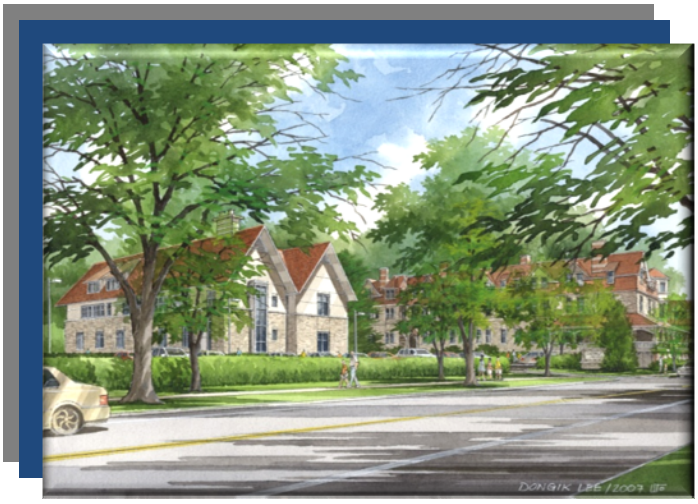
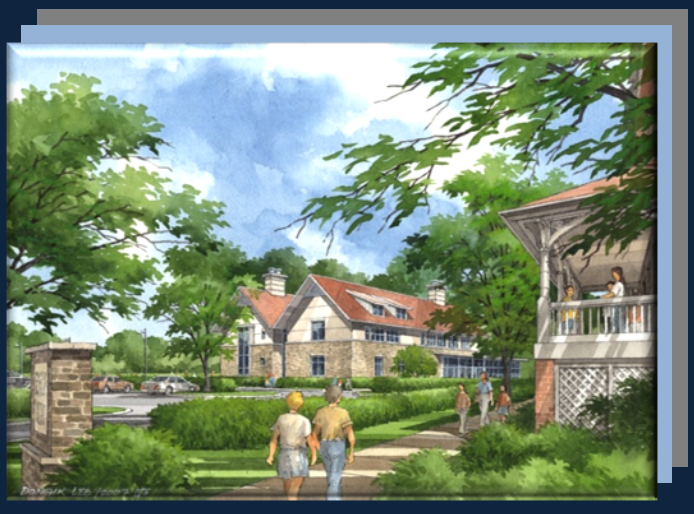


Science & Technology Center
Chestnut Hill Academy
Philadelphia, PA

Michael R. Pothering

Construction Management



Proposal

Advisor Dr. Messner

Science and Technology Center
Chestnut Hill Academy
Philadelphia, PA

Project Team
Owner: Chestnut Hill Academy
Owners rep. : Aegis Property Group
Architect: Lilley.Dadagian Architects
Assoc. Architect: Krieger + Assoc., Inc.
CM/GC: Tuner Construction Company
Engineers: Roome & Guarracino. LLC
Cairone & Kaupp, Inc.
Bruce E. Brookes & assoc.

Architectural Features
26,870 sq.ft.
two stories with mechanical attic
Stone & stucco veneer
court yard and aboretum
glass curtinwall and punched windows
ashphalt shingles

Structural System
spread footing fountdation
slab on grade
steel braced frames for lateral loads
metal decking with concrete slabs
structural steel beams and columns
metal stud framed walls

LEED/Sustainability
LEED for Schools certification
photovoltaic cells
solar panels
wind turbine
grey water system - porous paving
and storm water retention system

Electrical System
480/277V , 3 phase, 4 wire
power provided by campus grid
400A main distribution panel
primarily flouresent lighting
lutron eco system lighting control
HPS exterior parking lighting

Mechanical System
two AHU's 6500 cfm & 8000 cfm with
packaged enthalpy wheels
57.1 ton chiller
VAV controlled ductwork

Michael R. Pothering
Construction Management
www.engr.psu.edu/ae/thesis/portfolios/2009/mrp5012

Executive Summary

The following proposal contains four areas of the Science & Technology Center that pose as a problem/challenge during construction or is an opportunity for improvement. These areas will be researched and analyzed in hopes of decreasing the schedule or cost to the project.

Analysis #1 Exterior Façade Construction

The lower portion of the exterior façade will be resigned from a traditional field stone masonry wall to utilize precast stone. This will allow for possible schedule acceleration and cost savings. This change will impact the structural system by applying additional load to the existing system. If this system is not adequate the redesign of the walls using precast will be investigated, therefore making it a structural breadth.

