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ENGINEERING Inc.

SILVER FALLS SCHOOL DISTRICT

DISTRICT WIDE
SEISMIC EVALUATION
Executive Summary

Marion County, Oregon

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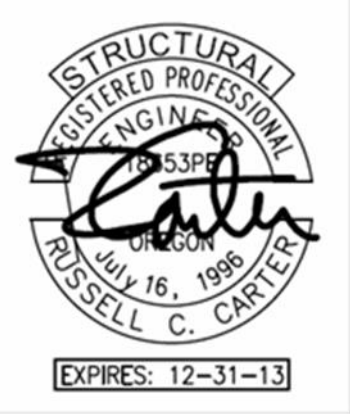

December 11, 2013

1.0 Executive Summary

1.1 Background

The Silver Falls School District (District) is centrally located in Silverton, Oregon in Marion County, approximately 14 miles east of Salem, Oregon. The District operates out of thirteen schools located within the community, ten of which will be the subject of this evaluation.

The purpose of this report is to evaluate ten educational facilities of varied ages built in a high seismicity zone. The school facilities cover approximately 260,000 square-feet total, and are used for classrooms, administrative offices, and assembly areas. All of the school structures vary in style, age, condition, and use. All but one of the schools evaluated have received multiple additions. The schools studied as part of this planning effort include:

- Bethany Charter Elementary School
- Butte Creek Elementary School
- Central Howell Elementary
- Evergreen Elementary School
- Mark Twain Middle School
- Pratum Elementary School
- Robert Frost Elementary School
- Scotts Mills Elementary School
- Silver Crest Elementary School
- Victor Point Elementary School

The objective of this planning effort is to perform visual observations at each of the above mentioned schools and perform a seismic performance expectation review of the structural systems in order to identify obvious deficiencies and necessary improvements. This study provides the District with recommendations and budgetary planning level construction values for each school along with specifically discussing the most significant deficiencies observed. It is recommended that the District use this report to prioritize improvements and determine interest in seeking grant funding through the seismic rehabilitation grant programs.

1.2 Observation Results

The following table summarizes the results of our observations and ranks each school based on the relative hazard severity of the observed deficiencies.

School	Relative Hazard Severity*	Potential Grant Candidate?
Butte Creek Elementary School	High	Yes
Robert Frost Elementary School	High	Yes
Mark Twain Middle School	High	Yes
Scotts Mills Elementary School	High	Yes
Bethany Charter Elementary School	Moderate	Yes
Pratum Elementary School	Moderate	No

Silver Crest Elementary School	Moderate	No
Central Howell Elementary School	Moderate	No
Evergreen Elementary School	Low	No
Victor Point Elementary School	Low	No

*****Relative Hazard Severity levels indicate perceived risk of substantial damage potential in the event of a seismic event based on our observations of the structural systems present and our past experience with similar structures and their performance during seismic events.

1.3 Recommended Improvements

Section 3.0 discusses the specific deficiencies and subsequent recommendations observed in each of the ten schools; however, some of the highest priority items are highlighted below:

- Bethany Charter Elementary –
  - The exterior walls of the gymnasium are covered with lap siding rather than sheathing. The straight lap siding provides little lateral load resistance. Additionally, the roof is framed using bow-string trusses and 2x purlins. This type of roof structure is highly fragile and coupled with the large deflections expected with straight sheathed walls could result in substantial damage. The gymnasium walls can be sheathed with plywood relatively easy and retrofit solutions can be developed to increase the reliability of the bow-string trusses.
  - The original portion of the school was constructed over a rubble rock foundation. Current standards require that walls are attached to footings to resist wind and earthquake loading. The existing rubble foundations should be retrofit or replaced utilizing cast-in-place concrete to ensure that the structure above is secured.

- Butte Creek Elementary –
  - The gymnasium roof is clearly deflecting under its own weight. Temporary shoring is highly recommended while a permanent solution is considered. It is our understanding that the deflections are monitored regularly and that limitations have been placed on the use of the gymnasium when it snows. Failure of this roof while children are present could have catastrophic consequences and it is recommended that action is taken to shore up the roof structure at a minimum. Retrofitting the existing roof structure could be accomplished using new beams beneath the original beams.
  - Butte Creek Elementary - The walls of the original school structure are made of unreinforced masonry (URM) and are unreliable during seismic events. Additionally, the roof is straight sheathed and does not meet aspect ratios for existing structures. Retrofitting the existing walls to provide additional strength and installing plywood sheathing over the existing straight sheathed diaphragm are recommended.

