SALT LAKE CITY, UTAH

INTRODUCTION

The fact that Salt Lake City has been affected by medium size earthquakes in recent times and that the city is located within a relatively close distance to California are key factors in the collective awareness of earthquakes in the area. At present, Salt Lake City and County are in the process of revising their ordinances and regulations in order to reduce the city's exposure to earthquake hazards. As part of this process local governments are making a large number of seismic safety measures mandatory.

This ongoing process in Salt Lake City can be extremely useful to many other cities throughout the U.S. that although located in seismic risk areas are not presently enforcing ordinances conducive to reducing their vulnerability to earthquakes.

Salt Lake City has a large stock of unreinforced masonry buildings constructed during World War II and located along the city's major fault system. This case study highlights the development of Salt Lake City, the potential damage that a medium size earthquake could cause the city, and discussion of a number of ordinances presently developed by Salt Lake County and City in order to mitigate potential earthquake damage.

DEVELOPMENT OF SALT LAKE CITY

The first written record of the Salt Lake Valley appears in the 1776 journal of Silvestre Escalante, a Franciscan friar and leader of a party of Spanish explorers seeking an overland route from Santa Fe, New Mexico to Monterrey, California. Initial explorations were followed by spanish traders, American and British fur trappers, government explorers, and California-bound pioneers who periodically traversed the territory.[13] However, until 1847 -- the year of the first Mormon expedition -- Utah remained a large wilderness, inhabited by scattered indian settlements.

The Mormons established the first settlements in Utah. They arrived at the valley seeking religious freedom after they were expelled from the states of New York, Ohio, Missouri, and Illinois. Early settlement patterns still exert an important influence on the physical, social, and economic development of Utah, and also have a definite influence on earthquake safety. Utah towns were developed along the Wasatch Range as it tended to provide access to water, timber, and irrigable land to fulfill agricultural functions. These early urban configurations formed a corridor which today includes more than 85 percent of the population (Youngs, et al., 1987), and are responsible for the fact that the majority of the people of Utah are exposed to earthquake risks as they live within a few kilometers of the Wasatch Fault.

Other elements in the development of Utah played a significant role in terms of earthquake safety. Distinctive social and economic functions gave hegemony to Salt Lake City from the beginning among other Utah cities. For instance, during the pioneer era Salt Lake City served as a headquarters for the Mormon Church, a receiving station for thousands of Mormon immigrants, and a commercial center and supply source for California's gold rush.

This early hegemony of Salt Lake City did not diminish as the city evolved and faced consecutive development trends. During the 1870s, the gold rush, and the transcontinental telegraph and railroad brought a decline in the isolation of Utah, and an increase in the non-Mormon population. Contrary to early migrations which were almost strictly concerned with religious beliefs, mine workers arrived in large numbers. At the turn of the century, as electric trolleys replaced horsedrawn streetcars, more population was attracted to the existing urban corridor which already comprised most of the towns and business districts.

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[13] Most of the data and information presented herein has been gathered from "Utah's History", Poll, Richard et al, 1989

However, in spite of these developments, Utah was slow in breaking from its early agricultural heritage and moving into a fully industrialized economy. Most Pacific Coast states reached industrialization shortly before World War I, while in Utah the majority of its population stayed in rural areas until the late 1920s. Several economic set backs played a role in this slow growth. For instance, as World War I ended, the federal government abruptly canceled most war contracts, thus hindering an incipient industrialization process. Also, mineral prices collapsed, and agriculture -- particularly staple crop production -- remained in a depressed condition as the federal government moved away from financing sales of American farm products to Europe. In addition, during the stock market crash of 1929 and the depression of the early 1930s, unemployment affected one third of the population and per capita income fell to three-fourths of the national average. During this period, hundreds of mine workers walked the streets of Salt Lake City searching for work.

This stagnation of Utah remained unchanged until World War II. Defense expenditures induced the creation of major industries for the production of commodities and services, especially those related to steel and munitions. Such industries which comprised both military and civilian operations, transformed unemployment into worker shortages. Personal incomes and population climbed dramatically. After three decades of net outward migration, between 1940 and 1946 Utah experienced a net inward migration.

Most of the existing unreinforced masonry buildings were constructed in Salt Lake City and neighboring counties during this period. This vigorous development of a defense related industry triggered the demand of new housing and towns along the Wasatch Fault. Shortages in housing reached such levels that in 1941 the Housing Committee of the State Defense Council was organized. The Council was commissioned to identify rental accommodations in existing homes, and to coordinate the construction of new temporary and permanent facilities in the area. As a result, a variety of government-sponsored projects were implemented, which included the construction of multifamily frame buildings, prefabricated units, conventional housing, and trailer villages.

