# Loyola Intercollegiate Athletic Complex
# Baltimore, MD

## Technical Assignment # 3

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## Executive Summary

This technical assignment takes a look at some of the constructability issues faced on the Loyola Intercollegiate Athletic Complex and their resolutions. Also, the various schedule acceleration methods and the value engineering topics incorporated on this project. Then this report explains some of the problems that I have identified on the Loyola IAC and possible topics for further research.

The top constructability issues include Vegetation Reinforcing Steep Slopes (VRSS) dealing with the soils conditions, VRSS slopes dealing with the curves in the walls, and artificial grass field installation and testing. The Loyola site did not have enough soil onsite so the project team had to bring soil from offsite sources making it difficult to get the perfect soil for compaction for the VRSS slopes. The project team had no way of tracking the locations of the curves in the wall so using the sources available determined a way to track the curves of the VRSS slopes. Coordination between the field crew, project team, and the testing agency was an issue because of the distance of where the crew and inspector were coming from. The field crew was coming from Texas and the inspector was traveling from Tennessee.

The critical path for the Loyola IAC was the VRSS slopes then the building concrete and steel erection. Most of schedule acceleration was done by adding equipment, manpower, and working longer hours. The main value engineering idea used on this project was changing the bleacher system from pre-cast to cast-in-place concrete. The other two value engineering ideas used were to change the exterior metal panel to spray on EIFS and change all ground faced veneer CMU to split faced units.

Problems on the Loyola project include the VRSS slopes, masonry façade, MEP coordination, LEED Accreditation Analysis, the sequencing of steel erection and concrete pours, didn’t have mockups of rooms, and the communication among the project team. Each of these areas could have been improved to help with the successful completion of the project. Some of the listed problems will be solved or redesigned next semester for senior thesis. Possible ideas for next semester include MEP coordination, masonry facades, LEED analysis, and the schedule for the VRSS slopes.

# A. Constructability Challenges

### A.1 Overview

Since the Loyola Intercollegiate Athletic complex is on such a large site, many of the constructability challenges stem from the site work. However, with large sites and mass excavation, it is not uncommon to have construction issues with site work. The top three constructability challenges that are being presented are derived from communication with the onsite project team through interviews and observations made over the two summer internships onsite. They represent views from different positions and allow for a complete, well rounded analysis of each topic.

### A.2 Vegetation Reinforcing Steep Slopes (Unsuitable Soils)

As discussed in the previous two technical assignments, the athletic complex has a stadium, three fields, and a parking lot that are supported by vegetation reinforcing steep slopes. The project consists of five Vegetation Reinforcing Steep Slopes (VRSS). The height varies in these slopes from 60 to 110 feet tall.

There are several issues with the installation process of the VRSS slopes. One of the main issues was achieving the right soil compaction. VRSS slopes are placed and compacted in 1.5 ft lifts. Lifts consisted of welded wire baskets, primary reinforcement layer, face wrap, vegetation, and reinforced soils, which was composed of soil and a geo membrane. The geo membrane was placed in between each lift. Since there was not enough soil onsite for the mass excavation, the soil had to be brought onto the site from outside sources. Even though the right soil was selected, the compaction levels were not always reached from weather and from damp or wet soil. The soil had to be equal to or more than 93% compacted to pass the compaction test. Also, multiple rows reached the compaction level required, however the wall was pumping too much according to the onsite inspector.

The issue was simple to solve but took a lot of time, manpower, and money. The project staff knew up front of these issues so allotted time in the schedule for these delays. The first step to help remedy the weather was to “close” the soil piles up the night before if there was rain in the forecast. When you close up the soil piles, the dirt crew would simply compact the top layer of soil, which would prevent water from penetrating the soil pile. Next, since the site was so large, was that on nice days the dirt crew would spread out the soil on site to help dry it out so it was suitable to be placed on the wall, refer to the image 1 below. The most challenging issue to accommodate was the pumping within the wall. The solution was to “bridge” the wall

by using two lifts of CR-6, which is the type of rock they used to tie the ends of the walls into the rest of the site. This solution was very expensive but in turn did not cause any delays to the schedule because all the CR-6 was onsite already.

