

Aria Health ED Expansion

Philadelphia, PA

Technical Analysis Report 3

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Construction Option

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Executive Summary

Schedule Acceleration Scenarios

Driving the critical path from the beginning, the site utility relocation work at the Aria Health ED Expansion project proved vital for keeping on track for the completion date. The demolition of old medium voltage switchgear, the relocation of two incoming electric feeds, and the installation of the new medium voltage switchgear were necessary before any other work could be completed. From there, the critical path continued with Level 1 excavation and foundation, followed by structural steel erection, building enclosure, and fit-out. Substantial completion is scheduled for June 27th, 2014.

The biggest risk to the project completion date lies in waiting for the notice to proceed for the Outpatient Lobby area that links up to the existing hospital. The owner is reluctant to allow the project team to enter that area because of the patient and staff rerouting necessary during the absorption of the "Main Street" corridor.

The project has lost 40 total days due to permitting issues and weather delays. To remedy this loss in schedule, the project team has implemented pull scheduling techniques and general construction logic to eliminate float from the schedule. If more time is lost on the project, the team may request a push back in the substantial completion date. There are no damages associated with the project contract, therefore a later substantial completion date is not a major problem. Maintaining budget is one of the most important aspects of this project, therefore any extra costs associated with increased man power is not an option.

Value Engineering

Five implemented areas of value engineering were analyzed along with three items that were proposed but not accepted by the owner. Cooling tower #5 was originally meant to be installed where the existing four cooling towers are located in the cooling tower farm on the west side of the project site. CT-5 will be moved to the Level 2 roof to decrease material and labor costs. Secondly, the entire Level 3 exterior façade facing the Level 2 roof will be redesigned to be installed with stucco in lieu of the original brick veneer. This will save money initially for the project, while also saving money later when the hospital decides to expand in the future. Next, all of the interior finishes have been eliminated from the Level 3 core and shell space. The owner decided that this was no longer necessary because no one will be occupying that area for an extended period of time. The last two VE items are associated with the deletion of the Outpatient Canopy and the associated loop road originally meant to access this secondary entrance. The owner felt that they only needed one main entrance and has turned the Outpatient Lobby area into an egress-only exit.

The owner's primary goal is the clinical needs of the hospital emergency department, where all available resources will be used. Any extra costs must be kept to an absolute minimum, as the project budget is fixed with no room for error or additions.

Not all VE items were accepted however. The project team proposed the deletion of the entire Level 3 core and shell space, but the owner decided to keep it for future renovation and expansion. The deletion of one structural bay to Level 3 was also unacceptable, along with the deletion of the structure and roofing required for the interior courtyard.

Executive Summary

Critical Industry Issues

Two breakout sessions took place at the PACE Roundtable where assembling effective cross-functional teams and multi-trade prefabrication were discussed. During the first session, it was decided that for an effective cross-functional team, leadership and collaboration starts at the top of a project organizational chart and permeates downward throughout the respective parties. Collocation was described as an effective way for a project to operate, where all the associated trades, general contractor, and owner reside in the same office or trailer area.

Multi-trade prefabrication was seen as an effective and safe way to better install preassembled MEP racks to accelerate field productivity. It is possible for multiple subcontractors to come together and build runs of conduit, piping, hangers, and wiring. This has been done before and proved to be a successful way to collaborate and coordinate trades.

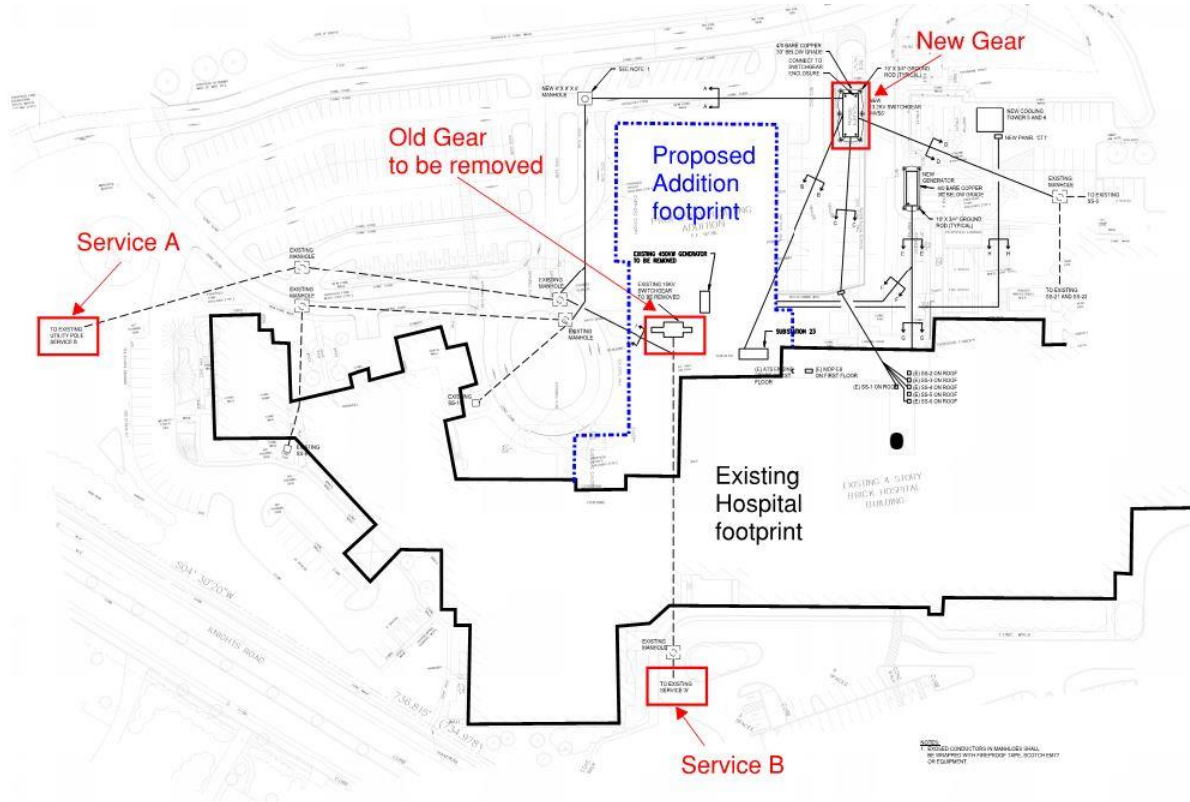
Feedback from Industry Roundtable

After speaking with industry professional Dan Buchta, Project Director at Barton Malow Company, several areas of research for the spring semester were realized. Most substantial of these were to look at a different project procurement method, as well as a new project delivery. The Aria Health ED Expansion project is a traditional design-bid-build, where there are many areas that could be improved by early subcontractor involvement and more owner collaboration.

