THE NEW YORK TIMES BUILDING

IPD / BIM THESIS - PROPOSAL

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EXECUTIVE SUMMARY

The following document is a proposal of the work that will be completed during the spring 2010 semester by the IPD / BIM thesis team 3, which includes Matthew Hedrick, Kyle Horst, Casey Leman and Andres Perez. The purpose of this proposal is to introduce alternative concepts in the design and construction of the New York Times Building by utilizing both an integrated project delivery method and building information modeling. The alternative concepts will focus on achieving an overall team goal of increasing the profitability and marketability of the building while maintaining its iconic and sustainable image.

In order to achieve this primary goal, the following three strategies have been identified:

1. Decrease the floor to floor height with the intension of adding additional rentable floors.
2. Redesigning the core configuration structurally and architecturally in order to add additional rentable space to each floor while maintaining the efficiency of the lateral system.
3. Improve the sustainability profile of the spaces to add marketability and possibly charge a higher rent.

To achieve a decreased floor to floor height several the team is considering modifying the structural floor configuration to a castellated composite steel beam system. In addition the underfloor air distribution system will be replaced with an active chilled beam system which will be coordinated with the castellated beam system. A feasibility study will be done in order to determine the viability of adding additional rentable floors.

The redesign of the core configuration will involve an investigation of alternative architectural layouts in order to increase rentable floor area. When changing the architectural configuration of the core the layout of the lateral system must be a consideration. Therefore, the opportunity of redesigning the lateral force resisting system with an alternative solution was presented. The alternative solution to be explored is that of a concrete core with outriggers on the mechanical floors. The investigation of the core will also involve an analysis of necessary infrastructure such as elevators and MEP risers.

Improving the sustainability profile will involve two main redesign tasks. The first will involve the façade which currently contributes to a large portion of the overall building cooling and heating loads. The team will work toward developing an alternative design which will optimize energy usage and maintain acceptable daylighting of the space. The second task will involve a redesign of the cogeneration system in order to decrease energy costs and associated emissions for the building. The goal for this redesign is to supply The New York Times Company floors with 100% of its power needs, but ultimately cost, energy use and emissions will be the driving factors.

It will be the responsibility of all of the team members to update a central BIM file that the group uses. This model will be used to coordinate the different redesigns and efficiently organize the interior spaces of the New York Times Building. It will be important to analyze what ways BIM helped our project. Integrating the efforts of each of the team members is of high importance of this project. It will be essential to keep open the lines of communication between all of the team members. Utilizing BIM to aid our methods of analysis will help to integrate our ideas together.

THE BACKGROUND OF THE PROBLEM

The New York Times Headquarters Building (NYTB) is home to the New York Times newsroom and offices, as well as several law firms, whose offices are leased through Forest City Ratner. In collaboration with FXFOWLE Architects, the intent of the Renzo Piano Workshop was to introduce a flagship structure which promoted sustainability, lightness, and transparency. The architectural façade reflects the ever-changing environment surrounding the building, an appropriate acknowledgment of the heart of New York City.

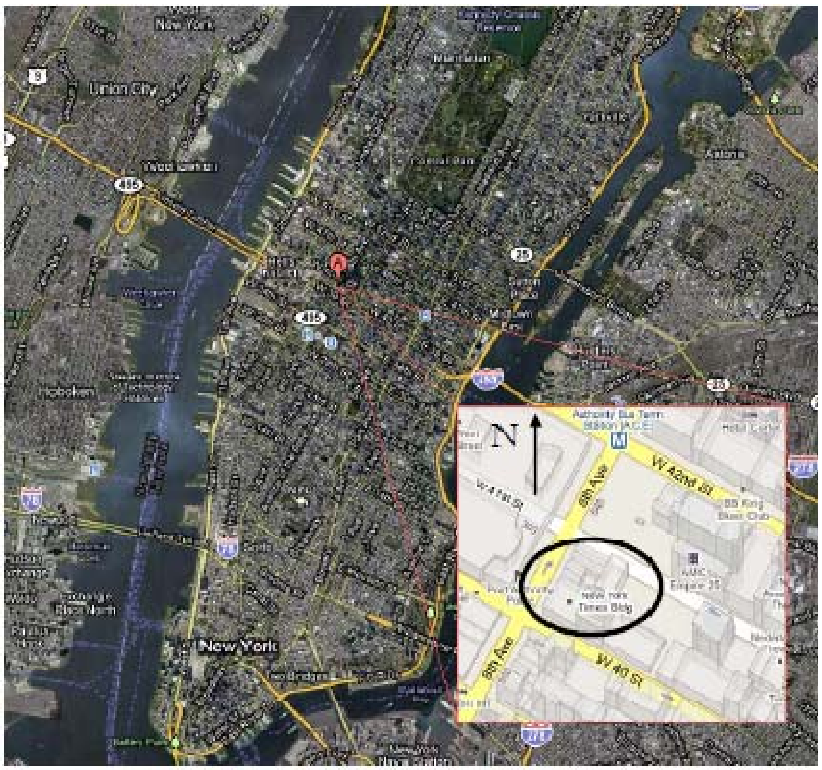


Figure 1: New York Times Building Location (Google Maps)

The 52 story, 1,500,000 square foot building rises 744 feet above Eighth Avenue between 40th and 41st Street creating a 200' x 400' footprint. The tower's 300 foot mast allows for the structure to top out at 1048 feet above ground level. The New York Times occupies the entire five-story podium of the structure, and the first 27 levels in the tower. The additional levels are the office spaces leased through Forest City Ratner. Story heights average approximately 13 feet 9 inches in the tower, lending a great view to the open office plans. At the mechanical floors on levels 28 and 51, however, the floor height is approximately 27 feet to accommodate equipment and steel outriggers which link the perimeter columns to the braced framed core.

STRUCTURAL SYSTEM BACKGROUND

EXISTING GRAVITY SYSTEM

30" by 30" box columns (Figure 2) surround the perimeter of the New York Times Building's tower. These columns consist of two 30 inch long flange plates and two web plates inset 3 inches from the exterior of the column on either side. Each web plate decreases in thickness from 7 inches as the column extends up the structure to account for the reduction in axial loads. Each flange plate decreases from 4 inches in thickness to relate to the architectural vision of the tower. Interior columns are a combination of built-up sections and rolled shapes. Column locations stay consistent throughout the height of the building, and every column is engaged in the lateral system.

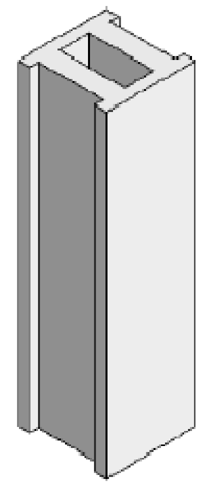


Figure: 2: Box Column As Modeled In Revit Structure

The existing floor structure of the NYTB is comprised of a composite steel beam system. The typical bay size is 30'-0"x 40'-0" with 2 ½" normal weight concrete and 3" metal deck, typically spanning 10'-0" from W12x19 to W18x35 infill beams. These infill beams frame into W18x40 girders which in turn, transfer the floor loads to the various build-up columns throughout the structure. The rectangular bays are configured into a cruciform shape around the perimeter of the core. This composite system was selected to reduce the self weight of the structural system which greatly affects member sizes in high rise buildings. By reducing member sizes, the structural system was able to conform to "transparency" desired by the architectural design. Refer to Appendix B to view the typical floor framing plan.

EXISTING LATERAL SYSTEM

The main lateral load resisting system for the tower of the New York Times Building consists of a centralized steel braced frame core with outriggers on the two mechanical floors (Levels 28 and 51). The structural core consists of a combination of concentric and eccentric bracing which surrounds elevator shafts, MEP shafts, and stair wells. At this time, the member sizes of these braces have yet to be disclosed. The core configuration remains consistent from the ground level to the 27th floor as shown in Figure 4. But above the 28th floor, the low rise elevators were no longer required. In order to optimize the rentable space on the upper levels of the tower, the number of bracing lines in the North/South direction were reduced from two to one (Figure 5). Refer to Figures 6 and 7 to view the typical core bracing configurations.

