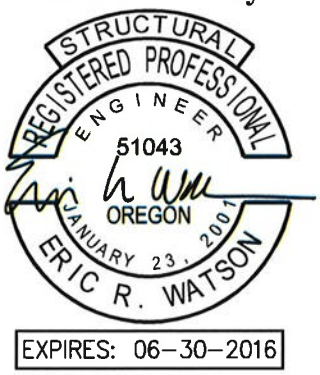
Owner-Directed Facility Seismic Evaluation

Benton County Courthouse
120 NW 4th Avenue, Corvallis, Oregon

Prepared for
Benton County



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Prepared by

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BENTON COUNTY COURTHOUSE EXECUTIVE SUMMARY

Overview

Benton County has contracted Miller Consulting Engineers to seismically evaluate the Benton County Courthouse using the ASCE 41-13 standard. As the building sits today, the vertical system of the building consists of wood framing that bears on the unreinforced masonry (URM) walls and the lateral system is dependent on the friction from the framing bearing on the URM walls. The friction capacity is sufficient to transfer the lateral loads for wind loading to the existing lateral force-resisting system, but in the event of a seismic event, the friction capacity will be lost as a result of vertical ground movement and the building will be unable to transfer the lateral loads to the existing lateral force-resisting system. Subsequently, the building elements will begin to be damaged during the seismic event and the building may collapse depending on the seismic hazard's direction (where the earthquake originated), intensity (the severity of the ground movement) and duration (how long the event lasts).

The ASCE 41-13 standard has been developed so that buildings meeting the Basic Performance Objective (BPOE) are expected to experience little damage from relatively frequent, moderate earthquakes but significantly more damage and potential economic loss from the most severe and infrequent earthquakes. In order to seismically evaluate the building, the ASCE 41-13 uses site-specific information that is generated from the U.S. Geological Survey (USGS). The USGS information provides the spectral acceleration for different return periods in which the BPOE-1E seismic hazard has a 225-year return period and the BPOE-2E seismic hazard has a 975-year return period. This information is then modified into a design acceleration considering the building's structural system and other factors such as the soil conditions at the site.

We evaluated the building using the BPOE-1E seismic hazard, which is a considered a moderate earthquake and used the Life Safety and Immediate Occupancy Building Performance Level standards with the following goals.

- **Basic Performance Objective for Existing Buildings.** The goal of this objective is to allow the occupants to safely exit the structure after an earthquake. Continued occupancy might not be likely before repair work is completed.

- **Enhanced Performance Objective for Existing Buildings.** The goal of this objective is to allow the building to be immediately operable after an earthquake. It is expected that the building will develop cracks and items that are damaged will remain in place.

We also evaluated the building using the BPOE-2E seismic hazard, which is a considered a severe earthquake and used the Collapse Prevention Building Performance Level standards with the following goal.

- **Limited Performance Objective for Existing Buildings.** The goal of this objective is to prevent the building from collapsing during a major earthquake. It is expected that the building will be severely damaged and should not continue to be occupied following the earthquake.

This two tier method of evaluation produces an envelope of results for the building using the performance levels and seismic hazards to provide feedback to where the building is deficient and to what degree the building is deficient. The evaluation identified the following items that need to be addressed considering each of the performance objectives as part of the proposed seismic upgrade:

- Strengthening the roof and floor diaphragms to transfer lateral loads to the walls
- Providing connections between the walls and diaphragm for in-plane and out-of-plane loads
- Providing connections at the roof and floor diaphragm to account for plan irregularities
- Providing concrete shear walls on the lower floors to support the in-plane loading
- Providing structural steel horizontal framing members at the stairway openings to support the unreinforced masonry walls for out-of-plane loads
- Providing structural steel support columns for the secondary support of the trusses and beams that are independent of the unreinforced masonry walls

When considering the basic and enhanced performance objectives, there are additional items that need to be addressed including the following:

- Addressing the non-structural concerns identified in the evaluation including bracing the fire suppression lines, bracing the gas line, bracing the suspended gypsum ceilings, bracing the in-line mechanical equipment and anchoring the non-compliant shelves.

Lastly, there are additional items that need to be addressed when considering the enhanced and limited performance objective including the following:

- Providing bonded shear walls to reinforce the unreinforced masonry walls at the fourth floor bell lounge for out-of-plane loads
- Providing more concrete shear walls for many of the unreinforced masonry walls to support the in-plane loading

Depending on what performance objective is selected, we anticipate that the proposed upgrade work will take approximately 12 to 24 months to complete and will require the building to be vacated during construction. It is intended that the above repairs will be completed in such a way that the new construction will be encapsulated within a wall cavity or masked in some manner to preserve the historical and architectural features where possible. The following is our preliminary estimate of probable construction cost to upgrade the building:

Performance Objective	Construction	Contingency	Total Cost	Cost per sq. foot
Basic	$4,312,271	$1,078,068	$6,737,923	$204
Enhanced	$5,824,570	$1,456,143	$9,100,891	$275
Limited	$6,966,813	$1,741,703	$10,885,645	$329

The above costs only consider the structural upgrades and corresponding work as required by the structural upgrades; the other concerns with the building such as HVAC, plumbing, ADA access or other tenant improvement costs are not included in this cost. The above cost estimate is based on the work being completed as a whole and not broken into phases to allow for the continued occupancy of the building during construction. Furthermore, these estimates are limited to the repairs of the detailed items and do not include relocation costs of staff or other soft costs. Within our opinion of probable construction cost estimate, we have included the contractor's overhead and profit, as well as a 25% construction contingency as further detailed in the cost portion of this report.

