Project X

NYC, NY

Luke Gray

Construction Management

Revised Proposal

Consultant: Dr. Rob Leicht

January 15, 2010

LUKE GRAY
CONSTRUCTION MANAGEMENT

PROJECT X
NEW YORK

MECHANICAL, ELECTRICAL, LIGHTING

MECHANICAL-AHU'S RANGING FROM 8650-6300CFM ON EACH FLOOR, SUPPLEMENTARY HYDRONIC FIN TUBE BASEBOARD RADIATION ALONG THE PERIMETER

ELECTRICAL-POWER IS DISTRIBUTED WITH 208/120V, 3-PHASE , 4 WIRE PANELS ON EACH FLOOR; DRY TYPE TRANSFORMER

LIGHTING-THERE ARE MANY TYPES LAMPS USED WITHIN THE BUILDING INCLUDING FLUORESCENT, INCANDESCENT, METAL HALIDE, H.I.D. FIXTURES. THE EMERGENCY LIGHTING FOR THE BUILDING IS SUPPLIED BY FLUORESCENT FIXTURES WITH A 90 MINUTE EMERGENCY BATTERY PACK.

ARCHITECTURAL & STRUCTURAL

FOUNDATION-REINFORCED MAT SLAB
10" DEEP TWO-WAY FLOOR SLAB
COLUMN LAYOUT 24' X 24'
THE EXTERIOR WALLS NATURAL BRICK WITH THREE CURTAIN WALL SLOTS TO BREAK UP THE BRICK FACADE THAT BLENDS SEAMLESSLY INTO THE SURROUNDING HISTORICALLY RICH TOWN-HOUSES
THERE ARE THREE LEVELS OF 12" INTENSIVE GREEN ROOFS

CM-SKANSKA
ARCHITECT-MA ARCHITECTS
STRUCTURAL-ROBERT SILMAN
MECHANICAL-FMC ASSOCIATES
LIGHTING-RS LIGHTING DESIGN
DURATION-AUGUST 2008-JULY 2010
SIZE-54,640SF
BUILDING USE-OFFICES & THEATRE

HTTP://WWW.ENGR.PSU.EDU/AE/THESIS/PORTFOLIOS/2011/LAG290/INDEX.HTML

Executive Summary

This proposal is a result of a detailed five month study of the existing conditions studies in Technical Report 1, 2, 3. It outlines the research and analysis that will occur from January 2011 to May 2011. The primary goal of this research will be to identify ways in which the rework and site congestion can be reduced in urban environment.

Analysis 1: Alternative Structural Bracing for the Playhouse

For the first analysis research will be conducted to find an alternative temporary bracing of the existing masonry walls. This will be accomplished by hand calculating the lateral wind and seismic loads and the loads of the masonry walls themselves. Also, Revit structures will be used for quantity takeoff, scheduling, cost estimate, 4D modeling, and structural analysis. The primary goal of this research is to find a suitable alternative for the internal temporary steel bracing to reduce site congestion and improve productivity.

Analysis 2: The building will be connected to the University's X Combined Heat and Power System (CHP)

The next analysis will be used to fulfill the thesis's electrical breadth. The original designed mechanical and electrical systems will be identified and the primary equipment will be priced based on vendor's input. This value engineering analysis will evaluate the alternative of connecting Project's electrical and mechanical utility tie in to University X's CHP. The mechanical and electrical loads will be calculated. Next, an alternative electrical system will be designed based on other building at the university. Then the schedule will be evaluated based on equipment lead time to account for the MEP utility tie-in before the above ground work started. Site investigation of the site will be conducted to consider the MEP utility tie-in conflicts with other trades.

Analysis 3: Utilization a Matrix schedule

The crowded construction site of New York City proved to be the ideal selection for creating a matrix schedule. By dividing up the site plan into zones a feasible alternative was easily found. Scheduling the underground utility work in the beginning phase of construction potential delays from underground work can be prevented.

