Project X
NYC, NY

Luke Gray

Construction Management

Technical Report 3

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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

Technical report 3 addresses areas in regards to Project X that are good candidates for research, alternative methods, value engineering, and schedule compression. A site interview was conducted with the Project Manager of Project X, John Gunning, to discuss these topics. The report ends with an observation of problem identification and technical analysis methods. The first constructability challenge was monitoring movement of adjacent buildings and excavation support systems during construction. Extensive measures had been taken to monitor the vibration, lateral, and vertical displacements by the geotechnical and structural engineers. The second constructability challenge was preserving the playhouse walls. The third constructability challenge was that there was no material laydown area. This required the project team to close down one of the lanes of traffic during construction. Other constructability challenges included cold weather concrete substructure placement, collisions of lagging and tiebacks with chilled water lines.

The biggest risk was the client not being able to move in June 25, 2010, because the owner had to terminate their lease. The primary acceleration method was working overtime and second shift. This was done by the interior finish crews, interior fit out crews, concrete subcontractors.

Value Engineering (VE) ideas that have been implemented on Project X include: corrugated metal paneling on penthouse, traditional 4” red brick used on the façade. VE ideas not implemented despite cost implications are a green roof terrace and aluminum roof railing.

Problems that arose during construction were dealing with public opinion of the project, five year estimating and value engineering sessions, low value of BIM due to the small size of the building, and scheduling.

The areas of technical analysis are Utilizing BIM for estimates, design, and owner validation; Implementing BIM in the field; Identify and recommend potential areas that owners can utilize BIM after construction; Small projects uses of BIM advantages and disadvantages; and Identify current design limitations of BIM technology.

Table of Contents

Constructability Challenges

The first constructability challenge was monitoring movement of adjacent buildings and excavation support systems during construction. Monitoring of excavation system was done by installing reference points at 25-ft on-center around the entire perimeter of the excavation to properly monitor the ground movements behind the excavation support system and to properly monitor building movements. As the excavation proceeded, points were installed on soldier piles to measure potential lateral deflection. Points were installed at the top, the mid-point, and at the base of the excavation. These locations were subject to review by the Owner's structural and Geotechnical Engineers. First, this task was achieved by monitoring points had to be established by the Contractor employing a Professional Land Surveyor licensed in the State of New York, and referenced to a fixed off-site benchmark. A building across the street from the construction was used for a reference. Second, monitoring of the excavation support system was performed on a semiweekly basis during any sheeting, bracing, underpinning and excavation work. Readings were being taken to nearest 0.005 ft. Written reports summarizing the monitoring results were submitted within 24 hours of a reading by the Contractor's Professional Engineer and/or Surveyor to the Construction Manager for review by the Owner's Structural and Geotechnical Engineers.

Monitoring of adjacent buildings the Owner's Geotechnical Engineer conducted movement and cracks monitoring of the adjacent buildings. Vibration monitoring was implemented for all adjacent buildings. The contractor received monitoring reports on a weekly basis and was notified within 24 hours of a reading when a threshold is exceeded. The threshold limit was defined as the maximum allowable vertical or lateral movement is 3/8 inches and the maximum allowable particle wave velocity is 0.5 inch per second. The engineer devised a plan if the above thresholds approach exceeding limit. First, the Contractor will immediately stop work if movement reaches ¼-in and/or vibration level reaches 0.3 inch per second. Then, the contractor would inspect the building for potential damage. Inspections would be made by the Contractor, his engineer, the Owner's Engineers, and the adjacent building's engineer. Next, the contractor would develop alternate methods and procedures, subject to the review and approval of the Owner's Engineers and the adjacent building's engineer to stabilize the building, stop movements and/or lower vibration levels. The contractor would have to resume work using the agreed upon alternative method. Lastly, the Contractor would have to restore, to the satisfaction of the Property Owner, by repair or otherwise, the portions of buildings, or their contents, altered by the Contractor in furtherance of his sheeting, bracing, and underpinning work.

Restoration would have to be completed to the conditions, which existed prior to the start of work. This put a great deal on the contractor. Fortunately, there were no lateral movements to the adjacent building. The adjacent buildings were extensively braced on the south side due to the preservation of the existing playhouse's walls. The existing adjacent structure required additional c-channel to reinforce the north neighboring structure by tying into the floor wood trusses of the neighboring structure; because the wall was not load bearing wall it was only two courses thick. Also a great deal of underpinning concrete was used to uphold the adjacent structures.

