

WestEnd25

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1229-1231 25St. NW

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Technical Assignment III: Alternative Methods Analysis



Executive Summary:

WestEnd25 is a conversion of two six story office buildings to residential rental apartments. The project will add four post tensioned concrete stories to the top of the existing buildings, and will fully connect the two buildings. Technical Assignment III serves as an investigation of constructability challenges, schedule risks, and value engineering on WestEnd25 to identify areas of future research. Information for analysis came from actual project documentation, and construction knowledge gained through course work and on the job experiences.

In order to obtain information regarding constructability challenges, schedule acceleration scenarios and value engineering Greg Medsker of the WestEnd25 project team was interviewed. WestEnd25's constructability challenges originate for the renovation nature of the project. The top three constructability challenges, slab elevations, slab edges, and poor utility records, all deal with the existing conditions. Both innovative features, such as self-leveling concrete, and professional judgment for utilities are being used to overcome these issues.

The critical path of WestEnd25 runs through the curtain wall installation and the interior work. For acceleration the main option is multiple crews. This type of acceleration is planned for the brick façade due to the constructability challenges of the slab edges. The next opportunity for acceleration to occur will be with interior work. Interior work is on the critical path and space will be limited for multiple crews. Therefore, in order to have successful acceleration proper planning of work and the labor to perform the work will be necessary.

Value engineering was first termed during World War II when society had to do more with less. One of the key components of value engineering is to maintain or increase functionality without increasing the price. The implemented value engineering decisions gathered from the interview maintain functions desired by the owner with reduced material costs. The considered but not implemented ideas fail to maintain the original functionality but do reduce the cost.

From the completion of previous Technical Assignments and familiarization with WestEnd25 several topics that contain room for improvement have been found. These topics address construction planning and construction methods to reduce cost and shorten activity durations. Issues that address multiple areas are considered for a technical analysis.

Identified problems that contain multiple construction management issues were considered for technical analysis. The problems addressed by the analysis are explained. The information and steps that need to be gathered and taken to successfully complete a meaningful analysis are also explained. A matrix graphically shows that the analyses cover multiple areas of construction management.

From this report a research proposal will be created that will further detail the requirements for each analysis. The proposal will detail each step needed for a complete analysis as well as all the information that will be needed to produce useful comparisons.



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A. Constructability Challenges:

Unique Constructability:

Constructability generally means the extent to which the design provides for ease of construction. Unique constructability issues on WestEnd25 derive from the existing conditions. The scope of WestEnd25 comprises of joining two existing office buildings into one residential building. An interview with the Assistant Project Manager, Greg Medsker, was completed to determine the different constructability issues on WestEnd25.

Overcome Challenges:

Existing Structures Elevation:

Tying two existing buildings together is difficult, especially when the building's elevations are not identical. This is the case on WestEnd25. The existing northern 1231 building is actually a 1" lower than the southern 1229 building. The difference between buildings must be solved to create a level slab across both buildings. In order to accomplish a level slab a topping slab will be added to the 1231 building to even the floor elevations to the 1229 building. The topping slab will be Ardex V1200 a self leveling flooring underlayment. The weight per square foot cannot be more than 15 lbs/sf so not to overload the design of the columns.

