STEM Building

Science **T**echnology **E**ngineering **M**athematics

Hagerstown Community College

Hagerstown, MD

Proposal

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Executive Summary

This proposal will outline the analyses that will be performed over the course of the spring semester. These analyses will cover two breadth studies in the structural and mechanical option. They will also investigate areas of critical industry issue research, value engineering analysis, constructability review and schedule acceleration.

These analyses include:

1. Lowering the footings and foundation walls
2. Expanding the green roof
3. Changing the stick built curtain wall to a unitized curtail wall.

The first analysis will meet the structural breadth and investigate into value engineering and constructability review. This analysis was chosen when it was discovered that competent rock was found at a lower elevation than planned. An alternative method of lowering the footing will be explored in this analysis.

The second analysis will meet the mechanical breadth and research critical industry issues and value engineering. Expanding the green roof will lead to lower heating and cooling loads which can provide long term saving for the STEM Building. The payback period, long term saving and overall load reduction from installing the green roof will be investigated in this analysis.

The third analysis of converting the stick built curtain wall system to a unitized curtain wall system will help cover the constructability review and schedule acceleration requirements. A unitized curtain wall system offers fewer laborers and quicker on site construction time.

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Analysis I: Lower Footings and Foundation Walls

Problem Background

Footings and foundation walls for the STEM Building must be set on competent rock. During the excavation process, competent rock was located at a lower elevation than originally designed. To remedy this problem, lean concrete was formed up to the original footing elevation so construction could continue as planned. This can be seen in Figure 1 below. Although this was a simple solution, it was costly in terms of material.

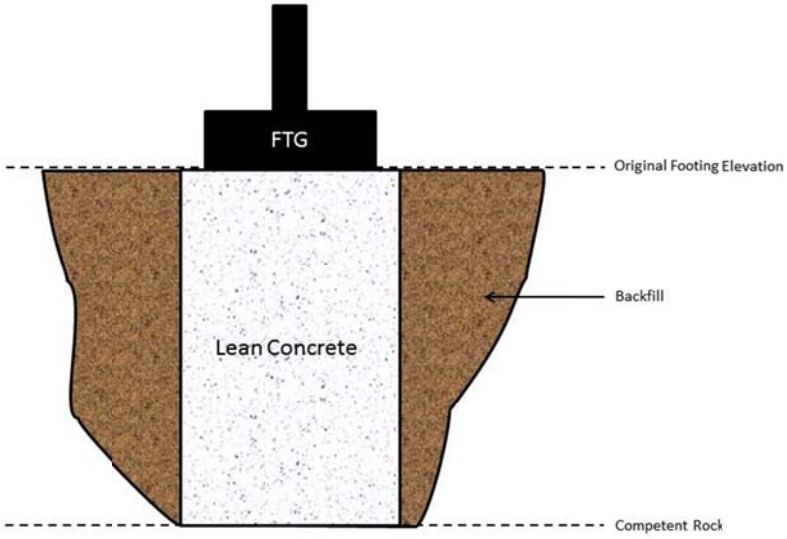

Figure 1

Potential Solution

Analysis one will look into a more cost efficient option, forming minimal lean concrete for leveling purposes and lowering the footing and foundation wall to the competent rock elevation. See Figure 2 below.

