Portsmouth Senior Center Structural Assessment

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Introduction & Project Goals

In 2020 the City of Portsmouth renovated the former Lt. Paul A. Double U.S. Army Reserve Center into a public senior activity center. The building was originally constructed in 1957. Due to budgetary constraints, the assembly hall was not included in the structural modifications, however, it was updated with new windows, HVAC, and lighting. The purpose of this project is to bring the assembly hall up to current structural code for use as an emergency shelter. This will include a structural assessment, structural analysis, and research of structural improvement options.

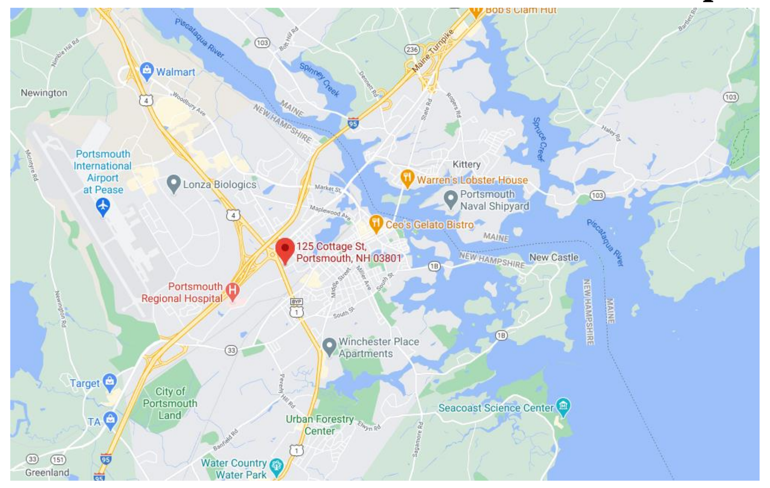

Figure 1: Locus Map

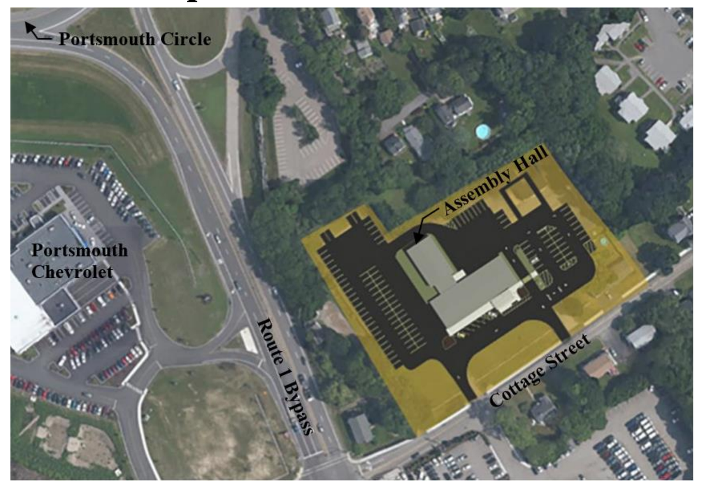

Figure 2: Senior Activity Center

