# The Pegula Ice Arena

## University Park, PA

Technical Report II

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Department of architectural engineering
Construction Management Option

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## Executive Summary

The following technical assignment includes an investigation and analysis of the Pegula Ice Arena for the Pennsylvania State University. Specifically included in this report is a project schedule, detailed structural systems estimate, general conditions estimate, BIM use evaluation, and constructability challenges the project team faced.

The project schedule is of ultimate importance on this project. Since the ice arena's primary use will be Penn State division 1 hockey it is essential the building be opened by the home opener on October 11, 2013. The notice to proceed date was January 26, 2012 and the last interior finish Mortenson is responsible for is set to be installed July 29, 2013. This is a schedule duration of 393 days. The bulk of the schedule is sequenced in a way which starts in the south east portion of the building and works its way counter clockwise around the building.

In addition to the schedule a structural and general conditions estimate was performed. The structural estimate performed was of the entire building. It was recommended that a typical bay be chosen, however due to the uniqueness of the structural systems an entire structural take off and estimate were required. The structural systems resulted in a cost of $13,634,066 and $59.57 per sf. This fell within 5% of Mortenson's estimated total. The general conditions estimate resulted in $4,281,900 which was in between 5% to 10% of Mortenson's costs. *RSMeans Building Construction Cost Data* was utilized to find the structural estimate. While the general conditions estimate was determined utilizing past experience, past projects that required general condition estimates, and *RSMeans Building Construction Cost Data*.

A Building Information Modeling use evaluation was also performed. Penn State along with the Office of Physical Plant have extensive requirements for how Building Information Modeling should be used on Penn State projects. These cover mandatory requirements from design to turnover. Specific analysis was also done on Mortenson specific BIM applications. These covered their use of clash detection, lift drawings, and 4D models.

Constructability concerns are the last thing covered within this report. One constructability challenge is the fact that the building is located on a student campus. This makes logistics of material delivery essential and ensuring student life is not disturbed and kept as safe as possible. The schedule is another key concern throughout construction and also included is a specific problem incurred with some of the ADA requirements within the building.

Through doing Technical Report 2 many things have been learned and discovered that will help moving into Technical Report 3 and beyond. Continued research into the structural systems will offer insight into potential structural redesigns; while continued focus into the schedule and constructability concerns will help provide solutions on providing a more efficient plan for project sequencing.

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## Detailed Project Schedule

The project schedule created consists of 345 line items. The schedule Mortenson uses on site is actually much larger because of all the sequences. In Technical Report 1, the steel sequencing was detailed out. In reality it was broken down into 15 different sequences which does not include the trusses. For purposes, of keeping this schedule moderately low in line items each sequence was not broken down per Motenson's schedule and instead broken down into four quadrants: south east, north east, north west, and south west. These quadrants can be seen in Figure 1.

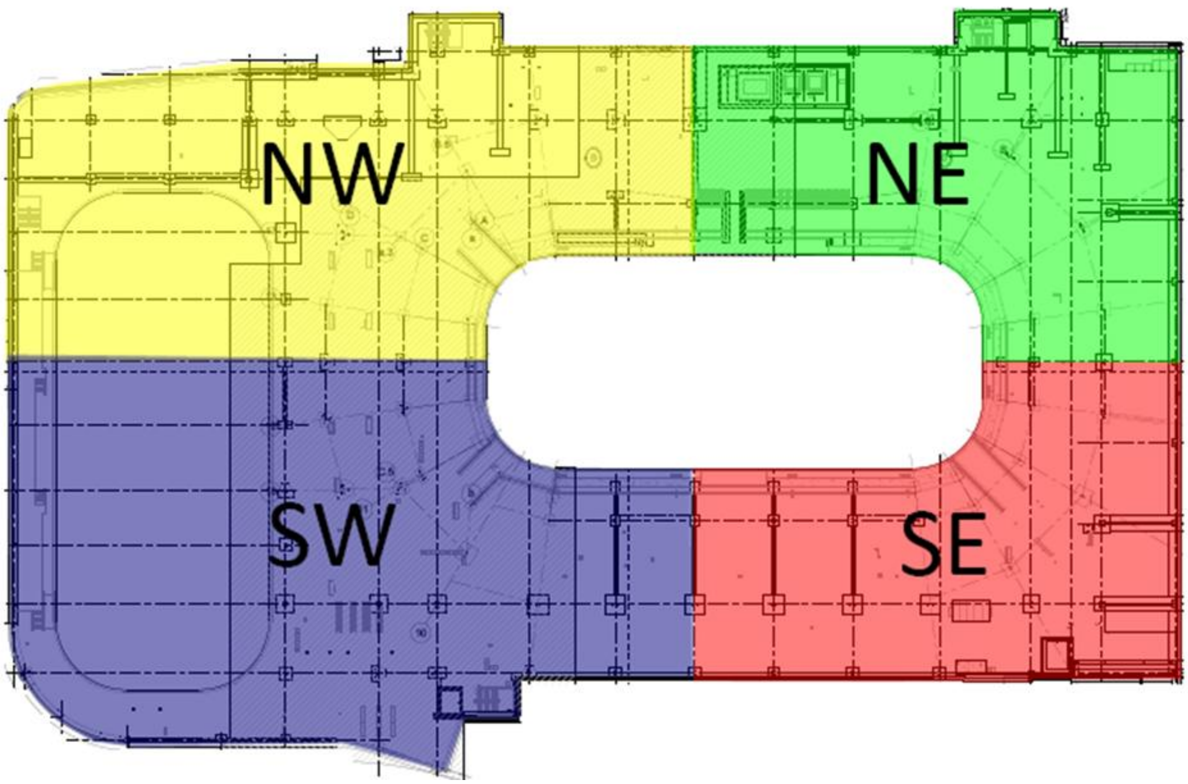



Figure 1: Pegula Ice Arena Scheduling Sequencing

## Microsoft Project Schedule

This is the schedule breakdown. It should be noticed that actual construction runs from February 13, 2012 until July 29, 2013. This however, does not include FFE. It should be noted that although Mortenson did assist in the creation of this schedule, in no way does this represent their exact schedule of values or sequencing for construction.

Table 1: Pegula Ice Arena Project Schedule

| Microsoft Project Schedule | | | |
|---|---|---|---|
| Phase | Start | Finish | Duration |
| **Design & Procurement** | 11/30/2010 | 9/4/2012 | 460 |
| **Excavation** | 2/13/2012 | 8/22/2012 | 136 |
| Excavation | 2/13/2012 | 4/13/2012 | 43 |
| Deep Foundations | 4/11/2012 | 5/31/2012 | 36 |
| Form, Rebar, Pour Spread Footings | 3/27/2012 | 7/24/2012 | 85 |
| Wall Footings | 4/27/2012 | 7/2/2012 | 47 |
| Foundation Walls & Elevator Pits | 4/13/2012 | 8/22/2012 | 94 |
| **Structure** | 4/24/2012 | 11/17/2012 | 148 |
| Underground & SOG | 4/24/2012 | 8/31/2012 | 92 |
| Steel Structure | 5/31/2012 | 11/17/2012 | 121 |
| Precast | 8/6/2012 | 11/1/2012 | 62 |
| **Enclosure** | 8/10/2012 | 3/7/2013 | 149 |
| Wall Enclosure Systems | 8/10/2012 | 3/7/2013 | 149 |
| Glazing Systems | 12/6/2012 | 1/23/2013 | 34 |
| Roof Systems | 9/25/2012 | 12/25/2012 | 65 |
| **Conveying Systems** | 10/8/2012 | 1/28/2013 | 80 |
| Elevators | 10/8/2012 | 1/28/2013 | 80 |
| **Interior Rough-In** | 7/20/2012 | 3/20/2013 | 174 |
| Hangers | 7/23/2012 | 10/25/2012 | 67 |
| Steel Stairs | 7/24/2012 | 10/24/2012 | 66 |
| Plumbing Rough-In | 9/12/2012 | 2/12/2013 | 109 |
| HVAC Rough-In | 9/17/2012 | 2/22/2013 | 113 |
| Electrical Rough-In | 10/8/2012 | 3/20/2013 | 116 |
| Architectural Rough-In | 7/20/2012 | 3/5/2013 | 163 |
| **Equipment** | 10/4/2012 | 4/23/2013 | 144 |
| Mechanical Equipment | 10/4/2012 | 2/6/2013 | 89 |
| Electrical Equipment | 11/16/2012 | 11/26/2012 | 7 |
| Specialty Equipment | 12/3/2012 | 4/23/2013 | 101 |
| **Drywall & Interior Finishes** | 12/13/2012 | 7/29/2013 | 163 |
| Drywall | 12/13/2012 | 4/2/2013 | 79 |
| Finishes | 1/2/2013 | 7/29/2013 | 149 |
| **Project Closeout** | 7/11/2013 | 10/11/2013 | 66 |

***The Microsoft Project Schedule can be viewed in full in Appendix A.***

## Construction Activities

### Excavation

As detailed in in Technical Report 1 the soil conditions came as quite of a surprise to Mortenson. The soil consisted of varying elevations of rock. Therefore it needed blasted in order to loosen up the soil before site removal. This was not something designed for in the beginning stages of preconstruction, therefore this did take longer than expected and caused an initial hiccup within the schedule.

### Structure

The structure started with the slab on grade in the south east portion of the building. From this south east portion basically everything in the building is sequenced in this same counter clockwise fashion starting in the south east. After the slab on grade was poured, the steel around the building started to be erected. Once, the entire south east corner was erected, buttoned, and SOMD poured the precast erection could occur. The schedule does not reflect precast starting directly after the south east portion is finished, but this was to allow the fire proofing crew to mobilized and get out in front of the precast. The precast can continue ahead of the fireproofing, but was designed to stay ahead of the precast in order to ensure no overspray onto the precast occurred.

### Enclosure

The enclosure consists of CMU blocking, prefabricated metal panels, face brick, curtain wall with glazing and primarily a thermoplastic polyolefin roofing system. The enclosure started with the prefabricated metal panels in the south east portion of the building and then is working counter clockwise around the building with the exception of locations where curtain wall and CMU blocking exists. The CMU blocking is one of the few definable features of work that does not start in the south east. Although, this is simply because it does not exist at this location. Obviously, the face brick cannot begin until either the blocking or panels are erected but one interesting schedule note is that roofing cannot begin until the metal panels are erected and detailed at the roof. Therefore, due to slight delays in the prefabricated metal panels along the south east the roofing began later than originally scheduled.

**Conveying Systems**

There are three elevators that are to be located within the Pegula Ice Arena. The first one just started within the schedule and will take until the end of November to complete. Once this elevator is completely erected temporary use of this elevator will be permitted throughout construction. This will be important within construction and will allow certain materials and equipment to be transported throughout the building without the safety hazards of attempting to locate it within the building using a telehandler or other similar equipment.

**Interior Rough-In**

Interior Rough-In started with installing all of the hangers being used for the MEP equipment. Following the hangers, the actual MEP equipment started to be roughed-in. The one exception here was at the roof. The bottom of the roof decking needs to fireproofing since the system does not have concrete poured on top of it. However, no fireproofing can be applied until the roof is assembled. Therefore, only priority items have been roughed-in where no roofing exists. After this begins, interior metal studs can begin.

**Equipment**

The significant mechanical equipment actually just started to be installed on site. The bulk of the AHU's are being located on the roof at the west end of the building. They are being picked by the crane that was recently assembled to help with truss erection. The equipment to be located within the mechanical room is set to start in November and is sequenced behind the interior CMU blocking, among other line items. The main scoreboard is to start installation at the end of December.

**Drywall and Interior Finishes**

The drywall is to begin at the end of December. The drywall and other finishes cannot be started until the building is enclosed and proper heat is maintained. Therefore, the drywall and interior finishes cannot begin until the face brick finishes along the SE and the building has heat. Technically, temporary heat could be utilized but ideally will be unnecessary assuming some of the HVAC systems are in operation by this point.

# Detailed Structural Systems Estimate

This section contains a detailed structural estimate of the entire Pegula Ice Arena. Although, it was recommended that a typical bay be chosen to estimate, which could then be extrapolated to coincide with the expected entire systems cost, there were reasons that this simply would not work. For starters, the uniqueness of the building made it difficult. About two thirds of the building's systems are dedicated to support the main rink while the other third supports the community rink. Secondly, the deep foundations on site are nearly non-existent in the south, but working counterclockwise, get increasingly populated, specifically in the western portion of the structure. Lastly, just the level of systems made it important to take off and estimate the entire building. The systems include micropiles, pile caps, spread footers, continuous footers, foundation walls, shear walls, a retaining wall, wide flange columns, hollow structural steel columns, wide flange beams, hollow structural steel beams, long span joists, KSP joists, and trusses over the main arena. For these three reasons, an entire building take off and estimate were required to accurately represent the true price of the structural systems for the Pegula Ice Arena.

## Structural Estimate Breakdown

Table 2 below details the cost breakdown between concrete, steel, and precast. The final number for the structural system came out to be $13,634,066 and $59.57 per sf. When compared with Mortenson's GMP estimate this came within 5% of the cost they totaled.

**Table 2: Structural Estimate**

| Structural Estimate<br>The Pegula Ice Arena \| 228,862 S.F. | | |
|---|---|---|
| **Structural System** | **Cost** | **Cost / S.F** |
| **Concrete** | **$ 5,238,714** | $ 22.89 S.F. |
| **Steel** | **$ 6,500,632** | $ 28.40 S.F. |
| **Precast** | **$ 1,894,720** | $ 8.28 S.F. |
| **Total** | **$ 13,634,066** | **$ 59.57 S.F.** |

***A Detailed Structural Estimate can be viewed in full in Appendix B.***

## Structural Systems Breakdown

### Deep Foundations and Spread Footers

It was determined that micropiles were the most suitable foundation for the arena. The estimated cost determined for the micropiles and the pile caps came out to be $108,143. The construction of the micropiles required a separate contractor to drill and fill the micropiles with concrete. The concrete material was added as part of the structural estimate but the drilling was not included as part of the cost. Therefore, drilling micropiles actually increased the overall cost in a much more impactful way then the structural estimate represents.

The spread footers totaled $86,482. They were all cast in place concrete pours. The concrete used had a strength of 4,000 psi and totaled 190 cubic yards worth of concrete.

### Foundation, Shear, and Retaining Wall

These three systems accounted for $489,996. The foundation and shear wall had similar thicknesses and were therefore priced very similarly. The foundation wall accounts for the large majority of the cost of these three systems given that it is built along the entire east, north, and west portion of the building. There is a retaining wall at the southeast corner of the building that had a thicker width to it and therefore was priced accordingly.