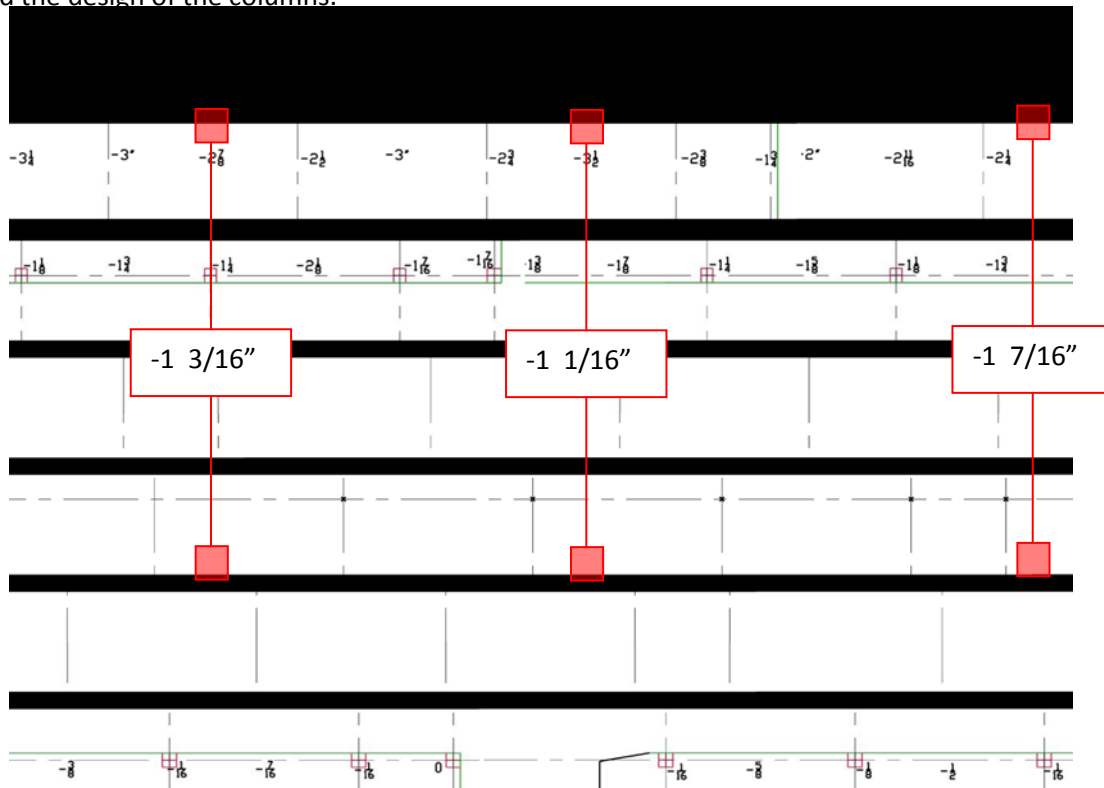
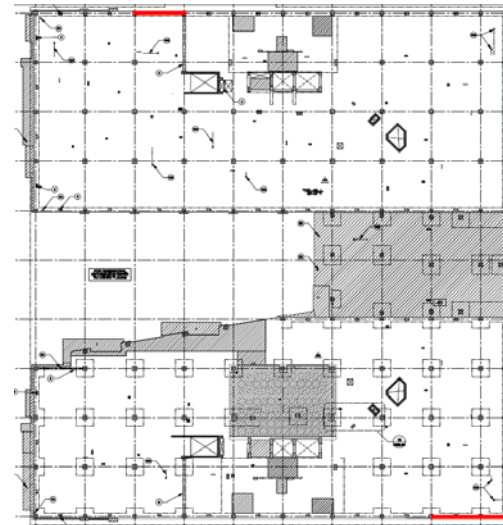


