The New York Times Building

IPD/ BIM Thesis Technical Assignment Three

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EXECUTIVE SUMMARY

The first section of this report focuses on problem identification pertaining to the New York Times Building and IPD/BIM Thesis Team 1. Many problematic areas of the New York Times Building are identified within the problem identification section of this report. Problematic areas are situations pertaining to construction and design that may affect the building in a negative way. The areas covered are BIM Execution Planning, structural collaboration, mechanical collaboration, and lighting/electrical collaboration. These areas cover many topics relating to the building in addition to Team 1.

Each issue is also analyzed to address the problems and challenges identified. Individual issues are discussed on how analysis will be completed, along with any further research that is required. Specific design and construction analyses are stated, along with ideas for areas of collaboration between design options.

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PROBLEM IDENTIFICATION

The purpose of the problem identification is to state several problematic features of the building that could be pursued through a detailed analysis. Technical building systems and construction methods will be considered and reviewed. This IPD/BIM report will address construction management issues as well as problems associated with each team member. The main theme is based on team collaboration between each team member. There is also the interaction and between each design option as well as the construction management issues associated with each.

BIM EXECUTION PLANNING

Introduction

A Building Information Model Execution Plan is a four-step procedure to develop a structured plan for BIM implementation. The BIM Plan outlines the overall implementation and vision for the team to follow throughout the project. A traditional BIM Plan is developed early in a project, and is updated, monitored and revised throughout the project. A BIM Plan defines the scope of BIM execution on the project, identifies the process flow for BIM tasks, defines the information exchanges between affected parties, and describes the required project and company infrastructure required to support the implementation. Collaboration is a vital part of Building Information Modeling, and the BIM Execution Planning Guide developed by Penn State CIC Research Program serves as a great resource for developing a BIM Ex Plan. The overview of the BIM Execution Planning Procedure from the guide is shown in Figure 1.