### SOG, SOMD, and Roof Decking

These three systems combined totaled $5,420,428. The concrete placed on grade and metal deck had a strength of 4,000 psi. The slab on grade utilized a concrete pump and was pumped in place where possible. Specifically, the north side needed a concrete pump since the concrete truck could not reach both sides of the slab due to the foundation wall. While, along the entire west and south portion of the building the concrete truck could either pour from both sides or reach the entire system and therefore was cast in place. The slab on metal deck utilized a concrete pump during pours and also had to be moved by barrel where certain pour strips are required.

### Steel Structure

The entire steel system cost $6,500,632. The bulk of the steel system was constructed with by a crawler crane with a latticed boom and fixed jib. The community rink joists were constructed with a hydraulic boom crane; while the truss assembly required an additional crawler crane that was positioned at the south portion of the site.

**Precast**

The precast stadia and vomitory walls totaled $1,894,720. The systems is pre-tensioned and cast in Center Valley, Pennsylvania. The deliveries are being stored offsite south of Medlar Field. When needed the precast gets trucked into site during second shift, which is when the precast is being constructed, to allow the crane, inside the rink, to be constantly moving.

## General Conditions Estimate

Detailed below is the general conditions estimate for the Pegula Ice Arena. The estimate is made up of staffing costs; bonding and insurance; general services; and temporary facilities and utilities.

Steve Laurila, the Senior Project Manager of Mortenson, assisted in the creation of this estimate. Due to privacy within Mortenson costs, Mr. Laurila requested that I not use direct costs that the company used. Therefore, this estimate was done with estimates obtained from my own experience, past projects that required general condition estimates, and RS Means data. However, Mr. Laurila did provide information that implies this estimate detailed below is approximately within five to ten percent of the actual estimate.

The final number obtained was $4,281,900. The general conditions costs must be monitored on a weekly basis. There are many concerns involved with overrunning on the budget the project management team has assembled. Any overruns in cost will directly affect the final fee Mortenson expects to receive and therefore must be maintained under the actual estimate.

The overall general conditions can be seen in Table 3, and additional breakdowns can be seen in Figure 2.

Table 3: General Conditions Estimate

| General Conditions Estimate | | |
|---|---|---|
| Staffing Plan | $ | 2,908,250 |
| Bonding Insurance | $ | 994,000 |
| General Services | $ | 94,550 |
| Temporary Facilities & Utilities | $ | 285,100 |
| Total | $ | 4,281,900 |

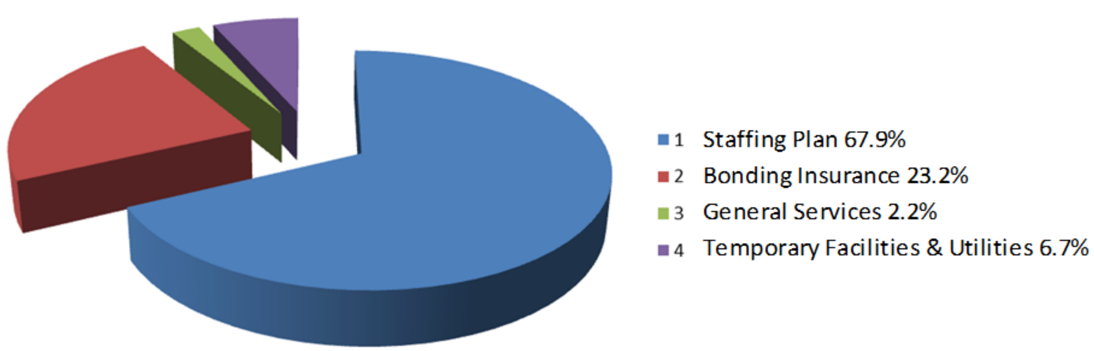



Figure 2: General Conditions Pie Chart

***A Detailed General Conditions Estimate can be viewed in full in Appendix C.***

# Building Information Modeling Use Evaluation

The Pennsylvania State University required the use of Building Information Modeling for the Pegula Ice Arena. The Office of Physical Plant is responsible for the oversight and construction of all new and existing structures on the Penn State University campus. OPP standards now state that any project over five million dollars requires the use of BIM. They have created and subsequently aligned their BIM uses with the BIM Project Execution Guide.

## BIM Project Execution

Following the BIM Project Execution Guide, the first step is to identify BIM goals and uses. This is done by setting goals for BIM usage within a project. OPP has a standard set of BIM goals and uses that they use for every project. Crawford Architects and Mortenson Construction followed this standard and utilized the following BIM uses for the Pegula Ice Arena seen in Table 4.

Table 4: BIM Use Evaluation Guide

| BIM Use | Phase | Penn State Requirements |
|---|---|---|
| Design Intent Model | Design | Mandatory |
| Design Reviews | Design | Mandatory |
| 3D Design Coordination | Design | Mandatory |
| Energy Analysis | Design | Mandatory |
| Model Commisioning | Design | Mandatory |
| Preconstruction Coordination | Design | Significant Effort |
| Structural Analysis | Design | Significant Effort |
| Mechanical Analysis | Design | Significant Effort |
| Constructability Model | Construction | Mandatory |
| Constructablility Reviews | Construction | Mandatory |
| 3D Construction Coordination | Construction | Mandatory |
| Model Commissioning Verification | Construction | Mandatory |
| 4D Modeling | Construction | Significant Effort |
| Record Model | Turnover | Mandatory |
| As-Built Model | Turnover | Mandatory |
| Maximo System Integration | Turnover | Mandatory |

It can be seen that throughout design the architect and consultants were required to use modeling as part of their design. This ensures there will be minimal design conflicts once construction begins. The structural engineer, Thorton Tomasetti, and the mechanical engineer, Moore Engineers, also created models that, in theory, were developed to minimize the amount of conflicts subcontractors had when creating shop drawings of the systems they were to construct.

Mortenson was also very proactive during the design phase, in coordinating their own models that were to be used once construction began.

Mortenson gained Right of Reliance on the model used for construction. This becomes helpful in that the model can be used as a very powerful tool throughout construction. It enables a construction manager the ability to go into a 3D model and pull any dimensions they may need to use during a field related problem. However, gaining this Right of Reliance makes a construction manager responsible for errors in field dimensioning. Therefore, it has its pros and cons. Ultimately, the reason it made sense to gain Right of Reliance was due to some of the turnover requirements Penn State and OPP have.

Ultimately, OPP requires an As-Built Model be turned over at the summation of the project. Therefore, any conditions within the model that need changed slightly are the responsibility of Mortenson. This is actually very helpful, in that it provides Mortenson the opportunity to go in and change certain aspects within the model without having to send it to a team of designers who would then need to collaborate and fix the model. This can save significant time.

***A BIM Process Map can be viewed in Appendix D.***

## Mortenson Specific BIM Applications

In speaking with Nicholas Kantor, Integrated Construction Coordinator II with Mortenson, and working on site over the summer, specific BIM applications Mortenson used were discussed and noticed.

### Clash Detection

Navisworks is currently being used to coordinate all MEP, fire protection, and low voltage systems throughout the building. The Farfield Company is the subcontractor responsible for all the MEP work, while Communale is responsible for fire protection, and Biter is responsible for the low voltage systems. Since MEP is the largest portion of coordination that needs to go on throughout the overhead systems, Farfield is responsible for all clash detections between their own MEP systems. This made it easier for Mortenson to coordinate the clash detections in that they only needed to worry about clash detections in the walls, steel, and some minor conflicts between Communale and Biter. The Navisworks model will then be turned over at the end of the project and used as an as-built model. Therefore it is essential that all trades follow the Navisworks model. This should not be hard to accomplish since the Navisworks model was created to make construction of these systems as easy and mistake free as possible.

One instance where the clash detection came into use was through one of the fire rated walls. Originally Farfield designed a duct to pass through a wall above a drop down ceiling. They obviously did not think of this as a problem since it would be hidden from view. However, Mortenson was able to recognize this as a fire rated wall which if passed through would require Communale to design, fabricate, and install a fire protection system through this wall. This would have added cost and time to the schedule. Since Mortenson caught the issue ahead of time, they were able to have Farfield simply reroute the ductwork.

**Lift Drawings**

Mortenson is self-performing all the concrete on site. One of the ways Mortenson seperates themselves from the competition is by requiring lift drawing be utilized for all foundation and shear walls. Mortenson works entirely off these lift drawings when pouring concrete, which allows field staff not to have to worry about reading the documents. The lift drawings on this project coordinated sleeve, block-out, and embed locations. This was an extremely useful tool on this project. It provided a 3D diagram, with dimensions, which makes it easy to understand. This was specifically important since most of the employees were pulled from a labor hall and subsequently not experienced in reading drawings. The lift drawings provide a visual understanding that someone not experienced in reading drawings can easily understand.

**4D Model**

The 4D model was originally created for this job as a way of marketing. It was a competitive advantage Mortenson had when bidding the job, and among many other reasons, is partially why they were awarded the job. However, finding ways to carry it over into construction was difficult. The model carries a ton of valuable information that if utilized could truly help throughout construction. The problem is the amount of time required to keep an updated 4D model is tremendous. The qualified BIM professional on site would have to essentially become an expert in scheduling and would devote more than half their week to maintain a current and accurate model. However, stated again, the benefits could be tremendous.

In discussions with Nicholas Kantor, he provided an example where this model could truly benefit the construction process. The first five trusses are already assembled on site. The trusses started from east to west until the fifth truss in was complete. The crane has to exit through a portion of the building unfinished in the center of the building along the south wall. This requires the crane to assemble the remaining trusses from west to east. Essentially, a precast vomitory wall along the west portion has to be set in place before the truss can be set. The vomitory wall cannot be set until a concrete strip is poured. The concrete strip cannot be poured until the precast stadia is set in place. As, one can notice this is a fairly confusing sequence of events that needs to take place. The superintendent on site is trying to obtain a complete grasp of the sequencing and relay that message to the subcontractors on site. A quick meeting utilizing an accurate 4D model could get everyone on the same page very quickly. This would save a large headache the superintendent is having; and potentially simmer the complaints the subcontractors are having for not understanding either why they are being rushed or slowed down.

# Constructability Challenges

In such a large project there are going to be many challenges throughout construction. Below are only a few challenges faced throughout the project. They range from broad challenges to very specific. It should be noted that certain issues are not detailed out within this report due to the sensitivity of the subject matter.

## Student Campus

The first constructability challenge faced with by Mortenson was how to plan for working on a student campus. Therefore, understanding traffic patterns, student schedules, and general immaturity was extremely important.

The traffic patterns on campus were essential to understand and plan for to maintain a safe and as undisturbed campus as possible. The Pegula Ice Arena rests along University Drive just south of Curtain Road. Both of these streets are essential to student traffic. Therefore, it was necessary to keep these streets free from excessive truck traffic and material delivery. Since this was the case, Mortenson emphasized the importance of trafficking in all deliveries from I-99 through Park Avenue and then onto University Drive and into the site. This became the excavation and steel delivery traffic patterns. There are obviously some deliveries that need sequenced into the construction site differently, but generally speaking cause minor interference within the student life. Also, during any heavy trafficking on and out of the site flaggers are needed at the site entrance. This included all mass excavation done, steel deliveries, and precast stadia deliveries which are done during second shift.


Figure 3: Traffic Patter Bing Map

The student schedule has classes starting at 8:00 a.m. Although on campus living is located just north west of the construction site, it is far enough away that Mortenson was not forced to start any later than they may have wanted. This however, was a concern at a storm retention center being built south west of the site near additional on campus living. Mortenson was informed that if major student disturbance occurred it would be requested that they not start until 8:00 a.m. Luckily, a large portion of the "loud" work was done by that point, so that Mortenson did not need to adjust their work hours at that location. Although Mortenson did plan ahead in the event of a worst case scenario and had prepared to have one of the superintendents be there every morning at 8:00 a.m. to discuss the plan of the day.

The last concern with working on a student campus is general immaturity. General immaturity is something Mortenson has had to work through during the project. Young students can often have an interest in the construction going on at site and therefore feel as if they should walk onto site to see what is going on. Although, Mortenson and Penn State are excited about the student interest in such a unique project it was and still is essential that no one wonder onto site. Thusly, Mortenson subscribed to Penn State's policy of putting blue mesh around the entirety of the project site fence. This aligns itself with all Penn State construction, that an active work zone is ongoing and that no one not working on site should enter. Large events are also important to manage. During the fourth of July this past summer, Mortenson had to fence off any significant stockpiles and decommission all active temporary stairs to ensure no students could get onto any top levels.

## Schedule

The schedule is extremely important to meet on this particular project. The first hockey game is to take place October 11, 2012. It is expected that the building will be complete and commissioned by this point. If the schedule is delayed Penn State will lose earnings due to no ticket sales. Although, it does not have quite the same impact as a lost home game at Beaver Stadium it would still certainly be a blow. Therefore, Mortenson has extremely tight sequencing in order to ensure there is not wasted time between trade activities. There have and still are scopes of work that are done overnight and on Saturday to ensure the construction schedule meets this end date of October 11, 2013.

