Introduction

120,000 SF
10 Stories (90ft)
$40 Million

Presentation Outline

• Introduction
  Base Steel Redesign
  Progressive Collapse
  Tie Force
  Alternative Path
  Enhanced Local Resistance
  Architectural Breadth
  Conclusions

Project Team

Owner: Health Research
Architect & Engineer:
General Contractor:
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Progressive Collapse

UFC 4-023: Typical Action Classifications

<table>
<thead>
<tr>
<th>Component</th>
<th>Deformation-Controlled Action</th>
<th>Force-Controlled Action</th>
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</thead>
<tbody>
<tr>
<td>Moment Frames</td>
<td>Moment (M)</td>
<td>Shear (V)</td>
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<tr>
<td>- Beams</td>
<td>M</td>
<td>Axial load (P), V</td>
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<td>- Columns</td>
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<tr>
<td>- Joints</td>
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<tr>
<td>Shear Walls</td>
<td>M, V</td>
<td>P</td>
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<tr>
<td>Braced Frames</td>
<td>P</td>
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<td>- Braces</td>
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<tr>
<td>- Beams</td>
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<tr>
<td>- Columns</td>
<td>V</td>
<td>P, M</td>
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<tr>
<td>- Shear Link</td>
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<tr>
<td>Connections</td>
<td>P, V, M</td>
<td>P, V, M</td>
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</tbody>
</table>

Alternative Path Analysis

Interaction Equation

\[ \frac{Pr}{\Omega * Pc} + \frac{8}{9} \left( \frac{Mrx}{\Omega * Mcx} + \frac{Mry}{\Omega * Mcy} \right) \cdot m - \text{factor} \]
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Progressive Collapse
West Façade Column

Alternative Path Analysis
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Architecture Breadth
Existing Interior Atrium View

Atrium Curtain Wall
Redesigned Interior Atrium View
Conclusions

Goals

- Design to UFC criteria
- Explore impacts of this analysis
- Minimal architectural impact

Costs

Progressive Collapse Requirements

- Slab Reinforcement: 596% Increase
- Columns: 113% Increase
- Beams: 9.9% Increase
- Total Superstructure: 7.4% Increase