Seismic Analysis and Retrofit of UVU

Civil Engineering Capstone Spring 2024

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Project Objectives

Provide comprehensive assessment of buildings located on the UVU campus with a focus on identifying structures that may require seismic retrofitting. A thorough inspection was conducted to evaluate the extent of these vulnerabilities, followed by the estimation of associated costs for implementing necessary retrofit measures. Ultimately, the project will develop a final retrofit design to address the seismic deficiencies of the building that needs structural enhancements. This approach aims to enhance the overall seismic resilience of UVU's campus infrastructure, ensuring the safety and security of its occupants.

Solution Detail

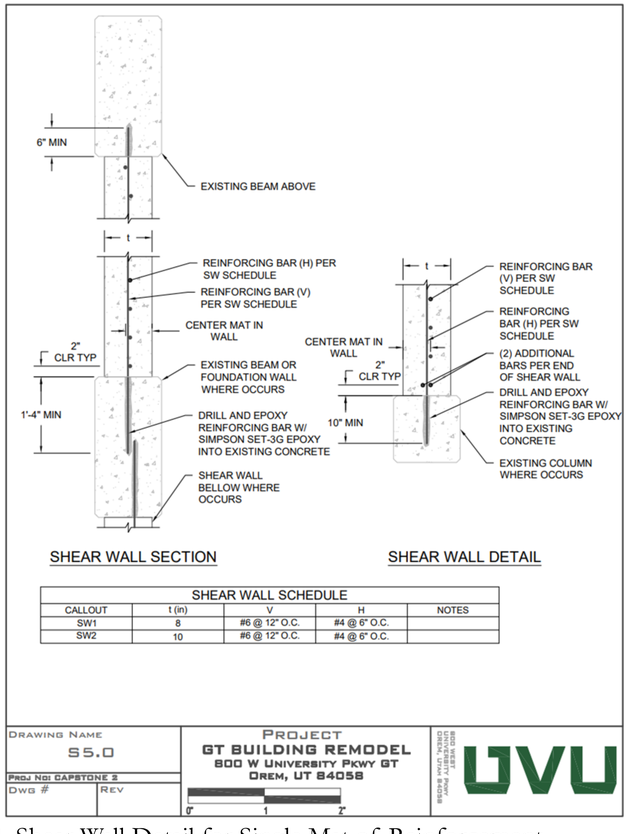

Figure 1. Shear Wall Detail for Single Mat of Reinforcement.

Alternatives

Concrete Shear wall: Shear walls are walls built in a building with the purpose of resisting lateral forces such as seismic forces. Shear walls in a building increase its stiffness which reduces its ability to sway which can crack and damage a structure.

Carbon fiber wrap: Carbon fiber retrofitting involves wrapping structural members in a carbon fiber using an adhesive to keep it in place. It is easier to implement as it does not require as much heavy manual labor as concrete or masonry shear walls.

Total Reconstruction: Removal of the existing structure to build a new building component that meets the current seismic standards. Replacing a structure with a similar sized structure is often the most costly and time-consuming option.

Comparisons

Within this segment, an exhaustive analysis of all structures in the project was conducted. Employing diverse criteria to assign scores corresponding to the subject's specific parameters. The ranking process was executed methodically, relying on verifiable data accrued throughout the project's duration. The Gunther Technology Building was determined to be the worst seismically.

Total Cost for Shear Walls	
Building	Total
Gunther Technology	$ 5,536,961
Sparks Automotive	$ 3,438,155
Woodbury Business	$ 3,495,650
Browning Administration	$ 4,128,148
Losee Center	$ 3,761,623
Pope Science	$ 5,111,041
Environmental Technology	$ 632,533
UCCU Event Center	$ 6,176,575

Rank	Building	Cost	Need of retrofit	Environmental Impact	Social impact	Operation and Maintenance	Over all score
1	Gunther Technology	1	10	5	5	2	6.6
2	Environmental Technology	9	4	9	9	9	6.3
3	Browning Administration	3	8	6	5	4	6.2
4	Losee Center	4	7	7	5	5	6.1
5	Pope Science	2	4	3	3	3	3.3
6	Woodbury Business	4	2	6	4	6	3.2
7	Sparks Automotive	4	1	5	4	5	2.5
8	UCCU Event Center	1	2	1	1	1	1.6

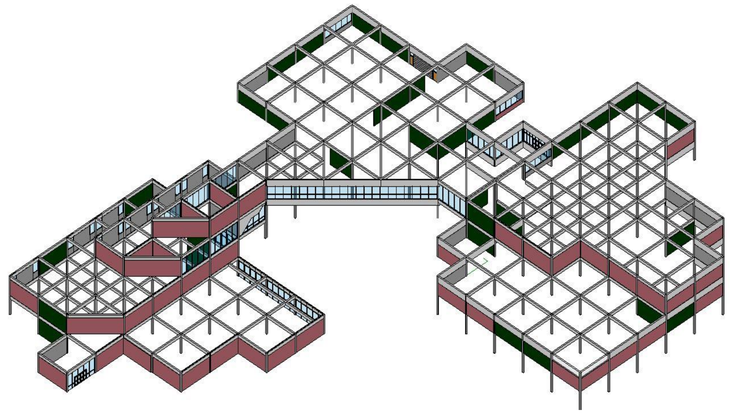

Figure 2. Rendering of Shear Wall Locations

Recommendations or Lessons:

It is recommended that the university takes proactive measures to improve the seismic performance of several buildings on campus by consulting with professional engineers for tailored solutions.

It is also advised that the university commissions another seismic study conducted by professional engineers. This additional assessment will offer a fresh perspective and provide valuable insights into identifying buildings that require retrofitting.

Codes and Software

ACI 318 – Building Code Requirements for Structural Concrete
ASCE 41-17 - Seismic Evaluation and Retrofit of Existing Buildings
ASCE 7 – 22 – Minimum Design Loads and Associated Criteria for Buildings
Bentley – Ram Elements
Autodesk – Revit