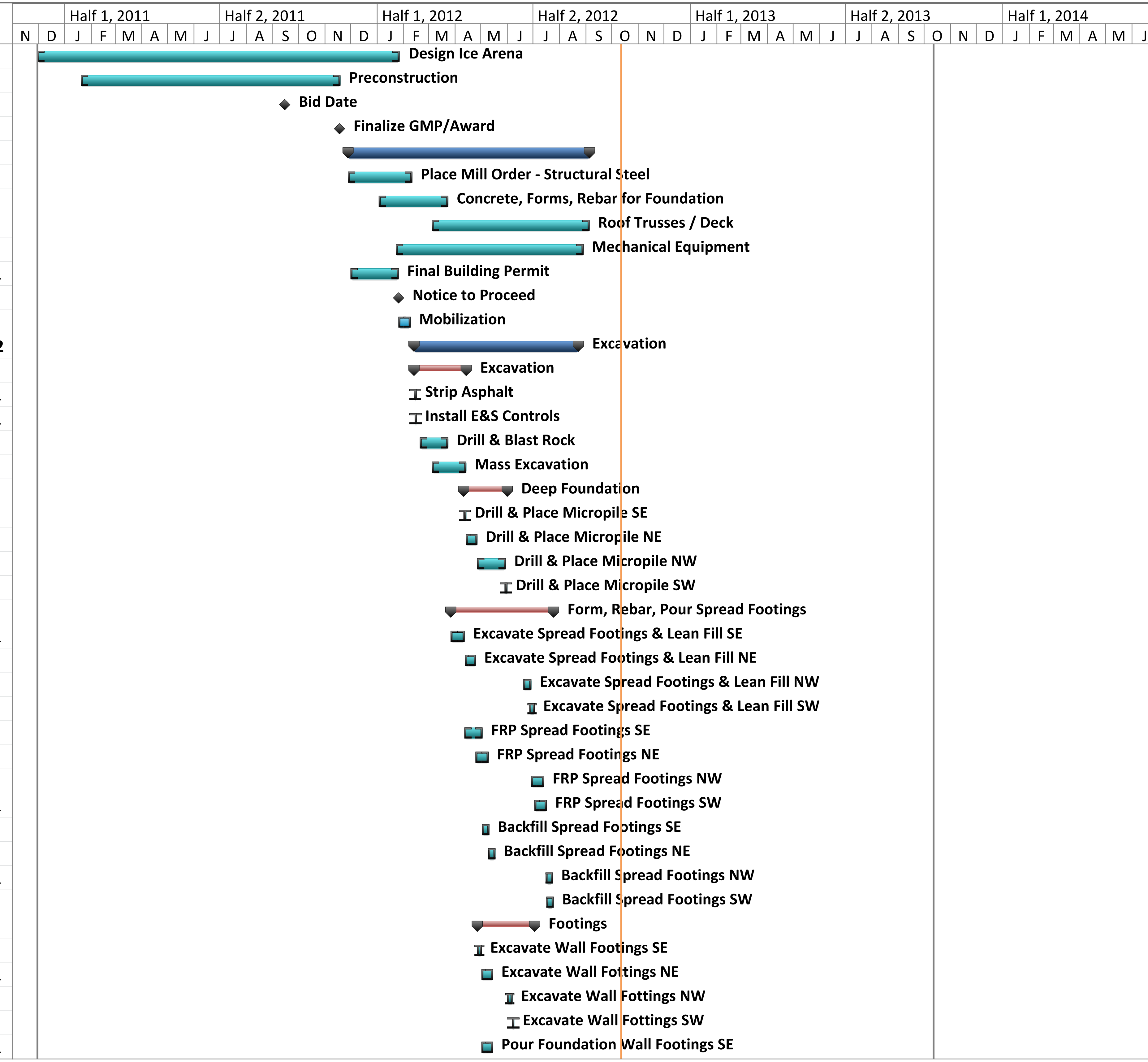
## ADA Chair

The Pegula Ice Arena has a medical treatment facility explicitly designed for student hockey athletes. There are three different pool like structures that are being located inside this room. The three pools are a hot tub, cold tub, and hydrotherapy tub. The hydrotherapy tub is equipped with an underwater treadmill that can actually rise to the surface allowing athletes to directly step onto the treadmill from floor level. During design, code dictated that only one out of every three pools clustered together needed to be ADA accessible. Therefore, since the hydrotherapy pool could be entered from ground level it was determined that they met the sufficient requirements.

Later in design, a new set of codes came out that had language that indicates all pools, including pre-existing ones, need to be ADA accessible. Through discussions with code consultants, this was discovered during the summer. Unfortunately, due to the point at construction, Mortenson had to be as proactive as possible and assist with the design as much as they could. Therefore, much research was done into different types of ADA chairs that can be submerged into pools. Since this type of equipment was not expected during design, most of the chairs found cause many problems. Some chairs were hitting walls, others did not slope into the pool at the proper angle, and one did not meet ADA requirements. Finally, one was recently discovered that meets all the requirements of the specific conditions. This process has caused much difficulty and has not allowed for the construction of this particular area to sequence properly. Now, Mortenson is in the process of finding the proper framing, bracing and anchors to support the chairs which should allow the concrete pours to continue in this area and any subsequent work to follow.

# Appendix A: Detailed Project Schedule

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | Design Ice Arena | 303 days | Tue 11/30/10 | Thu 1/26/12 |
| 2 | Preconstruction | 217 days | Thu 1/20/11 | Fri 11/18/11 |
| 3 | Bid Date | 0 days | Thu 9/15/11 | Thu 9/15/11 |
| 4 | Finalize GMP/Award | 0 days | Fri 11/18/11 | Fri 11/18/11 |
| 5 | **Procurement** | **202 days** | **Mon 11/28/11** | **Tue 9/4/12** |
| 6 | Place Mill Order - Structural Steel | 55 days | Mon 11/28/11 | Fri 2/10/12 |
| 7 | Concrete, Forms, Rebar for Foundation | 59 days | Tue 1/3/12 | Fri 3/23/12 |
| 8 | Roof Trusses / Deck | 132 days | Mon 3/5/12 | Tue 9/4/12 |
| 9 | Mechanical Equipment | 157 days | Mon 1/23/12 | Tue 8/28/12 |
| 10 | Final Building Permit | 40 days | Thu 12/1/11 | Wed 1/25/12 |
| 11 | Notice to Proceed | 0 days | Thu 1/26/12 | Thu 1/26/12 |
| 12 | Mobilization | 10 days | Thu 1/26/12 | Wed 2/8/12 |
| 13 | **Excavation** | **138 days** | **Mon 2/13/12** | **Wed 8/22/12** |
| 14 | **Excavation** | **45 days** | **Mon 2/13/12** | **Fri 4/13/12** |
| 15 | Strip Asphalt | 3 days | Mon 2/13/12 | Wed 2/15/12 |
| 16 | Install E&S Controls | 2 days | Tue 2/14/12 | Wed 2/15/12 |
| 17 | Drill & Blast Rock | 25 days | Mon 2/20/12 | Fri 3/23/12 |
| 18 | Mass Excavation | 30 days | Mon 3/5/12 | Fri 4/13/12 |
| 19 | **Deep Foundation** | **37 days** | **Wed 4/11/12** | **Thu 5/31/12** |
| 20 | Drill & Place Micropile SE | 3 days | Wed 4/11/12 | Fri 4/13/12 |
| 21 | Drill & Place Micropile NE | 10 days | Sat 4/14/12 | Thu 4/26/12 |
| 22 | Drill & Place Micropile NW | 23 days | Fri 4/27/12 | Tue 5/29/12 |
| 23 | Drill & Place Micropile SW | 3 days | Tue 5/29/12 | Thu 5/31/12 |
| 24 | **Form, Rebar, Pour Spread Footings** | **86 days** | **Tue 3/27/12** | **Tue 7/24/12** |
| 25 | Excavate Spread Footings & Lean Fill SE | 12 days | Tue 3/27/12 | Wed 4/11/12 |
| 26 | Excavate Spread Footings & Lean Fill NE | 8 days | Fri 4/13/12 | Tue 4/24/12 |
| 27 | Excavate Spread Footings & Lean Fill NW | 7 days | Wed 6/20/12 | Thu 6/28/12 |
| 28 | Excavate Spread Footings & Lean Fill SW | 4 days | Wed 6/27/12 | Mon 7/2/12 |
| 29 | FRP Spread Footings SE | 15 days | Thu 4/12/12 | Wed 5/2/12 |
| 30 | FRP Spread Footings NE | 11 days | Wed 4/25/12 | Wed 5/9/12 |
| 31 | FRP Spread Footings NW | 11 days | Fri 6/29/12 | Fri 7/13/12 |
| 32 | FRP Spread Footings SW | 10 days | Tue 7/3/12 | Mon 7/16/12 |
| 33 | Backfill Spread Footings SE | 6 days | Thu 5/3/12 | Thu 5/10/12 |
| 34 | Backfill Spread Footings NE | 6 days | Thu 5/10/12 | Thu 5/17/12 |
| 35 | Backfill Spread Footings NW | 6 days | Mon 7/16/12 | Mon 7/23/12 |
| 36 | Backfill Spread Footings SW | 6 days | Tue 7/17/12 | Tue 7/24/12 |
| 37 | **Footings** | **47 days** | **Fri 4/27/12** | **Mon 7/2/12** |
| 38 | Excavate Wall Footings SE | 3 days | Fri 4/27/12 | Tue 5/1/12 |
| 39 | Excavate Wall Fottings NE | 9 days | Wed 5/2/12 | Mon 5/14/12 |
| 40 | Excavate Wall Fottings NW | 4 days | Fri 6/1/12 | Wed 6/6/12 |
| 41 | Excavate Wall Fottings SW | 2 days | Thu 6/7/12 | Fri 6/8/12 |
| 42 | Pour Foundation Wall Footings SE | 9 days | Wed 5/2/12 | Mon 5/14/12 |




Project: The Pegula Ice Arena
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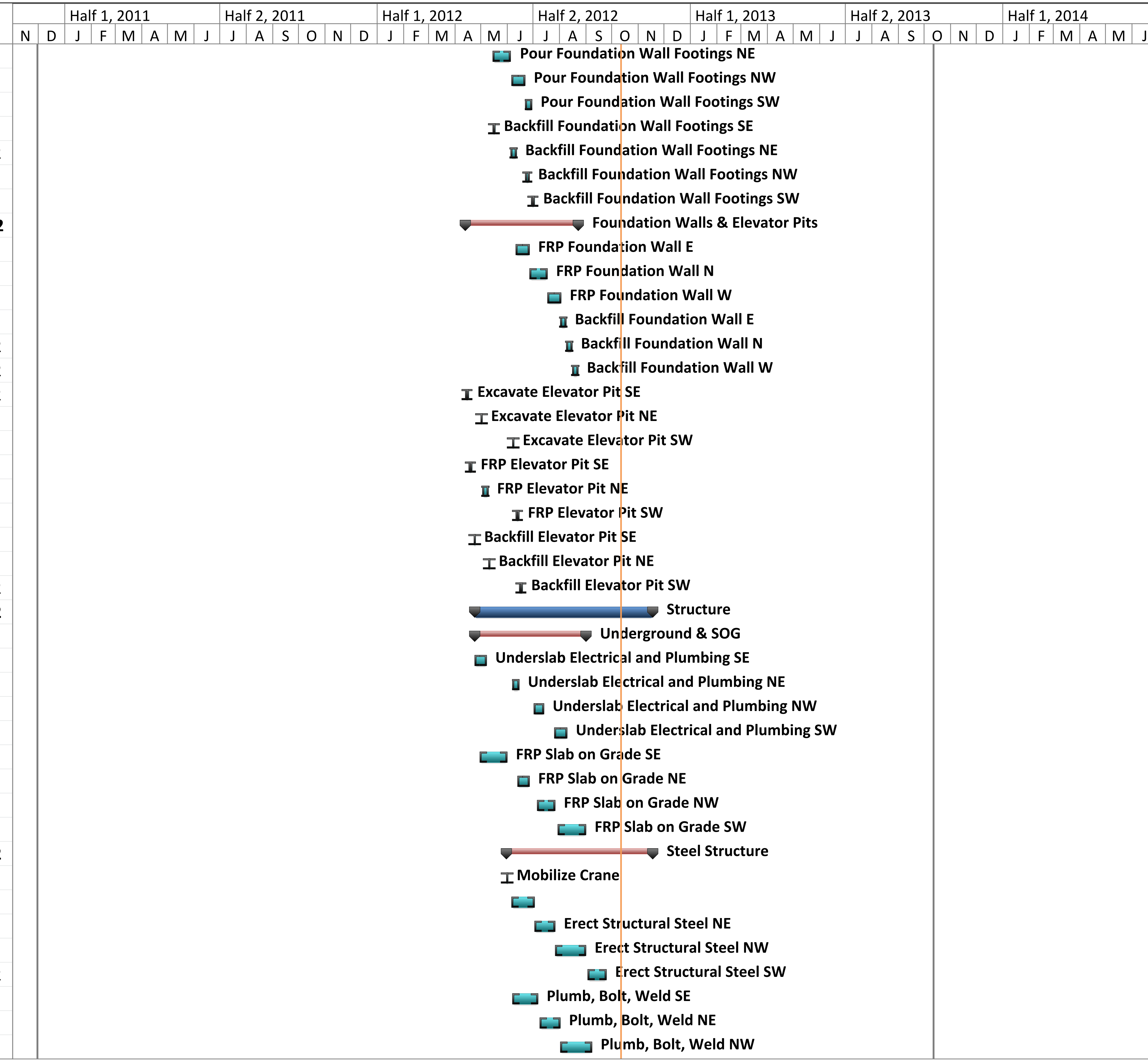
Milestone ◆ Summary Task

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 43 | Pour Foundation Wall Footings NE | 15 days | Tue 5/15/12 | Mon 6/4/12 |
| 44 | Pour Foundation Wall Footings NW | 12 days | Wed 6/6/12 | Thu 6/21/12 |
| 45 | Pour Foundation Wall Footings SW | 6 days | Fri 6/22/12 | Fri 6/29/12 |
| 46 | Backfill Foundation Wall Footings SE | 3 days | Tue 5/15/12 | Thu 5/17/12 |
| 47 | Backfill Foundation Wall Footings NE | 5 days | Tue 6/5/12 | Mon 6/11/12 |
| 48 | Backfill Foundation Wall Footings NW | 3 days | Fri 6/22/12 | Tue 6/26/12 |
| 49 | Backfill Foundation Wall Footings SW | 2 days | Fri 6/29/12 | Mon 7/2/12 |
| 50 | **Foundation Walls & Elevator Pits** | **94 days** | **Fri 4/13/12** | **Wed 8/22/12** |
| 51 | FRP Foundation Wall E | 12 days | Mon 6/11/12 | Tue 6/26/12 |
| 52 | FRP Foundation Wall N | 15 days | Wed 6/27/12 | Tue 7/17/12 |
| 53 | FRP Foundation Wall W | 12 days | Wed 7/18/12 | Thu 8/2/12 |
| 54 | Backfill Foundation Wall E | 5 days | Thu 8/2/12 | Wed 8/8/12 |
| 55 | Backfill Foundation Wall N | 5 days | Thu 8/9/12 | Wed 8/15/12 |
| 56 | Backfill Foundation Wall W | 5 days | Thu 8/16/12 | Wed 8/22/12 |
| 57 | Excavate Elevator Pit SE | 2 days | Fri 4/13/12 | Mon 4/16/12 |
| 58 | Excavate Elevator Pit NE | 2 days | Tue 5/1/12 | Wed 5/2/12 |
| 59 | Excavate Elevator Pit SW | 2 days | Thu 6/7/12 | Fri 6/8/12 |
| 60 | FRP Elevator Pit SE | 4 days | Tue 4/17/12 | Fri 4/20/12 |
| 61 | FRP Elevator Pit NE | 5 days | Thu 5/3/12 | Wed 5/9/12 |
| 62 | FRP Elevator Pit SW | 4 days | Mon 6/11/12 | Thu 6/14/12 |
| 63 | Backfill Elevator Pit SE | 2 days | Mon 4/23/12 | Tue 4/24/12 |
| 64 | Backfill Elevator Pit NE | 2 days | Thu 5/10/12 | Fri 5/11/12 |
| 65 | Backfill Elevator Pit SW | 2 days | Fri 6/15/12 | Mon 6/18/12 |
| 66 | **Structure** | **149 days** | **Tue 4/24/12** | **Sat 11/17/12** |
| 67 | **Underground & SOG** | **94 days** | **Tue 4/24/12** | **Fri 8/31/12** |
| 68 | Underslab Electrical and Plumbing SE | 10 days | Tue 4/24/12 | Mon 5/7/12 |
| 69 | Underslab Electrical and Plumbing NE | 6 days | Thu 6/7/12 | Thu 6/14/12 |
| 70 | Underslab Electrical and Plumbing NW | 10 days | Mon 7/2/12 | Fri 7/13/12 |
| 71 | Underslab Electrical and Plumbing SW | 11 days | Thu 7/26/12 | Thu 8/9/12 |
| 72 | FRP Slab on Grade SE | 24 days | Mon 4/30/12 | Thu 5/31/12 |
| 73 | FRP Slab on Grade NE | 10 days | Wed 6/13/12 | Tue 6/26/12 |
| 74 | FRP Slab on Grade NW | 15 days | Fri 7/6/12 | Thu 7/26/12 |
| 75 | FRP Slab on Grade SW | 25 days | Mon 7/30/12 | Fri 8/31/12 |
| 76 | **Steel Structure** | **122 days** | **Thu 5/31/12** | **Sat 11/17/12** |
| 77 | Mobilize Crane | 2 days | Thu 5/31/12 | Fri 6/1/12 |
| 78 | Erect Structural Steel SE | 19 days | Wed 6/6/12 | Mon 7/2/12 |
| 79 | Erect Structural Steel NE | 18 days | Tue 7/3/12 | Thu 7/26/12 |
| 80 | Erect Structural Steel NW | 26 days | Fri 7/27/12 | Fri 8/31/12 |
| 81 | Erect Structural Steel SW | 16 days | Mon 9/3/12 | Mon 9/24/12 |
| 82 | Plumb, Bolt, Weld SE | 22 days | Thu 6/7/12 | Fri 7/6/12 |
| 83 | Plumb, Bolt, Weld NE | 18 days | Mon 7/9/12 | Wed 8/1/12 |
| 84 | Plumb, Bolt, Weld NW | 27 days | Thu 8/2/12 | Fri 9/7/12 |

