METHODS OF SEISMIC HAZARDS EVALUATION, FOCUS 95 pdf

1: Monitoring Seismic Activity (U.S. National Park Service)

Proceedings of the Topical Meeting on Methods of Seismic Hazards Evaluation, Focus ' September , , Las Vegas, Nevada.

In , one month after the Long Beach Earthquake destroyed 70 schools, seriously damaged others, and caused minor damaged to more, California passed the Field Act to ensure seismic safety in new public schools. Following the Long Beach Earthquake, the state also passed the Riley Act, which requires local governments to have building departments that issue permits for new construction and alterations to existing structures and conduct inspections. Permit fees paid by building owners generally fund the work of local building departments. The Act also set minimum seismic safety requirements that have since been incorporated into all building codes. The state passed the Strong Motion Instrumentation Act in in response to the extensive damage to buildings and bridges caused by the San Fernando Earthquake. The earthquake highlighted the need for more data on strong ground shaking during earthquakes and on the response of structures to the shaking. The Act established a statewide network of strong motion instruments to gather vital earthquake data for the engineering and scientific communities. Data obtained from the strong motion instruments is used to recommend changes to building codes, assist local governments in the development of their general plans, and help emergency response personnel in the event of a disaster. Requires city and county plans to include seismic safety elements. The law was another response to the San Fernando Earthquake, which produced extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. Before issuing building permits, cities and counties must require a geologic investigation to ensure that proposed buildings will not be constructed across active faults. Proposed building sites must be evaluated by a licensed geologist. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault. The loss of emergency functions and hospital collapses due to the San Fernando Earthquake prompted passage of the Hospital Seismic Safety Act of Regulates the design, construction and alteration of hospitals; set seismic safety standards for new hospitals; created an advisory Hospital Building Safety Board. To address these weaknesses, in the state legislature created the independent California Seismic Safety Commission CSSC to provide a consistent earthquake policy framework for the state. Directs California Seismic Safety Commission to assess policy and program implications of earthquake prediction and to develop seismic safety program and financing plan for the state. Requires design and construction standards for hospitals; requires that after Jan. After the Mexico City Earthquake, in California passed the Earthquake Hazards Reduction Act, which called for a coordinated state program to implement new and expanded activities to significantly reduce earthquake threat. The program is coordinated by California Seismic Safety Commission, which is required to specify priorities, funding sources and amounts, schedules, and other resources. As of , local governments have established programs and 16, buildings have either been retrofitted or demolished. Cities and counties rely on a variety of funding sources, including building permit fees, to pay for these programs. Some local programs offer financial, planning, and zoning incentives to building owners for retrofit. In the state passed the Essential Services Building Seismic Safety Act to require enhanced regulatory oversight by local governments during the design and construction of new essential service facilities, such as fire and police stations and emergency communications and operations facilities. There are no statewide regulations for evaluating and retrofitting locally regulated essential services buildings that existed prior to except for unreinforced masonry buildings in some jurisdictions. Some local governments and state agencies have voluntarily retrofitted or replaced their vulnerable buildings. Requires all private schools to develop disaster plans and an earthquake emergency procedure system. Since the San Fernando Earthquake, CalTrans has been authorized to seismically retrofit vulnerable state and local bridges. The purpose of the Act is to reduce the threat to public safety and to minimize the loss of life and property by identifying and mitigating these seismic hazards. The Act requires geotechnical investigations to identify hazards and formulate mitigation measures before permitting most developments within mapped Zones of Required Investigation. Establishes seismic safety standards for ambulatory surgical centers; requires fixed medical

