

**STRUCTURAL/SEISMIC REPORT
Roosevelt Elementary School**

Report prepared by DCI Engineers

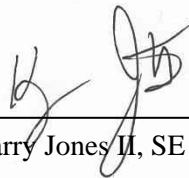
For

Medford School District



Completed By:

DCI Engineers

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Harry Jones II, SE

May 29, 2007

DCI project # 07-31-058



Introduction

DCI Engineers has reviewed available drawings and performed several site visits to observe Roosevelt Elementary School. The purpose of our review was to identify any seismic deficiencies that might impact a major renovation of the school. Our findings are based on an ASCE 31 life safety assessment of the building and our experience with other buildings of similar age and construction. In addition to a seismic review we also reviewed remediation measures for correcting any obvious signs of structural distress observed during our site visit. The following report contains our findings and recommendations.

The overall seismic performance goal identified by the school district for these buildings is life safety. To achieve this goal there should not be a full or partial collapse of the structure during a major earthquake and any “heavy” cladding elements such as brick or concrete walls should not fall from the building and result in a life safety concern. The buildings may however sustain major damage and need to be closed after a major earthquake. In general newer buildings (i.e. those constructed after the mid 1970’s) should easily perform at a life safety level and meet the district’s performance goals. The focus of our review has therefore been on the older buildings.

Summary

Based on our study we recommend saving only the 1949 wing and the separate cafeteria building. While the other areas of the school “could” be saved and renovated it is our opinion that the structural concerns are sufficient to warrant demolition and that any attempt to save these portions would be costly. The largest issue is the unreinforced brick masonry construction which performs poorly in earthquakes and can be costly to renovate. However we also encounter other significant problems such as cracking in large areas of brick walls (apparently due to an inadequate brick firing process) and substandard wood bowstring roof trusses. While the media center is a newer structure it was tied into and seismically braced off the existing 1949 building. It is our opinion that the configuration of the media center and the lack of alignment between its floor/roof and the floor/roof of the 1949 building will create serious seismic performance concerns.

The following sections of this report describe our detailed findings:

Existing Construction

The school consists of the following five main areas (Fig 1) which represent distinct structures which were built at different times:

Area 1

This was the original school building and includes administrative areas and some classrooms. It was constructed in the 1911. The structure is two stories tall with wood framed roofs and floors and perimeter unreinforced brick masonry walls.

Area 2

This area consists of the gymnasium and was most likely built in 1931. It includes a wood framed roof and first floor with unreinforced brick masonry perimeter walls. The roof framing includes wood bowstring trusses which span the entire width of the gym.

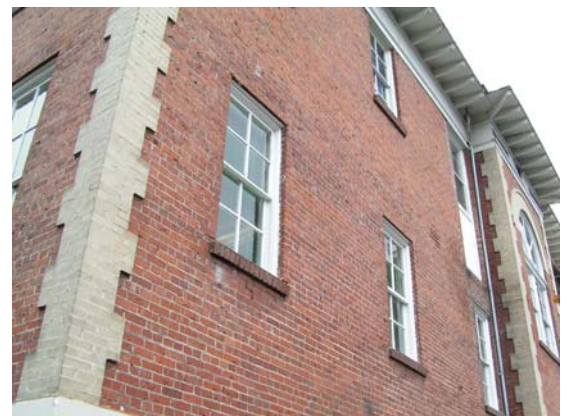


Photo 1- Original Building



The foundation system includes very lightly reinforced perimeter concrete stem walls and footings.

Area 3

This is a classroom area which was constructed in 1949 and consists of a two story reinforced concrete building. The floors and roof are wood framed.

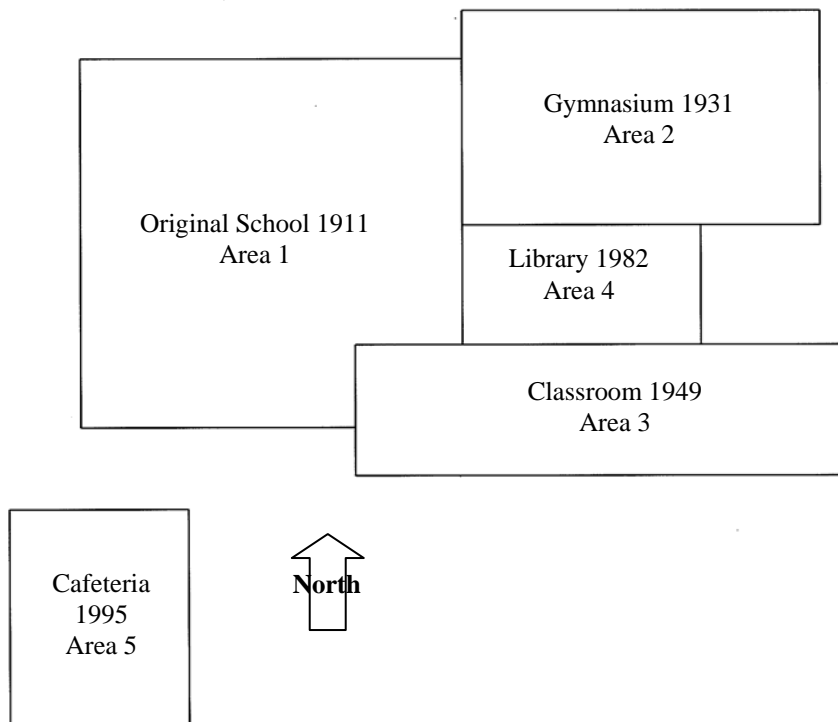
Area 4

This area is a two story steel and wood framed structure constructed in 1982. It houses a library on the upper floor and multipurpose room on the first floor. The lateral system consist of rod bracing on the north side and CMU shearwalls on the east and west sides. The South side of the buildings is braced by the 1949 adjacent building.



