Parameter</th>
<th>ASCE 7-05</th>
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</thead>
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<tr>
<td>R-Value</td>
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<tr>
<td>Occupancy Category</td>
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</tr>
<tr>
<td>Importance Factor</td>
<td>1.25</td>
<td>1.5</td>
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<tr>
<td>Sx</td>
<td>0.125</td>
<td>0.165</td>
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<tr>
<td>Cx</td>
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<tr>
<td>Building Weight</td>
<td>11,606 k</td>
<td>11,606 k</td>
</tr>
<tr>
<td>Base Shear N-S</td>
<td>275.4 k</td>
<td>278.5 k</td>
</tr>
</tbody>
</table>

2-D Escarpment

Wind from North
**PRESENTATION OUTLINE**

- Introduction
  - Building History & Statistics
  - Existing Structure
- Thesis Goals
- Structural Depth
  - ASCE Code Comparison
  - Moment Frames
  - Braced Frames
  - Shear Walls
  - MAE Course Related Study
- Architectural Breadth
- Construction Management Breadth
- Conclusion

---

**Structural Depth**

**Moment Frame System**

**Advantages**
- Open Floor Plan

**Disadvantages**
- Relatively Flexible Lateral System

**Typical Sizes**
- Beams: W21x48
- Columns: W14x90, W14x132, W14x159

**Max Expected Roof Drift**
- Earthquake: 2.292" (Storm)
- Wind: 1.904" (Wind)

**Allowable Roof Drift**
- Earthquake: 12.96" (Wind)
- Wind: 2.16" (Wind)

---

**Moment Frame Details**

- Typical Moment Connection Detail

---

**UPMC Hamot Womens Hospital**

- Erie, PA

---

**Typical Moment Connection Detail**

- Moment Frame along CL 1
Structural Depth

**Braced Frame System**

**Advantages**
- Increased Stiffness and Decreased Deflection

**Disadvantages**
- Potentially affects Interior Architecture

**Typical Sizes**
- Beams: W18x35
- Columns: W10x40, W10x60, W10x88
- Braces: HSS6x6x3/8

Max Expected Roof Drift
- Earthquake: 1.744"
- Wind: 1.449"

Allowable Roof Drift
- Earthquake: 12.96"
- Wind: 2.16"

---

**Braced Frame Details**

Typical Braced Frame Detail

Braced Frame along CL 1
PRESENTATION OUTLINE
- Introduction
- Building History & Statistics
- Existing Structure
- Thesis Goals
- Structural Depth
- ASCE Code Comparison
- Moment Frames
- Braced Frames
- Shear Walls
- MAE Course Related Study
- Architectural Breadth
- Construction Management Breadth
- Conclusion

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Structural Depth

Shear Wall System

Advantages
- Much more rigid than Moment Frames

Disadvantages
- Takes additional time to Form, Reinforce, Pour, and allow walls to cure

Typical Sizes
- 8” Thick Reinforced Concrete Shear Walls

Max. Expected Roof Drift
Earthquake: 1.370”
Wind: 1.390”

Allowable Roof Drift
Earthquake: 12.96”
Wind: 2.16”

UWEC Hamot Women’s Hospital
Erie, PA

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PRESENTATION OUTLINE
- Introduction
- Building History & Statistics
- Existing Structure
- Thesis Goals
- Structural Depth
- ASCE Code Comparison
- Moment Frames
- Braced Frames
- Shear Walls
- MAE Course Related Study
- Architectural Breadth
- Construction Management Breadth
- Conclusion

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Structural Depth

Shear Wall Details

4th Floor Details

UWEC Hamot Women’s Hospital
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**PRESENTATION OUTLINE**

<table>
<thead>
<tr>
<th></th>
<th>Architectural Breadth</th>
<th>UPMC Hamot Womens Hospital</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2nd Floor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moment Frame System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5th Floor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Braced Frame System</td>
<td></td>
</tr>
</tbody>
</table>

- Introduction
- Building History & Statistics
- Existing Structure
- Thesis Goals
- Structural Depth
- ASCE Code Comparison
- Moment Frames
- Braided Frames
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- MAE Course Related Study
- Architectural Breadth
- Construction Management Breadth
- Conclusion