Analysis #2 Lighting & Sustainable Energy

The lighting system was viewed as a value engineering opportunity to reduce the fixture quantity, which reduced the overall system cost. The system will be reviewed for the possible reduction of additional light fixtures or possible addition of more effective and efficient fixtures. The renewable energy of the project will also be studied with the addition of two systems: solar shingles and solar powered exterior lighting. The value of these systems will be reviewed to find if each addition will be worthy of the initial cost. These two topic areas result in the second breadth for lighting/electrical.

Analysis #3 Building Information Modeling

Building Information Modeling (BIM) will be researched in hopes of understanding what possible impact it may have had on the Science & Technology Center. The use of a BIM to improve the overall construction methods of projects throughout the world is becoming extremely popular. The growth of BIM in the market has established it as critical issue of research for this study. The implementation of BIM on projects will be researched to understand the good or bad qualities of this rising technology.

Analysis #4 Site Layout & Congestion

The site is located on the campus of Chestnut Hill Academy preparatory school in Philadelphia. It has limited storage and available room for construction traffic. A review of the construction schedule and sequence as well as the site layout plans. This will be done to find if there is a more efficient use of the surrounding site in hopes of easing construction.

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Analysis 1: Exterior Façade Construction

Problem Statement:

The façade of the building consists of field stone masonry and stucco. The lower portion of the exterior wall is made up of various sized ashlar patterned stone masonry units. The construction of this must be done by experienced masons and done so that the weight of the stone does not crush the mortar joints, which limits the number of rows of stone that can be placed before the mortar sets. This slows down production of the activity which also slows down the remaining façade activities like the upper stucco portion, as well as adding to site congestion from the scaffolding and material lay down. This area of the wall itself takes 12 weeks to erect and is the longest activity of the building envelope. The remaining trades must follow the stone mason around the building finishing each portion of their work at a slow pace.

Potential Solution:

In an effort to speed up this activity as well as save money, the stone masonry system will be examined in its worth compared to a precast stone wall. The system would be cast off site and delivered. The precast stone has the potential of saving material cost as well as schedule time. Erecting the precast could possibly reduce the original stone duration significantly therefore the schedule acceleration impact will be studied. Quality control will also be a bonus due to the automated manufacturing processes, therefore the area for human error and variability will be reduced.

In order for this system to work, the owner and architect would need to approve of the aesthetic qualities in comparison to the natural field stone. The structural capabilities of the precast walls must be studied to find out if the existing composition of the wall behind the stone will be adequate to support the precast panels. As well as the insulation properties and available manufactured sizes. Due to the projects sustainability background the LEED issues must also be investigated in the areas of recyclability and local manufacturer availability. Contact must be made with manufacturers of the product for the technical information as well as availability and costs. Several experienced contractors will be

interviewed for erection times and the overall ease of construction. The owner and architect will be contacted for opinions of material change. Expressing the change with a 4D model that shows the erection sequence, as well as the use of the site plan and 3D model to aid in the site layout and flow will clarify the solution.

Areas of Research:

Prefabricated Stone Walls

→ Cost
→ Structural Properties
→ Architectural Properties
→ Standard Sizes & Dimensions
→ BIM planning
→ Proper Installation Sequence
→ Estimated Construction Time
→ Insulation Properties

Steps:

- Research and Review product information on types of precast stone façade systems.
- Contact contractors and suppliers of product for pricing information as well as estimated construction times
- Study the necessary connections for precast façade to building structure.
- Conduct cost estimate of existing façade versus proposed façade.
- Investigate schedule impacts.
- Incorporate BIM technology to express the changes
- Summarization and recommendations

Expected Outcome:

The use of a precast façade system compared to a traditional masonry stone system will reduce the schedule duration as well as the systems cost. The reduced duration of the façade will without a doubt reduce the overall construction schedule. Additional bonuses to this system are the overall site congestion reduction with less material and personnel required to be on site at the given activity's time. The combination of BIM technology with the redesign will express the changes made through a visual manor.

Analysis 2: Lighting & Sustainable Energy

Problem Statement

The building's main energy source for the Science & Technology Center is a branch connection from the campus infrastructure. A value engineering idea used on the project was reducing the lighting fixture quantities to minimize energy consumption. Calculating the foot candle requirements for the different areas throughout the building could possibly limit more lighting fixtures or possibly find that more fixtures should be added. The building's uses of technology such as the dimmable ballasts will also need to be accounted for with these calculations due to the effect of day light. Reviewing the calculations and various light fixture layouts can aid with reducing lighting quantities. Calculating the amount of energy savings from the use of the ecosystem dimmable ballasts can also be valuable information.