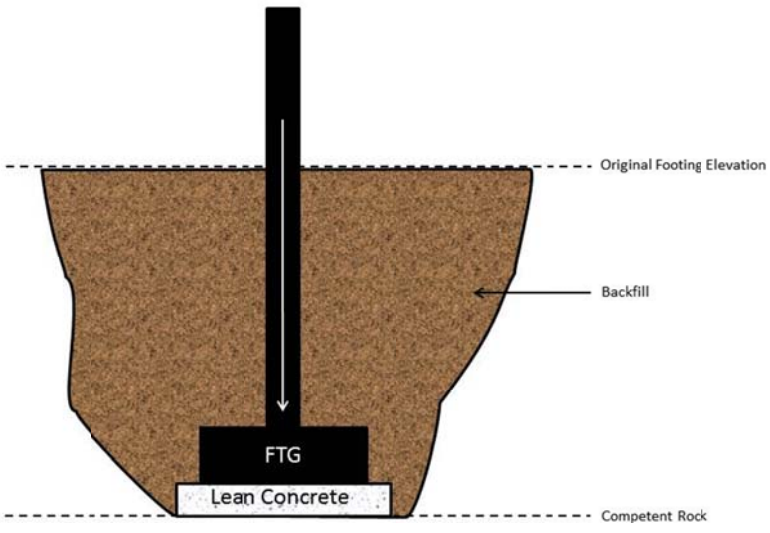

Figure 2

Solution Methodology

1. Calculate total load applied to footing due to extended foundation wall.
2. Determine if footing needs to be resized using knowledge learned in AE 404: Building Structural Systems in Steel and Concrete.
3. Calculate amount of concrete used.

Expected Outcome

If the footing can carry the additional load of the extended foundation wall, cost savings will be found through the decreased amount of concrete that will be used. If the footing needs to be redesigned, the amount saved on concrete is assumed to be greater than the cost needed to increase the rebar and concrete.

Analysis II: Expand Green Roof

Problem Background

The STEM Building utilizes green roof at two levels of the building on the third and fifth floor roofs. Rain water will be collected from these green roofs and collected in a cistern within the building. While this is a great addition to the building, there are additional areas that could be converted to a green roof.

Potential Solution

Analysis two will propose to add a green roof to the lower roof of the STEM Building.

Solution Methodology

1. Apply same green roofing system as the third and fifth floor to the lower roof.
2. Calculate square footage of the lower roof.
3. Calculate additional load applied by the green roof.
4. Set a meeting with structural engineer to discuss structural integrity of the roofing system.
5. Set a meeting with the MEP engineer to discuss heating and cooling load reductions.
6. Calculate annual rainwater that can be collected from the lower roof.
7. Determine the amount of additional piping needed to divert water to cistern.
8. Calculate the payback period.

Expected Outcome

The additional water collected by the green roof will lessen the amount of non potable water needed for the building. This will lead to savings which will accrue to an amount greater than the initial cost to install the green roof. The payback period will be calculated during the spring semester.

Another aspect of this analysis will determine how much the heating and cooling loads can be reduced. These loads will be reduced because a green roof is a great insulator. This will add to savings that will reduce the payback period of the green roof.

The last aspect of this analysis will delve into the structural integrity of the roofing system which the green roof will rest. A green roof brings additional loads that have to be accounted for to ensure the roofing system is adequate.

Analysis III: Convert Stick Built Curtain Wall to Unitized Curtain Wall

Problem Background

The current curtain wall on the STEM Building is a stick built system. This can be a timely process which has potential for schedule acceleration.

Problem Solution

Converting the curtain wall from a stick built system to unitized system provides an area for schedule acceleration

Solution Methodology

1. Perform quantity takeoff for the amount of glass panels in the curtain wall.
2. Determine increase of upfront cost and lead time.
3. Determine decrease in labor hours.
4. Compare findings to stick built curtain wall system.

Expected Outcome

Lead time and initial cost will increase but a unitized system provides faster construction and less labor hours. In the end, the stick built system and unitized system have similar prices when taking into account decreased labor hours, decreased schedule and increased initial cost. There are also benefits of having fewer laborers on site and less material. This allows for easier sequencing and material staging due to the small site.

Appendix 1 – Breadth Studies

Structural Breadth

The structural breadth will be met primarily by the first analysis of lowering the footings and foundation walls to the competent rock. A well rounded analysis will be performed to ensure that the footings and foundation walls will have adequate strength to support its additional loads. If the footings and foundation walls are discovered to be inadequate, they will be redesigned through further investigation.

Mechanical Breadth

The second analysis of this proposal, expanding the green roof, will be the main means of showing mechanical breadth. Total heating and cooling load reduction will be calculated and compared against the designed loads. From here, money savings will be able to be determined.

Weight Matrix

Description	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
Lower Footings and Foundation Walls	0	10	20	0	30
Expand Green Roof	20	20	0	0	40
Convert Stick Built Curtain Wall to Unitized Curtain Wall	0	0	10	20	30
Total	20	30	30	20	100