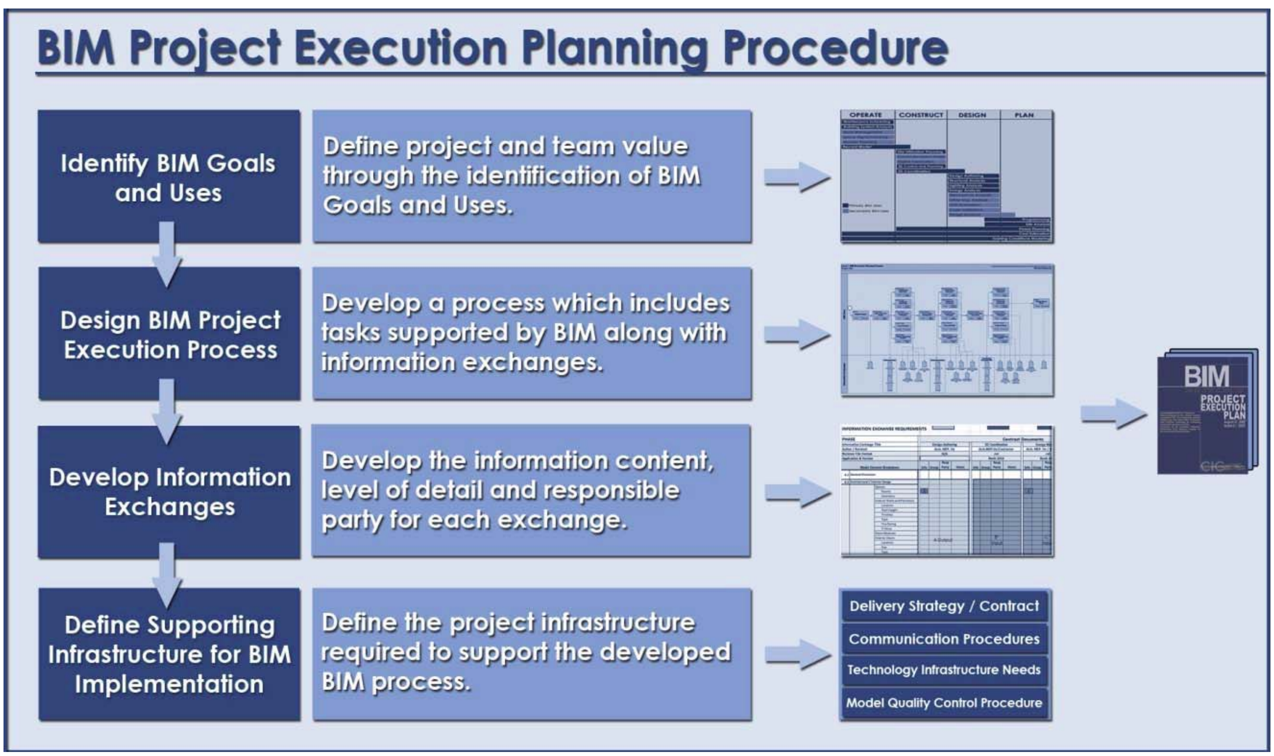

Figure 1: BIM Execution Planning Procedure

When referencing the BIM Execution Planning Guide, the beginning of the process requires the identification of BIM Goals and Uses. The goals and uses were developed as a team during multiple meetings between all team members along with the aid of members of the CIC Research team that developed the BIM Execution Planning Guide. After developing the goals, BIM use analyses were developed for each goal and potential use for the project. BIM uses are unique procedures or tasks, which can benefit from the integration of BIM into that process. The uses include design authoring, engineering analyses, 4D modeling, LEED Evaluation as well as many other uses.

An analysis of the potential BIM uses is accomplished after the goals and uses are defined. The analysis focuses on desired outcomes for the project as well as value to the project and responsible parties. The analysis also defines the capability of affected parties and any additional responsibilities or competencies required for the project. Could a detailed BIM Execution Plan be used for a premier high-rise building?

Identifying BIM Goals

At the beginning of the BIM Ex process, our team developed BIM goal applicable to the entire team as well as specialized goals for each respective option within the team. These goals also addressed the desires of the owner. Goals were developed to be well defined, obtainable and measurable. Our team began with general, overarching goals, which will be undertaken by all members of our team. These goals were chosen as "Unification" and "Sustainability." These two goals act as a common theme for the entire team. Additional goals were then developed for individual options pertaining to the project. The goals were developed to reflect the desires of the owner as well as the specific options within the team. Some goals relate to specific team members, while other goals relate to multiple team members. After BIM goals were developed, potential BIM uses were defined for each goal. Some uses include cost estimation, record modeling, energy analysis, 3D coordination and virtual mockup. A breakdown of the goals developed for Team 1 is shown in Figure 2.

Priority (1-3)	Goal Description	Potential BIM Uses
1- Most Important	**Value added objectives**	
0	Pull all ideas together (Unification);(Sustainability)	ALL
1	Preserve Architectural Integrity (Desires of Owner)	Design Reviews, Design Authoring, Record Modeling
1	Emphasize Energy Efficiency (Carbon Neutral)	Energy Analysis, LEED Evaluation
1	Maintain/Exceed Occupant Safety/Health/Comfort	Energy Analysis, Daylighting Analysis, Code Validation, Structural Analysis, Disaster Planning
2	Optimize façade to meet goals	Energy Analysis, Lighting Analysis, LEED Evaluation, Site Analysis, Structural Analysis, Cost Estimation, Construction System Design
2	Optimize Electric Lighting to respond to Daylight	Lighting Analysis, Energy Analysis
2	Optimize Structural System for increased space, reduce construction duration, reduce cost	Structural Analysis, 4D Modeling, Cost Estimation, Construction System Design
3	Increase profitability of the building	Cost estimation, 4D Coordination, Digital Fabrication, Virtual Mockup

Figure 2: BIM Goal Descriptions and Potential BIM Uses

BIM Uses Analysis

A BIM Use Analysis is completed following the completion of BIM goals and potential BIM uses. Each BIM use is placed in the BIM Use Analysis worksheet to determine whether each use is worth implementing on the project. Each use is then analyzed for the value to the project, responsible parties and value to the responsible parties. A capability analysis is then rated for each party on each BIM use. Capabilities include resources, competencies and experience. Resources and competencies were not determined because the team resolved that experience level would be driving the selection process. Additional resources and competencies required are also determined for the selection process. Once the analysis was complete, specific BIM uses were chosen to be pursued or omitted by the team. There were also some uses that require further investigation due to an unclear resolution. The BIM Use Analysis worksheet can be seen in Figure 3.