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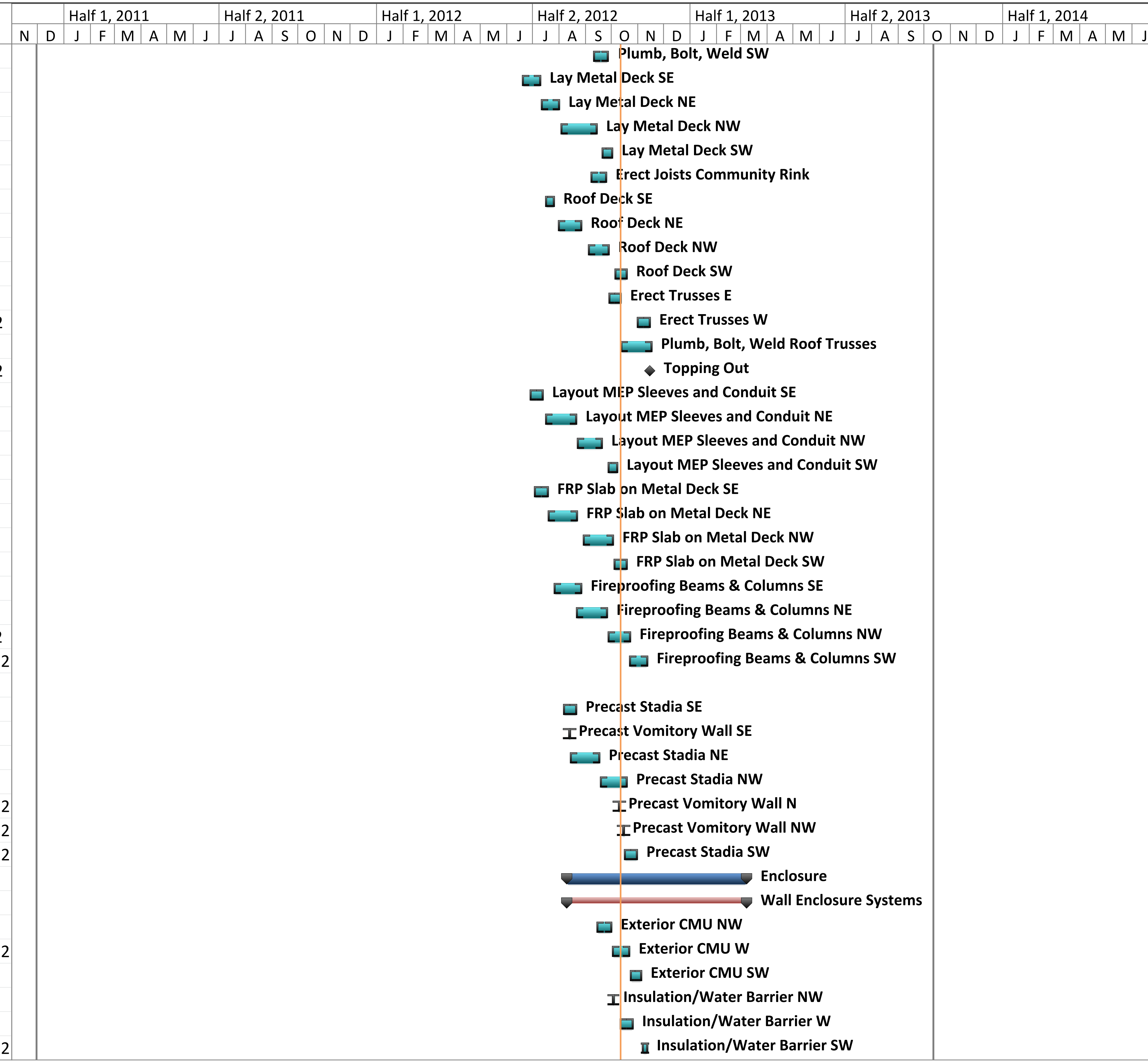
Milestone ◆ Summary Task

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 85 | Plumb, Bolt, Weld SW | 14 days | Mon 9/10/12 | Thu 9/27/12 |
| 86 | Lay Metal Deck SE | 16 days | Tue 6/19/12 | Tue 7/10/12 |
| 87 | Lay Metal Deck NE | 16 days | Wed 7/11/12 | Wed 8/1/12 |
| 88 | Lay Metal Deck NW | 31 days | Fri 8/3/12 | Fri 9/14/12 |
| 89 | Lay Metal Deck SW | 9 days | Thu 9/20/12 | Tue 10/2/12 |
| 90 | Erect Joists Community Rink | 13 days | Fri 9/7/12 | Tue 9/25/12 |
| 91 | Roof Deck SE | 9 days | Mon 7/16/12 | Thu 7/26/12 |
| 92 | Roof Deck NE | 20 days | Tue 7/31/12 | Mon 8/27/12 |
| 93 | Roof Deck NW | 19 days | Tue 9/4/12 | Fri 9/28/12 |
| 94 | Roof Deck SW | 11 days | Fri 10/5/12 | Fri 10/19/12 |
| 95 | Erect Trusses E | 11 days | Fri 9/28/12 | Fri 10/12/12 |
| 96 | Erect Trusses W | 12 days | Wed 10/31/12 | Thu 11/15/12 |
| 97 | Plumb, Bolt, Weld Roof Trusses | 27 days | Fri 10/12/12 | Sat 11/17/12 |
| 98 | Topping Out | 0 days | Thu 11/15/12 | Thu 11/15/12 |
| 99 | Layout MEP Sleeves and Conduit SE | 12 days | Thu 6/28/12 | Fri 7/13/12 |
| 100 | Layout MEP Sleeves and Conduit NE | 27 days | Mon 7/16/12 | Tue 8/21/12 |
| 101 | Layout MEP Sleeves and Conduit NW | 22 days | Wed 8/22/12 | Thu 9/20/12 |
| 102 | Layout MEP Sleeves and Conduit SW | 8 days | Thu 9/27/12 | Mon 10/8/12 |
| 103 | FRP Slab on Metal Deck SE | 13 days | Tue 7/3/12 | Thu 7/19/12 |
| 104 | FRP Slab on Metal Deck NE | 25 days | Thu 7/19/12 | Wed 8/22/12 |
| 105 | FRP Slab on Metal Deck NW | 26 days | Wed 8/29/12 | Wed 10/3/12 |
| 106 | FRP Slab on Metal Deck SW | 12 days | Thu 10/4/12 | Fri 10/19/12 |
| 107 | Fireproofing Beams & Columns SE | 23 days | Thu 7/26/12 | Mon 8/27/12 |
| 108 | Fireproofing Beams & Columns NE | 27 days | Tue 8/21/12 | Wed 9/26/12 |
| 109 | Fireproofing Beams & Columns NW | 19 days | Thu 9/27/12 | Tue 10/23/12 |
| 110 | Fireproofing Beams & Columns SW | 16 days | Mon 10/22/12 | Mon 11/12/12 |
| 111 | **Precast** | **64 days** | **Mon 8/6/12** | **Thu 11/1/12** |
| 112 | Precast Stadia SE | 12 days | Mon 8/6/12 | Tue 8/21/12 |
| 113 | Precast Vomitory Wall SE | 1 day | Mon 8/13/12 | Mon 8/13/12 |
| 114 | Precast Stadia NE | 25 days | Tue 8/14/12 | Mon 9/17/12 |
| 115 | Precast Stadia NW | 24 days | Tue 9/18/12 | Fri 10/19/12 |
| 116 | Precast Vomitory Wall N | 1 day | Wed 10/10/12 | Wed 10/10/12 |
| 117 | Precast Vomitory Wall NW | 1 day | Mon 10/15/12 | Mon 10/15/12 |
| 118 | Precast Stadia SW | 12 days | Tue 10/16/12 | Wed 10/31/12 |
| 119 | **Enclosure** | **150 days** | **Fri 8/10/12** | **Thu 3/7/13** |
| 120 | **Wall Enclosure Systems** | **150 days** | **Fri 8/10/12** | **Thu 3/7/13** |
| 121 | Exterior CMU NW | 12 days | Fri 9/14/12 | Mon 10/1/12 |
| 122 | Exterior CMU W | 15 days | Tue 10/2/12 | Mon 10/22/12 |
| 123 | Exterior CMU SW | 10 days | Tue 10/23/12 | Mon 11/5/12 |
| 124 | Insulation/Water Barrier NW | 3 days | Tue 10/2/12 | Thu 10/4/12 |
| 125 | Insulation/Water Barrier W | 12 days | Thu 10/11/12 | Fri 10/26/12 |
| 126 | Insulation/Water Barrier SW | 5 days | Tue 11/6/12 | Mon 11/12/12 |

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Milestone ◆ Summary Task

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 127 | Erect Prefab CFMF Wall Panel System SE | 35 days | Fri 8/10/12 | Thu 9/27/12 |
| 128 | Erect Prefab CFMF Wall Panel System NE | 27 days | Tue 10/2/12 | Wed 11/7/12 |
| 129 | Erect Prefab CFMF Wall Panel System NW | 16 days | Fri 11/9/12 | Fri 11/30/12 |
| 130 | Erect Prefab CFMF Wall Panel System SW | 14 days | Mon 12/3/12 | Thu 12/20/12 |
| 131 | Install Brick Ties SE | 9 days | Mon 10/1/12 | Thu 10/11/12 |
| 132 | Install Brick Ties NE | 29 days | Fri 10/12/12 | Wed 11/21/12 |
| 133 | Install Brick Ties NW | 18 days | Mon 11/26/12 | Wed 12/19/12 |
| 134 | Install Brick Ties SW | 2 days | Thu 12/27/12 | Fri 12/28/12 |
| 135 | Face Brick SE | 15 days | Wed 11/21/12 | Tue 12/11/12 |
| 136 | Face Brick NE | 24 days | Mon 11/26/12 | Thu 12/27/12 |
| 137 | Face Brick SW | 8 days | Wed 1/2/13 | Fri 1/11/13 |
| 138 | Building Enclosure | 0 days | Fri 1/11/13 | Fri 1/11/13 |
| 139 | Install Metal Panel Soffit/Fascia SE | 8 days | Mon 12/24/12 | Wed 1/2/13 |
| 140 | Install Metal Panel Soffit/Fascia NE | 10 days | Wed 1/9/13 | Tue 1/22/13 |
| 141 | Install Metal Panel Soffit/Fascia NW | 16 days | Wed 1/23/13 | Wed 2/13/13 |
| 142 | Install Metal Panel Soffit/Fascia SW | 16 days | Thu 2/14/13 | Thu 3/7/13 |
| 143 | **Glazing Systems** | **35 days** | **Thu 12/6/12** | **Wed 1/23/13** |
| 144 | Curtain Wall Framing & Glazing SE | 16 days | Thu 12/6/12 | Thu 12/27/12 |
| 145 | Curtain Wall Framing & Glazing NE | 19 days | Fri 12/28/12 | Wed 1/23/13 |
| 146 | **Roof Systems** | **66 days** | **Tue 9/25/12** | **Tue 12/25/12** |
| 147 | Install Roof Blocking | 22 days | Tue 9/25/12 | Wed 10/24/12 |
| 148 | Membrane Roof SE | 8 days | Mon 10/1/12 | Wed 10/10/12 |
| 149 | Membrane Roof NE | 9 days | Wed 10/10/12 | Mon 10/22/12 |
| 150 | Membrane Roof NW | 23 days | Tue 10/23/12 | Thu 11/22/12 |
| 151 | Membrane Roof SW | 23 days | Fri 11/23/12 | Tue 12/25/12 |
| 152 | **Conveying Systems** | **81 days** | **Mon 10/8/12** | **Mon 1/28/13** |
| 153 | **Elevators** | **81 days** | **Mon 10/8/12** | **Mon 1/28/13** |
| 154 | Install Elevator SE | 37 days | Mon 10/8/12 | Tue 11/27/12 |
| 155 | Install Elevator NE | 28 days | Tue 11/13/12 | Thu 12/20/12 |
| 156 | Install Elevator SW | 27 days | Fri 12/21/12 | Mon 1/28/13 |
| 157 | Temporary Use of SE Elevator | 0 days | Fri 11/30/12 | Fri 11/30/12 |
| 158 | **Interior Rough-In** | **174 days** | **Fri 7/20/12** | **Wed 3/20/13** |
| 159 | **Hangers** | **69 days** | **Mon 7/23/12** | **Thu 10/25/12** |
| 160 | Install Hangers SE | 13 days | Mon 7/23/12 | Wed 8/8/12 |
| 161 | Install Hangers NE | 27 days | Fri 8/17/12 | Mon 9/24/12 |
| 162 | Install Hangers NW | 11 days | Thu 9/27/12 | Thu 10/11/12 |
| 163 | Install Hangers SW | 9 days | Mon 10/15/12 | Thu 10/25/12 |
| 164 | **Steel Stairs** | **67 days** | **Tue 7/24/12** | **Wed 10/24/12** |
| 165 | Erect Steel Stairs NE | 7 days | Tue 7/24/12 | Wed 8/1/12 |
| 166 | Erect Steel Stairs Grand Stair | 3 days | Mon 8/27/12 | Wed 8/29/12 |
| 167 | Erect Steel Stairs NW | 37 days | Tue 9/4/12 | Wed 10/24/12 |
| 168 | Erect Steel Stairs SW | 6 days | Mon 10/1/12 | Mon 10/8/12 |