Figure shows elevation difference between buildings

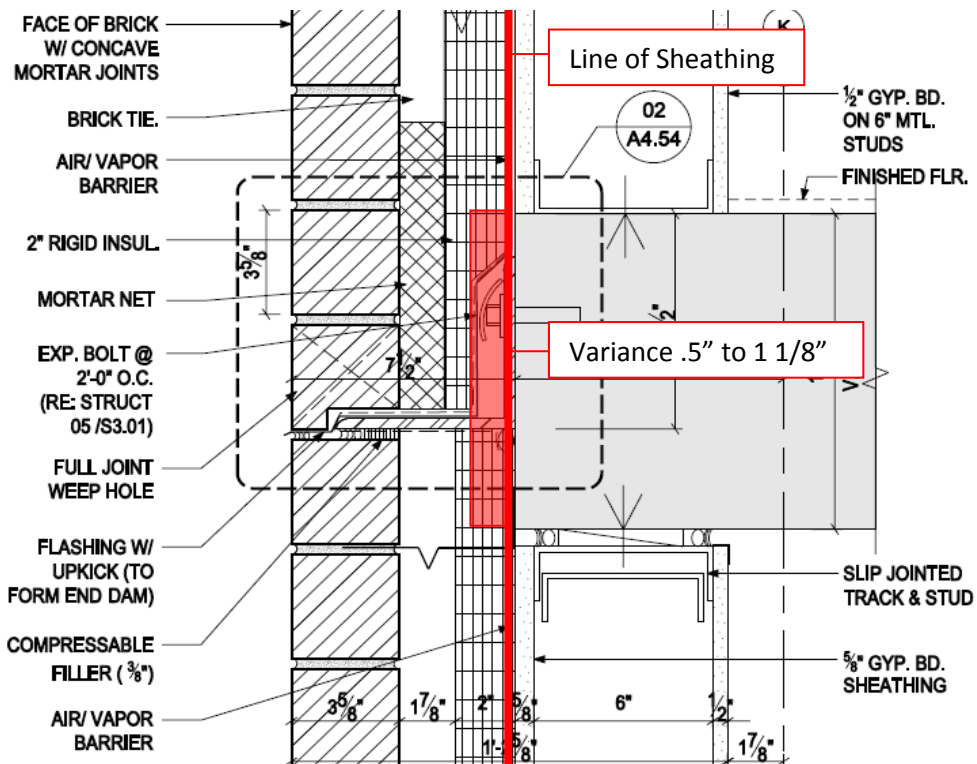


Slab Edges:

On the West façade the slab was extended to increase the building size and create protrusions in the architecture. The other parts of the building were not extended. However some existing slab edges are not perfectly straight across and are outside the face of sheathing. The illustration to the right indicates locations of this problem on the fourth floor. These locations are similar for the second through sixth floors. The variations range from .5" to 1 1/8" past the face of the sheathing. The slab edge extending past the face of sheathing affects the installation of the brick angle, windows, and waterproofing. The detail below illustrates the problem with the slab extending beyond the face of sheathing. The edges must be adjusted before façade work can commence, so the slab edges were cut back at the problem locations. This is affecting both the demolition budget as well as the schedule for the façade.



Areas of slab edge adjustments



Façade detail of at existing slab edge



Utilities, Poor Public Records:

Due to poor recodes of the utility locations there was extensive utility discovery/test pitting and coordination/redesign of approved plans. A plan takes a long time to get approved for the District of Columbia and if changes need to be made to this plan, getting municipalities to sign off on the changes also takes a considerable amount of time. Business relationships are extremely important to being successful in a competitive environment. The owner, Vornado, is a prominent developer in the D.C. area and has some influence in regards to obtaining decisions from the utility provider, PEPCO, in order to keep WestEnd25 utility work moving. PEPCO is notorious for slow decisions when approving designs. Vornado has made PEPCO aware of WestEnd25 allowing for a realistic schedule for the permanent power process. Quicker approval has led to the ability to accelerate the schedule and minimize the cost of temporary power.

B. Schedule Acceleration Scenarios:**Project Critical Path:**

The critical path of the project is the installation of the curtain wall followed by interior work. The curtain wall comprises of the entire west elevation including wrapping around the courtyard. The curtain wall is a unitized system that will be installed from inside the building. Therefore, framing and finishes cannot be installed until the curtain wall is installed. Installation of the curtain wall may be delayed by its extensive design and long lead items. Interior work on the critical path flows floor to floor until the project is completed. Proper management of the flow of subcontractors through the interior work stages of the project will lead to a successful completion.

Schedule Risk:

Any delays experienced with the curtain wall will have a direct effect to the project's critical path. Therefore, if the curtain wall gets behind schedule the entire project will get behind schedule. Activities to make up time in the schedule actually include interior work which can only start after the installation of the curtain wall and is also on the critical path. A benefit of this is that the amount the schedule needs to be compressed will be known and acceleration can occur.

Potential Acceleration:

An example of acceleration that can occur is the use of multiple crews. After the slab edges are fixed the drywall subcontractor will work at least two crews to frame and sheathe the building. This acceleration is necessary to ensure the proper start of interior work that can only proceed after the building is water tight. This will increase the labor cost, but the benefits will be gained in the long run. Further acceleration can occur after the building is watertight. Space permitting multiple crews can work on interiors to accelerate the schedule. If there are space limitations another option of acceleration is working overtime or multiple shifts.



C. Value Engineering Topics:

Implemented Value Engineering:

Value engineering is a systematic approach to obtain the most value for the cost of construction. There are three primary ways to implement value engineering into a project. Those ways are to improve function with no added cost, keep function same with reduced cost and to improve function with reduced cost. The three most cost effective value engineering decisions made on WestEnd25 are covered below.

Colonnade Material:



Entrance Colonnade

A prominent street feature is the entrance colonnade. This colonnade extends across the entire entrance of the courtyard. There are 75 individual pieces that comprise the colonnade. By alternating the material of those pieces from steel to wood would save \$60,000. Also, wood for the colonnade would be more constructible and have less of a lead time. The overall appearance will fit in with the naturalistic appearance of the entrance courtyard.