Schedule Acceleration Scenarios

Critical Path

The critical path of the Aria Health ED Expansion project began with the relocation of two vital and operational incoming electricity feeds from the Philadelphia Electric Company (PECO). These two 13.2 kV lines were required to be strategically rerouted, one at a time, with associated electricity shutdowns and switchovers causing areas of concern for the existing hospital. The main hospital building was originally running off of electrical service A from the West and service B from the south ends of the site. These lines fed directly to the existing medium voltage switchgear, which had to be removed due to its location within the proposed new building perimeter footprint. The incoming PECO lines were then rerouted around the



new building addition to be connected to the new medium voltage switchgear at the north-east corner of the new addition. This process of installing the new switchgear, switching over incoming feeds, and demolishing the existing switchgear drove the beginning of the project schedule critical path. No other site work or excavation within the new building footprint could be completed prior to these permanent utility changes, therefore it was vital that they be done according to schedule and without major issues.

Following the successful completion of the site utility relocation and demolition, excavation could begin within the addition site on May 5th, 2013. According to the detailed project schedule provided by Turner Construction Company, next on the critical path were the Level 1 concrete foundation wall footings followed by the foundation walls themselves, all of which are below grade. This then continued to drive the critical path for a total of 29 days, beginning on May 30th, 2013 and ending on July 7th, 2013. Level 2 foundation, which is at grade, is shown with some float, considering that work could be completed simultaneously with Level 1. After the completion of Level 1 foundation, the structural steel superstructure began on July 10th, 2013 with a total duration of 41 days, ending on September 4, 2013. The new building was broken up into 15 separate “Derricks” where each of the respective derricks took

Schedule Acceleration Scenarios

between 1 day and 4 days to erect. Metal deck steel, shear studs, and bolting were not shown as critical, due to the decreased duration for installation. Following the erection of structural steel, the interior concrete slabs were poured and finished.

Currently, the project is striving toward complete building enclosure, which will be a major milestone within the critical path schedule. Crews are currently working on sheathing the exterior walls, installing metal panels, and placing brick masonry and painted concrete panels. After the completion of the building enclosure on December 20th, 2013, work can begin on interior finishes without concern for weather related damages to material.



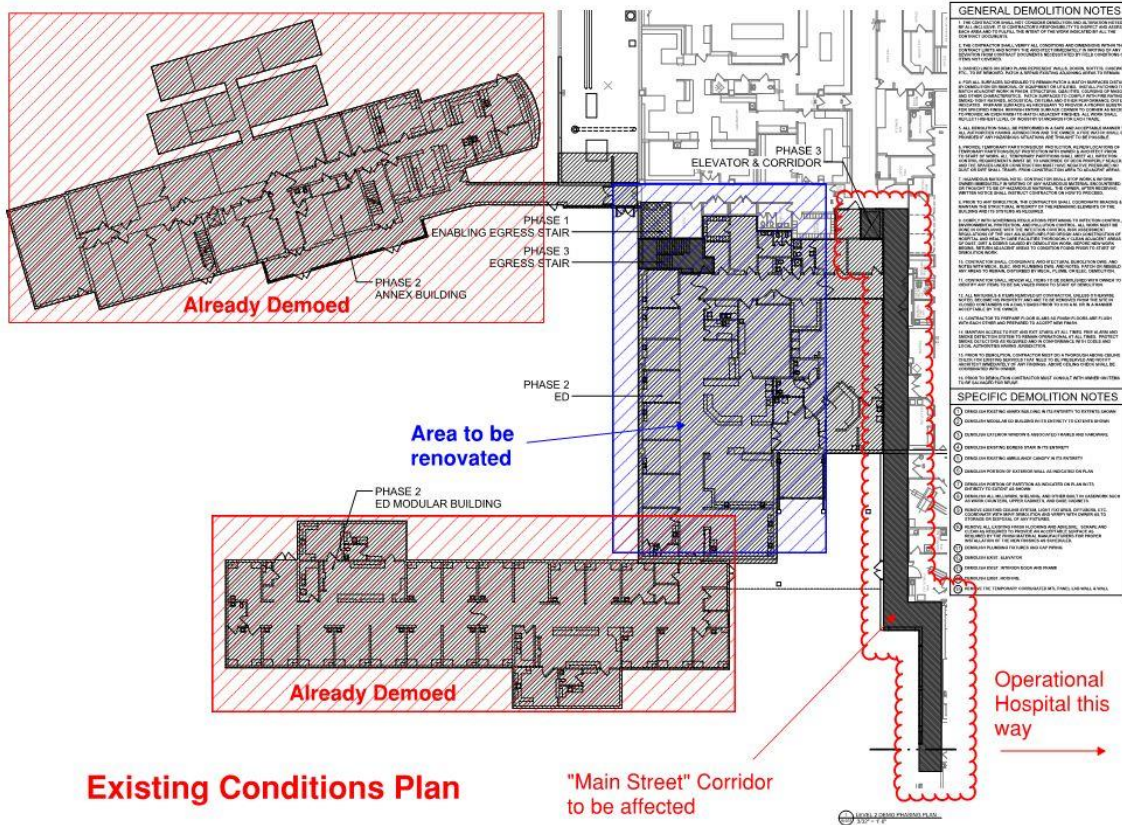
Following the building enclosure, Level 2 MEP installation will become critical for the winter months. The project team needs to get tempered air moving throughout the building to begin TAB and commissioning, as well as to heat condition the interior spaces for finishes.

After all material and equipment has been installed, substantial completion will follow with a date of June 27th, 2014. After substantial completion, Department of Health (DOH) inspections, township inspections, and DOH licensing will be necessary for building occupancy and the 1st patient day scheduled for July 1st, 2014.