After World War II, the Korean War helped Utah to consolidate a defense sector which has continued to be a predominant factor in Utah's economic growth. In addition to being a preferred location for defense related industries the state is experiencing a boom in service-related employment through tourism in winter with the ski industry and in the summer with water and mountain resorts. The total population of the State of Utah is 1,468,596 of which 42 percent resides in Salt Lake County. The population of Salt Lake County has increased about 62 percent in the past 20 years and is expected to increase another 52 percent by the year 2,000. (Metropolitan Water District, 1982).

The fact that a large number of buildings and housing units in Salt Lake City, and in Utah in general, were built prior to World War II has a particular significance for earthquake safety. Indeed, studies sponsored by the Seismic Safety Advisory Council[14] (1980) have identified important time-boundaries for the construction of buildings. Such studies show a direct relation between the age of the building and earthquake vulnerability, based mainly, on the lack of compliance with sound seismic provisions. For instance, it has been established that structures built during the 1920s exhibit the most earthquake-vulnerable types of frame and masonry construction. These buildings as well as pre-1940 buildings were virtually not governed by any construction codes. Typically buildings constructed during these periods were large multistory structures built with poor or no lateral force provisions.

This situation remained almost unaltered until the 1960s. Salt Lake City first adopted construction standards that considered lateral earthquake forces for certain types of buildings when the UBC was adopted in 1958. Following this date, the construction of buildings improved, albeit several problems still remained. For instance, limited attention was given to seismic lateral forces as the code contained seismic provisions only as an appendix and these were purely optional. In addition, from 1960 to 1970, UBC seismic provisions and maps considered Utah as seismic zone 2, a fact that changed in later UBC versions in which Utah was considered

[14] Council established in 1977, charged to prepared assessments of earthquake hazards and associated risks to life property in the State of Utah.

seismic zone 3. In 1961 seismic provisions became part of the main body of the code, and new provisions were required to comply with seismic design standards. However, the adoption of seismic safety measures found resistance among important sectors of the community. This lack of support, plus the absence of a well defined seismic policy and code enforcement procedures, limited the adoption of seismic safety provisions for buildings constructed during this period. (Seismic Safety Advisory Council, 1980)

At present, a wide range of buildings are at risk in Utah. For instance, studies conducted by Emmi and Horton, (no date) for commercial unreinforced masonry structures in Salt Lake County show that this type of building represents the most seismically vulnerable class of structures; they are concentrated in zones of expected high ground shaking intensities, and compared to residential structures, tend to be occupied at higher densities. These studies also show that older structures are remodeled once every 16 to 20 years or at a rate of five to six percent of the stock per year, and that such restorations do not include retrofitting. Without a retrofit program, 96 percent of the current stock of commercial unreinforced masonry structures inside the downtown Salt Lake is expected to remain standing for another 20 years. These estimates suggest that unless Salt Lake City undertakes an aggressive retrofitting program, a considerable number of buildings will be exposed to high risks from future earthquakes.

In a similar fashion, studies prepared by the Seismic Safety Advisory Council (1980) highlight the exposure of public buildings. Ninety percent of state-owned buildings are located within the zone of greatest seismicity. Most of this space has moderate to high occupancy use, and much of it is located near the Wasatch Fault zone, and thus, can be expected to experience severe damage.

It has been shown that 20 percent of the school buildings in Utah are 50 or more years old and exhibit similar vulnerabilities as other buildings constructed within the same time frame. This situation is critical since the major cities, in which the most schools exist, lie in the most seismically active zones. Of singular interest is the fact that, in 1981, legislation was introduced by certain interest groups who were against government-sponsored activities. This bill, which fortunately was vetoed, would have excluded schools from conforming to building codes and given them exemption from complying with safety and health factors in the interest of economy and local control. (Atwood and Mabey, 1987)

REDEVELOPMENT IN SALT LAKE CITY

Beginning in 1956, efforts were made in the Utah Legislature to enable major cities to undertake redevelopment programs. The first redevelopment legislation was passed in 1965; however, attempts to establish a redevelopment authority in Salt Lake City under this statute failed.

In 1968, the University of Utah released a report showing that Salt Lake City had missed receiving more than $30 million in federal aid since 1965 due to the fact that the city did not have a redevelopment authority. In 1969, new legislation was introduced, and in October 1969 the Salt Lake City Commission created the first redevelopment agency.

In Utah, redevelopment agencies are governed by two laws: the Utah Neighborhood Development Act, which gives power to redevelopment agencies to improve areas of urban blight; and the Utah Residential Rehabilitation Act, which allows these agencies to issue bonds to finance the rehabilitation of single and multi-family housing. Through its redevelopment agency Salt Lake City has undertaken actions to reverse the downward spiral that has affected significant portions of the city. Major business areas became deteriorated and housed buildings that were abandoned or in disrepair. One of the results of these downward trends was that while the assessed valuation of important segments of inner city properties decreased, the need to provide support for tax funded services continued to increase.

In Salt Lake City, as well as in most cities of the U.S.(see chapter 5), the engine that drives the redevelopment agency is tax increment financing (TIF). TIF allows the agency to use property taxes generated by new buildings to stimulate further growth. The new taxes are reinvested in selected project areas and serve to further increase the tax base.