Background

The Benton County Courthouse is located at 120 NW Fourth Avenue in Corvallis, Oregon, and is Oregon's oldest active courthouse. The building was originally constructed around 1889 with one major renovation that was completed circa 1978 that added the third and fourth floors, updated all the interior spaces, and added central air conditioning in the courtrooms. The current size of the building is approximately 33,052 square feet. Original construction documents were

not available for our review, but the plans from the remodel from Cy Stadsvold (1977) were reviewed, of which the basic floor plan has changed very little since the remodel was completed. Also, we received and reviewed documents from K & D Engineering (1985), Endex Engineering (2001), Hennebery Eddy Architects (2008), KPFF (2012) and Pillar Consulting Group (2015), which were used in our evaluation as well. We also conducted three visual site observations at the building observing all the accessible spaces including the clock tower, the elevator shaft, the attic spaces, the third floor cavity areas and above the restrooms on the second floor.

The courthouse building is a five-story structure comprised of three primary areas on each floor, which consist of a central core area and an east and west wing area to the east and west of the core area. The basement level is a partially exposed story with the concrete floor slab that is approximately 4 feet below the exterior grade, but has an ADA-accessible ramp on the west side of the building, as well as an employee entry access on the east side of the building. The first floor of the courthouse is approximately 6 feet above the exterior grade and houses the main public access entry on the east side of the building. The building houses the county courts, the judge's offices, and the district attorney's offices and support staff, as well as several other county departments including the elections office and the licensing office.

The exterior walls of the building consist of 30" unreinforced stone walls at the basement, 20" unreinforced brick walls with stucco exterior finish at the first floor, 16" unreinforced brick walls with stucco exterior finish at the second floor, and 12" unreinforced brick walls with stucco exterior finish at the third and fourth floors. The interior load bearing walls of the building typically consist of 12" unreinforced brick walls while the non-load bearing interior walls typically consist of light wood framing with plaster finish. The clock tower is a light wood-framed structure with board sheathing that sits atop the 12" unreinforced brick walls of the fourth floor bell lounge room in the east wing; the clock tower walls consist of battered light wood framing with four primary support columns that support each section of the tower and extend from the lower section floor (bell level) to the top of the middle section (clock level). The upper section (flag level) has steep 3x rafters that are supported at the floor with a tension ring and at the peak by a compression ring.

The roof framing of the building consists of 2x roof rafters at 24" o.c. typically that bear on the exterior walls with straight tongue-and-groove lumber roof sheathing (the lumber is installed

perpendicular to the framing). The rafters are notched and toenailed to a 4 x 12 wood bearing plate that was set in a bed of mortar on top of the brick walls that also has small diameter bolts (3/8" diameter) spaced at 10' o.c. that appear to be embedded into the top of the brick wall. The bolts have wood spacers for unknown reasons of varying length where the nut bears on top of the spacer. The core area roof is framed differently than the wings and has heavy timber trusses at 12' o.c. that bear on heavy steel plates on the exterior brick walls, which the trusses support the roof and ceiling framing. However, the heavy steel plates at the truss bearing locations do not appear to be anchored or connected to the top of the brick wall in any way.

The floor framing of the building consists typically of 3x floor joists spaced at 16" o.c. with straight tongue-and-groove lumber floor sheathing observed directly above the joists. It was reported that the floors either have another layer of ¾" finished wood flooring or a layer of ¾" plywood sheathing above the base layer. The floor joists have varying bearing conditions, which include the following: bearing on a wood bearing plate at a ledge where the bearing wall thicknesses change; embedded in the bearing wall where the wall thickness does not change; or bearing on a wood bearing plate on top of the wall, which only occurs at the clock tower. In each of these bearing conditions, there was no positive connection observed from the floor structure to the wall in order to transfer in-plane or out-of-plane loads from the diaphragm to the walls or vice versa. Where the floor joists are parallel with the walls, there is a joist in close proximity to the wall, but there was no positive connection observed from the joist to the wall either.

Scope of Work

Miller Consulting Engineers, Inc. was contracted by Benton County to provide an ASCE 41-13 evaluation of the county courthouse located in Corvallis, Oregon, using three criteria found in the *ASCE 41-13* document. The first criterion was considered the Basic Performance Objective (BPOE) and utilizes the Basic Safety Objective for Life-Safety (3-C). The second criterion was considered the Enhanced Performance Objective (EPOE) and utilizes an immediate occupancy structural performance level (S-1) and a non-structural performance level (N-B), which is position retention of non-structural components. And the third criterion was considered the Limited Performance Objective (LPOE) and utilizes a collapse prevention structural performance level (5-C) and a non-structural performance level (N-D), in which non-structural components are not evaluated. Both the BPOE and the EPOE use the BSE-1E seismic hazard level, which is an earthquake that has the probability of exceedance of 20% in 50 years or a mean return period

of 225 years between occurrences. The LPOE uses the BSE-2E seismic hazard level, which is an earthquake that has the probability of exceedance of 5% in 50 years or a mean return period of 975 years between occurrences.

For each of the evaluations, the non-structural reviews exclude building contents and furnishings. Furthermore, soils information was based on information obtained from the Oregon Department of Geology and Mineral Information (DOGAMI) website, which provided the site classification, soil rupture information, and liquefaction information for this study.

Miller Consulting Engineers, Inc. (MCE) also provided an engineer's preliminary estimate of probable construction costs to correct deficiencies found based on the evaluations. These estimates are limited to the repairs of the items and do not include relocation costs of staff or other soft costs.