Schedule Acceleration Scenarios

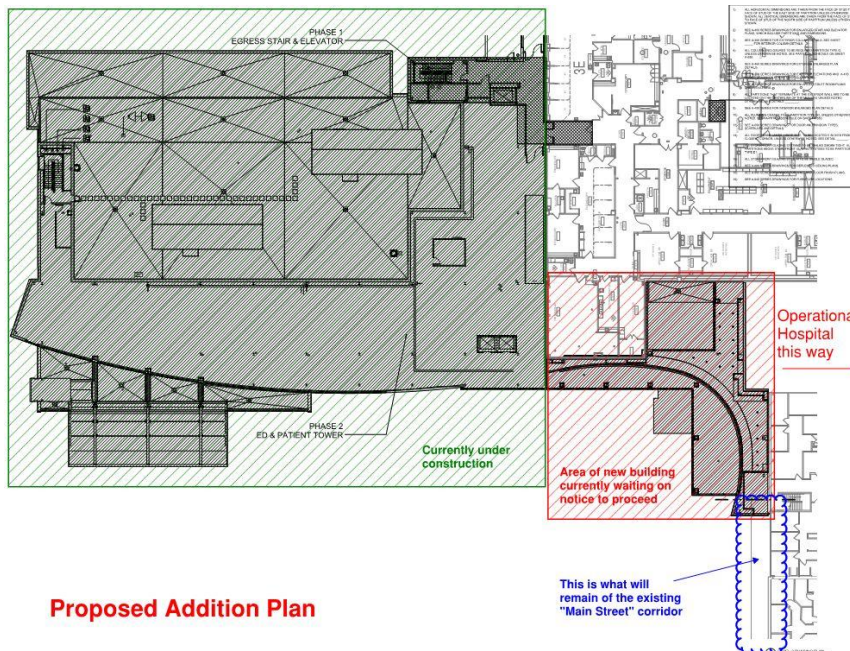
Biggest Risks to Completion Date

Currently, the biggest risk to the project completion date at the Aria Health ED Expansion project is the notice to proceed for the absorption and renovation of the existing "Main Street" corridor that is heavily utilized by patients and staff of the operational hospital to travel along the north exterior edge of the building. This is shown in the existing conditions plan below.



Existing Conditions Plan

"Main Street" Corridor to be affected



Proposed Addition Plan

This schedule hold-up will affect 6,000 SF of new building consisting of foundation, steel erection, façade, roofing, and interior fit-out. The project team is currently waiting for the building owner to give them permission to move into this area and begin work. The hesitation associated with this proceeding lies in the owner's concern for day-to-day operations in that area of the hospital. Along with the rerouting of patient and staff, patient disturbance is always a key area of concern.

Schedule Acceleration Scenarios

Potential Areas of Acceleration and Associated Costs

The Aria Health ED Expansion project team was faced with some schedule delays during the early phases of construction. Initially problems with building construction and demolition permitting proved to be a substantial issue. After these issues were resolved, the team was then faced with additional days lost due to weather during excavation and foundation work. These two concerns led to the realization of 40 lost work days, which were ultimately made up since, through elimination of float within the schedule, as well as general construction scheduling logic. The project team implemented pull scheduling techniques, where each of the trade supervisors' worked together with the Turner Superintendent to ultimately accomplish the project end date. The team has regular meetings where each foreman writes down where he needs to be and the work he needs to finish on a sticky note. These sticky notes are then placed on a white board along with all of the other trades. The sticky notes also include the work others need to complete in order for them to be able to perform their own work. Then, through logic and discussion, the durations are worked backward from the end date and coordinated so that each of the trades can complete their respective scopes. Through this implementation, the initial schedule float was eliminated and the lost work days revived. The substantial completion date is currently scheduled to be met.

Other than the pull scheduling techniques mentioned above, there have been no special or different acceleration scenarios considered. If the schedule begins to lose more work days in the future, the team will request the substantial completion date be pushed back. This has been discussed and is well received by the owner, because the hospital is a non-profit organization. Therefore there will be no liquidated or actual damages associated with a pushed completion date. One might ask why the team does not increase manpower to accelerate the schedule. This is not considered as an option because of the additional costs incurred through this technique. The budget for the project is fixed, with little or not room for added costs. The project team must work with which they are provided to accomplish a successful and safe completion date.

Value Engineering

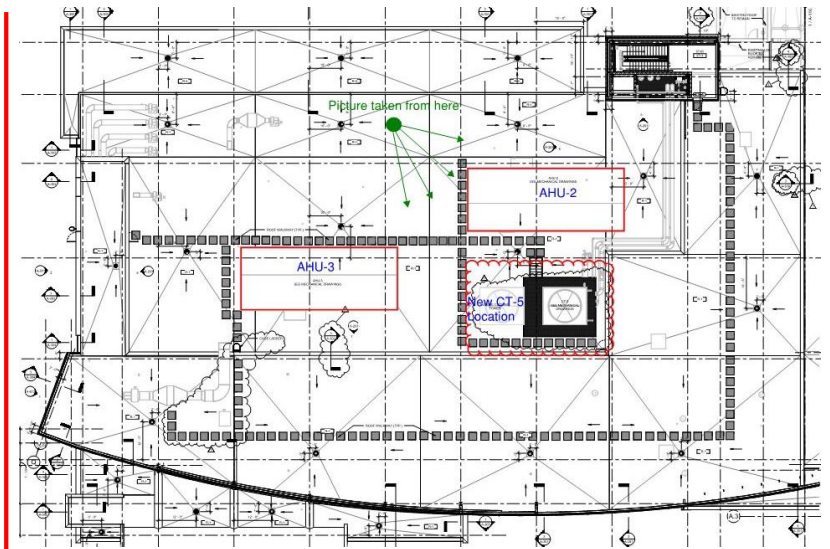
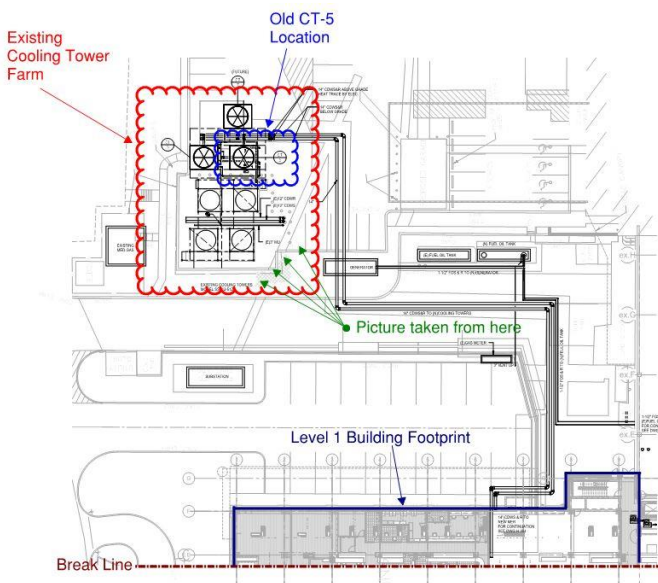
Key Areas Implemented

There have been several changes to the scope of work, as well as substantial redesign of the Aria Health ED Expansion project. These changes have been made with the primary purpose to maintain the project budget and meet the owner's current and future goals for the new addition. Five value engineering topics will be discussed that were implemented, as well as three ideas that were proposed but not accepted by the owner.