Tax increment financing has provided Salt Lake City with the means to fund a considerably large number of redevelopment programs. In Utah, The period of time a redevelopment agency can use tax increment funding within a particular project area is limited to 25 years. The amount of increment that an agency can claim is 100 percent of a project area's tax increment for the first five years. For the next five years the agency can claim 80 percent. Every five years thereafter, the increment decreases by five-ten percent.

By and large, redevelopment has taken place by assembling land and reselling it at a price below its market value (write down). To capture new funds, the agency "freezes" the total assessed value of a particular district at a current level. The last equalized assessment roll for the project area (before the adoption of a redevelopment plan) is the "base roll." The tax increment is the tax revenue based on an increase in the assessed valuation above the base roll. This tax increment is available to the redevelopment agency to fund redevelopment programs. As mentioned before, the agency can use all or part of this increment. Taxes levied against the base roll, and that portion of the increment not used for a project, are paid to taxing districts.

Major Salt Lake City redevelopment projects encompass several blocks in connection with the Salt Palace Convention Center, the Business District, and the City and County Building. Redevelopment programs also include several projects in the area known as Sugar House, the city's first satellite commercial area which emerged in the early 1900s; and in the West Temple Gateway area that serves the central business district. Through redevelopment it is estimated that $500 million has been invested in downtown offices, shops, hotels and housing. In addition $45 million has been used for public improvements which include streets, sidewalks, plazas, parking structures, and public utilities. The assessed valuation of the redevelopment area has increased 210 percent from $320 million to more than $985 million.

In addition, the agency has a goal of assisting in the rehabilitation of 200 housing units annually. The city's housing rehabilitation efforts predate the redevelopment agency having their genesis in the federally funded rehabilitation programs of the 1960s. According to data of the redevelopment agency, three-quarters of Salt Lake City's housing is in areas that can qualify for redevelopment agency assistance in the form of low-interest, long-term loans. Each year the redevelopment agency uses federal Community Development Block Grant (CDBG) funds to make individual loans totalling $2 million for the rehabilitation of such units in Salt Lake City. In the 1980s, more than 1,800 housing units were renovated with $14.2 million in redevelopment agency assistance.

One of the major problems faced by Salt Lake City in terms of earthquake safety is that redevelopment programs devote limited attention to the seismic performance of buildings, albeit large number of buildings under urban redevelopment programs are of high risk. The urban corridor along the Wasatch Front includes the majority of the Utah's population, the largest inventory of old buildings, and the largest inventory of unreinforced masonry structures. This forth of seismic safety by redevelopment agencies is not an exclusive situation of Salt Lake City; on the contrary, throughout the U.S. seismic safety is typically not part of redevelopment programs. Usually, the major goals of these agencies are directed toward the preservation of the urban heritage, economic growth, expansion of the tax base, and elimination of urban blight.

Currently Salt Lake City lacks the economic means to retrofit its large stock of unreinforced masonry buildings, and unlike California does not have ordinances that mandate and facilitate the rehabilitation of unreinforced buildings. Most of the literature available on Salt Lake City's earthquake risk suggests that replacement and major retrofit programs for existing buildings cannot be justified. The inclusion of earthquake safety measures, namely retrofitting, is usually considered too expensive by most government agencies -- including redevelopment agencies -- and would absorb almost all funds available for other urban programs. The low

probability of a large earthquake and the high cost for replacement or retrofit cannot be justified in terms of cost-benefits. (Seismic Safety advisory Council, 1980)

At present, the main strategy for retrofitting Salt Lake City's existing buildings has been the use of a selective process through which major historical buildings and key critical facilities vulnerable to earthquakes are identified. A good example is the rehabilitation, restoration, and retrofitting of the City and County Building. The total amount of this project was estimated at $40 million of which $5 million was used in seismic retrofitting. CDBG funds have been used for the retrofitting of most of the fire stations operating in Salt Lake City.

EARTHQUAKES AND SALT LAKE CITY

The Wasatch Fault is considered the most active and longest fault in Utah. It is over 200 miles long, extending from Malad City, Idaho to Fayette, Utah. Segments along the central two-thirds of the fault -- comprising an area from Brigham City to Nephi -- are capable of generating a large-magnitude earthquake. During the past many large earthquakes have occurred averaging from 7 to 7.5 magnitude. These events have a period of recurrence averaging from 340 to 415 years. (Arabasz, 1991)

The largest historical earthquakes in Utah have been the 1934 Hansel Valley earthquake of magnitude (Ms) 6.6 and the 1901 Richfield earthquake of similar magnitude. Six other earthquakes ranging from 6 to 6.5 Ms have occurred in recent times in the region. Moderate, potentially damaging earthquakes occur on average once every 6 to 7 years in Utah. (Arabasz, 1990). The most damaging recent earthquake in Utah occurred in 1962 (Ms 5.7) near Richmond, Cache Valley. Over three-fourths of the houses in the area were damaged and mudslides and rock falls closed highways and canals. Structural damage occurred in several large buildings in both, Richmond and Logan, and one building had to be demolished.