Critical Industry Issue: Building Information Model (BIM) and Facility Management Integration Background

Research will be conducted by interview professionals in the industry and job shadow maintenance personnel. This research will be used to construct as a representation of how owners can utilize the BIM for purposes beyond the construction completion. This research will bring value to owner's BIM thus encouraging owners to utilize BIM on construction projects. First, the owner's desired information will be identified. Then the mechanical and electrical equipment will be sized based on building's loads. The equipment information will be formatted in COBie format. This information will be imported into the BIM. Finally this information will be exported as a COBie file for input into the owner's BMS. This approach will only include the primary mechanical and electric system.

Table of Contents

Project Background

Building Statistics Part 1		
General Building Data		
Building name	Project X	
Client	Any town University	
Location	New York, NY	
Function	Office building and Theatre	
Dates of Construction	August 2008- July 2010	
Construction Cost	Withheld at owners request	
Project Delivery	Construction Management	
Lot Size	96'-6" x 88'-9"	
Lot Area	8432 SF	
Width of Street	50' (narrow street)	
Construction Classification	I-C Non-Combustible 2 HR. Protection	
Occupancy Group	E Business (27-253)	
General Codes	New York Building Code Article 19	
Earthquake Codes	Local Law 17/95 of NY	
Flood Zone Code	Local Law 58/83 of NY	
Disabilities Codes	Local Law 58/87 of NY	
Concrete Code	ACI 318	
Construciton Classification (Table 3-4)	I-C Non-combustible 2 hr. Protection	
Area & Height Limitations (Table 4-2 for Sprinklered buildings):	All Partitions separating use groups to be min 2 hr. Per Table 5-1 & 5-2	
For Business E (Table 6-1)	Max. Travel Dist. (Sprinklered)=300'	
	Corridors min. width=44"	
	Max. dead end corridors=50'	
Exit & Access Requirements:	Occupant load (table 6-2)	
Zoning	Residential Use: R7-2 Commercial Use:C1-5	
Height & Setback	Maximum Height 60' or 6 Stories	
Historical Requirements	The original four walls of the Playhouse is to remain up to the second floor	
Building SF		
Floor	Existing Gross FA	Proposed Gross FA
Cellar	4,580 SQ FT	8,430 SQ FT
Basement	7,620 SQ FT	8,430 SQ FT
Floor 1	6,410 SQ FT	8,430 SQ FT
Floor 2	5,390 SQ FT	6,256 SQ FT
Floor 3	4,480 SQ FT	6,256 SQ FT
Floor 4	4,480 SQ FT	6,256 SQ FT
Floor 5	0 SQ FT	6,256 SQ FT
Floor 6	0 SQ FT	4,326 SQ FT
Total Area	39,960 SQ FT	54,640 SQ FT
Project Team		
CM	Skanska	www.skanska.com
Historical Consultant	Higgins Quasebarth & Partners	http://www.hqpreservation.com/
Architect	Morris Adjmi Architects	http://www.ma.com/
Environmental Consultants	Langan	http://home.langan.com/web/
Structural Engineer	Robert Silman Associate	http://www.rsapc.com/
LEED Consultant	Kinetix	http://www.kinetixllc.com/
Mechanical Engineer	FMC Associates	http://www.fmcassociates.com/
Waterproofing Consultants	Frank Seta & Associates	http://www.frankseta.com/
Lighting Designer	RS Lighting Design	http://www.rsltg.com/

BUILDING SYSTEMS SUMMARY		
YES	NO	WORK SCOPE
X		Demolition Required
X		Structural Steel Frame
X		Cast-in-Place Concrete
X		Precast Concrete
X		Mechanical System
X		Electrical System
X		Masonry
X		Curtain Wall
X		Support of Excavation

Cast-in-Place Concrete

Conventional concrete two-way plate structure construction is utilized throughout the building with reinforcement specified by middle strip and column strip details. All of the concrete is 5000psi concrete. The floor construction is a 10" deep flat plate slab. The columns' sizes range from 12"x24" to 18"x36". The anticipated columns loads at cellar level for the new structure are about 1,000 kips (dead plus live load). The column layout is 24-feet on center. At the exterior column in the slabs stud rails by Decon are used to enhance the shear capacity of the floors along the eastern side of building. 12"x12" and 12"x13" beams are used to brace the slab along the east and west sides of the elevator. The cast-in-place concrete construction presented the construction team with many obstacles.
The concrete slabs and columns were poured at a rate of one floor per week, with a crew of 25 men. This progress was hindered by the complexities of the regulations for the new cast-in-place scissor stairs. The construction crew laid out the formwork to accommodate the conduct and water holes ahead of time before the pure, so that the penetrations did not weaken the structural integrity of the slab. One of the challenges encountered was pouring the 2st floor above the theatre. 26 feet of scaffolding was used to support the formwork and concrete; this logistical nightmare was intensified due to the steel structural bracing as shown in the Figure 6. Simon forms were used for the vertical formwork of the foundation walls and the load bearing wall in the theatre. A pump truck was used to place the cast-in-place concrete. Power trowel were used to finish the elevated slab.. 7 | P a g e