<table>
<thead>
<tr>
<th>Architectural Breadth</th>
<th>Braced Frame System</th>
<th>2nd Floor</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>5th Floor</td>
<td>Braced Frame System</td>
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</table>

<table>
<thead>
<tr>
<th>Architectural Breadth</th>
<th>Braced Frame System</th>
<th>5th Floor</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2nd Floor</td>
<td>Braced Frame System</td>
</tr>
</tbody>
</table>
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- Building History & Statistics
- Existing Structure
- Thesis Goals
- Structural Depth
- ASCE Code Comparison
- Moment Frames
- Braced Frames
- Shear Walls
- MAE Course Related Study
- Architectural Breadth
- Construction Management Breadth
- Conclusion

Construction Management Breadth

UPMC Hamot Womens Hospital
Erie, PA

Justin Kovach

Schedule Analysis

<table>
<thead>
<tr>
<th>System</th>
<th>Phase 1 Completion Date</th>
<th>Date</th>
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<tr>
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<td>1/2/2008</td>
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<td></td>
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<tr>
<td>Shear Walls</td>
<td>2/19/2008</td>
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</tbody>
</table>

Construction Management Breadth

Cost Analysis

- Cost and Schedule Assumptions
  - Only analyzing Phase 1 (Structural Shell) of the project
  - Phase 1 Critical Path changes will directly move the entire Phase 2 start date
  - Comparable Cost was completed based on Financial Data that is publicly available on the UPMC Hamot Hospital System

<table>
<thead>
<tr>
<th>System</th>
<th>Cost</th>
<th>Schedule Adjustment</th>
<th>Additional Audit</th>
<th>Comparable Cost</th>
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<tbody>
<tr>
<td>Existing System</td>
<td>$9,000,000</td>
<td>N/A</td>
<td>N/A</td>
<td>$9,000,000</td>
</tr>
<tr>
<td>Moment Frames</td>
<td>$10,705,332</td>
<td>10</td>
<td>$2,394,612</td>
<td>$8,310,720</td>
</tr>
<tr>
<td>Braced Frames</td>
<td>$10,193,456</td>
<td>10</td>
<td>$2,394,612</td>
<td>$7,798,844</td>
</tr>
<tr>
<td>Shear Walls</td>
<td>$9,327,483</td>
<td>9</td>
<td>$2,155,150</td>
<td>$7,172,332</td>
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</tbody>
</table>

Cost and Schedule Analysis

<table>
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<th>Cost</th>
<th>Schedule Adjustment</th>
<th>Additional Audit</th>
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<tr>
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<td>$9,327,483</td>
<td>9</td>
<td>$2,155,150</td>
<td>$7,172,332</td>
</tr>
</tbody>
</table>
Conclusion

Upon final analysis of the UPMC Hamot Women's Hospital recommendation would have been to use the Concrete Shear Wall system around the vertical circulation of the structure. This becomes efficient when the building is completely demolished from the start of Phase 1 and also allows for the views that the architect and building owner desire.

Lateral Systems

Moment Frame, braced Frame, and Shear Wall Systems were effectively designed Lateral Systems for the UPMC Hamot Women's Hospital.

Architectural Impacts

The Braced Frame System was decided on desirable due to the loss of the views desired by the architect and the potential health impacts.

Construction Management Impacts

It was determined that impaling the building and starting from scratch was the most feasible design for both cost and schedule.

Final Thoughts

Acknowledgements

Atlantic Engineering Services
- Gil Taylor and John Schneider
Penn State AE Faculty
- Dr. Boothby
- Dr. Hanagan
- Professor Parfitt
Family
- For their constant love and support throughout my life!
Friends
- I have been blessed beyond belief in every aspect of my life. I hope to use the talents given to me to bring joy to me and to the future.