The absence of large earthquakes in the region has perhaps blurred the real potential for earthquake damage in the area. Various studies (Arabasz, 1990; Hecker, 1991, Christenson, 1991) indicate that the Wasatch Front area can be characterized as a seismically active region having only moderate historical seismicity but high catastrophic potential from future large earthquakes. These studies show that in spite of the fact that the area has not experienced a magnitude 7.0 to 7.5 earthquake since the area was settled, large earthquakes did occur in the past and are likely to occur in the future within the active segments of the Wasatch Fault. In fact, based on this data, and considering different models of earthquake occurrence, it has been estimated that there is a 12-24 percent probability of such an earthquake occurring along the Wasatch Fault within a 50 year period. (Nishenko and Schawartz, 1990 in Christenson, 1991) On the other hand, moderate but potentially damaging non-surface-faulting earthquakes of magnitudes ranging between 5.5 to 6.5, may occur anywhere within the region. (Arabasz, 1991)

Of particular significance in terms of earthquake risks is the fact that many factors enhance the effects of earthquakes along the Wasatch Front area. The Salt Lake City-Ogden-Provo urban corridor is underlined by soil deposits that tend to amplify earthquake ground motions in narrow period bands. Studies indicate that the properties of the Salt Lake Valley in terms of deep and soft sediments are likely to enhance the ground shaking effects on high rise structures seated upon these soils, especially for distant (50 to 250 km) earthquakes. Due to these factors, an earthquake of a given size is likely to be more destructive in the Salt Lake area, than in, the Los Angeles area, for instance. In addition, as a result of an earthquake, liquefaction, landslides, rock falls, and broad permanent tilting of valley floors could possibly cause the Great Salt Lake or Utah Lake to inundate part of Salt Lake City or Provo. (Arabasz, 1990)

The fundamental problem in the evaluation of the ground-shaking in Salt Lake City, Ogden, and Provo is the lack of scientific and engineering data. In spite of the fact that earthquakes in the Utah region have been recorded digitally by the University of Utah seismic network since January 1981, no strong ground-motion data existed prior to this date to define regional seismic-wave attenuation relationships.

Arabasz (1990) summarizes the potential losses resulting from a earthquake of 7.5 magnitude. Building damages for Salt Lake, Davis, Utah and Weber Counties could exceed $4.5 billion. Moderate-sized earthquakes to one of the Wasatch Front's major cities could produce more than $2.3 billion for a 6.5 magnitude earthquake and more than $830 million for a magnitude 5.5 earthquake.

Unreinforced masonry building -- such as those built before 1960 are expected to account for 75 percent of the building losses. Losses from a large earthquake could reach 30-40 percent of replacement value. Projected life-loss and injury studies by Roger and others[15] (1976) indicate that under the worst conditions (excepting dam failure) 2,300 people could die and 9,000 suffer injuries requiring medical treatment. As many as 30,000 people could be homeless and require temporary shelter.

EARTHQUAKE SAFETY

In Utah, urban planning was initiated in 1920. Despite the development of master plans, economic pressures exerted by developers and homeowners have been the primary determinant of urban development throughout the state. Downtown Salt Lake city is and will continue to be the major business and financial center for the metropolitan area and will continue to exhibit the largest number of unreinforced masonry buildings vulnerable to earthquake in the area.

Several efforts have been made to reduce earthquake risks in Utah. A first attempt was undertaken by the Utah Seismic Safety Advisory Council. This Council was formed to recommend a comprehensive public policy framework for earthquake safety. The work of this Council, which includes the preparation of 22 reports, has been highly regarded. However, the work of the Council has been overshadowed by a limited implementation. Major recommendations have been followed by few public agencies or private groups. According to Atwood and Mabey (1987) the limited impact of the Council in terms of earthquake safety is correlated to important political changes that took place during this period. By the time final reports were issued, the legislature consisted of many new members, several of whom believed in less government intervention in local affairs.

In 1983, a second effort was organized to create an earthquake hazard reduction program. This program began as part of the USGS and the Urban Earthquake Hazards Assessments, an element of the National Earthquake Hazards Reduction Program. This program targeted the creation of information systems, hazard evaluation and synthesis, ground motion modeling, loss estimation models, and implementation methods. (Atwood and Mabey, 1987)

During 1983 and in 1984, several communities along the Wasatch Front experienced widespread flooding, landslides, and mudflows. As a result, local officials became familiar with the destructive forces of natural disasters and began to acknowledge potential earthquakes risks. However, these views were also confronted by other views against organized government-sponsored activities.

