&
Earthquake Hazards

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DISABLED PERSONS AND EARTHQUAKE HAZARDS

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Preface

The project summarized here is the first study to focus on how earthquake hazards affect the large and growing segment of the population that is disabled. One of our initial discoveries in conducting the research was that there is very littl solid data available on the topic. Disabled people are an invisible population in the disaster research literature, just as, until recently, they have been in society. We want to stress that the findings and generalizations in the report represent an attempt to conceptualize the problem and develop hypotheses; they are only a first step in what needs to be done in this area. The conclusions and recommendations should be seen as tentative, rather than definitive. More research is needed to address the range of problems disabled persons face in disaster situations.

Several persons played major supportive roles in the project, and we want to thank them for their contribution. John C. Archea, of the State University of New York at Buffalo, developed the interview guide used in the study of disabled victims of the 1983 Coalinga, California earthquake and assisted with the Coalinga field work. Ramona Cayuela-Petak, University of Southern California, compiled an extensive bibliography on disabilities, participated in the field work, and assisted with the development of the taxonomies discussed in Chapter V. Michael Durkin, of Durkin and Associates, Woodland Hills, California, also contributed to the formulations on earthquake-induced hazards to building occupants. Linda B. Nilson conducted interviews with a sample of Los Angeles County nursing home directors to obtain information on earthquake hazard mitigation and preparedness measures in those facilities. Guna Selvaduray, San Jose State University, developed a checklist and assessed several Los Angeles area buildings from the standpoint of occupant safety.

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CHAPTER I

INTRODUCTION

Since 1983, an interdisciplinary team of researchers at the University of Southern California has been examining earthquake hazard mitigation and emergency response issues from the standpoint of members of the population with physical disabilities. The general objectives of the project are to develop a conceptual framework for addressing the needs of disabled persons in earthquakes and to provide data that will inform public policy in the natural hazards and disability areas.

This work is part of a general trend in the field of hazards research that recognizes that populations-at-risk are not homogeneous undifferentiated masses but rather are composed of various subgroups with different degrees of vulnerability to, understanding of, and ability to cope with natural hazards and emergency situations. Recent research (Turner et al., 1979; Perry and Mushkatel, 1984; Bolin and Bolton, 1986) has focused increasingly on the significance of racial, ethnic, and socioeconomic differences in hazard awareness and response. However, until recently, both researchers and those responsible for natural hazards policy and planning have virtually ignored those millions of persons whose physical capabilities differ from those of the general population. For example, although studies of community mental health and human services resources in disasters have sought to identify groups with special needs (Tierney and Baisden, 1979), they do not make any specific references to the distinctive needs of disabled persons. While studies on elderly persons in disasters have been conducted (Bell, 1978; Huerta and Horton, 1978; Kilijanek and Drabek, 1979), such studies do not explore the connection between age and disability or discuss systematically how disabilities may add to the problems of elderly persons in disasters. In the area of special policies and programs, a relatively small number of task forces and conferences have considered the topic of disabled persons in emergencies (see Levin, 1980, and Clive, 1983, for examples); while numerous recommendations were made as a result of these conferences, the majority of the recommendations were not based on solid research, and conference participants often did not concur on how best to achieve improved safety for disabled persons. In view of the lack of an adequate knowledge base, this is not surprising.

One conference panel which addressed the issue of fire safety for disabled individuals (Levin, 1980) pointed out that in order to increase the safety of persons with disability in fire situations, data are needed on the actual physical capabilities of persons with disabilities; the extent of the need for protective devices and safety procedures in various settings; the manner in which disabled persons have coped in actual fires; and the interaction of disabled and nondisabled persons with one another when a fire occurs (for example, to provide assistance).

Similar information on the needs and coping capacities of disabled persons is needed with regard to other hazards, and we incorporated the above recommendations into our own earthquake research agenda. What we found is that existing information is extremely sketchy.

The Increasing Significance of the Disabled Population

The need for solid information that can serve as a basis for improved policies and programs is particularly acute because, in spite of their relative lack of social visibility and political power, disabled persons constitute an increasingly large and important segment of the U.S. population. In the sections that follow, we discuss why physically disabled persons in the population warrant special emphasis in natural hazards research and policy.

Growth in the Number of Disabled Persons

Several societal features and trends have increased the importance of disabled people as a population at risk from natural hazards. First, disability is quite prevalent. There is a large and growing disabled population, in part because the U.S. is an industrialized society with distinctive demographic characteristics and an advanced health care system.

During earlier periods in history, people tended to die young from infectious diseases or other acute conditions. Due to improved nutrition, more effective public health measures, and new medical treatments, life expectancies in the U.S. and other Western industrial societies have increased. At the same time, chronic health problems and their attendant physical disabilities have become increasingly widespread (Berkowitz, Johnson, and Murphy, 1976; Fingerhut, Wilson, and Feldman, 1980). As the U.S. population gets older and lives longer, the management of chronic illness is consuming an increasing share of health care resources (Strauss, 1975). Several of the most prevalent chronic illnesses--arthritis, heart disease, and diabetes, for example--are typically accompanied by physical impairments or limitations, so their growth is related to the growth in the number of persons with disabilities.

Disability is also common at the opposite end of the life cycle. Infant mortality has declined, and the health care system now intervenes in seriously disabling physical conditions, such as severe birth defects, that in the past would have been fatal. As a result, severely impaired younger members of the population survive, but may require high levels of physical support.

The proportion of people that is disabled in the U.S. has also increased because the modern health care system now saves many victims of acute illness and accidental trauma who, under other circumstances, would not have survived. In many cases, those saved have been relatively young persons, who were subsequently left with residual physical impairments. Examples of this group include people affected by earlier polio epidemics who are now adults and people who have lost mobility in their limbs because of serious spinal cord injuries.

Other societal features also contribute to higher rates of disability. Modern transportation systems, together with high rates of transportation related accidents, clearly add significantly to the number of disabled persons. Lifestyle choices that persist in industrial societies despite trends to the contrary--lack of physical exercise and high rates of cigarette smoking, for example--are related to chronic illnesses such as heart disease. Moreover, workers are exposed in the workplace to hazardous substances, such as asbestos and coal dust, that can cause significant physical impairments.

Currently, an estimated 36 million people in the U.S. have some degree of disability. It has been estimated that "by the year 2000, there will be one chronically ill, over sixty-five, or disabled citizen for every able-bodied person in the country" (Bowe, 1980, p. xiv).

Increased Integration into Society

Besides this increase in numbers, there has also been increasing variation in the settings in which disabled persons can be found. In the past, disabled people tended to be residentially and institutionally segregated. Now, due to changes in the economy, law, and public policy, they are more widely dispersed throughout society. Although the rate of unemployment among disabled people remains very high, people with disabilities are becoming more numerous in the labor force. One factor in this trend is that, as the U.S. economy has become more service oriented and technologically sophisticated, physical qualifications have become less important as criteria for employment. Automation and improved safety in the workplace have reduced the risk of on-the-job injury for both disabled and nondisabled workers. Studies comparing the productivity and safety records of the two groups suggest that the performance of disabled workers is equal to or better than that of their able-bodied counterparts (Allan, 1963; Nathanson, 1977; E.I. Dupont, 1982).

The entry of disabled persons into the workforce has been encouraged by legislation, mainly at the federal, level, that attempts to remedy previous discriminatory practices. The most significant legislation in this area is the Vocational Rehabilitation Act of 1973. Sections 501-504 of the act were designed to end discrimination based on physical disability in workplaces and public facilities. Section 504 states that "no otherwise qualified handicapped individual . . . shall, solely by reason of his handicap, be . . . subjected to discrimination under any program or activity receiving Federal financial assistance." Disability subsequently became an element in employers' affirmative action programs, along with race, ethnicity, gender, and religious beliefs.

Greater integration of persons with disabilities was also encouraged by legislation to make the built environment more accessible to people with physical limitations. In 1968, a federal law was passed to remove architectural barriers, but as of the early 1970s the law was not being effectively enforced. Section 502 of the 1973 Vocational Rehabilitation Act created the Architectural and Transportation Barriers Compliance Board to enforce the law and encourage the removal of both architectural and "attitudinal" barriers to integration of the disabled. Such actions indicated an "implicit official recognition that such barriers have been a major source of the segregation of disabled persons in workplaces, transportation, public facilities, and other environments" (Hahn, 1983, p. 41).

Disabled children began receiving increased legal protection in the mid-1970s, with the passage of the Developmentally Disabled Assistance and Bill of Rights Act and the Education for All Handicapped Children Act (Public Law 94-142). The latter prohibits public schools in the U.S. from rejecting children based on their disabilities. The law also requires that the education of each disabled child take place in the least restrictive environment and that education be consistent with the individual needs of the child. Rather than segregating disabled children into special schools, educational policy now emphasizes "mainstreaming" both physically and developmentally disabled children.

In addition to legislation at the federal level, many states have also passed laws protecting the rights of disabled persons in a wide range of areas, from housing to education, credit, and insurance. The areas most commonly covered in state statutes are employment, housing, and public accommodations (Sales et al., 1982).

Two other trends, deinstitutionalization and the independent living movement, have also led to changes in the residency patterns of people with disabilities. Prior to the 1960s, people with physical limitations, as well as mentally ill and mentally retarded persons, were likely to reside in special institutions such as state hospitals and nursing homes. In many cases, the only treatment given in such facilities was rudimentary custodial care. Little consideration was given to the appropriateness of such institutional placements for the individual or to the possible iatrogenic effects of institutionalization. Beginning in the 1960s, however, legal and fiscal pressure brought about the closing of many such institutions and the release of numerous residents, including people with physical disabilities, into less restrictive community settings.

In the early 1970s, the Independent Living (IL) movement began to gain influence, particularly among young adults with disabilities. A civil rights, advocacy, and self-help movement, IL emphasizes the goals of self-sufficient community living and maximum autonomy for disabled persons (De Jong, 1979). IL has been helped along not only by policies such as those discussed above, which are aimed at removing environmental barriers, but also by legislation. The Housing and Community Development Act of 1974 made federal funds available to support housing for people with disabilities. Disabled persons now qualify for HUD "Section 8" rent subsidies, which help enable them to live independently. State laws also provide housing assistance. For example, in California, Senate Bill 49 provides aftercare assistance that subsidizes rents for physically, developmentally, and mentally disabled persons who are able to live independently or semi-independently in the community but who are unable to afford housing. In 1978, amendments to the Vocational Rehabilitation Act provided additional funds for programs; under Title VII of Public Law 95-602, the federal government provides funds specifically earmarked for independent living programs for people with disabilities.

In light of these changes, the disaster-related needs of individuals with disabilities take on a new significance. The fact that persons with disabilities are now more integrated with the general population in schools, workplaces, and other settings means that they now face the same range of hazards as members of the general public. At the same time, however, their ability to cope with these hazards may not be as great. Moreover, safety features and preparedness programs designed to protect nondisabled persons may not offer their disabled counterparts an equivalent degree of protection. To a person who uses a wheelchair, the sign above the elevator in high-rise office buildings that states "In Case of Fire or Earthquake, Do Not Use Elevator, Go to Stairways" must seem ominous indeed (Hahn, 1982).

As noted above, until relatively recently disabled persons tended to spend much of their lives under the care and supervision of others. They lived in specialized institutions, attended special schools, and the expectation was that they were assisted in the performance of everyday activities by family members or other caretakers. Individuals with disabilities were viewed as dependent persons who would require assistance in emergency situations. With the exception of public safety agencies and the custodial institutions themselves, providing emergency assistance was not defined as the responsibility of most organizations or of the community at large. The situation is quite different today. Disabled persons participate more in the mainstream of social life and increasingly choose to live independently. There is also a large and growing population of elderly persons with activity limitations who live alone, without family members to care for them either in normal times or in emergencies. The issue of safety, once considered mainly the province of the family or the specialized institution charged with caring for the disabled individual, is now an issue that must be considered by a range of organizations and institutions in both the public and the private sector. The challenge is to develop programs that are responsive to the needs of this growing and diverse population and that recognize both their right to independence and self-sufficiency *and* their right to protection from safety and health hazards.

Aims of This Research

This study consisted of several interrelated tasks. We recognize that disabilities vary in the extent to which physical capacities such as hearing, seeing, and mobility are affected; we assume that these different capacities are related to the ability to cope independently in emergencies. For this reason, our first objectives were to 1) develop a conceptual framework for classifying the large number and wide range of disabilities and 2) relate the different categories of disability to earthquake-generated needs, such as the need to take self-protective measures.

Policies and programs to increase the safety of a population at risk must be based on an understanding of the risks faced by that population. We quickly became aware that no work had been done that specifically addressed disaster-related needs of persons with disabilities. Thus, we undertook a second task to assemble as much data as possible on the size and demographic characteristics of the disabled population, both in the U.S. and in areas with high earthquake potential. From this data base, we hoped to make generalizations that could help inform mitigation and preparedness policy. Part of this work involved an exploratory study to determine where and in what types of buildings disabled persons are most likely to reside in the earthquake-prone Southern California region.

Realistic earthquake safety planning for people with disabilities must be based on accurate information about what these individuals can and cannot do in the earthquake situation. A third aspect of our work involved reviewing the literature on topics such as how disabled people cope in disaster situations and what special risks they face. We also attempted to obtain as much information as possible on how persons with disabilities coped in recent earthquakes, both through reviewing the literature on occupant behavior and conducting our own study of victims of the 1983 Coalinga (California) event.

A fourth task focused on specialized facilities for disabled persons. Recent years have seen an increase in both the supply and the utilization of long-term care facilities in the U.S. (Dunlop, 1979). The majority of the residents in such facilities tend to be physically or mentally disabled. In fact, a major dimension of disability--dependency or the inability to engage in self-care activities--is the most important reason why individuals enter nursing homes. Unlike hospitals, which are short-stay, acute-care facilities, nursing homes have a long-term responsibility for the care of disabled persons; residents face an ongoing risk if safety issues are not adequately addressed at the facilities in which they reside. Like hospital patients, nursing home residents who are physically limited are dependent on those in charge of the facility to take measures to ensure their safety. Obviously, nursing home operators bear a great deal of responsibility for the safety of residents.

In the U.S., most nursing homes are businesses, rather than public or nonprofit institutions. They must comply with numerous regulations and be accountable to various agencies in areas as diverse as facility design, building safety, staffing, and patient care, and still remain profitable. Disaster preparedness must compete with many other priorities for funds and staff attention, and we were interested in determining how much attention is actually being given to the earthquake problem. Thus, another important task in the study involved an assessment of the extent to which the management of nursing homes in areas of high seismic risk are aware of and taking steps to mitigate earthquake hazards.

Organization and Content of Chapters

Chapter II presents a conceptual model of disability and discusses various ways in which disability has been defined for public policy purposes and a rationale for viewing disability in sociopolitical terms. The chapter also contains an overview of how disaster planners view disabled persons. In Chapter III, we summarize survey data on the size and characteristics of the disabled population and present data on the residential patterns of disabled persons in Los Angeles. Chapter IV discusses the risks and physical challenges disabled persons can expect to face in an earthquake situation and reviews the literature on disaster-related injuries. Chapter V considers earthquake effects on buildings and their likely consequences for disabled building occupants; it also contains material from earthquake-effects scenarios, developed through on-site inspections at different types of facilities, that gives special emphasis to the likely needs of disabled persons. Chapter VI focuses on the topic of earthquake preparedness and response programs, both in the community and in nursing homes. Chapter VII presents propositions and generalizations derived from the research and discusses alternative approaches to mitigating the hazards this population faces.

CHAPTER II

CONCEPTS AND MODELS IN THE STUDY OF DISABILITY

Conceptualizing Disability

One of the first tasks addressed in this project was to adopt a framework for conceptualizing disability that recognizes its distinctive characteristics. As used in this report, the term *disability* refers to the total or partial limitation of an individual's performance of typical social roles that is associated with a physical or mental impairment. Besides differing in their severity, disabilities vary in their permanence; for some persons, a disability is chronic or irreversible, while for others--such as an accident victim who is undergoing physical therapy and is expected to recover--it is a temporary condition.

For conceptual clarification, it is important to distinguish the term *disability* from other related terms such as *pathology*, *disease*, *physical impairment*, and *activity limitation*. These terms are not synonymous; for example, not all physical illnesses result either in impairments or in disabilities, and not all disabilities stem from illness or injury. Depending on various factors, particularly the societal response to the impairment, the same type or degree of physical impairment may or may not result in a disabling condition.

Several conceptual frameworks have been developed to describe disability. Ours draws upon the work of Howards, Brehm, and Nagi (1980) and the World Health Organization (1980). As used in our discussions, the word *pathology* (*illness* or *disease*) refers to an abnormal physiological or mental condition, which may be acute or chronic. The term *impairment* refers to a deviation in some aspect of the body's structure that is the residual effect of illness, injury, genetic factors, or the environment (although such agents do not always produce impairments).

Functional or *activity limitations* are restrictions on various types of daily living activities that individuals may experience as a result of impairments. Examples of activity limitations include difficulties with walking, bending, lifting objects, and engaging in self-care activities. Much of the literature in the rehabilitation area centers on how to develop appropriate, reliable, and valid measures of limitations in the activities of daily living (ADL) (see Gresham and Labi, 1984, for an overview of these methods).

The relationship between impairments and functional limitations is not straightforward. Not all impairments lead to functional limitations; many impairments are inconsequential for an individual's performance, and others can be corrected. Different impairments can result in similar functional limitations (blindness, for example, can stem from many different physical causes), and two individuals with similar impairments can have different functional capabilities.

The Social Dimension of Disability

This discussion conceptualizes disabilities as an "inability or limitation in performing social roles and activities" (Nagi, 1976, p. 441) that is the result of a combination of individual and socioenvironmental factors. What makes disability distinct from the other terms mentioned above, is that the concept has a social dimension. There are several senses in which disability is social. First, the term disability implies a lowered ability to carry out prescribed social roles or activities that are considered usual, typical, or appropriate for members of a particular culture. Since roles differ for various groups in society, criteria for identifying someone as disabled also differ. For example, for adults under 65, disability is usually defined in terms of roles such as work and housekeeping. For older persons, beyond what our society considers working age, the degree of disability is assessed relative to such activities as self-care or the performance of daily activities such as housework or cooking. A person with a particular impairment or activity limitation might be identified as disabled or nondisabled, depending on his or her age and role responsibilities. A child would be considered disabled if he or she had a functional limitation that interfered with involvement in play activities or school attendance.

Second, while everyone is limited in the extent to which he or she can perform some tasks, not all activity limitations constitute disabilities, because not all activities have the same social significance. For example, only a few persons have the capability to be world-class athletes or opera singers, but for the vast majority of persons, the inability to perform such roles successfully is not considered a disability. Disabling conditions are those that limit individuals in the performance of key social roles that are expected of most members of their age or status group.

