

## Executive Summary

This senior thesis final report includes four different analyses of the 227,500 square foot Pegula Ice Arena located on University Park of the Pennsylvania State University. Once completed, this building is going to be the future home of Division 1 hockey for Penn State. The four analyses include: a detailed look into the sequencing of the community rink with a structural breadth; a retrospective look at the schedule to determine if the project could have been expedited by an altered sequence; an analysis into a new façade system with an architectural breadth; and research into different methods of performing a geotechnical analysis.

### Analysis 1 | Community Rink Sequence off Critical Path

The project team at the Pegula Ice Arena took many steps to ensure they could start the finish work inside the building early enough to finish the project on time. In discussions with Heidi Brown, Mortenson PM, she proposed that the community rink be sequenced off the critical path. Doing this, allows for work trades to focus more on the main rink portion of the building where the bulk of finish work is located.

Ultimately, removing the community rink off the critical path proved to have the potential to save three weeks on overall duration. As beneficial to the project team removing the community rink off the critical path would be, it was entirely unbeneficial to the owner and architect. It raised the cost of the project by over \$260,000 and significantly disrupted an architectural aspect inside the building. With this, it seems that there are more disadvantages than advantages, which is why this proposed change would not be recommended.

*A structural design was also performed determining the best possible solution in redistributing the loads to ensure the community rink could be scheduled off the critical path.*

### Analysis 2 | Building Sequence

After a detailed review of the community rink was finished a more retrospective look at the entire schedule was analyzed. Two different schedule analyses were performed as part of the building sequencing. The first was analyzing the feasibility of utilizing two crews throughout part of construction. If excavation, concrete, and steel were constructed with two crews the building could have been opened prior to the start of the 2013 school year. This would have helped allow the building manager to ensure the building was commissioned properly prior to the home opener and it also would have helped generate interest for the upcoming hockey season. However, due to the expected premium in cost and more importantly the challenges that would result in site logistics, this sequence would not be recommended.

The second sequence looked into was with regards to the project start location. The beginning of the project proved to be largely driven by the foundation wall which wraps around three sides of the

building. However, a completed foundation wall does not allow finish work to begin any sooner. In contrast, moving the SOG start location back would have allowed finish work to begin without interfering with the foundation wall. The newly proposed start point would have the potential to save two weeks of schedule while not interfering with any other project sequence.

### **Analysis 3 | Building Enclosure**

Due to the finish date of this project it was necessary for the project team to accelerate the enclosure to ensure temporary heat could be provided prior to the start of winter. This was to ensure finishes could begin and finish as scheduled. This project also faced multiple safety incidents. Therefore, the removal of any potentially harmful work sequences drove to the decision to explore a new façade system.

The façade system analyzed and proposed contains insulation sandwiched between concrete. It was able to provide a safer system by removing scaffolding and exterior work during winter weather. As important as safety is, the newly proposed system does not save any overall schedule duration when compared to the original system. The newly proposed system would also add an additional \$200,821 to the project. Subsequently, this proposed alternative system would not be recommended.

*An architectural design was done by analyzing the thermal and moisture performance of the wall as well as architectural details that could be utilized as part of the contract drawings.*

### **Analysis 4 | Geotechnical Investigation**

A look into different ways to analyze subsurface conditions was done in the fourth and final analysis. Prior to construction, the Pegula Ice Arena site had a lacrosse field at that location. Penn State did not want to remove or damage this field until they had to which is why they utilized ground penetrating radar (GPR) over the field with bore holes surrounding the rest of the project site. The geotechnical report proved fairly accurate over boring locations but inaccurate over locations where GPR was utilized.

In a thorough comparison and review of the two methods of subsurface analysis; and discussions with THG Geophysics it was determined that GPR would not be recommended as the sole source of subsurface investigation. GPR is good for many things including roadway construction and utility line locations. However, GPR does not function well in clay type soils and cannot accurately identify soils at large depths.