Other efforts to improve seismic safety programs were initiated in 1985. As part of the National Earthquake Hazards Reduction Program, funds were provided for five counties to employ three geologists. The selected counties were Salt Lake, Weber, Davis, Utah, and Juab. The main responsibility of this staff was to compile published and unpublished reports containing geologic hazard information, to prepare adequate mapping, and to respond to request for assistance from city and county agencies. These geologists also were responsible for site investigation, project reviews, and technical advice in conjunction with local planning departments.

[15] Rogers, Albert; David Carver; Walter Hays; and Kenneth King "Preliminary Estimates of Geographic Variation in Relative Ground Shaking in the Wasatch Front Urban Corridor", in USGS Open File Report 84-763 (A Workshop on "Evaluation of Regional and Urban Earthquake Hazards and Risk in Utah [this reference should be transferred to bibliography]

In May 1989, the Salt Lake County Commissioners approved the Natural Hazards Ordinance (as Chapter 19.75 of the County's Zoning Ordinance). Salt Lake County has retained, since then, a full time geologist who is aiding the planning division in the compliance of this ordinance.

Currently, Salt Lake County is enforcing the adoption of geological studies as a pre-condition for urban development. A series of maps comprised as part of "A Natural Hazards Special Study Area" (ordinance 1070) are used to identify major fault areas and liquefaction potential.

A Salt Lake County Ordinance (section 19.75.050) prohibits structures designed for human occupancy from being built astride an active fault. Where unknown faults are suspected and/or discovered during the construction of a project, special studies are required before approval of any construction, particularly of high-rise buildings. These required investigations must be conducted by qualified geotechnical engineers. Where buildings are to be constructed adjacent to known faults they must be designed to withstand fault movement. Equal considerations are taken for areas known to be susceptible to liquefaction. However, setback distances from hazardous faults are not required. Appropriate setbacks are left to those recommended in the geological studies.

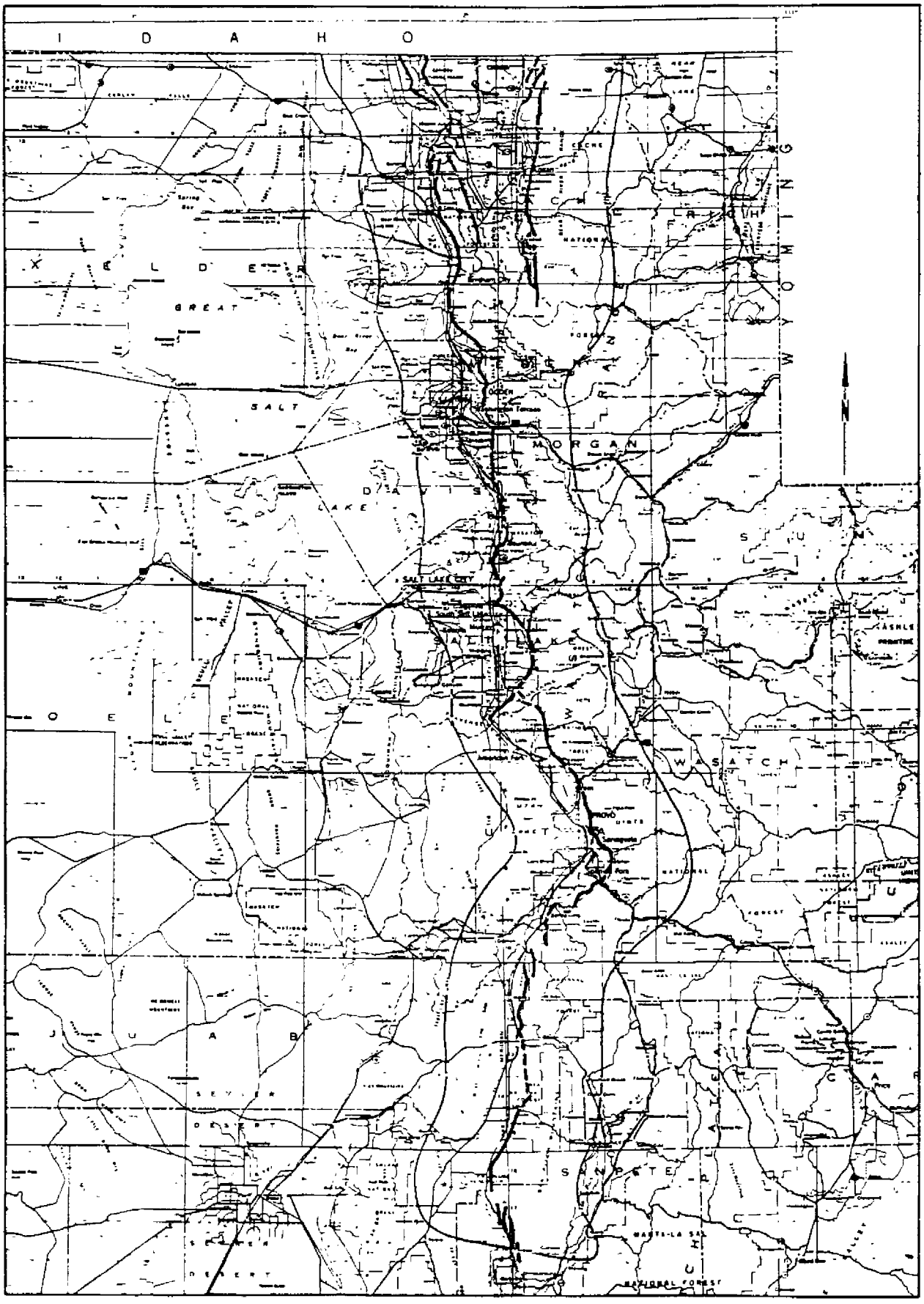
In terms of liquefaction potential, Salt Lake County has adopted several measures directed at reducing the effects of this hazard. Sites having liquefaction potential have been grouped to create a liquefaction map which deals with the unincorporated areas of the county. The map serves as a reference tool for areas that warrant further investigation. Liquefaction has been classified as high, moderate, low or very low. Measures to be carried out depend on a range of individual choices which may include the adoption of mitigation measures, the purchase of earthquake insurance, or the acceptance of the risk in cases of low and very low liquefaction potential.