Questions and Comments
Appendix Guide

- Code Literature
- Snow Load Calcs
- Wind Load Calcs
- Earthquake Load Calcs
- Moment Frames
- Braced Frames
- Concrete Shear Walls
- MAE Course Material
- CM Breadth Calcs

Code Literature

UPMC Hamot Womens Hospital
Erie, PA

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jkovach@upmc.edu

ASCE 7-05

ASCE 7-10

Table 1.1.1 (Revised): Load and Force Design Values for Steel, Concrete, and Other Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Load Category</th>
<th>Design Value</th>
</tr>
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<tbody>
<tr>
<td>Steel</td>
<td>Dead</td>
<td>0.15</td>
</tr>
<tr>
<td>Steel</td>
<td>Live</td>
<td>0.25</td>
</tr>
<tr>
<td>Concrete</td>
<td>Dead</td>
<td>0.20</td>
</tr>
<tr>
<td>Concrete</td>
<td>Live</td>
<td>0.30</td>
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</tbody>
</table>

ASCE 7-10

Table 1.1.1 (Revised): Load and Force Design Values for Steel, Concrete, and Other Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Load Category</th>
<th>Design Value</th>
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<tbody>
<tr>
<td>Steel</td>
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<td>Concrete</td>
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<td>0.30</td>
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<td>Snow Load Calcs</td>
<td>UPMC Hamot Womens Hospital</td>
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<td>----------------</td>
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<td>p = 0.7 &amp; Cc &amp; Cp = 0.8</td>
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<td>• Wind Load Calcs</td>
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<td>• Earthquake Load Calcs</td>
<td>Table 7-2, Fully Exposed,</td>
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<td>• Moment Frames</td>
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<td>Erie Code Office for this info</td>
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\[ p = 0.7(0.8)(1.0)(1.1)(40 \text{ psf}) \]
\[ p = 24.64 \text{ psf} \]

<table>
<thead>
<tr>
<th>Appendix Guide</th>
<th>Wind Load Calcs</th>
<th>UPMC Hamot Womens Hospital</th>
</tr>
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<tr>
<td>• Code Literature</td>
<td>ASCE 7-05 (Method 2 - Analytical Procedure)</td>
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<tr>
<td>• Snow Load Calcs</td>
<td>Assume: Enclosed Building</td>
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<tr>
<td>• Wind Load Calcs</td>
<td>Rigid Building</td>
<td></td>
</tr>
<tr>
<td>• Earthquake Load Calcs</td>
<td>Wind from North</td>
<td></td>
</tr>
<tr>
<td>• Moment Frames</td>
<td>V = 90 mph Figure 6-1</td>
<td></td>
</tr>
<tr>
<td>• Braced Frames</td>
<td>K = 1.15 Table 6-1</td>
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</tr>
<tr>
<td>• Concrete Shear Walls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MAE Course Material</td>
<td>Occupancy Category = III Table 7-1</td>
<td></td>
</tr>
<tr>
<td>• CM Breadth Calcs</td>
<td>G = 0.85 Section 5.8.8</td>
<td></td>
</tr>
</tbody>
</table>

\[ p = -15.55 \text{ psf} \text{ (Leeward)} \]
\[ p = -15.55 \text{ psf} \text{ (Windward)} \]

|风荷载计算| UPMC Hamot Women's Hospital |
|----------------|----------------|---------------------------|
| • Code Literature | ASCE 7-05 (Method 2 - Analytical Procedure) | Erie, PA |
| • Snow Load Calcs | Assume: Enclosed Building |  |
| • Wind Load Calcs | Rigid Building |  |
| • Earthquake Load Calcs | Wind from North |  |
| • Moment Frames | V = 90 mph Figure 6-1 |  |
| • Braced Frames | K = 1.15 Table 6-1 |  |
| • Concrete Shear Walls |  |  |
| • MAE Course Material | Occupancy Category = III Table 7-1 |  |
| • CM Breadth Calcs | G = 0.85 Section 5.8.8 |  |

\[ p = -15.55 \text{ psf} \text{ (Leeward)} \]
\[ p = -15.55 \text{ psf} \text{ (Windward)} \]
Appendix Guide

- Code Literature
- Snow Load Calcs
- Wind Load Calcs
- Earthquake Load Calcs
- Moment Frames
- Braced Frames
- Concrete Shear Walls
- MAE Course Material
- CM Breadth Calcs