Existing Conditions

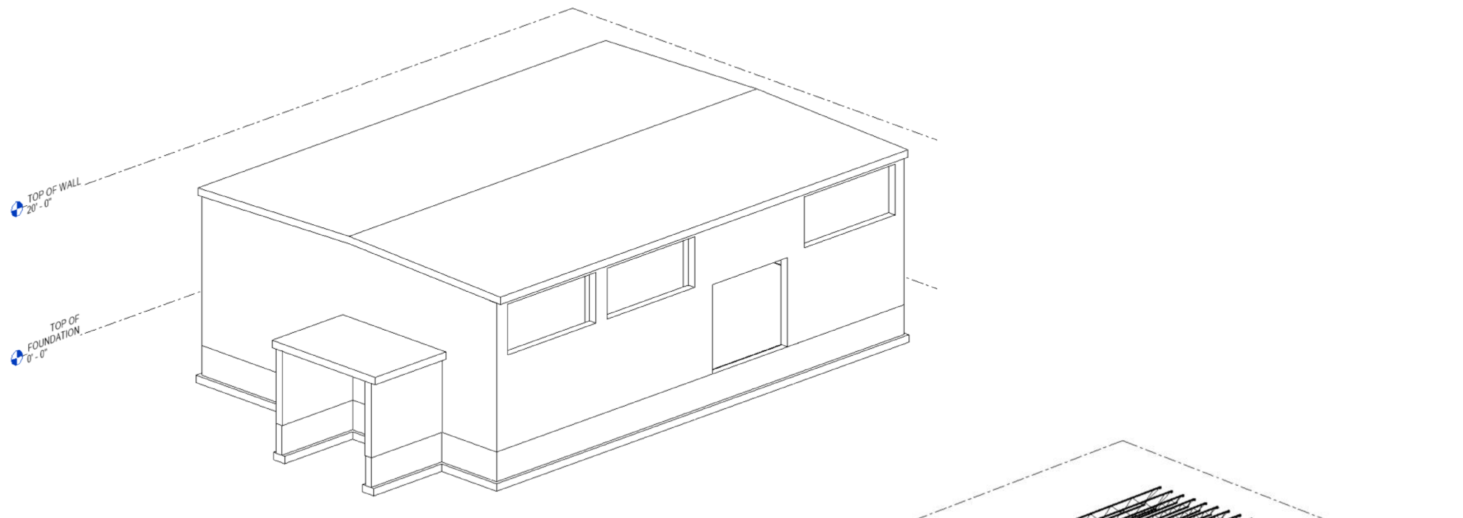

Figure 3: 3D View

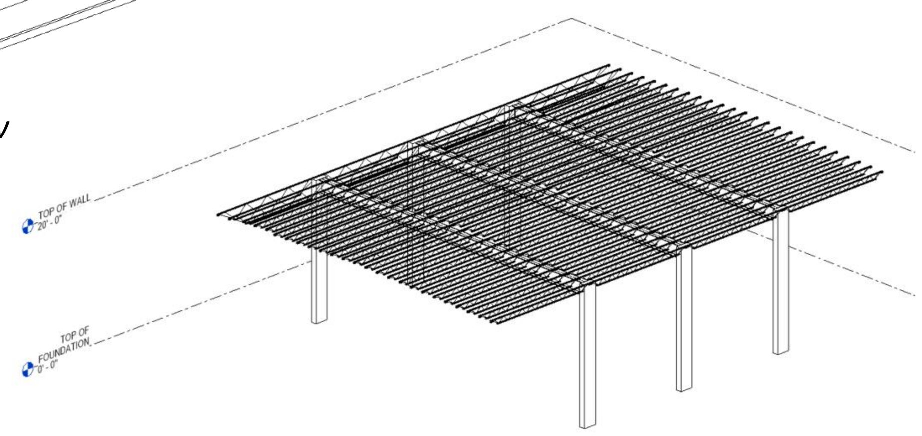

Figure 4: 3D View of Pilasters and Roof Framing

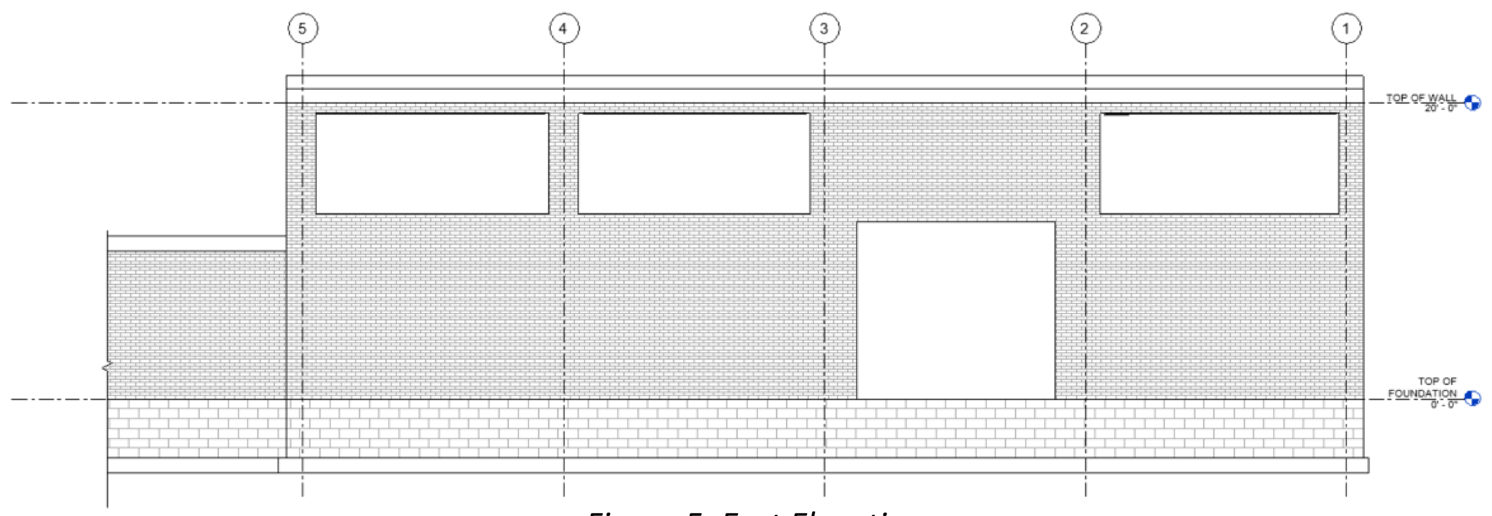

Figure 5: East Elevation

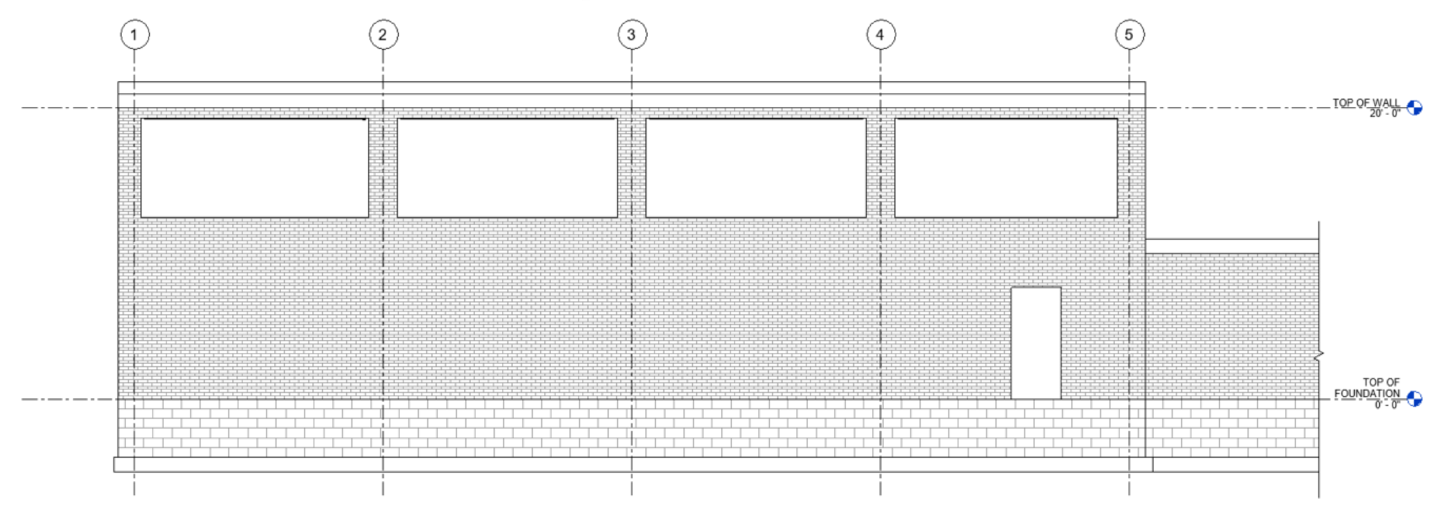

Figure 6: West Elevation

Structural Assessment

An evaluation of the existing exterior and interior structural conditions revealed the following:

- Long window spans in the East and West walls, as well as new wall penetrations in the West wall, caused insufficient lateral capacity within the shear walls.
- The roof framing was found to be adequate despite new loads introduced from updated lighting fixtures and HVAC.
- The observation of interior and exterior wall step cracking during the site visit could be a result of large in-plane loads.
- The bubbled interior wall surface along the East wall indicated the presence of moisture within the wall.
- The lack of connection between the joists and walls is a violation of current code guidelines.
- The lack of reinforcing of the masonry walls does not meet the requirements for a building with an ASCE 7-10 risk category IV distinction.
- An analysis of the pilasters found them to have insufficient moment capacity.

Figure 7: Exterior Wall Step Cracking

Figure 8: Exterior Step Cracking by Window Along East Wall

Figure 9: Windows & New Wall Penetrations in West Wall

Figure 10: Windows Along East Wall

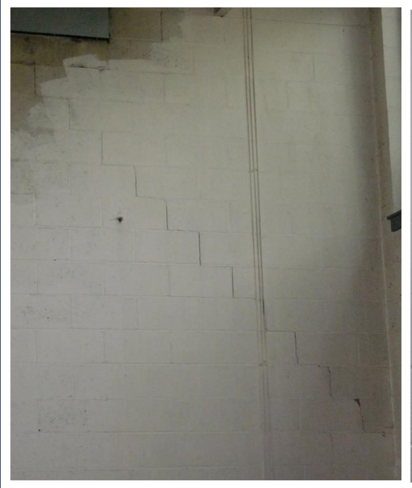

Figure 11: Interior Wall Step Cracking

Figure 12: New Paint Bubbling From Interior Moisture

Figure 13: Joists Resting on Masonry Wall

Figure 14: New Lighting and HVAC

Structural Analysis

To analyze the structural members of the assembly hall the following loads were considered:

- Dead Load
  - Self Weight of Framing Members
  - Weight of the Roof
  - Ductwork and Lighting
- Roof Live Load
- Flat Roof Snow Load
- Equivalent Lateral Seismic Force
- Wind Load

The analysis was performed using Visual Analysis© software. The components analyzed include the pilasters, shear walls, and girders.

References

American Society of Civil Engineers. (2010). Minimum Design Loads for Buildings and Other Structures. ASCE 7-10. Reston, Virginia.

Community Development. (n.d.) *New Senior Activity Center.* City of Portsmouth, http://cityofportsmouth.com/community/new-senior-activity-center.

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International Code Council. (October 2015). 2015 International Building Code. IBC 2015.

Structural Improvements

Issue to be Addressed	Renovation Options
Unreinforced masonry walls	• FRP overlay applied to walls • Reinforced shotcrete system installed on the interior side of the walls • Steel framing system on the interior side of the walls • Timber strong back system installed on the interior side of the walls
Roof framing not anchored to structure	• Use ledger angles to connect the roof joists to the walls
Pilasters – Insufficient moment capacity	• Timber strong back system installed on the interior side of the wall • Steel framing system installed on the interior side of the walls
West wall– Insufficient in shear	• FRP overlay applied to walls • Reinforced shotcrete system installed on the interior side of the walls

Renovation Option	Pros	Cons
Anchoring and tying elements together (Roof angle clips)	• Helps resist out-of-plane loading (wind and seismic loads) • Stronger composite diaphragm system • Relatively inexpensive	• Accessibility to the roof and installation of clip angles can be hard due to limited working room
Out of plane wall bracing with timber or steel members	• Stiffens the walls to increase flexural, bending, and shear capacity in the walls	• Wall thickness increases resulting in less area inside of the assembly hall • Costly if new foundations are needed to support new timber/steel members
In plane wall strengthening - Shotcrete	• Reduces the tension forces in the walls, which will help to reduce further step cracking	• Adds significant weight to the building which leads to greater seismic forces
In plane wall strengthening – Fiberglass-reinforced plastic (FRP)	• Reduces the tension forces in the walls, which will help to reduce further step cracking	• FRP materials and installation can be expensive • Requires unique skilled labor

Acknowledgements

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