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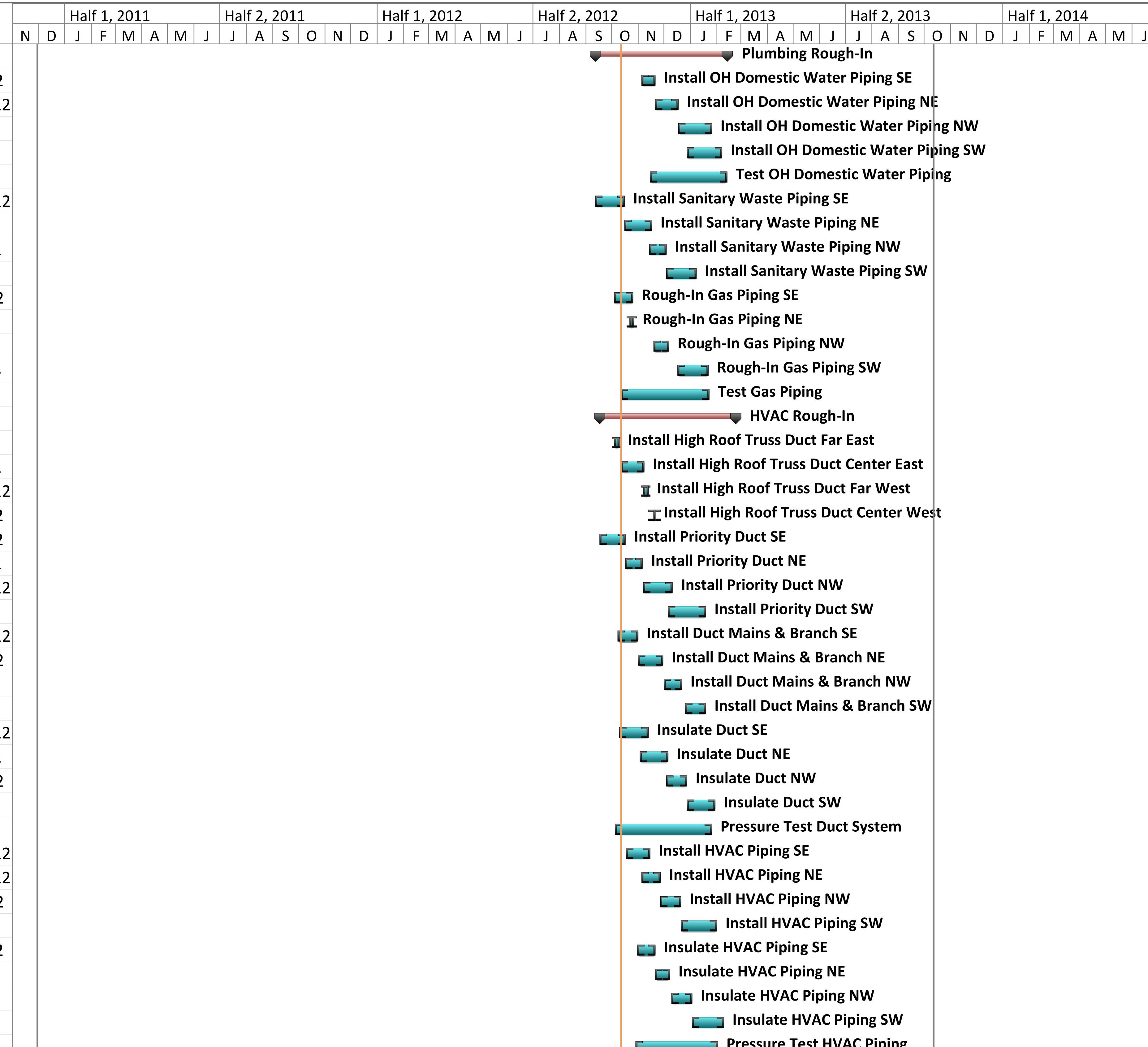
| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 169 | **Plumbing Rough-In** | **110 days** | **Wed 9/12/12** | **Tue 2/12/13** |
| 170 | Install OH Domestic Water Piping SE | 12 days | Mon 11/5/12 | Tue 11/20/12 |
| 171 | Install OH Domestic Water Piping NE | 19 days | Wed 11/21/12 | Mon 12/17/12 |
| 172 | Install OH Domestic Water Piping NW | 29 days | Tue 12/18/12 | Fri 1/25/13 |
| 173 | Install OH Domestic Water Piping SW | 29 days | Fri 12/28/12 | Wed 2/6/13 |
| 174 | Test OH Domestic Water Piping | 64 days | Thu 11/15/12 | Tue 2/12/13 |
| 175 | Install Sanitary Waste Piping SE | 24 days | Wed 9/12/12 | Mon 10/15/12 |
| 176 | Install Sanitary Waste Piping NE | 24 days | Tue 10/16/12 | Fri 11/16/12 |
| 177 | Install Sanitary Waste Piping NW | 14 days | Wed 11/14/12 | Mon 12/3/12 |
| 178 | Install Sanitary Waste Piping SW | 25 days | Tue 12/4/12 | Mon 1/7/13 |
| 179 | Rough-In Gas Piping SE | 16 days | Thu 10/4/12 | Thu 10/25/12 |
| 180 | Rough-In Gas Piping NE | 5 days | Mon 10/22/12 | Fri 10/26/12 |
| 181 | Rough-In Gas Piping NW | 14 days | Mon 11/19/12 | Thu 12/6/12 |
| 182 | Rough-In Gas Piping SW | 26 days | Mon 12/17/12 | Mon 1/21/13 |
| 183 | Test Gas Piping | 73 days | Fri 10/12/12 | Tue 1/22/13 |
| 184 | **HVAC Rough-In** | **115 days** | **Mon 9/17/12** | **Fri 2/22/13** |
| 185 | Install High Roof Truss Duct Far East | 4 days | Thu 10/4/12 | Tue 10/9/12 |
| 186 | Install High Roof Truss Duct Center East | 19 days | Fri 10/12/12 | Wed 11/7/12 |
| 187 | Install High Roof Truss Duct Far West | 4 days | Wed 11/7/12 | Mon 11/12/12 |
| 188 | Install High Roof Truss Duct Center West | 2 days | Mon 11/19/12 | Tue 11/20/12 |
| 189 | Install Priority Duct SE | 22 days | Mon 9/17/12 | Tue 10/16/12 |
| 190 | Install Priority Duct NE | 14 days | Wed 10/17/12 | Mon 11/5/12 |
| 191 | Install Priority Duct NW | 24 days | Wed 11/7/12 | Mon 12/10/12 |
| 192 | Install Priority Duct SW | 32 days | Thu 12/6/12 | Fri 1/18/13 |
| 193 | Install Duct Mains & Branch SE | 18 days | Mon 10/8/12 | Wed 10/31/12 |
| 194 | Install Duct Mains & Branch NE | 21 days | Thu 11/1/12 | Thu 11/29/12 |
| 195 | Install Duct Mains & Branch NW | 16 days | Sat 12/1/12 | Fri 12/21/12 |
| 196 | Install Duct Mains & Branch SW | 18 days | Wed 12/26/12 | Fri 1/18/13 |
| 197 | Insulate Duct SE | 24 days | Wed 10/10/12 | Mon 11/12/12 |
| 198 | Insulate Duct NE | 24 days | Sat 11/3/12 | Wed 12/5/12 |
| 199 | Insulate Duct NW | 18 days | Tue 12/4/12 | Thu 12/27/12 |
| 200 | Insulate Duct SW | 23 days | Fri 12/28/12 | Tue 1/29/13 |
| 201 | Pressure Test Duct System | 81 days | Fri 10/5/12 | Fri 1/25/13 |
| 202 | Install HVAC Piping SE | 20 days | Thu 10/18/12 | Wed 11/14/12 |
| 203 | Install HVAC Piping NE | 16 days | Mon 11/5/12 | Mon 11/26/12 |
| 204 | Install HVAC Piping NW | 18 days | Tue 11/27/12 | Thu 12/20/12 |
| 205 | Install HVAC Piping SW | 30 days | Fri 12/21/12 | Thu 1/31/13 |
| 206 | Insulate HVAC Piping SE | 15 days | Wed 10/31/12 | Tue 11/20/12 |
| 207 | Insulate HVAC Piping NE | 13 days | Wed 11/21/12 | Fri 12/7/12 |
| 208 | Insulate HVAC Piping NW | 18 days | Mon 12/10/12 | Wed 1/2/13 |
| 209 | Insulate HVAC Piping SW | 27 days | Thu 1/3/13 | Fri 2/8/13 |
| 210 | Pressure Test HVAC Piping | 70 days | Mon 10/29/12 | Fri 2/1/13 |

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Milestone ◆ Summary Task

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 211 | Install Fire Sprinkler SE | 19 days | Wed 11/21/12 | Mon 12/17/12 |
| 212 | Install Fire Sprinkler NE | 9 days | Tue 12/18/12 | Fri 12/28/12 |
| 213 | Install Fire Sprinkler NW | 18 days | Mon 12/31/12 | Wed 1/23/13 |
| 214 | Install Fire Sprinkler SW | 22 days | Thu 1/24/13 | Fri 2/22/13 |
| 215 | **Electrical Rough-In** | **118 days** | **Mon 10/8/12** | **Wed 3/20/13** |
| 216 | Install OH Branch/Feeder Conduit SE | 14 days | Thu 10/18/12 | Tue 11/6/12 |
| 217 | Install OH Branch/Feeder Conduit NE | 14 days | Wed 11/7/12 | Mon 11/26/12 |
| 218 | Install OH Branch/Feeder Conduit NW | 17 days | Wed 11/28/12 | Thu 12/20/12 |
| 219 | Install OH Branch/Feeder Conduit SW | 32 days | Fri 12/21/12 | Mon 2/4/13 |
| 220 | Pull Feeder Cable SE | 15 days | Fri 10/26/12 | Thu 11/15/12 |
| 221 | Pull Feeder Cable NE | 12 days | Fri 11/16/12 | Mon 12/3/12 |
| 222 | Pull Feeder Cable NW | 15 days | Tue 12/4/12 | Mon 12/24/12 |
| 223 | Pull Feeder Cable SW | 32 days | Fri 12/28/12 | Mon 2/11/13 |
| 224 | Install In-Wall Electrical Rough-In SE | 16 days | Tue 10/23/12 | Tue 11/13/12 |
| 225 | Install In-Wall Electrical Rough-In NE | 20 days | Wed 11/14/12 | Tue 12/11/12 |
| 226 | Install In-Wall Electrical Rough-In NW | 13 days | Thu 12/13/12 | Mon 12/31/12 |
| 227 | Install In-Wall Electrical Rough-In SW | 24 days | Tue 1/1/13 | Fri 2/1/13 |
| 228 | Pull Branch Wire Arena Catwalk Lights and Scoreboard | 17 days | Thu 12/20/12 | Fri 1/11/13 |
| 229 | Pull Branch Wire SE | 18 days | Fri 12/21/12 | Tue 1/15/13 |
| 230 | Pull Branch Wire NE | 16 days | Wed 1/16/13 | Wed 2/6/13 |
| 231 | Pull Branch Wire NW | 18 days | Thu 2/7/13 | Mon 3/4/13 |
| 232 | Pull Branch Wire SW | 9 days | Tue 3/5/13 | Fri 3/15/13 |
| 233 | Install Electrical Panels/Equipment SE | 16 days | Mon 10/8/12 | Mon 10/29/12 |
| 234 | Install Electrical Panels/Equipment NE | 14 days | Mon 10/15/12 | Thu 11/1/12 |
| 235 | Install Electrical Panels/Equipment NW | 28 days | Tue 10/30/12 | Thu 12/6/12 |
| 236 | Install Electrical Panels/Equipment SW | 16 days | Wed 12/12/12 | Wed 1/2/13 |
| 237 | Electric Testing | 58 days | Mon 12/31/12 | Wed 3/20/13 |
| 238 | Permanent Power | 0 days | Wed 3/20/13 | Wed 3/20/13 |
| 239 | **Architectural Rough-In** | **163 days** | **Fri 7/20/12** | **Tue 3/5/13** |
| 240 | Layout & Install Top Track SE | 48 days | Fri 7/20/12 | Tue 9/25/12 |
| 241 | Layout & Install Top Track NE | 13 days | Wed 9/12/12 | Fri 9/28/12 |
| 242 | Layout & Install Top Track NW | 7 days | Mon 10/1/12 | Tue 10/9/12 |
| 243 | Layout & Install Top Track SW | 9 days | Thu 10/11/12 | Tue 10/23/12 |
| 244 | Interior Masonry SE | 13 days | Tue 8/21/12 | Thu 9/6/12 |
| 245 | Interior Masonry NE | 5 days | Fri 9/7/12 | Thu 9/13/12 |
| 246 | Interior Masonry NW | 11 days | Mon 9/24/12 | Mon 10/8/12 |
| 247 | Interior Masonry SW | 35 days | Fri 10/12/12 | Thu 11/29/12 |
| 248 | Erect Metal Studs SE | 33 days | Tue 9/4/12 | Thu 10/18/12 |
| 249 | Erect Metal Studs NE | 34 days | Tue 9/18/12 | Fri 11/2/12 |
| 250 | Erect Metal Studs NW | 27 days | Wed 10/24/12 | Thu 11/29/12 |
| 251 | Erect Metal Studs SW | 25 days | Mon 11/26/12 | Fri 12/28/12 |