BIM Use*	Value to Project	Responsible Party	Value to Resp Party	Capability Rating			Additional Resources / Competencies Required to Implement	Notes	Proceed with Use
	High / Med / Low		High / Med / Low	Scale 1-3 (1 = Low)					YES / NO / MAYBE
				Resources	Competency	Experience			
Maintenance Scheduling	LOW	NONE							**N**
Building Systems Analysis	HIGH	Ben	H			2			**Y**
		Craig	H			2			
		Nicole	H			2			
Record Modeling	MED	Justin	L			1			**N**
Cost Estimation	HIGH	Justin	H			2			**Y**
4D Modeling	MED	Justin	H			3			**Y**
Site Utilization Planning	LOW	Justin	L			1			**N**
Layout Control & Planning	LOW	Justin	L			1			**N**
3D Coordination (Construction)	LOW	Justin	M			2			**N**
Structural Analysis	HIGH	Ben	H			3			**Y**
Mechanical Analysis	HIGH	Nicole	H			2			**Y**
Lighting Analysis	HIGH	Craig	H			3			**Y**
Energy Analysis	HIGH	Nicole	H			2			**Y**
Site Analysis	HIGH	ALL	H			2			**Y**
Design Reviews	HIGH	ALL	H			2			**Y**
3D Coordination (Design)	HIGH	ALL	H			2			**Y**
Existing Conditions Modeling	HIGH	ALL	M			3			**Y**
Design Authoring	HIGH	ALL	H			3			**Y**
Programming	LOW	BOB	H			1			**N**
LEED Evaluation	LOW	ALL	L			1			**M**
Construction System Design	MED	Justin	H			1			**M**
Virtual Mockup	MED	All	H			3			**Y**

Figure 3: BIM Use Analysis

STRUCTURAL COLLABORATION

Lateral System Change

Proposing a new lateral system will have several effects on the building. When first designed, the building contains a complete steel structure. The core is comprised of built up steel columns, which transfer the wind and seismic loads from the exterior of the building down to the foundation. The steel core results in a very large lead-time needed for ordering the steel. There are also problems with the required space needed for layout and storage on site. By changing the lateral system to a concrete core, there are many possible implications to the construction schedule, cost, constructability and architecture. Some issues arise when dealing with the specific unions for concrete and steel construction.

There are also issues that arise from concrete construction starting before steel construction. There are scheduling implications, cost changes for labor and schedule as well as materials, and possible implications for occupancy of the building to occur earlier or later. While keeping the desires of the owner and architect is vital while changing the lateral system, some changes may need to occur to make the change succeed. Specific layouts of the spaces could result from the change along with key building features including emergency stairs and service elevator access. There could also be more coordination issues between the structural system and the mechanical system when dealing with the distribution to each floor. What are the effects of changing the lateral system to the owner, architect, engineering design and constructability? When changing the lateral of the building, can the building be improved while retaining the desired image of the owner and architect?

MECHANICAL COLLABORATION

Mechanical Systems Change

Changing the mechanical system can have many effects on the building. One possible change would involve creating a hybrid ventilation system for the entire or part of the building. The changes could improve indoor air quality or create a reduction in equipment sizing and energy loads. When discussing the possible changes to the ventilation system, several ideas occurred. The first idea was to include operable windows along the facade of the building. The windows could be controlled electronically thus creating a more controllable system.

The ventilation system could also allow for passive ventilation throughout the building. When properly controlled, these changes could generate a reduction in loads. The change could influence cost and scheduling with increased labor spent on installation and commissioning of the system. There is also the possibility of reducing initial cost as well as long-term cost savings by decreasing mechanical system sizing as well as improving building efficiency. With operable windows, security and safety are major factors associated with the change. Operable window will only be able to open to a certain distance, and may be limited to certain areas of the building due to public and occupant safety.