Throughout construction vibration monitoring has been used to guarantee none of the adjacent buildings are disturbed. Despite the precautions taken to preserve the walls of the playhouse, the north wall had to be removed because of it's the structural integrity.

Foundation

The Foundation is a 30” thick matt slab on top of a 3” concrete mud slab. New 1’ 4” thick foundation walls are used to support the office portion of the building. The playhouses existing walls support the 2nd through 6th. Buttresses laterally brace the existing masonry walls of the playhouse. In addition, there are Tie beams that span the playhouse in the north and south direction within the matt slab. Underneath the playhouse’s tie beams is a new concrete footing. As addressed in the existing conditions new underpinning was added under the adjacent buildings along the north south and eastern sides of the building.

Support of Excavation

The site resides in an Metropolitan area. There are no streams or natural water courses visible on premises. Neither are there any vaults located below the sidewalk level. The premise does not lie within any flood hazard area designated by the federal emergency management agency. The site will be dug down an additional 12 feet requiring sheeting at the west side, east side, and north wall. During the excavation stage under pinning was necessary for the existing apartments which are abut to the north and west wall in order to start foundation work. Also underpinning is required at the wall of the existing playhouse which will be the common wall for the office and play house. Piles were then drilled at the east property line to strengthen and stabilize existing soil and foundations of adjacent buildings. In addition to the piles drilled sheeting was installed. Then the 16 foot high construction fence was erected. Next the reinforced mat foundation slab is poured on top of the piles. Ground water is expected at 15’ 8” therefore a dewatering system is used. De watering the pumping of water from below ground level is then utilized. Well points were installed and the dewatering system ran 24/7 for 22 weeks.

Masonry/Precast Lintels

The all natural brick veneer is non-bearing will seamlessly blend into the neighboring buildings. The 4” brick veneer is a running bond. Windows will be double hung with 4”x8”x4’-4” precast concrete lintels and 4”x4”x4’ window sill lintels to accent the windows. Concrete lintels and the brick veneer are attached with a steel L-angle that is fastened to the 8” concrete masonry units. The expansion bolts anchor the angles. Cmu that have anchors going into mortar joint between them are grouted. The base of the building features a 70sf granite base at Mac Dougal Street. First through sixth floor features a brick facade. While, the sixth floor features 18” foot high terracotta cornice crown. Because the brick facade was laid in the winter temporary heat is needed for exterior masonry and building finishes. Swing scaffolding is used along the north, south, and east perimeter; while steel tubular masonry scaffolding is used for the west perimeter.

Curtain Wall

Three curtain wall slots were chosen to break up the brick façade to blend in with the surrounding townhouse buildings. The curtain wall system type of glazing is the Kawneer powder coated aluminum. This curtain wall configuration is dry glazed gaskets. The glass features fire rated ¾” 2 ply glass. There is 2 Layers of ½” fire rated gypsum board separating the curtain wall frame and metal stud which is mounted with a powder actuator fastener.

Analysis 1: Alternative Structural Bracing for the Playhouse

Background

One of the constructability challenge was preserving the existing playhouse's walls. The demolition of the existing 33,000SF building consists of four separate townhouses that were merged together during the 1940's. The existing building is compiled of brick and mortar, which has been primarily demolished by excavators. The playhouse was demolished by hand. The building has historical and cultural significance. It houses a 4,400SF playhouse on the ground and basement levels that is scheduled to remain. As part of the project, the interior walls of the theater will be demolished and rebuilt. The playhouse portion of the building is located at the southern end of the site's 8,430 SF footprint. Four exterior walls of the original theatre that is located on the basement and ground floor level will remain.

