Thesis Proposal

Timothy Bailiff | Structural Option

SUSQUEHANNA CENTER EXPANSION AND RENOVATION, HARFORD COMMUNITY COLLEGE

* Picture taken from Turner website

Executive Summary

The Susquehanna Center Renovation and Expansion project is an arena complex consisting of the integration of a new addition and the existing arena. The arena services as a recreation center for the Harford Community College located in Bel Air, MD. The arena is approximately 35 ft. tall and is a gross of 86,610 square feet. The expansion consists of two different floor systems based on the location within the arena. The concourse area contains 16 and 18 gage composite metal deck with 3.5" concrete topping. The entrance of the arena consists of an 8" one-way slab with beams. The lateral system of the arena was designed with longspan steel joists spaced an 8' O.C. with bridging and steel moment connections.

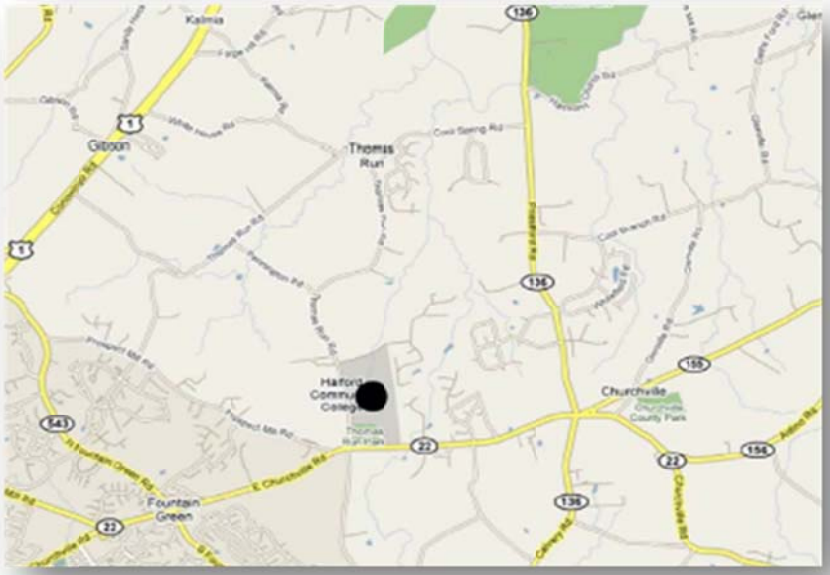
After conducting three technical reports in which gravity and lateral load analyses and alternative floor system designs studied; the Susquehanna Center has met all code and industry standard requirements and is adequate for design. The purpose of this proposal is to explore alternatives and make an alteration to the design of the Susquehanna Center. The structural depth will propose an alternative roof framing system to the existing longspan steel joists. With this design new gravity and lateral load analyses well have to be performed to unsure the efficiency and feasibility of the design.

In addition the structural depth study, two breath topics will as investigated. An architectural study will be conducted as of a result of the alteration of roof design, which will influence the aesthetic image of the roof. Also cost and scheduling assessments will be performed to explore if the change in materials will be feasible compared to the existing.

A timeline of the proposed tasks of this alternative redesign will be provided at the end of this report.

Building Introduction:

The Susquehanna Center Renovation and Expansion at Harford Community College is located on 401 Thomas Run Road in Bel Air, MD. The project will be constructed in August 2010 in collaboration with hord | coplan | macht as the architect, Site Resources, Inc. as the civil engineer, CMJ Structural Engineering, Inc. as the structural engineer, Burdette, Koehler, Murphy & Associates, Inc. as the mechanical electrical engineer and CounsilmanHunsaker as the natatorium consultant.



