STRUCTURE ANALYSIS OF SIMMONS COLLEGE SCHOOL OF MANAGEMENT

Fang Xu, Kara Wetzel, Kevin Walsh, Yuting Song
## General Building Data

<table>
<thead>
<tr>
<th>Building Name:</th>
<th>Simmons College School of Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location &amp; Site:</td>
<td>Boston Proper, Institutional Master Plan Area</td>
</tr>
<tr>
<td></td>
<td>300 The Fenway, Boston, Ma</td>
</tr>
<tr>
<td>Building Occupant:</td>
<td>Simmons College</td>
</tr>
<tr>
<td>Function:</td>
<td>Educational Facility</td>
</tr>
<tr>
<td>Size:</td>
<td>66,500 sf</td>
</tr>
<tr>
<td>Stories:</td>
<td>Five floors above grade, five below grade parking levels</td>
</tr>
</tbody>
</table>

### Project Team

| Owner:                  | Simmons College                              |
| CM:                     | Lee Kennedy                                   |
| Payton Construction     |                                               |
| Project Manager:        | Lynne Deninger                                |
| Bill Massey             |                                               |
| Architect:              | Andy Goetze                                   |
| Structural Engineer:    | John Boekelman                                |
| Mechanical Engineer:    | John Swift                                    |
| Plumbing Engineer:      | Mike Forth                                    |
| Geotechnical Engineer:  | Bob Hoyler                                    |
|                         | McPhail Associates                            |

### Dates of Construction

| Start Date:          | August, 2006                             |
| Completion Date:    | December, 2008                           |
| Cost:                | $63 Million, total project cost including the site |
| Project Delivery Method: | Construction Manager at risk, Design, Bid, Build |

The building is a five story educational facility with an additional five levels of sub grade parking.

Interior spaces include classrooms, offices, and administrative areas.

Vehicles access the building under its southwest corner and enter into a centrally planned garage.

The parking garage transitions to the building at the plaza level.

Here, much of the 222 foot square garage is covered by the landscaped quad to the north of the building.

The superstructure sits on the southeast corner of the garage.

Primary pedestrian access to the building is from the quad into the main lobby area.

A green roof patio overlooking the quad is accessible from the fifth floor.

A curving metal screen hides mechanical units on the roof. See figure one above.
Code Requirement & Zoning

Design Codes
- Reinforced Concrete: American Concrete Institute (ACI) 318
- Structural Steel: American Institute of Steel Construction (AISC)

Substitute Codes
- Building Loads: American Society of Civil Engineers (ASCE) 7-05
- Reinforced Concrete: American Concrete Institute (ACI) 318-08
- Seismic Design: AISC Seismic Design Manual
- Diaphragm Design Steel Deck Institute, Diaphragm Design Manual 3rd Edition

Zoning
The Simmons College School of Management lies within the institutional master plan area of Boston Proper. The project met all local Boston Zoning requirements as well as the requirements of the Longwood medical and Academic Area interim guidelines.

The Longwood Medical and Academic Area (also known as Longwood Medical Area, LMA, or simply Longwood) is a medical campus in Boston. It is most strongly associated with the Harvard Medical School and other medical facilities such as Harvard’s teaching hospitals, but prominent non-Harvard and non-medical institutions are located there as well, such as museums, colleges and research centers.

Medical Center has prepared an Institutional Master Plan to provide an up to date inventory and analysis of the current campus, its land and facilities. It provides for the continued use of the existing buildings within Tufts Medical Center Campus, and presents the facility initiatives anticipated within the next ten years, as well as provides directional guidance for development in the following 15-20 years to meet the growing and evolving program needs described above.
Problem Statement

- Existing building stands on one side constraining expansion construction
- Water table near the surface, once dig down, water will gush in, which requires pumping all the time
- Standard construction method costs a lot
Design Criteria

- Resist all the dead loads and live loads according to ASCE 7-05
- Reduce torsional effects induced by eccentricity
- Reduce accidental torsional effects required in load analysis
- Design structural system to meet drift requirements
- Meet all structural requirements for the base and expanded systems
Design Structure

- Post tensioned underground parking
- 3 Feet slurry wall retaining system
- Steel framing structure above ground
- Composite action floor system
- Steel brace frame lateral system
Lateral load combinations applying to this building is determined from ASCE 7-05

**ASCE 7-05 Lateral Load Cases**

1.2D + 1.6 (Lr or S or R) + 0.8W

1.2D + 1.6W + L + 0.5 (Lr or S or R)