Thermal Protection:

The initial thermal protection system was an air membrane and rigid board system. In order to save money the system was changed to a blueskin and cavity insulation system. By making this change the insulation cost was reduced in half from \$5/sf to \$2.5/sf which totals a savings of \$188,000 and the function of the system is not diminished.



Illustration of Blueskin System

Stone Tops:



Kitchen Countertop

To take advantage of economies of scale the stone countertops for the entire building was standardized to only use one type. This will make delivery, coordination and installation easier for the project. With multiple types of stone tops the price was \$50/sf and with standard stone tops the price is \$40/sf which totals a savings of \$125,000. This change should not reduce the owner's ability to rent apartments.

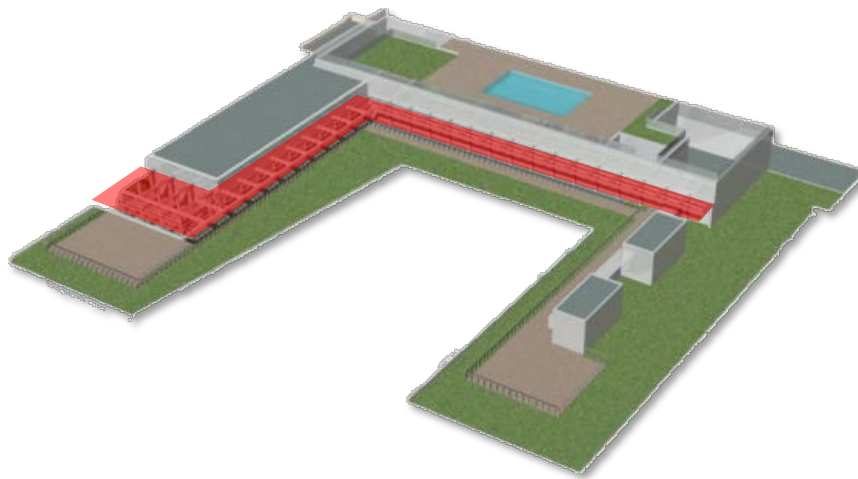
Considered Value Engineering:

There were several value engineering ideas that were presented to the owner but were rejected. One of the primary concerns of the owner is the overall esthetics of the building and the marketability of the apartments. In these cases the cost would have been reduced but the owner felt that there was a significant loss in function that may be overall detrimental to the project, specifically selling apartments. The ideas that were not accepted by the owner are listed below.

- Delete Trellis at Roof Level
- Delete Blinds
- Individual Electric Water Heaters
- Remove Living Area Track Lighting

Roof Trellis:

The roof trellis runs along the perimeter of the rooftop penthouse and is highlighted with red in the figure below. 6" x 6" steel posts at 16' on center support the 2" x 8" IPE wood purlins of the trellis. With the deletion of the trellis the project would save \$168,192. This cost savings suggestions was not accepted because the trellis is an integral part of the roof design that the owner and designers fought the Park Service and Planning Department to allow the trellis.



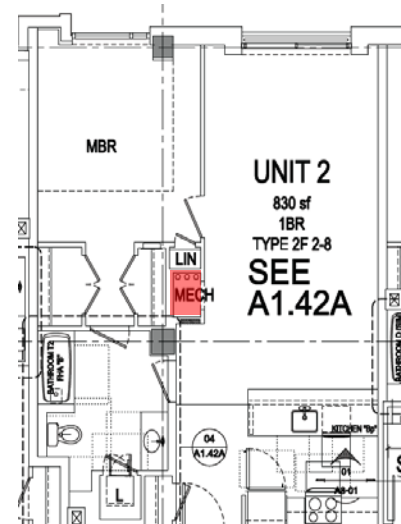
Location of Roof Trellis

Blinds:

By providing apartments without blinds the project would see a cost savings of \$121,400. However, window treatments have been factored into the energy envelope study, glass selection, and mechanical equipment sizing. Furthermore, the owner's previous experience shows that on condominium projects where blinds have been deleted the tenant regretted the decision based on aesthetic loss. For this rental project the owner does not want to risk the possibility that blinds will preclude the ability to rent units.

Electric Water Heaters:

It would be possible for every apartment to have its own water heater, instead of a central system. If this system was originally chosen it would cost \$159,000 less. The figure to the left shows a typical apartment floor plan. The highlighted red section is the mechanical closet which houses the HVAC equipment for the apartment and has no room for a water heater. So, changing the system from the original design would require architectural redesigns to create space for the water heater to be located. Any savings in reduced piping and reduced equipment would be lost in design fees.