These individual choices are complemented with the use of a formal disclosure document. The Natural Hazards Ordinance requires that a formal disclosure document must be available for projects located within a "Natural Hazards Special Study Area." Such a document applies to both surface fault rupture and liquefaction potential. The purpose of the disclosure document is to make surface faulting and liquefaction information available to the public.

In the case of high and moderate liquefaction, the formal disclosure document is recorded together with the property deed as part of the approval process. When disclosure is required, the owners should return the completed form to the county geologist. The forms are then recorded with the parcel legal description at no cost to the owners. There are two types of disclosure forms: the "Acknowledgment and Disclosure" form and the "Acknowledgment, Disclosure, and Agreement" form. The former is used in cases when no special liquefaction report is required, such as for new single lot subdivisions or for new construction on existing lots in subdivisions approved prior to the enactment of the Natural Hazards Ordinance. The latter form is used in cases where a liquefaction report addressing the liquefaction potential has been prepared. The "Agreement" aspect implies that the owner has agreed to comply with liquefaction hazard reduction conditions set by the County as recommended in the liquefaction report. However, it is meaningful to note that the county has limited capabilities to enforce the recommendations made in the special studies as a pre condition for construction approval. The main purpose to the disclosure document is to indicate that hazard reductions techniques are required and does not provide for a suspension of construction permits.

At the time of preparing this report, a study is in progress analyzing the status of downtown buildings. This inventory will be followed by a disclosure act to be enforced by the municipality. Specific legal requirements for real-estate agents to formally disclose natural hazards information to potential buyers will be required.

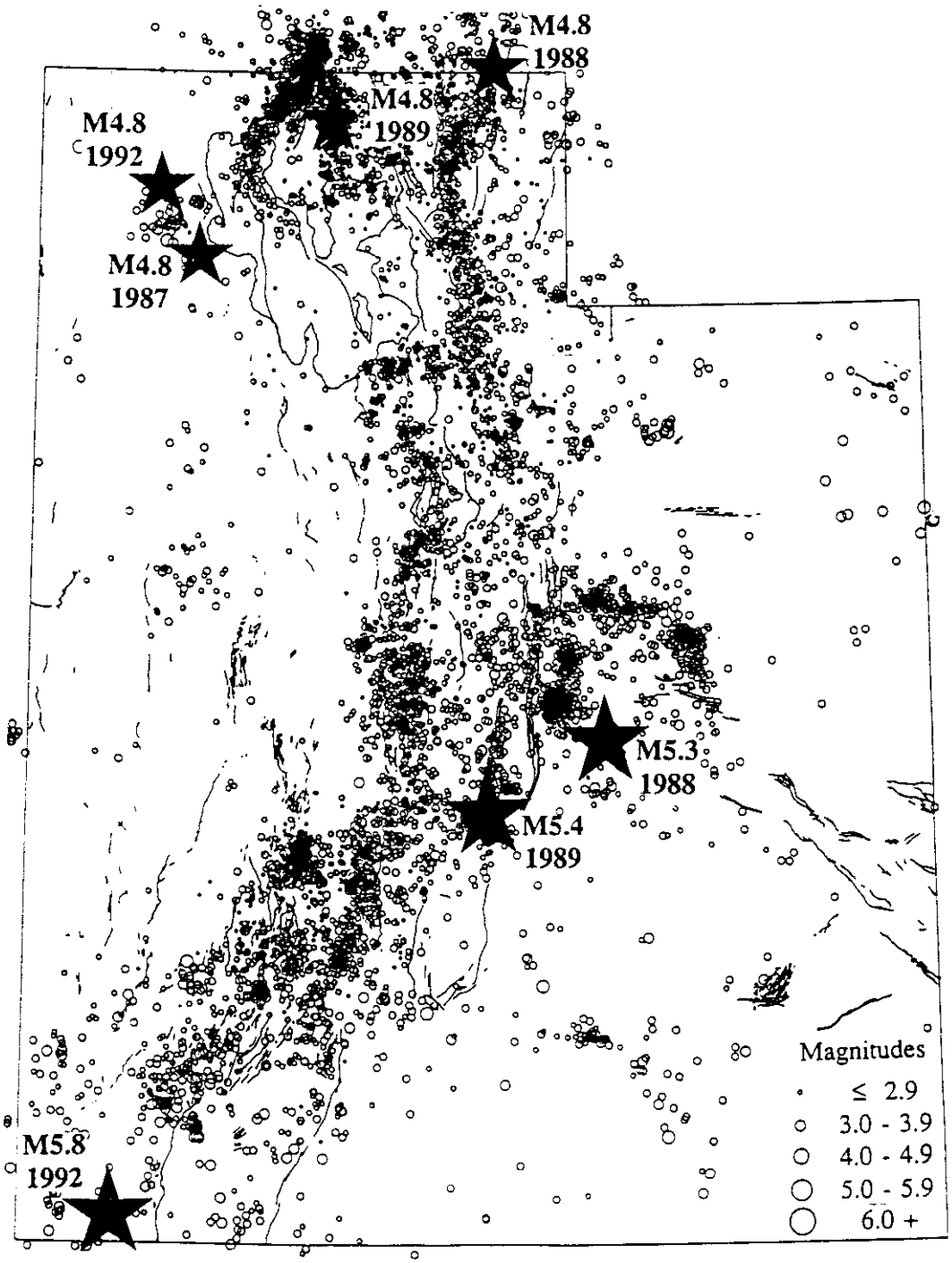
Exhibit 13 **WASATCH FRONT SEISMIC ZONE**