The project team has done the following to preserve the historical significance of the theater: The owner has preserved the exact volume and footprint of the playhouse theater. The owner has preserved and restored the 1940's playhouse façade. The owner has integrated relevant historical features and pieces of the existing theater. The owner has built a smaller building than allowed by zoning. New construction is low-scale, contextual, brick building for law faculty and student research.

As part of the project the existing theater walls had to remain in place, Foundation walls had to be underpinned, Four stories of existing building had to be removed around temporary bracing, New footings installed while temporary bracing was in place, All new poured in place concrete superstructure had to be framed and poured around bracing.

Figure 2: Shows Temporary Structural Steel Bracing

Figure 3: Shows an Up-close View of the Structural Steel Bracing

Opportunity for Improvement

A temporary steel frame was used to preserve the existing theatre walls and the adjacent building. This made construction activity very difficult due to the structural bracing. The steel bracing was anchored to the adjacent building's masonry wall. Double l-angle steel wielded together was used for vertical members and round hollow structural sections (hss) steel tubing was used for the lateral members shown in Figures 2 and Figure 3. One lane of traffic was closed during construction to allow for a crawler crane to be used.

Potential Solution

Design a structural system for the theatre that would serve as a permanent structural system as well as be used in conjunction with the demolition. The cost and schedule will be compared with the existing system. Restructuring the building will involve replacing the internal load bearing structural elements while leaving the façade. The goal is to devise a permanent feature that stabilize lateral rigidity to sustain the construction loads live loads and the gravity loads of the new structure. The positioning of the propping needs, to be carefully considered to avoid obstructions to the four stories of demolition work, the new footings are to be installed while temporary bracing is in place, and forming and pouring of the concrete superstructure.

Research/Analysis Steps (B1=Breadth 1, CM = Construction Management Analysis)

1) Identify the purpose of the temporary bracing used for construction, is it a for ensuring safety, for repair, strengthening and restructuring. – CM – B1

2) Find three feasible alternatives to the method chosen for the theatre. CM –B1

a) The first alternative is doing the office building demolition and construction, then doing the theatre after the superstructure and buttresses are poured to stabilize the wall between the theatre and the office building.

b) The second alternative I will study is diving H-piles next to the historical walls, then attaching the masonry to the facade with anchors going through the mortar in the masonry on the outside of the wall.

c) The third alternative is bracing the facade along the perimeter using a flying box shoring spanning the sides of the building for the longer sides. In order to provide in-plane stability to the walls during reconstruction. The box girder flying shores requires a central support prop or tower. This support needs to have a temporary foundation to take the loads which it will carry.

d) The fourth method is strapping the façade with structural steel to prevent spread from wind forces by using horizontal or inclined steel sections fixed as straps around the perimeter of the building.

e) The fifth alternative I will study involves bracing the structure on the short ends on the outside of the building and the long spans the masonry walls could be attached to the adjacent structure. The externally placed scaffolding shown in Figure 5 shows the structure steel grantry over the sidewalk and pavement. This type of system is use to instead of a concrete block because it provides access and protection to the public underneath the temporary structure. Clearly, the external work creates no obstruction to the insertion of the new frame.

f) The fifth method strengthening the existing masonry to improve the structural performance in order to enable the building to fulfill it's new functional requirements.

3) Discuss the design criteria for the structural system with the structural engineer and the construction manager. CM –B1

4) Decide on one alternative method based on conceptual constructability, cost, and schedule. CM – B1

5) Create a Revit model of the existing concrete structure. – CM – B1

6) Model the temporary steel structure in oder to develop a cost of the original temporary steel cost. –CM –B2
7) Calculate the construction live, wind and seismic loads on the existing masonry wall.-B1
8) Perform hand calculation for preliminary design of the temporary steel structure.-B1
9) Model the choosen option in revit and perform a structural analysis to verify hand calculations.-B1
10) Evaluate how the altered temporary will effect site logistics, MEP, and the new concrete flat plate system. Also special attention will need to be paid to the steel angles attached to the historical masonry wall for the new concrete floor attachment to the masonry. -CM