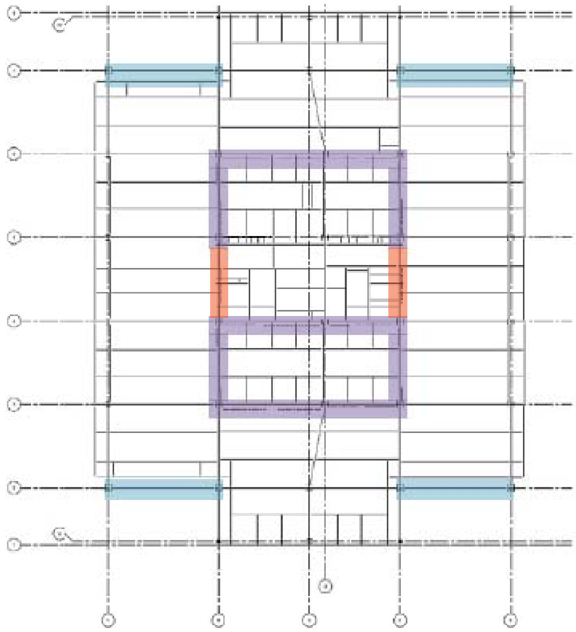


Figure 4: Typical Lateral System (Floors 29 50)

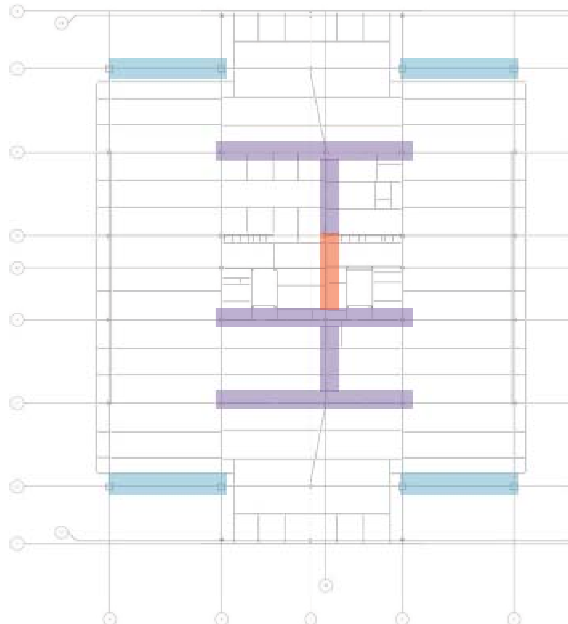


Figure 5: Typical Lateral System (Floors 1 27)

Key:
- Single Diagonal Bracing
- Pre-Tensioned Steel Rod X-Bracing
- Chevron & Eccentric Bracing

The outriggers on the mechanical floors consist of chevron braces (Figure 10) and single diagonal braces. The outrigger system was designed to increase the stiffness of the tower by engaging the perimeter columns into the lateral system. Refer to page 7 to view the framing plans and bracing elevations of the outrigger system.

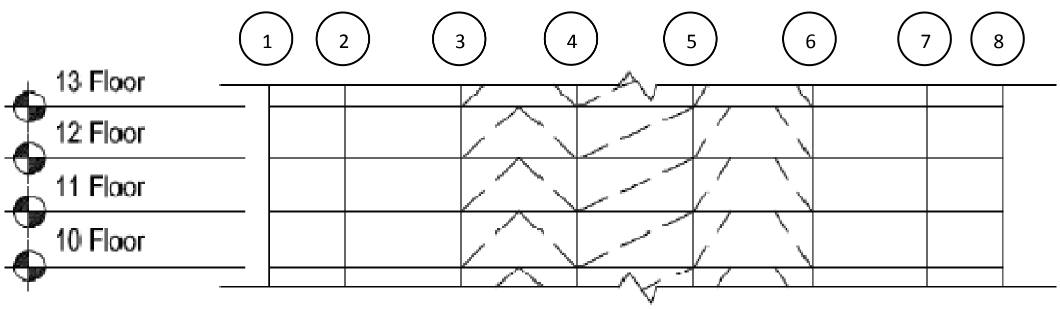


Figure 6: Typical Core N/S Core Bracing Elevation

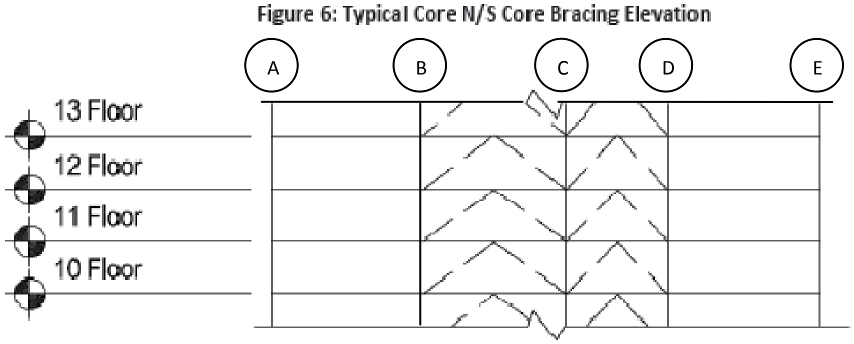


Figure 7: Typical Core E/W Core Bracing Elevation

In order to increase stiffness and meet wind deflection criterion, the structural engineers utilized the double story steel rod X-braces (original to Renzo Piano's exterior design) instead of increasing the member sizes of the main lateral force resisting system. These X-braces can be located on Figures 4 and 5 on the previous page. The steel rods transition from 2.5" to 4" in diameter and were prestressed to 210 kips. This induced tensile load prevents the need for large compression members which would not conform to the architectural vision of the exterior.

Figure 8: Image of Rod X-Braces at Notches

Although the X-braces did reduce the need for an overall member size increase, the lateral system still did not completely conform to the deflection criterion. Therefore, some of the 30” by 30” base columns were designed as built-up solid sections which reduced the building drift caused by the building overturning moment. After combining these solid base columns and the X-braces with the main lateral force resisting system, the calculated deflection of the tower due to wind was L/450 with a 10 year return period and a building acceleration of less than 0.025g for non-hurricane winds.

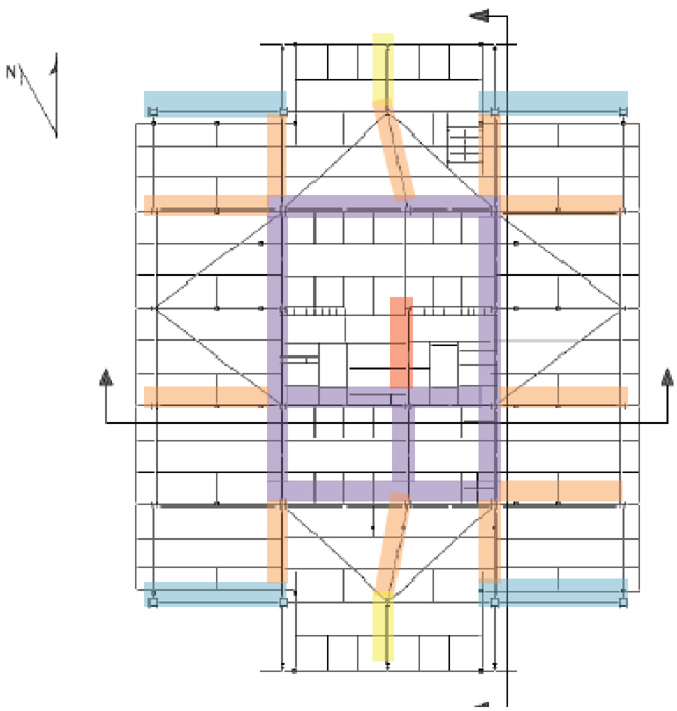


Figure 9: Mechanical Floor Framing Plan (Floors 28 & 51)

Key:
- Single Diagonal Bracing
- Pre-Tensioned Steel Rod X-Bracing
- Chevron & Open Knee Bracing
- Outrigger Bracing
- Single Diagonal Brace at Cantilever

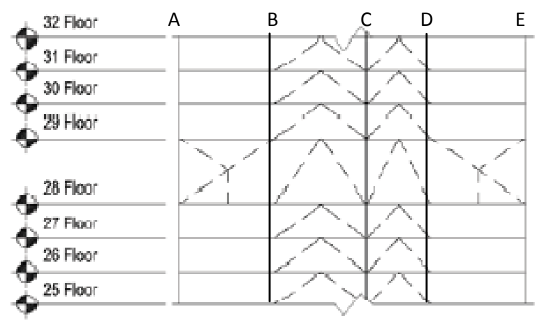


Figure 10: Typical E/W Outrigger Section (28th Floor)

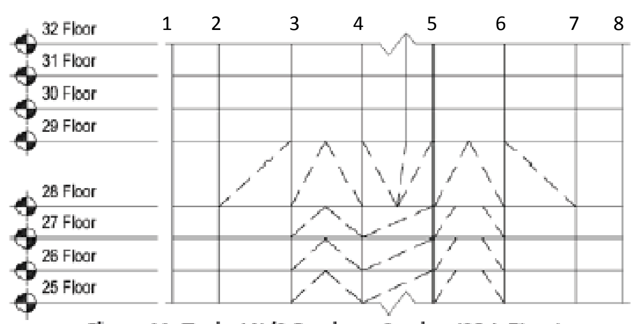


Figure 11: Typical N/S Outrigger Section (28th Floor)

MECHANICAL BACKGROUND

The building cooling load is served by a 6250 ton chilled water system, which consists of five 1,200 ton centrifugal chillers and one 250 ton single stage absorption chiller. The chilled water is pre-cooled by the absorption chiller before it enters the centrifugal chillers. A 1.4 MW natural gas-fired cogeneration plant with two parallel reciprocating engines provides the waste heat to run the absorption chiller. Both the chilled and condenser water system utilizes a variable flow primary pumping scheme, and a water-side economizer which provides "free cooling" and increased energy savings. Heating for the building is provided via high-pressure steam purchased from Consolidated Edison. Low-pressure steam is then distributed to each floor-by-floor air handler's heating coil. As an added cost, the New York Times Company also uses steam to humidify outdoor air.

Air distribution is achieved via variable air volume boxes for interior zones and fan powered boxes with heating coils for exterior zones. The floors occupied by the New York Times utilize an UFAD system (See Figure 1 below). Swirl diffusers were installed to provide occupant control, while in high occupancy spaces perforated floor tiles provide a more visually pleasing layout. A traditional overhead ducted system was implemented on the Forest City Ratner floors. Demand controlled ventilation is achieved via carbon dioxide and VOC sensors located in the return ducts for each floor. Outdoor air is brought in through outdoor air units in the two mechanical penthouses on the 28th and 51nd floors, and then is distributed throughout the building.

