The New York Times Building

Technical Assignment Three

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December 2009

Executive Summary

A brief outline of the contents of Technical Assignment 3 will be provided in an executive summary following obtaining information from the Turner Construction phone interview.

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CONSTRUCTABILITY CHALLENGES

The following section will be completed following a phone interview with a Project Manager from Turner Construction who was involved with the New York Times Building project.

This section will be updated prior to the end of the semester, and all course administrators and faculty will be notified via email after revisions have taken place.

SCHEDULE ACCELERATION SCENARIOS

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VALUE ENGINEERING TOPICS

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PROBLEM IDENTIFICATION

An interdisciplinary, team based approach was used to formulate several design and construction issues related to each specific option. The following list outlines many of the core issues and problems that the project team is interested in investigating further, organized by design discipline.

STRUCTURAL SYSTEM

LATERAL SYSTEMS

Through the course of lateral systems analysis by the structural (option-specific) team, it was discovered that several alternatives to the existing lateral system exist. The New York Times Building, as currently configured, does not utilize the most optimal lateral support system- several alternative systems exist, each with their own set of benefits and limitations.

First, the existing cross bracing visible from the exterior is purely architectural in nature. Based on preliminary analysis by structural team members, it became apparent that an equal level of lateral support could be achieved without the presence of cross bracing being used in a structural role, but rather as an architectural feature. This would require minor (if any) alterations to the other lateral support systems. Furthermore, based on the structural research it appears that switching the structure (currently steel with steel outriggers) to one consisting of a concrete core with steel outriggers or to a purely concrete core building are viable options.

Should a purely steel structural system be selected, it was discovered that it is possible to further optimize the structure to allow the removal of the upper outrigger system and create a penthouse suite that could potentially yield higher rental rates for the owners of the building.

Structural Members

Many structural members are built up members- meaning that they were prefabricated off-site and are comprised of several smaller structural elements. The large box columns and the existing lateral system are the most evident implementations of the built up members- the plausibility of replacing these prefabricated members with rolled shapes is one possible area of investigation for structural and construction management team members.

MECHANICAL SYSTEM

Under floor Air Distribution (UFAD) System vs. Ducted System

Currently, a UFAD system is being utilized in the New York Times owned portion of the building. In theory, the UFAD system used in the New York Times Building is very efficient and effective. The floors owned by Forest City Ratner Companies (FCRC) utilize a traditional ducted system.

The feasibility of implementing a UFAD system in the FCRC spaces will be investigated, as will the possibility of using an optimized ducted system in lieu of a UFAD system in the New York Times spaces.

Cogeneration Plant

The cogeneration plant located on the building pedestal serves as a means for the New York Times Building to produce electricity on site with a byproduct of building heat. However, this system does not serve the full electrical or heating load of the entire building- this could be accomplished by increasing the equipment size. In theory, an increase in the equipment size will yield an increased output with regard to electricity and heat- but this increase in output will require an increase in source fuel usage.

The implementation of microturbine generators is one alternative to the current cogeneration plant. Microturbines produce significantly more electrical energy and heat for less consumed fuel.

All team members will be required to determine the changes to the life cycle cost that the system upsizing would generate or remove as well as its impact on other building systems.

Demand Controlled Ventilation Systems

In the current design, ventilation is not provided to workspaces based on how many occupants are in that space. Demand controlled ventilation systems operate by detecting CO_2 levels in a room, and adjusting the ventilation rate accordingly. The provision of ventilation to under-occupied spaces is highly inefficient, especially without proper zoning.

The overall relationship between how demand control ventilation systems impact consumed energy as well as life cycle cost will be analyzed by the team in order to determine a more optimized system.

LIGHTING AND ELECTRICAL SYSTEMS

Very much like Construction Management, many of problems associated with lighting and electrical systems are highly interdisciplinary- particularly with respect to mechanical systems and construction aspects.

Alternative Façade Systems

[Note: Alternative façade systems are included under the Lighting and Electrical Systems category for the purpose of this technical report, but in actuality it will be a highly interdisciplinary category requiring the input of all team members]

The current curtain wall system consists of a series of cylindrical tubes arranged horizontally across the façade of the building. Based on preliminary analysis from lighting/ electrical and mechanical students, the current cylindrical profile is not the optimal shape to control daylighting and solar heat gain.

Alternative façade systems and the configuration of their components will be investigated by the integrated design team with respect to efficiency, constructability, and cost.

CONSTRUCTION MANAGEMENT

Most of the issues outlined above for the three major design areas have very strong construction management implications with respect to project costs, operating costs, and schedule time.

Knuckle Connections and Lateral Cross Bracing

The knuckle connections that are used to connect these cross braces into the rest of the structure are highly customized for the New York Times Building, and are not in standard use throughout the industry. Based on knowledge gained from structural analysis courses regarding constructability, it can be assumed that these knuckle connections require a significant amount of costly prefabrication time.

Since the exposed cross bracing lateral support system does not serve a structural purpose, it is possible to convert the cross bracing to an architectural (rather than structural) feature. By eliminating the knuckle joint connection, it is possible that there could be savings with respect to the lead time and cost of the connection.