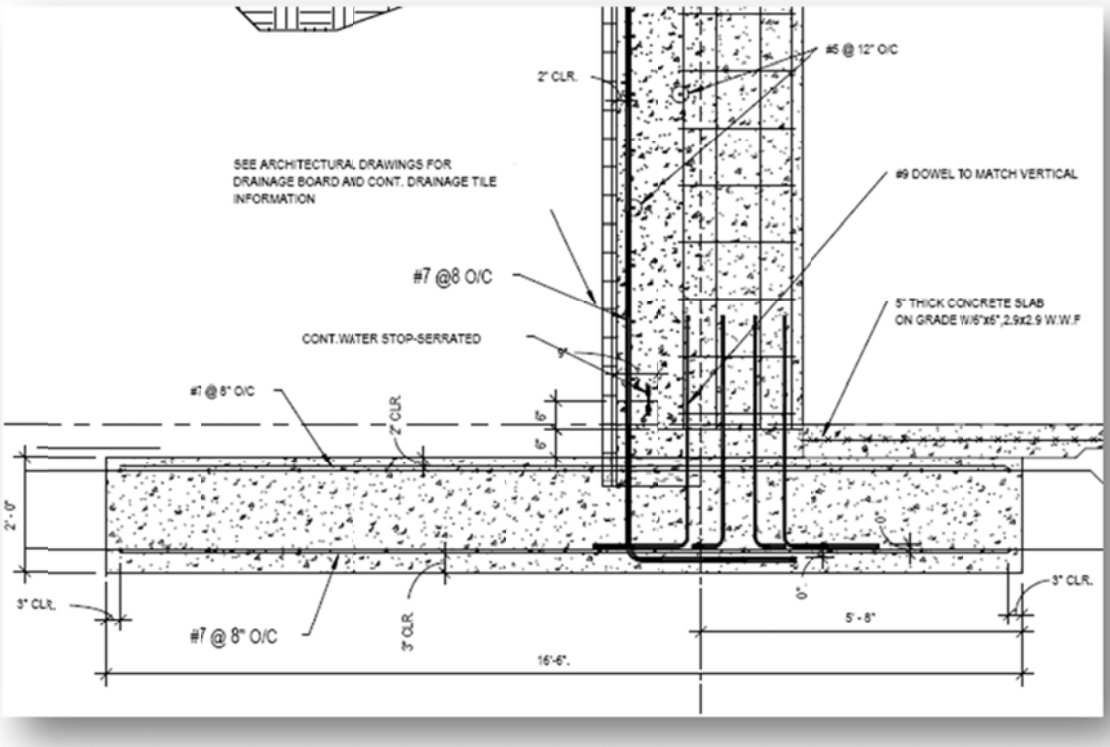
The Susquehanna Center consists of a renovated arena, pool and a fitness center. The center is 49,150 SF which will be totally interiorly renovated and the expansion will include a new 37,460 SF arena, which will expand the total area of the building to 86,610 SF. The project will also include a new parking lot of 160 spaces, a new loop around the building and realigning of the entrances at the entrance drive.

Structural Overview:

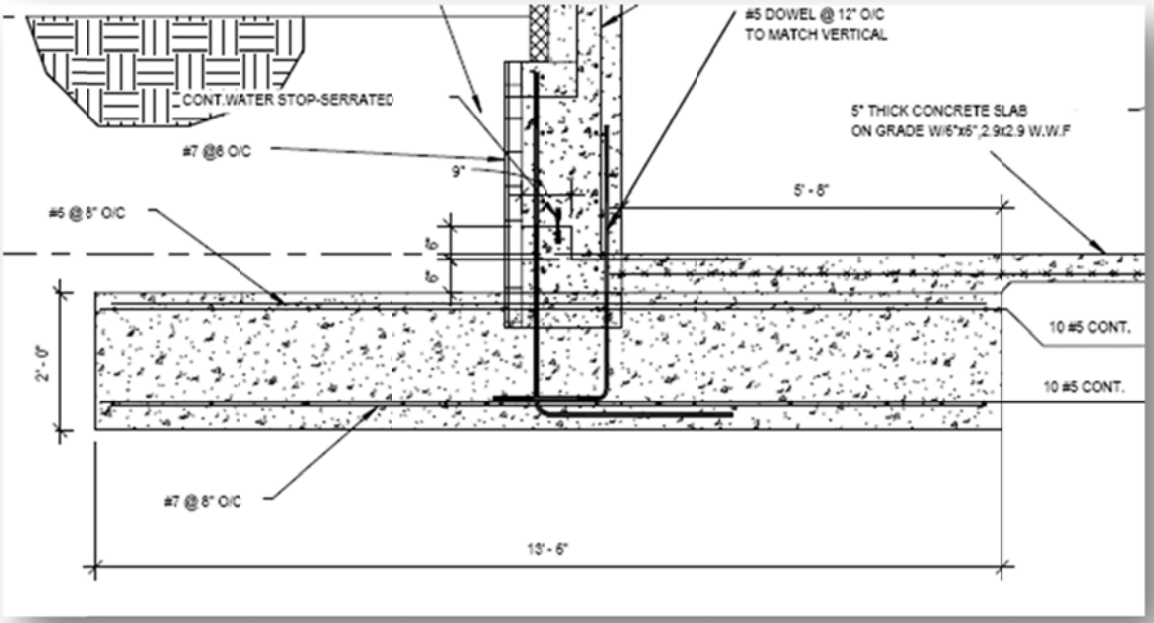
The structure of the Susquehanna Center Renovation and Expansion consists primary of retaining walls, spread footings and concrete piers, with a combination of concrete, composite deck and steel for its framing elements. The façade of the building of composed of brick and concrete masonry units.

Foundations:

All the spread footings in the buildings foundation were designed for an allowable bearing pressure of 3000 PSF, which was based on the geotechnical report performed by Herbst/Benson & Associates. The footings were designed to be 2 feet thick with #7 bars placed at 8" O.C., running at both the top and bottom of the footing. Also, #9 dowels were used to anchor the foundation to the base of the walls and columns.



