

DRAFT Preliminary Seismic Evaluation

of

**The Seattle Public Library –
Queen Anne Facilities Building**

1529 Fourth Avenue West
Seattle, WA 98119
MLA Project No. 2014.105.2

Prepared for
The Seattle Public Library
1000 Fourth Avenue
Seattle, WA 98104



Prepared by

MLA Engineering, pllc
1424 Fourth Ave, Suite 815
Seattle, Washington 98101
206.264.2727
206.264.4835 Fax

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Introduction

MLA Engineering (MLA) was retained to provide a preliminary seismic evaluation of The Seattle Public Library's Queen Anne Facilities Building, located at 1529 Fourth Avenue West, Seattle, Washington.

Constructed in 1921, this is a three-story building of approximately 23,000 sf. It was previously the Pacific New Bell Exchange Building owned by the Pacific Telephone and Telegraph Company.

Scope of Work

The scope of this evaluation is to identify potential structural seismic vulnerabilities of the existing building that would likely pose a life-safety risk to the building's occupants during a design level earthquake. The methods used to provide this evaluation include:

- Review of available design documents of the existing structure:
 - Original design drawings
 - Design drawings of subsequent building alterations
 - Previously-performed building assessments
- Limited site observations of visible elements
- Evaluation of the building using "Rapid Visual Screening of Buildings for Potential Seismic Hazards" (FEMA 154).

This evaluation does not include assessment of potential seismic hazards from the building's contents, such as anchorage of shelving. This evaluation also does not include assessment of non-seismic elements, such as gravity load framing. However, this report may mention potential non-seismic vulnerabilities, if any were incidentally observed.

Review of Archive Documents

The Seattle Public Library provided MLA with design drawings for the original construction of the building and design drawings for various subsequent renovations through 1961. All drawings were prepared by the Office of the Chief Engineer of the Pacific Telephone and Telegraph Company. The following are relevant findings determined from our review of these documents:

Original Design

The original design drawings show that the building was initially two stories high with the intent for a future third story. The floors and roof are concrete slabs bearing on structural steel beams. The structural steel beams are supported at the building interior by composite structural steel/ concrete columns and at the building exterior by unreinforced brick bearing walls. The exterior brick walls bear on concrete foundation walls. These foundation walls and the interior columns bear on concrete spread footings.

Significant non-structural elements include unreinforced masonry parapets and interior unreinforced hollow tile partition walls. Interior ceiling and wall faces are typically clad with cement plaster.

The lateral force resisting system for wind and seismic loads consists of the concrete roof and floors acting as horizontal diaphragms to transfer forces to the unreinforced brick walls which carry these lateral forces down to the concrete foundations.

1929 Design Renovations

Design drawings from 1929 show the addition of the third story. The construction type is the same as described for the original construction.

1950 Design Renovations

Design drawings from 1950 show modifications of architectural and mechanical elements. The work shown on these drawings does not appear significantly relevant to the building's overall seismic performance.

2008 Structural Site Review (Coughlin Porter Lunden (CPL))

A 2008 memo provided by CPL summarizes their findings from site observations looking for seismic damage after the 2001 Nisqually earthquake. According to the memo, the engineer observed the following:

- Cracks in the fire-proofing concrete that encases the steel floor beams. The memo states that these cracks were reported by SPL personnel as having increased in size from the Nisqually earthquake.
- Hairline cracks in the brick walls surrounding window openings.
- The masonry inside of the building is in poor condition with crumbling mortar.
- Cracks in the concrete floor slabs.

The memo did not identify the specific locations within the building where the noted damage was observed.

The memo concludes that the overall structural system appears intact and recommended that a mason inspect the interior masonry to determine if any repairs are required.

Site Observations

MLA, accompanied by Glenn Osako of The Seattle Public Library, visited the site on October 2, 2014 to observe existing conditions. Our observations included noting the type and condition of visible building materials and verifying the building's general conformance with the available design drawings. Our observations were limited primarily to major interior rooms, the rooftop, and to exterior walls as observable from exterior ground-level. All observations were limited to building elements that are not hidden from view by existing wall, floor, or ceiling finishes.

The following are MLA observations relevant to the building's seismic performance:

Observed Building Construction

Based upon our site observations, the building construction appears consistent with the available design drawings.

Observed Building Condition

During this site visit MLA observed the following damage:

1. The exterior masonry wall banister alongside the front steps is crumbling at its low end. (see Photo 1)
2. The fire-proofing concrete that encases the steel floor beams has numerous rock pockets, however the locations that we observed did not have cracking of the type reported in the 2008 CPL memo.