equipment floor roof or wall mounted to be installed using services of licensed architect or structural engineer; and requires inspection every five years. Requires new and replacement water heaters to be braced and anchored. Requires CalTrans to prepare plan to retrofit transportation structures; requests UC and requires CSU to give priority consideration to seismic safety in allocation of funds for construction projects. Authorizes local governments to adopt ordinances requiring installation of earthquake sensitive gas shutoff devices in buildings due to motion caused by an earthquake; allows Division of the State Architect to establish a certification procedure for installation. The California Emergency Services Act provides the legal authority for emergency management and the foundation for coordination of state and local emergency response, recovery, preparedness, and mitigation activities throughout California. It is the intent of this chapter to provide that authority. It is the purpose of this chapter to authorize, guide, and otherwise enable cities, counties, and other entities to prepare in advance of a disaster, such as a devastating earthquake, for the expeditious and orderly recovery and reconstruction of the community or region. Each city, county, or other local subdivision of the state, may prepare, prior to a disaster, plans and ordinances facilitating the expeditious and orderly recovery and reconstruction of the area under its jurisdiction, should a disaster occur. These plans and ordinances may include any of the following: An evaluation of the vulnerability of specific areas under its jurisdiction to damage from a potential disaster, together with streamlined procedures for the appropriate modification of existing general plans or zoning ordinances affecting those areas after a disaster. The Legislature finds and declares that the disaster response of state agencies does not adequately focus on the economic impact of a natural disaster on the business community. It is the purpose of this chapter to institutionalize the planning and response of state agencies to disasters in order to reduce economic hardship stemming from these disasters to business. The Director of the Office of Emergency Services shall invoke the assignments made pursuant to Section , specifying the emergency functions of each agency or department. The Director of the Office of Emergency Services, in executing the purposes of this chapter, shall establish appropriate task forces or emergency teams to include concerned elements of federal, state, and local governments and the private sector. Applicants are also required to have on file with Cal EMA, a resolution designating an authorized representative OES for each disaster. The primary responsibility for emergency management lies with local government. Local jurisdictions first use their own resources, and as they are exhausted, obtain more from neighboring cities and special districts, the county in which they are located, and other counties throughout the state through the Statewide Mutual Aid System. This article applies to the transfer by sale, exchange, installment land sale contract , lease with an option to purchase, any other option to purchase, or ground lease coupled with improvements, of any real property described in subdivision or residential stock cooperative, improved with or consisting of not less than one nor more than four dwelling units. The following are representations made by the transferor and his or her agent s based on their knowledge and maps drawn by the state and federal governments. This information is a disclosure and is not intended to be part of any contract between the transferee and transferor. The disclosures must indicated if the real property lies within any of the following hazardous areas: The Legislature also finds that decisions involving the future growth of the state, most of which are made and will continue to be made at the local level, should be guided by an effective planning process, including the local general plan, and should proceed within the framework of officially approved statewide goals and policies directed to land use, population growth and distribution, development, open space, resource preservation and utilization, air and water quality, and other related physical, social and economic development factors. Costs and benefits of growth. The Legislature further finds and declares that recommendation, continuous evaluation and execution of statewide environmental goals, policies and plans are included within the scope of the executive functions of the Governor and responsibility for assuring orderly administration of this process within state government should be assigned to a governmental unit reporting directly to the Governor.

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2: Hazard and Risk Assessment

Proceedings of the September meeting, in sections on methods and uncertainty in seismic hazards, field data acquisition and analysis for ground motion and faulting, tectonic models, engineering applications, and postclosure impact of tectonic activity.