Third, disability has a social dimension because the social context shapes the life chances of disabled individuals and thus can strongly influence both the nature and the extent of disability. Technology, law, public policies, organizational practices, and the attitudes of other members of society have an impact on the extent to which physical impairments limit activity and constrain role performance. The definition of disability, policies concerning the provision of income assistance and rehabilitation services, and outcomes for affected individuals differ across nations and cultures as a result of social, economic, and political factors. Examples of such factors include: the extent of the economy's demand for labor; the age composition of the population, including the work force; and the political ideology of the society, as reflected in government policies (Noble, 1979). In contrast with industrialized countries, developing nations have tended to focus on basic health-care issues and have only recently begun incorporating rehabilitation into their health planning (Safilios-Rothschild, 1981). Even among the industrialized nations, policies and programs differ (Copeland, 1977; Albrecht, 1981; Hammerman and Maikowski, 1981).

It is possible to cite many examples that illustrate the relationship between social factors and disability. For example, attitudinal barriers that discourage the hiring of cognitively impaired persons contribute to their work-disabled status. Before affirmative action programs and regulations existed to ensure access to buildings by disabled people, many physically impaired individuals were work-disabled not because of the extent of their functional limitations, but rather because of employment discrimination and architectural barriers that made working in some settings impossible.

Sigelman, Vengroff, and Spanhel (1984) have developed a model of disability that shows that the relationship between limitations in functioning and disability is not direct, but is mediated by a number of environmental factors (see Figure II-l). In this model, impairments are manifested in limitations in various life functions (mobility, health, communication, etc.) which interact with environmental variables (e.g., the physical and social environment), which in turn feed back to affect life function limitations and also directly influence life outcomes. (Disabilities in the areas of work and independent living are included among life outcomes.)

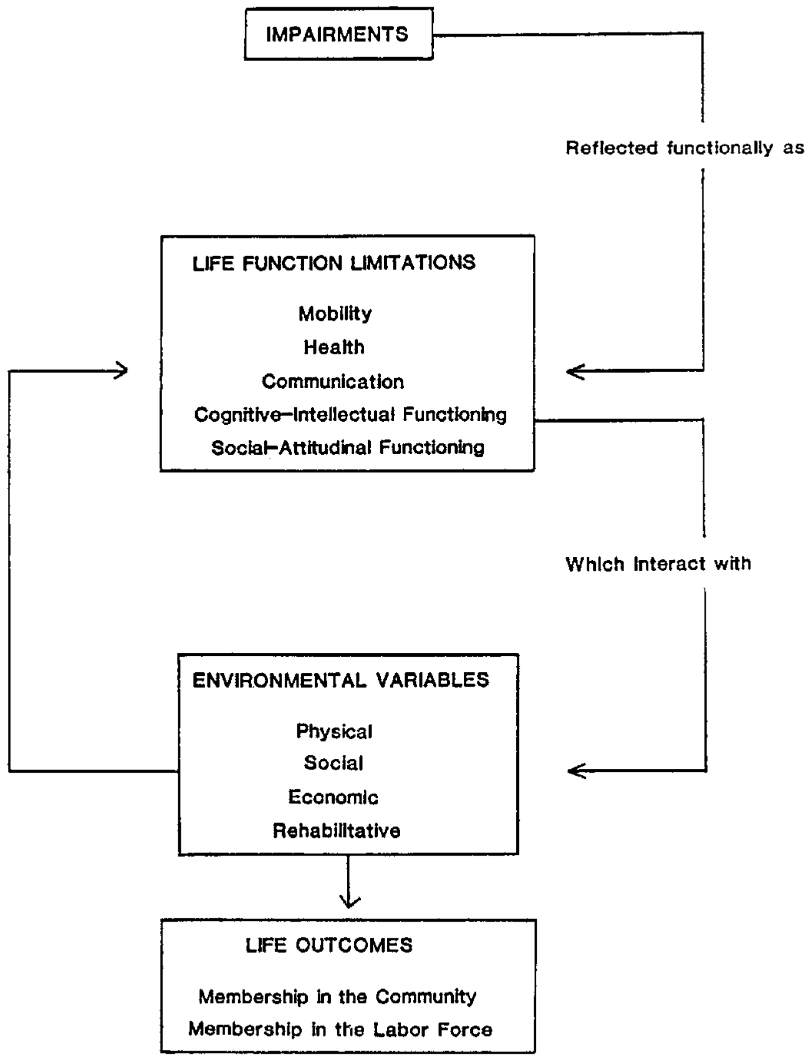


Figure II–1: Relationship Between Impairments and Disabilities
Source: Sigelman, Vengroff, and Spanhel (1984)

Models of Disability

At least three different conceptual models have informed public policy on disability: the medical, economic, and sociopolitical models. Each is based on a different set of assumptions, defines disability in a distinctive way, and suggests different approaches to ameliorating the problems of the disabled (see Hahn 1984a, 1984b, and 1984c, for more detailed discussions of these distinctions).

According to the medical approach, a disability is a physiological or mental condition caused by an illness, impairment, or other factor, and it should be treated as a medical problem, by means of therapy and rehabilitation. The medical perspective groups disabilities into various categories based on etiology or symptoms.

For several reasons the medical model is probably the most influential perspective on disability. The medical and health-care professions have high prestige in society, and members of these professions have established themselves as authorities on the origins and management of disabilities. This is the case even though disabilities are not diseases and despite the medical profession's slowness in developing strategies to provide care for analogous conditions such as chronic illness (Strauss, 1975). Physicians have considerable influence over the lives of disabled persons because they commonly serve as gatekeepers concerning eligibility for assistance for disabled persons. Participation in most disability and rehabilitation programs is dependent on a medical determination.

One consequence of accepting this view is that disability comes to be thought of as an individual-level characteristic. Disability is seen as stemming from the individual's impairments and limitations; the influence of the social context is obscured. Employing the medical prescriptive also de-emphasizes the fact that people with different disabilities often have common problems, regardless of the origin or type of disability.

Acceptance of the medical model has had a number of other consequences for disabled persons and for society. To the extent that disability is seen as a medical problem, the disabled person is required to assume the "sick role" (Parsons, 1951), which may lead to increased dependence on health and human service delivery systems. Because of the model's emphasis on the diagnostic categories that distinguish disabilities, disabled people are encouraged to engage in rehabilitative activities that center on specific disorders, such as blindness and deafness, even though they may have common problems and interests, regardless of the nature of their impairments.

Further, self-help and mutual support activities and efforts to influence policies, legislation, and programs have tended to center on specific categories of disabilities, such as developmental disabilities, rather than on the broader concerns of all disabled people. Groups representing persons with different disabilities have tended to compete with one another for available research and programming funds rather than to cooperate in obtaining funds to assist the broader disabled community.

Finally, since disability is defined in the medical model as a characteristic of the individual, the ameliorative approaches suggested are typically individual-level strategies (e.g., training in the use of prosthetic devices, job training) that focus on helping the individual fit into society. While such strategies are certainly appropriate, so are societal-level interventions that would prevent disability or ameliorate its negative consequences and attempts to find collective, rather than individualized, solutions for the problems disabled persons confront.

The economic model defines disability as a health-related limitation or lack of ability that restricts the amount or type of work an individual can do. The main focus in economic approaches to disability is the rehabilitation of individuals for gainful employment. The economic model has guided income assistance policies in the U.S. since the time they began; disability benefits have typically been offered first to workers in important segments of the economy and to those whose work contributed to national interests (e.g., veterans) (Albrecht and Levy, 1981).

The economic model is exemplified in the policies of agencies such as the Social Security Administration (SSA) and departments of vocational rehabilitation. Programs such as SSA's Social Security Disability Insurance (SSDI) provide income for those unable to work due to a physical or mental impairment. Vocational rehabilitation programs focus on restoring the individual's capacity for earning an income in the competitive job sector.

Some policies based on an economic definition of disability emphasize the notion that disabled persons can become economically productive members of society. Programs are justified in terms of the positive impact they have on individual income and the nation's economy. Bowe (1980) argues that employment-centered rehabilitation programs for disabled persons are among the least expensive and most cost-effective government programs, with the potential for returning three dollars for every dollar of funds invested. According to some criteria, the economic approach to disability represents an enlightened view of the problem.

However, the economic model also has limitations and drawbacks. Among the more obvious is the fact that the definition of disability it employs does not encompass disabled persons who are not in the work force, such as children and persons who are beyond working age. The economic model also ignores persons with physical limitations who are able to work. According to the economic definition of disability, a paraplegic with a job is not considered disabled, while a paraplegic who is not currently working is.

Other problematic aspects of the economic approach are less obvious. Like the programs influenced by the medical model, vocation rehabilitation programs tend to focus on individualized solutions such as job training rather than on environmental modification and other social remedies for the problems of disabled persons. Moreover, the economic model seems to take for granted the idea that the ability to work is determined mainly by an individual's physical abilities and functional capacities, and not by other factors. Critics of the economic/job rehabilitation approach argue that this is not necessarily the case; in a post-industrial, technological society like ours, the great majority of jobs can be performed by people with a variety of different physical capabilities. These critics point out that the idea that particular jobs can only be performed by people with particular abilities is no longer viable, if it ever was.

Additionally, despite its emphasis on jobs, the economic model of disability tends to downplay the role of the economy and the employment market in influencing who is classified as disabled. Rates of disability change with fluctuations in the economy and with the demand for labor (Howards, Brehm, and Nagi, 1980). As noted elsewhere in this report, during World War II there was a decline in unemployment rates for people with disabilities, because physical requirements for hiring were waived. During times when the economy is poor, more people are included among those receiving disability assistance than during more prosperous times. Disability rates vary by race and sex, even among individuals with similar levels of physical impairment (Nagi, 1976). Such patterns call into question the notion that disability is purely a matter of whether or not a person is physically able to perform a job.

The sociopolitical approach views disability in a radically different manner. According to the two views discussed above, disability is a property of individuals and a consequence of some antecedent physical or mental condition that restricts the individual. According to the sociopolitical approach, on the other hand, a disability is the consequence of environmental and social factors that interact to restrict the capabilities of some individuals.

According to the sociopolitical view, disability has its origins not in the individual but in the socioenvironmental field. In the case of a paralyzed individual, for example, disability is seen as resulting not from the physical condition per se but rather from 1) the social stigma that results from being physically different in a society that emphasizes idealized models of physical appearance; 2) environmental barriers that make mobility difficult; 3) discriminatory employment policies that define the person as lacking the potential to be productive and thus exclude the individual from serious consideration for jobs; and 4) cultural beliefs that devalue the person's worth and capacity for contributing to society. As this example illustrates, when a disability is considered from the standpoint of the sociopolitical approach, the emphasis shifts from a focus on the individual and his or her physical condition or ability to work to a consideration of the broader social, cultural, economic, and political environment that "creates" the disability.

Adopting a sociopolitical model necessitates a shift, not only in how disability is conceptualized, but also in approaches to disability policy. According to the sociopolitical model, people with disabilities should be viewed as members of a minority group--victims of stereotyping, prejudice, and discrimination. Physical impairments are the equivalent of traits such as skin color, gender, and age, which are also used to justify unequal treatment. Indeed, in this view, many of the functional limitations and incapacities of members of the disabled population can be traced, not to their own lack of ability to adapt, but to decisions made about planning, design, architecture, the organization of work, and the delivery of services that fail to take into account people who differ from the societal norm or ideal. Numerous features of contemporary life--buildings, offices, factories, transportation systems, housing patterns--combine to create a "disabling environment." The disabling environment, stereotyped attitudes, and discriminatory practices serve to perpetuate the disadvantaged status of disabled persons.

According to the proponents of the sociopolitical approach, these various forms of unequal treatment have the same negative effects on impaired persons as they have on the members of other minority groups: the disabled individual is socially isolated, lacks self-esteem, and may even internalize widely held myths about the capabilities of disabled people. Disability thus becomes a self-fulfilling prophecy.

The critique offered by the sociopolitical perspective is similar to the approach that was advanced by labeling theorists in the area of social deviance (Lemert, 1951; Scheff, 1966). According to this approach, a condition such as mental illness, or physical disability, does not exist objectively as a trait of an individual so much as it is produced through a combination of factors: the way others in society react to and treat the individual; the roles and statuses to which the individual is relegated; and the options that society makes available to the individual. In the disability area, some writers (e.g., Friedson, 1965; Illich et al., 1977) argue that the health professions play a key role in labeling individuals in our society as disabled. Taking a labeling approach, if persons with physical impairments are labeled as different, assumed by others to be limited in various ways, treated as incompetent, sick, or child-like by able-bodied members of society, and constrained by their physical environments, then they will eventually tend to behave--and think of themselves--accordingly.

The sociopolitical view of disability also makes assumptions that are similar to the perspective in sociology that argues that social problems do not exist objectively, but instead are socially constructed (Blumer, 1971; Spector and Kitsuse, 1973). According to this perspective, whether or not a condition or situation (like drug use, mental retardation, herpes, hyperkinesis, or disability) is defined as a social problem and how the societal response to the problem is structured are dependent upon the activities of various interest groups in society. A key idea in this approach is that sectors, groups, and institutions that have something to gain in the process shape both how the problem is defined and what solutions to the problem will be considered. In the case of disability, as with many other problems that have a physiological dimension, the problem-definition process has had several consequences. First, the medical and rehabilitation professions have defined the problem in medical terms. Second, bureaucratic record-keeping practices have been developed that make it seem as if disabilities have an objective reality. Third, individualized solutions (e.g., physical therapy and rehabilitation) have been emphasized because these are the kinds of interventions that benefit influential groups (Albrecht and Levy, 1981). Those who adhere to the sociopolitical view argue that this is not the only way--and not the best way--to respond to the needs of disabled persons.

Several tenets of the sociopolitical approach have begun making their way into discussions of public policy. For example, responding to the failure to enforce Section 504 of the Rehabilitation Act of 1973, which prohibits discrimination based on disability, many disabled people began increasingly to define the problem of disability in civil rights terms. More and more this group is defining itself and being defined as a minority group that has been assigned a second-class position in society and otherwise segregated and discriminated against.

One consequence of this change in perception has been increased political involvement by disabled persons. In the past, disability programs and policies were mainly developed by professionals and experts, but recently, disabled persons have begun to form political organizations and lobby for changes in legislation and public policy. Their focus has shifted from a concern with combatting physical limitations and individualized attempts to "overcome" handicaps to efforts to modify disabling aspects of the environment and eliminate arbitrary qualifications for employment (Hahn, 1985).

In attempting systematically to address the question of earthquake-related needs of disabled persons, we were guided by several assumptions. First, the sociopolitical perspective seems to be the most appropriate model for characterizing the situation of disabled persons with respect to the earthquake hazard. Second, since there are many types and degrees of disability, it is obvious that disabled individuals will have differing needs and capabilities in earthquakes. Some disabled individuals may be just as capable of self-sufficiency during and after an earthquake as nondisabled persons, while others may be almost totally dependent on caretakers, family members, or fellow employees for assistance. Third, disabled persons are found in a variety of settings, from independent living situations to total institutional care, and these differences can be expected to affect their needs and abilities in an earthquake as well as their expectations about what others will do with and for them. Fourth, like the able-bodied population, the disabled population is heterogeneous with regard to traits such as race, ethnicity, education, and income. All these factors are related to earthquake awareness and response capability. We thus concluded that it is not possible to generalize about how disabled persons as a category will respond in an earthquake or to discuss the needs of the "typical" disabled victim. Instead, we emphasize the dimensions along which disabilities and physical settings vary and point out the significance of these variations in the earthquake situation. These points are elaborated in the chapters that follow.

CHAPTER III

THE EPIDEMIOLOGY OF DISABILITY

A first step in developing policies to increase the earthquake safety of people with disabilities is to determine the size, characteristics, and disaster-related needs of this population. Ideally, it would be desirable to learn as much as possible about the prevalence of different forms of disability, the degree of physical impairment that is associated with each of the various disabilities, the social characteristics of the disabled population, their residential patterns, and other attributes that could have policy relevance. Unfortunately, existing data on the disabled population offer little in the way of definitive answers on such topics. However, the data do include enough general information on disabilities to be of some use in policy formulation.

The discussion that follows is in no way meant to be a definitive and comprehensive treatment of the epidemiology and demography of disability. Instead, we will 1) present descriptions of major surveys in the disability area; 2) summarize some of the important findings from these surveys; and 3) attempt to illustrate how data on the prevalence of disability and the residential patterns of disabled persons might be used by policy makers and emergency managers.

Sources of Data on Disabilities

The U.S. Census and Specialized Surveys

In both 1970 and 1980, the U.S. Census questionnaire contained a limited number of questions on disability. In 1970, three questions were asked concerning the degree and duration of work disability for persons age 14 to 64. In the 1980 census, questions centered on work disability for persons of working age and limitations in the ability to use public transportation for persons 65 and over. The census data are useful for some purposes. For example, they can be used to estimate the number and socioeconomic characteristics of disabled persons living in a community and to plot their residential patterns (see our own analysis of the greater Los Angeles area for one such application). However, these data do not contain information on the nature of respondents' disabilities, and there is some question about the statistical reliability of the items (Nicholls, 1979).

The 1976 Survey of Income and Education, also conducted by the U.S. Bureau of the Census, includes several questions on disability (although gathering data on disabilities was not its primary purpose). The questions, asked for each household member, concern limitations in school attendance and work, limitations in self-care, and the duration of the disability.

Data on some members of the disabled population are also collected in special surveys of 1) persons with relatively rare disabilities who would not be found in sufficient numbers in random sample surveys of the general population; and 2) individuals whose disabilities could cause them to be undercounted in conventional surveys. The first category includes surveys such as the National Multiple Sclerosis Study, conducted in 1976 by the National Institute of Neurological and Communicative Disorders and Stroke (Baum and Rothschild, 1983). The National Census of the Deaf Population (Schein and Delk, 1974) is an example of the second category.

National Surveys

Several national surveys of the general population have been designed to provide estimates of the prevalence of various disabling conditions and activity limitations. The National Health Interview Survey, administered by the National Center for Health Statistics, is the result of face-to-face interviews conducted periodically since 1977 on a sample of U.S. households. It contains a number of disability-related items, including questions on the extent of the limitations on major activities (ability to attend school, work, or perform self-care activities) for persons in all age groups with chronic health conditions and impairments.

The 1966 and 1972 Social Security Administration surveys include members of the U.S. population age 18-64 (20-64 in 1972) who were not living in institutions. These surveys contain questions about limitations in the ability to perform work and housework. Disabilities are classified into three categories according to severity.