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| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 252 | Install Backing/Blocking SE | 5 days | Mon 9/24/12 | Fri 9/28/12 |
| 253 | Install Backing/Blocking NE | 12 days | Mon 10/1/12 | Tue 10/16/12 |
| 254 | Install Backing/Blocking NW | 25 days | Mon 10/29/12 | Fri 11/30/12 |
| 255 | Install Backing/Blocking SW | 25 days | Thu 11/29/12 | Wed 1/2/13 |
| 256 | Install Door Frames SE | 17 days | Tue 9/25/12 | Wed 10/17/12 |
| 257 | Install Door Frames NE | 15 days | Tue 10/2/12 | Mon 10/22/12 |
| 258 | Install Door Frames NW | 23 days | Mon 10/29/12 | Wed 11/28/12 |
| 259 | Install Door Frames SW | 28 days | Thu 11/29/12 | Mon 1/7/13 |
| 260 | Erect Ceiling/Soffit Studs SE | 17 days | Fri 11/30/12 | Mon 12/24/12 |
| 261 | Erect Ceiling/Soffit Studs NE | 15 days | Thu 12/27/12 | Wed 1/16/13 |
| 262 | Erect Ceiling/Soffit Studs NW | 14 days | Thu 1/17/13 | Tue 2/5/13 |
| 263 | Erect Ceiling/Soffit Studs SW | 20 days | Wed 2/6/13 | Tue 3/5/13 |
| 264 | Building Controls SE | 20 days | Thu 10/25/12 | Wed 11/21/12 |
| 265 | Building Controls NE | 22 days | Thu 11/22/12 | Fri 12/21/12 |
| 266 | Building Controls NW | 15 days | Wed 12/26/12 | Tue 1/15/13 |
| 267 | Building Controls SW | 23 days | Thu 1/17/13 | Mon 2/18/13 |
| 268 | **Equipment** | **144 days** | **Thu 10/4/12** | **Tue 4/23/13** |
| 269 | **Mechanical Equipment** | **90 days** | **Thu 10/4/12** | **Wed 2/6/13** |
| 270 | Set AHUs NW | 7 days | Thu 10/18/12 | Fri 10/26/12 |
| 271 | Set & Install AHUs SW | 5 days | Mon 10/29/12 | Fri 11/2/12 |
| 272 | Set Pumps, Heat Exchangers, Tanks, & VFDs Mech. Court | 19 days | Tue 11/20/12 | Fri 12/14/12 |
| 273 | Install Accessories for Mechanical Equipment | 36 days | Mon 12/17/12 | Mon 2/4/13 |
| 274 | Install and Connect HVAC Equipment Connections SE | 24 days | Thu 10/4/12 | Tue 11/6/12 |
| 275 | Install and Connect HVAC Equipment Connections NE | 26 days | Fri 10/26/12 | Fri 11/30/12 |
| 276 | Install and Connect HVAC Equipment Connections NW | 19 days | Mon 11/19/12 | Thu 12/13/12 |
| 277 | Install and Connect HVAC Equipment Connections SW | 38 days | Mon 12/17/12 | Wed 2/6/13 |
| 278 | **Electrical Equipment** | **7 days** | **Fri 11/16/12** | **Mon 11/26/12** |
| 279 | Set Switchgear | 7 days | Fri 11/16/12 | Mon 11/26/12 |
| 280 | **Specialty Equipment** | **102 days** | **Mon 12/3/12** | **Tue 4/23/13** |
| 281 | Install FS Counter & Set FS Equipment SE | 26 days | Fri 1/18/13 | Fri 2/22/13 |
| 282 | Install FS Counter & Set FS Equipment NE | 36 days | Mon 2/11/13 | Mon 4/1/13 |
| 283 | Install FS Counter & Set FS Equipment NW | 25 days | Tue 3/12/13 | Mon 4/15/13 |
| 284 | Install FS Counter & Set FS Equipment SW | 13 days | Fri 3/29/13 | Tue 4/16/13 |
| 285 | Mech./Elec. Conn @ FS Equipment SE | 14 days | Tue 2/12/13 | Fri 3/1/13 |
| 286 | Mech./Elec. Conn @ FS Equipment NE | 21 days | Thu 3/7/13 | Thu 4/4/13 |
| 287 | Mech./Elec. Conn @ FS Equipment NW | 21 days | Fri 3/22/13 | Fri 4/19/13 |
| 288 | Mech./Elec. Conn @ FS Equipment SW | 11 days | Tue 4/9/13 | Tue 4/23/13 |


Project: The Pegula Ice Arena
Date: 10/10/12

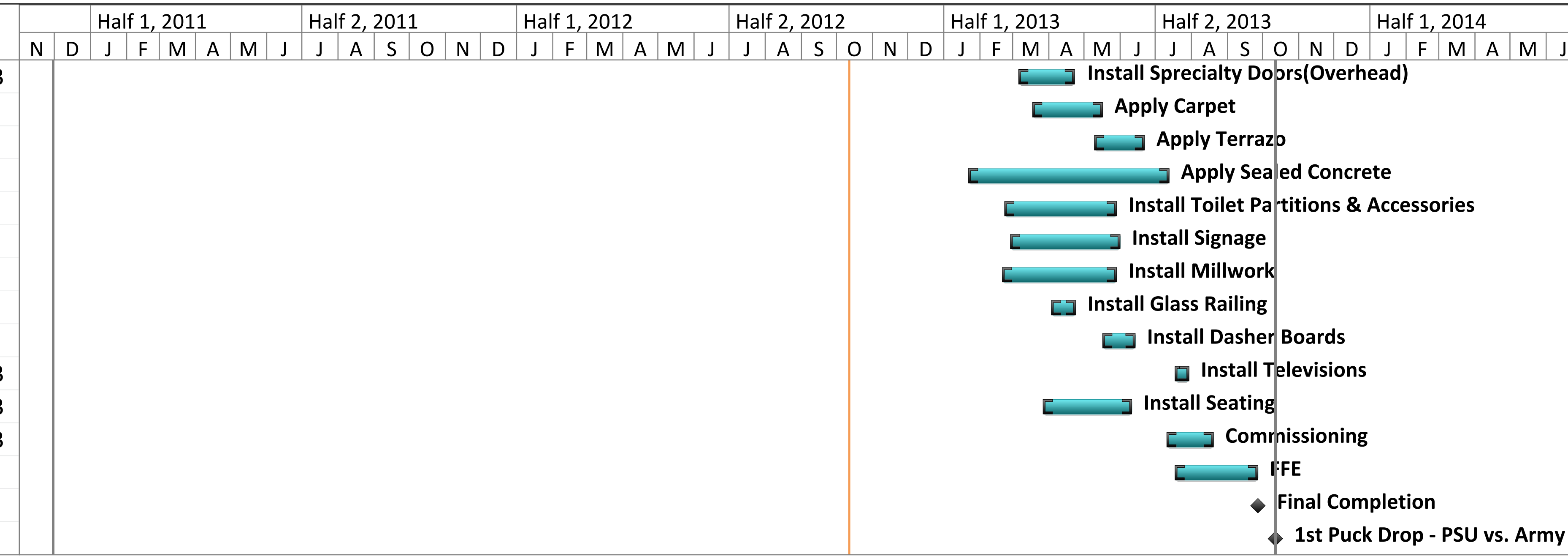
Milestone ◆ Summary Task

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 289 | Ribbon Board Installation South | 4 days | Fri 12/28/12 | Wed 1/2/13 |
| 290 | Scoreboard Installation Main Ice Floor | 16 days | Fri 12/28/12 | Fri 1/18/13 |
| 291 | Ribbon Board Installation East | 2 days | Thu 1/3/13 | Fri 1/4/13 |
| 292 | Ribbon Board Installation North | 3 days | Mon 1/7/13 | Wed 1/9/13 |
| 293 | Scoreboard Installation Community Ice Rink | 5 days | Wed 2/20/13 | Tue 2/26/13 |
| 294 | Set and Connect Hydrotherapy Pools | 5 days | Mon 12/3/12 | Fri 12/7/12 |
| 295 | **Drywall & Interior Finishes** | **163 days** | **Thu 12/13/12** | **Mon 7/29/13** |
| 296 | **Drywall** | **79 days** | **Thu 12/13/12** | **Tue 4/2/13** |
| 297 | Drywall, Tape, Sand SE | 29 days | Thu 12/13/12 | Tue 1/22/13 |
| 298 | Drywall, Tape, Sand NE | 23 days | Mon 1/14/13 | Wed 2/13/13 |
| 299 | Drywall, Tape, Sand NW | 30 days | Mon 1/28/13 | Fri 3/8/13 |
| 300 | Drywall, Tape, Sand NE | 37 days | Mon 2/11/13 | Tue 4/2/13 |
| 301 | **Finishes** | **149 days** | **Wed 1/2/13** | **Mon 7/29/13** |
| 302 | Paint SE | 59 days | Mon 1/28/13 | Thu 4/18/13 |
| 303 | Paint NE | 27 days | Tue 3/26/13 | Wed 5/1/13 |
| 304 | Paint NW | 17 days | Tue 4/16/13 | Wed 5/8/13 |
| 305 | Paint SW | 18 days | Thu 5/9/13 | Mon 6/3/13 |
| 306 | Wall/Floor/Base Tile SE | 24 days | Fri 1/18/13 | Wed 2/20/13 |
| 307 | Wall/Floor/Base Tile NE | 26 days | Thu 1/31/13 | Thu 3/7/13 |
| 308 | Wall/Floor/Base Tile NW | 17 days | Fri 3/1/13 | Mon 3/25/13 |
| 309 | Wall/Floor/Base TileSW | 23 days | Tue 3/19/13 | Thu 4/18/13 |
| 310 | Ceiling Tile SE | 5 days | Wed 2/13/13 | Tue 2/19/13 |
| 311 | Ceiling Tile NE | 13 days | Wed 2/20/13 | Fri 3/8/13 |
| 312 | Ceiling Tile NW | 11 days | Tue 3/12/13 | Tue 3/26/13 |
| 313 | Ceiling Tile SW | 17 days | Thu 3/28/13 | Fri 4/19/13 |
| 314 | Plumbing Fixtures SE | 15 days | Tue 2/5/13 | Mon 2/25/13 |
| 315 | Plumbing Fixtures NE | 13 days | Fri 2/15/13 | Tue 3/5/13 |
| 316 | Plumbing Fixtures NW | 16 days | Wed 3/6/13 | Wed 3/27/13 |
| 317 | Plumbing Fixtures SW | 20 days | Thu 3/28/13 | Wed 4/24/13 |
| 318 | Install Grilles & Diffusers SE | 14 days | Thu 1/24/13 | Tue 2/12/13 |
| 319 | Install Grilles & Diffusers NE | 14 days | Mon 2/11/13 | Thu 2/28/13 |
| 320 | Install Grilles & Diffusers NW | 13 days | Fri 3/1/13 | Tue 3/19/13 |
| 321 | Install Grilles & Diffusers SW | 14 days | Wed 3/20/13 | Mon 4/8/13 |
| 322 | Drop Sprinkler Heads SE | 11 days | Thu 1/24/13 | Thu 2/7/13 |
| 323 | Drop Sprinkler Heads NE | 18 days | Mon 2/4/13 | Wed 2/27/13 |
| 324 | Drop Sprinkler Heads NW | 12 days | Thu 2/28/13 | Fri 3/15/13 |
| 325 | Drop Sprinkler Heads SW | 17 days | Mon 3/18/13 | Tue 4/9/13 |
| 326 | Electrical Devices | 59 days | Thu 1/17/13 | Tue 4/9/13 |
| 327 | Lighting Devices | 61 days | Fri 1/18/13 | Fri 4/12/13 |
| 328 | Install Hollow Metal Doors & Hardware | 51 days | Wed 1/2/13 | Wed 3/13/13 |
| 329 | Install Wood Doors & Hardware | 22 days | Thu 3/28/13 | Fri 4/26/13 |
| 330 | Install Rolling Coil Doors | 46 days | Mon 1/28/13 | Mon 4/1/13 |


Project: The Pegula Ice Arena
Date: 10/10/12

Milestone ◆ Summary Task

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 331 | Install Sprecialty Doors(Overhead) | 34 days | Wed 3/6/13 | Mon 4/22/13 |
| 332 | Apply Carpet | 44 days | Mon 3/18/13 | Thu 5/16/13 |
| 333 | Apply Terrazo | 31 days | Fri 5/10/13 | Fri 6/21/13 |
| 334 | Apply Sealed Concrete | 124 days | Tue 1/22/13 | Fri 7/12/13 |
| 335 | Install Toilet Partitions & Accessories | 68 days | Fri 2/22/13 | Tue 5/28/13 |
| 336 | Install Signage | 68 days | Wed 2/27/13 | Fri 5/31/13 |
| 337 | Install Millwork | 70 days | Wed 2/20/13 | Tue 5/28/13 |
| 338 | Install Glass Railing | 15 days | Wed 4/3/13 | Tue 4/23/13 |
| 339 | Install Dasher Boards | 20 days | Fri 5/17/13 | Thu 6/13/13 |
| 340 | Install Televisions | 8 days | Thu 7/18/13 | Mon 7/29/13 |
| 341 | Install Seating | 54 days | Wed 3/27/13 | Mon 6/10/13 |
| 342 | Commissioning | 28 days | Thu 7/11/13 | Mon 8/19/13 |
| 343 | FFE | 51 days | Thu 7/18/13 | Thu 9/26/13 |
| 344 | Final Completion | 0 days | Thu 9/26/13 | Thu 9/26/13 |
| 345 | 1st Puck Drop - PSU vs. Army | 0 days | Fri 10/11/13 | Fri 10/11/13 |




