Executive Summary

Sojka Pavilion and the Kinney Natatorium are 122,000+ Sqft addition to the Kenneth Langone Recreation and Athletic center built to house a 4000 seat basketball arena and NCAA regulation size swimming pool on the campus of Bucknell University in Lewisburg Pennsylvania.

The floor system of each building section in the Kenneth Langone Recreation and Athletic center are a composite construction, using 2" deep 18 gauge metal decking with ¾" x 5" shear studs and 6 ½" deep concrete slab. This floor is supported by W shape steel beams varying in size as needed.

In Technical Assignment #2 it was determined that alternative flooring systems should be considered for this building. The most likely alternative system for this building is an all wood system composed of structural glulam beams and a wood panel flooring system. With the change of the floor system to wood a change to the entire structural system will be evaluated. This change would include the columns being changed to structural glulam members as well as the roof system being changed to structural glulam arches. In addition to the structural and floor systems being changed the lateral system will also be changed to use both structural glulam member and tensioned steel cables as it was determined in Technical Assignments 2 and 3 that the current lateral force resisting system was inadequate. However, strength isn't the only criteria of an engineers design.

In order to determine if the new system is an economical alternative, a cost analysis will be performed on the new and old systems. The comparison will be performed between the original steel structural system and the newly designed wood structural system.

Breadth Summary

Breadth Topic #1: LEED Certification

The first breadth topic will be a study of LEED Certification. A study will be done to determine what design changes could be incorporated in order to receive a LEED Certification for this building. This requires a 26 out of a possible 69 points on the Green Building Rating System, Version 2.2. Moreover, one category on the checklist will be selected and the subcategories will be designed.

Breadth Topic #2: HVAC Delivery System

The second breadth topic will be a redesign of the duct system in the natatorium. Being in a natatorium, mechanical vibrations transferred through metal duct working cause a noticeable amount of noise due to the large amount of hard surfaces such as the tile floors and walls and the water. Because of this the use of a soft cloth duct system will be designed in order to reduce the amount of mechanical noise being transferred to the room.

Introduction:

Sojka Pavilion and the Kinney Natatorium are 122,000+ Sqft addition to the Robert Langone Recreation and Athletic center build to house a 4000 seat basketball arena and NCAA regulation size swimming pool on the campus of Bucknell University in Lewisburg Pennsylvania. Because of there functions both buildings require clear spans of over 100' which could affect the distribution of lateral forces. For the purpose of this report the lateral loads will be applied along the length of the building.

Overall Structural System:

The ground floor of both the Sojka Pavilion and Kinney Natatorium is a 5" deep concrete slab on grade, reinforced by 6x6 W2.9x W2.9 welded wire fabric. The second floor of each building is a composite construction, using 2" deep 18 gauge metal decking with ¾" x 5" shear studs and 6 ½" deep concrete slab. This floor is supported by W shape steel beams varying in size as needed.

Bearing walls are W shaped steel columns of varying size support on concrete continuous footings. The columns are supported laterally by steel cross bracing. The foundation is comprised of Strip footings. The strip footings range from 1'6" to 8' wide and 1'6" to 4' deep. They are reinforced with continuous #8 or 9 bars with additional reinforcement as required. These strip footings carry concentrated loads from columns and distributed loads from walls. The Footings were designed with a soil bearing capacity of 2500 PSF.

The lateral force resisting system of the Sojka Pavilion and Kinney Natatorium is comprised of X-braced frames. The frames are located along all 4 walls of both adjoining buildings. The X-bracing uses both steel angles and tubular steel.

Problem Statement:

A building must be designed to resist all applied forces in accordance with the International Building Code. This includes gravity loads and lateral loads. The gravity loads are determined from the dead loads of the building and the live loads established in Table 1607.1 of the IBC. The lateral forces take into take into account the effects of wind and seismic. These forces are also calculated in accordance with IBC with references to ASCE 7. Because of load combinations set forth in the IBC, the building does not have to resist both wind and seismic concurrently.

After a review of Technical Assignment #2 it was observed that several alternate floor systems were worth further investigation. The most viable alternative floor system is a wood beam system. This was determined because it has the most advantages. It was concluded in Technical Assignment #3 that wind forces control the design of the lateral force resisting system as was the case in the original design. It was however determined that some of the members in the X braced frames were inadequate and therefore alternative frame and or members will need to be designed.

One of the most important things to consider when designing a building is to make sure it is as economical as possible. Because of this, it is important to consider alternative solutions.

Problem Solution:

The solution to this is to design an alternate system and compare it to the original design. The alternative system being considered in this proposal is a glulam wood system. This system will be comprised of arched LVL roof beams supported by LVL columns. The floor system will be comprised of LVL beams and girders and a wood panel decking. This new system will then be compared to the original design to determine whether it is a considerable alternative.

Solution Method:

The first step in solving this problem is to accurately determine the loads on the building according to appropriate codes and references. The gravity loads must be applied to determine the necessary roof and floor system requirements and column sizes. Each of these systems will be designed using the 2005 Edition of the NDS and its subsequent supplements.

The international building Code and ASCE 7 will be used to determine whether the building acts as a rigid or flexible diaphragm. After determining the correct method, the lateral forces will be applied and distributed to determine the forces in each X braced frame. This will allow the frames to be designed. The same NDS standards will be used for the design of these frames. After all the design is completed, an economic analysis will be performed.

Breadth Studies:

Two breadth topics will be studied as part of this thesis. The first breadth topic will be a study of LEED Certification. A study will be done to determine what design changes could be incorporated in order to receive a LEED Certification for this building. This requires a 26 out of a possible 69 points on the Green Building Rating System, Version 2.2. Moreover, one category on the checklist will be selected and the subcategories will be designed.

The second breadth topic will be a redesign of the duct system in the natatorium. Being in a natatorium, mechanical vibrations transferred through metal duct working cause a noticeable amount of noise due to the large amount of hard surfaces such as the tile floors and walls and the water. Because of this the use of a soft cloth duct system will be designed in order to reduce the amount of mechanical noise being transferred to the room.

Tasks and Tools:

Task 1: Determine Loads

A. Determine Gravity Loads from Dead loads and Live load Table 1607.1 in IBC
B. Determine Wind and Seismic forces in accordance with ASCE 7 – 05 chapters 6 & 9 respectively.

Task 2: Apply Loads and Find Critical Design Members

A. Determine critical roof loads
B. Determine critical floor loads
C. Determine critical column loads
D. Determine critical x braced frame loads

Task 3: Design of System

A. Design arched roof beams
B. Design floor beams and girders
C. Find required floor panel size
D. Design columns
E. Design X braces vs. Wood Shear Walls
F. Check Foundations
G. Create Computer Model
H. Check Drift and Stiffness
I. Check Torsional Effects

Task 4: Breadth Topic: LEED Certification

A. Research LEED Certification
B. Perform required work on chosen LEED topic

Task 5: Breadth Topic: Duct Redesign

A. Perform redesign of natatorium duct system

Task 5: Report

A. Compile Final Report
B. Review
C. Final presentation

Time Table:

	January			Febuary				March				April	
	1/15 - 1/19	1/22 - 1/26	1/29 - 2/2	2/5 - 2/9	2/12 - 2/16	2/19 - 2/23	2/26 - 3/2	3/5 - 3/9	3/12 - 3/16	3/19 - 3/23	3/26 - 3/30	4/2 - 4/6	4/9 - 4/13
Task 1													
Task 2													
Task 3									BREAK				
Task 4													
Task 5													
Task 6													