Item #:

1. Cooling Tower Relocation

Originally, the hospital emergency department design called for the addition of one cooling tower to be installed within the area of the existing cooling tower farm located to the east of the new building. This location would have necessitated the excavation, foundation, structural steel, and a substantial amount of condenser water piping. It was decided that the new cooling tower, CT-5, should be relocated to the Level 2 roof, where it will stand on a steel platform. This eliminates several variables, including the material and labor required for excavation, concrete, and additional condenser water piping at its original location. This relocation has produced a substantial cost savings, which is currently unknown.



Old location



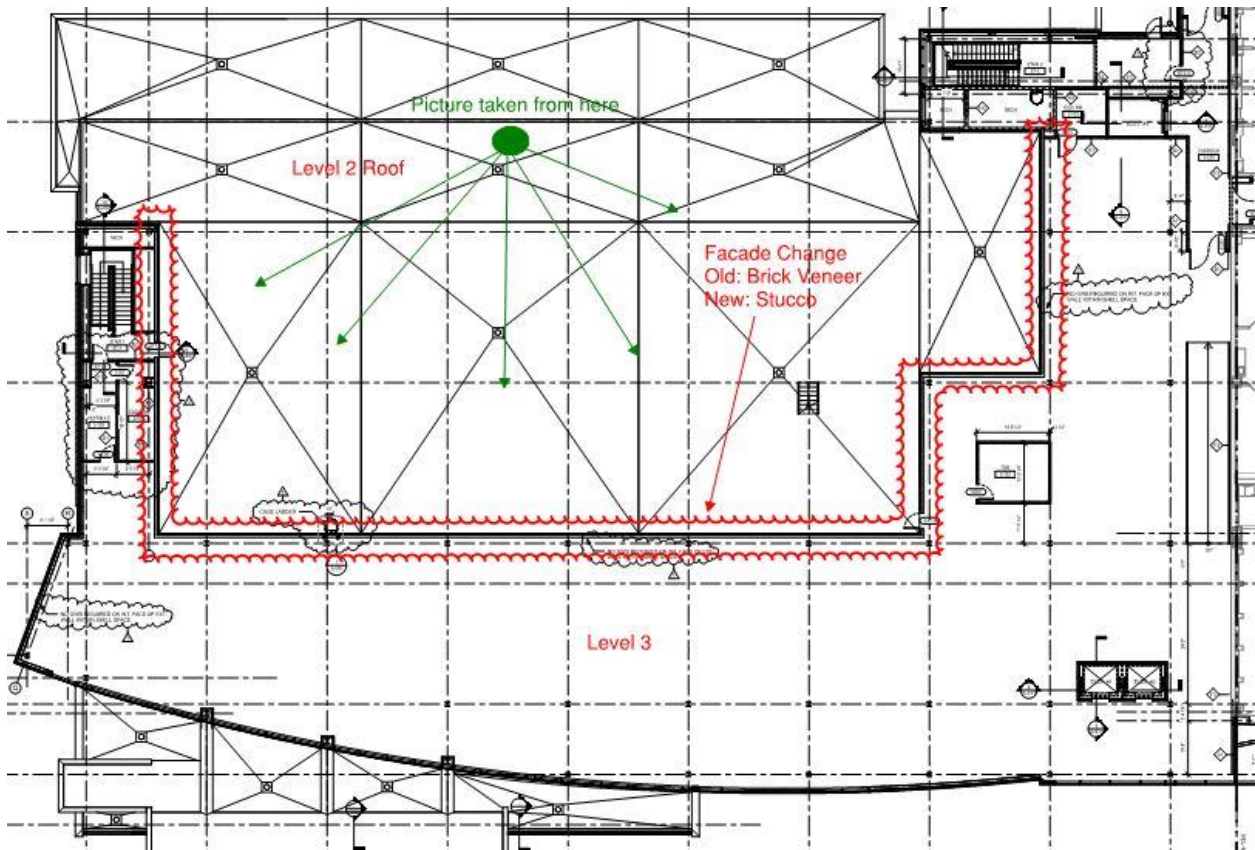
New location

Value Engineering

2. Level 3 Façade Change

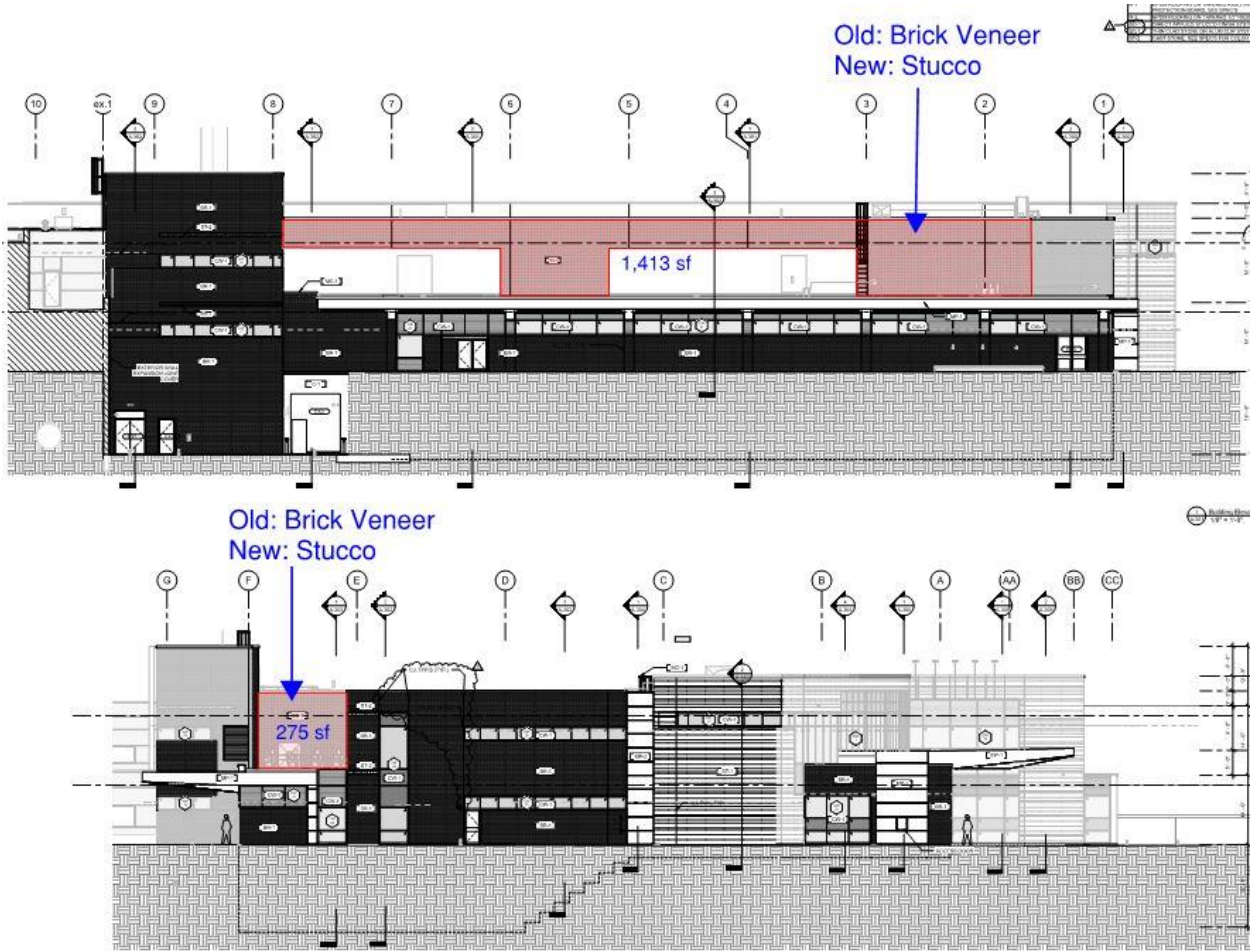
Secondly, another area where value engineering was implemented was the Level 3 exterior façade that overlooks the Level 2 roof. The original design called for a brick veneer, which would prove to be high in material costs, as well as be substantially labor intensive. The reason for this change lies in the hospital's plans for future expansion, as well as obstruction of view. The Level 2 roof contains two air handlers and one cooling tower, which are set in front of the Level 3 façade hiding the brick veneer. Also, the building owner decided that the added cost for material and labor associated with brick is unnecessary considering the possibility for adding another floor to the Level 2 roof. The brick veneer would ultimately be demoed, wasting the material and labor when it would not have been seen to begin with. A rough cost calculation was performed using material and labor costs from RS Means 2013, where a total of \$12,523 would be saved.