Wind Load Calcs

ASCE 7-10 (Directional Procedure)

Assume: Enclosed Building

Rigid Building

Section 26.10

Wind Load Calc

Risk Category = IV, Table 15.6-1

K = 0.85

Table 26.6-1

G = 0.85

Section 26.9.4

GCpi = +/- 0.18

Table 26.11-1

Cp = 0.8

Figure 27.4-1 (Windward Wall)

Cp = -0.5

Figure 27.4-1 (Leeward Wall)

Cp = -0.9

Figure 27.4-1 (Roof – 0' to 78')

Cp = -0.5

Figure 27.4-1 (Roof – 78' to 145')

ASCE 7-10 (continued)

p = -27.96 psf

(Leeward)

Values that vary with Height

z Kd Kz Kzt qz pz

(Table 27.3-1) (Figure 26.8-1) (Section 27.3.2) (Section 27.4.1)

92 1.41 1.046 46.21 39.74

90 1.40 1.070 46.94 40.24

80 1.38 1.105 47.78 40.81

70 1.34 1.162 48.79 41.72

60 1.31 1.252 51.39 43.48

50 1.27 1.391 55.35 46.18

40 1.22 1.620 61.93 50.65

30 1.16 1.783 64.81 52.61

25 1.12 1.997 70.08 56.19

20 1.08 2.275 76.99 60.89

15 1.03 3.803 122.74 92.00

Earthquake Load Calcs

ASCE 7-05

Moment Frames

R = 3

Table 12.2-1

T = 0.55

Table 15.5-1

T = 2

Figure 12.2-1

T = C.T = 1.17 (1.05) 1.77

C = 1.7

Table 12.8-1

Ta = Cthn/x = 0.028(92') = 0.8

S = 0.175

From USGS

S = 0.078

From USGS

C = 0.0183

W = 11,606 kips

V = C.W = 0.0136(11,606 kips) = 212.39 k

ASCE 7-05 (continued)

Weight (k) Height (ft) C v Fv

Level Penthouse 315.4 92 0.08118 17.24

Stair Roof 74.8 82 0.01604 3.41

Roof 1616.0 72 0.26611 60.77

5th Floor 2282.7 58 0.2953 61.71

4th Floor 2348.6 44 0.18077 41.64

3rd Floor 2401.9 28 0.10058 21.36

2nd Floor 2567.1 12 0.02949 #6.28

UPMC Hamot Womens Hospital

Erie, PA

Justin Kovach

USC/ECE
Appendix Guide

- Code Literature
- Snow Load Calculations
- Wind Load Calculations
- Earthquake Load Calculations
- Moment Frames
- Beam Frames
- Concrete Shear Walls
- MAE Course Material
- CM Breadth Calculations

Earthquake Load Calculations

**ASCE 7-10**

- Moment Frames

  \[ T = \frac{G}{R} \text{ Table 12.2-1, Table 11.5-1, Figure 12.2-1} \]

  \[ G = 1.7(1.043) = 1.77 \]

  \[ R = 3 \]

  \[ \text{Cu} = 1.7 \text{ Table 12.8-1} \]

  \[ \text{Ta} = C_{thn}^{x} = 0.028(92')^{0.8} = 1.043 \]

  \[ S_u = 0.165 \text{ From USGS} \]

  \[ S_i = 0.565 \text{ From USGS} \]

  \[ C_y = 0.024 \]

  \[ W = 11,606 \text{ kips} \]

  \[ V = C_y W = 0.024(11,606 \text{ k}) = 278.54 \text{ k} \]

**ASCE 7-10 (continued)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Weight (k)</th>
<th>Height (ft)</th>
<th>C_y</th>
<th>F_r</th>
</tr>
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<tr>
<td>Penthouse</td>
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<td>82</td>
<td>0.01604</td>
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<tr>
<td>Roof</td>
<td>1615.0</td>
<td>72</td>
<td>0.26611</td>
<td>79.69</td>
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<tr>
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<td>2282.7</td>
<td>58</td>
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<tr>
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<td>2348.6</td>
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<td>0.19607</td>
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</table>