1.2D + E + L + 0.2S

0.9D + 1.6W + 1.6H

0.9D + E + 1.6H

### Dead Loads

<table>
<thead>
<tr>
<th>Design Value (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FD01 43.2</td>
</tr>
<tr>
<td>FD02 42.7</td>
</tr>
<tr>
<td>FD03 69.0</td>
</tr>
<tr>
<td>FD04 96.8</td>
</tr>
<tr>
<td>PT floor slab 175</td>
</tr>
<tr>
<td>Structural Steel Per AISC Manual</td>
</tr>
<tr>
<td>Green Roof 100</td>
</tr>
</tbody>
</table>

### Superimposed Dead Loads

<table>
<thead>
<tr>
<th>Design Value (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP 10</td>
</tr>
<tr>
<td>Partitions 20</td>
</tr>
<tr>
<td>Finishes/Misc 5</td>
</tr>
<tr>
<td>Curtain Wall 10</td>
</tr>
</tbody>
</table>

### Live Loads Space

<table>
<thead>
<tr>
<th>Design Value</th>
<th>ASCE 7-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking Floors 50</td>
<td>40</td>
</tr>
<tr>
<td>Plaza 100</td>
<td>100</td>
</tr>
<tr>
<td>Exit Corridors 100</td>
<td>100</td>
</tr>
<tr>
<td>Stairs 100</td>
<td>100</td>
</tr>
<tr>
<td>Lobbies 100</td>
<td>100</td>
</tr>
<tr>
<td>Typical Floor 50</td>
<td>50 (office load)</td>
</tr>
<tr>
<td>Corridors above 1st Floor 80</td>
<td>80</td>
</tr>
<tr>
<td>Roof Garden 100</td>
<td>100</td>
</tr>
<tr>
<td>Mechanical Areas 150</td>
<td>100</td>
</tr>
<tr>
<td>Mechanical Areas 150</td>
<td>100</td>
</tr>
</tbody>
</table>
Wind and seismic loads applying to the building are considered in the primary X and Y directions.

Wind loads were applied to the building at the center of pressure.

Seismic loads were applied to the building at the center of the mass of each floor diaphragm, ASCE 7-05 categorizes the lateral system an R-factor of 6 in EW direction and 3.25 in NS direction.
The system was constructed by Top Down method – Bendneath Slurry Wall, and installed load bearing elements prior to excavation.

Loading bearing elements are constructed with W14 columns from the garage embedded in concrete shafts.

For the main building without underground garage, \( t=0.365''\) \( \Phi=10.75''\) concrete steel pipes are used at column locations.
Structure System – Floor Systems

- The underground parking garage uses post-tensioned concrete slabs for floor system.
- The ground and +1st levels use steel beams with composite floor slabs.
- The upper ground levels use steel beams with composite actions.
Structure System – Columns

- Typical column sections are wide flange sections with some usage of hollow structural steel (HSS). The most widely used column is W14*90.

- All columns below the -1st underground level use 2’-8” concrete diameter round columns.
Structure System – Lateral Systems

- In NS direction, use steel braced frames
- In EW direction, use combination of steel braced frames and steel moments frames.
Structure System – Supplementary Systems

- At the roof, a braced frame screen is utilized to hide the penthouse and mechanical equipment.

- In the underground garage, reinforced concrete members are utilized to ramp access to all parking levels.
Foundation Analysis

- Water level
- Landfill
- Marine clay
- Marine sand
Structure Analysis

Existing Foundations

BENTIONITE

SLURRY WALLS

BEARING

BIGHT

Mechanical Area

Water table 3’ below surface

Landfill

Marine clay

Marine sand
Structure Analysis

Some area have large members
For example: Plate Girder 58*849

Plaza Level
Designed to hold 2 cranes and construction vehicle during construction

Steel columns with 4’ plates at slab
Levels encased in flowable Field to hold in place
Clipped off and encase With concrete.

Lateral Brace
2-way post tensioned 14” concrete slabs

5 story parking garage
600~700 spaces
Construction Process

Step 1
Insert the slurry wall deep into the ground before excavation

Step 2
Build the plaza level and one level below as the construction platform.

Step 3
Then build the above floors

Step 4
The ground floor and under ground floor was built simultaneously

Step 4
Leave the space for the future expansion
Load Tracing
Loading
Moment and Shear

Moment

Shear
Deflection and Axis Forces

Deflection

Axis Forces
Reference

East Coast Slurry
http://www.eastcoastslurry.com/simmons.html

Boston Ground Water Trust
http://www.bostongroundwater.org/let020.html

Academic Thesis

Structure Drawings of Simmons School of Management and New Main Quad, Cannon Design, 2006

Special Thanks to:
Dr. Matt Dates
John Boekelman
THANK YOU!