11) Update schedule with alternate structural bracing. Determine if there was a significant schedule reduction.-CM
12) Perform takeoff and estimate of the proposed structural system. Utilizing the automated takeoff provided by Revit.-CM
13) Compare the two structural systems the original and alternative based on cost, schedule, and obstruction of other trades productivity. CM

a) Labor costs from local union
b) Initial Costs from steel manufacture

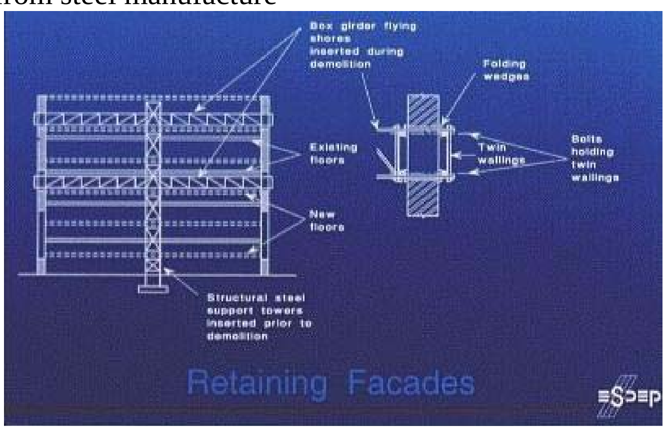

Figure 3: Shows the third alternative Flying shore system

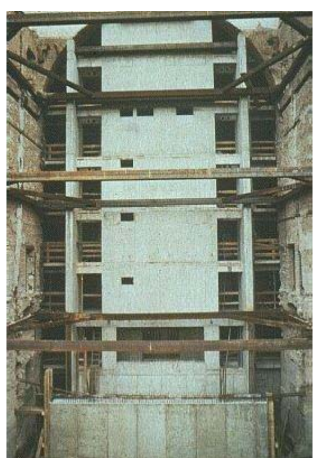

Figure 4: Shows an example of method three, in this case the facades can be tied to prevent spread from wind forces.

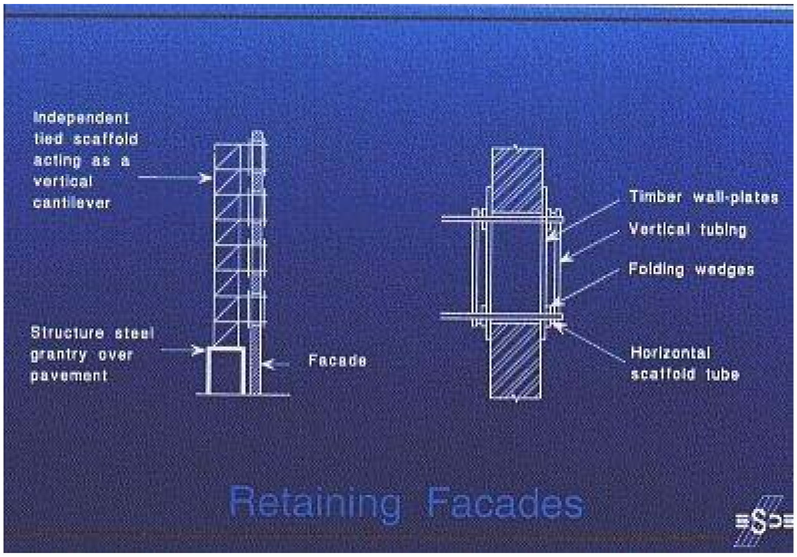

Figure 5: Shows the method 4 of retaining the façade on the outside of the structure.| Provided by http://www.fgg.uni-lj.si/kmk/ESDEP/master/wg16/l0300.htm

Tools & Resources
- Revit Structures
- Bently RAM Structural system (this will be used as an alternate if Revit Structures can't be used for analysis)
- RS Means Cost Data

Resources
AISC Steel Manual

Expected Outcomes
The alternative structural lateral bracing will result in a less congested site. Reducing the amount of temporary steel reinforcement with the other trades. This will provide the site with an safer and more productive working environment.