*Image 1 Drying the Soil Out*

**A.3 Vegetation Reinforcing Steep Slopes (Curves in the Walls)**

I had talked previously about the height of the VRSS slopes but haven't touched too much on the length of the walls. The five walls ranged in lengths of 130 feet to 850 ft long. Not all of the walls were straight; they included curves to accommodate the parking lots and playing fields.

A complication came about when the project got to a VRSS slope with curves, refer to image 2 to the left. There was no way to actually keep track of the curves in the slopes. This could cause the slopes to be too far in or too far out. If the VRSS slopes were too far out, they would not be structural sound and could cause the slopes to fail in the future. If

*Image 2 Curves on the Walls*

the VRSS slopes were too far in, two things could happen; the playing fields would have to be redesigned to fit in a smaller area or the parking lot would lose valuable parking space.

The project team went through several ideas before deciding on a solution. The drawings included the design equation for the walls. Using this equation, the row the wall crew was on, and the surveys from the surveyor, the data could be put into the excel spreadsheet to let the project team know how far in or out the wall was off at the specific points. The points were set up by the surveyors. Also, the surveyors sent the AutoCAD files to give the owners a visual of the status of the walls.

**A.4 Artificial Grass Field Installation/ Testing**

As stated in previous assignments, the Loyola IAC has 2 artificial grass fields. One is the home game field and the other is the practice field but can also be used for games if there are two sporting events at the same time. The artificial grass fields are coming from a company located in Texas called Sportexe. The crews that install the fields are also coming from Texas. The guy that tested the fields was coming from Georgia, normally drove up that day, and had to conduct 12 tests in a minimum amount of time. He was from Testing Services INC. out of Georgia.

The constructability challenge with the installation and testing of the artificial grass fields came apparent when the project team had to coordinate with the testing agency and the crews installing the fields without throwing off the schedule. Both fields had to be tested with just the base, then with just the turf and finally with the rubber infill in the turf. Even with the extensive coordination done, when the inspector showed up to start the testing on the fields, the project team was not prepared to give the water pressure needed for the testing apparatus , which you can see in image 3 to your right, this caused the testing to last two days instead of one.

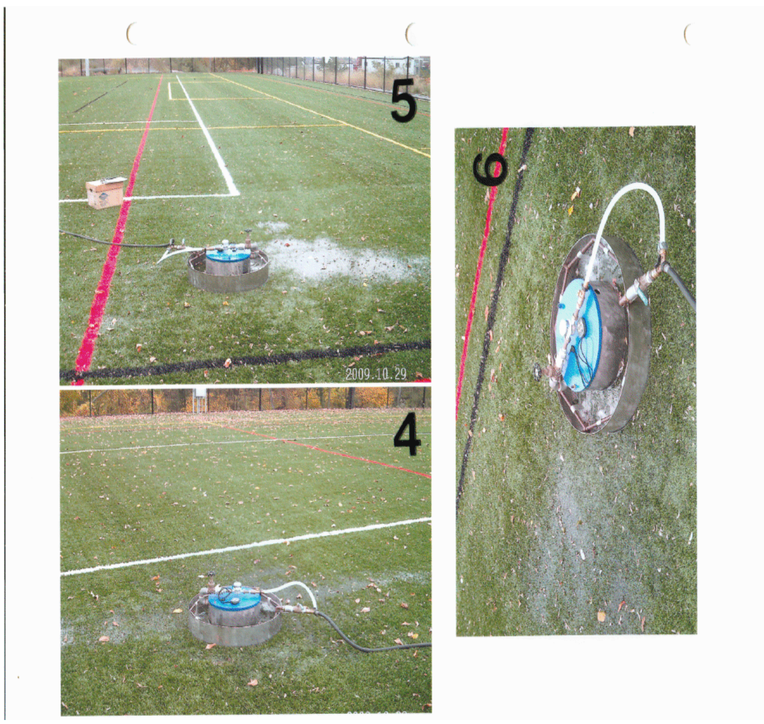


*Image 3 Testing Apparatus*

During the coordination of this process, the project team sat down and figured out how the field crews could be working while the tests on the fields were going on. The solution they came up with was have the field crew lay the turf down the center of the field and then have the inspector come in and do the 6 tests on just the base and turf in the same day. The project team had to act quickly when they found out that the pressure of the water was not sufficient for the testing apparatus. The superintendent on site went out and got a fire hose and ran it from the local fire hydrant, which allowed the testing to move forward despite the delay.