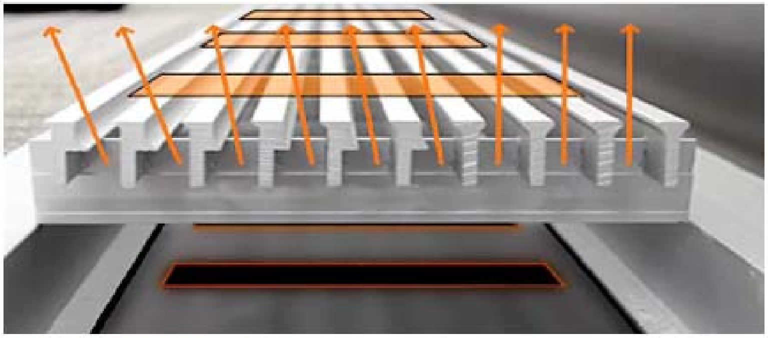


FIGURE 12: UFAD ILLUSTRATION

An energy analysis and existing conditions evaluation of the NYTB was performed and reported in mechanical technical assignments one and two (See Table 1 and Chart 1 below). The third mechanical technical report presented three research studies that were performed to investigate the areas in which the building could be improved from a mechanical system point of view. These three studies focused on three topics including façade redesign, energy sources and alternative air distribution systems. The goal of these studies was to identify areas in which the design could be altered in order to optimize overall performance in areas such as energy use, sustainability, operating costs and maintainability. The report also investigated the mechanical engineer's role in a project which utilizes Building Information Modeling (BIM) and the Integrated Project Delivery (IPD) method.

Heating	814986	47%
Cooling	455743	26%
Auxiliary Fans/Pumps	126680	7%
Lighting	256644	15%
Receptacle	98009	6%
Total	1,752,062	(kBtu/yr)

TABLE 1: UFAD ENERGY BREAKDOWN

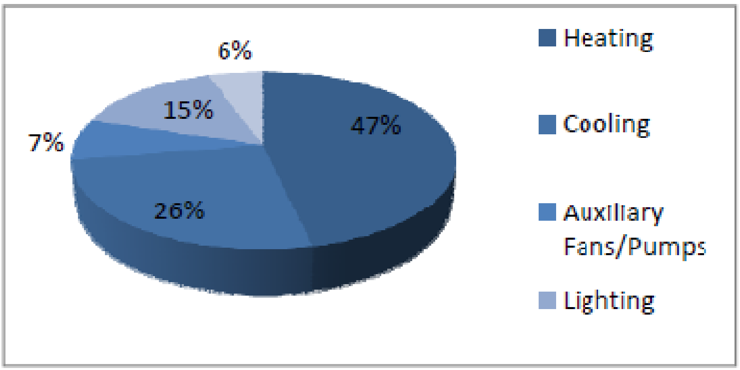


CHART 1: UFAD ENERGY BREAKDOWN

A STATEMENT OF THE PROBLEM

The challenge for our redesign project will be to increase the marketability and profitability of the building while maintaining the iconic image that the New York Times Building reflects. The redesign must also focus on both primary energy use and the sustainability of the overall building.

When brainstorming goals for the development of this IPD / BIM Thesis project, the group found that there were a few areas which provided the opportunity to enhance the New York Times Building. Some of the areas of focus included increasing the amount of rentable space, and improving overall sustainability profile of the building. Further discussion of these topics revealed that all of the options would have some hand in developing these possible areas of focus.

ADDING ADDITIONAL RENTABLE SPACE

FLOOR TO FLOOR HEIGHTS

Another goal that was put forward by the group was to investigate whether it would be possible to lower the floor to floor height in order to add additional floors. These additional floors could offer a payback to the owner by providing additional rentable office space in the building. There are a few ways that the group came up with to possibly eliminate height from each floor.

Andres explored the possibility of using a castellated beam system that would allow for penetrations through the structural members. This would allow the possible coordination of HVAC, electrical, and fire protection distribution through these castellations. In order to possibly lower the floor to floor height, the group would perhaps eliminate the raised floor system and explore the use of chilled beams to take care of heating and cooling the space. The chilled beams would decrease the size of ductwork that would be needed to condition the space and allow for it to possibly be run through the castellations in the structural members.

The typical floor sandwich in the New York Times typical floors is 4' – 9" from the bottom of the ceiling to the top of the raised floor system. The goal of the group is to reduce the overall height of the floor sandwich to be able to reduce the floor to floor height and add additional rentable floors to the building.

REDESIGN OF THE CORE

In addition to lowering floor to floor heights, the group determined that redesigning the core in order to increase the rentable space within the New York Times Building would be a viable investigation. Increasing the rentable space on each floor will cause the owner's profits to increase. The group plans on shrinking the core footprint by investigating alternative architectural layouts. By altering the architectural core configuration of the New York Times Building, the lateral system of the structure must be reconfigured as well.

FAÇADE

The façade was immediately looked at as a focus for all of the group members. There is a lot of room for improvement in the current New York Times façade's envelope efficiency and shading abilities. The façade is comprised of an ultra-clear glazing system accompanied by an array of ceramic tubes that provide shading to the interior of the building. The intent of the façade is to give a transparent feel to the building.

The ceramic rods on the façade account for 30% shading of the interiors but only provide 1% energy savings in the mechanical systems. This provides a great opportunity to investigate how to best improve the façade system in order to create a more efficient envelope. If the changes made can lower the amount of heating and cooling that is needed, it can save on the energy use of the HVAC system in the building. A better performing façade can be produced by changing to a higher reflective glazing and a more efficient shading system. Some of the systems that are being looked into will drastically affect how the structural system would perform.

COGENERATION OPTIMIZATION

The current cogeneration plant provides The New York Times Company's floors with roughly 40% of their overall power needs. Compared to a national average of 12 cents per kWh, New York City has extremely high electricity rates at roughly 25 cents per kWh. (See appendix A) Also, this energy is produced from primarily non-renewable fossil fuels which have varying associated emissions. (See appendix B)Therefore, the plant must be optimized to help reduce lifecycle cost and associated emissions from electricity use. However, equipment is costly and initial cost will also play a large role in the sizing of the cogeneration plant. Ultimately the plant needs to be sized in order to best balance the electrical needs and the heating and cooling needs of the building while being cost and energy conscious.

PROPOSED SOLUTION(S) TO THE PROBLEM

The overall goal of the group is to increase the marketability and profitability of the building while maintaining the iconic image that the New York Times Building reflects. Profitability will be defined as the buildings ability to both generate revenue for the Forrest City Ratner Company and decrease payback period for The New York Times Company. The redesign must also focus on both primary energy use and the sustainability of the overall building. There are three main strategies that the group has come up with to achieve these goals:

1. Decrease the floor to floor height with the intension of adding additional rentable floors.
2. Redesigning the core configuration structurally and architecturally in order to add additional rentable space to each floor while maintaining the efficiency of the lateral system.
3. Improve the sustainability profile of the spaces to add marketability and possibly charge a higher rent.

DECREASE THE FLOOR TO FLOOR HEIGHT

There is a huge opportunity to provide benefit to the owner by reducing the height of the typical floor sandwich in both the New York Times and the Forrest City Ratner sections of the building. A reduction in floor/ceiling assembly height can provide the opportunity of adding additional floors to the building. Assuming that the New York Times has no need for additional floor space, additional floors can be used by Forrest City Ratner to lease to possible tenants and accrue additional income. For the purposes of this engineering study, the team has assumed that current economic issues are not present and that a market does exist for additional office space.

MECHANICAL FOCUS

During the mechanical redesign the primary task will involve an optimization of the HVAC system to save space between floors in the building while maintaining desirable energy efficiency and indoor air quality. We are proposing to remove the underfloor air distribution system from all New York Times floors and the conventional overhead VAV system from all Forest City Ratner floors. An active chilled beam system coupled with a dedicated outdoor air application will replace these two systems on every floor. This alternative system will save space between floors by eliminating the underfloor plenum. It will also work in conjunction with the alternative floor system which employs a castellated beam system where smaller ducts and piping can be run through structural members.

Energy modeling and emissions analysis will be done in Trane TRACE in order to determine overall cost and sustainability benefits. In order to analyze the viability of BIM for HVAC analysis Revit MEP will be used for system layout design, and additional energy analysis will be attempted with this software in conjunction with the IES tool.

LIGHTING / ELECTRICAL FOCUS (TYPICAL OFFICE)

Refer to Appendix E: L/E Proposal Summary for a detailed workload review

The current lighting system of the office spaces consists of recessed linear fluorescent. The proposed solution will aim to implement pendant fixtures, wall slots, and task-lighting. Each of these sources will use either linear or compact fluorescents. Once the new design is in place, new branch circuiting will be put into place. This portion of the project will focus on integrating BIM technologies to plan out an efficient, space saving distribution system. Coordination will be required between each member of the BIM Team to create the most practical system. Conduit and HVAC equipment will be organized and routed through the proposed castellated beam system, which will provide decreased plenum depth.

STRUCTURAL FOCUS

In order to ultimately add additional rentable space to the New York Times Building, the structural floor system must be designed to maximize the flexibility of coordination between the other disciplines while minimizing the depth of the floor sandwich. The existing composite beam structural floor system, shown in Figure 13, will only allow service distribution to be coordinated below the level of the steel beams. Therefore, an alternative structural floor system is to be investigated.