Course Reference
AE 308: Introduction to Structural Analysis
AE 401: Design of Steel and Wood Structures for Buildings
AE 430: Indeterminate Structures
AE 475: Building Construction Engineering
AE 472: Building Construction Planning and Management

Analysis 2: The building will be connected to the University's X Combined Heat and Power System (CHP)

Background

University X has recently finished replacing and expanding its Cogeneration Plant to improve energy efficiency, reduce emission and improve reliability. The University has an existing combined heat and power (CHP) plant which provides electrical power to 7 of their buildings and high temperature hot water to 40 their buildings throughout the Washington Square campus. Because the plant is at the end of its useful life, the university has the opportunity to upgrade and replace the electrical generating equipment to increase the CHP plant output, efficiency, and environmental performance. The new plant will continue to provide high temperature hot water to 40 University's buildings and will also provide electrical power to an additional 18 to 20 University's buildings.

The University is planning to connect Project X to the combined heat and power system within 3 years. The University has finished the Cogeneration Plant and is now in the process of connecting the adjacent building. The project has been started in the spring of 2007 and was completed in the fall of 2009. Also the underground MEP connection to adjacent building was constructed while the masonry was going on. The primary construction issue was there was not enough room in the street. The project was completed ahead of schedule. Although site congestion could have been reduced if the underground utilities were completed before the above ground work started.

Opportunity for Improvement

The new electrical power distribution system will need to be updated to allow for connection to the CHP system. This will require the maintenance department to revamp their current BMS. This is an opportunity to implement the COBie information for the project. Also this will provide an opportunity to MEP 3D coordination and implement the BIM for facility management.

Potential Solutions

Design the new electrical equipment, HVAC, and plumbing system necessary for the connection to the CHP system. Reschedule the MEP work earlier in the project.

Research/Analysis Steps (B2=Breadth 2, CM = Construction Management Analysis)

1. Identify the current MEP systems that are used on University X campus. - B2
2. Identify which MEP systems would need to be replaced in order to be compatible with the CHP. - B2
3. Calculate the building's Electrical loads - B2
4. Calculate the building's Mechanical loads - B2
5. Design the primary HVAC system – B20
6. Design the switch gear and protection required for the new electrical distribution system – B2
7. Compare the costs of the CHP compatible equipment with the existing MEP equipment – CM
8. Find out the lead times from the product vendors for the required - CM
9. Identify potential time periods in the critical path schedule that the underground MEP work can be reschedule. - CM
10. Discuss the viable alternatives with the Skanska project team and design team. – CM- B2
11. Reschedule the project to account for the underground work for the MEP in the schedule before the masonry or sequence the masonry to account for the underground MEP work. - CM
12. Reissue the site plan and material storage areas to account for the underground MEP work. - CM

Tools & Resources

-Revit MEP
- SKM System Analysis for arch
- ASHRAE standard 62.1 & 90.1

- NEC 2011
- RS Means Cost Data

Expected Outcomes

Determine the MEP requirements needed for Project X in order to be compatible to University X's CHP system.

This can reduce rework in the future for University X in order to connect the CHP system. This system will cost the owner more money up front but in the end this

Course Reference

AE 311: Fundamentals of Electrical and Illumination Systems for Building
AE 310: Fundamentals of Heating, Ventilating, and Air Conditioning
AE 467: Advanced Building Electrical System Design
AE 473: Building Construction Management and Control
AE 475: Building Construction Engineering I
AE 476: Building Construction Engineering II
AE 472: Building Construction Planning and Management

Analysis 3: Utilizing a Matrix Schedule

Background

The University's central combined heat and power (CHP) plant was connects its high temperature hot water and chilled water piping to the Project X building. The site congestion caused the high temperature hot water and chilled water piping (hw/cw) to be moved from occurring in the interior fit-out stage to the end of the project. All of the following trades were accelerated drywall, electric trim, taping, and paint with overtime. Also, carpet and furniture was installed on second shift. Therefore material deliveries had to be made frequently. Since, second shift and overtime work had to be done there was not enough room on the site to close down both lanes of traffic in-front of the site to allow for the hw/cw piping placement.

Opportunity for Improvement

For logistical reasons it is always better to do the site utility tie-ins before the masonry and interior fit-out begins. The plumbing utilities which included hw/cw piping can be re-sequenced to occur in one of the earlier stages of construction.