**ASCE 7-05**

- Beam Frames

  \[ T = \frac{G}{R} \text{ Table 12.2-1, Table 11.5-1, Figure 12.2-1} \]

  \[ G = 1.7(1.043) = 1.77 \]

  \[ R = 3 \]

  \[ \text{Cu} = 1.7 \text{ Table 12.8-1} \]

  \[ \text{Ta} = C_{thn}^{x} = 0.028(92')^{0.8} = 1.043 \]

  \[ S_u = 0.175 \text{ From USGS} \]

  \[ S_i = 0.575 \text{ From USGS} \]

  \[ C_y = 0.0183 \]

  \[ W = 11,606 \text{ kips} \]

  \[ V = C_y W = 0.0183(11,606 \text{ k}) = 210.47 \text{ k} \]

**ASCE 7-05 (continued)**

<table>
<thead>
<tr>
<th>Level</th>
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<th>F_r</th>
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<td>0.29063</td>
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<td>0.08381</td>
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</table>
### Earthquake Load Calcs

#### ASCE 7-10

**Braced Frames**
- **R** = 3
- **T** = 1.7
- **Cu** = 1.7
- **Ta** = \( C_{thn}^x = 0.028(92')^0.8 = 1.043 \)
- **SDS** = 0.165
- **SD1** = 0.085
- **Cs** = 0.024
- **W** = 11,501 kips
- **V** = \( CsW = 0.024(11,501 \text{ k}) = 276.02 \text{ k} \)

#### ASCE 7-10 (continued)

<table>
<thead>
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<th>C</th>
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<td>0.08381</td>
<td>23.13</td>
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</table>

#### Earthquake Load Calcs

**Concrete Shear Walls**
- **R** = 4
- **T** = 1.7
- **Cu** = 1.7
- **Ta** = \( C_{thn}^x = 0.028(92')^0.8 = 1.043 \)
- **SDS** = 0.175
- **SD1** = 0.078
- **Cs** = 0.0137
- **W** = 13,579 kips
- **V** = \( CsW = 0.0137(13,579 \text{ k}) = 282.67 \text{ k} \)

#### ASCE 7-05 (continued)

<table>
<thead>
<tr>
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</table>
### Earthquake Load Calcs

#### ASCE 7-10

- **Concrete Shear Walls**
  - Table 12.2-1
  - Table 11.5-1
  - Figure 12.2-1

- **T** = C.T. = 1/1.7
- **Cu** = 1.7
- **Ta** = Cthn^x = 0.028(92')^0.8 = 1.043

#### Level Weight (k) Height (ft) C v Fv

<table>
<thead>
<tr>
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- **Cu** = wA_v^2
- **C** = V

#### Earthquake Load Calcs

- **ASCE 7-10 (continued)**

- **Concrete Shear Walls**
  - Table 12.2-1
  - Table 11.5-1
  - Figure 12.2-1

- **T** = C.T. = 1/1.7
- **Cu** = 1.7
- **Ta** = Cthn^x = 0.028(92')^0.8 = 1.043

- **SDS** = 0.165 From USGS
- **SD1** = 0.085 From USGS
- **Cs** = 0.0180
- **W** = 13,579 kips
- **V** = CsW = 0.0180(13,579 kips) = 244.42 k
<table>
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<th>MAE Course Material</th>
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<tbody>
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<tr>
<td>• CM Breadth Calcs</td>
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**Bracing Connection Details**

- [Graphs and calculations showing bracing connection details]

**UPMC Hamot Womens Hospital**

Erie, PA

Justin Kovach

- [Images of structural engineering diagrams]
<table>
<thead>
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<th>UPMC Hamot Womens Hospital</th>
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<td></td>
<td>Justin Kovach</td>
</tr>
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<td>• Earthquake Load Calcs</td>
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<td>21</td>
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<tr>
<td>• Moment Frames</td>
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</table>
Appendix Guide

• Code Literature
• Snow Load Calcs
• Wind Load Calcs
• Earthquake Load Calcs
• Moment Frames
• Braced Frames
• Concrete Shear Walls
• MAE Course Material
• CM Breadth Calcs

CM Breadth Calcs

Cost Details/Calcs