Source: State University of Utah

EARTHQUAKE EPICENTERS IN UTAH
1962-1992

Exhibit 14



Source: State University of Utah

SANTA ROSA, CALIFORNIA

INTRODUCTION

This case study highlights a number of measures taken by Santa Rosa city officials in the aftermath of the 1969 Santa Rosa earthquake which devastated major portions of the downtown area. The uniqueness of this case study in relation with others included in this report is that Santa Rosa experienced two major earthquakes while federal funding was available for financing urban redevelopment programs. Indeed, in 1969, urban renewal programs were showing significant funding levels. [Federal funding remained relatively stable until 1973 when most urban programs were either terminated or replaced by a system of community development programs based on decentralization and federal revenue sharing (see chapter 2).]

The redevelopment program adopted by Santa Rosa after the earthquakes resulted not only in redeveloping its downtown area in a very successful manner, but also increasing considerably the economic base of the downtown area.

REDEVELOPMENT IN SANTA ROSA

The two earthquakes experienced by Santa Rosa in 1969 reached magnitudes of 5.6 and 5.7, respectively, and occurred within a two-hour period. Instrumental data recorded a total of 255 shocks following these earthquakes over a period of 17 days. These earthquakes severely damaged major portions of downtown Santa Rosa. The area most affected was within and adjacent to the downtown area where urban redevelopment programs had been recently carried out. Estimates indicated that a total of 750 buildings and structures were affected. Twenty-one commercial buildings were damaged beyond repair; thirty-five, due to the lack of lateral load requirements, were found unrepairable; and eighteen others were substantially damaged but still in repairable conditions.

Unlike other urban redevelopment processes undertaken with a strong community participation, the redevelopment process of the city of Santa Rosa was very much a linear process. Throughout the process, City council and city planning officials remained in control of the entire decision making process.

One of the first steps adopted by the city council was to request federal funds from the HUD regional office to assist in the repair of one hundred buildings in the downtown area. This request was finally authorized by HUD headquarters after being turned down by the regional office. It is important to note that before the earthquakes, the city had undertaken an urban renewal program for which it had exhausted authorized funding. One year earlier, city officials had halted redevelopment programs when confronted with the impossibility of financing new expansions. In this sense, the 1969 Santa Rosa earthquakes created opportunities for securing federal funds that otherwise would not had been available.

After the earthquakes, Santa Rosa expanded its existing downtown redevelopment area to include the damaged commercial portion of the city. City officials took advantage of the urban renewal project to expand the original boundaries and include the area containing most of the older buildings. The new expansion included the western half of the old downtown area which prior to the earthquakes was the location of small retail business, manufacturing firms, and older housing units.

One of the first priorities of the redevelopment program was to address the rehabilitation and retrofitting of the damaged buildings while still allowing commercial activities to continue downtown. Shortly after the earthquakes the Santa Rosa Building Department began reviewing damage to buildings and repairing those buildings that still could be inhabited. However, due to the large amount of buildings affected by the earthquakes the city council placed a moratorium on abatement action and appointed a commission --composed of prominent structural engineers, construction, real estate, and financial representatives of the business

community-- to develop a program in order to establish a systematic identification, review and abatement of seismically hazardous buildings.