Material	UOM	Quantity	Material	Labor	Equipment	Tot U.C.	Tot Cost
Brick	SF	1688	\$4.47	\$7.20	\$0.00	\$11.67	\$19,698.96
Stucco	SY	188	\$6.00	\$30.00	\$2.26	\$38.26	\$7,175.88
						Savings	\$12,523.08



Level 3 Façade – Plan View

Value Engineering



Level 3 Façade - Drawing Elevation

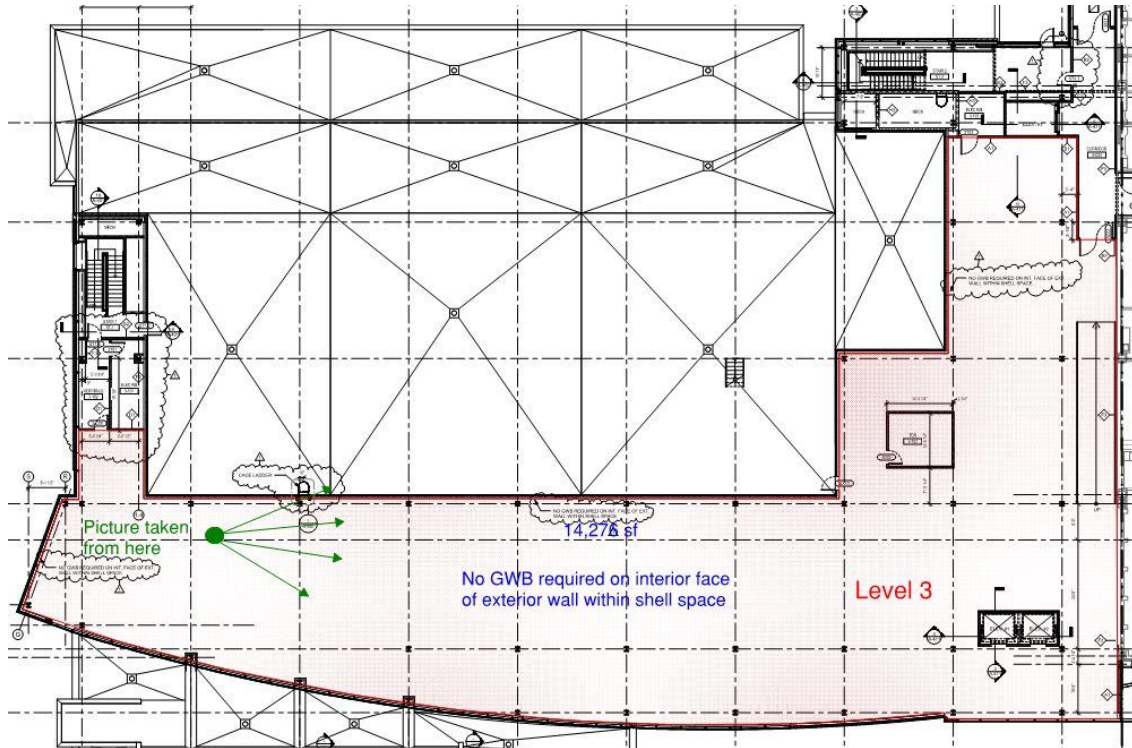


Level 3 Façade - Actual Elevation

Value Engineering

3. Level 3 Finishes Elimination

Next, originally Level 3 of the new hospital addition was meant to be a core and shell space with finishes. In an effort to maintain budget and reduce the scope of work, all of the interior finishes within Level 3 have been eliminated. The owner has decided that these finishes are not necessary considering this space is meant to be for future hospital expansion, where they will spend the money on interior finishes when the time comes for renovation. In addition to the elimination of finishes, the elevator installation has been terminated as well. In total, this VE item saved the project \$196,000. This number was derived from the Turner Construction Budget Control Report dated 11/16/12.