Limited space in typical floor plan

Track Lighting:

There are two locations of track lighting in each apartment. One location is in the kitchen and one is in the living area. The fixtures specified retail just over \$100 and removing the strip lighting in the living area of each apartment would save \$284,000. This idea was not accepted because it would make a negative effect on marketing efforts when the units are being delivered without furnishings. The units have deep interior space that will be hard to rent without the extra artificial light.



Living Area Track Lighting

Considered Value Engineering Summary:

The previous value engineering ideas fail to perform the original functionality desired by the owner. Therefore, these ideas were rejected. Improved value engineering ideas would keep the same function but reduce the material cost, a less expensive light fixture or material for the roof trellis, for example. The owner is sophisticated and is an experienced developer; therefore simple cost cutting will not replace value engineering.

D. Problem Identification:

Problem Overview:

There are several items that present themselves as challenges or areas of improvement. In order to identify difficult aspects of the project opportunity to simplify constructability, reduce durations, and decrease costs were considered. Several difficult features of WestEnd25 that can be pursued through a detailed analysis of technical building systems and construction methods are listed below.

- Trade Stacking
- Curtain Wall
- Concrete Pump vs. Crane and Bucket
- Punch List Software
- Brick vs. Precast Façade

Trade Stacking:

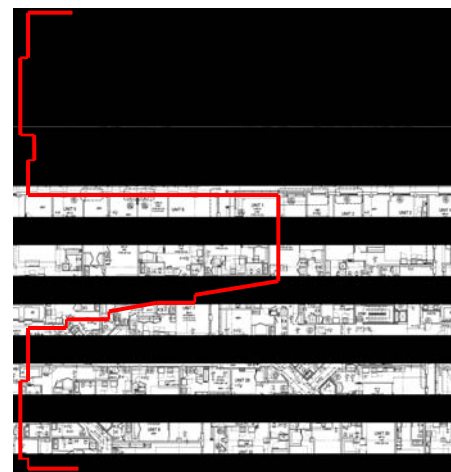


Flow of Trades

Trade stacking and flow is always a critical issue on a construction site. Often times this is an issue that is accepted and expected by subcontractors. However, this problem is worsened on WestEnd25 by the urban location and small footprint. If this problem is not addressed it may cause project delays and in turn lawsuits. Therefore, proper planning of trades and spaces for the duration of the project needs to occur to avoid the stacking of trades.

Curtain Wall:

A watertight building cannot be reached without the installation of the curtain wall. WestEnd25's curtain wall wraps around the western façade, as shown in figure to the left. Curtain wall panels will be stored inside the building. Floors will contain the panels for the story below so that the interior crane system can lower the panel to the floor below. The opportunities for improvement can be found in the delivery and installation of the curtain wall system.



Red highlighting curtain wall

Concrete Placement:

The concrete placement technique used on WestEnd25 is crane and bucket. Another option that can be researched is the placement of pumping the concrete in place. Pumping concrete is quicker and requires less labor. In fact, Associated Construction Publications states that contractors find a 50% savings in labor costs compared traditional methods¹. A possible analysis can look at the cost difference and time difference between each system, including the necessary planning needed for placement via a pump.



Bucket for Placing Concrete

Punch List Software:

In residential construction punch list items are critical based on the numerous tenets and their desire for flawless quality of finishes and performance. Being able to track and manage these list items is critical. Trades need to be managed to finish their work for completion and final payment. Due to the possible punch list items problems can arise from poor documentation and management follow up. Recently, software has offered a solution to help manage this process. These programs allow for immediate verification of completed on site via a PDA. Therefore, a possible area of research is the use of these software programs and their benefits.

Façade:

The existing façade for WestEnd25 was precast architectural panels. Brick will replace this façade. Brick is an aesthetically pleasing choice that has a relatively simple installation. The brick option is causing problems because the slab edges do not run in straight lines in some locations. In order to solve this problem extra work must be completed before installation can happen. If the existing precast was removed and replaced with a new architectural precast brick façade the slab edges would not be an issue. An analysis would look at the cost and schedule impacts from altering the façade type.



