APPLYING TECHNOLOGY TO LAND USE PLANNING

Betty Croly, AICP (I)
Edward A. Danehy (II)
Presenting Author: Edward A. Danehy

SUMMARY

Geologic and seismic engineering knowledge has been gradually applied to land use planning. The slow rate of application can be attributed partly to a lag in transfer of technical information from professionals to the public and decision makers. The lack of coordination between interdependent jurisdictions and agencies is an additional factor. The Hayward fault study area has a high vulnerability to seismic hazards. The existing process of seismic regulation implementation is not being utilized to the fullest. A specific proposal is presented to address the issues identified in this study.

INTRODUCTION

In California, land use decisions and building code enforcement occur at the city or county level for public and private development. Both within and adjoining these jurisdictions are many independent local agencies as well as state and federal agencies, resulting in fractional responsibilities and regulations. Within the past 12 years significant actions at the state level have resulted in more effective consideration of faults and earthquakes. This study focuses on land use along the Hayward fault (Figure 1) as one way of identifying additional means of applying seismic technology to land use planning and to suggest increased public participation in implementation of seismic land use decisions.

This study derived from the association of the authors in the 1982 revision of the Alameda County Seismic Safety Element. The present collaboration has combined the perspectives of their different backgrounds. The planning co-author has over 20 years of policy planning and research experience with public agencies and has been in charge of preparation of the Alameda County General Plan and nine mandated elements. The engineering geologist co-author conducted technical studies in the private sector for over 20 years prior to 1981. Since then, as engineering geologist for Alameda County Public Works Agency, his work has included the review of geologic and soil engineering investigations submitted to the County in compliance with the Subdivision Ordinance and the Building Code.

In addition to referenced resource materials, the Seismic Safety Element of a number of jurisdictions was reviewed. Acknowledgement is given to Planning Directors of Alameda, Contra Costa and Santa Clara Counties and to Planning Directors of the cities through which the Hayward fault traverses for the provision of Seismic Element information.