Figure 1: Shows the C-Channel used to reinforce north side of adjacent structure

The second constructability challenge was preserving the existing playhouse's walls. A protective sidewalk bridge was used to permit pedestrians flow during non-working hours. 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 walls of the original theatre that is located on the basement and ground floor level will remain throughout construction.

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.

These four walls, which were mortared together with a variety of stones and bricks, will be temporarily preserved by shoring the walls with steel beam structural system. This is a very challenging task because there is a dentist office on the south side. In addition there are restaurants adjacent to the building that lends to daily delivery. Also there are apartments on the north and west side and a small one-way street on the east side. The playhouse portion of the building is located in the southern end of the site.

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.

Figure 2: Shows Temporary Structural Steel Bracing

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

The third constructability challenge was that there was no material layout area. All of the material deliveries had to be just in time deliveries. There was no room on the site for material storage. All of the long lead items had to be ordered prematurely to ensure a timely delivery when needed. The cast-in-place concrete system congested the site with formwork and shoring. In order to allow space for the delivery trucks and crane one of the lanes traffic to be closed for a two week period. Also the entire road had to be closed in order to install new service off the existing water main, which runs approximately center and parallel to MacDougal Street. MacDougal Street (from West 4th to West 3rd Street) was closed beginning no earlier than October 26, 2009, 8:00 AM to 4:00 PM, Monday to Saturday. Sidewalk access on the east side of street will be maintained at all times. No impact to the water service to the adjacent neighbors is anticipated. Neighbors directly south of 133-139 MacDougal Street will be able to back up their cars to the front of their property. At the end of each work day - after 4:00 PM - steel plates will be placed over the pit to allow street access.

Figure 4: Illustrates the Very Limited Storage Area

Figure 5: Shows limited material handling due to the space required for shoring and formwork

Schedule Acceleration Scenarios

Risk to Completion Date:

The biggest risk was the client not being able to move in on June 25, 2010.After the client terminated their current lease; they saved about 400k and therefore that money was spent on overtime and insuring the work was complete. As part of the law school's master plan, Project X moves the admissions office from the distant leased building, which allowed the school to save the cost of leasing office space and brought key departments back to campus. The main contributing factor to completing the project on time was weather delays. Not getting the building enclosed would prevent the sheetrock & subsequent finishes from starting. Also design changes requiring fabrication could impact installation sequences and delay follow-on work. Since, the concrete superstructure is in the critical path, the concrete pours were schedule for one week per pour this activity is highly dependent upon the weather conditions. This required the concrete subcontractors to work one day a week for approximately 10 weeks, weather permitting. The contractor worked between 8:00PM and 12:00AM to trowel newly poured concrete. This one day per week will coincide with the day of the concrete pour of each slab level. When the pour is complete and while the concrete is still wet, a gas powered trowel machine will be used to make the slab smooth and level before the concrete has begun the curing process. The completion time of the concrete finishing was temperature driven. Warmer weather would allow for an earlier completion time. In colder temperatures, it would take longer. Temporary heating units were used when the temperature dropped to expedite the work.

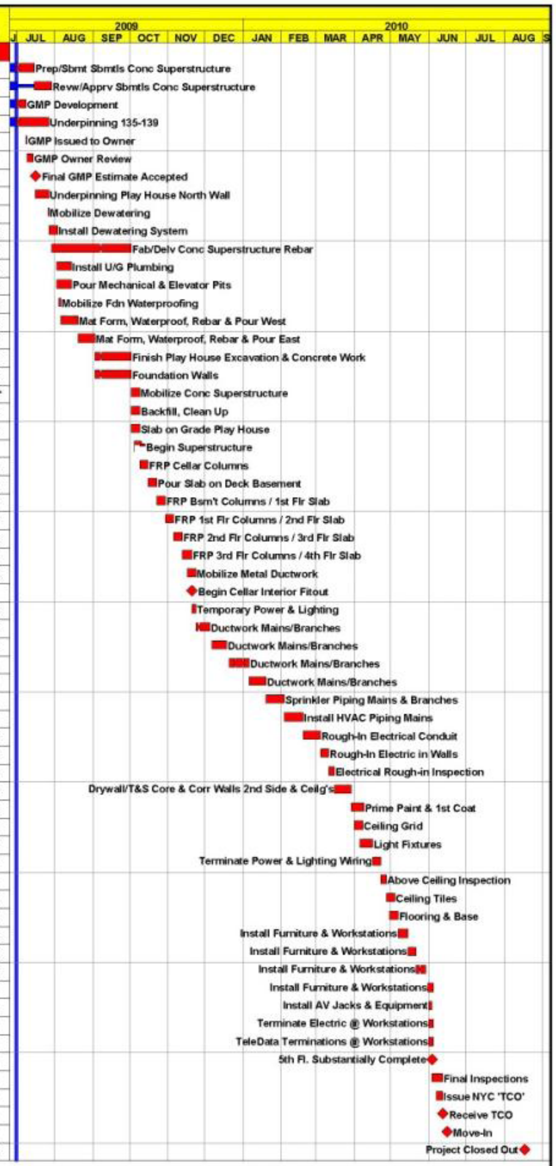
Areas of Potential Acceleration:

All areas were accelerated drywall, electric trim, taping and paint. Carpet and furniture install were done on second shift to make time. Increase Manpower and working overtime were the two techniques utilized to complete the project on time. Interior fit-out and MEP rough-in trades can accelerate by working more floors simultaneously, finish trades can work overtime or double shifts. The primary cost of schedule acceleration was the cost of overtime premium and second shift premium**.**

Critical Path:

The first activity was to erect structure to get building roofed to allowed the lobby lift to proceed, which the allowed the sheetrock and finishes to proceed up the building. Once the 2nd floor was completed, the furniture installation continued through the 5th floor. Note: 6th floor was smaller than the 5th floor so it didn't take as long. See Figure 6 critical activities report. The timing of moving out of occupants leaving existing building and move-in of occupants is essential. The critical path is show in Figure 6 below.

Activity ID	Activity Description	Orig Dur	Rem Dur	Early Start	Early Finish
0					
BP03.211	Prep/Sbmt Sbmtls Conc Superstructure	25	10	02FEB09A	15JUL09
BP03.212	Revw/Apprv Sbmtls Conc Superstructure	15	10	27FEB09A	29JUL09
CMGR.107	GMP Development	86	5	02MAR09A	08JUL09
FNDN.180	Underpinning 135-139	25	18	23JUN09A	27JUL09
CMGR.108	GMP Issued to Owner	1	1	09JUL09	09JUL09
CMGR.109	GMP Owner Review	3	3	10JUL09	14JUL09
CMGR.106	Final GMP Estimate Accepted	0	0		16JUL09
FNDN.190	Underpinning Play House North Wall	7	7	17JUL09	27JUL09
BP08.174	Mobilize Dewatering	1	1	27JUL09	27JUL09
FNDN.185	Install Dewatering System	5	5	28JUL09	03AUG09
BP03.213	Fab/Delv Conc Superstructure Rebar	45	45	30JUL09	01OCT09
FNDN.103	Install U/G Plumbing	10	10	03AUG09	14AUG09
FNDN.195	Pour Mechanical & Elevator Pits	10	10	03AUG09	14AUG09
BP07.434	Mobilize Fdn Waterproofing	1	1	05AUG09	05AUG09
FNDN.200	Mat Form, Waterproof, Rebar & Pour West	10	10	06AUG09	19AUG09
FNDN.210	Mat Form, Waterproof, Rebar & Pour East	10	10	20AUG09	02SEP09
FNDN.205	Finish Play House Excavation & Concrete	20	20	03SEP09	01OCT09
FNDN.215	Foundation Walls	20	20	03SEP09	01OCT09
BP03.214	Mobilize Conc Superstructure	5	5	02OCT09	08OCT09*
FNDN.220	Backfill, Clean Up	5	5	02OCT09	08OCT09
FNDN.225	Slab on Grade Play House	5	5	02OCT09	08OCT09
MSTN.004	Begin Superstructure	0	0	09OCT09	
STRU.100	FRP Cellar Columns	5	5	09OCT09	15OCT09
STRU.158	Pour Slab on Deck Basement	5	5	16OCT09	22OCT09
STRU.102	FRP Bsm't Columns / 1st Flr Slab	5	5	23OCT09	29OCT09
STRU.103	FRP 1st Flr Columns / 2nd Flr Slab	5	5	30OCT09	05NOV09
STRU.104	FRP 2nd Flr Columns / 3rd Flr Slab	5	5	06NOV09	12NOV09
STRU.106	FRP 3rd Flr Columns / 4th Flr Slab	5	5	13NOV09	19NOV09
BPM3.314	Mobilize Metal Ductwork	5	5	17NOV09	23NOV09
FL00.500	Begin Cellar Interior Fitout	0	0	20NOV09	
FLCL.100	Temporary Power & Lighting	2	2	20NOV09	23NOV09
FLCL.106	Ductwork Mains/Branches	8	8	24NOV09	04DEC09
FLBS.104	Ductwork Mains/Branches	10	10	07DEC09	18DEC09