As of , only 6 percent of the operating seismographs in the United States could accurately record both very small and fairly large earthquakes on-scale USGS, Digital waveform data, either weak or strong motion, are used to further improve earthquake locations, characterize seismic source and wave propagation effects, measure the state of stress in the brittle crust, and develop ground motion attenuation models. Digital waveform data also have many uses in earthquake engineering, as described in Chapter 6. Monitoring in the Urban Environment For close to a century, standard seismological practice has been to site delicate instruments far from urban centers and other sources of noise. Studies of weak ground motions, faint vibrations from earthquakes occurring around the globe, led to important scientific advances during the twentieth century. Recent earthquakes, however, have dramatically demonstrated the vulnerability of the urban environment to earthquake-related damage. Unprecedented growth in urban areas during the last few decades has served to increase the level of earthquake risk faster than our efforts to reduce or mitigate it. Addressing seismic hazard and risk issues in the urban environment has required a change in the standard Page 81 Share Cite Suggested Citation: Assessing the Value of Reduced Uncertainty. The National Academies Press. Recording on-scale ground motions close to active faulting the near field and within structures, and obtaining a better understanding of ground response in urban areas, have become critical elements in the national goal of reducing seismic risk. The existing ground motion hazard mapsâ€”as illustrated in Figure 4. Tsunami Monitoring Tsunamis are oceanic gravity waves that may be caused by submarine earthquakes or other geologic processes such as volcanic eruptions or landslides. In the United States, tsunamis present a significant although relatively infrequent danger to coastal communities in California, Washington, Oregon, Alaska, Hawaii, and Puerto Rico. Seismic monitoring to detect large subduction zone earthquakes around the circum-Pacific and Caribbean regions provides valuable public safety information in advance of tsunami arrivals. Distant tsunamis and locally generated tsunamis require responses at significantly different time scales. For local tsunamis, the ability to warn coastal communities of a potentially dangerous situation immediately after a large local earthquake is the key to public safety. Locally generated tsunamis can reach the shoreline quickly within as little as 5 minutes , giving authorities limited time to issue any warnings or evacuations. The Mw 7. Regional groups throughout the Pacific Northwestâ€”such as the University of Washington, the Oregon Department of Geology and Mineral Industries, and the Bonneville Power Authorityâ€”recognize the significant local tsunami hazard posed by the Cascadia subduction zone and have begun installing strong motion instruments for real-time monitoring and warning for coastal communities. Distant or tele-tsunamis generated from other parts of the circum-Pacific are monitored by the Pacific Tsunami Warning System, which was established in following the Aleutian Unimak Island tsunami. This difference in wave speed makes it possible to issue tsunami warnings throughout the Pacific basin after an earthquake has been detected, but before the arrival of the tsunami. A Tsunami Watch Bulletin is released when an earthquake occurs with a magnitude of 6. A Tsunami Warning Bulletin is released when information from tidal stations indicates that a potentially destructive tsunami exists. Although great strides have been made over the past 50 years in tsunami detection and warning, 75 percent of all tsunami warnings issued since were false alarms and evacuation was not required. Not only are these false alarm evacuations costly, they also erode the credibility of the tsunami warning system. Furthermore, the fear and disruption of a false alarm can itself put a population at physical riskâ€”fatalities and injuries have occurred during an evacuation due to such things as heart attacks and accidents. Improved seismic data, coupled with information from deep-sea buoys that detect water pressure changes, will enable the accurate determination of tsunami size in real time and eliminate or reduce unnecessary coastal evacuations. The recent provision of funding to enable the USGS to expand seismic instrumentation for tsunami warning and response, 1 following the Indian Ocean tsunami of , represents an

explicit recognition by Congress of the value of seismic networks for emergency response. Volcano Monitoring Nearly every recorded volcanic eruption has been preceded by an increase in earthquake activity beneath or near the volcano. For this reason, seismic monitoring has become one of the most useful tools for eruption forecasting and monitoring McNutt, Systematic volcano monitoring enabled the accurate prediction, from hours to even a few weeks in advance, of nearly all the post-May 18, , dome-building 1 H. Page 83 Share Cite Suggested Citation: Real-time and near-real-time seismic monitoring capabilities at numerous volcanoes around the world provide a major advance for identifying and guarding against volcano hazards. In addition to monitoring, the improved ability to locate earthquakes recorded by permanent seismic networks provides three-dimensional images of the magmatic plumbing systems beneath some volcanoes. The increasing use of broadband seismometers has facilitated the complete recording and comprehensive analysis of long-period seismic signals, which have preceded and accompanied a number of eruptions. A more quantitative understanding of long-period seismicity not only refines short-term forecasts of volcano hazards, but also improves our knowledge of magma transport and eruption dynamics. The economic consequences of volcanism in the United States are wide and varied, ranging from the destruction associated with the May eruption of Mount St. In the past 30 years, more than 90 jet-powered commercial airplanes worldwide have encountered clouds of volcanic ash and suffered varying amounts of damage as a result Guffanti and Miller, Coordinated observations, using both land- and space-based data, are needed to evaluate volcanic threats in real time. Seismic monitoring coupled with satellite observations and ash-cloud transport models enables the air transportation industry to reroute flights and avoid costly ash-cloud encounters. More than potentially dangerous volcanoes lie under air routes in the North Pacific. Along the Alaska Peninsula and the Aleutian Islands there are more than 41 historically active volcanoes. As of July , the Alaska Volcano Observatory operated networks at 23 of the most dangerous volcanoes in Alaska and had plans to instrument additional volcanoes to achieve the ANSS goal of having all potentially active volcanoes in the United States monitored by at least three seismograph stations within 20 km of the volcano. In the western United States, ground motion models are based mostly on the recorded ground motions of past earthquakes. In the central and eastern United States, they are based mostly on computer simulations of earthquake ground motions derived using seismological theory e. The strength of earthquake ground motion has a large degree of variability from one location to the next, even when these locations are at the same distance from the same earthquake. For this reason, ground motion models specify two measures of the ground motion levelâ€”the average value and the variability standard deviation about this average value e. The standard deviation in ground motion models typically has values that range from a factor of 1. This large degree of variability is reflected in the irregular distribution of both damage and ground shaking intensity patterns observed following earthquakes. Use of Ground Motion Prediction Models for Building Codes and Seismic Design Because of the uncertainty in the location and timing of future earthquakes, engineers generally take a probabilistic approach to characterizing the strength of future earthquake ground motions for seismic design at a given site. In this approach, the frequency with which a given ground motion level is expected to occur at a site is calculated based on consideration of the frequency of occurrence of all of the possible earthquakes that could occur on all of the faults that are close enough to affect the site. The probabilistic ground motion calculation also takes into account the variability in the level of the ground motion expected from a given earthquake. In seismically active areas such as the coastal regions of California, earthquakes recur on some faults as frequently as once every few hundred years. Consequently, construction design may have to accommodate the largest ground motion that would be expected from the occurrence of 10 earthquakes on such faults. If there were no variability in the ground motion level caused by a given earthquake, then the largest ground Page 85 Share Cite Suggested Citation:

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3: California - Western States Seismic Policy Council

A global seismic hazard assessment was conducted using the probabilistic approach in conjunction with a modified means of evaluating the seismicity parameters.

Only certain key points are highlighted here in the summary; the rest are included in later chapters. In its treatment of the use of expert opinion, SSHAC outlines four possible levels of effort and complexity. But the SSHAC report is strongly flavored by emphasis on hazard analysis for nuclear and other critical facilities, and SSHAC therefore discusses at great length its highest-level level 4 procedure for evaluating expert opinion. And although SSHAC includes proper disclaimers the unwary reader could gain the incorrect impression that the high-level level 4 PSHA procedure is needed for every hazard analysis. The panel agrees that all PSHA projects should share the same basic principles and goals, but that the elaborate level 4 methodology is not required for every PSHA study. SSHAC does indeed recognize that alternate simpler methods are probably adequate for less critical facilities, but the simpler methods are not discussed in detail and the reader is not fully advised about other sources of information. Adequate disclaimers in the SSHAC report should protect the analyst who chooses to use procedures other than those recommended by SSHAC from the need to defend that decision in a regulatory setting. Guidance on Uncertainty and Use of Experts. The National Academies Press. In outlining its four levels of complexity, SSHAC visualizes three distinct roles that experts should play at various stages of the process. First, an expert may start out as the proponent of a particular position data or model. Then the expert is asked to become an objective evaluator of the positions of the other experts in the group. Finally, the expert becomes an integrator and aggregates all the positions to arrive at a putative position of the whole informed scientific community. This estimation of the position of the whole informed community by integration of the positions of a sample of well-qualified experts is the primary goal of the more complex SSHAC procedure. The panel questions whether any group of experts can truly assess the view of the whole informed scientific community on the entire range of relevant issues. They deserve more attention. Recognition of the two kinds of uncertainty is useful initially when eliciting and combining expert inputs. Experts need to be aware of the sources of uncertainties e. However, as detailed in Chapter 3 of this report, the panel believes that the statistical analysis and uncertainty separation procedures recommended by SSHAC may in some cases be more sophisticated than is warranted by the data or the purposes for which the results are to be used. During the planning of a PSHA, a detailed analysis of uncertainty would be helpful but typically is not available. It may be sufficient for planning purposes to conduct limited sensitivity analyses, using bounding hypotheses, and to consider the level of effort that would be required to reduce the associated uncertainty. In particular, it is not clear that such a separation would be more helpful than the display of expert-to-expert variability of a mean hazard at the time of an analysis, with an explanation of the source of the differences. The panel believes that the SSHAC report makes a solid contribution to the methodology of hazard analysis, especially in the use of expert opinion. Page 1 Share Cite Suggested Citation:

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