FEMA 154 Evaluation

FEMA 154 is a publication containing an evaluation procedure intended for rapid visual screening of a building for potential seismic hazards. It enables users to classify surveyed buildings into one of two categories: those acceptable as to risk to life safety; or those that should be evaluated in greater detail by a design professional experienced in seismic design.

A data collection screening form provided in FEMA 154 is used to assemble basic information about the building. For buildings on the West Coast of the United States, including Seattle, FEMA 154 requires using its "High Seismicity" version of the data collection form. On this screening form, building characteristics that affect seismic performance are assigned numerical values which are summed at the bottom to produce a "Final Score" for the building. This scoring methodology is a useful means for comparing relative status of multiple buildings. Based upon present seismic design criteria, FEMA 154 suggests that buildings with a final score of 2.0 or less be investigated in greater detail.

The building characteristics that significantly influence the score for this building are:

1. Soil Type: According to the "Site Class Map of King County, Washington", provided by the Washington State Department of Natural Resources, the soil underlying this site is seismic site class C.
2. Building Type: The building's lateral force resisting system is unreinforced masonry (URM).
3. Pre-Code: This building was constructed before 1941.
4. Plan Irregularity: The building's u-shaped plan adds complexity to the seismic load paths.

The resulting FEMA 154 Final Score for this building is, $S = 0.7$, which falls below the suggested 2.0 threshold for deeming a building seismically adequate for providing a minimum life-safety risk level.

Summary of Seismic Vulnerabilities

Based upon the aforementioned findings and our engineering experience, the building, in our opinion, has the following potential seismic vulnerabilities:

Unreinforced masonry shearwalls

This building's unreinforced masonry walls were a common construction type during the era in which it was built. Because of its low ductility to resist cyclical seismic loads, modern building codes have not allowed unreinforced masonry in new construction for many decades now. Once cracked, the strength and stiffness of unreinforced masonry shearwalls degrades rapidly.

Due to their minimal anchorage, the unreinforced brick walls are also susceptible to separating from the building's floors and roof during an earthquake. This separation can result in collapse of the exterior walls and of the supported floors and roof.

We did not observe any indications of existing damage from previous earthquakes in the portions of the building's masonry walls that we viewed. The observed damage in the exterior brick wall banister may be from a non-seismic cause because it is highly localized damage to a short wall that is otherwise lightly loaded. This wall's degradation, however, demonstrates the brittle performance of unreinforced masonry after it has been subject to overstresses.

Falling material hazards

The unreinforced brick roof parapets are vulnerable to collapse during a design-level earthquake. In addition, bricks and decorative terra cotta blocks over egress doors may be falling hazards.

Fire-proofing concrete that encases steel floor beams

This is non-structural concrete, therefore the cracking observed by CPL and the rock pockets that we observed do not reduce the seismic-resisting capability of the building's overall structural system.

Future earthquakes could induce additional cracking of this concrete and potential separation from the steel beams, possibly resulting in falling concrete hazards. The original design drawings show steel welded wire reinforcement within this concrete, however, which helps resist separation of individual concrete pieces.

FEMA 154 Evaluation

The low Final Score is consistent with the vulnerabilities described above.

Recommendations/ Next Steps

Based upon the findings of our preliminary investigation, we recommend that The Seattle Public Library undertake the following steps under the guidance of qualified professionals:

1. More precisely evaluate the building's seismic vulnerabilities by performing an in-depth analysis of its seismic capabilities using evaluation methodology from the publication "Seismic Evaluation and Retrofit of Existing Buildings" (ASCE 41), by the American Society of Civil Engineers.
2. If the analysis in recommendation number 1 identifies life-safety vulnerabilities, then ASCE 41 methodology could further be used to design retrofits to the building. Retrofits might include addition of reinforced concrete or masonry shearwalls and/or steel braced frames, lateral bracing of parapets, anchorage of individual terra cotta blocks located above egress doors, and additional anchorage of the exterior brick walls to the concrete floors and roof.
3. Because it occurs at ground level, the current extent of localized damage to the exterior banister is presently low risk to life safety. We recommend repair, however, to prevent further unraveling of the brick banister.

We are pleased to have provided this preliminary seismic evaluation and are available to answer questions.

