SENIOR THESIS PROPOSAL
STRUCTURAL REDESIGN USING STEEL FRAMING

THE TOWERS AT THE CITY UNIVERSITY OF NEW YORK
NEW YORK CITY, NEW YORK

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DECEMBER 15, 2006
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EXECUTIVE SUMMARY

The Towers at the City University of New York is a new residence hall for CUNY students and faculty. It is the first dormitory for the Manhattan college in its 185 year history. The building is located at 130th Street and Saint Nicholas Terrace in the upper west side of New York City. The 11 story building is capable of housing 600 CUNY students and faculty in 165 apartments. The total cost of development and construction of the Towers was $54 million.

Some of the features of the 185,000 square foot building are fully furnished apartments with private bedrooms, a laundry room, a fitness room, classroom spaces, administrative offices, a reception desk that is operational 24 hours a day, and numerous lounge and study spaces. Ground was broken in May 2005 and was completed in August 2006.

The goal of this thesis project is to redesign to building structure using steel columns, steel beams and composite deck. Steel braced frames will also be implemented where the concrete shear walls were in the building. This will create a more regular column grid layout and eliminate the large concrete columns the corner window spaces.

In addition to the structural redesign of The Towers, other breadth topics will be studied to determine if they have any impact on the steel structural system. The first topic to be studied will be the impact on the construction schedule and cost from changing the framing system from concrete to steel. The second topic will be to determine if a LEED rating can be achieved for the building. A few credits will be studied in depth and to find more cost and energy efficient building systems that can be used in the building.

BUILDING BACKGROUND

The Towers at CCNY is a new residence hall for The City University of New York students and faculty. The 130 apartment unit complex is the first residence hall for the City college in it's 160 year history. The building is located in Harlem, the upper west side of Manhattan.

FOUNDATIONS

The slabs and spread footings sit directly on top of the bedrock. Matt slab foundations that range in thickness from 36″ to 42″ are used to support the loads from the concrete shear walls around the stair and elevator cores. The foundation walls are cast in place reinforced concrete atop spread footings. Rectangular spread footings up to 30″ in depth support the gravity load from the concrete columns.

FLOOR SLAB

The typical structural slab for all 11 stories of the Towers a is two way 8″ elevated flat plate concrete slab. The slab is reinforced with #4 bars at 12″ on center. Extra bars are provided at column locations for added resistance against shear forces. For the basement, a 4″ slab on grade was used. The slab on grade is reinforced with welded wire fabric and is cast over a vapor barrier and 4″ of a porous fill base. The floor system for the first level is the flat plate concrete slab. The floor system of the structural steel penthouse consists of a 4 ½″ concrete slab with metal deck.

COLUMNS

The floor slab is tied in to the columns by studrails at each face, and reinforcing bars over the column transfer the floor loads into the columns. The thin brick prefabricated panels that make up the façade of the building are also connected to the top of the slab with steel angles. Expansion joints are used at the edges of the slab where they meet with the exterior wall panels. 2″ seismic expansion joints are also used at the corners of the building.

LATERAL SYSTEM

Lateral loads imposed on the building will be resisted by concrete shear walls located throughout the building. One wall is located in the north wing of the building, and the other walls are around the stair towers and elevator core. The typical structural layout in Figure 1 below illustrates the locations of columns and shear walls. The floor slab acts as a rigid diaphragm to transfer the toads to the lateral force resisting system. The shear walls are 10″ thick and are reinforced with two curtains of rebar.