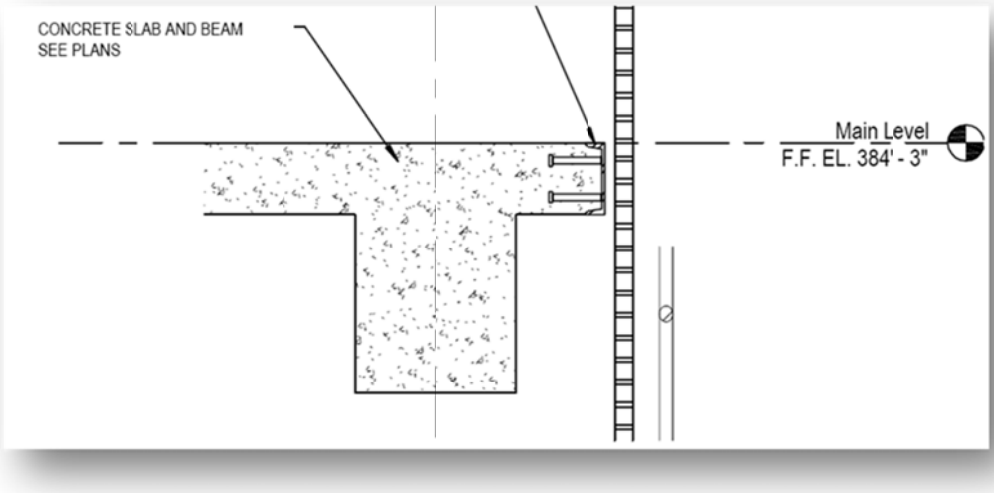
Spread Footing at Column Base



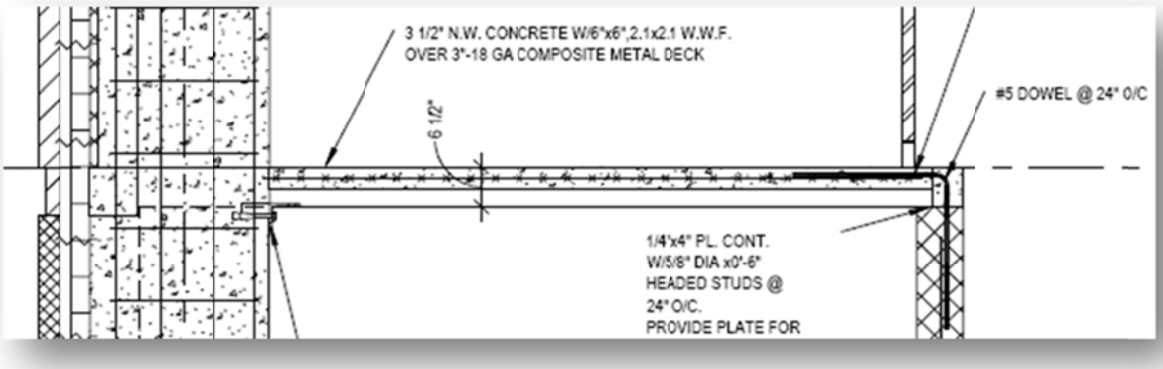
Spread Footing at Wall Base

Floor Systems:

The floor systems of the Susquehanna Center consist of a combination of 3 ½” N.W. concrete slab, reinforced with W/6”x6”, 2.1x2.1 W.W.F. over a 3”-18 Gage composite metal deck and concrete wall beams. The other floor system consists of a one-way slab with concrete beams.



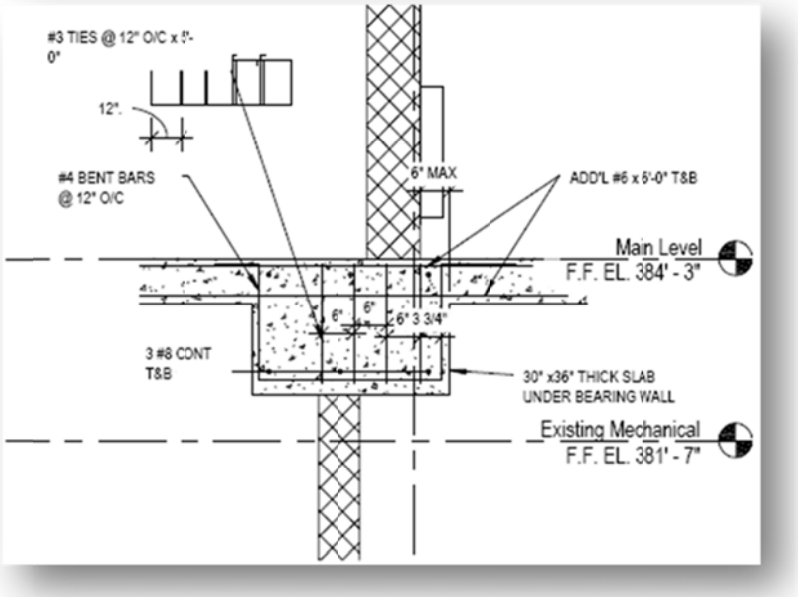
One-Way Slab with Beams



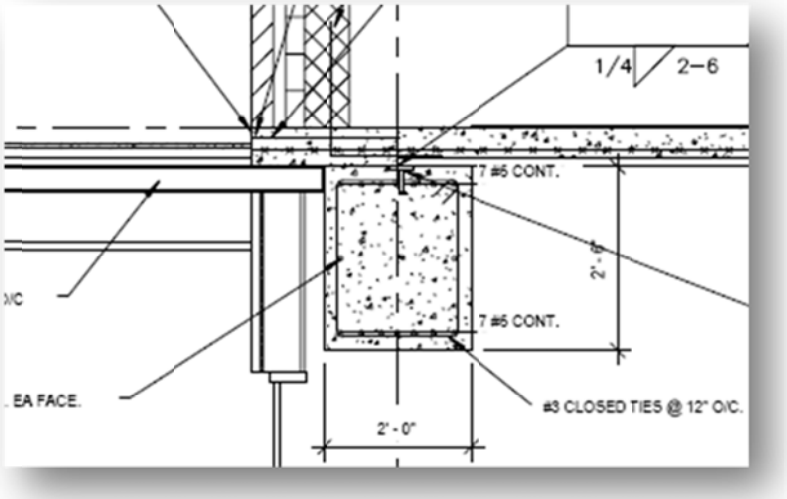
Composite Metal Deck

Framing Systems:

The superstructure of the Susquehanna Center primary consists of a combination of 28”x28” and 18”x18” concrete columns and 18”x24” wall beams, and 12” CMU bearing walls.