These surveys yield rough estimates of the proportion of the population in some age groups that have a disability or an activity limitation. However, the information they provide is not really comprehensive or detailed. Most of the studies take an economic approach to disability; a disability is defined as a condition that limits a person's ability to work. Recently, the National Health Survey broadened its focus, recording data on the activity limitations experienced by older persons and young children. For those beyond working age, data are obtained on limitations in the ability to engage in basic self-care activities such as preparing food and cleaning.

Also consistent with the economic view of disability, most surveys sample only among members of the working-age population--usually those between 18 and 64. Relatively little information is provided on persons 65 and over, except in the National Health Survey. Since disabilities increase with age, surveys underestimate the number of disabled persons. Focusing only on noninstitutionalized persons has the same effect. Most surveys provide no information on the prevalence of disabilities among younger members of the population, because those under 16 or 18 are typically not included.

Besides lacking information on some dimensions of disability and some groups in the population, national surveys are not designed to explore the relationship between physical impairments and activity limitations. The surveys tend to focus on one or the other of these facets--that is, either the physical impairment or the activity limitation--but not both. One national survey that does explore such links was conducted by Nagi (1976). In this study personal interviews were conducted with 8,000 adults in a random sample of U.S. households. The objective was to determine the prevalence of physical and emotional impairments and to specify how these impairments are related to limitation in work and independent living.

Survey Findings

Rates of disability found in various national surveys are not comparable, because of differences in the age ranges sampled, the dimensions of disability measured, the time references used in questions, and data collection methods. Despite this lack of comparability, data from national sources at least make it possible to characterize and generalize about some sectors of the disabled population. The following are examples of the kinds of relevant information surveys can provide:

- Most estimates of the prevalence of disability in the working-age population in the U.S. range between 11% and 14%.

- Rates of disability increase with age. While an estimated 3% of those between 16 and 24 and 5% of those 25-34 are disabled, the rate jumps to about 30% for those 65-74.

- Most working-age disabled persons live with families, but about 14% live alone. About 16% of those who reported having chronic activity limitations in the 1980 Health Interview Survey lived alone.

- Disabled persons are much more likely to be unemployed and living in poverty than their nondisabled counterparts.

- Rates of disability vary by race and ethnicity. Blacks, in particular, have higher rates of disability than whites.

- About 10% of the U.S. population has a major activity limitation. The proportion of the population with major activity limitations increases with age, with about 18% of all persons 45-64 and one-fourth of persons 65 and over reporting a major limitation in 1983.

- As of 1977, an estimated 6.5 million persons or 3% of the civilian noninstitutionalized population used one or more special aids (canes, special shoes, braces, walkers, etc.). Canes and walking sticks were among the most common aids; 645,000 persons reported using wheelchairs, and half these individuals use them all the time.

From the standpoint of program planning and policy development in a number of different areas, including hazard mitigation and emergency management, these kinds of data are useful. For example, since disability is more prevalent among the older population, communities that have large numbers of older persons--retirement communities, for example--can assume that they have a larger than average disabled population and can plan accordingly.

Additional data on the demographic characteristics of the disabled population will be presented below; statistical summaries by Mathematics Policy Research (1984) and the U.S. Bureau of Census (1980) also provide background information on persons with disabilities.

Data on People with Disabilities in California

The discussion that follows focuses on data on the disabled population of one earthquake-prone state--California. The information has been taken from the California Disability Survey and the 1976 Survey of Income and Education. The California Disability Survey (CDS) was conducted in 1978 by the University of California Survey Research Centers at Berkeley and UCLA for the California Department of Rehabilitation. The CDS consisted of telephone interviews with disabled and nondisabled adult members of 30,000 California households. The main objectives of the survey were to determine rates of disability both statewide and for the 26 Department of Rehabilitation districts and to determine the characteristics of the disabled population. The CDS obtained information not only on work disability but also on activity limitations, physical dependency, and other dimensions of disability. Regarding the social and demographic characteristics of disabled persons, the survey results discussed below are quite similar to the findings in larger national surveys such as the 1966 and 1972 Social Security Administration surveys, but they are more recent.

Prevalence of Disabilities

The CDS found that approximately 1,450,000 persons age 16-64 in California's population (which at that time was 13,834,000) had a work or housework disability that had lasted for at least three months. This constitutes approximately 10.5% of the working-age population; the percentage would be substantially higher if persons 65 and over were included in this count. Of this group, an estimated 1,050,000 were classified as severely disabled according to the study criteria--that is, they were classified as limited in the ability to work, with serious physical or mental impairments as well as significant activity limitations.

Social and Demographic Characteristics

As noted above, the CDS found many of the same patterns that had been uncovered in other surveys. There was a close relationship found between age and disability. Only about 1.5% of the survey population under 25 were severely disabled, compared with 22% of those 60-64. Consistent with other studies, women were found to have higher rates of disability--including severe disability--than men. This gender difference was interpreted as being due to men having higher rates of mortality than women as well as to disabled women being in a more disadvantaged position in the job market than disabled men.

Ethnic groups were found to have different rates of disability. Such differences are due to some extent to differences in the age composition of the ethnic groups. For example, the Hispanic population tends to have a large proportion of young people, and disability is relatively uncommon among the young. It was thus necessary to adjust rates to take these differences into account. Age- and sex-standardized rates of severe disability were found to be highest for blacks (15.6%) and lowest for Asians and persons with Pacific-island ancestry (3.4% and 4.3%, respectively).

The CDS found that rates of disability are higher for inner-city and rural California residents than for those living in suburban areas. Again, this was largely due to age differences; the suburban population is relatively young, and older residents are more heavily concentrated in urbanized and rural areas in California. According to the CDS, the majority of persons who are disabled are married. Statistically, however, disabled persons are less likely to marry and more likely to be divorced or separated than those who are not disabled.

The CDS did not request information on income from respondents. However, the survey did attempt to determine whether or not respondents were working or "in the labor force" (either working or seeking work). The majority of the severely disabled respondents were found to be not in the labor force; that is, they were not working and did not expect to find work. About one-half of the disabled respondents were receiving public assistance payments of various kinds. Social Security payments were the largest source of income assistance for disabled persons, while other income sources included public welfare, workers compensation, and unemployment compensation. Clearly, a large proportion of the disabled population falls in the lowest income categories. Bowe (1981) cites government statistics indicating that about 47% of disabled adults had incomes of less than $4,000 in 1981.

Findings from the 1976 Survey of Income and Education for California are similar. This survey, which included 4,202 California households, found that approximately 12% of the population over the age of two had a disability that limited normal activities. Rates of disability were found to be relatively low for Hispanics (8.8%) and high for blacks (18.2%). An estimated 16.2% of those below the poverty level were found to have disabilities. The highest rates of disability in the state--around 14%--were found in the Los Angeles-Long Beach area.

Conditions Associated With Disability

Determining which physical conditions are the most prevalent sources of disability on the basis of survey data is difficult. Many individuals are disabled due to multiple impairments, and surveys differ in the extent to which information on specific impairments and chronic conditions is recorded. Moreover, not all impairments and chronic conditions are disabling. Based on their review of the literature on 14 impairments that are chronic, associated with severe functional limitations, and common in all age groups, Sigleman et al. concluded that it is "impossible to collect comprehensive information on the proportion of each impairment group experiencing a limitation, or to distinguish between temporary limitations and enduring limitations" (1984, p. 8). The dynamics of disability are too complex to reduce to a small number of survey questions.

In the CDS, which did attempt to obtain information specifically on the conditions that lead to disability, musculoskeletal conditions were found to be the most common, with a rate of 70.9 per 1,000 members of the working-age population. Arthritis and rheumatism were the most prevalent musculoskeletal disabling conditions. Circulatory conditions were the second most common problem (30 per 1,000), followed by mental disorders (21.1 per 1,000) and respiratory conditions (12.5 per 1,000). Visual and hearing impairments were reported at rates of 8.5 per 1,000 and 11.4 per 1,000, respectively.

The National Health Survey (NHS) reports data on impairments and chronic conditions (i.e., conditions that have persisted for more than three months). These reported conditions may or may not be associated with significant activity limitations or disabilities, and an individual may have more than one condition. According to the NCHS (National Center for Health Statistics, 1985), arthritis is the most common chronic condition, with a rate of 133 per 1,000 persons; the second and third most prevalent chronic conditions are chronic sinusitis (about 121 per 1,000 persons) and high blood pressure (about 117 per 1,000). Orthopedic and hearing impairments are relatively common (99 and 87 per 1,000, respectively).

The data indicate that social and economic factors are associated with rates of various impairments and disabling conditions. In virtually all cases, rates of chronic conditions and impairments increase with age. For example, in the NHS, the rate of visual impairment is 13 per 1,000 for those under 18; 31 per 1,000 for those

18-44; 53 for those 45-64; 80 for those 65-74 and 135 for those 75 and older. There are also significant ethnic differences in the prevalence of some conditions; for example, hypertension is much more prevalent among blacks than among whites. Rates and types of impairments also differ according to gender, income group, place of residence, and other sociodemographic characteristics (National Center for Health Statistics, 1985).

Patterns of Residence and the Earthquake Hazard in the Greater Los Angeles Area

The Mexico City earthquakes of 1985 vividly showed that a major earthquake striking an urbanized area has the potential for causing large numbers of fatalities and injuries. That earthquake also underscored the relationship between the likelihood of being killed or injured in an earthquake and the type of setting an individual occupies at the time of earthquake impact. Some locations are more hazardous than others, due to such factors as distance from the epicenter of the earthquake, local ground shaking intensity, building construction characteristics, and nonstructural building hazards.

In the United States, old unreinforced masonry buildings are widely regarded as a significant threat in the event of an earthquake because of their potential for collapse and major structural damage. Persons who live in these kinds of structures face a higher risk of being killed or injured in an earthquake than those who inhabit safer structures, such as wood-frame dwellings. For this reason, a few California communities have passed special laws to make the strengthening or removal of these buildings mandatory, and the state of California recently passed a law requiring local jurisdictions to conduct inventories of unreinforced masonry structures.

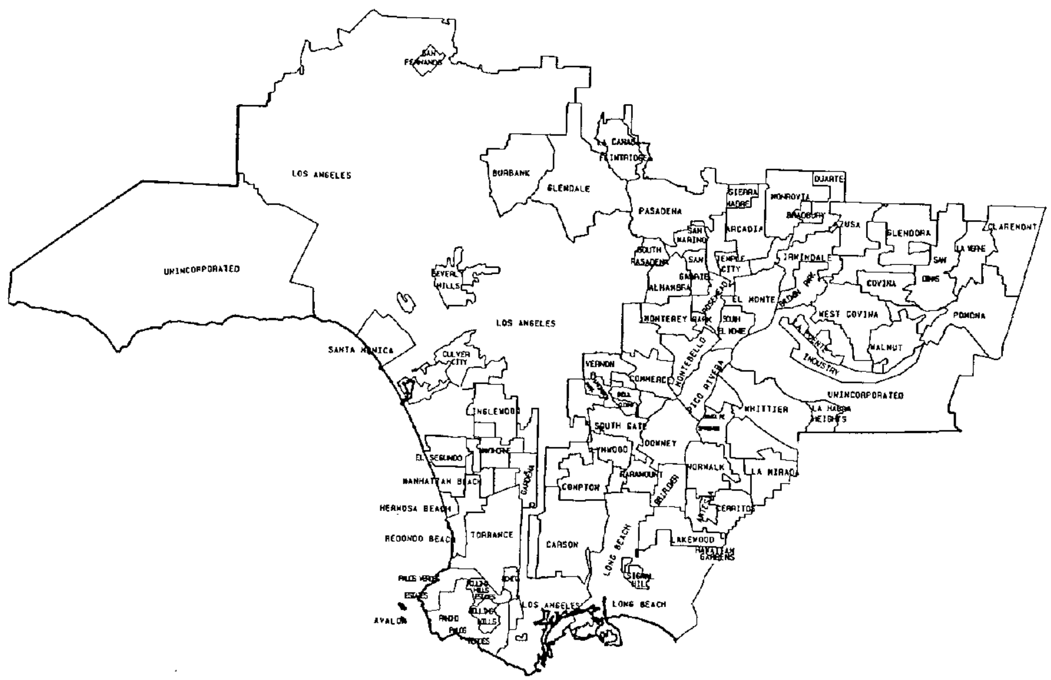
As already mentioned, disabled persons tend to have higher rates of unemployment and lower incomes that members of the general population. It has been estimated that three-fifths of all disabled adults receive incomes that place them below the poverty level (Bowe, 1980). Disabled persons who are left to rely solely on their own resources probably do not fare well in the high-cost Southern California housing market. Like other low-income persons, they may have to accept living in less desirable housing, because that is all they can afford. In Los Angeles, this could mean living in the older sections of the city that contain the old unreinforced masonry buildings that are most likely to be heavily damaged in a major earthquake. In particular, unreinforced brick apartment buildings have been a source of housing for low-income renters. Questions about the possible impact of renovation on rents and on the supply of affordable rental housing for low-income and elderly persons were raised during the 1970s in the debate over the Los Angeles hazardous buildings ordinance (Alesch and Petak, 1986).

We conducted several analyses to determine where members of the disabled population in Southern California live and to assess the level of hazard associated with those areas. For purposes of these analyses, the disabled population was defined as made up of 1) persons age 16 to 64 years of age who reported having a work disability in the 1980 census; and 2) persons 65 and older who reported having a transportation disability. The first set of analyses involved plotting maps to show the residential patterns of disabled persons. A subsequent analysis focused on the types of multifamily buildings in which disabled persons were living at the time of the census.

Geographic Distribution

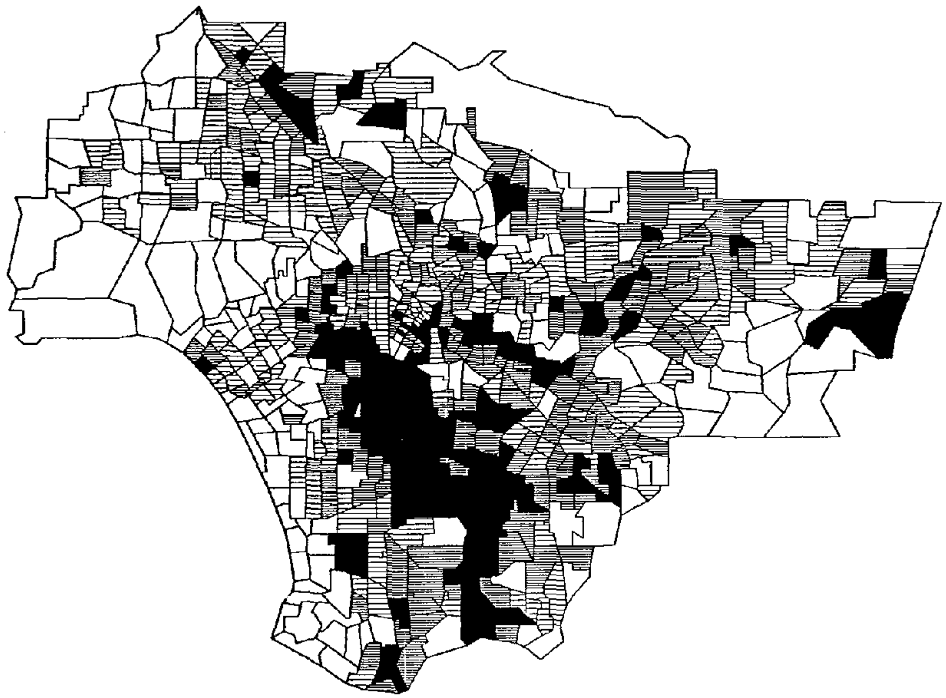
Figure III-1 is a map of the urbanized section of Los Angeles County that shows city boundaries; it is included in this section for reference. Three maps of this area drawn to the same scale were prepared from 1980 census data to indicate 1) the residential density of disabled persons per square mile; 2) raw counts of disabled persons; and 3) the percentage of the population that is disabled (see Figures III-2, III-3, and III-4). In order to produce maps that could be easily read and interpreted, analyses were performed using analytic zones rather than census tracts. Analytic zones are larger geographic units, composed of multiple census tracts whose populations have common demographic characteristics. The analytic zones we used were developed by the Southern California Association of Governments, the major regional planning body in the Southern California region, for a regional transportation model.

The most obvious fact shown by the maps is that residency patterns for disabled persons are not random. Persons with disabilities tend to be concentrated in certain sections of the greater Los Angeles area. More disabled persons (both in terms of absolute numbers and population concentrations) reside in central and south-central Los Angeles and in the southeastern section of Los Angeles County.