(I) Assistant Planning Director, Alameda County, California, USA

(II) Engineering Geologist, Alameda County, California, USA

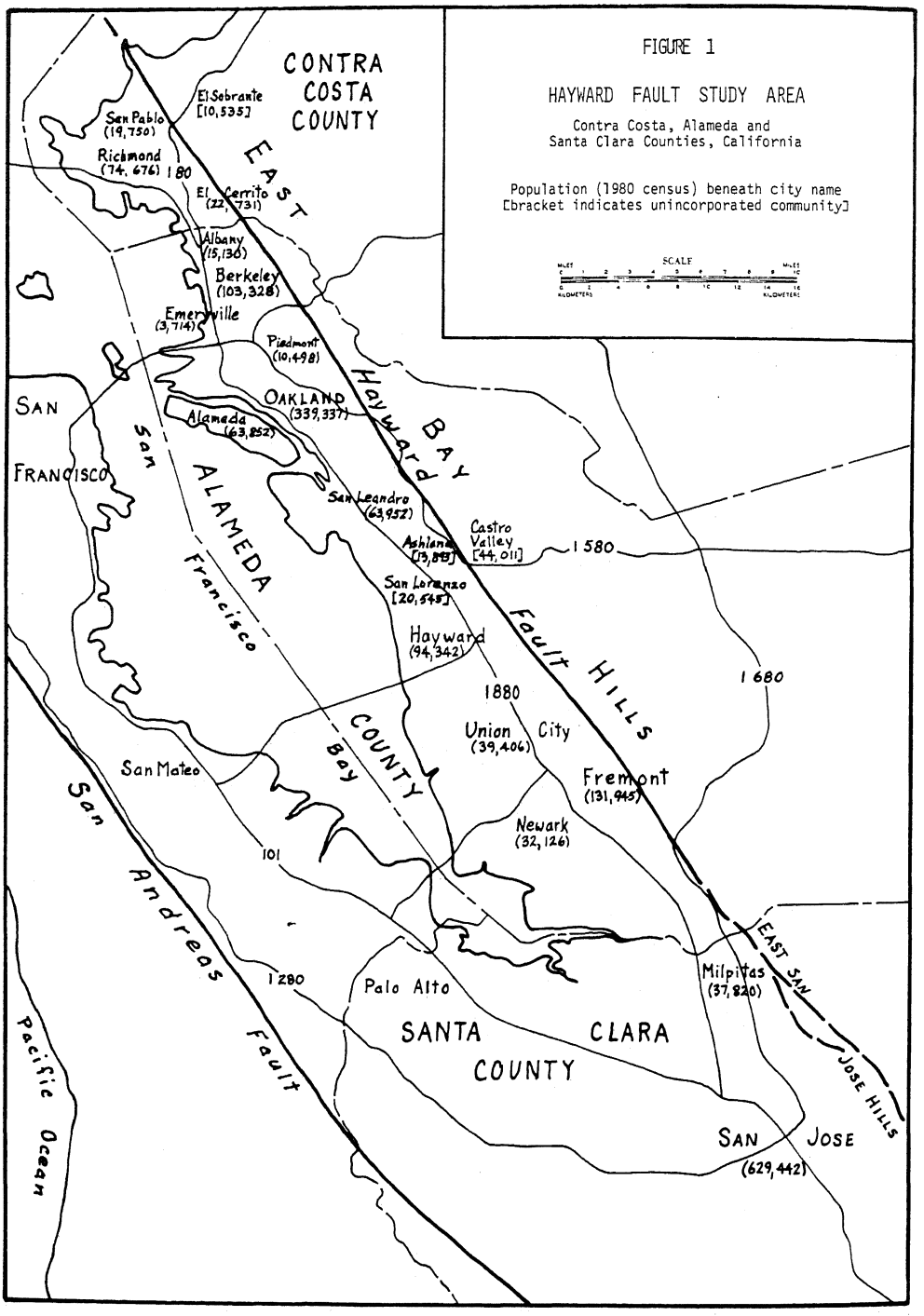


FIGURE 1
HAYWARD FAULT STUDY AREA
Contra Costa, Alameda and
Santa Clara Counties, California
Population (1980 census) beneath city name
[bracket indicates unincorporated community]
SCALE
CONTRA COSTA COUNTY
EAST BAY HILLS
Hayward Fault
El Sobrante [10,535]
San Pablo (19,750)
Richmond (74,676)
El Cerrito (22,731)
Albany (15,130)
Berkeley (103,328)
Emeryville (3,714)
Piedmont (10,498)
OAKLAND (339,337)
Alameda (63,852)
SAN FRANCISCO
San Francisco Bay
ALAMEDA COUNTY
San Leandro (63,952)
Ashland [19,855]
Castro Valley [44,011]
San Lorenzo [20,548]
Hayward (94,342)
Union City (39,406)
Fremont (131,945)
Newark (32,126)
San Mateo
Palo Alto
SANTA CLARA COUNTY
Milpitas (37,820)
SAN JOSE (629,442)
EAST SAN JOSE HILLS
San Andreas Fault
Pacific Ocean
80
580
680
880
101
280

ISSUES

Since 1971, the State of California has required each local jurisdiction to prepare, adopt and implement a seismic safety element to the General Plan, and has required each jurisdiction to adopt and implement the Alquist-Priolo Act Special Studies Zone Maps issued in 1974. Although each jurisdiction in the study area has complied with these and their own local regulations, there remain a number of issues relating to the application of seismic technology to land use planning. Some of the significant issues are:

- o Pressure by developers to develop in seismically sensitive areas.
- o Apathetic public and political concern in regard to seismic issues.
- o Lack of incentive and funding to implement seismic elements beyond present legal requirements.
- o Overlapping jurisdictions and responsibilities.