FL01.104	Ductwork Mains/Branches	10	10	21DEC09	05JAN10
FL02.106	Ductwork Mains/Branches	10	10	06JAN10	19JAN10
FL02.116	Sprinkler Piping Mains & Branches	10	10	20JAN10	02FEB10
FL02.108	Install HVAC Piping Mains	12	12	03FEB10	18FEB10
FL02.110	Rough-In Electrical Conduit	10	10	19FEB10	04MAR10
FL02.140	Rough-In Electric in Walls	5	5	05MAR10	11MAR10
FL02.168	Electrical Rough-in Inspection	2	2	12MAR10	15MAR10
FL02.172	Drywall/T&S Core & Corr Walls 2nd Side &	10	10	16MAR10	29MAR10
FL02.178	Prime Paint & 1st Coat	8	8	30MAR10	08APR10
FL02.180	Ceiling Grid	5	5	01APR10	07APR10
FL02.196	Light Fixtures	8	8	06APR10	15APR10
FL02.206	Terminate Power & Lighting Wiring	5	5	16APR10	22APR10
FL02.210	Above Ceiling Inspection	2	2	23APR10	26APR10
FL02.214	Ceiling Tiles	5	5	27APR10	03MAY10
FL02.216	Flooring & Base	5	5	30APR10	06MAY10
FL02.228	Install Furniture & Workstations	5	5	07MAY10	13MAY10
FL03.226	Install Furniture & Workstations	5	5	14MAY10	20MAY10
FL04.226	Install Furniture & Workstations	5	5	21MAY10	28MAY10
FL05.226	Install Furniture & Workstations	4	4	31MAY10	03JUN10
FL05.230	Install AV Jacks & Equipment	2	2	01JUN10	02JUN10
FL05.232	Terminate Electric @ Workstations	3	3	01JUN10	03JUN10
FL05.234	TeleData Terminations @ Workstations	3	3	01JUN10	03JUN10
FL05.240	5th Fl. Substantially Complete	0	0		02JUN10
CMPL.113	Final Inspections	7	7	03JUN10	11JUN10
CMPL.114	Issue NYC 'TCO'	5	5	07JUN10	11JUN10
MSTN.007	Receive TCO	0	0		11JUN10
MSTN.010	Move-In	0	0		14JUN10
MSTN.009	Project Closed Out	0	0		16AUG10



Start Date	02JUN08	Early Bar	NL08	Sheet 1 of 1
Finish Date	16AUG10	Progress Bar		
Data Date	01JUL09	Critical Activity		
Run Date	08JUL09 08:54			

SKANSKA

Figure 6: Shows the Critical Path Schedule

Value Engineering Topics

Value Engineering Ideas Implemented

Metal panel system vs. brick

The owner went with a metal panel system instead of brick on the 6th floor. The cost of the metal paneling system $131,360, while the brick would have cost $287,350 a total cost saving of $155,990.

Figure 7: Shows the Adjacent Height Restrictions and the Metal façade Used on the Roof Level.

The client decided to have an extra floor but do the sunken first floor, because they had a height restriction of aligning with the existing surrounding building. This cost the owner less by not having to construct façade and windows on the 1st floor. Also, this allowed the owner to meet the goal of adding square footage while maintaining the buildings low profile. The cost of heating and cooling the underground portion will also be less for the owner. The owner originally wanted a taller building to add 3 floors to the original building and renovate the existing building. Though the existing structure could not support additional floors and the existing pressure on the bearing wall footings was not adequate for additional load required. Therefore the owner decided to sink two of the floors into the ground in order to satisfy the square footage requirements.