Photo 2- Cracking of bricks

Fig 1- School Key Plan



Area 5

This area is a completely separate building which houses the cafeteria. It is a one story wood framed structure built in 1995.



Findings/Recommendations

There are several significant concerns associated with the buildings. The first concern is the brick used in the original construction (Area 1). Photo 2 shows the cracking which can be observed over all the exterior and interior faces of the brick walls for this area. Two bricks were removed from the building so that we could review the extent of the cracking on the interior surfaces. Photo 3 shows this brick after it was removed from the exterior wall of the building. Generally the cracks extend through a large portion of the brick. This cracking is likely a result of problems with the firing process. The brick may have been too wet or dry when fired. However, whatever the cause of the cracking these bricks represent a significant concern for this area of the building. They are very brittle and have a low strength. Generally unreinforced brick performs very poorly during an earthquake and would need to be upgraded by backing the walls with a layer of reinforced concrete. Based on the extent of cracking associated with the brick we would recommend that the exterior walls be completely replaced. Since there are other significant changes needed to the buildings related to the mechanical and electrical systems and ADA requirements it may not be cost effective to try and save this building.



Photo 3- Exterior Cracked Bricks



Fig 2- Repaired Roof Truss Area 2

The second concern we found is with the gymnasium. This building is unreinforced masonry and also has wood framed bowstring trusses. We observed repairs to these trusses due to previous failures (Fig 2). These repairs appear to only marginally address the structural concerns. A major school renovation would warrant further study of these trusses and most likely additional repairs.

The final concern is related to Area 4. This building has combination of lateral elements including being braced off the 1949 building (Area 3). Any upgrade of this building would need address its interaction with the adjacent 1949 building. Of particular concerns is that the floor and roof of this building does not align with the floor and roof of the 1949 area (Fig 3). This offset would likely overstress the wall during an earthquake. Since this building area is relatively small our recommendation would be to demolish it and save just Area 3. While Area 3 is older it does have substantial concrete shearwalls in each direction and should perform well if the attached media center building were removed.

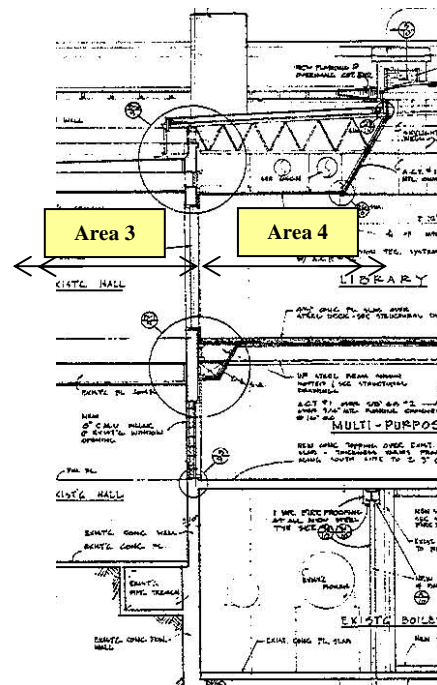


Fig 3- Wall Section



Area 5 was built in 1995 and is a separate building. This building could easily be saved and should not need any seismic renovation.

Construction Cost

We have reviewed the construction cost information for structural renovation of each area of the building. The following table indicates our rough order of magnitude unit costs for each area. This is based on our experience with other similar building types. The costs include only structural/seismic renovations construction cost except for Area 1, which also includes cost for recladding of the exterior walls to address removal of the cracked brick.

Area	Seismic Renovation Unit Cost	Notes
1	\$40/SF to \$50/SF	Includes costs for new cladding system
2	\$30/SF to \$40/SF	Includes new roof trusses
3	\$5/SF to \$10/SF	Assumes Area 4 demolished
4	\$20/SF to \$30/SF	Includes costs of strengthening area 3 so that it can support area 4
5	N/A	

Structural costs for new construction typically range from \$35 to \$45 per square foot. Our recommendations for demolition is based on the assumption that that major nonstructural changes such as MEP, architectural and programmatic improvements to the existing school will also be needed. These changes will be easier to achieve with new construction. Therefore in areas where the structural renovation is only slightly less than new construction and could warrant saving the building the additional cost for the nonstructural changes will make demolition the preferred approach.

Conclusions

Our findings indicate that the demolition of all areas except for Areas 3 and 5 would likely be the most cost effective approach to the school renovation project.

At the request of Mark Button we have also reviewed the structural risk associated with the continued use of this building for two more years. The concern is the potential for an earthquake which might cause life threatening damage. Since we observed the brick cracking on both the outside face of the wall and the inside we are reasonably confident that this cracking extends throughout the wall. We have not encountered this type of brick failure on other buildings and we do not know of any test data regarding its performance during an earthquake; however it does appear that the cracks have substantially weakened the bricks and it is likely that any significant lateral seismic load could cause the brick to crack. This cracking in combination with other typical URM concerns such as the lack of anchorage between the walls and roof means Roosevelt is likely the most hazardous school building (from a seismic performance standpoint) in the Medford School District.



It is important to note that Jackson Elementary School which was built at the same time as Roosevelt and has very similar construction (including the cracked brick issues) had a seismic renovation project in 1995 which included tying the brick walls into the roof. This renovation work was however not completed at Roosevelt. This makes Roosevelt a more hazardous building than Jackson. Since the seismic hazard of these buildings was first noted in 1995 (twelve years ago) and was even partially addressed in Jackson we believe it would be considered prudent to close Roosevelt at the end of this school year and keep it closed until it can be renovated.