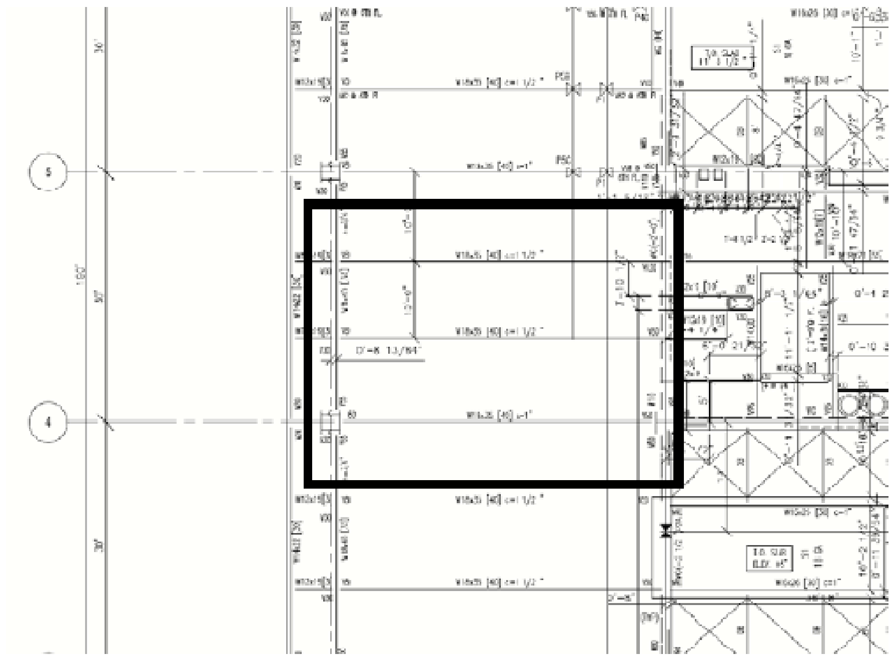


Figure 13 Typical 30'-0" x 40'-0" exterior bay

The alternative involves changing the structural floor system to a composite castellated steel beam system with light weight concrete. Two configurations, shown in Figure14 and 15, will be investigated and selected based upon their feasibility. The first configuration will utilize long span metal deck and one intermediate beam while the second will use typical metal deck spanning two intermediate beams. These systems will be designed to meet strength, serviceability, and cost criterion. However, the feasibility of the designs will also be dictated by structural depth and flexibility of service coordination.

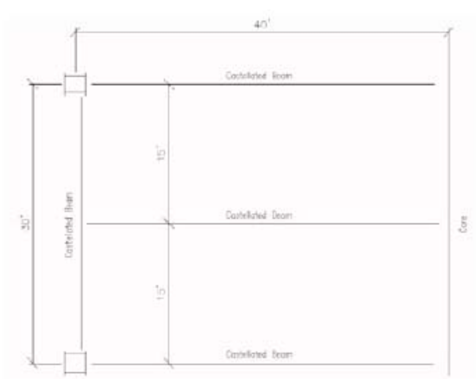


Figure14: Castellated Beam w/ Long Span Metal Decking Alternative

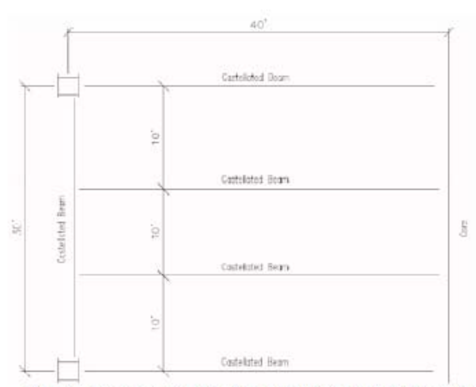


Figure15: Castellated Beam w/ Typical Metal Decking Alternative

CONSTRUCTION MANAGEMENT FOCUS

Cost is going to be a big driving force for this analysis. It will be important to keep track of the running cost benefit of changing the floor/ceiling system and adding additional rentable space to the building. Research will have to be done to find out what the value of the additional space is and what the system changes will cost. A return on investment study will help to gauge whether this alternative will be valuable to the owner.

Additionally, it will be important to efficiently coordinate the plenum space of the proposed system in order to achieve the smallest height from the bottom of the ceiling to the top of the finished floor. Building Information Modeling will be used heavily to achieve this goal. All of the group members will be authoring their design changes in a common BIM model. The model will be used to coordinate and organize the ideas of each of the team members. By keeping a typical floor model with all of the updated system components, the group can stay informed on what each other are working on. The construction management student can perform live 3D coordination of the typical floor and find opportunities of reducing floor to floor height.

CORE REDESIGN

This is an architecturally and structurally intensive analysis of modifying the core of the New York Times Building. The overall goal is to shrink the footprint of the core in order to add rentable space to each of the floors of the building. Various strategies will be looked into to help reconfigure the core to an optimal layout and size. The benefits of this redesign are also to be considered.

STRUCTURAL FOCUS

As stated previously, the existing lateral system of the New York Times Building consists of a centralized steel braced frame core with outriggers on the two mechanical floors. When modifying the existing core configuration to increase the rentable space in the building, the impacts on the lateral system must be considered. Therefore, the opportunity of redesigning the lateral force resisting system with an alternative solution was presented.

Based upon the analysis of the Structural Technical Report 3 and comments from design professionals and faculty, the alternative solution to be explored is that of a concrete core with outriggers on the mechanical floors. This alternative lateral system will be designed to meet strength, serviceability, and cost criterion. However, most importantly, the concrete core will be configured to reach the overall goal of increasing rentable space while maintaining an efficient structural design. The location and number of outriggers will be dictated upon the configuration and efficiency of the concrete core.

CONSTRUCTION MANAGEMENT FOCUS

Investigation into the constructability of a concrete core will be very important. Performing a redesign of the core of the building will affect the cost, constructability, and the schedule of the overall project. Researching the constructability and the schedule implications that this system will have will affect the cost changes of the redesign. Investigation into other buildings in New York with concrete cores will help to find out the impacts that can be expected from this design change. One World Trade Center is a building currently being constructed in New York with a concrete core. An image of 1 WTC is shown to the right.

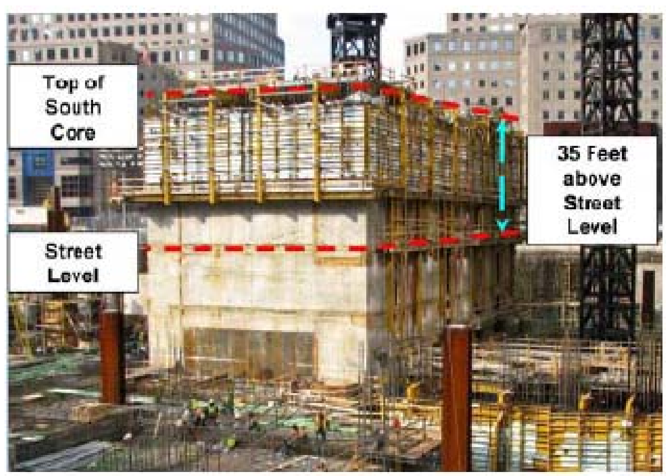


FIGURE 16: 1 WTC

Improving the efficiency of the architectural layout of the core will be important when trying to increase the amount of rentable space. The group will use BIM to layout the core and find opportunities of improving it. Some of these strategies include reducing the number of elevators in the core, reducing corridor width, and rearranging the components of the core layout in order to reduce the size of the footprint. It will be important to integrate the structural and architectural layout of the core in order to most efficiently use the space needed. Coordination using Building Information Modeling will help to keep track of changes and best layout the core.

LIGHTING/ELECTRICAL FOCUS (CORE)

Refer to Appendix E: L/E Proposal Summary for a detailed workload review

With consideration going into redesigning the lateral system and the core of the building, management of the risers will be a big part of the process. To reduce the required space for electrical feeders, the current conduit and wire system for the NYT portion of the building will be switched out for bus duct. This design solution will decrease the amount of required space in the risers and also provide an adequate power supply.

Upon changing the core design, several of the spaces may need to be outfitted with a new lighting system. The current lighting design mainly uses recessed linear fluorescents. The new design would provide a solution similar to that of the open office space to maintain consistency throughout the building. Under the circumstance that a new lighting design is applied, an additional redesign of the branch circuiting will also be completed.

A short circuit study will be done to analyze the protection of the distribution system. The panel to be analyzed will be on the 8th floor, a typical office layout. The panel under consideration will be P-8-2. This panel receives power from main panel DP-3, which is fed from Service Switchboard No.3. This system then ties back into a utility transformer from the primary utility, ConEd.

IMPROVE THE SUSTAINABILITY PROFILE

It is the desire of The New York Times Company to maintain an iconic image within their industry and around the world. Sustainability and energy consciousness were indeed factors when the building began design nearly a decade ago. However they are no doubt much more of a focus in today's society and within the current building industry. For this reason improving the sustainability profile of the building while maintaining a certain transparent feel within the space will be very important in our redesign.

MECHANICAL FOCUS

In order to improve the sustainability profile of the building, two mechanical solutions have been established. The first redesign solution will involve taking a look at a new façade design in order to minimize heating and cooling envelope loads on the building in conjunction with achieving desirable day lighting. The goal of reduced thermal loads on the building will be accomplished through a combination of several methods, including a decrease in glazing area, a higher glazing shading coefficient and more effective exterior solar shades. Trane TRACE will be used to evaluate the overall energy saving effectiveness of each method.