URBANIZED SECTION OF LOS ANGELES COUNTY,
WITH CITY NAMES AND BOUNDARIES

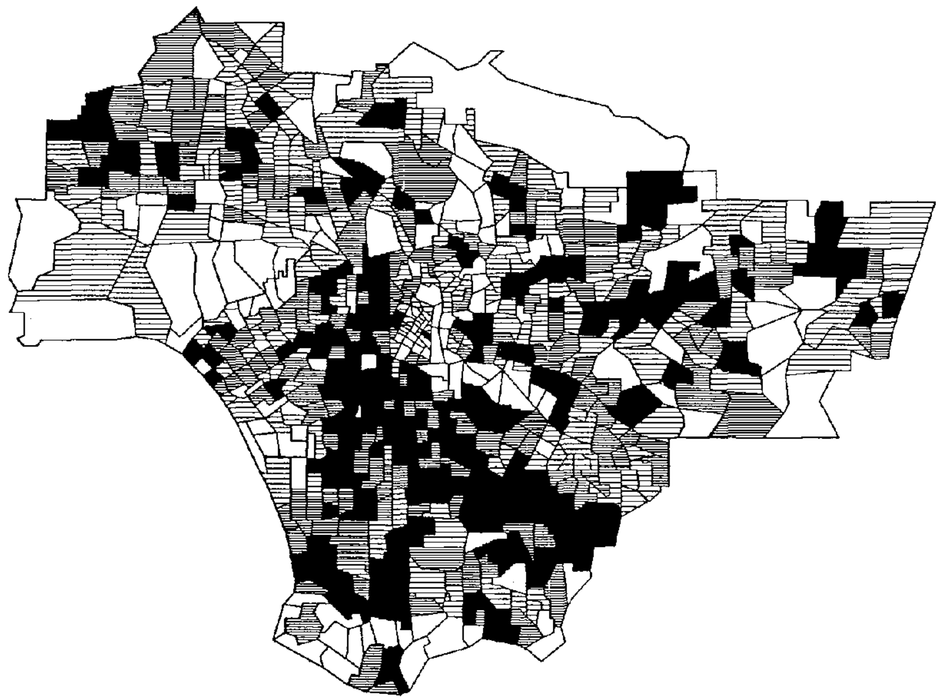
Figure III-1



DISABLED POPULATION DENSITY BY ANALYSIS ZONE:
URBANIZED PORTION OF LOS ANGELES COUNTY

Figure III-2

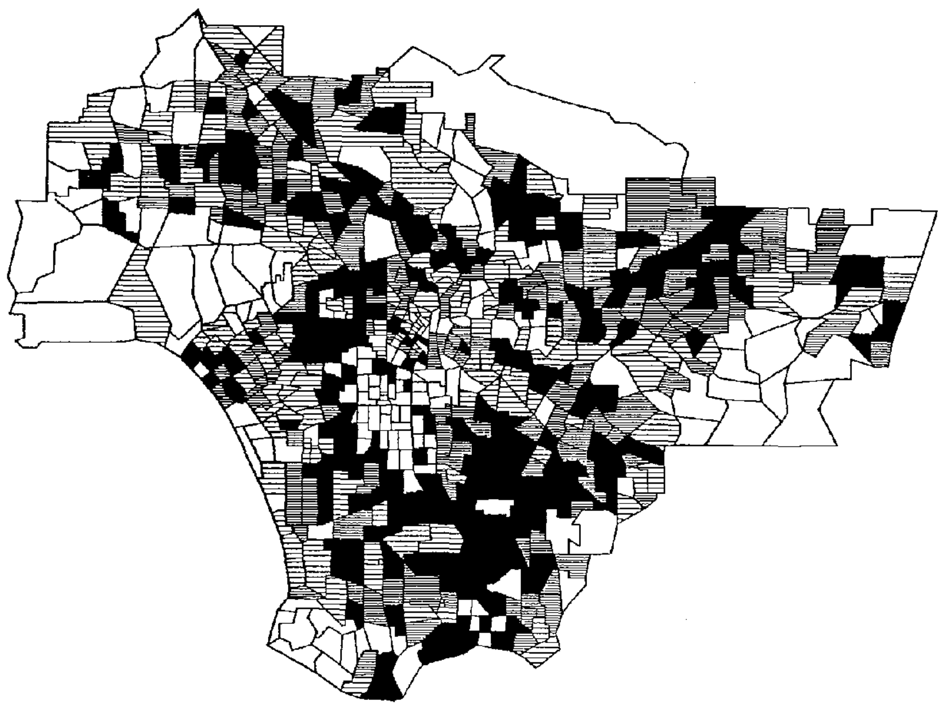
■	114.00 to 551.00	▤	88.00 to 114.00	▤	68.00 to 88.00	□	0.00 to 68.00



NUMBER OF DISABLED BY ANALYSIS ZONE:
URBANIZED PORTION OF LOS ANGELES COUNTY

Figure III-3

900.00 to 2000.00 | 626.00 to 900.00 | 376.00 to 626.00 | 0.00 to 376.00



DISABLED POPULATION PERCENTAGE BY ANALYSIS ZONE:
URBANIZED PORTION OF LOS ANGELES COUNTY

Figure III-4

Another pattern evident in the maps is that the fewest disabled persons (particularly in terms of population density) reside in those areas where household incomes and property values are highest--that is, in communities in the coastal zone (e.g., Marina Del Rey, Manhattan Beach, Redondo Beach, the Palos Verdes peninsula) and in the western section of the San Fernando Valley. Besides being among the more affluent, these communities have buildings that are newer and presumably more earthquake resistant than those in other parts of the county. Many of these communities have a lower overall population density and more single-family dwellings than other sections of greater Los Angeles. (The exception to this residency pattern is the Santa Monica-Venice area, which has higher concentrations of disabled persons than other coastal communities.)

Although all three maps support these general conclusions, they all provide slightly different information. The map in Figure III-2, which shows residential densities of disabled persons is the most distinctive. It indicates that the areas with the highest density-per-square-mile of disabled persons are in central and south-central Los Angeles and along a corridor that runs south to the Los Angeles Harbor area and downtown Long Beach.

Figure III-3, which shows differences in absolute numbers of disabled persons is similar to the density map, except that it indicates that large numbers of disabled persons also live in the southeastern section of the county.

Figure III-4, which shows disabled persons as a percentage of the population reveals a roughly similar pattern. Areas with the highest percentages of disabled persons are again concentrated mainly in the central, southern, and southeastern sections of the county. These are the areas where, in the event of an earthquake, the ratio of disabled to nondisabled residents would be highest. This map suggests that in many areas of the county, up to 10% of the population above 16 years of age has a disability, as defined by the census.

Additional analyses performed with individual census tracts (rather than analytic zones) as the unit of analysis indicated that some census tracts have very high percentages of disabled adults; combining census tracts into analytic zones masked these high percentages. To find the areas with the highest percentages, we selected all census tracts in the county in which 20% or more of the adult population had identified themselves as disabled. Thirty-six such census tracts were found in Los Angeles County, and, of these, all but ten are located in the city of Los Angeles. The Los

Angeles tracts are all very close to the downtown area; they are located directly south of the downtown city center and in the lower Wilshire Boulevard district. Four census tracts were located in the city of Long Beach, with three of these in that community's downtown area. Four other tracts were located in unincorporated areas of Los Angeles County, and two more were in other incorporated cities in the southwestern sector of the county.

These analyses indicate that, according to census data, disabled residents of Los Angeles and surrounding communities are concentrated in the older, high-density, urbanized sections of the county that are likely to sustain heavy damage in a major earthquake. Many disabled persons reside in central Los Angeles, where a number of that city's old unreinforced masonry buildings are located.

Age of Multifamily Housing and Disability

The foregoing analyses indicate geographic areas in which persons who reported disabilities in the 1980 census are most likely to live. However, they provide no information on the types of buildings in which those persons live. We went on to explore the question of whether disabled persons are more likely than their able-bodied counterparts to live in structures that lack earthquake resistance--particularly old, unreinforced masonry apartment buildings.

Masonry structures built in California before 1933 have been shown to be very susceptible to earthquake damage. After the 1933 Long Beach earthquake, which made this problem very apparent, building codes and practices were made more strict, to ensure earthquake resistant construction. Existing structures built before 1933 are considered hazardous; in some California communities, owners of these buildings are required to retrofit or remove them (see Alesch and Petak, 1986, for a discussion of hazardous buildings programs in California). The city of Los Angeles has nearly 8,000 of these structures, located primarily in the downtown, mid-Wilshire, and Hollywood districts.

We used population and housing census data to examine the hypothesis that disabled persons are more likely than their nondisabled counterparts to live in such buildings. The housing census data do not include information on the type of material used in the construction of residential dwellings, but they do contain information on approximately when these dwellings were constructed. Our analysis focused on persons living in multifamily residential dwellings of four stories or more in the city of Los Angeles that were built 1) in 1939 or earlier; 2) between 1940 and 1960; and 3) between 1960 and the present. (Unfortunately, the census data were not grouped to permit a cutoff date of 1934.)

As Table III-1 below indicates, disabled persons do appear more likely than those who are able-bodied to be living in older structures. Of the 88,820 persons 16 years of age and older living in apartment buildings of four or more stories, 13,720, or about 15.5%, are persons with disabilities. While approximately 38% of those who are not disabled live in buildings constructed in 1939 and earlier, nearly 50% of disabled persons reside in such structures.

Conversely, disabled persons are less likely to live in newer, more earthquake resistant buildings. While most residents of the multistory, multifamily structures are not disabled, a case can be made that disabled persons face a proportionately higher risk from building hazards.

Implications for Policies and Programs

This chapter has reviewed epidemiologic studies on disabilities and data on the residential patterns of disabled persons in the Los Angeles

	Year Built			
	pre-1939	*1940-1959*	*1960-1979*	*Total*
Nondisabled	28,460 (37.95%)	13,920 (18.54%)	32,720 (43.57%)	75,100 (84.55%)
Disabled	6,760 (49.27%)	2,040 (14.87%)	4,920 (35.86%)	13,720 (15.45%)
Total	35,220 (39.65%)	15,960 (17.97%)	37,640 (42.38%)	88,820 (100%)

Table III-1

Number and Percentage of Disabled and Nondisabled Adults
By Year of Residence Construction

area. One point that all these surveys make clear is that disability is quite prevalent; between 10% and 15% of the working-age population and a much higher proportion of the population over 65 have some degree of disability, according to one or more criteria. This number constitutes a significant segment of the population, whether viewed on a national, regional, statewide, or local basis.

Earthquake preparedness instructions to the public frequently stress the idea that individuals and households should expect to be on their own for at least 72 hours after an earthquake. The need for autonomy and self-help is stressed because emergency agencies expect to be greatly taxed immediately following a quake by demands for such things as care for the injured and suppression of secondary hazards. However, the data on the prevalence of disabilities indicate that a relatively large segment of the population has problems with some aspect of their daily living activities on an everyday basis. In other words, many individuals are not completely self-sufficient or capable of "self-help" during normal times, and these persons will almost certainly experience added burdens in the event of an earthquake. Disabled persons may thus face a higher risk of death or injury in an earthquake.

Information contained in the census and survey data on disabled persons is valuable from a policy and preparedness planning standpoint. For example, the majority of seriously disabled working-age and elderly persons do not work. This suggests that, while concern for the safety of disabled persons in the workplace is warranted, policies and programs should stress ensuring the safety of individuals in residential settings and public facilities. We have already noted that understanding the age structure and ethnic composition of a community can help officials mobilize resources more appropriately, since age and ethnicity are related to disability.

The demographic data on disabilities tend to confirm the notion that disabled persons are socially isolated. Although many are married, disabled adults are more likely than the nondisabled to be unmarried or divorced. Although many live with families, a substantial number live alone. Because so many disabled persons do not have jobs, they also lack ties with others in the workplace. Research suggests that an individual's ideas about the earthquake threat are influenced by "impersonal" sources of information, such as the print and electronic media, but that these ideas need to be confirmed and reinforced through personal ties (Turner et al., 1979). If disabled persons have fewer of these kinds of ties than able-bodied persons, they probably also have less awareness of the earthquake hazard and less access to earthquake safety information. This suggests that 1) special programs are needed to communicate with the disabled population about the earthquake threat and earthquake safety; and 2) efforts should be increased to establish and/or strengthen mutual assistance networks in the community to reduce the social isolation of disabled persons.

The fact that the income levels of persons with disabilities tend to be so low has implications on two levels. First, since income levels are related to both hazard awareness and the capacity to prepare for earthquakes (Turner et al., 1979), it can be assumed that the disabled population is, by and large, underprepared to cope with the earthquake threat. Second, the majority of disabled individuals probably lack the material and financial resources to increase their preparedness (e.g., by storing food, purchasing emergency first-aid equipment, upgrading their living quarters to increase earthquake safety). To improve the situation, some form of subsidy or other financial assistance may be required, either for the entire disabled population or some high-need/high-risk segment.

With respect to the greater Los Angeles area, the demographic analyses suggest that the areas where the highest number of disabled persons live are also areas that can anticipate high levels of damage in an earthquake. Disabled persons are concentrated in types of structures that are very vulnerable to earthquakes, and these buildings are in areas where the need for emergency lifesaving measures is likely to be high after an earthquake and emergency resources are likely to be taxed.

Following the 1985 Mexico City earthquake, the city of Los Angeles stepped up its timetable for bringing old buildings into compliance with its earthquake ordinance. This action raises the probability that, in the long run, Los angeles residents--including disabled persons--will face fewer building hazards. In the short run, however, special efforts such as educational programs, financial aid, and the provision of material assistance to disabled persons seem justified on the basis of the high vulnerability of this population.

CHAPTER IV

DISABILITY AND THE RISK OF EARTHQUAKE-RELATED INJURY

Because most buildings are designed with nondisabled people in mind, many settings are difficult for disabled persons to negotiate even during normal times. When an earthquake occurs, buildings can become unsafe for all occupants. Even in the absence of collapse or major damage, people inside buildings face the risk of death or injury from broken glass, falling light fixtures, and heavy objects and equipment that move as a result of earthquake forces. Because disabled persons have physical impairments and functional limitations, it seems reasonable to assume that the risks they face in an earthquake are different from, and perhaps greater than, those faced by able-bodied persons.

This chapter examines the probable health and safety risks disabled people face in earthquakes. The discussions that follow are based on information from two sources: published research reports on earthquake injuries and occupant behavior and interviews conducted with disabled earthquake victims.

One major objective of our work was to determine whether there is evidence from past events to suggest that being disabled raises the probability that an individual will be killed or injured in an earthquake. As a preliminary step in addressing this issue, we reviewed the literature in the areas of building safety and human response to earthquakes and other comparable hazards.

The literature in both of these areas is relatively sparse, and neither type of study has focused on the degree of association between disability and earthquake-related injury. We attempted to gather additional data, but our own efforts did not shed much additional light on the question. We were unable to obtain a sufficiently rich set of data, despite attempts to locate and interview disabled individuals who had lived through earthquakes or other natural disasters. We did conduct interviews with 18 disabled victims of the 1983 Coalinga, California earthquake (discussed later in this chapter). However, the sample was relatively homogeneous and was probably not representative of the disabled population; moreover, the range of building types in which disabled persons were located at the time that earthquake struck was relatively narrow.

A complete explanation of the causes of death and injury in earthquakes, at either the macro-level (epidemiologic data) or the micro-level (occupant behavior) would have to take into account both the separate and the interactive effects of the following variables:

1) *Situational factors*: time of day; day of the week; presence or absence of persons who could render assistance;

2) *Earthquake characteristics*: earthquake magnitude; ground shaking intensities; number and intensity of aftershocks; presence or absence of secondary emergencies such as fire;

3) *Individual characteristics*: age; presence or absence of activity limitations; familiarity with the earthquake hazard; earthquake experience;

4) *The behavior of individuals during and immediately after impact*: the ability to take self-protective actions; the ability to control secondary hazards;

5) *Characteristics of the built environment*: building type, age, and condition; number and nature of hazardous building features; extent to which earthquake hazards to building and contents have been mitigated; and

6) *The capacity of the emergency-care system to respond*: search-and-rescue capabilities; EMS capacity, etc.

At present, there are no data bases that would permit researchers to address relationships among these factors. Nothing approaching a comprehensive framework for assessing the factors contributing to personal safety has been developed, either for disabled persons or for the able-bodied. To date, research has focused on the influence of a relatively small number of possible contributing factors and a limited number of associations among factors. After examining the literature, we found that, at best, existing studies provide only a limited basis for generalizing about how earthquakes may affect the safety of disabled persons and what they can do to reduce the risk of injury. Some of the more important findings and conclusions are discussed in the next two sections.

Evidence from the Literature

Studies of earthquake-related deaths and injuries fall into two general categories: epidemiologic studies of death and injury rates that take the entire affected population as the unit of analysis; and occupant behavior studies that focus on specific groups or individuals, such as the people who were present in a particular building at the time of impact, and attempt to explain what factors are associated with being a fatality or casualty. These studies take the individual as the unit of analysis.

Epidemiologic Studies

The first category of relevant studies includes epidemiologic work on the incidence of earthquake-related deaths and injuries. In their study of casualties in the 1983 Coalinga, California earthquake, Durkin, Aroni, and Coulson (1984) found that the rate of serious injuries was higher among persons over 60 years of age than among those in the younger age groups. The authors note that while it may be the case that the activity limitations associated with age contributed to these injuries, it is also possible that age is related to other contributing factors, such as the types of buildings victims were in at the time of impact, and that these factors explain the higher rates.

Glass et al. (1977) conducted a study in one small village in which 5% of the population was killed in the 1976 earthquake in Guatemala. The objective of the research was to examine the relationships between building materials, victims' social characteristics, and health effects (death and injury). All the deaths and serious injuries in this earthquake were related to building type; old adobe dwellings simply collapsed on their occupants during the period of impact. The researchers found that the rate of serious injuries to adults increased continuously with age and that mortality rates were high for both young children and the elderly. Among younger victims, mortality rates were highest for the second-to-youngest child in the family. (The authors argue that youngest children tended to be sleeping with their mothers at the time of earthquake impact and were thus more likely than the next-oldest siblings to be the recipients of life-saving assistance.) Ohashi and Ohta (1984) analyzed the data on casualties in several large earthquakes that have occurred in Japan since 1960. They found that the rates of both serious and minor injuries increased with age.

The findings from these studies suggest that able-bodied persons fare best in earthquakes and that having a physical limitation may be an additional risk factor. However, because of the nature of the data, the relationship between disability and the risk of injury can only be inferred. For example, being elderly is highly likely to be associated with having one or more physical limitations, and such disabilities could contribute to higher rates of injury. However, it is also likely that older persons, particularly those with low incomes, live in settings that are among the most hazardous, such as older and substandard buildings.

Occupant Behavior Studies

The second category, occupant behavior studies, focuses on the effects of an earthquake or other disaster on buildings and their contents and on the actions taken by building occupants, including self-protective actions and evacuation efforts. In a typical occupant behavior study, individuals who were present at the time of the earthquake, fire, or other disaster are interviewed in depth, and their sequence of actions is mapped. One objective of such research is to determine how people get injured and to use this information to determine how to lower the risk of disaster-related death and injury. We are not aware of any studies, except our own small data collection effort with victims of the Coalinga earthquake, that focus specifically on the behavior of disabled building occupants in earthquakes. However, the findings and conclusions of some other studies on factors that affect the response of able-bodied persons in earthquakes can be extrapolated to people with disabilities. Additionally, studies of occupant behavior in fires do contain some information on how persons with disabilities respond in those emergencies.

We began our research assuming that people with disabilities face a higher risk of injury in earthquakes because their physical limitations may reduce their ability to carry out recommended self-protective actions. For example, persons using wheelchairs may be unable to get under desks or tables to protect themselves from falling debris and moving furniture during earthquake shaking. However, recent studies of occupant behavior and earthquake-related injury suggest that attempting to take recommended self-protective actions may not always reduce the risk of injury and, conversely, that the inability to move about during and immediately after earthquake impact may not necessarily increase risk. Archea and

Kobayashi (1984) interviewed 41 persons who had been at home during a March, 1982 Japanese earthquake that produced damage and casualties in several towns. (This earthquake measured 7.1 on the open-ended Richter Scale, with a Modified Mercalli shaking intensity of between 9 and 10.) The objective of the research was to reconstruct residents' activities during the period of ground shaking. Only six interviewees reported remaining still during the 30 seconds of shaking; most people were active, engaging in an average of five activities. Occupants traveled an average of 27 feet during the 30-second period. Six individuals moved more than 50 feet, and one person even traveled 174 feet.