Traditional brick vs. green brick

A red masonry façade elon 70/30 (4" Brick) was used on the project in lieu of the specified "green" brick for the exterior wall. It saved approximately $65,000 for the owner. Although, the owner wanted the "green" brick as a selling feature of the building however economics won out.

Value Engineering Ideas Considered But Not Implemented

Green roof vs. traditional roofing methods

Traditional roofing methods were suggested by Skanska however a green roof was still used despite cost implications. Adding green roofing cost the owner approximately $300,000 more than traditional methods. The green roof was a part of the owner's requirements to implement practices and procedures to meet the project's environmental performance goals, which include achieving LEED Platinum Certification.

Figure 8: Shows Green Roof and Aluminum Railing

Not using aluminum roof railing

Skanska suggested not using aluminum roofing. Since, the aluminum roof railing did not require maintenance the owner decided to use the aluminum roof railing. Aluminum roof railings were added in lieu of painted steel railings, even though this would cost approximately $50,000 more. The owner's goal for the aluminum roof railing was to allow for occupants on the green roof terraces.

Project X went thru an exhaustive 5 year estimating and value engineering sessions until the owner had a design they liked and could afford. Skanska vetted everything extensively. Project X went thru an exhaustive 5 year estimating and value engineering sessions until the owner had a design they liked and could afford. Skanska vetted everything extensively.

Problem Identification

Dealing with Public opinion of project

The school and the greater university have trumpeted the building as a positive addition to the neighborhood. With the Project X, the university attempted to foster a dialogue with the community to avoid increasingly negative perception of the university. The university went to great lengths to build a contextual building and to preserve the walls of the Playhouse and develop an enhanced performance space for this historic theater. Maintaining the existing walls of the Playhouse was a main point of contention between community leaders and the university, and when structural instability in one of the walls was discovered during construction last summer, some of it was demolished without public announcement, angering community officials. Although, the owner has preserved everything possible the community was still generally angered by the construction.

NYU has recently discussed with local community groups about a construction project on the site that would provide space for legal research centers for the NYU School of Law. Before construction an office and apartment building which houses the Playhouse, occupies an important cultural spot in the history of the American theatre. However, the actual building that previously existed on the site today looks nothing like the building occupied by the playhouse theater, most famous for launching the career of Eugene O'Neill among many others of his contemporary writers, actors and artists. The existing building is the result of a major renovation in the 1940s when four separate houses were converted into one apartment building. This conversion included the complete renovation of the interiors of the buildings and the construction of a single façade that you see today. Figure 9 shows the Pre-1940s renovation on the left and the new building on the right.

Figure 9: Shows the Pre-1940's Renovation on the Left and the New Project X Building on the Right.

Reduce the rework time and cost in estimating

The contractors, the designers, and the owner had to constantly be updating new drawing during the five year estimating and value engineering sessions. Could the team have benefitted from converting the project into a paperless project?

Low value of BIM due to the small size of the building

The project was a small size, therefore the owner and contractors decided not to implement BIM on the project. BIM modeling could have possibly been used to persuade the public opinion of the project. Also, the BIM model could potentially bring time savings cost savings to the project.

Schedule

Schedule acceleration had to revert to working overtime and second shifts in order to complete the project on time. Is there an alternate schedule acceleration method that could have been used? Possibly, implementing Vela systems on the project could have saved the project team money in by expediting the schedule.

Technical Analysis Methods

Utilizing BIM for estimates, design, and owner validation

Identify specific areas of Project X design which were extensively analyzed by the owner, redesign by the designer, and estimated by the contractor. Analyze time savings that could have been achieved by sharing information in the preconstruction stage.

Develop a strategy for the owner to use on future projects to use for a more streamlined and integrated information exchange between the owner, contractor, and designers by developing a BIM project plan using The BIM Project Execution Plan. This can be used by the owner as an example for future building development. The BIM Project Execution Plan, which was created to provide a practical manual that, can be used by the project teams for designing their BIM strategy and developing a BIM Project Plan.

Implementing BIM in the field

The second topic of interest is carrying BIM to the field- new responsibilities, roles, & competencies. How can the trades utilize the BIM to decrease the amount of time in spent construction? How can the construction managers' verify the construction in the field more efficiently? As more people see the potential for BIM in construction, they realize that it can be used in all phases of the construction process from planning, bidding and designing to building and management and be taken out to the field.