Increased On-site Steam Production

Heat is a byproduct of the cogeneration plant equipment and is used to create steam to heat the building. However, the amount of steam produced is far less than the amount of steam required to heat the building. Based on a presentation by the New York Times design team and owner, a significant amount of steam is purchased from local utility Consolidated Edison to account for this difference.

By producing more steam on site, it is possible to reduce the dependency on purchased steam. This could have two very important consequences- a significant reduction in annual utility expenses, and a further reduction in dependence on the local utility grid.

Electrical Service Distribution

Bus ducts provide electrical service for the upper rentable floors, while wire in conduit is used for the New York Times spaces. The usage of wire in conduit can have many challenges with respect to constructability, particularly when it is spanning over twenty-five floors.

By switching to a bus duct system for electrical risers, it is quite possible to significantly reduce the amount of labor involved in constructing the electrical distribution system. It is possible that this could lead to schedule savings, overall project cost savings, and reduce conductor material consumption.

Coordinating a BIM-Based Team

From interactions with team members to date, it is becoming more apparent that the construction management team member will play more of a construction agent/ project architect role in addition to providing constructability, cost, and scheduling advice. An organized management plan and workflow will be required once the interdisciplinary teams formally begin to work together on a daily basis.

Several interdisciplinary team management strategies are currently coming to prominence in the industry. Two schools of thought will need to be evaluated and compared prior to the beginning of next semester: The *BIM Project Execution Planning Guide* created by the CIC research group at Penn State, and the *Integrative Design Guide to Green Building* by the consultancy 7group.

TECHNICAL ANALYSIS METHODS

The needs of a construction management team member in an integrated design team will be far more diverse than in a traditional delivery system. In the case of this thesis project the construction manager will act as a coordinator of the design disciplines, will offer design feedback of their own, and will provide constructability and economic feedback (as in a traditional delivery method).

This section focuses on the four issues presented in the Construction Management subsection of the Problem Identification section of Technical Assignment three in addition to one additional issue specifically related to the BIM Thesis program.

Knuckle Connections and Lateral Cross Bracing

Based on the lateral system analysis completed by structural team members, it is known that the exposed exterior cross bracing serves little to no structural purpose. The cross bracing members of the lateral system are connected to the rest of the structure through a knuckle connection. Due to the complexity of this connection type and its assumed long lead time due to prefabrication, substituting an architectural cross bracing feature for the façade and removing the knuckle connection from the structure will be investigated as a potential value engineering item.

In order to successfully analyze and ultimately make a value engineering suggestion, several important points must be considered. Foremost, the knuckle connections were partially chosen based on architectural appearance. It will be compulsory to maintain a nearly identical (yet non-structural) connection in order to maintain original aesthetic design intent.

Second, it is very likely that at one time during the design process these cross bracing members did serve some structural purpose. If multiple changes are being made to the structural system by other team members, it is important to note that these changes do not then require this cross bracing system to be in place and serve a structural purpose. In other words, it is imperative that there is enough structural redundancy with in place with respect to the lateral system so that the modified cross bracing system will never be required to fill a structural role.

Electrical Service Distribution

The New York Times owned spaces (floors 2-27) are currently provided electrical service by means of a conduit in wire system, whereas the Forest City Ratner Companies spaces are provided service through a system of bus duct risers.

There are several inherent constructability challenges that exist with this configuration-most prominently, wire that is spanning over twenty-five floors will be extremely thick, or many sets of smaller parallel conductors will have to be used. In comparison to a bus duct system, much more time and money will be spent on construction system with the wire in conduit distribution method.

The New York Times Company was initially skeptical over the concept of a bus duct, and felt that after consulting with their facility management group that the more traditional wire in conduit method was more reliable than a bus duct system. If it is determined that a bus duct system is more economical and less of a burden on the schedule, further research will be conducted investigating the lifespan and ease of replacement on the two distribution methods to provide the owner with a more complete set of information.

In order for a successful analysis to take place, the approximate cost of the existing electrical system needs to be compared to that of a proposed bus-duct based riser system. Pricing on bus duct riser equipment will also need to be obtained from manufacturers as well as any relevant construction costs and issues prevalent with this type of system.

Increase On-Site Steam Production

As currently designed, the on site cogeneration plant produces some steam from heat byproducts of the cogeneration process, but not enough to completely meet the demand loads of the building.

After a presentation by the WSP Flack + Kurtz MEP design team for the New York Times Building, it became apparent that the owners of the building were paying a large sum of money (approximately $200,000) on an annual basis to purchase steam from the local utility Consolidated Edison to supplement the demand load for steam. Sustainability was a very important criterion for the owners of the New York Times Building, and providing an opportunity for the building to me more independent from the utility grid should be investigated.