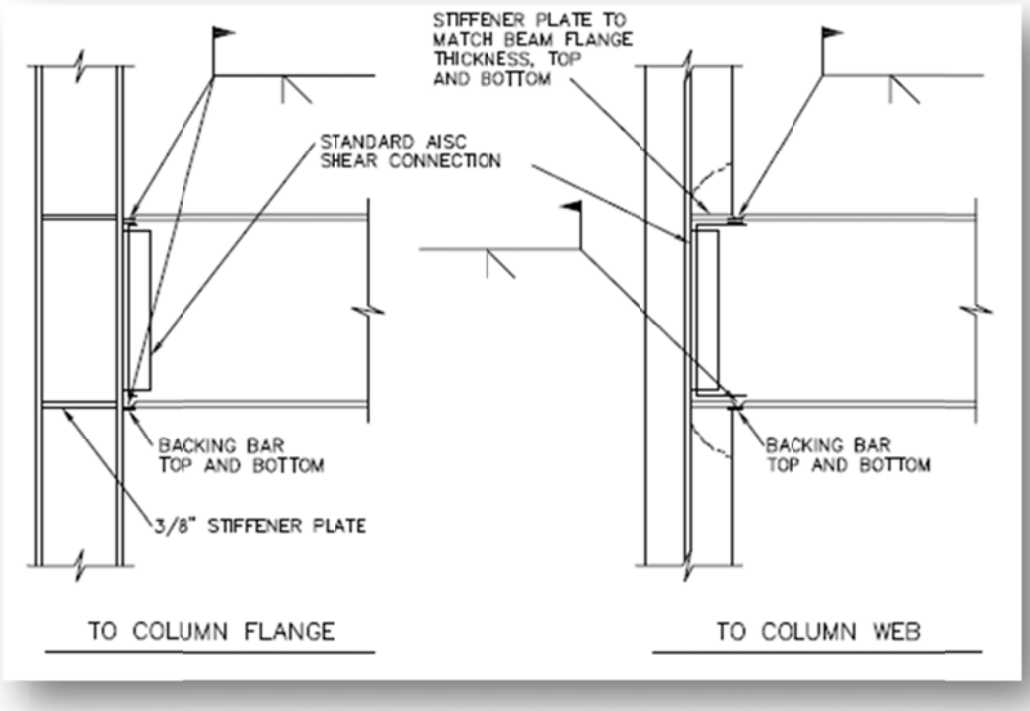


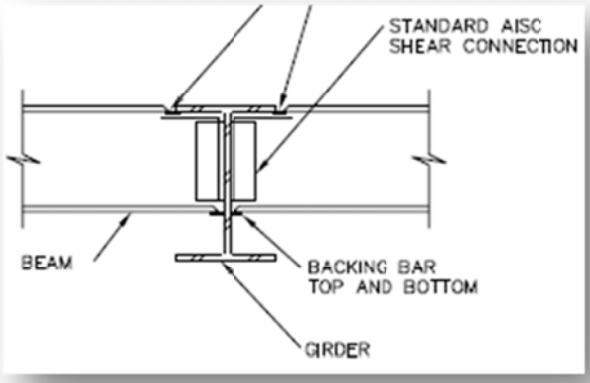
12”CMU Bearing Walls
Column and Wall Beam



Lateral System:

The lateral resisting system in the Susquehanna Center is composed of concrete moment frames and steel moment connections. Details of the connections and their locations can be located in the figures below.