The background to these issues is discussed and a proposal is made as one means of addressing the problems.

SEISMIC SETTING

Geology

San Francisco Bay occupies what was a broad valley during the Pleistocene glacial stages. Soft, low-density sediments were deposited during the past 10,000 years in the bay bottom and marshlands. The continental sediments of the bay-bordering plain and the alluvial-fan piedmont areas are predominantly late to early Pleistocene in age. In places the presence of granular material and shallow groundwater create a potential for liquefaction.

Rising from the bay plain to a height of 2600 feet, the East Bay hills are composed of bedrock ranging in age from Pliocene rhyolite to Cretaceous sedimentary rocks. The oldest rocks are the Jurassic-Cretaceous Franciscan assemblage of sedimentary rocks, melange and associated serpentinite and gabbro. Some rocks within the hills are suitable for crushed stone, but large areas consist of structurally weak materials. The potential for landslides is present in both natural and graded slopes regardless of the slope inclination. Because these hills are tectonically active, very steep slopes are present in many places.

The Hayward fault traverses this area in a northwest-southeast trend (Figure 1). In Contra Costa County on the north, the fault extends 9 miles (15 km) southeastward from the bay margin. Within Alameda County the fault runs 37 miles (60 km) along the east margin of a corridor in which

the majority of the County's population lives. At approximately the Santa Clara County line, the fault loses its identity as a single, well-defined trace. The 12 miles (19 km) or so within Santa Clara County is represented by several branches. Throughout the length of this fault, the trace lies predominantly in the hills or near the western toe of the hills.

Earthquake History

The period of recorded history began with the founding in 1777 of Pueblo de San Jose de Guadalupe, now the City of San Jose. In 1836, a damaging earthquake occurred along the Hayward fault based on anecdotal records. Again in 1868, a damaging earthquake on the fault, with an estimated Richter magnitude of 7, caused ground rupture over a distance of 30 miles (48 km). The details of scientific observations of that event are limited and appear to have been suppressed. The Carnegie report (Ref. 1) includes observations of the 1868 Hayward earthquake as well as the effects in the East Bay area of the 1906 San Andreas earthquake, which shook the study area in the range of intensity 7 to 9 on the Rossi-Forel scale (Ref. 2).

Significantly damaging earthquakes have not affected the region since 1906. However, both the Hayward and the San Andreas faults have the potential of causing severe damage in the study area (Ref. 3). This double jeopardy makes this highly populated area the most seismically vulnerable part of the San Francisco Bay Region, and makes it necessary to continue actions to provide greater public safety.

HISTORICAL PERSPECTIVE

Land Use

The study area within the three counties involved includes 20 cities and unincorporated communities on the bay plain and/or traversed by the Hayward fault (Figure 1). The 1980 census indicates an affected population on the order of 1.5 million. Except for the City of Oakland, in 1900 the population centers were small with rural inhabitants around them. By the 1950 census, significant growth had occurred in northern Alameda County and in Contra Costa County. After 1950, there was a rapid increase in the population of southern Alameda County and northern Santa Clara County and a number of communities became incorporated.

Although the technical knowledge had existed for some time, the Hayward fault zone and land subject to ground shaking hazards were built upon until the 1960's as if no damaging earthquakes had occurred. The growing use of geologists in conjunction with engineers for land development began to have an impact. After nearly a decade of effort within the profession, California legislation for registration of geologists became effective in 1969. At the same time, planners were developing open space elements, some of which took cognizance of fault areas as necessary open space.

Controls of Land Use and Building Design

Table A lists major events and the resulting actions as they apply to the study area. Until the 1933 Long Beach earthquake, the belief that little could be done regarding earthquakes seems to have been prevalent. The Field Act regulating public school design was enacted shortly after the 1933 earthquake, but over 40 years elapsed before the results encompassed all buildings in all school districts. The San Fernando earthquake in 1971 resulted in a number of effective actions. It is too early to know, but the 1983 Coalinga earthquake may result in additional legislation.