For a successful analysis, several important features of the steam production system and the current local utility provider need to be understood. Two different aspects of steam production can be researched simultaneously. An analysis and comparison of the output effectiveness of several steam producing systems need to be investigated. More specifically, whether or not it is economical to supplement the cogeneration plant with additional equipment of the same type and size, the cogeneration plant equipment should remain in the same quantity but be increased in size, or if additional steam producing mechanical equipment of a different type would be most efficient in offsetting the demand load needs to be investigated. Concurrently, the difference between the average demand load for steam versus steam produced could lead to a better selection of equipment.

Local utility prices were found during by the mechanical team members on a previous technical assignment and can be used to assist in calculating the life cycle cost. However, prices for the actual equipment will need to be obtained from various manufacturers (including the cost of equipment currently in place).

Mechanical system equipment changes are very interdisciplinary in nature and have a very large impact across several other systems. The mechanical and electrical project team members will be analyzing the cogeneration plant for some of the purposes outlined in the Problem Identification section. The structural team member will have to be consulted throughout the process, as any additional mechanical equipment will likely have an effect on the existing structural system in the area.

Additional information regarding the general design and assembly of mechanical systems will also be researched, as outlined in the "Role of a Construction Manager in a BIM-Based Design Environment" in the subsection below.

The Role of a Construction Manager in a BIM Based Design Environment

This wide variety of roles requires that the construction team member be well versed in each of the design options- nearly to the point where they can step in and assist any other team member at any given time. This will be particularly beneficial towards the middle and end of the thesis analysis when other team members require rapid constructability and cost analysis for their various systems. Knowing how these systems function, are built, and designed will facilitate the collaboration process.

First, more research must be put in to understanding how various mechanical systems are designed, and more importantly why each of the elements in the New York Times Building mechanical systems were chosen. Resources such as *Mechanical and Electrical Equipment in Buildings (9th ed.)* will be consulted for basic background information on mechanical system design. This will lead to much more efficient and effective communication between construction management and mechanical team members, and ultimately a much better designed building. Based on prior coursework and field experience in lighting and electrical design and structural analysis, these areas are less of a concern.

Second, the construction manager should thoroughly research various integrated design and BIM project management guides- the foremost of each category being *BIM Project Execution Planning Guide* created by the CIC research group at Penn State, and the *Integrative Design Guide* to Green Building by the consulting team 7group, respectively.

[Note: at the time of the initial submission of Technical Assignment 3, Team 2 was not able to successfully complete a BIM execution planning session with university faculty. This will be completed prior to the completion of the proposal, and incorporated into the revised CM technical assignment 3 (here) and into the proposal itself].

It is important to note that these guides were designed for teams of industry professionals, often in a situation where different disciplines work in different offices altogether. These guides are not entirely representative of the conditions of the BIM Thesis program, where only four students with different foci are working collaboratively.

Most importantly, as the construction manager and one who will likely be responsible for integrating the other design options, I intend to utilize the aforementioned guides and choose the best aspects of each that apply to the BIM Thesis team. At the conclusion of the thesis project, I intend to compare the structure that my group functioned best in compared to those suggested by the guides and analyze why certain differences may have arose. Any application these instances have to project delivery methods in industry will be highlighted and documented.

The Integrated Design Team Analysis Process

Several theories regarding the management and structure of the decision making/ analysis process of integrated design teams using BIM have come into prominence. Both the *BIM Project Execution Planning Guide* and portions of the *Integrative Design Guide to Green Building* suggest that the various design and construction disciplines work together semi-independently on the building as a whole and gradually begin to work more cohesively as the project progresses, coordinating each of their individual work with one another at established collaboration points. Due to the scale of many projects, the fact that in many cases the design and construction disciplines can be located very far away from one another, and that many individual (discipline specific) firms are highly dependent on the design/ performance of their system, the gradual cohesion of teams over time is a logical approach.

However, the configuration of the BIM Thesis teams is remarkably different. All of the design and construction team members are in one location- this allows for a slightly different approach to the integrated design process. Due to the background of architectural engineering students, it is quite possible that any student in an interdisciplinary team is capable of engaging in an informed design or construction discussion regarding an area of specialty outside of their own.

Based on this, it is possible that an integrated, sequential task-based problem solving method can be used. In this problem solving method, all interdisciplinary team members work on the same problem at the same time and strive to reach a common goal identified by the group. Ideally, the varied specialties and backgrounds of the team members will lead to different perspectives in solving the problem as a team, and this will ultimately lead to a solution that benefits all parties. For example: The team agrees as a whole that the cogeneration plant in a current design is not as optimized as it could be and evaluates changes to the system, receiving input from all team members in the initial design process.

In contrast, the traditional approach would be for each team member to have their own personal, discipline driven goals and merely interact with other team members as their own goals required the input of someone with a different specialization. For example, a mechanical student realizing that the cogeneration plant is undersized, increases the size of the equipment and then notifies the structural student that the loads have increased and the structural system should be changed accordingly.

The core difference in the two strategies is that the traditional method favors improvements an individual system, whereas the method employed by BIM Thesis Team 2 will ideally favors interdisciplinary problem experienced by the building as a whole. The entire team outlines major issues and then solves each of these issues in sequence.