Typical Moment Connection Details

Problem Statement

Technical reports one and three have confirmed that the Susquehanna Center Renovation and Expansion has been designed and built to meet sufficient strength and serviceability. In large scale projects such as arenas, the primary consideration to account for is efficient and effective design of long span structural members. The existing structure consists of super longspan steel joists sloping at an angle of 5/8”:12” to form an inclined roof. The joists span 167 ft. in the north south direction, spaced at 8’ O.C. running along the 167 ft. length of the arena.

The existing structural framing system has been efficiently designed for the lateral and gravity loads that act on the building. This proposal will focus on the design of an alternate framing system. The process will be affected by multiple factors ranging from serviceability, vibration control, and cost and scheduling.

Problem Solution

To adequately redesign an alternative roof framing system all of the limiting criteria listed above well have to be taken into account to ensure that the redesign is feasible.

This analysis will explore alternative structural systems unlike the existing longspan steel joists in the Susquehanna Center. These systems will be designed and analyzed against the gravity and lateral loads that were discussed in Tech 1. A table top truss configuration will be suggested because of its architectural and aesthetic details, as well as its serviceability aspects. This structural system is ideal for catwalk, rigging, lighting, and sound support system accessibility, unlike the complexity of the traditional longspan systems. Even though this system will decrease the total weight, it will alter the design and profile of the roof.

An alternative to the configuration above will be a laminated wood framing system which will also be explored to replace the existing steel joists.

Breadth Topics

Architectural

The table top configuration will provide to alter the architectural and aesthetic details of the roof both interiorly and exteriorly, thus this must be analyzed. Since the layout of the arena is rectangular the configuration shouldn't drastically alter the positions of the corner columns that support them. In addition, with an angled roof the design of the configuration must accommodate this so the exterior profile isn't altered.

Construction

Due to the reconfiguration of the existing roof system the construction timetable and costs will be affected. Included in this breadth will be estimations of the altered costs of new materials and installations. The new costs estimates will be compared to the existing to determine if it is feasible. Additionally, a construction schedule analysis will be performed to determine if the completion date of the building will still be on schedule.

Tasks

Task 1
Research and compare between the two alternate systems and determine final re-design.

Task 2
Preform gravity load analysis on new roof system

Task 3
Create computer model with the new roof system

Task 4
Preform wind and seismic load hand calculations and compare to them to computer model.

Task 5
Check direct shear and torsion

Task 6
Check strength and serviceability against code and industry standards.

