SEISMIC SAFETY

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POLICY

It is University policy - to the maximum extent feasible by present earthquake engineering practice - to acquire, build, maintain, and rehabilitate buildings and other facilities which provide an acceptable level of earthquake safety, as defined in this policy, for students, employees, and the public who occupy those buildings and other facilities at all locations where University operations and activities occur. It is also University policy to repair University buildings and other facilities damaged in an earthquake as set forth below in the section entitled Repair of Buildings and Other Facilities Damaged by Earthquakes. Feasibility is to be determined by weighing the practicability and cost of protective measures against the gravity and probability of injury resulting from a seismic occurrence.

Responsibility. The President is responsible for overall administration of this policy and shall provide for (1) interpretation or clarification of the policy as may be required; (2) development of seismic safety criteria, standards, and guidelines supplementary to the policy; (3) evaluation of seismic safety programs and review of specific proposals for the abatement of seismic hazards; and (4) determination of University-wide priorities among seismic safety projects and other projects proposed for inclusion in the Capital Improvement Program.

The President shall assign specific duties and authority to individuals within the Office of the President who may engage professional consultants or other specialists to advise and assist them in matters involving seismic safety.

The Chancellors, Senior Vice President-Business and Finance, Vice President-Agriculture and Natural Resources, Director-Lawrence Berkeley Laboratory, Director-Lawrence Livermore Laboratory, and Director-Los Alamos Scientific Laboratory are the officials responsible for taking all reasonable steps to assure protection of persons under their respective jurisdictions against the effects of earthquakes which could result in the loss of life or injury to persons. Each responsible official shall assign specific duties and authority to individuals under his or her jurisdiction for the purpose of discharging this responsibility.

Program for Abatement of Seismic Hazards.
Each responsible official shall develop a program for abatement of seismic hazards in existing buildings and other facilities within their respective jurisdictions and shall establish priorities for seismic safety projects in accordance with this policy. Each responsible official shall coordinate proposed seismic correctional work with (1) proposed fire protection work (see University policy on fire protection, issued September 22, 1971) [Editor's Note: In place of the aforementioned policy on fire protection, the University currently follows, as policy, fire protection regulations of CCR, Title 24, Part 9.], (2) other proposed work involving environmental health and safety considerations, and (3) reasonable and prudent rehabilitation for functional and programmatic improvements.

The program for abatement of seismic hazards shall include identification and temporary and permanent correction of potential earthquake falling, sliding, or rupturing hazards such as, but not limited to, interior and exterior building elements, utilities, equipment, fixtures, furnishings, and other contents which could be dislodged, fall, overturn, slide, or rupture during seismic disturbances. Temporary measures to reduce the risks of injury pending permanent corrective action shall be considered and implemented if feasible.

The Consulting Structural Engineer.
Each responsible official shall secure the services of one or more consulting structural engineers experienced in field investigations and analyses of damage in earthquakes. The consulting structural engineer shall be required to examine existing buildings and other facilities as directed by the responsible official and to submit to the responsible official reports on the adequacy of the resistance of such campus buildings and other facilities to seismic forces based on (1) conformance to the current seismic provisions of California Code of Regulations (CCR), Title 24, California Building Standards Code, or local seismic requirements (e.g., city or county building regulations), whichever requirements are more stringent; and (2) the consulting structural engineer's professional evaluation of their anticipated seismic performance, expressed in terms of Good, Fair, Poor, or Very Poor, as defined in Appendix A, with respect to degree of risk of injury to persons but not necessarily in conformance with the above specific seismic

provisions. For buildings and other facilities which are reported as Poor or Very Poor by the consulting structural engineer, the responsible official shall immediately consider alternatives to undiminished continued use and occupancy of the buildings and other facilities, including total or partial evacuation, temporary emergency measures, reductions in use, reconstruction, or combinations of these alternatives, and shall then take appropriate action.

The consulting structural engineer shall be required to include in all reports recommendations regarding priorities for abatement of seismic hazards and estimates of costs for correcting seismic deficiencies in accordance with this policy.

Standards for Seismic Rehabilitation Projects.
When evaluation by the consulting structural engineer of existing buildings or other facilities discloses conditions which do not afford an acceptable level of safety, proposed correctional work shall be incorporated in the program developed by the responsible official for abatement of seismic hazards and integrated in the University's proposed Capital Improvement Program. Seismic rehabilitation projects shall provide, as a minimum, an acceptable level of earthquake safety based on the sole consideration of the protection of life and prevention of personal injury, insofar as predictable, at a level of safety equivalent to that which would be established by compliance with the current seismic provisions of CCR, Title 24, California Building Standards Code, or local seismic requirements, whichever requirements are more stringent, disregarding, insofar as possible, potential building damage not jeopardizing life, which would be expected from one earthquake of the intensity of at least IX on the Modified Mercalli Intensity Scale (modified by Charles F. Richter in 1958, as shown in Appendix B), except that an intensity of VIII can be utilized for buildings on the Davis and ~~San Diego~~
Merced campuses. The intent of seismic rehabilitation shall be to reconstruct buildings and other structures so that they would have a Good seismic performance rating, as defined in Appendix A. based on the present state of the practice of earthquake engineering.