Potential Solution:

Sustainable energy in LEED rated buildings is a common method to gain rating as well as conserve energy consumption. Since the project is seeking LEED Silver it has a couple areas for sustainable energy. These areas are the roof mounted wind turbine, solar roof panels, and photovoltaic cells. The energy produced by these units is then transmitted into the system. The school incorporates into the system a state-of-the-art interactive meter wall which will display information collected from the energy saving devices which teachers may use in their teachings. Researching the integration of additional technologies of sustainable energy products can be another added value to an already green conscious building. Additional areas that were not considered are the use of solar shingles and solar exterior lighting. The shingles convert the sun's energy into a DC electric current, which is then directed to the building's circuits this system can easily be tied to the existing PV system. Given the location of the building in the North East of the United States, the use of solar energy products can be a valuable asset if done correctly. Finding an initial cost for these various materials and equipment ideas will give a base cost of investment. Although the initial cost of the equipment may be significant, calculating the amount of time that the energy products will eventually pay for themselves will be important part of this research. These investments could be a valuable commodity with the rising prices in the energy market as well as be an integral learning tool to incorporate into their existing system.

Steps to be performed:

- Review & Analyze the existing lighting and energy system
- Determine whether or not the system existing values are adequate
- Research alternative system components and layouts
- Determine the change of construction techniques or manpower needed to install
- Research the cost savings from changes
- Evaluate effects on construction

Areas of Research:

Sustainable Energy Products

Solar Shingles

→ Energy Production
→ Installation procedures
→ Life Cycle Durations
→ Architectural Appeal

Solar Exterior Lighting

→ Specifications
→ Costs

Lighting Considerations

→ Day lighting Effects
→ Energy Savings from dimmable ballasts
→ Foot candle requirements

Expected Outcome:

Through the study of the lighting system there can be areas of increased light output and efficiency with potential savings. By researching alternative fixtures as well as their layout, there can be additional savings from light fixture reduction much like the already implemented value engineering idea. The consideration of the ambient day lighting from the outside will help reduce the lighting from their use automatic dimmable ballasts.

Researching the potential additional energy saving ideas such as the solar shingles and solar powered exterior lighting will add to the already acquired energy produced from the other sustainable equipment. The addition of this equipment can be tied to the existing meter wall display unit showing their energy production in comparison to the other systems.

Analysis 3: Building Information Modeling

Problem Statement

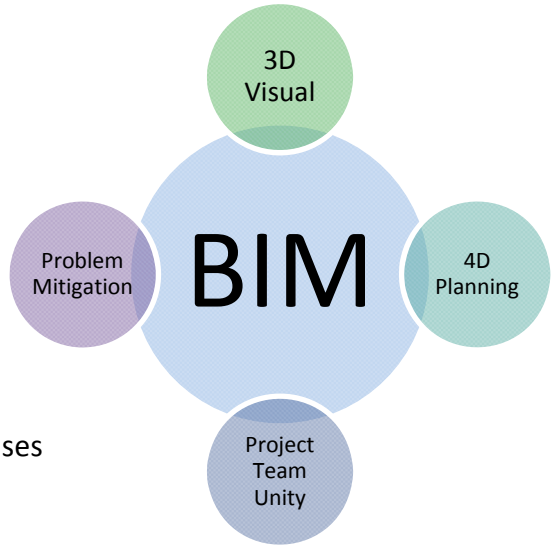
The use of Building Information Modeling (BIM) is becoming an ever growing asset to construction designs. Some advantages are better coordination, greater productivity, ability to visualize what is being constructed and many others. The Science & Technology Center does not implement BIM technologies; this could greatly help in project coordination as well as serve the school as a teaching tool for the academy. The contractor RFI's and misunderstandings would be reduced with the ability to see the project in additional dimensions. The construction manager would be able to use the programs to assist in site layout as well as sequencing.

Potential Solution:

Designing a 3D and 4D computer generated model. Implementing preplanning project meetings utilizing the constructed model will greatly increase the understanding and expectations of the project. Research on how the building components will be compiled during construction. Interviewing construction professionals for their opinions on BIM technology and if it would be a good investment for a project of this size. Contact current project team for their ideas and views regarding the BIM application.

Areas of Research:

→ Components of a Model Construction
→ methods of a 3D model
→ Examples existing models
→ Survey of construction professionals
→ Research existing BIM case studies



Steps:

- Research Building Information Modeling methods and uses
- Review existing studies and interviews on BIM
- Interview project team members about the use of BIM
- Develop 3D model using appropriate software
- Research the use of 4D and 3D combination with the project
- Review the possible creation of a 4D model utilizing the construction schedule

Expected Outcome:

This analysis will research and develop the use of BIM technology on the New Science & Technology Center. Along with the developed models it will give an understanding of the industries view on integrating BIM technology with in construction. It will show the benefits of the modeling as well as reasons it was not used.

