THE UNIVERSITY SCIENCES BUILDING

NORTHEASTERN, USA

Final Report

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The University Sciences Building

Northeastern, USA

Chris Dunlay | Structural Option | Dr. Thomas Boothby

General Building Information

Size	209,000 SF
Function	Classroom/Office/Laboratory
Height	142' (max) 114' (min)
Construction	August 2006 - December 2009
Construction Cost	Withheld by Owner
Delivery Method	Construction Manager at Risk

Project Team

Owner	Not Released
Architect	Mack Scogin Merrill and Elam
Structural	ARUP
MEP	ARUP
Civil	Civil and Environmental Consultants

Structure

Foundation:

- Drilled Caissons, strip and column footings

Superstructure:

- Lower floors: Formed Concrete columns, beams, and slabs
- Upper Floors: Steel columns and composite floor system
- Lateral System: Concrete shear walls and steel brace frames

Construction

- Foundation of building two was sequenced with construction of building one level 3.
- Complex floor framing and connections delayed fabricators and erectors, delaying overall schedule.

Architecture

- Two building System
  - Building 1– Offices and laboratories
  - Building 2 - Classrooms, Offices, Collaborative Spaces
- Central Idea - Atriums and Open Interactive Spaces
- Unevenly spaced windows with aluminum trim and zinc paneling façade
- Complex floor plans producing interesting cantilevers

MEP Systems

Mechanical:

- 11 Air Handling Units ranging from 4,800 - 40,700 CFM
  - 5 AHU's match exhaust unit with energy recovery wheel
- Multiple zones supplied by VAV boxes with terminal reheat
- Chilled water and steam supplied by the campus utility plant
- 3 atrium smoke exhaust fans

Electrical/Lighting:

- 4.16 kW main switchboard
- Main power is 480Y/277V 3 phase, 4 wire
- 900kW diesel emergency generator
- Lighting consists of fluorescent, metal halide, and decorative LED's

http://www.engr.psu.edu/ae/thesis/portfolios/2012/CJD5135/index.html

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PJ Dick Project Team

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Executive Summary

The University Sciences Building (USB) is a new and modern 209,000 SF educational facility located on an urban campus in the Northeast, USA. The USB has many interesting architectural and structural features that make it one of the most unique buildings in the area. Such features include the use of multi-story atriums, one-of a-kind cantilevers, and a black zinc paneling façade. The showcase atrium is a 3 story, 4400 sq. ft. atrium that utilizes a helical ramp as its main egress to 3 levels, with 2 classrooms that are located through its core. The facility consists of two different buildings, Building 2 – North and Building 1 – South that are connected by a 4 story passage. For the purpose of this report and those previous, only Building 1 will be considered analysis and the redesign

The existing structural system consists of a concrete foundation, steel superstructure with a dual shear wall/braced frame lateral system. The lateral system in Building 1 includes 8 braced frames and 3 shear walls, of which both lateral systems run the full height of the building. The gravity system is composite deck on steel framing with concrete topping.

Upon the analysis of Technical Reports 1 and 3, it was found that the existing building performs adequately under gravity and lateral loads when considering strength and serviceability. Although due to the complexity of the superstructure construction with steel, the construction schedule and cost were longer and larger than their original estimated amounts. For this reason, a redesign of a full concrete system will be investigated. Since the bottom three levels, storage and a parking garage, were originally concrete, only levels 4-Roof will be considered for the redesign. A two way flat plate floor system will be designed as the gravity system and shear walls with concrete moment frames interactive system will be analyzed as the lateral system.

The two way flat plate floor system uses a 12” thick slab with a compressive strength (f’c) of 6,000 psi. Gravity columns sizes range from 24”x24” to 12”x12” and moment frame columns are 24”x18”; both with an f’c of 6000 psi. Due to the complexity of the column/slab configuration, typical bays do not occur regularly. Bay sizes range from 27’x30’ to 16’x16’.

The lateral system consists for 3 shear walls resisting forces in the North-South direction, 4 in the East-West direction, 4 concrete moment frames in the North South Direction, and 3 concrete moment frames in the East-West direction. Shear walls run the height of the building and the moment frames vary in layout. Due to the added weight of concrete, seismic loading controls for both strength and deflection.

Since the driving factor of changing the superstructure from steel to concrete was the complexity and confusion of erection and detailing the steel, a construction management study will be investigated to compare schedules and costs.

Finally, a mechanical bready study will be investigated with an alternative glazing material and how it can potentially lower the cooling load on south facing spaces.