The second sustainable profile redesign solution will involve an optimization of the cogeneration plant in order to minimize energy costs and associated emissions for the building. Considering the high cost of electricity and the variability of associated emissions, we are proposing an increase in size of the cogeneration system to serve 100 percent of the electricity needs for the New York Times Company portion of the building. A lifecycle cost analysis will be done comparing various prime movers and fuel types in order to determine the most viable option. In addition to cost, primary energy use and associated emissions will both be key factors in the redesign. In order to prevent a drastic increase in cogeneration plant size, an investigation will be done to determine the viability of thermal storage as a load flattening device.

LIGHTING / ELECTRICAL FOCUS (TYPICAL OFFICE AND FAÇADE)

Refer to Appendix E: L/E Proposal Summary for a detailed workload review

As a work space, comfort should be a key concern for a new lighting solution. To promote communication and productivity, the lighting design should be uniform, reduce glare, and increase visual clarity. A concept that will be pursued will be to illuminate the ceiling and allow the space to feel more open, promoting a more active environment. The design should also take advantage of diffuse lighting that fills the entire space to allow for more comfortable working conditions. Daylight control will also be a key concern for this space. The reduction of direct daylight into the space will be a major design consideration for the façade and interior of the office space. Reducing the amount of daylight that directly penetrates into the space will greatly enhance the working conditions.

In regards to daylight sensors, there will be little to no redesign taken into consideration. The system in place provides the most optimized control that will be difficult if not impossible to enhance. The current system has the ability to automatically manage roller shades at all hours of the day and provide adequate dimming to reduce energy usage. Attempting to increase the benefits of this system would prove to be unrewarding.

A new façade design will be implemented to reduce direct daylight into the space and also enhance the concept of transparency. The new design should also allow for daylight to reduce the need for electric lighting and provide ample illumination throughout the building's floors. This alternate solution will attempt to keep the aesthetic appeal of the original design but will inherently increase functionality. The lighting of the façade will compare to the current conditions in how it allows the tower to disappear into the night sky; however, the integration of a new façade will require a completely different approach to the lighting solution. With the new façade design in place, the lighting methods will need to consider all available surfaces for illumination in order to provide a similar result to what is currently in place.

Another focus will be to optimize the CoGen Plant servicing the building. This system provides several possibilities to decrease energy consumption from the utility. The size of the system along with its contribution to the buildings power supply will be investigated. The goal will be to improve the system so that it can be used as a primary power supply and reduce utility costs and consumption.

CONSTRUCTION MANAGEMENT FOCUS

It will be important to have and accurate analysis of constructability and cost for any change that is made to the façade and the cogeneration facility in the New York Times Building. Any benefit to the owner from the redesigns will have to be weighed against upfront and life-cycle cost of the proposed change. Putting together cost and constructability analyses with the mechanical and electrical students will be key to showing the benefit of any redesign.

METHODS AND TOOLS TO BE USED

MECHANICAL TASKS AND TOOLS

1. HVAC redesign:
    a. Energy modeling and cost analysis
    b. Trane TRACE
    c. Layout and additional energy analysis
    d. Revit MEP / IES
2. Façade redesign:
    a. Energy modeling and cost analysis
    b. Trane TRACE
    c. Additional energy analysis
    d. Revit MEP / IES
3. Cogeneration redesign:
    a. Primary energy use, emissions, cost analysis
    b. Microsoft Excel

L/E TASKS AND TOOLS

1. Lighting Redesign:
    a. Layout and Performance
        i. AGI32
    b. BIM modeling
        i. Revit MEP
2. Façade Redesign:
    a. Façade Structure and BIM Modeling
        i. Revit
    b. Façade Daylighting Performance
        i. EcoTech
        ii. Daysim
        iii. AGI32
3. CoGen redesign:
    a. Energy and Cost Analysis
        i. Microsoft Excel
4. Bus Duct Implementation:
    a. System Management
        i. Calculations
    b. BIM Modeling:
        i. Revit
5. Short Circuit Analysis:
    a. Calculations
        i. Microsoft Excel
6. Branch Circuit Distribution:
    a. Planning out Distribution and Coordination
        i. AutoCAD
        ii. Revit MEP

STRUCTURAL TASKS AND TOOLS

1. Design of Structural Floor System
    a. Work with Matt to determine the most suitable material manufactures (metal deck and castellated beams)
    b. Preliminarily design both configurations at a typical bay
    c. Determine most feasible configuration based upon predetermined criterion
    d. Design and optimize the selected configuration for the structural floor system
    e. Utilize Revit Structure to coordinate with service distribution
2. Design of the alternative concrete core
    a. Create new core configuration (architecturally and structurally) which will increase rentable space within the New York Times Building
    b. Develop lateral loads per ASCE 7-05 (New seismic loads due to change in weight and mass) and determine story forces
    c. Model new configuration in ETABS
    d. Design shear walls to meet strength and serviceability criterion per ACI 318
    e. Design outriggers if found to be a feasible addition to the lateral system
    f. Utilize Revit Structure / Architecture throughout for design authoring of architecture and structure
3. Design of Steel Columns
    a. Determine loads due to new floor system
    b. Determine loads due to new lateral system
    c. Design columns to meet strength and serviceability requirements per AISC
    d. Utilize Revit Structure to coordinate with new façade design

CONSTRUCTION MANAGEMENT TOOLS

1. Reduce Floor to Floor Height
    a. Cost Analysis
        i. Research of lease rates in New York City
        ii. Feasibility of adding an additional floor
    b. Coordinate design changes
        i. Revit Architecture
        ii. Revit MEP
        iii. Revit Structure
    c. Clash Detection of Plenum
        i. Revit
        ii. NavisWorks
2. Core Redesign
    a. Track architectural effects
        i. Revit Architecture
    b. Investigate elevator requirements for the occupancy
        i. Contact: Jay A. Popp, Lerch Bates
    c. Cost Analysis
        i. RS Means
        ii. Similar Buildings
    d. Investigate Schedule implications of the change
        i. Research similar buildings
        ii. Microsoft Project or Primavera
        iii. Slip Forming Methods

   e. Investigate Schedule implications of the change
      i. Research similar buildings
      ii. Microsoft Project or Primavera
      iii. Slip Forming Methods
3. Façade Redesign
   a. Constructability analysis of the façade
      i. Prefabrication opportunities
   b. Cost analysis of Façade
      i. RS Means

BIM EXECUTION PLANNING PROCEDURE

When moving forward with the IPD / BIM Thesis program in the spring, it is going to be very important to keep the group organized. There will be a few methods that will be implemented in order to effectively organize the IPD teams. One resource that will be used is the BIM Project Execution Planning Guide developed by the Computer Integrated Construction Research Program at The Pennsylvania State University. The goal of this procedure is to help guide the early design participants to form consistent plans for the project.

The group's main goal is to use the BIM Project Execution Planning Procedure is to help organize the goals of the group and explore possible BIM uses that can be developed when moving forward with the project. The group will develop the uses of BIM that they feel will best aid the analyses and redesigns that are being proposed. It will be important to keep the BIM goals and uses in mind when proceeding through next semester.

Focusing in the inefficiencies in the building, the group brainstormed some goals that they thought were important when investigating the issues in the New York Times Building. Once the group discussed the goals that they have for the project they explored the possible BIM uses for each goal that was listed. From this list of goals, the group explored the value of each of the different BIM uses on the project. Each BIM use was graded on various criteria in order to decide the benefit of each use. The criteria included the value it will add to the project, the value and risk that each party would get out of each use, and the capability of each party to perform this BIM use. The group found that the following BIM uses would best benefit the group's efforts next semester:

- Design Authoring
- 3D Coordination
  - Clash Detection
  - Constructability

As the semester moves along the group will investigate the benefits of other BIM uses that would benefit the project and the owner of the New York Times Building. One BIM use that greatly benefits the owner is operation and maintenance modeling. O&M information for the equipment in the building will be loaded into the model.