The activities residents carried out were mainly related to reducing the risk of fire, protecting property, and getting out of their dwellings. Relatively few persons engaged in self-protective activity. Those who did attempt to shield themselves from moving and falling objects tended to use improvised methods, such as getting in a closet and using clothes as a protective material. The researchers found that the longer the shaking continued, the more people increased their rates of activity. Significantly, as people moved about during the shaking period, the chance of injury was increased. Based on the data, it also appears that efforts to protect property from damage frequently resulted in injury.

Other research also indicates that some actions taken during the period of ground shaking can increase the chance of injury. Many people surveyed in occupant behavior studies appear to have been aware of recommendations about appropriate protective actions. For example, Arnold et al. (1982), in a study of the behavior of occupants of a county office building in the 1979 Imperial County earthquake, found that a high proportion of occupants reported attempting to get under tables and in doorways during the impact. However, they also found that, of the 47 injuries that occurred, one-half involved people who were carrying out these actions. For example, one person stood in a doorway, only to be hit and injured by the door, which was swinging as the building shook. In several cases, people were injured as they moved about in an attempt to reach recommended safe areas.

Fear of building collapse may cause occupants to attempt leaving a building while an earthquake is occurring. However, taking such action may actually increase the risk of injury. In the Coalinga, California earthquake of 1983, rates of injury were particularly high in the downtown area, where there were many older, unreinforced brick buildings. A preliminary analysis of injury patterns in the downtown areas suggests that people were more likely to be injured if they tried to leave a building during the shaking period than if they remained inside. For example, some people were hurt by collapsing front walls outside one-story structures (Durkin, 1985). Building occupants would have been better off staying where they were at the time of the impact and trying to protect themselves from moving furniture and falling debris. The injury pattern in Coalinga suggests that "contrary to popular impulse, evacuating an unreinforced masonry building is not necessarily beneficial and may prove harmful" (Durkin, 1985, p. 278).

While not conclusive, the empirical evidence does suggest that individuals with mobility limitations do not necessarily face a higher risk of injury during earthquake shaking than fully ambulatory persons, so long as they have some means of avoiding being hit by falling or moving objects. Research findings suggest that the safest course of action for all building occupants--including persons with disabilities--during the period of actual shaking may be to 1) stay in approximately the same location until shaking stops; and 2) take whatever self-protective actions are feasible and avoid actions that are likely to increase risk, such as moving long distances to seek refuge or attempting to protect possessions from damage. Using an improvised self-protective strategy "in place" appears to be preferable to attempting to move to a place of safety during the shaking period.

Research on Behavior in Fires and Other Emergencies

Research on how individuals in various settings react during times of emergency has been dominated by studies of behavior in fires (see Stahl and Archea, 1977; and Canter, 1980, for research reviews). The literature on human behavior in fire emergencies includes various types of research designs, including retrospective case studies that attempt to reconstruct the behavior of building occupants (e.g., Abe, 1976; Bryan, 1982) and experiments and simulations of fire situations (Horiuchi, 1980). For several reasons, this literature is potentially relevant to the study of the behavior of disabled persons during and after earthquakes. First, these studies contain information about the physical capabilities of some categories of disabled persons in emergencies. Second, fire is a likely consequence of any major seismic event, and thus it is a logical element to include in earthquake effects scenarios. Third, some effects, such as blocked exits, the potential for reduced visibility, and lack of ability to use elevators as a means of egress, are common to both earthquake and fire. On the other hand, there are important distinctions between fires and earthquakes. For example, a fire typically starts in one area, leaving others undamaged, allowing building occupants to take actions to avoid the hazard entirely. In contrast, an earthquake affects all parts of a building at the same time, allowing very little opportunity for evasive action.

Studies conducted by Pearson and Joost (1983) on the response potential of disabled and elderly persons in fire situations are clearly relevant to this discussion. In one study, the researchers devised simulations to measure differences in evacuation response times for three categories of subjects: nondisabled college students, blind individuals, and persons who used wheelchairs. Subjects in each group were required to complete a sequence of subtasks that are elements in evacuation from a residence in a fire situation--putting on clothes, unlocking doors with keys, and the like--in six different scenarios (seated, lying down, with the lights off, etc.). The objective of the simulations was to determine whether it is possible for individuals with disabilities such as blindness and mobility limitations to evacuate with sufficient speed when threatened by a fire. In a second series of experiments, the researchers compared the response times of younger persons, elderly but physically unimpaired individuals, and elderly subjects disabled by arthritis.

Response times for all categories of subjects were within the projected margin of safety. In some cases, impaired subjects performed the assigned tasks more quickly than some able-bodied subjects. The researchers concluded that

> while a group of typical college students performed the actions more quickly than the disabled and elderly groups, all groups were able to perform the actions in a timely fashion. This demonstrates that at least some seriously disabled individuals (i.e., blind, wheelchair users and arthritic elderly) can perform necessary fire emergency actions without undue delay. (Pearson and Joost, 1983, p. vii)

These findings suggest that, in the event of an earthquake, many disabled persons would be capable of performing various emergency response activities--evacuation following earthquake impact and turning on the radio to listen for emergency instructions, for example--without assistance.

Studies of building egress behavior in fires, earthquakes, and evacuation drills have revealed several patterns that could prove useful for encouraging adaptive post-impact behavior by both disabled and able-bodied earthquake victims. First, researchers argue that the relationships that exist among individuals in a given setting influence evacuation behavior. Sime (1984) points out that evacuation is frequently characterized as individualistic; that is, it is seen as an activity in which each person independently pursues his or her individual line of action. However, evacuation is actually social. People do not exit from hazardous settings as single individuals, but rather as members of dyads or small groups. In emergency situations in offices and other work settings, for example, people look for and exit with friends and acquaintances.

A related idea is that egress decisions and behavior are affected by social roles. A study in Japan, which involved the simulation of a fire in an office building, found that female clerical staff waited to receive evacuation orders from male members of management--a pattern that followed the established, pre-emergency authority structure (Horiuchi, 1980). Edelman, Herz, and Bickman (1980) note that in the nursing home environment, staff members have considerable authority and responsibility, while residents assume a more dependent role and typically wait for staff directives. These patterns carry over into the emergency situation. Problems can develop, they argue, if staff are not able to direct patients in crisis.

Evacuation behavior also seems to be influenced by what Sime (1984) terms "movement toward the familiar." Sime argues that, in crises, people receive more sensory input and experience more cognitive ambiguity than they can handle comfortably. To offset this lack of predictability in the situation, people seek out settings that are familiar and enact behaviors that reduce the level of ambiguity and choice. They show little inclination to improvise in an emergency egress situation; the exit routes they choose reflect daily experience in the setting.

The evidence suggests that people are highly unlikely to choose escape routes with which they are not familiar, even if these routes are more convenient and clearly marked. Edelman, Herz, and Bickman (1980), for example, studied the case of an evacuation from a nursing home in a fire. Of the 22 residents, the majority (16 persons) used one particular stairway for egress, thereby disrupting firefighting activities and bringing evacuees close to the fire. This stairway was chosen because it was the stairway they used on an everyday basis.

Other work suggests that specially designated emergency routes that are not used on a daily basis will not be used at the time of an emergency either. Sime argues that "to expect an emergency escape route to be used, just because it is there, takes no account of people's natural inclination to escape in a familiar direction" (1984, p. 9).

In a similar vein, researchers point out that, paradoxically, many features of modern structures, assumed to be safer than older buildings, actually make them unfamiliar and confusing to building users and consequently less safe than they could be. Pauls (1983) argues that modern built environments may be "handicapping" for most people--both disabled and nondisabled. For example, the increasing focus on keeping some building areas secure or "off limits" to all but a few users creates unsafe situations in emergencies because it increases the occupant's sense of unfamiliarity with the setting. Large, complex building designs may confuse occupants during times of normal use; this confusion only increases in times of emergency. Sime (1984) notes that in public buildings escape routes may be located in areas with which staff are familiar, but about which members of the public have little knowledge. Moreover, a building may be designed with an adequate number of visible exit routes, but patterns of daily use may make only one or two routes familiar. Since people will not use unfamiliar exit routes in an emergency, the number of actual escape routes is in fact smaller than it appears.

Information on how building occupants perceive and use exit routes has clear implications for the safety of disabled building occupants. People who have disabilities are more likely than nondisabled persons to be forced to use a limited number of entry and exit routes. Thus, there are fewer routes with which they are familiar. A person who uses a wheelchair, for example, may always have to go into and out of the building using only one door (the one that has a ramp attached) and may have only one means for going from one floor to another--the elevator. He or she may never have even seen stairways or other means of emergency egress. An earthquake or fire could well leave the wheelchair user without a familiar exit route (Schroeder and Benedict, 1984). Blind persons typically have a particular set of routes they travel. When the familiar, accessible routes are blocked or not usable in an emergency, the individual may become disoriented. In short, to the extent that a disabled individual has fewer available options for emergency evacuation, he or she may be placed in a situation of very high risk relative to an able-bodied person in the same setting. Increasing building accessibility is a crucial factor in providing increased safety.

Studies on egress behavior in emergencies also suggest that prior training can influence evacuation patterns. For example, in the 1979 Imperial Valley earthquake, 79% of the occupants of the badly damaged Imperial County Services Building left the building according to a prearranged plan that was developed in response to the possibility that a bomb might be planted in the building. One exit stairway, believed to be safer than the other in the event of a bombing, was designated as the escape route. After the earthquake, the great majority of building occupants evacuated via this stairway, even though other routes out of the building were undamaged and available for use (Arnold et al., 1982).

Panic Versus Altruism in Emergency Situations

Mass media accounts of evacuations in fire situations suggest that panic is common. The existence of panic is typically inferred because a large number of occupants use the same exit route for evacuation--a pattern that can be explained by concepts such as familiarity and ambiguity reduction, discussed above. Panic is often assumed to be a major cause of fire-related deaths and injuries. Sime (1980) notes, for example, that British news accounts of the 1977 Beverly Hills Supper Club fire in Ohio carried headlines such as "Panic Kills 300" and "Panic and 300 Stampede to Death." Such reports were without foundation; post-event investigations determined that victims did not panic in that incident and that panic could not have been responsible for the deaths that occurred.

There is a parallel assumption that panic and rapid evacuation, possibly resulting in additional injury and loss of life, would occur during and immediately after an earthquake, particularly in large, high-density buildings. This image of occupant behavior suggests that persons with physical limitations would be in extreme danger during and after a major earthquake, because they would be unable to keep up with rapidly exiting, panicked building occupants. However, research on occupant behavior and evacuation in fires and earthquakes does not support this assumption; panic is not a prevalent response in fires and other emergencies. As noted above, researchers found that the 164 (not 300) persons who lost their lives in the Beverly Hills Club fire were not victims of panic (Sime, 1980). Regarding studies of two recent large-scale fires--the Beverly Hills and MGM Grand Hotel fires--Pauls notes that "studies conclude that panic was extremely rare. In fact, the behavior in these fires was marked by information-seeking activity and social responses that can be characterized as altruistic or helping behavior" (1983, p.39). In short, behavior in fires is the consequence of victims' logical attempts to obtain and process information in a complex, changing environment, and people can and do help one another in emergencies.

Empirical studies of occupant behavior in earthquakes indicate that, as is the case with fires, panic does not characterize actions taken during and after impact. For example, rather than engaging in panic flight, the subjects in the Kobayashi and Archea study took rational action to reduce the possibility of earthquake-generated fire. Occupants in the Imperial County Services Building evacuated in an orderly fashion, without succumbing to panic, according to Arnold et al. (1982). In their retrospective study of five hospitals in the 1971 San Fernando, California earthquake, Arnold and Durkin (1983) found that, after impact, rather than panicking or thinking only of their own safety, staff members acted in accordance with their assigned roles. They immediately began assisting patients, rescuing people who were trapped, and rendering medical treatment.

Evidence from Interviews with Victims of the Coalinga Earthquake

When this study was proposed, it was our intention to obtain data on the actual experiences of disabled persons in earthquakes and comparable disaster events. In the time period that the project covered, no new events occurred that would have provided this type of research opportunity and that could have been studied with available funds. Notices placed in publications for the disabled and rehabilitation communities (e.g., the newsletter of the American Coalition of Citizens with Disabilities and *Bulletins on Science and Technology for the Handicapped*) requesting information on their experiences from disabled persons who had been involved in disasters failed to generate a significant response. For this reason, a decision was made in the first year of the study to obtain retrospective data on the behavior of building occupants in an event that had occurred in May, 1983--the Coalinga, California earthquake. In July, 1984, the project staff conducted interviews in Coalinga with disabled residents who had been in the community at the time of the earthquake. That temblor, which registered 6.7 on the Richter scale, was the largest that had occurred in the state since 1980 and the largest earthquake in California's central valley since the 1952 Kern County event. The earthquake caused considerable damage in both residential and commercial structures.

Damage was particularly significant in the downtown area, which contained a number of unreinforced masonry buildings. These older, nonresistant structures either collapsed or were heavily damaged; after the earthquake, they were demolished by the city. Approximately 180 persons were treated at local hospitals between May 2 and May 10 for earthquake-related injuries. Of these, 16 were seriously injured.

Two strategies for collecting data on disabled Coalinga residents were originally developed and later abandoned. First, attempts were made to obtain information from agencies that would help identify which Coalinga residents and which recipients of disaster assistance were disabled at the time of the earthquake, so that project staff could contact these individuals. However, agency policies concerning confidentiality made obtaining the information virtually impossible. The second plan involved adding questions about respondents' disabilities to an interview guide being used in a study on earthquake-related injuries in Coalinga, but these data were not accessible to our staff. The project staff finally resorted to using a community informant to provide assistance with locating disabled persons to interview. This was, of course, not the best strategy for obtaining a representative sample of disabled persons. Only 18 individuals were located by this means.

All the disabled people identified were interviewed. Five of the 18 individuals in the sample were males. Elderly persons were over-represented in the group; fourteen of the interviewees were over 60 years of age. Most interviewees had two or more disabling conditions. Five persons interviewed were residents of a convalescent home at the time of the earthquake. Due to the small size and nonrepresentative nature of the group that was interviewed, little systematic analysis could be done and no definitive conclusions could be drawn. However, as the discussions that follow show, the data do appear to have heuristic value.

A special interview guide was developed for the study. The guide covered such topics as: the extent of the individual's physical limitations; what the interviewee was doing at the time of earthquake's onset; actions taken during the period of shaking; interviewees' perceptions and emotional responses during and immediately after the earthquake; whether or not the interviewee was injured; and other topics such as the extent of an individual's previous earthquake experience. The interview questions were based on instruments used in earlier studies that tried to reconstruct in detail patterns of occupant behavior in fires (Keating, Loftus, and

Manber, 1983; Keating and Loftus, 1984) and earthquakes (Arnold et al., 1982; Archea and Kobayashi, 1984). The guide contained both open-ended and close-ended questions in order to construct as complete a picture as possible of the behavioral sequences and experiences of disabled earthquake victims. (See Appendix I, Archea's "Development of the Coalinga Survey Instrument: Interview Protocols for Disabled Building Occupants Who Experienced the Earthquake of May 2, 1983," for a more complete discussion of how the instrument was developed.)

In an early part of the interview, interviewees were asked about their capacity to perform ten different activities, including moving from one place to another, opening and closing doors, and reading a newspaper. Fourteen of the 18 interviewees reported limitations in one or more of these areas. The highest number of limitations, reported by two interviewees, was four. Evidently, the majority of interviewees had mild to severe physical and mental impairments.

Interviewees were asked a series of questions concerning their whereabouts when the earthquake struck and what they did during and after earthquake shaking. As noted above, five persons were in a Coalinga nursing home at the time of the disaster. One individual was outdoors, one was in an automobile, and one was in an office. The remainder were in their own homes. With very few exceptions, interviewees tended to stay still during the period of earthquake shaking, which lasted about 23 seconds. However, some individuals did attempt to perform certain activities, such as leaving the house, during this period. Four individuals reported being hit by debris during the shaking. Of the remaining 14 persons, one individual recalled taking action to avoid being hit; the rest either did not feel that they were in immediate danger or did nothing to protect themselves against injury.

Interviewees were asked whether any actions they took, either during or after the earthquake impact, were especially difficult for them. Only five individuals reported that they had problems performing any activities. One reported problems with getting out of the house and turning off the gas. Another indicated that earthquake debris and the inability to see without glasses (which had been lost in the quake) made egress from the house difficult. A third person indicated that the door to the house was stuck closed, and a fourth individual reported that it was difficult to get around the house after the earthquake because of debris. A fifth interviewee, who left the building when the earthquake occurred, reported having difficulty with moving about outside, because of inability to breathe properly. Except in this last case, we were not able to determine the extent to which coping problems could be attributed to respondents' disabilities.

One interesting finding from these interviews is that there appear to be two distinct patterns of coping with the earthquake situation: a proactive mode and a passive or dependent mode. That is, some individuals actively attempted to cope during and after the earthquake, while others did nothing and waited for assistance from others. The narratives below, which summarize the interviews, illustrate these different patterns.

Subject Number 1: Proactive Mode

> The interviewee is a female, age 63, who does not regard herself as disabled. She has arthritis in both knees and cannot walk for long distances. She is a rather heavy woman who walks slowly with the aid of a crutch. She also finds it very difficult to negotiate stairs. She states that she is in constant pain when she moves and is chronically bothered by stiffness of the knee joints.
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> She was very clear about the events surrounding the earthquake. She knew where she was, what she was doing, and how she maneuvered herself out of her house and onto the lawn. Even though she was without her crutch she managed to walk across her kitchen, get to the living room where her husband assisted her through the living room onto the porch, which had separated away from the house, and onto the lawn. The earthquake appears to have upset her significantly. When asked question 43, "What was the easiest thing you did during the earthquake?," she answered that nothing was easy.
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> She also stated that she had never even thought about an earthquake occurring, at least not anything of this magnitude. The only thing she had ever been told to do in case of an earthquake had been to go underneath something, which is impossible for her to do in her condition.
>
> She found it very difficult to cope with the aftershocks and was very fearful . . . this apprehension lingered for a long time. To this day, she feels safer outside rather than inside a house.

Other cases that are examples of this active mode of response include an elderly man recovering from heart surgery who ran out of a building during the earthquake; another elderly man, dependent on bottled oxygen, who attempted to retrieve his reserve supply of oxygen from an adjacent room but ended up leaving the house without it; and a woman, legally blind, who moved about inside her house during the earthquake, left and locked the house, and sat outside in her yard after the shaking stopped.