When funds for seismic rehabilitation are limited, the program developed by the responsible official may include a phased rehabilitation program for selected buildings. The first phase would have the goal of reducing the greatest life safety hazards of the structure such as reducing the potential of partial building collapse and/or reducing falling hazards at building entrances and along adjacent walkways. Later phases, to be performed when funds are available, would complete the seismic rehabilitation program of the structure. The consulting structural engineer shall assist the responsible official in establishing the scope of work in each phase of a phased rehabilitation program.

Preliminary plans for all seismic rehabilitation projects shall be reviewed by the consulting structural engineer, who shall verify the scope of the rehabilitation work and shall prepare any recommendations regarding any special criteria which should be considered in the project design. Upon completion of plans and specifications, the consulting structural engineer shall review the plans and structural calculations for completeness, general accuracy, appropriateness of details, and for compliance with any special criteria. The design structural engineer shall incorporate comments into the plans prior to bidding.

Repair of Buildings and Other Facilities Damaged by Earthquakes. In addition to the requirements established elsewhere in the Policy pertaining to the construction, maintenance and rehabilitation of University buildings and facilities, the following standards shall apply to repair of University buildings and facilities which are damaged by earthquakes.

1. Subject to the provisions of paragraph 2, below, when the lateral load resisting capacity for the building or facility as a whole is reduced by less than 10%, repairs shall be in conformity with the requirements of codes currently applicable to University construction. Related work required by currently applicable codes shall also be performed in areas affected by the repairs.

2. When (i) the lateral load resisting capacity for the building or facility as a whole is reduced by 10% or more, or (ii) in the case of hospitals, skilled nursing facilities, intermediate-care facilities and essential service buildings as defined in Table 23-K of the 1991 California Code of Regulations, Title 24, California Building Standards Code, Part 2, California Building Code, the lateral load resisting capacity of the entire building or facility is reduced by 5% or more, or (iii) when the lateral load resisting capacity is reduced by less than 10%, but the estimated cost of repairs required to bring damaged elements into substantial compliance with the seismic performance objectives of current codes exceeds 10% of the replacement cost of the entire building or facility,

the entire building or facility shall be made to substantially comply with the seismic performance objectives of the codes currently applicable to University construction. Related work required by currently applicable codes shall also be performed in areas affected by the repairs. For purposes of this Policy, "replacement cost" is defined as construction cost of a like number of assignable square feet designed to house a like program on the same site and built in compliance with codes currently applicable to University construction.

3. When calculating the percentage reduction in total lateral load resisting capacity of any building or facility the construction of which was first completed prior to January 1, 1941, damage to all building or facility elements which served as lateral resisting elements shall be included, even if such elements were not originally designed or intended as lateral resisting elements, unless the building or facility possesses sufficient seismic resistance to substantially comply with the performance objectives of the codes currently applicable to University construction without these elements.

New Buildings and Other Facilities; Hospitals.
The design and construction of new buildings and other facilities on University premises shall, as a minimum, comply with the current seismic provisions of CCR, Title 24, California Building Standards Code, or local seismic requirements, whichever requirements are more stringent. In addition, provisions shall be made for adequate anchorage for seismic resistance of nonstructural building elements-including, but not limited to, glass, fixtures, furnishings, and other contents, equipment, material storage facilities, and utilities (gas, high-temperature water, steam, fireprotection water, etc.) - with respect to potential hazards to persons in the event of seismic disturbances.

New University buildings shall not be constructed on the trace of an active geological fault.

Preliminary plans for new major capital improvement projects, except pre-engineered buildings, wood-framed buildings of less than 3,000 square feet, and buildings not intended for human occupancy other than hospitals proposed for construction shall be examined by the consulting structural engineer, who shall prepare recommendations regarding any special criteria that, in that engineer's opinion, should be recognized in providing adequate resistance to seismic forces to minimize the risk of injury to persons and damage to property. Upon completion of the final plans, the consulting structural engineer shall review the plans and structural calculations for completeness, general accuracy, structural details, and for compliance with any special criteria previously established. Should seismic design standards be revised during the period between completion of final plans and the date of advertisement for bids, the consulting structural engineer shall review again the plans and structural calculations before advertising for bids. The design structural engineer shall incorporate all comments into the plans prior to bidding.

Prior to the release of funds for structures other than hospital or for seismic rehabilitation projects, a letter or report from the campus consulting structural engineer shall be submitted, stating that the construction plans are in general conformance with the University policy on seismic safety.