Analysis multiple case studies to identify potential areas BIM can be used in the field. BIM implementation varies from project to project, so it would be beneficial to have a source of successful project tools that could be used on different projects. The analysis will consist of the case studies listed in Table 1 and five construction company interviews. In the end, develop a list of technics that could be implemented on Project X. There many companies in the industry researching this subject. The goal of this portion is to bring a greater awareness of BIM in the field. BIMtofield.com Website by Trimble will be used for reference.

An interesting initiative spearheaded by Trimble is "BIM to Field" that will focus on helping building owners, contractors, and engineers better understand the potential of solutions that allow the transfer of BIM data to field level systems. While the BIMtoField.com Website is a major step forward in creating awareness about the transfer of BIM data to the field, the initiative's activities will extend further to include hosting annual seminars, Webinar series, as well as product and solution level certifications, according to King. For now the Website will be a resource for case studies, videos, white papers, and best practices learned from the industry. The initiative is comprised of industry leading solution providers including Accubid, Micro Application Packages LTD (MAP), QuickPen, Tekla, Trimble, Technical Sales International (TSI) and Vela Systems. Each of these partners has developed unique products and solutions that provide an aspect of delivering BIM data to the field. BIM to field was discussed by Jurrud Krug, marketing manager for Building Construction Division of Trimble at Trimble Dimensions 2010 Conference held in Las Vegas, Nevada. (AEC Weekly November 22, 2010 by Susan Smith)

Utilizing Vela systems Customer Case Studies			
CM	**Concept**	**Benefits**	**Project Type**
Barton Malow	Connecting BIM to Commissioning, Handover and Operations	Solution Reduces Costs of Handover and Operations for Owner and Improves Contractor Efficiency.	Hospital (Maryland General Hospital, Baltimore, Maryland) - Addition and Renovation
Turner	Managing QA/QC from an Enterprise Perspective - Verifying Conformance and Driving Performance	Technology Improves Enterprise-level Quality Assurance and Risk Management.	Condominium (Rittenhouse Square, PA), Military Housing Unit (Hampton Roads Naval Housing, VA) and others
DPR	BIM-enabled Real-Time Supply Chain Management at DPR Construction, Inc. with Tekla Structures and Vela Systems	Tekla-Vela integrated system accelerates schedule 20%, eliminates unnecessary reorders, improves coordination and crew allocation.	Education (UCSC Porter B College, Santa Cruz, California)
Robins & Morton	Robins & Morton Gains Efficiency and Accelerates Healthcare Project Delivery Using Vela Systems Field Software	Improved quality control processes towards a goal of zero punch. Accelerated project delivery without jeopardizing quality and client service.	Hospital, Central Energy Plant, Medical Office Building (Florida Hospital Memorial Medical Center, Ormond Beach, Florida)
Clabro	Cianbro Achieves Paperless Jobsite at Destiny USA: Integrated solution from Vela Systems and Autodesk automates electronic plan delivery and field activities on Tablet PCs	Achieved paperless jobsite, cut issue processing time from 5 days to 8 minutes.	Green Construction: Commercial Mall (Destiny USA, Syracuse, New York)
Hensel Phelps	Hensel Phelps Uses Vela Systems Field Software to Deliver Prototype of New Aircraft Launch System for the U.S. Navy	Saved Headcount by Automating Quality Inspection Processes and Using Electronic Documents in the Field.	Heavy-Military (EMALS Facility, Naval Air Engineering Station, Lakehurst, New Jersey)
Skanska	Skanska Uses Field BIM Solution to Save $1 Million on the New Meadowlands Stadium	Saved $1 Million in Project Costs.	Stadium (New Meadowlands Stadium, New Jersey)
BERRY	Industry Safety Leader William A. Berry & Son Uses Vela Systems to Improve Safety Verification and Subcontractor Accountability	Reduced Safety Inspection Time By 50%.	Hospital (Brigham and Women's Hospital new Cardiovascular Center, Boston, Mass)
SUFFOLK	Driving Efficiencies in the Construction Industry with Motion Tablet PCs	Suffolk Cuts Contractor Worklist Time By 50%.	Hospitality (Liberty Hotel, Boston, Mass)
Charleville Development Corp	Charleville Development Accelerates Project Delivery and Improves Quality with Vela Systems for The Blue at Doral Project	Gained 30 Days on Schedule.	Condominium and Hotel (The Blue at Doral, Miami, Fla)
Arquitectonica	Arquitectonica Launches Next Generation Construction Administration Services with Vela Systems	construction administration processes, saves time on each project due to field automation.	Commercial and Mixed Use (Wilkie D. Ferguson, Jr. United States Courthouse in Miami, Fla)
CMC	CMC Group Accelerates Grovenor House Project with Vela Systems Software	Finished 3 Months Ahead of Schedule.	High-rise Condominium (Grovenor House, Miami, Fla)