In 1971, the city council approved resolution 9820 (this resolution was modified later in 1979 through ordinance 2052) that established seven stages of priorities for building compliance. Through this resolution buildings constructed before December 31, 1957 were included in the review process. The goal was to review and bring up to code about 20 buildings per year. This approach was undertaken on the basis of the property being sold or the use being changed.

The first priority of buildings to be reviewed and evaluated were theaters, hotels, public assembly buildings of 100 or more people, hospitals, clinics and governmental and public buildings. The second priority were buildings adjacent to sidewalks with large volumes of pedestrian traffic. Third were buildings that were open to the general public, such as stores, shops, apartments, offices, etc., and residential buildings of more intense use down to four family dwellings Single family dwellings were not part of this particular program.

One of the most successful aspects of the Santa Rosa redevelopment program was the fact that the downtown became the site for a large regional shopping center. Before the 1969 Santa Rosa earthquakes the financial and commercial sectors served a population of 50,000 people. Redevelopment programs carried out after the earthquakes were distinctively designed to serve a larger population. The population of Santa Rosa, within city limits, has been estimated at 115,900 people[16]. Both the financial and commercial sectors served a regional population estimated at 450,000 people.

Wyner and Mann argue that if the earthquakes had not occurred the land-use changes that allowed the construction of the new shopping center would had been much more difficult; however they also argue that it is inappropriate to conclude that an earthquake usually causes such changes. However, redevelopment can exert important influences in land-use and the expansion of downtown Santa Rosa is a good example of this. After the earthquakes land clearance projects (large portions of land were cleared as damaged buildings were demolished) created opportunities for adopting new land-use patterns in the midst of the enormous devastation.

A complete analysis of the factors that intervened in the economic expansion of Santa Rosa after the earthquakes is beyond the scope of this case study. However, it is important to indicate that when redevelopment programs took place in Santa Rosa there were various important elements in place. For instance, there was a clear source of federal funding which enabled the city to set in motion an urban renewal program shortly after the earthquakes. [Although tax increment financing will not be discussed in this case study (it was been extensively discussed in chapter 5 and in the Santa Cruz case study), it is important to indicate that a substantial portion of the redevelopment programs of downtown Santa Rosa were financed through the adoption of this economic measure.] In addition, and unlike Santa Cruz, when the 1969 earthquakes devastated the downtown area of Santa Rosa the city was a rapidly expanding community and the population and property values were increasing rapidly. Santa Rosa also had the strong support of the real estate community, and had a financial institution willing to provide loans for the projects established under the urban renewal program. The combination of these factors led to the successful redevelopment of the commercial and financial area of downtown Santa Rosa.

EARTHQUAKES AND SANTA ROSA

The seismic setting in Santa Rosa is influenced by two fault systems. One is the San Adreas fault which lies about 25 miles to the west of (near Bodega Bay) and the second is the Healdsburg/Roger Creek fault which

[16] Data provided by the State of California Department of Finance

bisects the town in a north-south direction. The Healdsburg/Roger Creek fault enters the city through the older and more developed portions of the city.

The expectation of future earthquakes on the Healdsburg/Roger Creek fault is a 5.6 M earthquake with a recurrence level of about 100 years, and on the San Adreas fault an event of 8-8.5 in 50-100 years. The 1969 Santa Rosa earthquakes were caused by he Healdsburg/Roger Creek fault.

Past earthquakes have caused severe damage to downtown Santa Rosa. The City of Santa Rosa is located 55 miles north of San Francisco. The 1906 San Francisco earthquake, caused great damages to Santa Rosa in spite of its scarce development and population (less than 10,000) at that time. The business district was almost completly leveled.

EARTHQUAKE SAFETY

After the 1969 Santa Rosa earthquake Santa Rosa established a systematic evaluation for the rehabilitation or demolition of buildings affected by the earthquake. Buildings outside the urban renewal area were made subject to the 1967 Uniform Building Code. In order to make recovery economically feasible and to improve the safety in seismically hazardous buildings, the City of Santa Rosa established that buildings failing to comply with the code provisions were to be reviewed by a structural engineer and plans prepared to bring the building up to the requirements of the 1955 Uniform Building Code. If a building did not meet the 1955 requirement, then the property owner was advised to arrange for the abatement of the building within 365 days of notice. If the property owner did not comply with this city resolution, the city ordered the structure's demolition.

Since the 9820 resolution was adopted the city of Santa Rosa has progressed tremendously in terms of earthquake safety. More than 400 buildings have been considered within the review process. Santa Rosa, in addition to Los Angeles, is the only city that has undertaken the systematic evaluation of older building (the systematic review of buildings was relatively recently adopted by Los Angeles). In addition Santa Rosa is in compliance with the 1978 safety plan required by the State of California and has developed important ordinances to be adopted when new development takes place.