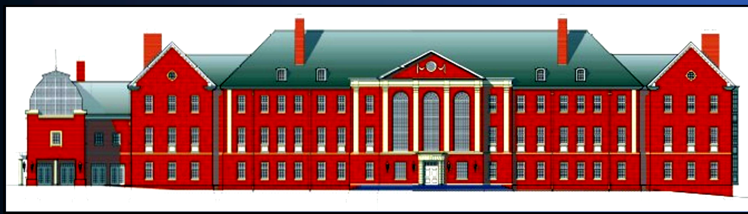

Barshinger Life Science & Philosophy Building

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Structural Option
Consultant: Dr. Hanagan
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Thesis Proposal

Improving Design Efficiency

Executive Summary

This Thesis Proposal distinguishes the specifics tasks that I hope to accomplish during the spring 2006 semester. The analyses previously completed for Technical Reports 1 • 3 identified specific aspects of the Barshinger Life Science and Philosophy Building at Franklin and Marshall College for further in-depth investigations. The overriding goal of the investigations can be characterized as "improving design efficiency."

Due to the relative simplicity of the structure, my depth topic will encompass both the lateral and foundation systems. Whereas the lateral system will be made more efficient within the existing concentrically-braced frame design, the foundation system will be investigated for a potential change from shallow spread footings to concrete caissons.

The breadth work focuses on two topics: constructability analyses of the altered systems from the depth topic and floor system vibration performance and fire ratings.

This proposal includes the following categories:

- Building Program Overview
- Structural System Overview
- Depth Topic
- Breadth Topics (2)
- Prospective Research Topics
- Task Breakdown & Methodology
- Schedule

1.0 The Building Program

The Barshinger Life Science and Philosophy Building will be the largest construction project in the long history of Lancaster, Pennsylvania's Franklin and Marshall College. The three-story Georgian-Colonial Revival structure will house the departments of biology, psychology, and philosophy, as well as two interdisciplinary programs in biological foundations of behavior and scientific and philosophical students of mind. At a total cost of $45 million, the 102,000 square-foot building will include state-of-the-art classrooms and laboratories, a greenhouse, a multi-story atrium, a 125-seat lecture hall, a commons for meetings and gatherings, and a vivarium for the study of primates and rodents.

2.0 Structural System Overview

2.1 Superstructure

The building superstructure is comprised of composite slab-on-deck in combination with composite wide-flange steel beams supported by wide-flange columns bearing on concrete piers and shallow footings. The framing system is separated into approximately 20'x30' bays. Floor-to-floor heights are typically found to be 14-feet. A typical floor frame consists of 2-inch composite metal deck with 4 ½-inches of normal weight concrete above the flutes. The composite slab is then carried by W16x26 filler beams spaced 7-feet apart. Interior girders, of size W18x40, are typically carried by W12x65 columns, sized for ease of fabrication and erection considering the OSHA-required four anchor bolt pier connection. The basic framing plan can be found in Appendix A

2.2 Lateral Force Resisting Systems

The structure's main lateral force resisting system is composed of ten concentrically braced steel frames of varying sizes. These frames typically utilize W12 shapes for the vertical and W14 shapes for the horizontal members with ½-inch thick HSS shapes for the braces. All of the steel members in the frames are specified to be A992 steel. The ten frames are located throughout the structure according to the Figure 2.2.1 below.