TABLE A. EVENTS AND ACTIONS

1800-1900 Decade	Hayward earthquake of 1836, very few inhabitants Hayward earthquake of 1868, sparse population
1900	San Andreas earthquake of 1906, detailed investigation (Ref. 1)
1910	Location of fault traces and seismic consequences of ground conditions not included in geologic folio (Ref. 4)
1920	Development of Uniform Building Code
1930	Long Beach earthquake, 1933 Field Act (public school design standards)
1940	Uniform Building Code lateral force requirements
1950	Tehachapi earthquake, 1952 Daly City earthquake, 1957
1960	Fault location studies requested by some local jurisdictions Requirement for fault invesitgation of new school sites (State of California) California registration of geologists
1970	San Fernando earthquake, 1971 California Environmental Quality Act Seismic Safety Element requirement for local General Plans (Ref. 5) State Seismic Safety Commission Requirements for new hospital development (State of California) Alquist-Priolo Special Studies Zone Act Some local jurisdictions employ staff geologist and others use consultant for required review of Alquist-Priolo reports San Francisco Bay Region Environment and Resources Planning Study (U.S. Geological Survey and Dept. of Housing and Urban Development) Uniform Building Code modifications based on 1971 earthquake

Not all actions have been instigated directly because of seismic events. As noted, the registration act for geologists came as a result of professional activity. The same is true for engineering standards, particularly improvements in the Uniform Building Code. Although legislation is the principal basis for state-wide action, professional individuals and associations have been effective both in fostering legislation and in upgrading design standards.

PLANNING, IMPLEMENTATION, LEGISLATION

The process of seismic regulation implementation is illustrated in Figure 2. Each of the jurisdictions in the study area have generally followed this process, and seismic elements have been implemented at least to the extent required by State law and in some cases to a greater extent. However, once the Seismic Element has been completed, except for students and some organizations, such as the League of Women Voters, there is little ongoing public education, concern or participation. Part of this problem is due to the practice of each jurisdiction pursuing work independently.

As demand for land development increases, pressures to build in seismically sensitive areas increase. Technologists and planners provide data and land use plans, but they need more assistance from the public and more awareness from the legislators to ensure proper land use planning and design implementation. An additional problem is the lack of funding to increase seismic education, which, in turn, would stimulate legislative efforts.