Level 3 Finishes – Plan View

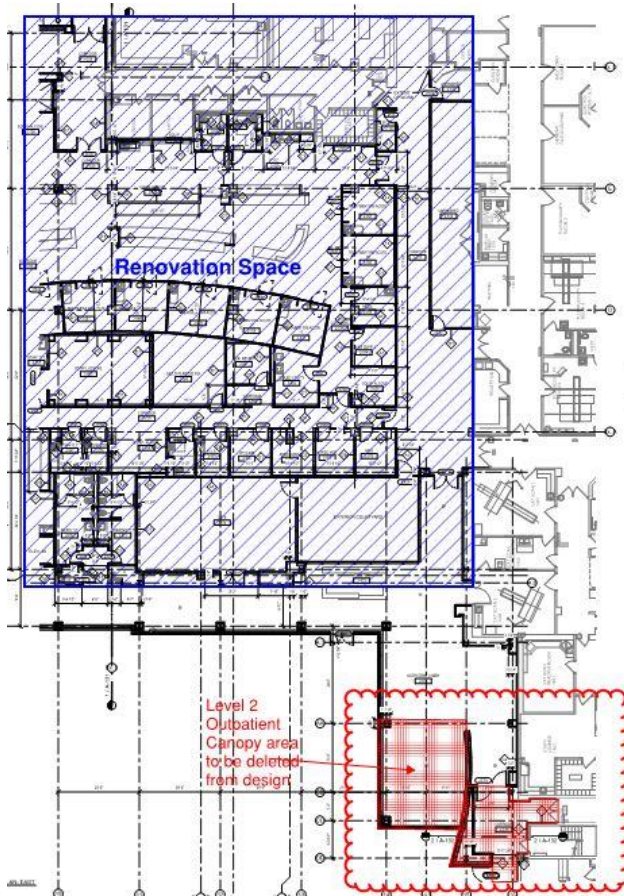


Level 3 Finishes – Actual View

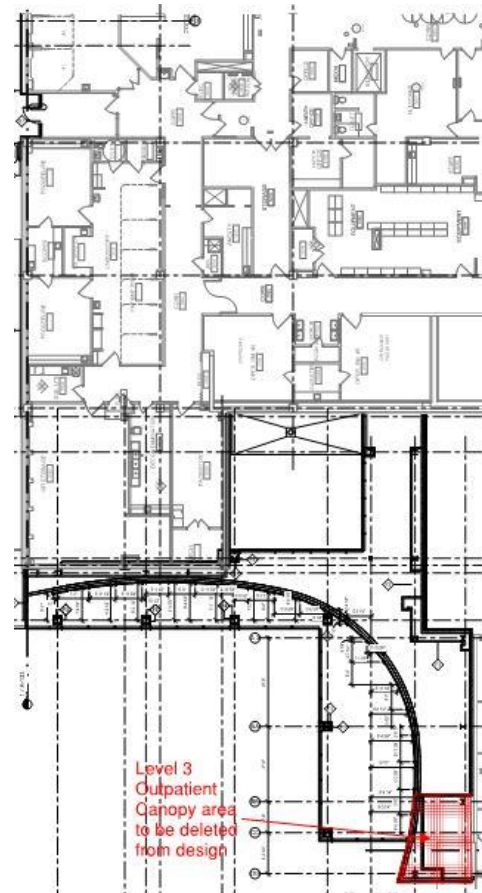
Value Engineering

4. Outpatient Lobby Reduction

One of the largest, physical changes to the Aria Health ED expansion project was the reduction of the Outpatient Lobby and elimination of the canopy. This area was originally meant to be a secondary entrance to the building. After careful consideration, the owner ultimately decided to delete this area in an effort to retain only one, main entrance. This VE option deleted 1,760 SF of space consisting of excavation, foundation, steel, and finishes and saved the project \$132,000 according to the Turner Construction Budget Control Report. The original design, as well as the redesign can be seen below.