Sincerely,

MLA Engineering, pllc

Dennis Pradere, P.E., S.E.
Associate



Michael S. Leonard, P.E., S.E.
Principal

Attachments:

Appendix A – FEMA 154 Data Collection Form
Appendix B - Photo



The Seattle Public Library
Queen Anne Facilities Building

Appendix A
FEMA 154 Data Collection Form

Rapid Visual Screening of Buildings for Potential Seismic Hazards
 FEMA-154 Data Collection Form

Garfield Office

HIGH Seismicity

Address: 1529 4th Ave SW ~~SW~~ Zip 98119

Other Identifiers _____

No. Stories 3 Year Built 1921

Screener DP Date 9-17-14

Total Floor Area (sq. ft.) 23000

Building Name ~~Garfield Office~~ Pacific

Use Library Storage

PHOTOGRAPH

Scale: _____

NW Bell Exchange Bldg

| OCCUPANCY | | SOIL | | TYPE | | | | | | FALLING HAZARDS | | | |
|----------------|-------------|---------------|-------------|------|------|----------|-------|------|------|--------------------------|-------------------------------------|-------------------------------------|--------------------------|
| Assembly | <u>Govt</u> | | | A | B | <u>C</u> | D | E | F | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Commercial | Historic | <u>Office</u> | Residential | Hard | Avg. | Dense | Stiff | Soft | Poor | Unreinforced | Parapets | Cladding | Other: |
| Emer. Services | Industrial | School | | Rock | Rock | Soil | Soil | Soil | Soil | Chimneys | | <u>Brick</u> | |

| BASIC SCORE, MODIFIERS, AND FINAL SCORE, S | | | | | | | | | | | | | | | |
|--|------|------|----------|---------|---------|------------|--------------|----------|---------|--------------|----------|------|----------|----------|-------------|
| BUILDING TYPE | W1 | W2 | S1 (MRF) | S2 (BR) | S3 (LM) | S4 (RC SW) | S5 (URM INF) | C1 (MRF) | C2 (SW) | C3 (URM INF) | PC1 (TU) | PC2 | RM1 (FD) | RM2 (RD) | URM |
| Basic Score | 4.4 | 3.8 | 2.8 | 3.0 | 3.2 | 2.8 | 2.0 | 2.5 | 2.8 | 1.6 | 2.6 | 2.4 | 2.8 | 2.8 | <u>-1.8</u> |
| Mid Rise (4 to 7 stories) | N/A | N/A | +0.2 | +0.4 | N/A | +0.4 | +0.4 | +0.4 | +0.4 | +0.2 | N/A | +0.2 | +0.4 | +0.4 | 0.0 |
| High Rise (> 7 stories) | N/A | N/A | +0.6 | +0.8 | N/A | +0.8 | +0.8 | +0.6 | +0.8 | +0.3 | N/A | +0.4 | N/A | +0.6 | N/A |
| Vertical Irregularity | -2.5 | -2.0 | -1.0 | -1.5 | N/A | -1.0 | -1.0 | -1.5 | -1.0 | -1.0 | N/A | -1.0 | -1.0 | -1.0 | -1.0 |
| Plan Irregularity | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | <u>-0.5</u> |
| Pre-Code | 0.0 | -1.0 | -1.0 | -0.8 | -0.6 | -0.8 | -0.2 | -1.2 | -1.0 | -0.2 | -0.8 | -0.8 | -1.0 | -0.8 | <u>-0.2</u> |
| Post-Benchmark | +2.4 | +2.4 | +1.4 | +1.4 | N/A | +1.6 | N/A | +1.4 | +2.4 | N/A | +2.4 | N/A | +2.8 | +2.6 | N/A |
| Soil Type C | 0.0 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | <u>-0.4</u> |
| Soil Type D | 0.0 | -0.8 | -0.6 | -0.6 | -0.6 | -0.6 | -0.4 | -0.6 | -0.6 | -0.4 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 |
| Soil Type E | 0.0 | -0.8 | -1.2 | -1.2 | -1.0 | -1.2 | -0.8 | -1.2 | -0.8 | -0.8 | -0.4 | -1.2 | -0.4 | -0.6 | -0.8 |

FINAL SCORE, S 0.7

COMMENTS _____

Detailed Evaluation Required
 YES NO

* = Estimated, subjective, or unreliable data
 DNK = Do Not Know
 BR = Braced frame
 FD = Flexible diaphragm
 LM = Light metal
 MRF = Moment-resisting frame
 RC = Reinforced concrete
 RD = Rigid diaphragm
 SW = Shear wall
 TU = Tilt up
 URM INF = Unreinforced masonry infill

Figure 5-2 High seismicity Data Collection Form selected for Anyplace, USA.



The Seattle Public Library
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Appendix B Photos



Photo 1: Damaged banister