Table 1: Shows the Case Studies that Will Be Utilized for Finding More Information About Field Implementation of BIM|This table was provided by Vela systems.

Identify and recommend potential areas that owners can utilize BIM after construction
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. The goal is to developing models to meet the client's needs. "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? 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 requests 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 include too much information and too little information. Ideally the contractor would have recommendations from the owner; however owners don't necessarily know all the choses. Thus the goal of this analysis would be to contribute this data to The Pennsylvania State University's BIM Execution Plan.

The following is goals I am looking to accomplish in shadowing The Pennsylvania State University's OPP Area services.
Identify how the current practices of commissioning for project closeout and continuous commissioning.
Identify viable information that can be uploaded into the BIM model.
Identify which maps and O&M are used by the universities maintenance department.
Identify ways the owners can store design intent and O&M in the BIM.
Development a strategy for universities maintenance department to organize data within the BIM model.
Identify which energy management system, BMS, cafum, MMS, CMMS, or ARTRA is being used by The Pennsylvania State University and University X.
Identify common renovation changes that can be updated simultaneously in the BMS and BIM.

This will be accomplished by shadowing The Pennsylvania State University's OPP and University X's OPP. At The Pennsylvania State University Andy Ellenberger Supervisor, Area Serves has granted me permission to shadow maintenance personal for a full week starting December 15, 2010 to December 25, 2010. In addition, research will require shadowing Project X's OPP maintenance worker for a day Area service personal's 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 Betchel to validate the conclusions.

Small projects uses of BIM advantages and disadvantages

COBIE is a standard used by the industry to monitor the dollar value of BIM use in construction.
Use COBIE Calculator for a case study of Project X and four other buildings of The Pennsylvania State University's buildings and University X.
Assist in cultivating a data base of case studies that could be used by the industry.
Develop recommendations for COBIE.
Identify predictions for feasibility studies relative to Contract types, conditions, uses, long term uses, and life cycle costs.
Determine time savings that can be achieved by the owner while using BIM technology.

Identify current design limitations of BIM technology

Structural

Design the concrete structural system with Revit Structures program.
Design the concrete structural system with Tekla Structures program.
Determine the benefits of a detailed structural model from the start of design.
Compare the disadvantages and advantages.
Find the current limitations of the software
Analyze time savings that could be saved in the shop drawing and detailing process.

Electrical

Design the electrical with Revit MEP systems.
Determine the benefits of a detailed electrical from the start of design.
Analyze time savings in the detailing process.
Determine the benefits of a detailed electrical model from the start of design.
Identify how 3D models assist in prefabrication of work for electrical contractors.
Identify how the 3D model can be helpful when complicated conduit bends are required.
Identify the benefits of representing the contractors' access and maintenance clearances in their models.
Identify the current areas that are lacking of product information.
Analyze time savings in the detailing process.

Conclusions

Modeling the building using current technology will clarify the current limitations of the software.
Identify the possibilities of model-based fabrication.
Compare the disadvantages and advantages Revit and Quickpen. Tekla, Trimble, Accubid.
Interviewing the designers of Project X to learn what software they used.
Find out the limitations of BIM in design application.

Research Interviews

Interview with Thornton Tomasetti discovered Tekla Software can detail concrete reinforcement. Typically this is only done for clarification purposes in the field of complex details, such as MEP penetrations, column splices, and foundation walls. This is a very simple to do (research the procedure for this.

Interview with Barton Associates to discover BIM's capabilities for electrical and HVAC design.

Interview with Dr. Lepage discover Tekla Software capabilities with concrete structures

Interview with Dr.Geschwindner to find out the applications of Steel construction in BIM technology