Subject Number 2: Passive/Dependent Mode

> The subject is a 57 year old female who has suffered from depression, dropsy, high blood pressure, pulmonary edema, glaucoma, and obesity for over 15 years. Collectively, these conditions result in a shortness of breath, slowness in moving, an inability to climb steps or hills, insufficient strength to open heavy doors . . . and frequent confusion--especially when she is off her medication. She stopped working three years ago, but now volunteers as a librarian. She was interviewed in the new home which replaced the one which was destroyed in the earthquake.
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> At the time of the May, 1983 earthquake she was sitting in a chair in the living room of her home, talking to her son. . . . She was first alerted to the earthquake when everything started shaking and her son threw himself on her. She was never scared during the earthquake because she had withdrawn into her shell, where she remained until the shaking stopped and she had been led outside.
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> Her first response to the earthquake was to tune out what was happening by withdrawing into her shell. She remembers seeing her son's eyes get big in amazement just before he threw himself on her. She also remembers listening to the roar of the earthquake and the sound of her mother's dishes breaking as the two of them held each other in the chair. After the shaking stopped her son and husband helped her out of the chair, led her across the broken glass on the floor, across the collapsed porch, and into the front yard. . . . Since she had withdrawn into her shell, she encountered no difficulties as she relied totally on her son and husband to help her out of the house.

Other interviewees who were classified as passive/dependent reported taking no action during or after earthquake shaking. They remained "in place" until someone came to offer assistance.

These patterns appear to be related to an interviewee's living situation. Qualitative analyses indicated that those individuals who were proactive, that is, who attempted to initiate some activity, tended to be living in the community, rather than in an institution. Unlike Subject Number 2, whose case is described above, the majority of those whose behavior in the earthquake was classified as passive were residents of the nursing home. These individuals remained in the position they were in when the earthquake started, did not attempt to initiate any new activities such as protecting themselves (although some reported thinking about taking some action), and waited for help and instructions from staff members. In those few cases of noninstitutionalized persons that responded passively, subjects relied on family members from whom they were accustomed to receiving assistance during nondisaster times.

Another difference between the two groups is that those taking a proactive approach in the emergency had a somewhat greater tendency to report being worried and concerned during the shaking period than those who were more passive. There are several possible explanations for this pattern. Victims who responded actively and reported being worried about possible injury may actually have been in greater danger than the less worried, passive responders. However, it may be that they were more aware of possible dangers in the environment because they pay more attention to the environment and are more accustomed to coping with it on a daily basis. Passive or dependent individuals may pay little attention to the environment either on a daily basis or in an emergency and may assume that they are safe in an emergency unless told otherwise.

The material from the Coalinga interviews seems to bear out statements made earlier in the review of literature on disabled persons in emergencies. First, disabled persons in institutional settings and disabled persons living independently in the community may differ in their perception of and response to the earthquake hazard. The data suggest that nursing home residents, unaccustomed to doing things for themselves in daily situations, are particularly dependent on staff members to help them interpret and cope with emergency situations. Disabled persons who face physical challenges on an everyday basis are more aware of the danger and more likely to try to take independent action in an emergency situation.

Second, these data do not suggest that disabled persons in typical community settings will be dependent or unable to cope in the event of an earthquake. "Active" responders probably do not differ significantly from able-bodied persons in their ability to avoid danger.

The limitations in the data should be stressed, however. The settings in which these individuals were located at the time of the earthquake represent a very narrow range, and the sample was small and not representative. The passivity of some respondents may have been due to an "institutional syndrome"--an attitude of dependence that develops because the institution directs and structures the lives of residents. On the other hand, since being severely impaired is associated with being in a nursing home, the passivity of nursing home residents may also be attributable simply to their higher degree of impairment. According to this view, "passive" respondents did less in the earthquake because they were physically less able to take action. The data collected by this project are equivocal in this area. While the respondents classified as passive or dependent did have a slightly higher tendency to report having difficulty with two or more daily living activities, some interviewees who responded actively in the earthquake situation also reported having multiple impairments. Interpretation is further complicated by the fact that the degree of impairment was assessed for the time of the interviews--about fifteen months after the earthquake--not the time of the earthquake.

Obviously, there is a need for more systematic research on the behaviors and experiences of disabled persons in earthquakes and other disasters. Studies of disaster-related injuries are a logical context for this type of research.

Conclusions and Implications

The literature has several implications for policy and practice with regard to disabled occupants of buildings. First, epidemiologic studies of the incidence of earthquake-related injuries and deaths suggest that disability is a risk factor. However, these data are far from conclusive. Rates of injury appear to be higher for the non-able-bodied. What is not known is the reason for this difference. It may be the case that injuries occur because disabled persons are less able to protect themselves and otherwise cope during the emergency, due to their physical limitations. On the other hand, it may be that, because of age, income, or other factors, disabled persons are found in environments that are inherently more hazardous--for example, old, substandard buildings. A considerable amount of additional research is needed to clarify the relationship between disability and injury.

Second, it appears that many aspects of the built environment that create limitations for able-bodied persons produce even greater barriers for persons with disabilities. Building security requirements can make buildings less accessible and less safe for all users. Changes that are made in the design of buildings and the use of space that consider the needs of functionally challenged persons are likely to make the environment safer for all building occupants--both disabled and able-bodied.

To the extent that disabled persons have limited choices among the routes they can use for getting into and out of buildings on a daily basis, they are even less familiar with these buildings than able-bodied persons, and they may even face more limited options and greater risks in the event of an emergency. As Schroeder and Benedict (1984, p. 541) note, "Many buildings that are wheelchair-accessible are not, however, designed for emergency exiting . . .

laws on building egressibility neither exist, nor are there federal funds available to alter buildings for this purpose." Providing multiple building access routes for disabled persons could make buildings safer.

Third, disabled persons who are in a dependent position, such as nursing home residents, will tend to expect and require more assistance than disabled persons with more mainstream living and working patterns. A significant proportion of the latter group are probably quite capable of taking independent action to increase their own safety, but those in the former group have more or less assumed the "sick role" (Parsons, 1951), which involves depending on others for help.

Fourth, any individual--whether disabled or previously able--bodied--may require special assistance in an earthquake situation. In general, there will be a tendency for other building occupants to respond to the needs of such individuals in a helpful and altruistic manner; individualistic or antisocial behavior should not be a problem in most settings. Seriously disabled, elderly, and injured persons can expect assistance from other building occupants in an emergency.

Fifth, training and educational experiences can be expected to carry over into actual emergency situations. Drills, exercises, and simulations can elicit appropriate actions in the event of an earthquake or other disaster. In many settings where fire and other emergency drills are routinely conducted, persons with disabilities (e.g., individuals with spinal cord injuries who use wheelchairs) are often not asked to participate in the drills because such participation may entail risks. However, excluding disabled persons from emergency training means they do not have the same access as other building occupants to the benefits that might be derived from this training, such as increased familiarity with exit routes and the chance to rehearse egress actions. Thus, they are less likely to become familiar with the steps they may need to take in an emergency or disaster.

CHAPTER V

PROBABLE EFFECTS OF EARTHQUAKE DAMAGE ON THE COPING CAPACITY OF BUILDING OCCUPANTS

This chapter presents material on how earthquake-generated building damage may affect the ability of disabled persons to engage in coping activities such as self-protection and building evacuation. First, we present a typology that classifies and groups disabilities. Next, we present material on how earthquakes affect different types of buildings and how this in turn affects building occupants. Then we discuss, in depth, earthquake hazards and preparedness activities in three different settings in the earthquake-prone Los Angeles area to illustrate challenges that disabled occupants of buildings are likely to face in an earthquake.

Classifying Disabilities

Chronic and acute diseases, congenital conditions, accidents, and the environment can produce a wide range of human impairments and limitations in humans. Classifying these physical and cognitive effects is difficult. There are thousands of types of disorders and impairments, and their relationship to disabilities is very complex. For example, a disease can produce impairments that vary in their severity; different diseases can lead to similar impairments and limitations; and the same physical problem can have different effects, depending on the characteristics of the affected individual and other factors. Thus, the first step in establishing a framework for viewing the challenges disabled persons face in earthquakes is to develop a relatively simple but comprehensive scheme for classifying the physical limitations associated with disabilities.

Disabilities are frequently classified on the basis of medical criteria. A particular physical impairment is associated with the health problem from which it originated, e.g., cerebral palsy, multiple sclerosis, arthritis, or spinal cord injury. For two reasons, such classifications are not appropriate in a study such as this one. First, medically-based classifications appear to locate the source of disability in the individual, ignoring the role played by external factors such as the social and organizational context and the built environment in the production of disability (see the discussion in Chapter II). Second, they tend to de-emphasize the functional limitations persons with different disabilities have in common. For example, while they are different medical conditions, arthritis, hemophilia, and polio can all be associated with severe mobility restrictions. From the standpoint of assessing and reducing earthquake-related risks, it is these commonalities that are important, not the origins or medical diagnosis of a disability.

We have attempted to develop conceptual frameworks and typologies that 1) assign a large number and a wide range of physical disabilities to a few discrete categories representing functional challenges that people face both in daily life and in emergency situations, and 2) describe the likely impact of earthquake-produced changes in the built environment on the coping abilities of people with different types of limitations.

As a first step, we decided to employ the term *functional challenge*, which denotes some limitation in an individual's capacity to perform and adapt to the built environment or to changes resulting from the impact of an earthquake. Functional challenges are a consequence not only of the individual's physical capabilities but also of the environment. In reviewing the literature on disability and the categorization of functional limitations, we initially modified some of the criteria used by the state of California (specifically the California Health and Welfare Agency) and the Transportation Research Board of the National Research Council (Middendorf et al., 1983) and identified six basic types of functional challenges: visual, hearing, verbal communication, mobility, cognitive, and medical. Visual and hearing challenges stem from blindness, deafness, or sight and hearing impairments serious enough to hinder a person's ability to function freely in the environment. Mobility limitations are restrictions in the ability to move arms, legs, and other parts of the body. Verbal challenges refer to limitations in the ability to speak, understand language, and respond verbally. Cognitive challenges are limitations that stem from mental impairments and emotional disabilities that prevent the individual from carrying out daily living activities. A medical challenge is a disability-related reliance on one or more special medical aids, such as a dialysis machine or a respirator.

Disabilities and Functional Challenges

Our research is fundamentally concerned with the relationship between the built environment and functional challenges and with how the environment influences the ability of disabled people to cope with disaster situations. As a first step to understanding these links, we have developed matrices that illustrate the relationships among functional challenges, levels of environmental support, and the likely impact of disaster-induced changes in the environment on persons with different types of limitations. However, it should be kept in mind that it is difficult to make definitive statements in these areas, because of the dearth of empirical data.

An emergency typically increases the degree of functional challenge for both able-bodied and disabled individuals. When a room fills with smoke, sighted individuals become visually impaired. If a high-rise building sustains earthquake damage, using the stairs for evacuation instead of taking the elevator is likely to physically challenge all building occupants. Even if they were formerly able-bodied, seriously injured disaster victims automatically join the ranks of the disabled. Additionally, among those likely to experience increased difficulties in an emergency are persons experiencing temporary physical limitations: women in the last months of pregnancy, persons on crutches or with a limb in a cast, persons recovering from surgery, and so on. However, persons who are already seriously or permanently disabled are likely to have the most problems in an emergency. The built environment presents challenges for these individuals during normal times--challenges that able-bodied persons do not experience. These difficulties are exacerbated in disasters that alter their physical surroundings. This chapter is mainly concerned with the emergency needs of this disabled group.

Table V-l shows relationships among a) selected diseases and impairments; b) the degree of support an individual requires from the system in order to cope with functional limitations; and (c) an individual's ability to cope with each of the six functional challenges he or she is likely to face both in everyday life and in emergency situations. The table indicates that an individual with a disability may be challenged in one functional area or in several. For example, a blind person will likely only be functionally challenged in one of six areas, while a person with severe multiple sclerosis would experience limitations in verbal communication, mobility, and cognition and might also be dependent on special medical

Table V-1

SYSTEM SUPPORT REQUIREMENTS IN EMERGENCIES AND FUNCTIONAL CHALLENGES

DISABILITIES		DEGREE OF MEDICAL OR SYSTEM SUPPORT			FUNCTIONAL CHALLENGES					
		High	Med.	Low	Visual	Hearing	Verbal	Mobility	Cognitive	Medical
Amputations	Unilateral (upper)			X	0	0	0	L	0	0
	Bilateral (upper)		X		0	0	0	H	0	0
	Bilateral with shoulder disarticulation	X			0	0	0	H	0	0
	Unilateral (lower)			X	0	0	0	L	0	0
	Bilateral (lower)		X		0	0	0	M	0	0
	Bilateral (above knee)		X		0	0	0	M	0	0
	Hemipelvectomy	X			0	0	0	H	0	0
	Hip disarticulation	X			0	0	0	H	0	0
Blindness and Visual Problems	Total Blindness	X			H	0	0	H	0	0
	Cecutiency (severe visual impairment)	X			H	0	0	H	0	0
Cardivascular Diseases	Coronary heart disease (advanced)	X			0	0	0	M-H	0	M-H
	Rheumatic heart disease (advanced)	X			0	0	0	M-H	0	M-H
	Congenital heart disease (advanced)	X			0	0	0	M-H	0	M-H
	Congestive heart failure (advanced)	X			0	0	0	M-H	0	M-H
	Hypertension (advanced)	X			0	0	0	L	0	M-H
Cerebral Palsy	Minimal disabilities			X	0	0	L	L	0	0
	Moderate disabilities		X		L	L	M	M	0	0
	Severe disabilities	X			L	L	H	H	M	L
Epilepsy	Petit mal (during emergency)		X ←	X	M	M	M	M	M	M
	Psychomotor (during emergency)	X			H	H	H	H	H	H
	Grand mal (during emergency)	X			H	H	H	H	H	H
Deaf-Blind	Deaf-blind	X			H	H	H	H	H	H
	Deaf, severely impaired visually	X			H	H	H	H	H	H
	Blind, severly impaired auditorily	X			H	H	H	H	H	H
	Severly impaired auditorily and visually	X			H	H	H	H	H	H

Table V-1 (continued)

DISABILITIES		DEGREE OF MEDICAL OR SYSTEM SUPPORT			FUNCTIONAL CHALLENGES					
		High	Med.	Low	Visual	Hearing	Verbal	Mobility	Cognitive	Medical
Hearing Impairments	Profoundly deaf:									
	birth and early childhood	X			0	H	H	0	0	0
	later childhood and adolescence	X			0	H	H	0	0	0
	elderly	X			0	H	H	0	0	0
	Hard of hearing:									
	birth and early childhood	X			0	H	H	0	0	0
	later childhood and adolescence	X			0	H	H	0	0	0
	elderly	X			0	H	H	0	0	0
Hemophilia	Hemophilia (severe)	X			0	0	0	H	0	H
	Hemophilia (moderate)		X		0	0	0	M	0	M
	Hemophilia (mild)			X	0	0	0	L	0	L
Mental Retardation	Mild retardation			X	0	0	L	0	L	0
	Moderate retardatiion		X		0	0	M	0	M	0
	Severe retardation	X			H	H	H	H	H	H
	Profound retardation	X			H	H	H	H	H	H
Multiple Sclerosis	With slower progress		X ←	X	L	0	L-M	L-M	L-M	M
	With rapid/severe progress	X			M-H	0	H	H	M-H	H
Neuromuscular Disease	Huntington's disease (advanced)	X			H	H	H	H	H	H
	Parkinson's disease (advanced)	X			0	0	M-H	H	H	H
	Friedrich's disease (advanced)	X			0	0	H	H	0	H
	Amyotrophic lateral sclerosis (adv.)	X			0	0	H	H	0	H
	Spinal muscular atrophy (advanced)	X			0	0	H	H	0	H
	Poliomyelitis (not progressive)			X	0	0	0	H	0	0
	Myasthenia gravis (advanced)	X			H	0	H	H	0	H
	Muscular dystrophy (advanced)	X			H	0	0	H	0	H

Table V-1 (continued)

DISABILITIES		DEGREE OF MEDICAL OR SYSTEM SUPPORT			FUNCTIONAL CHALLENGES					
		High	Med.	Low	Visual	Hearing	Verbal	Mobility	Cognitive	Medical
Organic Back Disorder	Moderate to severe disabilities	X ←	X		0	0	0	M-H	0	0
Polyneuropathies	Hereditary neuropathies (advanced, progressive)	X			0	0	0	M-H	M-H	M-H
	Toxic neuropathies (highly variable)		X ←	X	*	*	*	M-H	*	*
	Idiopathic neuropathies (variable)	X			0	0	0	M-H	0	0
	Disease associated (highly variable)	X ←	—	X	**	**	**	M-H	**	**
Pulmonary	Chronic obstructive pulmonary disease (COPD) (advanced)	X			0	0	0	M-H	0	H
	Asthma (highly variable)	X			0	0	0	M-H	0	H
	Occupational lund diseases (advanced)	X			0	0	0	M-H	0	H
	Cystic fibrosis	X			0	0	0	M-H	0	H
Rheumatic Diseases	Rheumatoid arthritis (advanced)	X			0	0	0	H	0	H
	Ankylosing spondylitis (advanced)		X		0	0	0	M-H	0	M
	Degenerative disease (DJD)	X ←	—	X	0	0	0	M-H	0	M
Speech and Language Impairment	Articulation		X ←	X	0	0	H	0	0	0
	Time and rhythm		X ←	X	0	H	H	0	0	0
	Voice			X	0	0	H	0	0	0
	Language usage	X		X	0	H	H	0	L-H	0
Spina Bifida	Spina bifida occulata			X	0	0	0	L	0	0
	Spina bifida with myelomeningocele	X			0	0	0	H	0	H

Table V-1 (continued)

DISABILITIES		DEGREE OF MEDICAL OR SYSTEM SUPPORT			FUNCTIONAL CHALLENGES					
		High	Med.	Low	Visual	Hearing	Verbal	Mobility	Cognitive	Medical
Spinal Cord Injuries	Paraplegic (incomplete)		X		0	0	0	M-H	0	M-H
	Paraplegic (complete)***	X ←	X		0	0	0	H	0	H
	Quadraplegic (incomplete)	X ←	X		0	0	0	H	0	H
	Quadraplegic (complete)	X			0	0	0	H	0	H
	Hemiplegic and other	X			0	0	0	M-H	0	H
Stroke and Cerebral Trauma****	Acute state	X			L-H	L-H	L-H	M-H	H	H
	Recuperative stage	X			0-H	L-H	L-H	M-H	M-H	H
	Ambulative and transfer impairments (significant)	X			0-L	0-L	0-L	H	0-L	H
	Rehabilitated	X ←		X	0-H	0-L	0-H	0-H	0-H	L-H
Traumatic Neuropathies*****	Neuropraxia, nerve damaged but intact			X	0	0	0	L	0	L
	Axonotmesis, nerve more severly damaged, but intact		X		0	0	0	M	0	M
	Neurotmesis, nerve completely severed	X			0	0	0	H	0	H

<u>Legend</u>: 0 - Most likely to cope
L - Low level of challenge
M - Moderate level of challenge
H - High level of challenge

* Full regeneration of nerves seldom occurs.