Potential Solution

When the site utility tie-in occurs during the demolition stage of construction two weeks would be saved at the end of the project schedule when this activity actually occurred on the site. In analysis 2 the electrical power connection to the building was evaluated. The CHP's electrical tie-in will be considered in the new matrix schedule.

Research/Analysis Steps

1. Perform research on matrix scheduling techniques.
2. Divide the site into zones
3. Determine the duration of time to complete each construction activity.
4. Create a matrix schedule for the site plan based on the grid lines and the time durations of each construction activity.
5. Re-sequence the hw/cw piping and electrical tie-in to the Central CHP plant.
6. Discuss the viable alternatives with the Skanska project team and design team.
7. Reissue the site plan to account for the underground MEP work.

Expected Outcomes

This analysis should visually prove thatthere is adequate space on the site plan to conduct the hw/cw piping and electrical tie-in to the Central CHP plant at the same time as the demolition.

Resources

John Gunning- Project Manager at Skanska

Dr. Rob Leicht- Assistant Professor of Architectural Engineering, The Pennsylvania State University

Critical Industry Issue: Building Information Model (BIM) and Facility Management Integration

Background

Currently, owners don't know the how the BIM can be used after construction. In most cases, it is archived and long-term value of the model is lost. Also, there is not a Building Management System that is integrated into the BIM. "Building information modeling is certainly the most talked about technology. In fact, market research indicates that more than 50% of the building and construction industry is now using BIM in some form." (ENR November 22, 2010) Despite these numbers, many owners don't know what to do with the BIM after construction. How can owners utilize the BIM for facility maintenance and operations?

Opportunity for Improvement

The solution begins by investigating the end uses of the model before the construction begins. On most projects the data owners need for facility maintenance, certification, and inspection data is not included in the model, because the owners don't put these requirements in the specifications. Thus this information must become apparent in order to include them in the BIM execution plan, so the contractors and designers don't want to include too much information or too little information. Ideally the contractor would have recommendations from the owner; however owners don't necessarily know all the choices. The University X's contract with the subcontractors does not require BIM to be used neither do they require coordination of the BIM model with the project closet documentation. Although, increasingly owners are creating BIM of their existing facilities and requiring BIM as a deliverable as-built drawing reference without knowledge of how to utilize the BIM after construction.

Potential Solution

The University X is currently looking at alternative ways of storing maintenance information. The goal of this research is to develop a way to utilize the BIM for the owners BMS. Also discover maintenance data which would be beneficial to be store in a BIM for easy accessibility by the maintenance department.

Research/Analysis Steps

The following is goals I am looking to accomplish in shadowing The Pennsylvania State University's OPP Area services.

1. Identify ways the trades can use the BIM to easily find drawings electronically through linking drawings to the model without having to reference hundreds of drawings.
2. Identify ways maintenance can use the model to easily find specifications electronically through linking specifications to the model without having to reference thousands of specifications.
3. Identify which maps and O&M are used by the universities maintenance department.
4. Identify ways the owners can store design intent in the BIM for reference when buying new equipment for clarification.
5. Identify which energy management system, BMS, cafum, MMS, CMMS, or ARTRA is being used by The Pennsylvania State University and University X.
6. Development a strategy for universities maintenance department to organize data within the BIM model.
7. Recognize common renovation changes that can be updated simultaneously in the BMS and BIM.
8. Input examples MEP equipment into the Project X BIM.

a. AHUs, VAVs, VFDs
b. Plumbing fixtures, domestic water booster pump, storage water heater
c. Light fixtures, panel boards, switch gears, transformers
d. Smoke detectors, manual pull stations, fire alarm control panel

9. Input the data from steps one to six into BIM equipment using the method using the COBie approach to entering the data.

This will be accomplished by shadowing The Pennsylvania State University's OPP and University X's OPP. Andy Ellenberger is the supervisor Area Services at The Pennsylvania State University, Area Services has granted me permission to shadow maintenance personal starting December 15, 2010 to December 23, 2010. In addition, research will require shadowing Project X's Facility and Construction Management service's personal with responsibilities include: electrical work, emergency repairs, environmental systems, everyday maintenance, plumbing and piping, preventative maintenance, refrigeration. It is very important for area services to identify the location and O&M required for maintenance in the least amount of time possible. Also, interviews will be conducted with the university's director of operations Kenny Lee and John Bechtel to validate the conclusions.