## B. Schedule Acceleration Scenarios

### B.1 Critical Path and Risks to the Project Completion Date

The critical path for this project is not like most projects because most projects don't have the VRSS slopes in the critical path. One of the biggest risks to the schedule is finishing the VRSS slopes on time. Because these walls need to be built before the building can start construction, the VRSS slopes are on the critical path. As discussed earlier in this report, the slopes posed a challenge to complete on time. The schedule issues posed with the slopes had to be closely watched to keep on schedule. Once the walls were complete, the building could begin construction.

The building foundations, columns, walls, and lower grandstands and foundations are on the critical path and were a big factor to the building completion. The project team found a way to keep this on schedule by hiring two different concrete companies to perform the work. The two companies were Belfast and JMP concrete out of Baltimore, MD. This turned out to work very well.

One of the most important activities on dealing with the building on the critical path is the steel erection. The project team handled the steel erection by assigning one assistant project manager to handle all the steel sequencing. The task was difficult because of the upper grandstands being supported from the main structure of the building.

A risk that is often overlooked and uncontrollable is the weather. Baltimore had really wet summers in 2007 and 2008. This caused the progress of the VRSS slopes to stop for as long as a week. The project team accounted for these weather delays but did leave enough buffer for the amount of rain Baltimore received. For the future, create a larger buffer for these unexpected delays.

### B.2 Key Areas of Potential Schedule Acceleration

There are a couple key areas of this project that could be potentially accelerated. The first area that could have been accelerated was the VRSS slopes. They could have accelerated the schedule of the slopes by doing three things: increase the wall crew size or make two wall crews, have more dump trucks/ excavators onsite to increase the amount of dirt that can be placed at one time, and before placing the dirt make sure it is dry enough to compact to avoid unnecessary delays.

Another key area of acceleration is the steel erection and the placement of the cast-in-place concrete. During the excavation and foundations stage, the least amount of people and equipment are on site. This allows for larger crews, more equipment and longer hours. Costs are reduced for overtime pay when fewer workers are on site and adding more workers does not create safety concerns with respect to other work areas. At the early stages of the steel erection, these concepts can also be used.

**B.3 Costs and Techniques**

The main technique of the schedule acceleration used would be to add manpower and work longer hours. These techniques, however, alone will not be the only thing needed to get back on schedule. Some other techniques used were to coordinate between the dirt & wall crews and sequence the concrete pours & steel erection.

The costs of the schedule acceleration techniques used are the overtime pay for the employees. Also, the extra equipment onsite will add costs to the budget. The coordination and sequencing don't have any added costs, just added time from the project team.

# C. Value Engineering Topics

## C.1 Value Engineering Ideas Implemented

The following table, table 1, shows the three largest value engineering ideas implemented on the project and the direct savings for each idea.

**Table 1:** Value Engineering Ideas Summary

| **Value Engineering Ideas** | |
|---|---|
| Idea | Direct Savings |
| Using a cast-in-place bleacher system instead of a precast bleacher system | $1,019,503.00 |
| Change the Exterior Metal Panel to spray on EIFS | $138,300.00 |
| Change all ground faced veneer CMU to split faced units | $87,000 |

## C.2 Impacts of the Value Engineering Ideas

The first value engineering (VE) idea, using a cast-in-place bleacher system instead of a pre-cast bleacher system, had very little impact. The pre-cast system had a longer lead time, which required to be ordered in advance. This system, however, once on site required less time and manpower. The cast-in-place system required more manpower on site and added time to the schedule because everything was being done on site. Since this VE idea adds time onto the schedule, this detracts from the owner's goals of finishing early but really did not have that large of an impact due to the coordination and sequencing.

The second VE idea was to change the metal panels to spray on EIFS (also commonly called synthetic stucco). EIFS is a multi-layered exterior finish, which with the right finishes can look like metal panels. The owner was very satisfied with this change because of the finish looking similar to the metal panels. This change did not detract from the owner's goals for the project.

The third VE idea was to change all ground faced veneer CMU to split faced units. The ground faced veneer units took a lot of time and manpower to install. By going with the split faced units, it saved time and money. This particular idea, since it relates to accelerating the construction process and saving money, correlates well the owner's goals.