** When offending cause is removed, condition will improve, but full regeneration does not occur.

*** More spinal cord injuries are catagorized as neurologically incomplete quadraplegic than any other category, followed by complete parapalegic.

**** Those who recover from stroke may have similar support needs as those with spinal cord injuries.

***** The prognosis varies greatly for traumatic neuropathics depending upon the extent of the trauma and the part of the body involved.

aids. In general, the greater the number of areas in which a disabled person is functionally challenged, the greater his or her need for system support, both during normal times and in an emergency. Disabilities such as deafness/blindness and neurological damage due to a major stroke represent disabilities with several associated functional challenges that require a high degree of support. On the other hand, organic back disorders, petit mal epilepsy, and mild hemophilia have fewer associated functional challenges and fewer support needs.

Two other relationships are apparent in Table V-1. First and most obvious is the fact that the type and severity of a disability is related to the degree of support an individual will require in an emergency. For example, while speech impairments can create some degree of functional challenge for individuals in everyday life, the majority of persons with speech impairments do not differ markedly from nonimpaired persons in their need for system support in emergencies. On the other hand, persons with spinal cord injuries can be expected to have high system support needs under emergency conditions. Mildly mentally retarded persons are likely to resemble nonimpaired emergency victims in their support needs, while persons with severe developmental disabilities are likely to be highly dependent in an emergency. The same is the case for other disabilities. The more profound the disability, in terms of its impact on functional capabilities, the greater its negative effect on coping capacity in an emergency.

A second point that is apparent from this table is that persons with different types of impairments are likely to differ in the behaviors and activities they find problematic in an emergency situation. For deaf persons, the main problem centers on being able to receive warnings and emergency instructions and to communicate verbally with others in the setting. Because deaf persons are endangered because they cannot hear fire alarms and recorded messages, considerable effort has been devoted to developing visual and tactile warning systems for fire (see Levin, 1980; Kennett, 1982). A nighttime power failure and the resulting inability to see would present problems for all building occupants except blind persons. A person with a mobility limitation stemming from an amputated leg, arthritis, quadriplegia, or some other impairment would have no problem seeing hazardous areas in a setting and hearing and understanding warning messages and instructions, but he or she might be unable to avoid hazards or carry out emergency instructions without assistance. A deaf and blind person will probably need assistance in several areas: seeing hazards, hearing warnings, getting to a place of safety, and so on.

Impact of Earthquakes on Persons with Functional Limitations

By their very nature, earthquakes radically alter the environment and create complex emergency response requirements. Unlike many types of disasters, they occur without warning. Persons who are caught in a particular situation during the impact of an earthquake must know immediately how to protect themselves; there is virtually no time for either mental or physical preparation. Like tornadoes (but unlike disaster agents such as fires and riverine floods) they affect all parts of a building simultaneously, making it impossible to escape the hazard during impact and increasing the need for rapid self-protective measures. Earthquake forces affect buildings and their contents in such a way that previously innocuous aspects of the environment (light fixtures, windows, file cabinets) immediately become hazardous. Because of the kinds of hazards earthquakes pose, it is important that, when an earthquake occurs, building occupants 1) know what to do to protect themselves; and 2) have at their disposal within the immediate environment the means to ensure their own safety during impact and to reduce the risk of post-earthquake injury.

Turning specifically to earthquake emergencies, Table V-2 presents a simplified model of likely earthquake effects on building components and contents and the difficulties these kinds of damage may present for persons with each of the six types of functional limitations or challenges. Examples of earthquake effects on structural building elements, nonstructural elements, and building contents, as well as residual earthquake impacts, are considered separately. The figure indicates that earthquake-produced physical barriers will create some additional degree of difficulty for all disabled persons. Those who are functionally challenged only in the areas of hearing and communication are likely to be the least seriously affected, but even they will experience coping difficulties. In general, provided such persons are able to receive and understand safety messages, they should have no more difficulty coping during and after an earthquake than able-bodied persons. (This is not meant to imply that the latter will have an easy time coping; they are likely to have a number of problems. The point is that persons with hearing and communication problems should not require additional assistance in most cases, provided they are able to obtain adequate information about the emergency situation.) However, for persons

Table V-2

FUNCTIONAL CHALLENGES ASSOCIATED WITH EARTHQUAKE-GENERATED HAZARDS AND BARRIERS

EARTHQUAKE CAUSED BARRIERS/THREATS	FUNCTIONAL CHALLENGES					
	Visual	Hearing	Verbal	Mobility	Cognitive	Medical
A. Structural						
1. Complete building collapse	●	●	●	●	●	●
2. Damage to structural elements (e.g. walls, trusses) resulting from partial collapse	◑	○	○	●	○	○
3. Building displacement due to structural failure (e.g. floor tilts, building shifts off foundation)	●	○	○	●	◑	◑
4. Separation (e.g. stairs separated from porch, stair tower collapse)	●	○	○	●	◑	○
B. Non-Structural Elements						
1. Failure of non-structual subsystems (e.g. glass windows breaking, lights or ceiling tiles falling, stairways blocked)	●	○	○	●	◑	◑
2. Damage to mechanical and electrical systems; elevator failure, limiting egress; HVAC dysfunction, causing physical discomfort; power failure, causing lighting outages and interruption of life support systems	●	◑	○	●	◑	◑
3. Damage to telephone and TTD Systems resulting in loss of communication	●	●	○	◑	●	○
4. Failure of water (spillage), gas (fire/smoke), and other utilities	●	○	○	●	●	●
C. Building Contents						
1. Furniture, appliances, equipment and personal effects falling, breaking, becoming obstacles and potential sources of injury	●	○	○	●	◑	○
2. Damage to or destruction of aids such as wheelchairs, oxygen, crutches, canes, respirators, etc.	●	○	○	●	◑	●
3. Loss of or inability to obtain medications and other essential supplies	◑	○	◑	◑	◑	●
4. Need to retrieve personal effects and other valuables	●	○	◑	●	◑	◑

Table V-2 (continued)

EARTHQUAKE CAUSED BARRIERS/THREATS	FUNCTIONAL CHALLENGES					
	Visual	Hearing	Verbal	Mobility	Cognitive	Medical
D. Residual Effects						
1. Lessened pathfinding ability/disorientation due to change in physical surroundings	●	○	○	●	●	◑
2. Poor visibility due to dust or smoke	○	●	●	●	●	◑
3. Earthquake generated noise	○	○	○	○	◑	○
4. Secondary emergencies (e.g. fires and chemical spills)	●	●	●	●	●	●

Legend: ○ Minimum
◑ Moderate
● Major

with other types of disabilities, coping difficulties will increase as a result of earthquake-produced changes in the built environment. Blind individuals, for example, will risk tripping over displaced furniture, not being able to see and avoid broken glass, being hit with falling debris and other objects, and being unable to negotiate blocked exits.

The coping problems many disabled persons will experience at the time of earthquake impact are likely to be much more severe than those of their nondisabled counterparts. Broken glass is a hazard for everyone, but it is less of a hazard for sighted persons who can avoid it than for blind individuals. All victims will be shocked and confused upon encountering changes brought about by earthquake damage. However, those who are accustomed to using a small number of uncomplicated, uncluttered travel routes within a building (e.g., blind persons, individuals who use wheelchairs) or who have limitations in problem-solving ability (e.g., persons with developmental disabilities) may be overwhelmed by the extent of changes in the environment and incapable of taking independent action following earthquake impact. Moreover, an earthquake is likely to damage, destroy, or render inoperable resources and aids needed by disabled persons: respirators, oxygen, elevators, medications, and mobility aids. For example, two people in Olive View Hospital reportedly died in the 1971 San Fernando Valley earthquake in California because their life-support equipment failed (Arnold and Durkin, 1983).

Table V-3 describes the nature and degree of earthquake-induced hazards in various building types: wood-frame, unreinforced masonry, and reinforced and steel-frame high- and low-rise buildings. Structural hazards are greatest in unreinforced masonry buildings and least serious in steel-frame structures. Hazards produced by nonstructural building components and building contents are serious in all types of buildings but are most serious in high-rise buildings because of the way these structures respond to earthquake forces. The extreme case in this category is the steel-frame high-rise, which may sustain little structural damage but a great deal of damage to other building systems and to building contents.

Generally speaking, building occupants, regardless of degree of disability, will be safest in wood-frame buildings and will face the most serious threats in unreinforced masonry buildings. Complete building collapse is a possibility in unreinforced masonry structures, and life-safety hazards are considerable in such buildings (Reitherman et al., 1984; Durkin, Aroni, and Coulson, 1984).

Table V-3

BARRIER/THREAT - BUILDING TYPES

EARTHQUAKE CAUSED BARRIERS/THREATS	BUILDING TYPES					
	Wood Frame	Unrein-forced Masonry	Reinforced Concrete		Steel Frame	
			Low Rise	High Rise	Low Rise	High Rise
A. Structural						
1. Complete building collapse	○	◑	○	○	○	○
2. Damage to structural elements (e.g. walls, trusses) resulting from partial collapse	○	●	○	○	○	○
3. Building displacement due to structural failure (e.g. floor tilts, building shifts off foundation)	◑	◑	◑	◑	○	○
4. Separation (e.g. stairs separated from porch, stair tower collapse)	●	●	●	◑	○	○
B. Non-Structural Elements						
1. Failure of non-structual subsystems (e.g. glass windows breaking, lights or ceiling tiles falling, stairways blocked)	●	●	●	●	●	●
2. Damage to mechanical and electrical systems; elevator failure, limiting egress; HVAC dysfunction, causing physical discomfort; power failure, causing lighting outages and interruption of life support systems	●	●	●	●	●	●
3. Damage to telephone and TTD Systems resulting in loss of communication	◑	◑	◑	●	◑	●
4. Failure of water (spillage), gas (fire/smoke), and other utilities	◑	◑	◑	●	◑	●
C. Building Contents						
1. Furniture, appliances, equipment and personal effects falling, breaking, becoming obstacles and potential sources of injury	●	●	●	●	●	●
2. Damage to or destruction of aids such as wheelchairs, oxygen, crutches, canes, respirators, etc.	●	●	●	●	●	●

Table V-3 (continued)

EARTHQUAKE CAUSED BARRIERS/THREATS	BUILDING TYPES: Wood Frame	Unreinforced Masonry	Reinforced Concrete: Low Rise	Reinforced Concrete: High Rise	Steel Frame: Low Rise	Steel Frame: High Rise
C. Building Contents (continued)						
3. Loss of or inability to obtain medications and other essential supplies	●	●	●	●	●	●
4. Need to retrieve personal effects and other valuables	○	●	○	●	○	●
D. Residual Effects						
1. Lessened pathfinding ability/disorientation due to change in physical surroundings	◑	◑	◑	●	◑	●
2. Poor visibility due to dust or smoke	○	◑	◑	●	◑	●
3. Earthquake generated noise	◑	●	●	●	●	●
4. Secondary emergencies (e.g. fires and chemical spills)	◑	◑	◑	●	◑	●

Legend:
○ Minimum
◑ Moderate
● Major

At least in southern California, noninstitutionalized disabled persons probably face a higher risk of injury in earthquakes, because they tend disproportionately to reside in these kinds of structures (see Chapter III). Disabled and elderly persons tend to have low incomes, and they need to live near public transportation and other services. Older buildings that contain low cost rental units and that are located in urban centers constitute a relatively convenient and affordable source of housing for these individuals.

Occupant Safety in Existing Buildings: Examples of Typical Urban Settings

In order to better understand the challenges disabled persons are likely to face during and immediately after earthquake impact, we undertook systematic on-site inspections of contrasting types of buildings in an urbanized region of Southern California. The inspections were conducted by an engineer who specializes in the study of nonstructural earthquake effects and earthquake hazard mitigation. A checklist developed by the consultant was used for the inspections (see Appendix II). The checklist focuses on the earthquake vulnerability of the buildings and major building subsystems (e.g., heating and ventilation) and on mitigation and preparedness measures. Inspection tours ranged in length from two hours (for the apartment building) to an entire day (for the large medical and rehabilitation facility). Observational data was supplemented with information obtained in interviews with persons responsible for building safety and emergency planning at each site.

The objectives of these inspections were 1) to assess structural, nonstructural, and other building hazards; 2) to hypothesize about the likely consequences of earthquake-induced failures for building occupants, particularly those with physical limitations; and 3) to obtain information on what earthquake hazard mitigation and preparedness measures, if any, had been instituted in each setting.

In selecting sites for inspection, we attempted to cover the range of settings in which disabled persons are found: an agency/office environment; a medical facility; and a residential setting. We do not claim that these three buildings represent the entire continuum of building types or settings disabled persons might use. Conducting a systematic assessment that large would be well beyond the scope of this study. Site descriptions are presented for illustrative purposes--to demonstrate different types and degrees of building hazards and different approaches to hazard management.

Johnson (1983) presents a framework that views emergency management for disabled persons during fires as a system consisting of three elements: the disabled building occupants themselves; management, or those responsible for the safety of persons using the building; and the building as a structural entity. He argues that maximum occupant safety is achieved when the following conditions are met:

1) Fire hazards in the building have been minimized. The building is fire resistant; there are adequate smoke detection and fire suppression systems; refuge areas exist in the building; and so on.
2) Building management is also prepared to cope with the emergency. There is a person designated as being in charge in case of emergency; emergency-related roles and tasks have been assigned to persons living or working in the building and are understood; and outside sources of assistance have been identified. In other words, building occupants have made a concerted effort to plan for the emergency.
3) Occupants understand the hazard and are prepared to respond. Building occupants can communicate with one another, are trained in self-protective techniques, and are capable of assisting one another. Measures have been developed to increase the safety of functionally challenged building occupants.

Where one or more of the three elements (for example, occupant capabilities or management commitment) are weak, the safety of occupants is reduced. Building safety can be increased by intervention at any of the three levels: making the building more fire resistant, improving emergency management, or increasing occupants' capacity to respond--for example, through training or the provision of special aids.

The same framework can be usefully applied in the area of earthquake safety. The risk of injury is reduced to the extent that building occupants understand and can carry out self-protective measures, someone takes responsibility for coordinating the response in the event of an emergency, and the building and its contents are capable of resisting earthquake-generated forces, so that damage, secondary hazards, and debris are kept to a minimum. Assessments of the three buildings focused on each of these three areas. Findings on each building are reported separately below.

As the narratives in the sections that follow indicate, the buildings that were evaluated varied considerably in the extent to which they met these standards. At the first site--a large medical and rehabilitation complex--mitigation and preparedness were major priorities, and considerable effort had been expended in ensuring the safety of both employees and patients. At the second site, a government-operated correctional facility, mitigation of building hazards had received less emphasis, but emergency management and the training of occupants had been stressed. At the third site, a multistory cooperative apartment building, very little had been done to make the building safer, improve emergency management, or increase occupants' capacity for self-help.

Site A (Multiple-Building Site)

Structural and Nonstructural Features

Inspections were conducted in several buildings that are part of a larger facility that includes 140 structures on a 400-acre site. The structures in the facility vary in age; the oldest building is a wooden structure dating from 1889, and the newest is a six-story ductile frame structure completed in 1979. Most of the buildings were constructed between 1930 and 1950. The site contains unreinforced masonry buildings that have been structurally retrofitted by surrounding the brick walls with a reinforced concrete structure.

Studies of the earthquake vulnerability of 36 of the buildings in this facility have been conducted by a structural engineering firm. The seismic criteria used in the study were a maximum site acceleration of 0.25g with a period of 0.5 seconds and a dynamic amplification of 3.0. The evaluation focused primarily on structural hazards. Even before the study, however, buildings known to lack earthquake resistance had been evacuated.

A number of nonstructural earthquake hazard reduction measures have already been implemented. All buildings with resident patients have emergency standby power provided by diesel generators that activate within seven seconds of a power failure. Cooling systems are self-contained and not dependent on water sources that could also fail.

Two buildings in the nursing care section of the facility were inspected. These buildings were chosen because they house long-term patients, all of whom are disabled. Of the two buildings, one has been retrofitted to reduce earthquake hazards, and the other has not. The differences between these two buildings are significant. For example, the retrofitted building has the following features:

1) T-bars supporting the ceiling acoustic tiles are connected to the upper floors by wires.

2) All lighting fixtures are also connected to the upper floor by means of wires, independent of the T-bars. The flexible conduits are also clipped to these wire supports.

3) Gas inlet lines have Sentinel valves, which detect earthquakes and shut off the gas supply to the building. Following an earthquake and after manual inspection of the building to ensure that there are no gas leaks, the valves are manually reset.

4) Closet and storage cabinets are built in, so that they will not topple over in an earthquake.

5) Television sets are mounted on steel hardware to prevent them from swaying and falling in the event of an earthquake.

6) Telephone receivers in the hallways are screw-mounted on holders attached to the walls, so they will not be thrown off the hook during earthquake shaking.

7) Electrical switching gear and pipelines in the basement are anchored.

8) Oxygen cylinders are connected to pressure regulators with coiled copper tubing and strapped to the walls with chains to keep them from falling down.

The building that houses the four boilers that provide steam to the facility was evaluated and determined to be strong enough to withstand earthquake forces. The boilers and all ancillary equipment, including exhaust lines, panels, and other equipment are either braced to specially constructed steel structures or anchored to the floor. In several locations, piping connections have sections of flexible piping installed to absorb the relative motion during earthquakes. Most pipelines are also independently braced to either the floor or the ceiling.

Other safety features are evident. All buildings requiring power for patient care are provided with back-up power from diesel generators with closed-loop cooling systems. The fuel stored on site is sufficient to operate these generators for at least four days. All hallways and stairwells are fitted with battery pack emergency lights good for four to eight hours.

In terms of structural and nonstructural earthquake hazard mitigation, the inspection revealed some areas where improvements could be made. First, the computer facility, which houses patient records, may be vulnerable to post-earthquake fire, since the facility lacks portable halon fire extinguishers. Additionally, computer equipment, the racks that hold computer tapes, and other contents of the facility are not anchored.