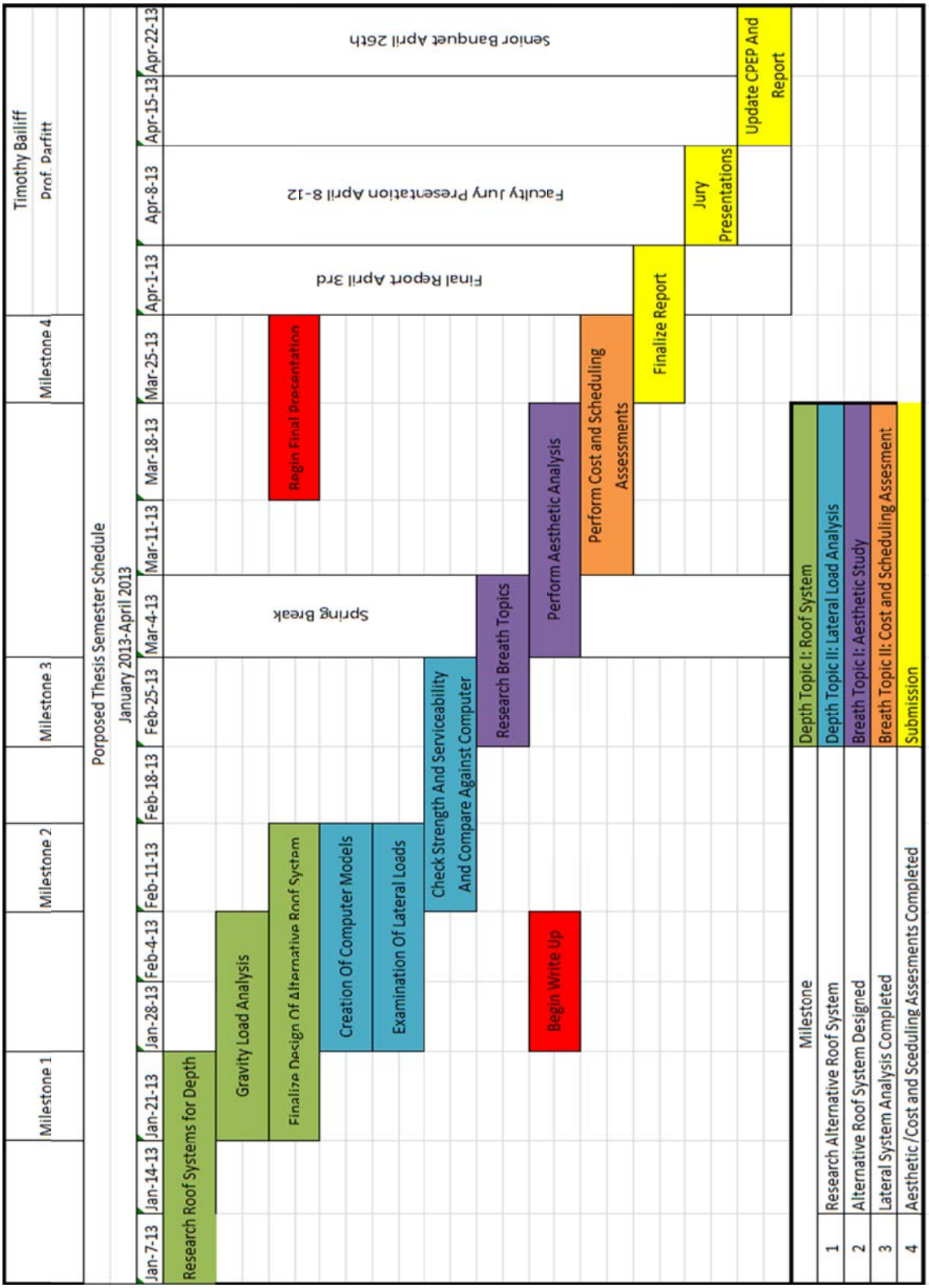
Task 7
Architectural breadth

Task 8
Preform cost and scheduling reports

Task 9
Prepare final presentation

Task 10
Write paper and make revisions

Timetable


Timothy Bailiff
Prof. Parfitt
Porposed Thesis Semester Schedule
January 2013-April 2013
Milestone 1
Milestone 2
Milestone 3
Milestone 4
Jan-7-13
Jan-14-13
Jan-21-13
Jan-28-13
Feb-4-13
Feb-11-13
Feb-18-13
Feb-25-13
Mar-4-13
Mar-11-13
Mar-18-13
Mar-25-13
Apr-1-13
Apr-8-13
Apr-15-13
Apr-22-13
Research Roof Systems for Depth
Gravity Load Analysis
Finalize Design Of Alternative Roof System
Creation Of Computer Models
Examination Of Lateral Loads
Check Strength And Serviceability And Compare Against Computer
Begin Write Up
Research Breath Topics
Spring Break
Perform Aesthetic Analysis
Begin Final Presentation
Perform Cost and Scheduling Assessments
Finalize Report
Final Report April 3rd
Jury Presentations
Faculty Jury Presentation April 8-12
Update CPEP And Report
Senior Banquet April 26th
Milestone
1 Research Alternative Roof System
2 Alternative Roof System Designed
3 Lateral System Analysis Completed
4 Aesthetic /Cost and Sceduling Assesments Completed
Depth Topic I: Roof System
Depth Topic II: Lateral Load Analysis
Breath Topic I: Aesthetic Study
Breath Topic II: Cost and Scheduling Assesment
Submission