

Basis of Design

This section applies to the seismic evaluation, analysis, and upgrade of existing buildings.

Background

- In addition to the “As Built” construction drawings maintained in Facilities Records, the University has completed structural analysis studies of many of the buildings on campus. Also, in October 1991, the Earthquake Readiness Advisory Committee (ERAC) at the University of Washington issued a report detailing its findings of its campus-wide seismic hazards survey. The purpose of the ERAC report was to establish a consistent set of rules to prioritize which existing buildings needed further seismic analysis. The ERAC report also prioritized existing buildings according to Damage Index numbers and Life Safety Index numbers and recommended a number of facilities that should have further detailed seismic analysis performed by a licensed structural engineer. A microfiche copy of the ERAC report is available from Record Services under Engineering Reports

Design Criteria

Evaluate and analyze in accordance with the following:

- 1) Perform a seismic study and evaluation per the latest edition of the American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) 31, “Seismic Evaluation of Existing Buildings”.
- 2) Design the upgrade per the latest edition of the Federal Emergency Management Agency (FEMA) 356, “Prestandard and Commentary for the Seismic Rehabilitation of Buildings”. Utilize ASCE 41 when it is published (publication estimated in Spring, 2007).

ASCE/SEI 31 Study

- Use “High” Level of Seismicity in the evaluation.
- Use “Life Safety” Performance Level except for Hospital and other essential facilities use “Immediate Occupancy” Performance Level.
- Determine “Site Class” from information contained in an existing geotechnical report for a particular building or neighboring building. Obtain new geotechnical information if no existing information is found.
- Conduct Tier 1 evaluation for all buildings. Conduct Tier 2 and 3 evaluations where required by ASCE/SEI 31 based on the building type, number of stories, and level of seismicity.
- Design proposed concepts for seismic strengthening in accordance with the applicable material chapters of the International Building Code (IBC), latest edition.

The ASCE/SEI 31 study shall include the following:

- Document review (existing drawings, specifications, and soils reports)
- General and structural building description. Nonstructural systems descriptions that affect seismic performance.
- Field survey including areas of structural distress or damage. Material test results as necessary.

- Statement of design criteria.
- Seismic analysis, including copy of evaluation checklists and structural calculations.
- Prioritized list of deficiencies.
- Concept designs (to allow cost estimate accuracy of $\pm 20\%$)
- Conceptual cost estimates
- Consultant to present the findings of the study along with the other requirements noted for the Programming Phase under the DESIGN EVALUATION section below at a meeting scheduled with CPO and Campus Engineering prior to issuing final copy.

FEMA 356 (ASCE 41) Upgrade

- Design all upgrades to meet the Life Safety Building Performance Level (3-C) for the BSE-1 Earthquake Hazard Level.
- Submit list of proposed upgrades that would likely be needed to upgrade the building to the Collapse Prevention Building Performance Level (5-E) for the BSE-2 Earthquake Hazard Level. The intent is to provide this list based on the Structural Engineering firm's experience on similar buildings and based upon engineering judgment. This list is to be discussed at a meeting scheduled with CPO and Campus Engineering to determine what items should be included with the upgrade design.
- Design is to include all of the mitigation work necessary to clear all the non-conformances identified in the ASCE/SEI 31 study.
- In Unreinforced Masonry (URM) Buildings, where the roof and floor structure is supported by a URM wall, provide secondary structure to support the vertical loads of the roof and floor members. This includes support of all the floor and roof structure including joists, beams, girders, rafters etc.
- For hospital and other essential facilities utilize the following Enhanced Rehabilitation Objective: Immediate Occupancy Performance Level (1-B) at BSE-1 Earthquake Hazard Level, and Collapse Prevention Performance Level (5-E) at BSE-2 Earthquake Hazard Level.
- Perform the design of seismic strengthening elements in accordance with the applicable material chapters of the IBC, latest edition.
- All existing structural defects discovered during design, demolition, and construction shall be repaired. This includes patching of spalls at exposed rebar in slabs, beams, and columns.

Design Evaluation

- Programming Phase: Provide the findings of the ASCE/SEI 31 study in a bound report. Along with the ASCE/SEI 31 study, submit a list of potential upgrades that would likely be needed to satisfy a FEMA 356 (ASCE 41) Collapse Prevention Building Performance Level (5-E) for the BSE-2 Earthquake Hazard Level. The project budget should consider the cost of both the ASCE/SEI 31 and FEMA 356(ASCE 41) upgrade requirements. In URM buildings, the project budget should also include the secondary structure to support the vertical loads of the roof and floor members. Include an executive summary which describes the existing building, evaluates the condition of the building, identifies and comments on the relative significance of any deficiencies, and makes alternative recommendations for correcting those deficiencies. Divide the recommended seismic improvements into those

which can be completed with minimal impact on the occupants of the building and those that will require vacating all or part of the building.

Related Sections

- Facilities Services Design Guide - General Requirements - Structural

END OF DESIGN GUIDE SECTION