Analysis 4: Site Layout & Congestion (Time Permitting)

Problem Statement:

Constructing buildings on condensed sites adds many challenges of site logistics, deliveries, and personnel management. Due to the site being located inside of a preparatory school's campus limits the amount of heavy construction traffic on and around the site. The location of the site in Philadelphia also adds to delay problems with potential traffic congestions possibly delaying the activities. The use of a crane on a small site practically closes down large areas of the site for safety reasons as well. The surrounding existing building and track greatly limits the available lay down and storage areas.

Potential Solution:

Reviewing the project schedule and discussing possible changes to site layout plans may increase productivity and project quality. Better understanding of the trade contractor's requirements for material and equipment storage can help dismiss some areas of congestion. After reviewing the possible changes to the building façade construction it may also change issues involving the scaffold congestion and material lay down, freeing up space for addition trades to occupy.

Area of Research:

→ Site Layout
→ Trade sequencing
→ Site Delivery
→ Scheduling and Phasing
→ Similar Projects

Steps:

- Analyze existing site conditions & layout
- Review similar projects for comparison
- Interview PM with potential errors and fixes with the existing plan
- Apply gathered input to existing site
- Develop and finalize improve plans

Expected Outcome:

The renewed site plans will open the project for improvement in the areas of storage, deliveries, personnel management, work flow, and equipment management. This will produce a safer and more productive working environment.

Critical Issues Research Method

Problem Statement:

The construction industry today has a rising technology at its disposal in Building Information Modeling. This technology has a great potential for helping the construction process with overall quality, speed, and clarity. The ever more complex buildings of today and the future along with the standards we've become custom to can benefit with this technology in countless ways from 3D MEP models with clash detection to 4D animated models. The problem with this technology is that it is still not being utilized on some projects.

Goal:

The goal of this research is to identify the benefits of implementing BIM on a project and develop an understanding of its use. It will also identify the preferred methods used in industry. As well as determine what is expected of the contributing parties in order to establish a comfortable and efficient construction environment.

Steps:

- Read and Analyze Articles & Applications of BIM
- Research components needed for BIM
- Determine how BIM can benefit the project team (Owner, CM, Architect, GC)
- Interview industry professionals for input on BIM
- Recommendations & Advising
- Summarize research

Survey Questions:

- Does your company utilize BIM technologies?
- What do you believe it would take for a project using BIM to fully utilize this technology and keep the project running smoothly?
- What are the methods you currently use to coordinate drawings with the specifications?
- What is the method you currently use to determine errors and design clashes in the various systems?
- What are some of the major factors facing companies when determining the usage of BIM technology?
- What do you believe are the advantages to using BIM technology on your projects?
- What do you believe are the disadvantages to using BIM technology on your projects?

Weight Matrix

Description	Research	Value Eng.	Const. Review	Sched. Reduction	Total
Exterior Façade Const.	10	10	10	10	*40*
Lighting & Sustainability	10	10			*20*
BIM Technology	10		10	5	*25*
Site Layout & Congestion			10	5	*15*
Total	*30*	*20*	*30*	*20*	**100**

Appendix 1:
Breadth Studies

Analysis 1 Exterior Façade Construction

The breadth areas that will be considered during the exterior façade construction will be structural, construction and minimal architecture. The structural system will be impacted due to the application of the precast stone veneer. The applied loads will need to be considered when attaching it to the existing system. If the existing backing system of the façade is not capable of supporting the change, there are two options that can be considered. The first option would be to increase the member sizes to allow for the imposed load, secondly switching the system to precast walls and floor members therefore eliminating the structural steel members. This will also include construction due to the possible acceleration of the schedule as well as the change in the site planning and sequencing. The value engineering of this system is also an additional area. The architectural outlook on the analysis will be to find a suitable material that will match or closely satisfy the prescribed materials set by the Architect and Owner.

Analysis 2 Lighting & Sustainable Energy

The analysis I will be doing on the lighting system will be investigating the lighting requirements for certain rooms in the school. A value engineering idea was to reduce the amounts of light fixtures in the building to save money. I will investigate this further to see if more fixtures can be removed or need to be added. The lighting system utilized a new technology from Lutron called Ecosystem. It incorporates dimmable ballasts along with occupancy sensors, therefore day lighting will need to be accounted for in this analysis. A minor study of the electrical system will need to be accounted for with the proposed addition of more renewable energy equipment. Quantity calculations of produced electricity as well as the payoff periods will need to be completed. The construction methods involved with using the solar shingles will need to be reviewed in case there are special accommodations needed by the system such as electrical wiring.