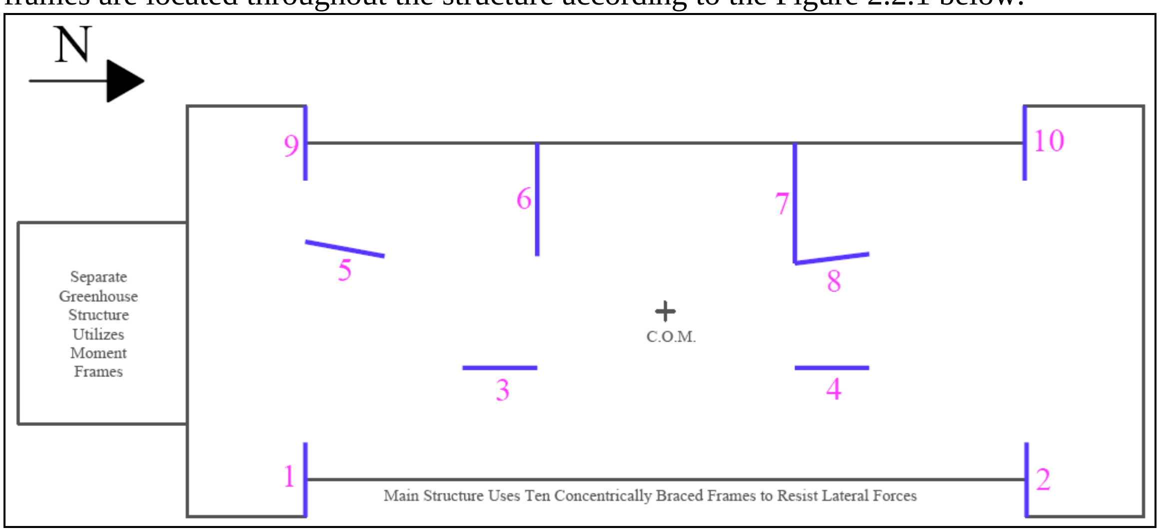

Figure 2.2.1 Layout of the 10 Concentrically Braced Frames

2.3 Foundations

The superstructure of the Barshinger Building rests upon shallow foundations, specifically spread footings. In the geotechnical report for the site, Advanced GeoServices Corp. of West Chester, PA recommended that the foundations not exceed an allowable bearing pressure of 3,000 pounds per square foot (psf). Large footings will be located to transfer the loads from the braced frames into the ground and resist overturning moments. Test borings encountered intact rock at depths ranging from 3 to 23.5 feet. The recommendation put forth requires excavating the rock as necessary to provide an ample soil cushion for the footings to bear on.

3.0 Depth Topic

The depth topic will focus on attempting to make the structure more efficient for environmental loads and constructability.

- Technical Report #3 analyzed the lateral force resisting system and determined that the use of ten concentrically braced steel frames is somewhat inefficient. Through further analysis, I hope to minimize the number of frames in the structure thereby reducing the foundation requirements and improving construction durations.
- At the same time, I will also investigate the use of caissons as an alternative foundation system. The subsurface investigations demonstrate a potential for caisson foundations that can bear directly on rock, making the structure more stable in the event of a seismic event.

4.0 Breadth Topics

4.1 Constructability Analyses

The alternate lateral force and foundations systems will warrant constructability analyses to determine any cost or schedule savings that could result from the change. I will utilize R.S. Means 2005catalogs to evaluate the potential of the new systems.

4.2 Vibration & Fireproofing Analysis

The structure is currently designed for composite slab on metal deck. The system is composed of 2” metal decking with 4 ½” of normal weight concrete above the flutes for a total depth of 6 ½”. The building only requires a 1-hour fire rating and the current floor system, which has a 2-hour rating, should be open to alteration. However, any alterations will be investigated for vibration performance as well. The building will house various laboratories with potentially sensitive equipment.

5.0 Prospective Research Topics

- Caisson Foundations
- Life Science Laboratory Equipment – Vibration Sensitivity
- Fireproofing Guidelines
- Vierendeel Truss Application & Design*
- Moment-Framed Greenhouse Design*
- MEP Requirements for laboratories housing live rodents and small primates*

**Time restrictions permitting*

6.0 Task Breakdown & Methodology

Lateral Force Resisting System Efficiency Evaluation/Alteration *(Task #1)*

- Develop improved structural models of the existing braced frames using STAAD.Pro computer software to recheck analysis from Technical Report #3.
- Create Excel spreadsheets to analyze the efficiency of the current and altered systems.
- Determine foundation requirements for the altered system using hand calculations and Excel spreadsheets.
- Quantify any material savings for use in the breadth topic.

Caisson Foundation Design/Comparison *(Task #2)*

- Research the design of caisson foundations.
- Redesign the current foundations to include any changes made to the lateral system using hand calculations and Excel spreadsheets.

Constructability Analyses *(Task #3)*

- Determine quantities of steel braced frames, concrete foundations, and excavation material from the depth analyses.
- Calculate cost and time savings using R.S. Means 2005.

Vibration & Fireproofing Assessment (Task #4)

- Redesign floor system to meet actual fire rating requirements using current product catalogs.
- Check system using RAM Steel computer software.
- Analyze/compare vibration performance of current and redesigned floor systems through hand calculations and/or Excel spreadsheets.
- Research vibration sensitivity of laboratory equipment and apply findings to the floor system comparison.

Prospective Research Topics *(Task #5)* | Time Permitting

Compile Final Report for Printing *(Task #6)* | April 5th

Prepare PowerPoint Presentation for Faculty Jury *(Task #7)* | April 10-12th

Prepare for Professional Jury Presentation *(Task #8)* | ?????

7.0 Schedule

Week	Date*	Task #
1	January 9	1
2	January 16	1
3	January 23	1
4	January 20	2
5	February 6	2
6	February 13	2
7	February 20	3
8	February 27	3
9	March 6	Spring Break
10	March 13	4
11	March 20	4
12	March 27	6
13	April 3	6, 7
14	April 10	7
15	April 17	8

* *All dates correspond to Mondays.*