**C.3 Value Engineering Ideas Not Implemented**

There were several value engineering ideas considered on this project, but were not implemented. There were two major VE ideas that would have saved the project a lot of money, yet maintained the standards and specifications. One was allowing multiple changes to the MEP layout of the ductwork and heat pump piping. Considering the project specifications and controls, researching and comparing components shows that this change would have produced a savings of $250, 000. Multiple electrical VE items would have saved the project a substantial amount of money and not detract value dealt with the electrical system. Some items include: provide MC cable in concealed areas, PVC for fiber/ data risers, use standard light fixtures to achieve same look, reduce light fixture quantity, AL bus all panels and series ratings where possible, use copper wire underground and aluminum wire everywhere else, and delete cable trays at second floor corridor and substitute with J-hooks. These VE ideas had a potential savings of $280, 000.

## D. Problem Identification

I worked for Whiting-Turner at the Loyola IAC as an Intern the past two summers. During my time working on this project, I became very familiar with a variety of problems that the project team had to solve. The following is a list of problems that I identified that could face the project team at Loyola Intercollegiate Athletic Complex:

- Vegetation Reinforcing Steep Slopes
- Masonry Work (Building Façade)
- MEP Coordination
- LEED Accreditation Analysis
- The sequencing of the steel erection and concrete pours
- Have mockups of rooms
- Communication among project team

In the following section a more detailed summary and on these topics will be provided along with the theory behind identifying these as problems.

## E. Technical Analysis Methods

### E.1 Technical Analysis Overview

Below I have outlined the technical analysis that I plan on performing for my senior thesis project in the spring semester. The content of these analyses and steps that I will take to complete each will be further developed and finalized in my thesis proposal. The four construction management analysis activities are:

- How could the MEP coordination process been improved?
- Is there a different façade that could have met the needs of the project better"
- Could the project achieve a LEED rating?
- How could the schedule of the VRSS slopes been reduced?

### E.2 MEP Coordination

MEP coordination took a long time and ended with many errors in the field and conflicts between the subcontractor and the project team. I will talk to the different members of the project team and discuss why they feel the process was not more successful. After my interviews, there will be two parts to my research. First, how could the process used been improved to return better results. Second, are there any new types of MEP coordination processes that might have worked for this project. Using Building Information Modeling (BIM) for MEP coordination and clash detection could be a possible tool to improve the results of coordination. I will look at the costs, schedule, potential results, and the ability of the project team to decide how the MEP coordination process could have been conducted more efficiently.

### E.3 Prefabricated Façade System

The use of a prefabricated façade system could potentially reduce the time and costs associated with this type of project. I will research various prefabricated options and manufacturers. I will also research the connection types that will be associated with each. I will analyze the system for constructability with the existing structural system. I will work through any connection details that will be necessary to support the system. Once this is complete I will analyze how this will impact the site logistics. I will compare the production of the typical masonry system with that of the prefabricated system. I will use this to adjust the schedule accordingly. For this system, an assemblies (should this be a possessive) estimate will be completed for both the masonry and pre-cast system and compared. This data will be compiled from masonry subcontractors and potential manufacturer/ installer of the pre-cast system.

### E.4 LEED Accreditation Analysis

The Loyola IAC incorporates several green features. LEED could be beneficial for this project because it would reduce the life-cycle costs for the owner and raise the value of the project. For a LEED analysis, I would investigate what the project team would have to do, LEED points that could be earned on this project, and other items of the project that could help the building get a LEED rating. Additional analyses would be required to determine the cost and schedule implications of going LEED.

### E.5 Schedule Reduction

As was described earlier, the VRSS slopes for this project consumed a significant amount of time and money. I will investigate if there were any other options or techniques that could be used to reduce the schedule time. I will research the history of these types of walls and search for different types of walls that could be more constructible. Also, I will research the different companies that install these types of walls. After I am done researching, I will evaluate any alternatives for constructability. A detailed takeoff will be determined to calculate how much dirt was needed for these walls along with the materials (i.e. geo membrane and welded wire baskets). Additionally, the schedule will be analyzed for reductions due to an improved system or an addition in wall crews.