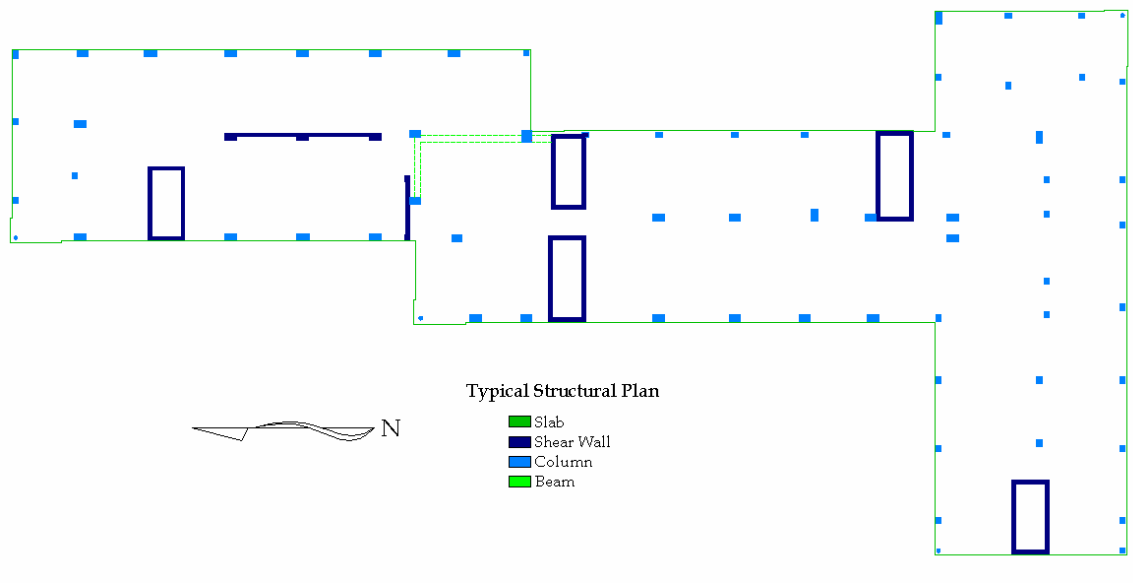

Figure 1: Typical structural framing plan

PROBLEM STATEMENT

The current structural system that was chosen for the Towers is most likely the most efficient system determined by the architect's design for the building based on the results of Technical Assignments 1,2, and 3. However, upon a site visit to The Towers, it was discovered that there were large concrete columns blocking the views out of the corner windows. Also, the columns are currently on an irregular grid which may have impacted the ease of constructibility.

PROPOSED SOLUTION

A steel structural system with columns on a regular is proposed to eliminate the large corner columns where there are windows and to also make the building construction more efficient. The total floor to floor height will be increased with steel, however it was determined that the heights can be increased up to 3 additional feet per the zoning requirements in the City of New York Building Code.

To create the grid, a study of the architectural floor plans will be performed to be sure that the columns will not be placed in window, door or egress spaces. The column grid will be imported into RAM Structural System to model and analyze the new structure. RAM Frame will be used to model and analyzed the braced frames.

BREADTH TOPICS

The first breadth topic that will be studied is the impact of construction schedule and cost by implementing the new steel framing system. The steel cost and schedule will be determined from using Primavera and MC2 software. A comparison will be made between the two framing systems based on the impact of the schedule and the change in cost, as well as constructibility and labor practices in the New York City area.

The second breadth topic is determining if The Towers can achieve a LEED certification. Using the certification criteria provided by the United States Green Building Council, it will be determined if a LEED rating could be achieved for The Towers. A few specific credits out of the 69 total will be studied to determine if more cost and energy efficient building systems can be designed to be used in the building. This analysis will also look at any current conditions that satisfy the LEED requirements.

TASKS AND TOOLS

The following is a list of tasks and tools that will be used for determination of proposed structure and breadth analysis. A schedule is also provided to illustrate the anticipated time needed to complete each task.

- Determination of gravity and lateral loads
  - *ASCE 7-05* for wind and live loads
  - *UBC* for seismic loads
  - *Building Code of the City of New York* for load provisions specific to New York City
- Gravity system design
  - Create new grid layout
  - RAM Structural System model and analysis
  - Design members by hand calculations using *AISC Steel Construction Manual 13th Edition*
- Preliminary braced frame design
  - RAM Frame model and analysis
  - Design members by hand using *AISC Steel Construction Manual 13th Edition*
- Determine construction impact
  - Determine the original construction schedule for casting the concrete columns and slabs
  - Determine cost of concrete construction
  - MC2 to determine steel construction cost
  - Primavera to determine the steel erection tasks and schedule

- LEED certification analysis
  - Research LEED certification criteria
  - Determine if any cost and efficient building systems can be used
- Write final report
- Prepare final presentation

Schedule

Task	Week 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Determination Of loads									SPRING BREAK							
RAM model Of gravity system																
Hand calcs for gravity design																
RAM frame model of lateral system																
Hand calcs for lateral design																
Construction schedule and cost impact																
LEED Certification analysis																
Final Report																
Final Presentation																
Review / Reflect																