Expected Outcomes

It is expected that this research will result in a greater understanding of how owners can use the BIM for facility management. Provide a guide for implementation of facility management software from the initial conceptual phase to operation and maintenance.

Resources

Andy Ellenberger-Supervisor of Area Services at The Pennsylvania State University
Dr. John Messner- Associate Professor of Architectural Engineering and Engineering Design, The Pennsylvania State University
John Gunning- Project Manager at Skanska
2010 PACE Roundtable Meeting
Dr. Rob Leicht- Assistant Professor of Architectural Engineering, The Pennsylvania State University

BIBLIOGRAPHY

'Appraisal of Existing Structures', Institution of Structural Engineers, London, 1980.
'Refurbishment', ARBED, Luxembourg, 1989.
'Historical Structural Steelwork Handbook', British Constructional Steelwork Association, London, 1984.

Appendix A: Weight Matrix

This weight matrix shows how time will be spent conducting preparing this senior thesis research and analysis.

Description	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
Structural Alternative system for the Theater Schedule Reduction		5	10	10	25
Redesign the Mech/Ele		10	15	10	35
COBie	5	10		5	20
Critical Industry Issue: BIM FM	20				20
Total	25	25	25	25	100

Appendix B: Breadth Studies

Structural Breadth

Wind and seismic calculations will be performed to attain the horizontal loads on the historical masonry façade.

Revit Structures will be used to perform the structural analysis of the temporary steel structural system used on the project. Hand calculations will be performed to validate the software data of the temporary structural system that was used. The alternative structural system will be designed based on AISC. The new temporary steel system will be input in the Revit Structures model for analysis.

Electrical & Mechanical Breadth

Primarily electrical design will be performed, although mechanical calculations will be performed for the integration of the combined heat and power (CHP) system. Research will be done for the requirements to account for the electrical redundancy requirements of the CHP. Electrical loads will be calculated based on the HVAC, lighting, and plumbing systems. The adequate electrical protection will be determined. The primary electrical equipment will be sized based on the factored building loads. Additionally, the buildings water pumps and heat exchanger will be investigated in order to accommodate the CHP.

Analysis 3: COBie vs Paper Based Information Exchange

Background

Today, most contracts require the handover of paper documents containing equipment list, product sheets, warranties, spare parts lists, preventive maintenance schedules, and other information. This information is essential to support operations, maintenance, and the management of facilities assets by the owner. The Construction Operations Building Information Exchange (COBie) has been adopted as a part of the commercial software tools since 2008 (http://wbdg.org/resources/cobie.php) The Construction Operations Building Information Exchange (COBie) has been adopted as a part of the commercial software tools since 2008 (http://wbdg.org/resources/cobie.php).

Opportunity for Improvement

The owner's documentation upon close-out includes: O&Ms, warrantees, guarantees, test reports, etc. Upon completion the owner can spend up to six months entering the data from vendors equipment into the building management system. Gathering this information at the end of the job, using current methods is very expensive, since most of the information has to be recreated from information created earlier. The COBie is a standard way to manage information from a BIM model. The COBie approach is to enter data as it is created during design, construction, and commissioning.

Potential Solution

The Construction Operations Building Information Exchange (COBie) has been adopted as a part of the commercial software since 2008 (http://wbdg.org/resources/cobie.php).

Research/Analysis Steps (CM = Construction Management Analysis)

1. Identify how the current practices of commissioning for project closeout and continuous commissioning in regards to documentation. - CM
2. Identify the method that was utilized on Project X for the information exchange - CM
3. Define the productivity rate, Project X's building statistics, and labor rates - CM
4. Produce the cost analysis of COBie system - CM
5. Estimate the actual paper based information exchange cost - CM
6. Acquire the cost incentives from the owner for early completion - CM
7. Evaluate potential schedule saving through using the COBie system - CM
8. Compare the costs calculated for using the COBie system vs. actual paper based method used on site - CM

Expected Outcomes

Determine if using COBie is a viable option for Project X rather than the paper based.

Resources

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2010 PACE Roundtable Meeting