901 NEW YORK Avenue

Thesis Proposal

901 New York Avenue
Washington, D.C.
Advisor: Ali Memari
Written by: Timothy H Park

Executive Summary

This report is a summary of design options for 901 New York Avenue. 901 New York Avenue is an 11-story building rising 130'-0" above grade. Located in the heart of the city, it sits on an entire city block, with the Convention Center and other major facilities nearby. Due to city limitations and zoning requirements, the building has been limited to it 130'-0" height and as such, used a two-way floor slab system.

The building rises to the full 130'-0" height, however prices soared due to the complicated design and construction of a two-way post-tensioned floor system. Although more expensive, this system was used to optimize floor-to-ceiling heights. Moment framing was also used to maximize floor space so as to not use shear walls. The typical floor bays were 20'-0" by 40'-0".

This report will assess the possibility of two alternatives to the current structural design that may or may not have been a better alternative. The first is the utilization of shear walls instead of moment framing, and the second is a completely re-design with a steel composite system. These two options both have benefits and downfalls, and will be analyzed and compared to the current system.

Two other breadth options will also be considered for re-design, to show the effects of changing the overall structural design. First is construction management. As changing from a concrete building to a steel structure drastically changes the overall design, it changes cost estimates, scheduling, and overall building construction in a drastic manner. The second is lighting design. Alternative systems maybe lower the floor-to-ceiling heights, so lighting options must be altered to keep the same lighting environment, from day lighting to the 3-story lobby hall on the ground floor.

Three main criteria will be analyzed and compared throughout the three different structural systems. These are: feasibility, cost, and time. Different structural designs requires different time constraints within the construction management field, as different lighting options may or may not alter the means of constructing MEP lines throughout the building.

Many other details and criteria will not be observed for brevity purposes. For example, the switch to steel will completely change all the architectural details. It would also affect the layout of the MEP systems. Although these important factors to the overall building design, it must also be noted that, due to time constraints, not all perspectives can be viewed.

An updated time schedule has also been proposed, planning a day-to-day procedure from Monday, February 26, 2007 to presentation time.

Background

The 901 New York Avenue office building is a mixed-use facility that is used for parking, commercial, and office use. The building stands at a full 130 feet height comprised of 11 stories, including a roof deck and a four-level parking facility (below grade). The land was purchased from Monument Realty to Boston Properties in 2000, and construction began in late 2002.

901 New York Avenue is centrally located in the heart of Washington, D.C. at the intersection of three of the five major business thoroughfares in downtown - New York Avenue, Massachusetts Avenue and K Street. This trophy office building is midway between the White House and the U.S. Capitol, across the street from the new 2.3 million square foot Convention Center and a few blocks from the MCI Center arena. The site is a joint venture with the New York State Common Fund. This 11-story Class A office building features floor plates of 50,000 square feet, a dramatic three-story atrium lobby encased by an all-aluminum truss frame, a rooftop deck, fitness center and concierge service.

The design had many criteria to fulfill in order to satisfy the owner's needs. To have 11 stories and maximum floor-to-floor heights, a two-way flat slab system was utilized to minimize the amount of floor thickness, along with no interior bays. Moment framing was used instead of shear walls to open up the floor space even further. Such a system was mandatory because of height limitations in D.C. (the building was limited to 130 feet).

901 New York Avenue was awarded in 2004 with the Architectural Precast Association Award. It was completed in 2005.

A rendering of 901 New York Avenue

Statement of the Problem

901 NYA's greatest issue was its height limitation. The architect desired large floor-to-ceiling heights in order to encourage innovative interior designing, but the owner could not do so at the expense of losing valuable stories to the building. As a result, it was found that 11" thick flat slabs along with large 20' by 40' bays were possible with a post-tensioned moment-framed structural system. Although not the most cost or time efficient, a two-way post-tensioned slab was the best compromise between the owner and the architect.

Proposal

Other options were considered briefly then overruled for several reasons. For one, shear walls could have provided a simpler lateral-resisting mechanism, but it was assumed that it would have been much too costly to use shear walls. A composite steel framing was proposed, but was turned down as well. This could have been due to lack of fabricators at the time, price of steel, or even simply not enough time for pre-fabrication.

Proposed Solution to the Problem

This proposal expresses the possibilities of both a steel composite system and the use of shear walls in place of the current moment-resisting frame.

To maintain a satisfactory design to the architect and owner, the current bay size and minimal floor thicknesses must be respected. A composite system will be tried (using both moment framing and braced frames) in order to test it viability. Some of the greatest effects this will have on the building will be total weight of the building, depth of floor thicknesses, and layout of the MEP systems. Although a preliminary trial was tested in Technical Report 2, the new trial will test the entire building in its true framing and dimensions. This may prove to have drastically different results from the preliminary trials, as the typical layout of the building is not rectangular (as was the initial test model).

