CEAS Student Center Expansion—Preliminary Design Analysis

Turner Solterman - Sean Hazen - Kyle Smith

College of Engineering and Applied Sciences - Western Michigan University

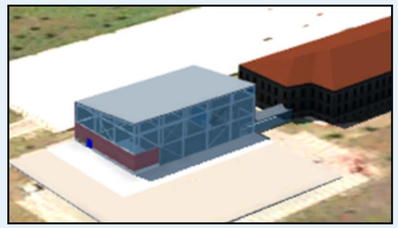
Background Information

Western Michigan University has had a long standing tradition of engineering excellence. To keep up with modern culture, and to maintain that Western Michigan will be on the forefront of providing an excellent engineering education, an expansion to the current CEAS building on Parkview campus is necessary.

Aptly named the CEAS Student Center Expansion, this project will be a space exclusively for student engineering groups. This will bring collaboration across different engineering disciplines. Through the alternative floor plans, we propose the goal of having a collaborative space, as well as a modernized building.

The new building will be located parallel to the existing Floyd Hall, on the former east employee parking lot.

Before the CEAS Student Center Expansion



After the CEAS Student Center Expansion

Project Constraints

In addition to looking similar to Floyd Hall, the CEAS Student Center Expansion must maintain an open floor plan with the goal of encouraging interdisciplinary collaboration.

The building must have the following characteristics:

- 14,000 square feet maximum
- Restrooms, conference rooms, and a full computer lab
- Storage for all of the RSO's and enough space for machines and tools

Alternatives

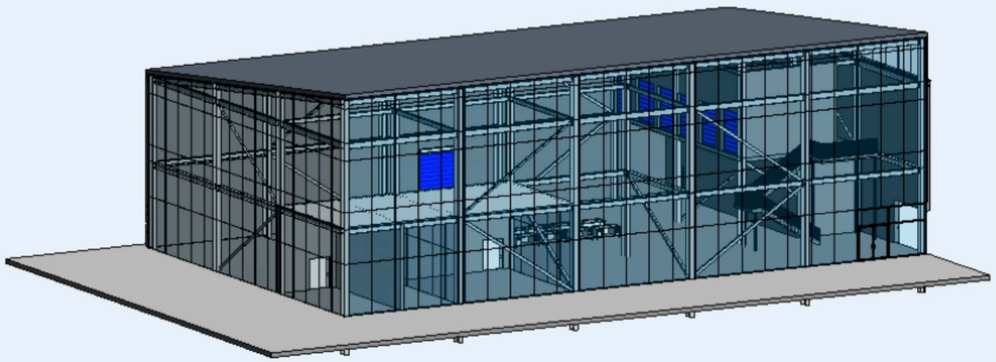
The purpose of the three alternatives was to better suit the goal of the building through multiple floor plans. The first floor plan focused on maximizing conference rooms. In contrast to this, the second floor plan focused on open floor space. The last floor plan was a mixture between open floor space and conference room areas.

Structural Steel Design

The steel design in this building is a braced frame with wide flange sections making up all of the beams and columns, while double angles make up the bracing. STADD.Pro V8i was used to model and design the steel, and then the design was input into AutoCad Revit to add architectural elements.

The STADD.Pro V8i software allowed us to model all of our AISC LFRD load cases with ease. We obtained our rain, wind, snow and live loads from ASCE 7-10, and only used the roof and storage slab in the STADD.Pro V8i model (along with all the steel). We assumed that the walls were self supporting, only relying on the steel structure for very small lateral support.

Steel Design Recommendations	
Member	Wide Flange Section
Columns	W14x90, W24x104
Beams	W12x50, W14x90, W16x100
Roof Beams	W14x99
Bracing	2L8x6x3/4
Total Weight	166.31 tons



Foundation Design

The foundation design for the CEAS Student Center Expansion was started by determining the soil properties. Once these were determined the geotechnical design was computed to determine the spread footing widths. Four foundation designs were found using the design chart method. The four designs were based off the highest load for each corner, exterior, interior, and storage columns. The structural design was then calculated to determine the thickness of each spread footing and required steel reinforcement.

The shear was checked for each footing to ensure that it would not fail in one-way or two-way shear. The next step was to check flexure failure to ensure that the concrete would not fail. Steel reinforcement was required in each of the footings. The final foundation design recommendations are shown in the table below.

Foundation Design Recommendations		
Location	Dimensions	Rebar
Corner	9'x9'x36"	9 #8 @ 12.75 in
Exterior	7.5'x7.5'x36"	14 #6 @ 6.5 in
Interior	5.5'x5.5'x24"	15 #4 @ 4.25 in
Storage Interior	7.5'x7.5'x36"	14 #6 @ 6.5 in

Sustainability

In the architectural and cost estimation portion of the project, every attempt to use recycled and energy saving material was made.

In the steel and foundation design, we stretched out the life cycle of the building by making our designs conservative. This allowed us to not worry about the structural integrity of the building.

Cost Estimate and Construction Schedule

The estimation of this project was completed with the help of Revit. Revit produced a material list for all of our alternatives. Once this list was attained, RSMeans was used to find the construction industry's average cost per unit. This gave an estimation to labor, material, and equipment. It was also used to approximate how long a certain construction activity would take, which helped produce the schedule for this project.

Cost Estimate and Construction Schedule		
	Cost Estimation	Duration (days)
Alternative 1 - Conference Rooms	$3,568,780	64
Alternative 2 - Work Space	$3,485,905	64
Alternative 3 - Mixed Space	$3,357,047	64

Final Recommendations

These five criteria were given a weight, depending on how important they are to the project. Each alternative was then given a score based on their layout and price. The mixed space alternative was chosen based on the highest score of 22.

Decision Table				
		Alternatives		
Criteria	Weight	Conference Rooms	Work space	Mixed Space
Total Open Floor Space	3	(1) 3	(3) 9	(2) 6
Number of Work Stations	3	(1) 3	(2) 6	(2) 6
Number of Conference Rooms	2	(3) 6	(1) 2	(2) 4
Computer Lab Size	1	(2) 2	(1) 1	(3) 3
Project Cost	1	(1) 1	(2) 2	(3) 3
Total Weighted Score		**15**	**20**	**22**

Acknowledgements Faculty Advisor : Dr. Decker Hains Sponsor : Dr. Houssam Toutanji Senior Design Faculty : Halla Atallah Eid Almajali