By reducing mechanical equipment, there is the opportunity for interaction between the mechanical, structural, electrical and construction teams for the project. Would a hybrid ventilation system offer improved building function while maintaining constructability?

Sustainability

Renewable energy is an increasing standard throughout the industry. Reducing energy usages, as well as improving efficiency are current trends in the construction industry. While the New York Times Building has taken an effort to reduce its dependence on energy, some improvements could still be made. One option is the addition of renewable energy systems to try to promote an off-grid aspect to the building. Currently, the New York Times Building contains a cogeneration plant on site that utilizes heat recovery to aid the absorption chillers within the building.

Renewable systems could be included throughout the building by adding different systems in optimal places. Some systems could include bio-fuel, solar/thermal and photovoltaic. Other energy reduction systems discussed include thermal mass, phase change and facade studies along with expanding or altering the under floor air distribution system that is already in place in the New York Times spaces or introducing a chilled beam system within the building. Each of these options would also require the integration between each member of Team 1. By adding additional systems to the building, could energy use from the grid could be reduced and could possibly be reduced to zero? Could these systems be tied into the existing on-site cogeneration plant?

LIGHTING/ELECTRICAL COLLABORATION

Façade Systems Optimization

Currently, the facade of the New York Times Building consists of a double-skin curtain wall system with ultra clear glass from floor to ceiling and a ceramic tube array on the exterior, which acts as a shading screen. The facade offers the opportunity to alter the components contained within the system. Altering the composition of the shading system could improve the functionality of the system as well as the entire building. The facade could also integrate renewable energy systems to improve sustainability. Photovoltaic tubes replacing the current ceramic tubes would retain the architectural look of the building while improving building function. Is integrating renewable energy systems into the facade economically viable? Could changing the glazing system improve energy efficiency?

Energy Performance

Energy performance is another problematic area of the New York Times Building. Controls systems are in place to track occupancy, daylighting, shading, and glare. Some systems can be problematic and not function properly, resulting in a less than optimally functioning building. Additional controls could be applied to the existing building control system to improve energy performance. These systems would include an occupancy controlled electrical outlet system throughout the office and cubical spaces as well as an artificial lighting system to focus more on task lighting instead of overall space lighting distribution. Could integrating these systems improve energy efficiency? Would adding these controls be economically practical to include in upfront construction costs? What would be the payback or long-term gains associated with incorporating these systems in all or part of the building?

A summary of design considerations generated by Team 1 can be found in Appendix A.

TECHNICAL ANALYSIS METHODS

BIM EXECUTION PLAN

After the goals and uses are determined for the BIM Execution Plan, there are several more steps, which follow. First, Mapping the BIM project execution process needs to occur. Mapping requires a BIM overview map, which shows the relationships of BIM uses employed on the project. Mapping also requires a more detailed BIM use process map, which identifies responsible parties for each process, reference information content, and information exchanges.

Requirements for each information exchange must be defined next along with developing the infrastructure for the BIM project execution plan. Additional research needs to be completed for implementing the BIM Project Execution Plan. Several case studies are included within the BIM Execution Planning Guide developed by the Penn State CIC Research Team. These case studies need to be evaluated and analyzed to determine similarities and differences between them and the New York Times Building.

Virtual mockups could also be vital to the construction process and should be researched more in-depth. By organizing and planning with all options, a virtual mockup may prove to be beneficial. The construction team initially constructed multiple mockups to ease construction issues, especially with the curtain wall system. A virtual mockup could help ease construction issues without expending materials or excessive labor hours to construct a mockup that may be torn down after completion of the building. By planning and executing the BIM Execution Plan to include enough detail for a virtual mockup, there may be the possibility of improving the finished product.

STRUCTURAL

Further analysis of the system change would consist of analyzing the effects on multiple areas. First, a major analysis would occur with the sequencing and scheduling of the separate trades of concrete and steel. Research of possible trade interaction, as well as 4D scheduling and phase planning could be explored to optimize the lateral system change. Cost analysis could be researched to show possible project savings or distribution to different times during construction. An architectural analysis could also be performed to discuss the architectural implications defined by the lateral system changes. Changes to the layout of building core spaces, as well as vertical distribution throughout the core could be researched and analyzed. The ability to enhance building construction methods to occupy the building earlier could also be researched by analyzing the scheduling implications and changes due to a different lateral system.