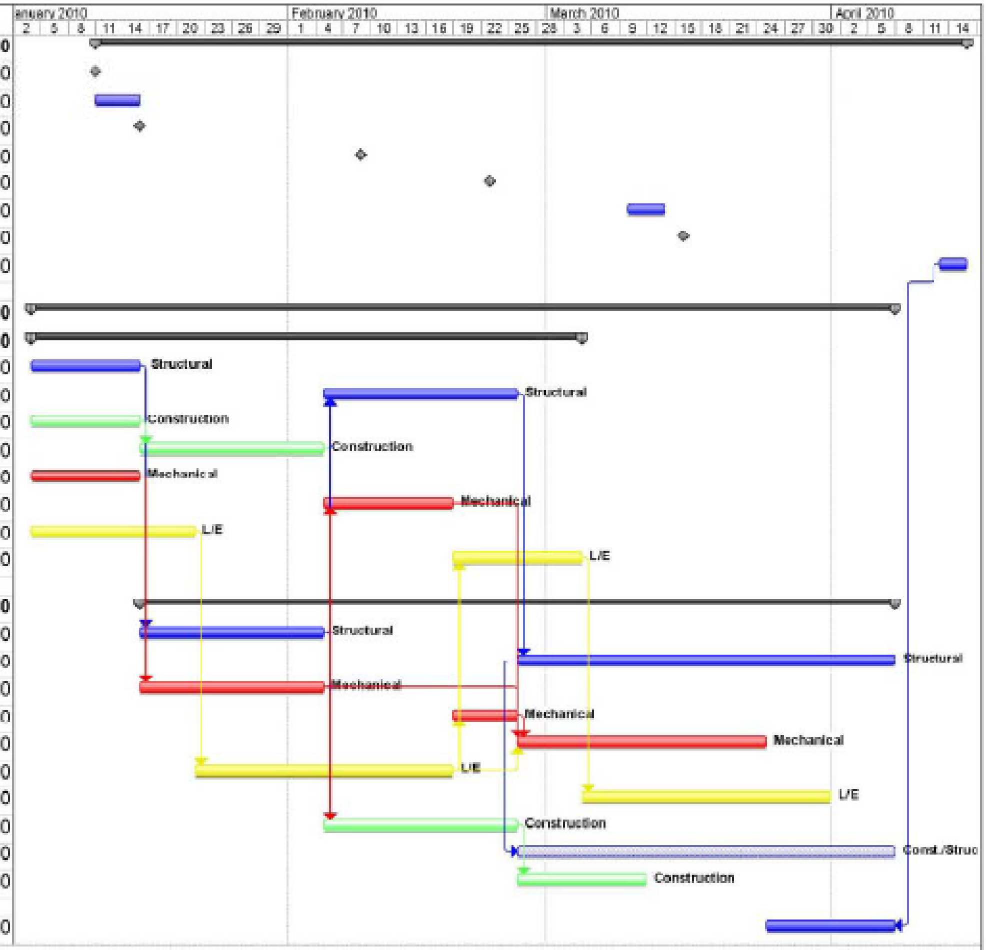
As the project moves along into next semester it will be important to keep our project goals and our BIM goals in mind. Further developing the BIM Execution Plan will help to organize the efforts of all of the group members.

A roadmap of the BIM and project goals can be shown visually to help communicate the overall plan of the project group. It will be important to show what inputs and outputs are required from each step in order to develop our investigations throughout the semester. Milestone meetings will be vital for the integrated project group to have between each phase of the project. A "Go – No Go" decision will be made in order to make sure we have all of the resources needed to move on to the next phase. At the conclusion of these meetings every team member will be on board and ready to attack the next phase.

Keeping the BIM Execution Planning Procedure in mind will help to shape the organization and increase the efficiency of the integrated project group.

SCHEDULE FOR SPRING SEMESTER

ID	Task Name	Responsible Party	Start	Finish
1	**Milestones**		**Mon 1/11/10**	**Thu 4/15/10**
2	Spring Semester Begins		Mon 1/11/10	Mon 1/11/10
3	Re-Evalutate Proposal and Goals		Mon 1/11/10	Fri 1/15/10
4	Project Schedule Update #1		Sat 1/16/10	Sat 1/16/10
5	Project Schedule Update #2		Tue 2/9/10	Tue 2/9/10
6	Project Schedule Update #3		Tue 2/23/10	Tue 2/23/10
7	Spring Break		Wed 3/10/10	Sat 3/13/10
8	Project Schedule Update #4		Tue 3/16/10	Tue 3/16/10
9	Presentation Week		Tue 4/13/10	Thu 4/15/10
10				
11	**Integrated Project Goals**		**Mon 1/4/10**	**Thu 4/8/10**
12	**Investigate**		**Mon 1/4/10**	**Thu 3/4/10**
13	Investigate Alternate Floor Systems	Structural	Mon 1/4/10	Fri 1/15/10
14	Investigate Lateral System	Structural	Fri 2/5/10	Thu 2/25/10
15	Inv. Floor to Floor Details	Construction	Mon 1/4/10	Fri 1/15/10
16	Inv. Architecture of Core	Construction	Sat 1/16/10	Thu 2/4/10
17	Investigate Chiled Beam vs. UFAD System	Mechanical	Mon 1/4/10	Fri 1/15/10
18	Investigate Co-Gen - Mechanical	Mechanical	Fri 2/5/10	Thu 2/18/10
19	Inv. Façade	L/E	Mon 1/4/10	Thu 1/21/10
20	Investigate Co-Gen - L/E	L/E	Fri 2/19/10	Thu 3/4/10
21				
22	**Design/Analyze**		**Sat 1/16/10**	**Wed 4/7/10**
23	Design New Floor System	Structural	Sat 1/16/10	Thu 2/4/10
24	Analyze/Design Lateral System	Structural	Fri 2/20/10	Wed 4/7/10
25	Design Chilled Beam System	Mechanical	Sat 1/16/10	Thu 2/4/10
26	Integrate Façade into Energy Model	Mechanical	Fri 2/19/10	Thu 2/25/10
27	Optimize Co-Gen - Mechanical	Mechanical	Fri 2/26/10	Wed 3/24/10
28	Façade Redesign	L/E	Fri 1/22/10	Thu 2/18/10
29	Optimize Co-Gen - L/E	L/E	Fri 3/5/10	Wed 3/31/10
30	Coordinate Ceiling Spaces	Construction	Fri 2/5/10	Thu 2/25/10
31	Arch. Layout For Core	Const./Structural	Fri 2/26/10	Wed 4/7/10
32	Run Clash Detection for Ceilings	Construction	Fri 2/26/10	Thu 3/11/10
33				
34	Finalize Report/Presentation		Thu 3/25/10	Thu 4/8/10



Project: Schedule.mpp
Date: Tue 12/15/09

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

METRICS OF SUCCESS

MECHANICAL

HVAC redesign:
- Primary energy use (MBtu/yr)
- Lifecycle cost
    - First cost ($)
    - Energy cost ($/month)
    - Maintenance cost ($/month)
- Associated emissions (lb CO_2E)

Façade redesign:
- Peak envelope loads
    - Cooling load (Btu/hr/floor)
    - Heating load (Btu/hr/floor)

Cogeneration redesign:
- Primary energy use (MBtu/yr)
- Lifecycle cost
    - First cost ($)
    - Energy cost ($/month)
    - Maintenance cost ($/month)
- Associated emissions (lb CO_2E)

LIGHTING/ELECTRICAL

Lighting Redesign
- Provide a quality lighting design
- Convey the concepts of the architect

Façade Redesign
- Provide equal to or better daylighting integration
- Convey the idea of transparency

Cogeneration Redesign
- Increase the use of the system
- Decrease utility costs and power consumption

STRUCTURAL

Structural Floor System:
- The redesign allows for a reduction in the depth of the floor sandwich
- Design is coordinated with the other disciplines effectively while maintaining a structurally efficient system
- The design remains an economical solution in comparison to the existing floor system

Lateral System
- Design allows for an increase in overall rentable space to the New York Times Building
- The design does not impose upon but conforms to the architectural vision of the existing high rise
- The design of the lateral system remains an economical solution when compared to the existing braced frame core

CONSTRUCTION MANAGEMENT

Reduce Floor to Floor Height

- Does the rent of the additional space outweigh the operational cost of the additional space
  - Upfront vs. Life-cycle costs
- Has the group reduced floor sandwich height to add additional rentable space

Core Redesign

- Is the proposed system a constructible system
- Does the rent of the additional space outweigh the operational cost of the additional space
- Can the proposed system work within the original schedule

Façade Redesign

- Is the system able to be constructed within the constraints of the project
- Is the proposed change cost effective

CONCLUDING REMARKS

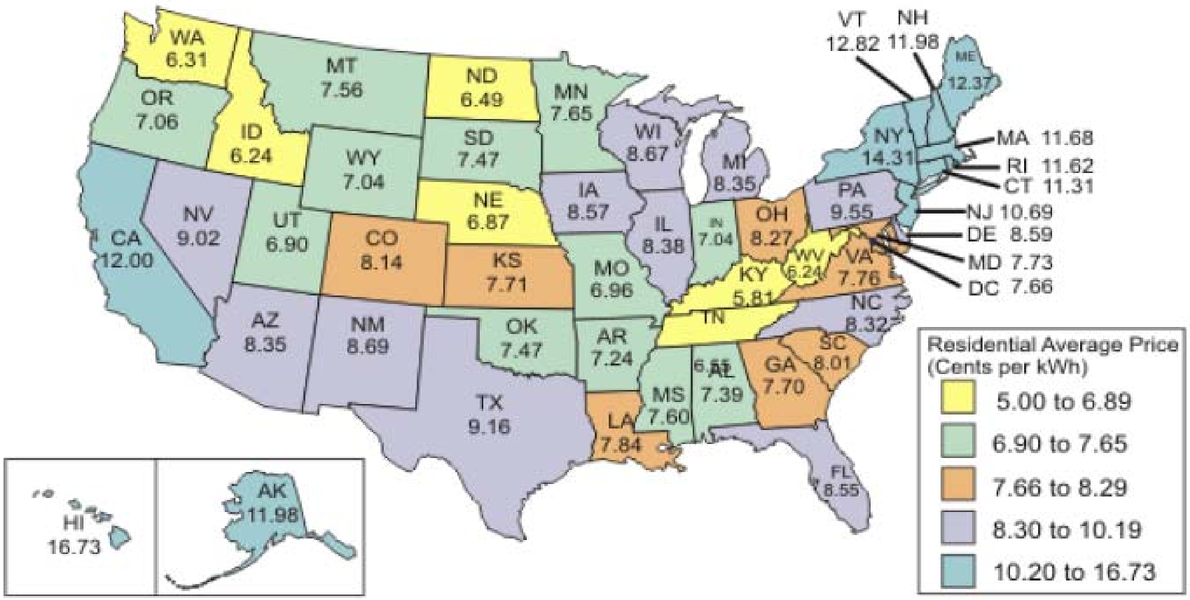
The challenge for our redesign project will be to increase the marketability and profitability of the building while maintaining the iconic image that the New York Times Building reflects. In addition, the redesign must focus on both primary energy use and the sustainability of the overall building.