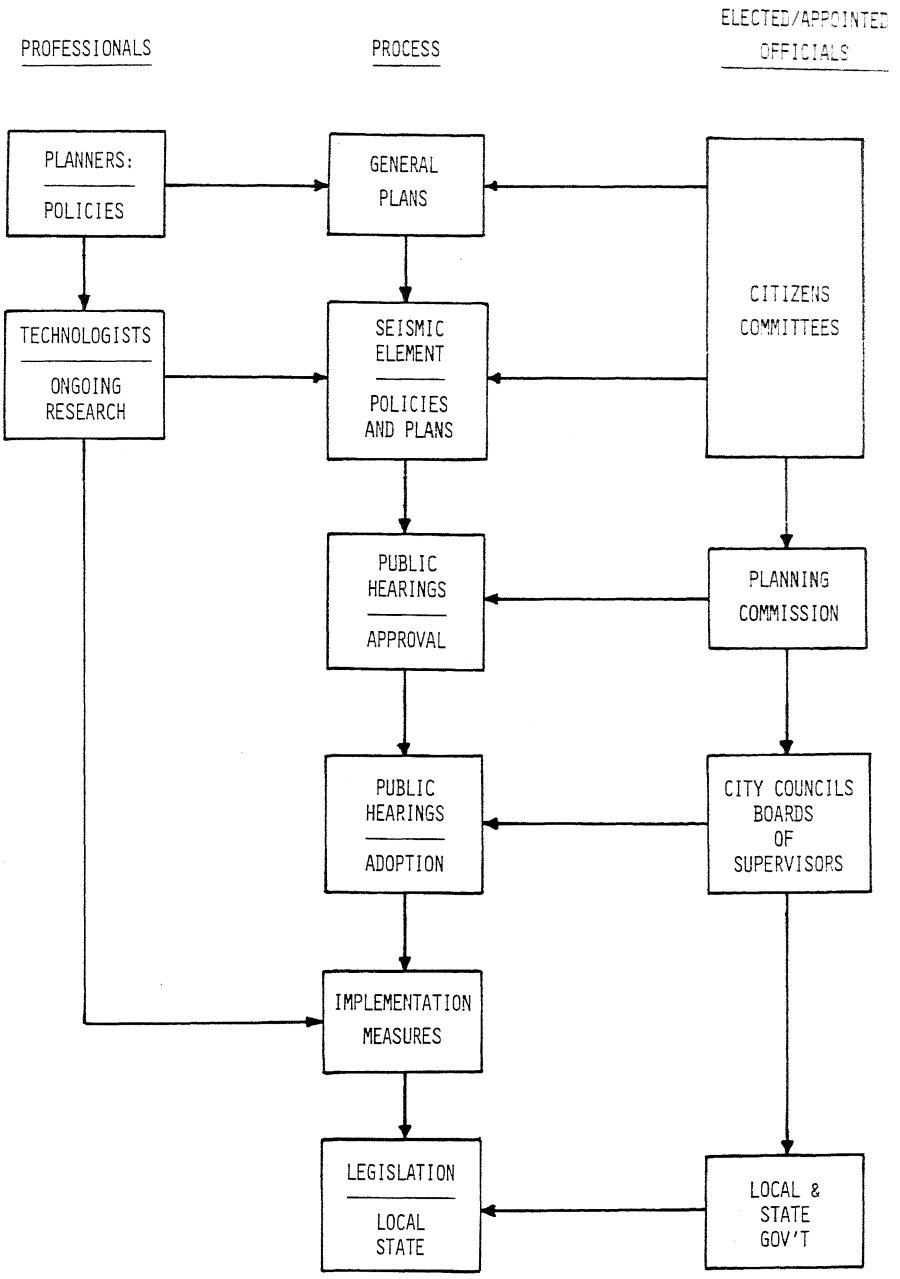
CONCLUSION

As a means of stimulating interest in local seismic concerns, it is herein proposed that a pilot task force in each of the three counties in the study area be assembled to study, over a two year period, local seismic problems and concerns. Funding for the task force would come from local, regional and State governments. The task force would include knowledgeable and recognized citizens, planners, geologists, engineers, representatives of local, regional and State governments, industry, transportation, utility and health agencies.

The primary responsibility of the task force would be to prepare specific land use policies on a county wide basis, using data prepared by the professionals. The resulting work would be used as a means of obtaining state and local funding and legislation to address seismic concerns prior to the occurrence of a major catastrophe. Instead of having, as in Alameda County, seismic safety elements in 14 cities and the County, there would be one overall County element adopted by each of the jurisdictions with common policies, regulations and ordinances. Also, the participation of overlapping jurisdictions, such as school, hospital, transit and utility districts, would be required to reduce conflicting policies and regulations.

Each county task force would seek funding from the State for a portion of the initial work, as well as for implementation of legislation growing from their work. These pilot task force groups would serve as models for other counties and perhaps serve as models for similar groups to study the problem of earthquake preparedness and response. The aim would be to eventually have every citizen of the community involved, or at least knowledgeable about seismic risks.

FIGURE 2. SEISMIC REGULATION IMPLEMENTATION PROCESS



It is anticipated that the task force would bring together concerned professionals, citizens and political representatives, who, with a common goal, could promote faster and more effective action than could many jurisdictions and entities acting alone.

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