The possibility of shear walls will be first analyzed. Location of the shear walls will be crucial, as shear walls will take up considerable more space on the floors than the current system. Then a comparison report shall determine whether or not it was indeed cheaper to ignore the use of shear walls in the framing of 901 NYA.

All alternatives shall also be observed in the construction management and lighting/electrical breadth options (described next page).

Breadth Options

Since changes in the structural design have an effect on other aspects of the building, 901 New York Avenue will also be briefly analyzed in two other breadth options. The two options will be focused in construction management and lighting design.

Changes in different floor slab systems changes almost entirely the process under which the building is constructed, from the location of the crane to cast-in-place concrete pouring schedule. Since steel is now a possibility, many things must be reconsidered, such as the benefits of pre-fabricated steel off site, running MEP lines throughout the building, fireproofing, etc. The primary change, that which matters most, will be the price change. Depending on current steel prices, or the amount of time required to build and install shear walls instead of a moment frame, these alternatives will have a strong opinion as to whether the current system is the best design.

Although money is a driving force in building construction, aesthetic appeal is also a great point to consider. For example, one-way slab systems with joists will limit the floor-to-ceiling space on each floor. In some cases, natural daylighting is a huge component of lighting the building during the daytime. Additions of dropped ceilings and MEP lines may also caused composite floor systems to have a "cramped" feel inside the building. The second breadth will observe possible changes in lighting design as a means to improve working environment in case floor-to-ceiling heights decrease. Different lighting options will also be considered in the lobby hall entrance.

Construction management was chosen as a breadth option due to its direct effect on structural changes. In essence, one cannot be changed without affecting the other to some degree. For example, a new foundation system changes the scheduling plan of pouring times. Waiting on a shipment of steel also has a different factor from pouring the concrete. Lighting design was considered as the second breadth option as it gives the opportunity to experiment with some aspects of architectural design without fully observing all of the changes and problems that would arise due to changes in structural design. To observe all the changes in architectural design due to structural changes would require more time than given for this observation. It also gives the student an opportunity to express skills outside of the structural option that he has obtained, such as use of 3-D modeling, lighting programs, and general design concepts.

Solution Method

As all design loads were calculated using ASCE-SEI 7-05, the same design aid will be used to observe the use of one-way floor joist systems and a steel structure. For concrete, ACI 318-05 will be used as an aid to design. For steel, LRFD will be used.

RAM will also be used as the main designing program, as it was the program used to design the initial design. Spot checks will be done and observed in order to verify information from RAM.

The final solution will be a system analyzed the following criteria: feasibility, cost, and time consumption. All three systems will be analyzed as such and will be compared likewise. Breadth options will be considered and observed for all three options.

Tasks and Tools

Option 1: Shear Wall Option

1. Determine optimum location of Shear Walls
2. Design
    a. Floor slab thickness changes, overall dead/live loads
    b. Column size changes
    c. Determine changes in foundation layout (if found necessary)
    d. Build in RAM, spot checks
3. Breadth option considerations

Option 2: Steel Composite Floor Slab and Column Alternative

1. Observe location of joists/beams/girders
2. Design
    a. Decking, joist/beams/girders
    b. Column sizing
    c. Composite design
    d. Changes in foundation layout (if found necessary)
    e. Build in RAM, spot checks
3. Breadth option considerations

Conclusions: How did the alternatives compare?

1. Structural Comparison
    a. Cost, Time, Feasibility Comparison
2. Effects in Lighting
3. Effects in Construction
4. Summary

Time Schedule for Spring 2007

February

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
25	**26** **Submit Tech 3**	**27** **Submit Proposal**	**28** L/E Breadth: build model			

March

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 L/E Breadth: build model	**2** L/E Breadth: build model	**3** L/E: fixtures, etc.
4 L/E: fixtures, etc.	**5** L/E Breadth: build model	**6** L/E Breadth: build model	**7** Build New Conc. Model	**8** Build New Conc. Model	**9** Build New Conc. Model	**10** Build New Conc. Model
11 Build New Conc. Model	**12** Build New Conc. Model	**13** Build New Stl. Model	**14** Build New Stl. Model	**15** Build New Stl. Model	**16** Build New Stl. Model	**17** Spot Checks
18 Spot Checks	**19** Review, Consult	**20** CM Breadth: scheduling	**21** CM Breadth: scheduling	**22** CM Breadth: scheduling	**23** CM Breadth: scheduling	**24** CM Breadth: costs
25 CM Breadth: costs	**26** CM Breadth: costs	**27** Misc.	**28** Misc.	**29** Thesis Write-up	**30** Thesis Write-up	**31**

April

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	**2** Thesis Write-up, Consult	**3** Thesis Write-up	**4** Thesis Write-up, Consult	**5** Thesis Write-up	**6** Thesis Write-up, Consult	**7**
8	**9** Misc.	**10** Misc.	**11** **Paper Due**	**12** Presentation Prep	**13** Presentation Prep	**14**
15	**16** **Presentation**	**17**	**18**	**19**	**20**	**21**