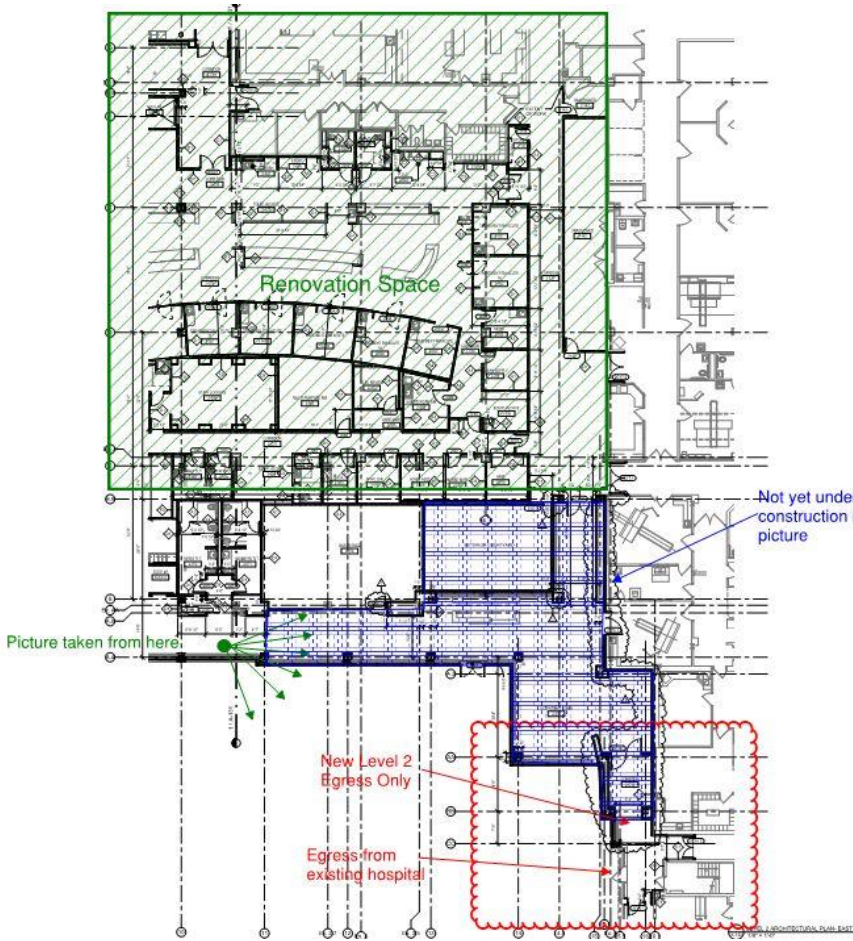


Old Level 2 Outpatient Lobby

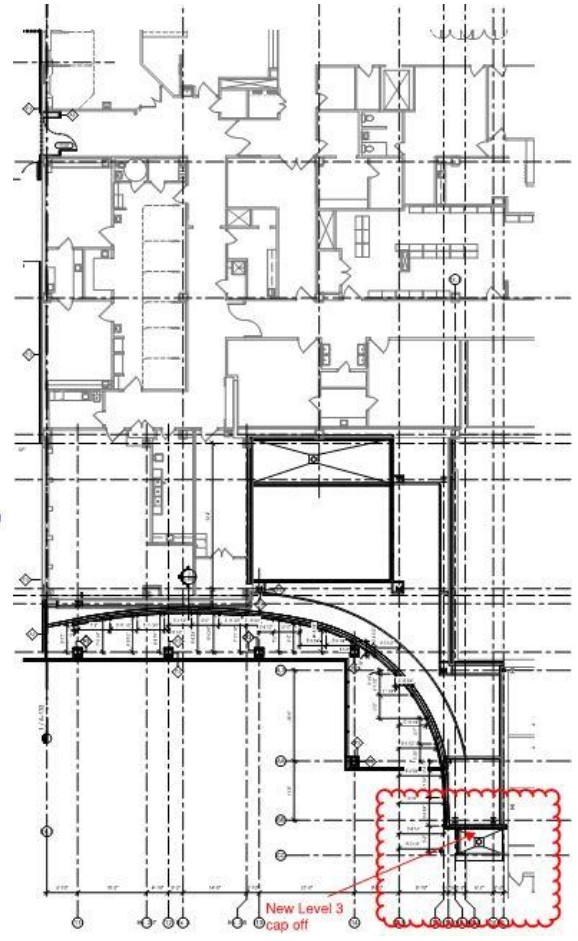


Old Level 3 Outpatient Lobby

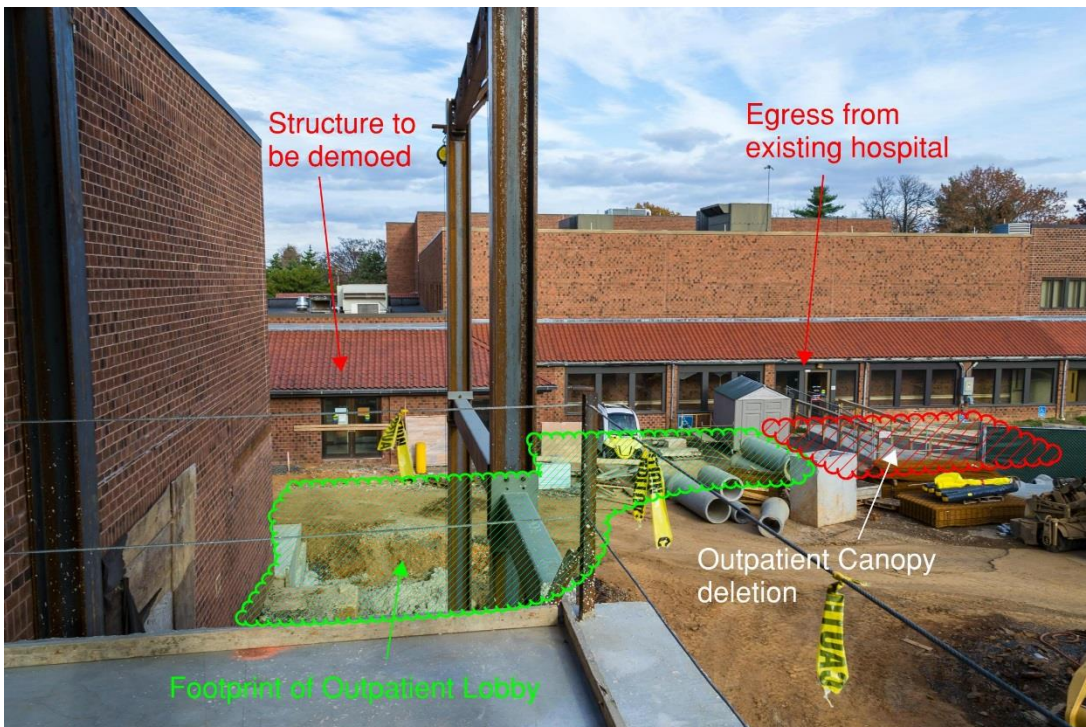
Value Engineering



New Level 2 Outpatient Lobby



New Level 3 Outpatient Lobby



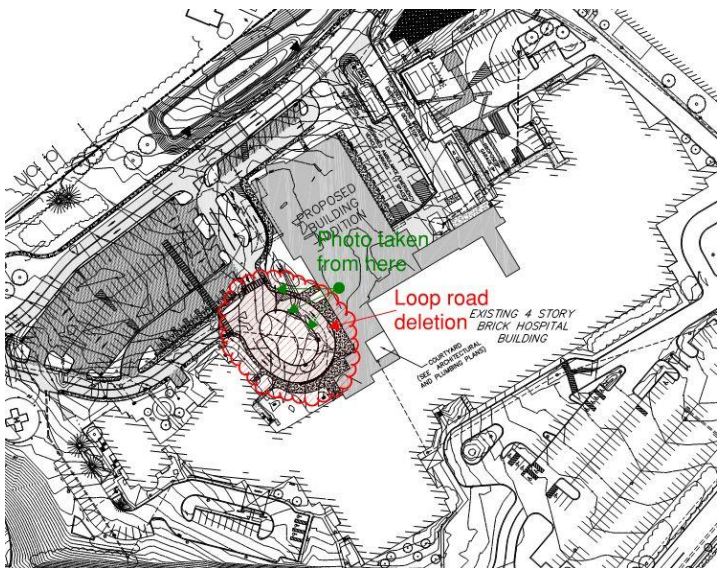
Area where the Outpatient Lobby will be

Value Engineering

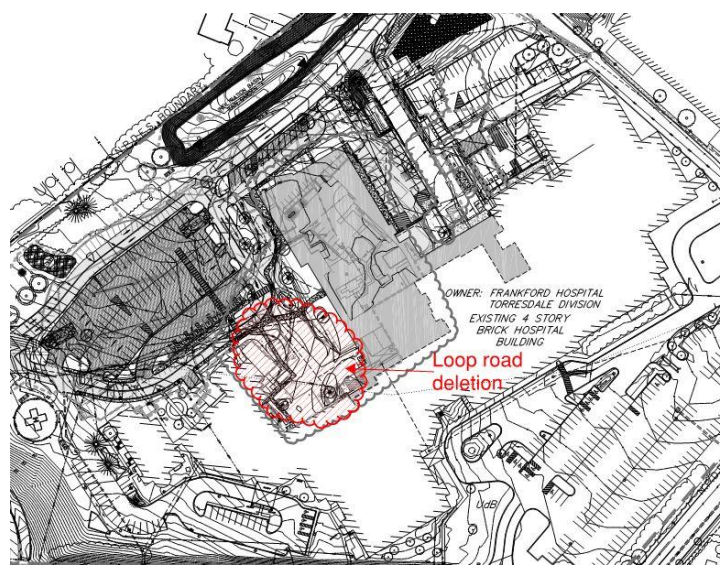
5. Loop Road Deletion

The largest deletion to the Aria ED scope of work is the deletion of the loop road located to the west of the building addition. This deletion was mainly in part due to the deletion of the Outpatient Canopy, where the loop road was the access point to that secondary entrance. An actual cost savings associated with this large deletion is unknown, but the scope is as follows:

- Deletion of Mansion House demolition
- Deletion of pavement and curb of loop drive
- Deletion of detectable warning surface
- Deletion of (2) "DO NOT ENTER" signs and (2) stop signs
- Deletion of demolition of existing concrete pad along northeast end of Mansion House
- Deletion of new stairs and walk at northeast of Mansion House
- Deletion of proposed walk around loop drive
- Revised walk orientation to proposed building
- Deletion of (2) storm inlets
- Deletion of roof drain at Mansion House
- Reduced quantities of storm piping
- Deletion of pavement markings along loop drive
- Reduced pipe size from 18" to 15"
- Reduced water line crossing
- Deletion of lower and raising water line at crossings
- Deletion of (6) trees
- Deletion of shrubs
- Deletion of sod in the courtyard to be replaced with seed
- Deletion of 4 light poles along the loop drive



Old Loop Road Layout



Loop Road Deleted

Value Engineering



Current Loop Road Layout for Construction Traffic

Correlation with Owner Goals

For the Aria Health ED Expansion project, the clinical needs for the patient and staff is the primary concern for the owner. With that said, maintaining the project budget is a close second, because all of the available resources retained by the owner are to go toward the emergency department spaces. Any additional costs must be kept to an absolute minimum because the budget for the project is fixed with no room for changes. Therefore, each of the items listed above will add value to the project by not only reducing the costs in certain areas, but using that savings to put into different spaces. Also, with future renovation and expansion in mind, VE items listed will prove valuable due to the forward thinking and reduced cost.

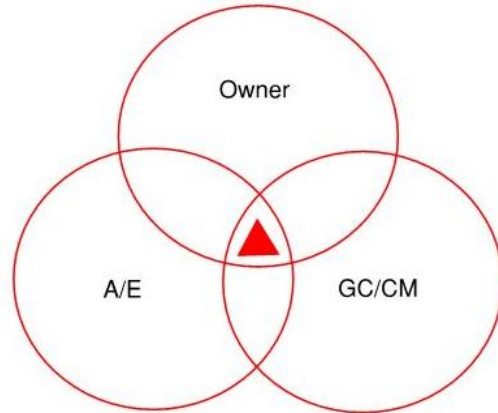
VE Ideas not Implemented

After sifting through multiple Turner Construction Budget Control Reports, it became obvious that there were very many items that the owner did not accept for deletion or redesign. Three of those items will be discussed because they seem to have been the most substantial. First, it was proposed that the entire third level core and shell space of the hospital addition be deleted. This could have saved \$700,000 in steel, concrete, and labor costs, but was unacceptable to the owner due to their plans for expansion. This area was deemed necessary for later renovation. Secondly, it was also proposed that only one structural bay of the third floor be terminated. This bay would have been 24'x32' and could have saved \$46,080. Lastly, the project team proposed a deletion of the structure and roofing associated with the exterior courtyard within the renovation space of the existing hospital. The owner decided to keep this area, as it will provide a place for patrons to sit outside without actually leaving the building.

Critical Industry Issues – PACE Roundtable

Breakout Session #1 – Assembling Effective Cross-Functional Teams

During the first breakout session at the PACE Roundtable event, an in-depth discussion took place regarding the assembly of cross-functional teams for a construction project. Among this topic, the idea of early involvement from everyone within the project, as well as a competent owner who believes in taking part in the project just as much as the designers and contractors. It became understood that the main component of a successful cross-functional team begins at the top and permeates downward within the project organizational chart.



▲ = Cross-Functional Team

It was said that everyone involved must have a common goal in mind and each of the players must hold one another accountable during the project. When a problem arises on a typical project, emails, phone calls, RFIs, and change orders are commonplace. In an effort to diminish this chain of communication, why not have a more personal relationship with those that you will be working with? One way to do this might be to have a single office or trailer space where all of the associated parties reside together. One open room, where instead of sending an email, waiting for a response, and then sending one back, the team may provide solutions to a problem while getting a cup of coffee together. This is just one example that was brought up during the session, but the idea of a cross-functional team seemed to be well-received from the participants within the room.

In order to implement a type of office atmosphere as that stated above, I might try to contact Dan Buchta, Project Director for Barton Malow Company. Barton Malow has implemented this arrangement on several of their projects where it has proved extremely successful results.

Breakout Session #2 – Multi-Trade Prefabrication

For the second breakout session, multi-trade prefabrication was discussed. The session started off somewhat slow, as the room comprised primarily of students and few industry professionals. After the conversation began to flow, it became evident that prefabrication of certain project assemblies make for a much smoother installation on site and provides a safer environment for workers to build. Pertaining to MEP systems, it is possible for multiple trade contractors to come together and build racks



consisting, but not limited to, conduit, wiring, cable trays, plumbing, med gas, mechanical piping, terminal air boxes, and associated hangers together, so that this assembly could be installed in one piece, rather than separately in the field. This comes with ample challenges however, and the need for extreme accuracy in coordination is vital. Also, the concern of who owns the rack, who will raise it into place, and transporting it are present. But for many, the ability to building a controlled environment and at a suitable height for limited additional costs is worth the benefit of quick and easy installation. For help on this topic I would contact Jimmy Haller, Construction Manager at Southland Industries.

Feedback from Industry Roundtable

Industry Member Feedback

At the end of the PACE Roundtable, the students took part in a session where an industry member was to give ideas and feedback about areas of research for the spring proposal. During that session, I spoke with Dan Buchta, Project Director at Barton Malow Company who spoke with me about the following topics:

- GPS tracking and installation for MEP hangers and sleeves
- Modular bathroom PODs
- Modular headwalls consisting of med gas and electricity for the emergency department patient rooms
- Bringing subcontractors into the schematic design process
- Looking at the procurement process from the owner's perspective
- Upfront preconstruction fees
- Assembling a cross-functional team with the owner, architect, and contractor with early collaboration
- The possibility of collocation where everyone trusts each other's judgment and communication
- Multi-trade prefabrication and the level of communication and accuracy required to do so

I believe that some of these topic areas will be of some interest for research while others will not be necessary. I like the idea of looking at a new project delivery method, as the Aria Health ED Expansion project is a typical design-bid-build, where the subcontractors were brought onboard late in the process. I think looking into a cross-functional team analysis, as well as the owner's perspective may lead to a viable depth topic for the spring semester.