Project: The Pegula Ice Arena
Date: 10/10/12

Milestone ◆ Summary Task

# Appendix B: Detailed Structural Estimate

| Structural Estimate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| System | Amount | Unit | Material | Labor | Equipment | Total | Total Incl. O and P | | Cost |
| **Pile Caps and Micropiles** | | | | | | | | **$** | **108,143** |
| P2A Concrete | 18 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ | 2,268 |
| P2A Rebar | 0.6 | Ton | 930 | 750 | | 1680 | 2225 | $ | 1,335 |
| P2A Anchorbolt | 9 | Set | 472 | 78 | | 550 | 640 | $ | 5,760 |
| P2A Piles | 20 | C.Y. | 202 | 8.2 | 0.25 | 210.5 | 236 | $ | 4,720 |
| P2A-U Concrete | 2 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ | 252 |
| P2A-U Rebar | 0.16 | Ton | 930 | 750 | | 1680 | 2225 | $ | 356 |
| P2A-U Anchorbolt | 1 | Set | 472 | 78 | | 550 | 640 | $ | 640 |
| P2A-U Piles | 2 | C.Y. | 202 | 8.2 | 0.25 | 210.5 | 236 | $ | 472 |
| P2B Concrete | 55 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ | 6,930 |
| P2B Rebar | 1.76 | Ton | 880 | 435 | | 1315 | 1675 | $ | 2,948 |
| P2B Anchorbolt | 11 | Set | 472 | 78 | | 550 | 640 | $ | 7,040 |
| P2B Piles | 25 | C.Y. | 202 | 8.2 | 0.25 | 210.5 | 236 | $ | 5,900 |
| P3A Concrete | 44 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ | 5,544 |
| P3A Rebar | 0.97 | Ton | 930 | 750 | | 1680 | 2225 | $ | 2,158 |
| P3A Anchorbolt | 12 | Set | 472 | 78 | | 550 | 640 | $ | 7,680 |
| P3A Piles | 40 | C.Y. | 202 | 8.2 | 0.25 | 210.5 | 236 | $ | 9,440 |
| P3A-U Concrete | 7 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ | 882 |
| P3A-U Rebar | 0.42 | Ton | 930 | 750 | | 1680 | 2225 | $ | 935 |
| P3A-U Anchorbolt | 2 | Set | 472 | 78 | | 550 | 640 | $ | 1,280 |
| P3A-U Piles | 7 | C.Y. | 202 | 8.2 | 0.25 | 210.5 | 236 | $ | 1,652 |
| P3B Concrete | 101 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ | 12,726 |
| P3B Rebar | 0.16 | Ton | 930 | 750 | | 1680 | 2225 | $ | 356 |
| P3B Anchorbolt | 13 | Set | 472 | 78 | | 550 | 640 | $ | 8,320 |
| P3B Piles | 44 | C.Y. | 202 | 8.2 | 0.25 | 210.5 | 236 | $ | 10,384 |
| P4A-U Concrete | 4 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ | 504 |
| P4A-U Rebar | 0.2 | Ton | 930 | 750 | | 1680 | 2225 | $ | 445 |
| P4A-U Anchorbolt | 1 | Set | 472 | 78 | | 550 | 640 | $ | 640 |
| P4A-U Piles | 5 | C.Y. | 202 | 8.2 | 0.25 | 210.5 | 236 | $ | 1,180 |
| P5B Concrete | 12 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ | 1,512 |
| P5B Rebar | 0.32 | Ton | 880 | 435 | | 1315 | 1675 | $ | 536 |
| P5B Anchorbolt | 1 | Set | 472 | 78 | | 550 | 640 | $ | 640 |
| P5B Piles | 6 | C.Y. | 202 | 8.2 | 0.25 | 210.5 | 236 | $ | 1,416 |
| Pile Cap Forms | 146 | SFCA | 1.9 | 4.39 | | 6.29 | 8.85 | $ | 1,292 |

## Structural Estimate

| System | Amount | Unit | Material | Labor | Equipment | Total | Total Incl. O and P | Cost |
|---|---|---|---|---|---|---|---|---|
| **Spread Footers** | | | | | | | | **$ 86,482** |
| F4 Concrete | 51 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ 6,426 |
| F4 Rebar | 1.03 | Ton | 880 | 435 | | 1315 | 1675 | $ 1,725 |
| F4 Anchorbolt | 43 | Set | 472 | 78 | | 550 | 640 | $ 27,520 |
| F4-U Concrete | 7 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ 882 |
| F4-U Rebar | 0.31 | Ton | 880 | 435 | | 1315 | 1675 | $ 519 |
| F4-U Anchorbolt | 6 | Set | 472 | 78 | | 550 | 640 | $ 3,840 |
| F5 Concrete | 20 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ 2,520 |
| F5 Rebar | 0.56 | Ton | 930 | 750 | | 1680 | 2225 | $ 1,246 |
| F5 Anchorbolt | 11 | Set | 472 | 78 | | 550 | 640 | $ 7,040 |
| F6 Concrete | 17 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ 2,142 |
| F6 Rebar | 0.44 | Ton | 930 | 750 | | 1680 | 2225 | $ 979 |
| F6 Anchorbolt | 5 | Set | 472 | 78 | | 550 | 640 | $ 3,200 |
| F7 Concrete | 45 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ 5,670 |
| F7 Rebar | 1.07 | Ton | 930 | 750 | | 1680 | 2225 | $ 2,381 |
| F7 Anchorbolt | 10 | Set | 472 | 78 | | 550 | 640 | $ 6,400 |
| F8 Concrete | 50 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ 6,300 |
| F8 Rebar | 0.99 | Ton | 930 | 750 | | 1680 | 2225 | $ 2,203 |
| F8 Anchorbolt | 7 | Set | 472 | 78 | | 550 | 640 | $ 4,480 |
| Spd. Footer Forms | 114 | SFCA | 1.9 | 4.39 | | 6.29 | 8.85 | $ 1,009 |
| **Foundation, Shear, Retaining Wall** | | | | | | | | **$ 489,996** |
| FW Footer Conc. | 324 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ 40,824 |
| FW Footer Rebar | 12.5 | Ton | 930 | 750 | | 1680 | 2225 | $ 27,813 |
| FW Concrete | 1350 | C.Y. | 103 | 20 | 6.4 | 129.5 | 150 | $ 202,500 |
| FW Rebar | 45 | Ton | 880 | 435 | | 1315 | 1675 | $ 75,375 |
| SW Footer Conc. | 50 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ 6,300 |
| SW Footer Rebar | 2 | Ton | 930 | 750 | | 1680 | 2225 | $ 4,450 |
| SW Concrete | 210 | C.Y. | 103 | 20 | 6.4 | 129.5 | 150 | $ 31,500 |
| SW Rebar | 7 | Ton | 880 | 435 | | 1315 | 1675 | $ 11,725 |
| RW Footer Conc. | 62 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ 7,812 |
| RW Footer Rebar | 3.5 | Ton | 880 | 435 | | 1315 | 1675 | $ 5,863 |
| RW Concrete | 56 | C.Y. | 103 | 20 | 6.4 | 129.5 | 150 | $ 8,400 |
| RW Rebar | 4.86 | Ton | 930 | 750 | | 1680 | 2225 | $ 10,814 |
| Continuous Footer | 135 | C.Y. | 103 | 8.2 | 0.25 | 111.5 | 126 | $ 17,010 |
| FW, SW, RW Forms | 1312 | SFCA | 1.9 | 4.39 | | 6.29 | 8.85 | $ 11,611 |
| Hydraulic Crane | 16 | Week | | | 1500 | 1500 | 1750 | $ 28,000 |

## Structural Estimate

| System | Amount | Unit | Material | Labor | Equipment | Total | Total Incl. O and P | Cost |
|---|---|---|---|---|---|---|---|---|
| **SOG, SOMD & Roof Decking** | | | | | | | | **$5,420,428** |
| SOG Concrete | 17500 | C.Y. | 94 | 8.2 | 0.25 | 102.5 | 115 | $ 2,012,500 |
| SOG Rebar | 44 | Ton | 930 | 750 | | 1680 | 2225 | $ 97,900 |
| Concourse Concrete | 13400 | C.Y. | 94 | 8.2 | 0.25 | 102.5 | 115 | $ 1,541,000 |
| Concourse Met. Deck | 58200 | S.F | 2.91 | 0.5 | 0.04 | 3.45 | 4.13 | $ 240,366 |
| Concourse Rebar | 4 | Ton | 880 | 435 | | 1315 | 1675 | $ 6,700 |
| Club Concrete | 8150 | C.Y. | 94 | 8.2 | 0.25 | 102.5 | 115 | $ 937,250 |
| Club Metal Deck | 41050 | S.F | 2.91 | 0.5 | 0.04 | 3.45 | 4.13 | $ 169,537 |
| Club Rebar | 27 | Ton | 880 | 435 | | 1315 | 1675 | $ 45,225 |
| Roof Deck | 122500 | S.F | 2.05 | 0.41 | 0.03 | 2.49 | 3.02 | $ 369,950 |
| **Columns** | | | | | | | | **$ 883,152** |
| W 12 x 45 | 16 | L.F. | 69 | 2.62 | 1.45 | 73.07 | 81.5 | $ 1,304 |
| W 12 x 87 | 218 | L.F. | 120 | 2.75 | 1.52 | 124.27 | 138 | $ 30,084 |
| W 12 x 106 | 170 | L.F. | 165 | 2.82 | 1.56 | 169.38 | 189 | $ 32,130 |
| W 14 x 45 | 62 | L.F. | 102 | 2.75 | 1.52 | 106.27 | 118 | $ 7,316 |
| W 14 x 61 | 390 | L.F. | 102 | 2.75 | 1.52 | 106.27 | 118 | $ 46,020 |
| W 14 x 68 | 39.5 | L.F. | 102 | 2.75 | 1.52 | 106.27 | 118 | $ 4,661 |
| W 14 x 74 | 575 | L.F. | 102 | 2.75 | 1.52 | 106.27 | 118 | $ 67,850 |
| W 14 x 82 | 200.5 | L.F. | 102 | 2.75 | 1.52 | 106.27 | 118 | $ 23,659 |
| W 14 x 90 | 823 | L.F. | 165 | 2.82 | 1.56 | 169.38 | 189 | $ 155,547 |
| W 14 x 99 | 100 | L.F. | 165 | 2.82 | 1.56 | 169.38 | 189 | $ 18,900 |
| W 14 x 120 | 196.5 | L.F. | 165 | 2.82 | 1.56 | 169.38 | 189 | $ 37,139 |
| W 14 x 145 | 126 | L.F. | 165 | 2.82 | 1.56 | 169.38 | 189 | $ 23,814 |
| W 18 x 119 | 884.5 | L.F. | 146 | 4.34 | 1.8 | 152.14 | 195.5 | $ 172,920 |
| W 24 x 146 | 229.5 | L.F. | 201 | 3.72 | 1.54 | 206.26 | 229 | $ 52,556 |
| W 24 x 176 | 739 | L.F. | 201 | 3.72 | 1.54 | 206.26 | 263.5 | $ 194,727 |
| HSS 6x6x3/8 | 98.5 | L.F. | 38 | 4.17 | 2.29 | 44.46 | 51.5 | $ 5,073 |
| Approx. Bolts | 1160 | EA | 1.61 | 3.59 | | 5.2 | 8.15 | $ 9,454 |
| **Rakers** | | | | | | | | **$ 694,500** |
| Event Rakers | 1250 | L.F | 395 | 5.24 | 2.18 | 402.5 | 463 | $ 578,750 |
| Club Rakers | 250 | L.F | 395 | 5.24 | 2.18 | 402.5 | 463 | $ 115,750 |

| Structural Estimate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| System | Amount | Unit | Material | Labor | Equipment | Total | Total Incl. O and P | | Cost |
| **Main Concourse Level Beams** | | | | | | | | **$** | **671,794** |
| W 12 x 19 | 341 | L.F. | 30.5 | 3.07 | 1.7 | 35.27 | 40.5 | $ | **13,811** |
| W 12 x 40 | 91 | L.F. | 69 | 3.6 | 2 | 74.6 | 84 | $ | **7,644** |
| W 14 x 22 | 255.5 | L.F. | 36 | 2.73 | 1.51 | 40.24 | 46 | $ | **11,753** |
| W 14 x 30 | 242 | L.F. | 41.5 | 3 | 1.66 | 46.16 | 52.5 | $ | **12,705** |
| W 16 x 26 | 490.5 | L.F. | 36 | 2.7 | 1.5 | 40.2 | 46 | $ | **22,563** |
| W 16 x 40 | 15.5 | L.F. | 55 | 3.38 | 1.87 | 60.25 | 68.5 | $ | **1,062** |
| W 16 x 50 | 89.5 | L.F. | 69 | 3.38 | 1.87 | 74.25 | 83.5 | $ | **7,473** |
| W 16 x 67 | 141 | L.F. | 92 | 3.56 | 1.97 | 97.53 | 109 | $ | **15,369** |
| W 18 x 35 | 2083.5 | L.F. | 48 | 4.07 | 1.69 | 53.76 | 62 | $ | **129,177** |
| W 18 x 40 | 368 | L.F. | 55 | 4.07 | 1.69 | 60.76 | 69.5 | $ | **25,576** |
| W 18 x 50 | 163 | L.F. | 69 | 4.28 | 1.77 | 75.05 | 85 | $ | **13,855** |
| W 18 x 55 | 34 | L.F. | 75.5 | 4.28 | 1.77 | 81.55 | 92.5 | $ | **3,145** |
| W 21 x 44 | 1584 | L.F. | 60.5 | 3.67 | 1.52 | 65.69 | 74.5 | $ | **118,008** |
| W 24 x 55 | 852.5 | L.F. | 75.5 | 3.52 | 1.46 | 80.48 | 90.5 | $ | **77,151** |
| W 24 x 62 | 736 | L.F. | 85.5 | 3.52 | 1.46 | 90.48 | 102 | $ | **75,072** |
| W 24 x 68 | 338.5 | L.F. | 93.5 | 3.52 | 1.46 | 98.48 | 111 | $ | **37,574** |
| W 24 x 94 | 35 | L.F. | 143 | 3.72 | 1.54 | 148.26 | 165 | $ | **5,775** |
| W 30 x 90 | 90 | L.F. | 136 | 3.25 | 1.35 | 140.6 | 157 | $ | **14,130** |
| W 30 x 148 | 73 | L.F. | 204 | 3.37 | 1.4 | 208.77 | 231 | $ | **16,863** |
| W 30 x 173 | 124 | L.F. | 238 | 3.49 | 1.45 | 242.94 | 270 | $ | **33,480** |
| HSS 6x6x3/8 | 106.5 | L.F. | 38 | 4.17 | 2.29 | 44.46 | 51.5 | $ | **5,485** |
| Approx. Bolts | 2960 | EA | 1.61 | 3.59 | | 5.2 | 8.15 | $ | **24,124** |