- Robert Frost Elementary –
  - The covered play area on the west side of the classroom pod structure was framed in the same manner as the rest of the pods and was likely intended to be infilled with classrooms as attendance increased. The classrooms were never added and the roof structure is supported solely with steel columns. This system does not provide a lateral load path to the foundation but can be retrofit using either infill shearwalls or cable bracing for relatively low costs.

- Mark Twain Middle –
  - The front and rear elevations of the classroom wing almost exclusively consist of window packages. Gravity load bearing elements are located between windows; however there is no lateral system at the exterior walls of the structure. This is coupled with a discontinuous diaphragm that was constructed with a roof step between the exterior and corridor walls. The lack of shearwalls can be rectified by infilling selective window panels. Additional analysis will be required to further evaluate and develop a solution to address the step in the roof diaphragm.
  - At the northern entrance to the school the canopy is supported by posts that likely do not provide the resistance required to resist lateral loads. Further examination of the system can be performed, or additional posts with embedded footings can be installed to provide the required stability.

- Pratum Elementary –
  - The gymnasium is structurally independent from the rest of the school building and is constructed with tall concrete perimeter walls approximately 7 feet tall. From that point up, the walls are framed with 2x studs. This system creates a hinge part of the way up the wall and was likely not designed to withstand out-of-plane loading. Additional detailing can be performed to ensure that the hinge is retrofit to support the required loading conditions.

- Scotts Mills Elementary –
  - The gymnasium was originally designed as a pre-manufactured metal building with beam and column frame lines. When the building was constructed, the structural program was altered and the metal building roof system was utilized. In place of the steel columns, masonry walls and pilasters were constructed to support the steel girders. The metal roof diaphragm likely does not provide adequate out-of-plane support for the tall masonry walls. To rectify this deficiency a structural steel system could be added to the perimeter walls to support the masonry under out-of-plane loading conditions.

- Silver Crest Elementary –
  - The 1970 addition to Silver Crest that houses the music room and library was framed utilizing a post and beam system with knee braces and rafters with collar ties. There was visible movement of the system, particularly at joints, and the connections are suspect. It is likely that this system would be unreliable during a code lateral event. Retrofitting the system or installing a new roof system are recommended.

At all schools with unreinforced masonry chimneys, replace the unreinforced masonry chimneys with a light-weight flue option.

1.4 Conclusions

Generally speaking, the condition of the District's schools was surprisingly good based on their respective ages. The schools are, for the most part, well cared for buildings that happen to be old. The recommended improvements listed above reflect items that do not pose a substantial immediate risk to the life safety of occupants (unless notes otherwise) outside of code lateral events. It should be noted the structural deficiencies in schools of this age group are fully expected and the severity of the deficiencies noted above is not uncommon.

One large reason that the deficiency lists and recommended improvements may not be as large as expected lies in the fact that many of these buildings started as small community schools. They were constructed in a redundant fashion using lightweight materials. Typically we start to see larger problems from a seismic standpoint when we come across heavy structures with few walls. Several of the schools with higher priority deficiencies listed above fall into this category. The smaller outlying schools have far less high priority deficiencies than the larger schools.

Construction costs to retrofit each of the schools observed will vary highly based on the degree of deficiencies being rectified. Seismic retrofit costs will likely range from $5 to $40 per square foot depending on the building being considered. These numbers are based on our experience retrofitting similar schools and cover both the highest priority deficiencies along with the lower priority deficiencies summarized for each building in Section 3.0.

It is clear based on the condition of the buildings that the District has invested in maintaining the buildings to get the most possible use out of each structure. To ensure that the District continues to get the most out of their schools and provide a safe learning environment for the students, we would recommend generating a priority list for capital projects to systematically address deficiencies as funds become available. Additionally, incremental updates should be considered during projects that may make performing the work easier. For example, during a roof replacement project a good time to install connections from the roof diaphragm to the walls or a window replacement project is a good time to install shearwalls in place of windows in a wall line that does not have enough shearwall length.

Attention should be paid to the potential for upcoming seismic retrofit grant programs. Several of the schools noted above are likely good candidates for programs that can fund some or all of the expenses related to seismic retrofit of school buildings. Should the District be interested in pursuing grant funding for one or more schools, ZCS would be happy to provide proposals for assisting in the preparation of grant packages.

The balance of the report provides specific details regarding the construction of each school, observed deficiencies, and recommended repairs.