MECHANICAL

A hybrid ventilation system has several areas for analysis. While operable window systems are utilized on many buildings, research could be conducted on the constructability of the system on a high rise building in an urban environment. Research should also be done to show how safety is maintained for building occupants as well as the public. The control system should be investigated for cost, installation and commissioning implications along with feasibility of positioning the system over the entire facade, or just part of the building.

Adding more sustainable systems to the building is also an area for analysis. Renewable energy sources often have high upfront costs, and long pay-back periods. Research could include an upfront cost versus pay-back period analysis, as well as constructability of the different systems. Also, analysis could include the effectiveness of different systems, and the ability to reduce dependency on purchased energy. Additional research could be conducted for new and improving systems that could be applied to the building, or planned for the future. Analysis of maintenance for the systems in addition to tying the systems in with the existing cogeneration plant could also be completed.

Lastly, collaboration between each member of Team 1 could be analyzed. Changes to the mechanical systems could influence structural design as well as electrical and lighting design, which would also affect construction cost, schedules and labor utilization. Software usage could be researched to track cost, update schedules or improve constructability by performing clash detection. A LEED evaluation may also be researched as to the usability of collaboration and technology in relation to tracking LEED certification.

LIGHTING/ELECTRICAL

The facade system in place on the New York Times Building offers many areas for analysis. The ceramic tube shading system on the exterior side of the curtain wall offers the analysis for optimizing the shading system. Changes to the shape or spacing of the ceramic rods along with a complete change to the shading system can be researched and analyzed. Changing the ceramic rods to the renewable energy system of photovoltaic tubes could be researched for cost, scheduling, lead and lag time, installation, controls and commissioning problems associated with the new system. Changing the glazing system from ultra-clear glazing to trichromatic glazing is researchable by comparing costs for different glazing as well as long-term savings due to energy load reduction.

Energy efficiency could also be improved by analyzing or adding controls systems within the building. Improving commissioning could be vital to the overall building function, while adding electronic controls may be imperative to reducing energy loads and continuing operational cost. The functionality of an occupancy electrical outlet control system could be researched further for constructability and commissioning issues.

Mockups are constructed to communicate complicated building components and systems away from the building to ensure fewer mistakes in the field. Virtual mockups are a great way to reduce costs and waste due to building actual mockups on or off site. While virtual mockups have been used on construction projects, further research could be completed for the usability of a virtual mockup for constructability in conjunction with daylighting or energy analysis. The software needed exists, but the ability to convey detailed information within the model needs to be researched and developed.

APPENDIX A: DESIGN SUMMARY

Structural

- Lateral System
  - Concrete Core
    - Possible reduction of outrigger number or size
    - Concrete Shear Walls 30''-24''-18'' thickness @ 20 Story Intervals
    - Architectural Impacts
      - Returns within elevator shafts and center area between elevator shafts
      - Spatial layout impacts
      - Emergency stair access
      - Service elevator openings
      - Mechanical equipment openings

Mechanical

- Façade Studies
  - Hybrid Ventilation
    - Operable Windows
    - Passive Ventilation
    - Reduce Energy Consumption
  - Renewable Energy – Biofuel, Photovoltaic, Solar/Thermal
    - Potential for off-grid
    - Energy use / Emissions Reduction
  - Emerging Load Reduction Strategies
    - Phase Change
    - Thermal Mass
    - Façade Studies
  - System Alternatives
    - Chilled Beams
    - UFAD

Lighting/Electrical

- Daylighting Optimization
  - Photovoltaic Integration
    - Change ceramic-rod system on facade
  - Daylighting Analysis
    - Effects of facade changes
    - Controls
    - Electrical response to new daylighting
    - Trichromatic Glazing
  - Optimization of Energy Performance
    - Ambient and task lighting changes
    - Occupancy controlled plugs
  - Aesthetic Lighting Designs