| Structural Estimate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| System | Amount | Unit | Material | Labor | Equipment | Total | Total Incl. O and P | Cost |
| **Club Level Beams** | | | | | | | | $ 948,832 |
| W 10 x 22 | 113 | L.F. | 30.5 | 4.5 | 2.49 | 37.49 | 44 | $ 4,972 |
| W 10 x 26 | 50 | L.F. | 36 | 4.5 | 2.49 | 42.99 | 50 | $ 2,500 |
| W 10 x 33 | 148 | L.F. | 45.5 | 4.91 | 2.72 | 53.13 | 61.5 | $ 9,102 |
| W 10 x 45 | 87 | L.F. | 67.5 | 4.91 | 2.72 | 75.13 | 85.5 | $ 7,439 |
| W 10 x 49 | 162 | L.F. | 67.5 | 4.91 | 2.72 | 75.13 | 85.5 | $ 13,851 |
| W 10 x 60 | 90 | L.F. | 67.5 | 4.91 | 2.72 | 75.13 | 97 | $ 8,730 |
| W 12 x 19 | 143.5 | L.F. | 30.5 | 3.07 | 1.7 | 35.27 | 40.5 | $ 5,812 |
| W 12 x 45 | 80 | L.F. | 69 | 3.6 | 2 | 74.6 | 84 | $ 6,720 |
| W 12 x 60 | 100 | L.F. | 80 | 3.6 | 2 | 85.6 | 96 | $ 9,600 |
| W 14 x 22 | 65.5 | L.F. | 36 | 2.73 | 1.51 | 40.24 | 46 | $ 3,013 |
| W 14 x 30 | 71 | L.F. | 41.5 | 3 | 1.66 | 46.16 | 52.5 | $ 3,728 |
| W 14 x 43 | 89 | L.F. | 59 | 3.34 | 1.85 | 64.19 | 72.5 | $ 6,453 |
| W 14 x 53 | 59 | L.F. | 73 | 3.38 | 1.87 | 78.25 | 88 | $ 5,192 |
| W 14 x 61 | 96 | L.F. | 102 | 3.56 | 1.97 | 107.53 | 120 | $ 11,520 |
| W 16 x 26 | 686.5 | L.F. | 36 | 2.7 | 1.5 | 40.2 | 46 | $ 31,579 |
| W 16 x 31 | 24 | L.F. | 42.5 | 3 | 1.66 | 47.16 | 54 | $ 1,296 |
| W 16 x 40 | 24 | L.F. | 55 | 3.38 | 1.87 | 60.25 | 68.5 | $ 1,644 |
| W 16 x 50 | 58 | L.F. | 69 | 3.38 | 1.87 | 74.25 | 83.5 | $ 4,843 |
| W 18 x 35 | 1577.5 | L.F. | 48 | 4.07 | 1.69 | 53.76 | 62 | $ 97,805 |
| W 18 x 40 | 223 | L.F. | 55 | 4.07 | 1.69 | 60.76 | 69.5 | $ 15,499 |
| W 18 x 50 | 29 | L.F. | 69 | 4.28 | 1.77 | 75.05 | 85 | $ 2,465 |
| W 18 x 60 | 30 | L.F. | 89.5 | 4.34 | 1.8 | 95.64 | 108 | $ 3,240 |
| W 18 x 76 | 32.5 | L.F. | 105 | 4.34 | 1.8 | 111.14 | 125 | $ 4,063 |
| W 20 x 148 | 56 | L.F. | 146 | 4.34 | 1.8 | 152.14 | 195.5 | $ 10,948 |
| W 21 x 44 | 1427 | L.F. | 60.5 | 3.67 | 1.52 | 65.69 | 74.5 | $ 106,312 |
| W 21 x 48 | 53 | L.F. | 69 | 3.67 | 1.52 | 74.19 | 83.5 | $ 4,426 |
| W 21 x 50 | 37.5 | L.F. | 69 | 3.67 | 1.52 | 74.19 | 83.5 | $ 3,131 |
| W 21 x 104 | 64 | L.F. | 139 | 3.9 | 1.62 | 144.52 | 162 | $ 10,368 |
| W 24 x 55 | 104 | L.F. | 75.5 | 3.52 | 1.46 | 80.48 | 90.5 | $ 9,412 |
| W 24 x 62 | 23 | L.F. | 85.5 | 3.52 | 1.46 | 90.48 | 102 | $ 2,346 |
| W 24 x 68 | 446.5 | L.F. | 93.5 | 3.52 | 1.46 | 98.48 | 111 | $ 49,562 |
| W 24 x 76 | 125.5 | L.F. | 105 | 3.52 | 1.46 | 109.98 | 123 | $ 15,437 |
| W 24 x 84 | 24 | L.F. | 116 | 3.61 | 1.5 | 121.11 | 135 | $ 3,240 |
| W 24 x 94 | 28.5 | L.F. | 129 | 3.61 | 1.5 | 134.11 | 150 | $ 4,275 |
| W 24 x 104 | 243.5 | L.F. | 143 | 3.72 | 1.54 | 148.26 | 165 | $ 40,178 |
| W 27 x 84 | 628.5 | L.F. | 116 | 3.28 | 1.36 | 120.64 | 134 | $ 84,219 |
| W 30 x 90 | 238 | L.F. | 136 | 3.25 | 1.35 | 140.6 | 157 | $ 37,366 |
| W 30 x 99 | 94 | L.F. | 136 | 3.25 | 1.35 | 140.6 | 157 | $ 14,758 |
| W 30 x 148 | 338 | L.F. | 204 | 3.37 | 1.4 | 208.77 | 231 | $ 78,078 |
| W 30 x 173 | 165 | L.F. | 238 | 3.49 | 1.45 | 242.94 | 270 | $ 44,550 |
| W 33 x 18 | 64 | L.F. | 162 | 3.32 | 1.38 | 166.7 | 185 | $ 11,840 |
| W 33 x 118 | 96 | L.F. | 162 | 3.32 | 1.38 | 166.7 | 185 | $ 17,760 |
| W 36 x 135 | 80 | L.F. | 186 | 3.34 | 1.38 | 190.72 | 211 | $ 16,880 |
| W 36 x 150 | 85 | L.F. | 206 | 3.34 | 1.38 | 210.72 | 234 | $ 19,890 |
| W 36 x 210 | 50.5 | L.F. | 320 | 3.47 | 1.44 | 324.91 | 360 | $ 18,180 |
| HSS 6x6x3/8 | 123.5 | L.F. | 38 | 4.17 | 2.29 | 44.46 | 51.5 | $ 6,360 |
| HSS 8x8x3/8 | 124.5 | L.F. | 61 | 4.5 | 2.5 | 68 | 78 | $ 9,711 |
| HSS 9x9x3/8 | 263 | L.F. | 113 | 4.7 | 2.58 | 120 | 133.5 | $ 35,111 |
| HSS 12x6x3/8 | 18 | L.F. | 113 | 4.7 | 2.58 | 120 | 133.5 | $ 2,403 |
| HSS 12x8x3/8 | 8 | L.F. | 113 | 4.7 | 2.58 | 120 | 133.5 | $ 1,068 |
| HSS 14x6x3/8 | 12 | L.F. | 130 | 5.41 | 2.97 | 138 | 153.5 | $ 1,842 |
| HSS 20x8x3/8 | 8 | L.F. | 147 | 6.11 | 3.35 | 156 | 173.5 | $ 1,388 |
| Approx. Bolts | 3280 | EA | 1.61 | 3.59 | | 5.2 | 8.15 | $ 26,732 |

| Structural Estimate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| System | Amount Unit | Material | Labor | Equipment | Total | Total Incl. O and P | | Cost |
| **Precast** | | | | | | | $ | 1,894,720 |
| Stadia (Event) | 50000 | 21 | 3.41 | 1.79 | 26.2 | 31 | $ | 1,550,000 |
| Stadia (Club) | 10000 | 21 | 3.41 | 1.79 | 26.2 | 31 | $ | 310,000 |
| Vomitory Walls | 1120 | 21 | 3.41 | 1.79 | 26.2 | 31 | $ | 34,720 |
| **Community Rink Joists** | | | | | | | $ | 163,511 |
| 68DLHSP | 2508 L.F. | 54.5 | 1.77 | 0.79 | 57.06 | 64 | $ | 160,512 |
| Approx. Bolts | 368 EA | 1.61 | 3.59 | | 5.2 | 8.15 | $ | 2,999 |
| **Catwalk Beams and Joists** | | | | | | | $ | 188,179 |
| W 12 x 30 | 128 L.F. | 48 | 3.34 | 1.85 | 53.19 | 60.5 | $ | 7,744 |
| W 12 x 45 | 64 L.F. | 69 | 3.6 | 2 | 74.6 | 84 | $ | 5,376 |
| W 14 x 43 | 128 L.F. | 59 | 3.34 | 1.85 | 64.19 | 72.5 | $ | 9,280 |
| W 24 x 55 | 464 L.F. | 75.5 | 3.52 | 1.46 | 80.48 | 90.5 | $ | 41,992 |
| W 24 x 68 | 136 L.F. | 93.5 | 3.52 | 1.46 | 98.48 | 111 | $ | 15,096 |
| W 24 x 94 | 64 L.F. | 129 | 3.61 | 1.5 | 134.11 | 150 | $ | 9,600 |
| W 24 x 104 | 64 L.F. | 143 | 3.72 | 1.54 | 148.26 | 165 | $ | 10,560 |
| HSS 9x9x3/8 | 351 L.F. | 113 | 4.7 | 2.58 | 120 | 133.5 | $ | 46,859 |
| 24KSP | 2560 L.F. | 9.85 | 1.77 | 0.79 | 12.41 | 14.75 | $ | 37,760 |
| Approx. Bolts | 480 EA | 1.61 | 3.59 | | 5.2 | 8.15 | $ | 3,912 |
| **Trusses and Bracing** | | | | | | | $ | 2,084,330 |
| Trusses | 340 Ton | 4250 | 470 | 195 | 4915 | 5700 | $ | 1,938,000 |
| W 14 x 34 | 620 L.F. | 59 | 3.34 | 1.85 | 64.19 | 72.5 | $ | 44,950 |
| W 14 x 43 | 248 L.F. | 59 | 3.34 | 1.85 | 64.19 | 72.5 | $ | 17,980 |
| Additional Crane | 6 Week | | | 5000 | 5000 | 5750 | $ | 34,500 |
| Approx. Bolts | 6000 EA | 1.61 | 3.59 | | 5.2 | 8.15 | $ | 48,900 |

# Appendix C: General Conditions Estimate

| Staffing Plan | Month | Rate/Month | Cost | Personnel |
|---|---|---|---|---|
| Construction Executive | 11 | $ 19,750 | **$ 217,250** | Hodge |
| Senior Project Manager | 18 | $ 18,000 | **$ 324,000** | Laurila |
| Project Manager | 20 | $ 16,000 | **$ 320,000** | Brown |
| Senior Superintendent | 20 | $ 14,250 | **$ 285,000** | Brown |
| Superintendent | 18 | $ 12,500 | **$ 225,000** | Moore |
| Superintendent | 14 | $ 12,500 | **$ 175,000** | Loy |
| Quality Manager | 20 | $ 11,500 | **$ 230,000** | Mallory |
| Integrated Construction Coordinator II | 19 | $ 11,000 | **$ 209,000** | Kantor |
| Integrated Construction Coordinator I | 6 | $ 10,000 | **$ 60,000** | Nahas |
| Safetey Engineer | 18 | $ 10,500 | **$ 189,000** | Guenther |
| MEP Engineer | 18 | $ 10,000 | **$ 180,000** | Alex |
| Field Engineer | 18 | $ 10,000 | **$ 180,000** | Brown |
| Field Engineer | 17 | $ 10,000 | **$ 170,000** | Thayor |
| Office Administrator | 16 | $ 8,250 | **$ 132,000** | Weekley |
| Intern | 12 | $ 1,000 | **$ 12,000** | Nahas/Marshall |
| | | **Total** | **$ 2,908,250** | |

| Insurance and Bonds | Quantity | Unit | Rate | Total |
|---|---|---|---|---|
| Builder's Risk Insurance | | | | Owner |
| Automobile Insurance | 2 | Year | $ 4,000 | **$ 8,000** |
| Liability Insurance | 0.75 | % | $ 68,000,000 | **$ 510,000** |
| Payment & Performance Bonds | 0.70 | % | $ 68,000,000 | **$ 476,000** |
| | | | **Total** | **$ 994,000** |

| General Services | Quantity | Unit | Rate | Total |
|---|---|---|---|---|
| Site Vehicle | | | | |
| Senior Project Manager | 18 | Month | $ 500 | **$ 9,000** |
| Senior Superintendent | 20 | Month | $ 400 | **$ 8,000** |
| Superintendent | 18 | Month | $ 400 | **$ 7,200** |
| Superintendent | 13 | Month | $ 400 | **$ 5,200** |
| Telephone | 16 | Ea | $ 75 | **$ 1,200** |
| Mobile Phone Monthly Bill | 20 | Month | $ 800 | **$ 16,000** |
| Handheld Transciever | 20 | Month | $ 50 | **$ 1,000** |
| IT | | | | |
| Server | 20 | Month | $ 100 | **$ 2,000** |
| Router/Wireless | 1 | Ea | $ 100 | **$ 100** |
| Terminal Computer | 10 | Ea | $ 800 | **$ 8,000** |
| Tablet Computer | 6 | Ea | $ 1,200 | **$ 7,200** |
| Plan Room Computer | 1 | Ea | $ 2,000 | **$ 2,000** |
| Projecter/Computer | 1 | Ea | $ 3,000 | **$ 3,000** |
| Printer | 1 | Ea | $ 300 | **$ 300** |
| Printer/Faxer/Scanner | 1 | Ea | $ 1,000 | **$ 1,000** |
| Camera | 5 | Ea | $ 70 | **$ 350** |
| Office Supplies/Paper | 1 | LS | $ 10,000 | **$ 10,000** |
| Shipping Expenses | 20 | Month | $ 100 | **$ 2,000** |
| Office Clean | 20 | Month | $ 400 | **$ 8,000** |
| Aerial Photos | 12 | Month | $ 250 | **$ 3,000** |
| | | | **Total** | **$ 94,550** |

| Temporary Facilities & Utilities | Quantity | Unit | Rate | Total |
|---|---|---|---|---|
| Trailer Rental | 20 | Month | $ 2,000 | **$ 40,000** |
| Trailer Setup & Removal | 1 | LS | $ 30,000 | **$ 30,000** |
| Site Fence | 1 | LS | $ 5,000 | **$ 5,000** |
| Tools/Gang Box | 1 | LS | $ 10,000 | **$ 10,000** |
| Signage | 1 | LS | $ 25,000 | **$ 25,000** |
| Dumpsters | 15 | Month | $ 4,000 | **$ 60,000** |
| IT/Network Setup | 1 | LS | $ 300 | **$ 300** |
| Monthly Internet Bill | 20 | Month | $ 500 | **$ 10,000** |
| Telephone Setup | 1 | LS | $ 300 | **$ 300** |
| Monthly Phone Bill | 20 | Month | $ 400 | **$ 8,000** |
| Electric Installation | 1 | LS | $ 1,000 | **$ 1,000** |
| Monthly Electric Bill | 20 | Month | $ 500 | **$ 10,000** |
| Water Setup | 1 | LS | $ 500 | **$ 500** |
| Monthly Water Bill | 20 | Month | $ 500 | **$ 10,000** |
| Temporary Toilets | 15 | LS | $ 5,000 | **$ 75,000** |
| | | | **Total** | **$ 285,100** |

# Appendix D: BIM Process Map

# Level 1 Process Map: The Pegula Ice Arena

University Park, PA