The IPD / BIM Thesis team found that there were a few areas that needed improvement in the New York Times Building. These areas of focus include increasing the amount of rentable space, and improving overall sustainability profile of the building. Further discussion of these topics revealed that all of the options would have some hand in developing these possible areas of focus.

There are three main strategies that the group has come up with to achieve the goals that have been set forth. The first is to decrease the floor to floor height with the intention of adding additional rentable floors. The second strategy involves the redesign of the core configuration structurally and architecturally in order to add additional rentable space to each floor while maintaining the efficiency of the lateral system. The third strategy involves the improvement of the sustainability profile of the spaces to add marketability and possibly charge a higher rent.

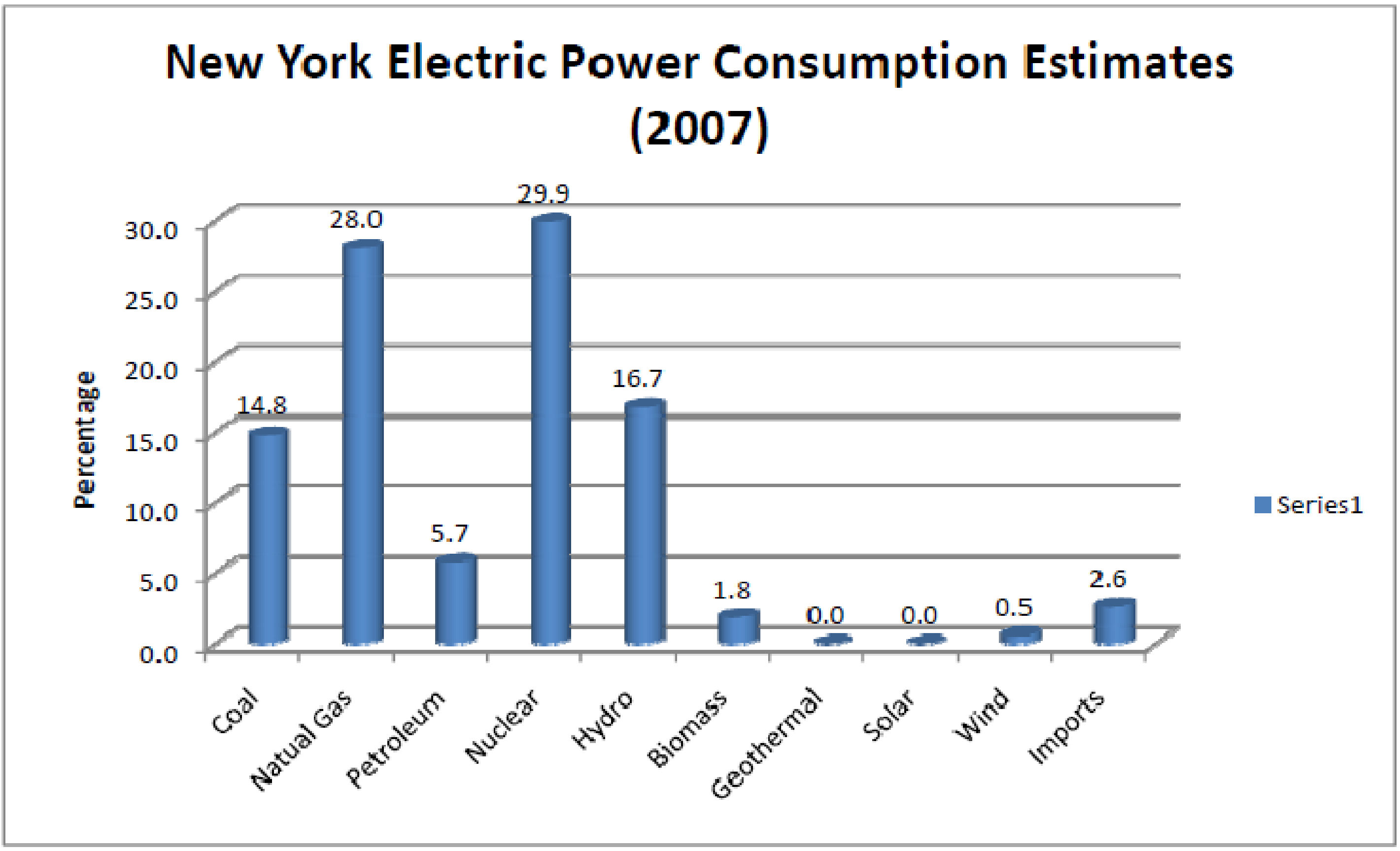
Each of the team members will have to utilize BIM throughout the semester in order to investigate the benefits to an integrated project team. A central model will be used to coordinate the different redesigns and efficiently organize the interior spaces of the New York Times Building. Integrating the efforts of each of the team members together is very important for this project. It will be essential for the group to communicate with each other. Utilizing BIM to aid our methods of analysis will better integrate our ideas together.

Appendix A: National Electricity Rates (August 2009)



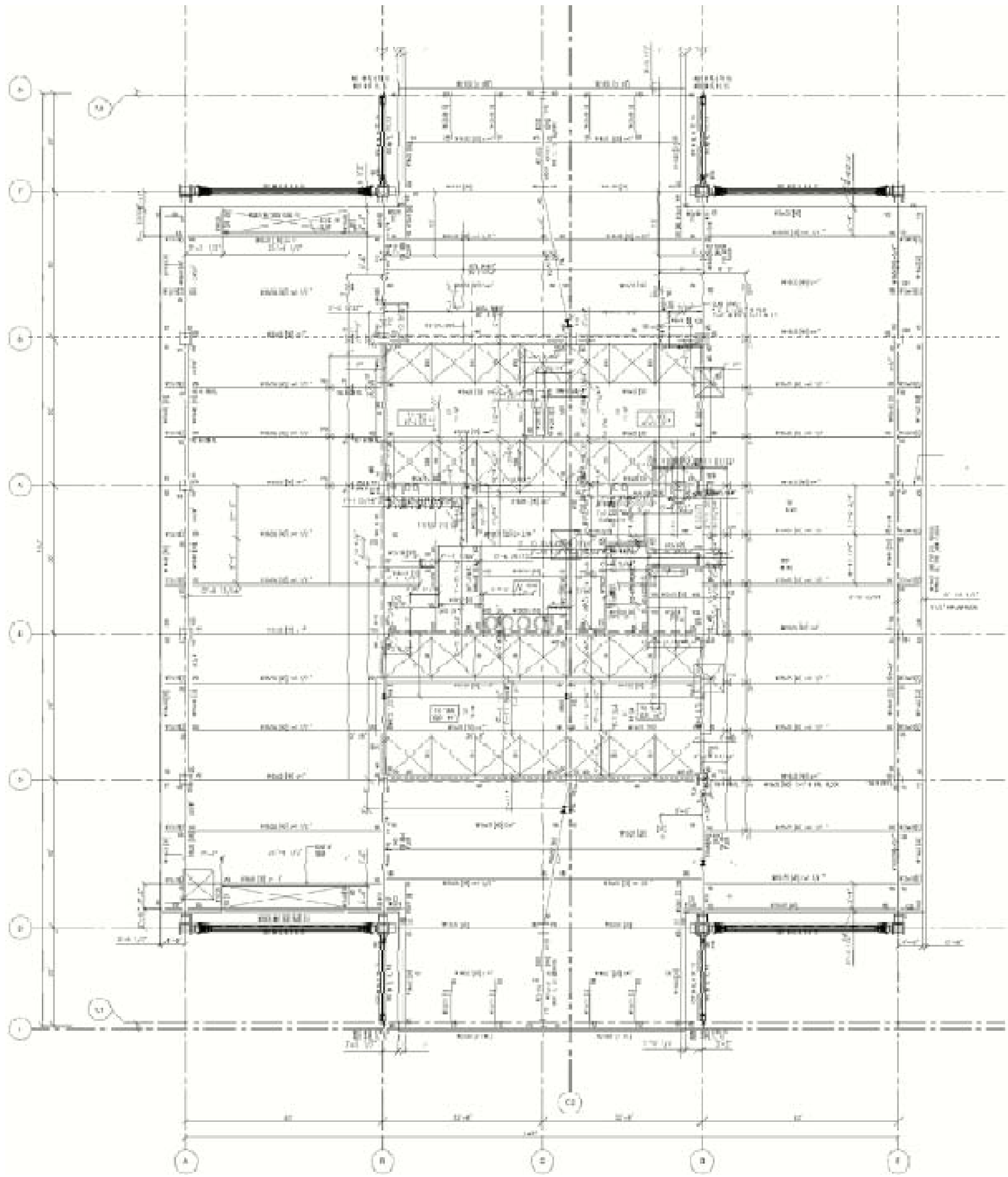
Source: Energy Information Administration, Form EIA-861, "Annual Electric Power Industry Report."