Precast Brick Sample

¹ Hayes, Kelly. *Why Pump Concrete? - Tips on Knowing When to Select Concrete Pumping Over Tradition Placement Methods*. Associated Construction Publications. 11/1/2008.
<http://www.acppubs.com/article/CA6606409.html?industryid=48572>

E. Technical Analysis:**Trade Stacking/Flow Analysis:****Problems Addressed:**

The curtain wall on WestEnd25 is a unitized system that will be installed from the interior of the building. Therefore the material storage, staging along with installation of the curtain will affect the other trades also working inside the building. To minimize the negative effects a plan to designate space at different times of the project must be developed and communicated to the subcontractors.

Analysis Description:

Spatial planning is important to minimize the amount of congestion. The plan will contain information determining the sequence of activities along with the necessary space for trades. Then potential conflicts will be determined and resolved. In order to effectively communicate this plan it will be shown with a 4D simulation. The required steps to complete this analysis are listed below:

- Material Information
- Space Determination
- Generate Floor Layouts
- Sequence of Subcontractors
- Conflict Analysis
- Conflict Resolution

Brick v. Precast Façade Analysis:**Problems Addressed:**

Installation of brick is a labor intensive activity. The masons are limited to the height they can place in a day. Therefore the amount of work, per crew per scaffold is limited per day. Precast would allow for more production and faster enclosure of floors. Furthermore, the existing structure is better suited for precast architectural panels since they were also the original façade.

Analysis Description:

This analysis will compare the current installation of the brick façade with precast. Time, cost and the ability to accelerate the installation will be considered as part of this analysis. Time comparison will be made with the current duration for the installation of brick of 106 days. Costs comparisons will include the material, labor and equipment. In order to complete this analysis all the information pertaining to time and cost of the precast system will be gathered and compared to the estimates of the current design. Also, included in the cost comparison will be the extra cost of demolition for slab edges.

After discussion with Mark Taylor of Nitterhouse Concrete Products, it has been determined that if precast panels were being installed as the new façade then the extra demolition would not be needed.

Curtain Wall System Analysis:

Problems Addressed:

The curtain wall is being installed from the inside which will most likely cause conflicts between the trades. The curtain wall crew will need to occupy multiple floors in order to install the curtain wall and the stored material will also occupy valuable floor space.

Analysis Description:

This analysis will look at the current system to decide if there is a better curtain wall system for this project. Factors that will be considered in this analysis are the delivery/storage method, equipment used for installation, and the effects on other trades. This analysis can tie into trade stacking analysis. That is if it is found that there is congestion that would reduce productivity or delay interior work the alternative curtain wall system and installation proposed here will also be modeled to show the potential savings from less congestion. Information that will be needed for further analysis will depend on alternative curtain wall systems and the methods materials can be deliver/stored and the way the system can be installed.

LEED Analysis:

Problems Addressed:

From the PACE seminar a problem about more ownership involvement in the LEED certification process was raised. One of the main concerns from the PACE discussion is the owner's ignorance of the certification process. This analysis will look at finding a method to have and document owner involvement in their building's certification process.

Analysis Description:

Industry members strongly feel that owners need to take a more prominent role in ascertaining LEED certification. One of the consensus ideas created at the PACE seminar is that a LEED point should be awarded for involvement in the LEED certification process. Therefore an analysis would look at the necessary documentation to prove adequate owner involvement and the willingness of the U.S. Green Building Council to implement. This analysis will also include a survey of experienced owners to ascertain the willingness to put their personnel through LEED training and take the exam to become LEED Accredited Professionals.

Concrete Placement Analysis:**Problem Addressed:**

The placement of concrete with crane and bucket is a time consuming process. This analysis will look at how the four additional stories could benefit from the use of a concrete pump.

Analysis Description:

In order to illustrate the difference between the placement of concrete via crane and bucket verses a concrete pump all the cost and time data for the crane and bucket method will first be gathered. Then costs and times for placement with a concrete pump will be gathered and compared. Judgment on the best system will include the overall cost compared with the placement duration.

Analyses Summary:

This illustrates the construction topics that each analysis would include. The analyses that cover more topics are better for further research. Five analysis ideas were completed in order to have options when deciding for the proposal what analyses will be further detailed. Below the analysis matrix illustrates that brick façade, concrete placement, and curtain wall topics would be good candidates for further research. The trade stacking and LEED analyses do not cover as many topics and therefore are not as good candidates.

Analysis Matrix:

Analysis	Critical Issue	Constructability	Schedule Acceleration	Value Engineering
Trade Stacking	X		X	
Brick Facade	X	X	X	X
Curtain Wall	X	X	X	
LEED	X			X
Concrete Placement		X	X	X