The design and construction of new facilities or alterations for hospitals, skilled nursing facilities, and intermediate-care facilities as defined in Section 15001 of the California Health and Safety Code, on University premises or under University operation shall comply with CCR, Title 24, California Building Standards Code.

BACKGROUND

This policy was setforthinVicePresidentMcCorkle'slettertotheChancellorsetal.,of January 20, l975. It was reported and accepted by The Regents' Committee on Grounds and Buildings on January 16, 1975. The policy was revised by President Gardner in his letter to the Chancellors et al., of May 17, 1988 and it was revised by President Peltason in his letter to the Chancellors et al., of January 17, 1995.

GUIDELINES

The Senior Vice President Business and Finance is responsible for coordination of seismic safety programs and may issue appropriate administrative guidelines as necessary.

APPENDIX A

Meaning of Good, Fair, Poor, or Very Poor Seismic Performance Ratings

"Good"
seismic performance rating would apply to buildings and other structures whose performance during a major seismic disturbance "is anticipated to result in some structural and/or nonstructural damage and/or falling hazards" that would not *significantly*
jeopardize life. Buildings and other structures with a "Good " rating would have a level of seismic resistance such that funds need not be spent to improve their seismic resistance to gain greater life safety, and would represent an acceptable level of earthquake safety.

"Fair"
seismic performance rating would apply to buildings and other structures whose performance during a major seismic disturbance is anticipated to result in structural and nonstructural damage and/or falling hazards that would represent *low*
life hazards. Buildings and other structures with a "Fair" seismic performance rating would be given a low priority for expenditures to improve their seismic resistance and/or to reduce falling hazards so that the building could be reclassified "Good."

"Poor"
seismic performance rating would apply to buildings and other structures whose performance during a major seismic disturbance is anticipated to result in significant structural and nonstructural damage and/or falling hazards that would represent *appreciable* life hazards. Such buildings or structures either would be given a *high priority* for expenditures to improve their seismic resistance and/or to reduce falling hazards so that the building could be reclassified as "Good," or would be considered for other abatement programs, such as reduction of occupancy.

"Very Poor"
seismic performance rating would apply to buildings and other structures whose performance during a major seismic disturbance is anticipated to result in *extensive*
structural and nonstructural damage, potential structural collapse, and/or falling hazards that would represent *high* life hazards. Such buildings or structures either would be given the *highest priority* for expenditures to improve their seismic resistance and/or to reduce falling hazards so that the building could be reclassified "Good," or would be considered for other abatement programs such as reduction of occupancy.

"Major seismic disturbance" is defined for the purposes of these seismic performance ratings as an earthquake *at the site* which would be given a Modified Mercalli Intensity Scale (modified by Charles F. Richter in 1958) rating of at least IX based on the description of the structural effects, except that an intensity of VIII can be utilized for buildings of the Davis and ~~San Diego~~ Merced campuses. It is assumed that the intensity of the ground shaking is not appreciably greater in areas rated MM X, MM XI, and MM XII than in areas rated MM IX. The damage descriptions in MM X, MM XI, and MM XII relate more to the geologic features and non-building structures.

"Falling Hazards" are defined for the purposes of these seismic performance ratings as potential falling or sliding hazards such as interior and exterior building elements including parapets, ornamentation, chimneys, walls, and partitions, but excluding equipment, fixtures, ceilings, furniture, furnishings, and other contents. The falling hazards in the excluded list above should not be used in the determination of the seismic performance rating of a building or structure but should be abated.

APPENDIX B

Modified Mercalli Intensity Scale***

I. Not felt. Marginal and long-period effects of large earthquakes.

II. Felt by persons at rest, on upper floors, or favorably placed.

III. Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks, or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of [intensity] IV, wooden walls and frames creak.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small, unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

VI. Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls, Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle).

VII. Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments). Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of motor cars affected. Damage to masonry C; partial collapse. Some to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

IX. General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations.) Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated areas, sand and mud ejected, earthquake fountains, sand craters.

X. Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.

XI. Rails bent greatly. Underground pipelines completely out of service.

XII. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

The version of the scale given above was published by Richter (1), and is a slight abridgment of the original scale. Richter also included the description of the types of construction included here. The original scale was published in 1931 by H.O. Wood and Frank Neumann (2).

Definition of Masonry A, B, C, D:

Masonry A.
Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.

Masonry B. Good workmanship and mortar; reinforced, but not designed in detail to resist lateral forces.

Masonry C.

Ordinary workmanship and mortar; no extreme weaknesses like failing to tie in at the corners, but neither reinforced nor designed against horizontal forces.

Masonry D. Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

(Bibliography:)

1. Richter, C.F., "Elementary Seismology" W.H. Freeman and Co. Inc., 1958, pp. 136-138.
2. Wood, H.O., and Neumann, "Modified Mercalli Intensity Scale of 1931," Bull. Seism. Soc. Am., 1931, 21:277-283.

Back to Index of Policies

Back to Table of Contents