APPENDIX B: NEW YORK ELECTRIC POWER CONSUMPTION ESTIMATES (2007)



Source: U.S. Energy Information Administration

APPENDIX C: TYPICAL FLOOR FRAMING PLAN



Appendix D: BIM Execution

Priority (1-3)	Goal Description	Potential BIM Uses
1- Most Important	Value added objectives	
1	Alternate Shading Techniques and Glazing	Energy Analysis, Lighting, Cost, design reviews, VM, DA
2	Increase the constructability of the façade	Structural, cost, phasing
2	Increase the comfortability of the building occupants	Lighting analysis, mechanical, cost analysis
2	Capture solar energy for heating degree days	Energy analysis, lighting analysis, Mechanical
1	Cost analysis of the façade for each design change	Cost, DA, DR
1	Keep the aesthetic appeal of the façade	DR, Programming Existing conditions
3	Decrease floor to floor height in order to add additional floors	DR, Programming, Cost, phasing, structural, 3D coordination, DA, Mechanical
2	Look at how to obtain a zero grid energy building	Mechanical, lighting, electrical, energy analysis, cost, site analysis
3	Utility cost analysis (cogen, natural gas, electricity)	Mechanical, lighting, electrical, energy analysis, cost, site analysis
3	Optimize the CoGen plant	Mechanical, lighting, electrical, energy analysis, cost, site analysis
2	Lateral system alternative	structural, cost, 3D coordination, DR, DA, Code validation, construction system design
3	Investigate serviceability of the structural system	Code validation, 3D coordination, cost, structural
3	Investigate the updated codes of NYC for concrete/steel union issue	No BIM

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			
Building Systems Analysis	Med	Mech	High	2	1	1			NO
		L/E	High	2	1	1			
		CM	Med	1	1	1			
Cost Estimation	High	CM	High	2	1	1			NO
4D Modeling	Med	CM	Med	3	2	2			Maybe
Engineering Analysis	Med	Structural	High	1	1	1			NO
		Lighting	Med	2	1	1			
		Mech.	Med	2	1	1			
Design Reviews	Med	CM/Arch	High	3	2	1			Maybe
		L/E	High	3	2	2			
		Mech.	Low	1	1	1			
		Structural	Low	1	1	1			
3D Coordination (Design)	High	CM	High	3	2	2			YES
		Mech	Med	3	1	1			
		Structural	Med	3	1	1			
		L/E	Med	2	1	1			
Design Authoring	High	CM	High	3	3	3			YES
		Mech	High	3	2	2			
		L/E	High	3	2	2			
		Structural	High	3	2	2			

* Additional BIM Uses as well as Information on each Use can be found at http://www.engr.psu.edu/ae/cic/bimex/

APPENDIX E: L/E PROPOSAL SUMMARY

PROPOSED CONSIDERATIONS FOR L/E REDESIGN

1. Typical Office Lighting
   - Redesign lighting system
   - Optimize daylight management
2. Typical Office Electrical
   - Redesign electrical branch circuit distribution
   - Complete a short circuit study for a panel on the 8th floor back to the service entrance
3. Typical Office BIM/IPD
   - Provide completed L/E BIM model

1. Façade Lighting
   - Optimize daylight penetration
   - Redesign lighting system
2. Façade Electrical
   - Redesign electrical branch circuit distribution
3. Façade BIM/IPD
   - Redesign structure of facade
   - Provide completed L/E BIM model

1. Core Lighting
   - Possible redesign of lighting systems for any altered spaces
2. Core Electrical
   - Possible redesign of electrical branch circuit distribution
   - Implement bus duct distribution in NYT portion of the risers
3. Core BIM/IPD
   - Provide completed BIM model

1. Lobby Lighting
   - Redesign lighting system
2. Lobby Electrical
   - Redesign electrical branch circuit distribution

1. Cafeteria Lighting
   - Joint redesign of lighting system with both Craig Casey and Dan Cox
2. Cafeteria electrical
   - Joint redesign of electrical branch circuit distribution

3. Cogeneration Plant
   - Optimize the use of cogeneration plant
     - Possible addition of bigger generators or increased capacity
     - Provide more power to the NYT building
     - Reduce utility energy consumption and costs
     - Investigate how a new system will affect the current switchgear and distribution systems

APPENDIX F: L/E PRESENTATION COMMENTARY

DESIGNER COMMENTS FROM TECH III PRESENTATION AT LUTRON (12/9/09)

Sandra Stashik – GWA Lighting (Philadelphia, PA)

- Good presentation style and format
- Make lighting graphics look more realistic
- Consider glare issues with rods and shades
- Investigate wall slots for grazing and desired look of separation between wall and ceiling
- Investigate ambient lighting with proposed office designs
- Consider implementing both wall slot and indirect systems
- Apply lighting for facial recognition in the lobby

Helen Diemer – The Lighting Practice (Philadelphia, PA)

- Good graphics and presentation of lighting layers
- Better description of proposed façade design
- Analyze the daylight aspects of the existing and proposed façade
- Good idea for façade lighting – needs refinement
- Provide plan views of each space
- Describe viewing angles/ where the building will be seen from

APPENDIX G: ADDITIONAL RESEARCH

MATT HEDRICK ADDITIONAL RESEARCH

MAE RESEARCH – BUILDING ENCLOSURES

To meet the MAE requirements for the thesis research, a study of the building enclosure will take place. There will be a detailed analysis of the constructability of the new proposed façade. The connections and the details of the system will be looked into and analyzed. Knowledge will be drawn from AE 542: Building Enclosures Science and Design.

CRITICAL INDUSTRY ISSUE - SUCCESS FACTORS FOR IPD TEAMS

One of the topics that were discussed at this year's PACE Roundtable event was the increased need for business networking in the building construction and design field. The emphasis was on the need for new types of relationships in the industry to accommodate a changing marketplace. A slowing economy paired with a rising demand for sustainable buildings has forced many companies to get creative in forming strategic partnerships with each other. Sustainable projects are requiring a more integrated approach to contracting in comparison to the majority of past projects.

The integrated approach to design and construction that leads to the most successful project is being found with projects that utilize a Design-Build or Integrated Project Delivery method of contracting. These delivery methods provide a way for designers and contractors to interact with each other and share ideas in an integrated manner by creating an infrastructure of sharing the risk of the project equally between all parties.

It is important to realize that not every partnership that is made will be a successful one. In order to form an integrated project team that can perform to its greatest potential there must be some consideration taken in forming the team. It will be important to investigate the various success factors that contribute to a thriving IPD team. Studying the Integrated Project Delivery contract from AIA will be important in order to come up with an idea of what terms are included in an IPD contract. Surveys can then be developed to give to contractors and designers that have participated in an IPD project. Data can be collected about what IPD teams thought contributed to a successful team and in turn a successful project.

KYLE HORST ADDITIONAL RESEARCH

MAE COURSE-RELATED STUDY

In order to fulfill the MAE requirement for this thesis project a redesign of the cogeneration system will be done using techniques and methods taught in AE551: Combined Heat and Power. The plant sizing, fuel source, prime mover, and primary energy use will all be examined during this redesign. In addition, AE557: Central Cooling and AE558: Central Heating will both be of use during the redesign of the HVAC system.

ANDRES PEREZ ADDITIONAL RESEARCH

MAE COURSE-RELATED STUDY

The MAE requirement for this course will be fulfilled by utilizing techniques acquired in AE 597A (Computer Modeling) when modeling the alternative lateral system of the New York Times Building. The knowledge of stiffness modifiers, semi-rigid diaphragms, and meshing will be vital in the redesign of the lateral system.

CASEY LEMAN ADDITIONAL RESEARCH

L/E THESIS REQUIREMENTS

The Lighting and Electrical Option requires that students analyze four separate spaces and apply new lighting designs and branch circuiting to each. As previously noted, two of the spaces under consideration will be the façade and typical office. To fulfill the remainder of the requirements, the main entrance lobby and cafeteria will also be analyzed. The following will describe the intended strategy for both of these spaces.

ENTRANCE LOBBY

The current lighting system of the lobby consists of recessed downlights and wallwashers. The proposed solution will aim to implement wall slots, downlights, and accent lighting. Each of these sources will use either linear or compact fluorescents. The space requires that the lighting system reflects the concepts of the architect while also providing adequate illumination. The entrance lobby should reveal the architect's plan for the whole building. The ideas of transparency, lightness, and innovation should be present in the lighting design. The space should feel inviting and comfortable while also promoting activity and interest. Once the new design is in place, new branch circuiting will be routed.

CAFETERIA

The lighting system in the cafeteria consists of recessed downlights, wallwashers, and specialty pendant fixtures. The proposed solution will attempt to portray either a space that is public and active or private and relaxing. This portion of the project will be done in a team made up of only the L/E students from each of the BIM/IPD Thesis groups. The purpose for this will be to reduce some of the workload required for the L/E Thesis. Each of the three students will collaborate and come up with a design solution that portrays one of the chosen Flynn Studies. Once the design is in place, branch circuiting will be completed throughout the space. Even though the design will be completed in a collaborative manner, each student will complete an individual final report.

BIM/IPD INTEGRATION

This portion of the project will not take an integrated approach or include input from the rest of the BIM/IPD teams. The redesign of the lighting system will be the responsibility of only the three L/E students. BIM models will also not be completed for either the lobby or cafeteria. The purpose of both of these designs will be solely to fulfill the L/E thesis requirements.