A second problem concerns the water supply. Potable water is supplied to the facility by the city water district. Water is stored in two tanks with a total capacity of 750,000 gallons. Water is gravity fed to the entire site from these two tanks by two asbestos cement pipelines that are laid side by side. This means that any failure due to localized ground motion could result in the failure of both lines. Moreover, the cement pipelines are very vulnerable to brittle fracture during shock loading--which can be expected in an earthquake. There is also a possibility that broken sewer lines could contaminate the water supply.

Despite these gaps in hazard mitigation, the administration and management of this facility have obviously devoted considerable effort toward making the facility safer. The measures that have been taken show an understanding of likely earthquake effects, considerable attention to detail, and a willingness to commit funds and personnel to hazard reduction.

Emergency Management

A comprehensive disaster plan was developed for the site in 1983 by heads of the various services (nursing, medical-surgical, pharmacy, etc.) under the direction of the facility's assistant chief of staff. The document contains plans for the facility as a whole and for individual buildings and services. At the time of our investigation, the plan had not yet been adopted as the official plan for the facility, however. The union that represents many workers at the facility was reluctant to endorse the plan because it was made without the union's active participation. Union representatives consider disaster preparedness an element in overall workplace safety, which they view as a negotiable issue. Therefore, at the time of our research, the facility lacked an officially adopted emergency plan, even though the consensus seemed to be that, if an earthquake were to occur, the plan developed in 1983 would be the one that would be used.

Particular sites within the facility have been designated as primary and secondary command posts in the event of a major disaster. During normal times, telephones are the main means of communication within the site. A mobile communications van with its own power source that would make it possible to communicate on various emergency radio frequencies was being outfitted for use during disasters when we visited the site. Within the site, emergency communications will be conducted by means of CB radio, and booster stations have been installed. Arrangements have also been made with local ham radio operators for emergency assistance.

Rather than sending injured persons to another site, this facility expects to receive casualties from the surrounding area in the event of an earthquake. Plans have been made to discharge all but the most seriously ill patients if beds are needed. The facility has a helicopter pad, so that even if the surrounding roads are cut off, patients can be flown into and out of the site. The facility has a mutual aid agreement with another major medical center located approximately two miles away.

The Health and Occupational Safety Department conducts at least one major disaster exercise a year, and training sessions for groups of employees are held several times a year. A recent bomb threat caused the evacuation of an entire building, and all patients, including those who were not ambulatory, were evacuated in about three minutes.

In 1983, following the development of the new comprehensive disaster plan, special training sessions were held for staff. The two-hour sessions centered on appropriate preparedness and response activities in the home and workplace. Reportedly, 56% of the staff at the facility attended the training sessions.

Building Occupants

There are approximately 5,000 employees at this site. Of this number, most are on-site during normal daytime working hours. There are approximately 1,350 inpatients at the facility. (Outpatients number 1,400 daily.) Of this number, about 25% would be incapable of evacuating without assistance in the event of an earthquake. Most of the building occupants requiring assistance would be located in the medical/surgical facility and in the nursing home buildings. Both these buildings have considerable earthquake resistance.

As was the case with other inpatient settings with which we had contact in the course of this study, not much has been done at this facility to train residents in earthquake response. The expectation is that staff will be responsible for directing and giving assistance to patients in the event of a major emergency. While staff are, in all likelihood, well-trained and competent, there could be delays in providing assistance if a disaster were to occur at night, on a weekend, or at some other time when few staff are present. Because many patients at this facility are long-term residents, the potential exists for carrying on a training program with residents.

Such a program would increase the likelihood of appropriate responses on the part of residents.

Site B

Structural and Nonstructural Features

Site B is a 14-story steel-frame structure located in central Los Angeles. It is a government building that contains a correctional facility on its upper floors. It was originally constructed in 1925, but several sections have been renovated or modified since then. However, the structural aspects of the building remain the same. The steel framework of the building is bolted with two to six bolts per joint on the first through seventh floors. The resulting assembly is encased in poured concrete. The upper floors have a welded steel-frame structure encased in concrete. The current occupants of the building consider the structure flexible; they do not expect it to behave in a brittle manner during an earthquake.

The utilities that come into the building are steam, natural gas, water, and electricity. Steam is used for both space and water heating. The advantage of this method for heating water is that there are no gas-fired water heaters. Natural gas is used only on the tenth floor, where there is a kitchen. Gas pipes enter the building in the basement and then travel vertically to the tenth floor. There are two gas shutoff valves: a manual valve and an automatic valve inside the building that would be activated in the event of a loss of pressure of the kind caused by a severing of the pipeline. In a situation in which the gas pipeline (normally carbon steel, and therefore ductile) has been merely damaged and leakage amounts resemble normal usage, the automatic shutoff device would not be activated. Neither the main gas meter nor the gas pipes have been strapped or braced for additional earthquake protection.

There are four metal 10,000 gallon capacity water tanks on the roof of the building. According to the emergency manager who was interviewed, they are strapped. With the exception of the kitchen area on the tenth floor, the building does not contain sprinklers. However, there are ample numbers of hose cabinets and portable fire extinguishers on each floor.

The power supply comes in through four panels, one for each quadrant of the building. There is a standby power generator on the roof capable of providing emergency lighting for four hours.

The building has two major entrances--one from each of two streets that border the structure. Both entrances are accessible only by stairways. There are several subsidiary entrances and exits to the building, and there is a ramp for disabled persons, but it provides access to the basement only. Access to other floors from the basement is either by stairways or elevators.

The evacuation routes inside the building are very clearly marked, and exit signs and emergency lights are backed up by battery power. There are no pieces of furniture that could obstruct passage ways in the corridors; however, the walls along the evacuation routes are marble-lined. There is a good chance that these marble sheets would be dislodged in an earthquake and that they would obstruct evacuation routes, including the stairs. Almost all the glass doors along the evacuation route are made of ordinary figured plate glass. These doors could also shatter and spray the evacuation routes with glass debris. The expectation appears to be that, during evacuation, occupants would walk over any fallen items; no special provisions have been made for clearing the passage ways of debris.

No measures have been taken to mitigate nonstructural damage in the building. Prominent sources of such damage include bookshelves, filing cabinets, electronic data processing cabinets, and ceiling light fixtures--especially those in the more recently renovated parts of the building. The chandeliers in the second floor reception lobby have not been restrained.

The external facade of the building consists of granite sheets and other decorative installations that could fall off during a severe earthquake, causing a life and safety hazard within a 50-foot radius of the building. The external evacuation site has been planned with this factor in mind; the command post at the site will be at least 150 feet away, and all other personnel are expected to stay 300 feet away from the building.

Emergency Management

Emergency operations for this building were reviewed in 1984, and a disaster plan was written in December of that year by in-house personnel. The plan is reviewed and updated on a quarterly basis. Under the overall direction of the emergency operations commander, each floor is managed during times of emergency by a "floor lieutenant." Each floor has four means of egress besides the fire exit--one main and three alternate stairways. A vertical, floor-by-floor evacuation plan has been developed. The planned command post and initial gathering site for evacuated occupants is the second floor lobby, which normally serves as a reception area. After an assessment of the situation, occupants could be evacuated to an external evacuation site--a parking lot approximately 300 feet from the building. (As noted above, areas closer to the building are considered unsafe.) Emergency personnel estimate that it will take three to four minutes per floor to evacuate occupants. A complete evacuation exercise was conducted in April, 1985.

One of the key features of the disaster plan is its focus on able-bodied personnel. According to the plan, the initial evacuation will not include occupants who have been injured or otherwise rendered immobile (for example, those persons trapped under debris). Instead, the plan states that, once occupants have assembled at the initial evacuation site, rescue teams will be formed that will then go back to help occupants who need assistance with evacuation. Following a major earthquake, the only usable evacuation routes will be the stairways.

Because the building is occupied mainly by members of the criminal justice system who are used to following a chain of command, it is reasonable to expect that the able-bodied building occupants who gather at the initial evacuation sites will return to the building to perform search and rescue. However, aftershocks are highly likely following a major earthquake. The plan to evacuate able-bodied persons first and to conduct search and rescue only after accounting for able-bodied building occupants may expose disabled, injured, and trapped victims to further hazards. Even if an aftershock does not occur, following the plan will certainly mean that there will be delays in responding to the needs of non-able-bodied persons.

<u>Building Occupants</u>

This correctional facility houses 1,600 inmates and 200 employees on the upper floors and 700 employees on floors one through eight. Relatively few employees occupy the basement and the first two floors; there are normally between 150 and 200 employees on floors three through eight. The building is most heavily used between 8:00 a.m. and 5:00 p.m. Only 50 to 75 employees are present in the building during the evening and nighttime hours; however, there are approximately 400 employees on 24-hour call.

The public has access to the building, but in contrast to structures that are heavily used by the general public (shopping centers, theaters, large hospitals, social welfare agencies), this building is mainly used by employees. In the event of an earthquake, the majority of building occupants can be expected to be at least somewhat familiar with the setting and with planned emergency procedures.

According to the individuals in charge of emergency management, there is only one employee known to be disabled. This individual, who uses a wheelchair, works in the data processing center. It appears that emergency managers have paid little attention to the needs of this individual or other disabled persons who might be using the building at the time of an earthquake.

The only automatic warning systems in the building are smoke alarms. There is no public address or other warning system. This violates the General Industrial Safety Order (GISO) 3220 ("Emergency Action Plan") and identical sections in the California Administrative Code. The designated floor lieutenant is expected to ensure that all occupants are warned and evacuated in emergencies. GISO 3220 suggests that one individual be in charge for every 20 persons to be evacuated, but it appears that this recommendation has not been followed in the case of this building.

Although no special provisions have been made for the safety of disabled individuals, due to several factors the facility does offer a relatively high degree of protection to building occupants. First, those in charge can expect occupants to know and follow emergency response procedures. Second, medical supplies are readily available, as are various modes of emergency transportation, including helicopters. Third, the building has a command center that is used on a daily basis. Fourth, a large proportion of the occupants of the buildings have portable radios that would be immediately available in the event of an emergency.

These safety features notwithstanding, a major earthquake would probably cause considerable nonstructural damage at this site that could increase the risk of injury to occupants. Insufficient attention appears to have been paid to the needs of disabled employees, other disabled building users, and able-bodied persons who could be disabled by an earthquake.

Site C

Structural and Nonstructural Features

Site C is a four-story unreinforced masonry cooperative apartment building in central Los Angeles. Built in the late 1920s, the building is located in a densely populated neighborhood that includes both residential and commercial structures, most of which are two stories high.

The design and floor plan of the apartments were undoubtedly developed with able-bodied persons in mind. There are no ramps or other means of access anywhere inside or outside the building. Doorways leading into individual rooms inside the apartments are quite narrow. Hallways in the apartment are not only narrow but also have sharp ninety-degree corners that probably cannot be negotiated by a person in a wheelchair. Two apartments in the building were inspected. None of the furniture in either apartment was tied down or restrained.

If a major earthquake occurs, this building will almost certainly sustain significant structural damage. The main threat to building occupants is total or partial collapse of the building. Even if collapse does not occur, an earthquake could cause nonstructural damage and warping of doorways sufficient to trap individuals inside with no means of egress and no way of calling for assistance except shouting or using the telephone--if telephones are still operate.

No structural or nonstructural upgrading has been done at this site. The building is subject to the Los Angeles ordinance requiring structural assessment and earthquake hazard mitigation in old unreinforced masonry buildings, but at the time of the visit to the site residents had not moved to comply with the ordinance. At that time, the building showed signs of significant structural distress: slanting floors and hallways, cracks in walls, and corners that were not aligned. An inspection of the masonry revealed that it is in extremely poor condition; it is possible to dislodge bricks and mortar by hand in some places.

All utilities at the site are purchased, and there are no emergency backups. The basement contains a boiler and hot water tank that have not been restrained. In the event of an earthquake, this building could lose all its utilities--electricity, natural gas, and water supply. The unanchored boilers in the basement could be dislodged from their mounting, and, more importantly, gas lines would probably be severed, resulting in gas leakage and the possibility of an explosion or fire. Perhaps the building's only saving grace is the fact that hallways are uncluttered, making post-earthquake evacuation easier. It does not appear that hallways were kept open because of safety considerations, however; rather, they seem to reflect the residents' penchant for neatness and organization.

Emergency Management

The governing board of the cooperative has not made emergency preparedness a priority; similarly, there is little support for doing the required work to mitigate structural earthquake hazards. Shortly before our visit to the site, a fire inspector had issued a citation for outdated hardware on fire doors. Beyond such enforcement efforts, neither the fire department nor any other public agency has offered assistance with emergency preparedness. Rather than merely citing violations, fire departments could take the additional step of educating occupants about building hazards and offering information on self-help and protective strategies.

The only means of emergency communication in the building are telephones. Even if telephone lines are not severed at the time of earthquake impact, telephones will likely not function. In the event of an earthquake, building occupants are likely to be without a means of communicating with emergency responders and other sources of outside assistance.

Building Occupants

The building has 92 apartments and approximately 100 residents. Several apartments are vacant, and some are occupied by couples and families; however, most apartments have a single occupant. Building residents tend to be elderly; many are retired. Approximately 10% of the occupants are disabled--visual and mobility limitations being the most common problems.

Likely earthquake effects on this building include total or partial collapse, major structural damage, widespread nonstructural damage, loss of utilities, and earthquake-generated fires. In view of these multiple hazards, it is important that occupants be able to get out of the building. However, based on the site inspection, evacuation may be very difficult. The three means of egress are stairways, elevators, and fire escapes. Even if an occupant were able to get out of his or her apartment--doubtful in many cases--the elevators would not be operating. In any case, the elevators (two on each side of the building) are of the same vintage as the building, and each can hold only about four persons comfortably.

The six exterior emergency fire escapes will not be usable by disabled and elderly occupants unless considerable assistance is provided. Nonambulatory persons, for example, would have to be carried down fire escapes. Furthermore, at the time of our inspection, the last flight of stairs on one fire escape (which connects the second story level to the sidewalk outside the building) was in disrepair, and the wrench that must be used to lower the stairs was missing. Had it been necessary to use the fire escape at that time, evacuees would have had to jump from the second story to the concrete sidewalk below, or else return to the building and seek another exit route.

It seems that the most likely routes of egress following an earthquake will be hallways, stairways, and windows. At least at first, disabled and injured building occupants will have to be assisted by other residents, many of whom are elderly themselves. There is considerable cohesiveness among building occupants during normal times. People visit with one another, offer one another assistance with shopping, transportation, and the like, and check on one another regularly. Thus, there is at least the potential for the emergence of a viable self-help network among residents. However, nothing has been done to date to facilitate the development of an emergency support network. Further, because so many residents are elderly and/or disabled, it may be that in the event of a major earthquake there will be more people needing help than persons available to assist.

Summary

This chapter presented a conceptual framework for classifying disabilities according to the kinds and severity of functional challenges with which they are associated and a set of matrices for illustrating how earthquakes can be expected to affect a disabled person's coping capabilities. Typical earthquake effects were viewed in terms of their impact on persons who are functionally challenged in each of six major areas (e.g., sight, mobility). The coping problems many disabled persons will experience in earthquakes will be more severe than those of able-bodied persons, but some disabled persons will experience more difficulty than others. Similarly, some settings will be more hazardous than others for both disabled and nondisabled victims.

Material from on-site assessments of three buildings in the greater Los Angeles area was presented to illustrate strengths and weaknesses in earthquake hazard mitigation, particularly as they relate to disabled persons. If Johnson's three conditions for occupant safety are taken as a standard, none of the sites that were evaluated has achieved optimal earthquake hazard reduction levels. Of the three, Site A has mobilized the most resources to promote earthquake safety. In this facility, considerable effort has been made to mitigate structural and nonstructural earthquake hazards. Those responsible for emergency preparedness have devised an emergency plan, although the plan lacks official status. Compared with Site A, Site B personnel have paid less attention to mitigation and placed about the same emphasis on emergency preparedness. At Site C, the only privately owned building that was studied, earthquake hazards are severe, and there has been no support for either mitigation or emergency preparedness. It is also worth noting that in all cases little or no effort has been devoted to educating building occupants--residents, staff, and other building users--about actions to take to prepare for and respond to earthquakes.

CHAPTER VI

EMERGENCY PREPAREDNESS AND RESPONSE MEASURES FOR PERSONS WITH DISABILITIES

Our research started from the premise that the disabled population is an important focus for disaster policy makers and planners because members of this population may differ from nondisabled persons in their ability to mitigate, plan for, and respond to hazards. For example, a sight or hearing disability may limit an individual's access to general information about emergency preparedness, specific warning messages, or other information available at the time of a disaster. Mobility limitations and environmental factors may affect an individual's ability to take self-protective actions or to evacuate in an emergency. If the participation of a disabled person in the community is low because of social isolation and physical and attitudinal barriers to social involvement, that individual may be cut off from important sources of information and social support in the event of a disaster. Activity limitations and the lack of discretionary income may also curtail an individual's ability to engage in predisaster preparedness activities. On the other hand, because a disabled person is required to cope with the physical environment and take various hazards into consideration on a daily basis, disabled individuals may be more aware of and more prepared for emergencies than able-bodied persons.

In the last five years, disaster agencies have become more concerned with disabled persons in disasters. For example, the Federal Emergency Management Agency (FEMA) has begun focusing on the disaster needs of "special populations," including disabled persons. In October, 1983, FEMA held a conference on emergency preparedness for disabled and elderly persons, and the agency has also published a pamphlet, originally developed by the Southern California Earthquake Preparedness Project (SCEPP), focusing specifically on earthquake safety measures for people with disabilities (Federal Emergency Management Agency, 1985). The California Specialized

Training Institute (CSTI), a branch of the California Office of Emergency Services, regularly holds training courses that highlight the special needs of this population. Organizations such as the Red Cross also publish material focusing on elderly and disabled individuals in disasters (American Red Cross, 1985). However, the objectives of these conferences and publications are relatively narrow. They mainly attempt to make emergency planning and response personnel aware of the distinctive needs of disabled and elderly persons and to provide general, elementary emergency preparedness information to people with disabilities. They do not consider disability in a policy context, impart information on the prevalence of disabilities that could form a basis for planning efforts, or classify disabled persons in terms of their likely disaster-related needs.

If discussions of disability in disaster preparedness materials are rare, as far as we have been able to determine, discussions of emergency preparedness in the disability literature are virtually nonexistent. Guides to independent living (e.g., Hale, 1979) contain some discussions of safety (how to avoid being splattered by hot liquids on the stove, for example), but they make no mention of natural hazard mitigation or preparedness. Books on architecture and design for persons with disabilities (e.g., Bednar, 1977; Cary, 1978) focus on building safety to some degree; however, they tend to place much more emphasis on other properties of settings, such as accessibility and convenience for persons with limitations, than on safety. The idea that a disaster could alter the physical setting or make the environment more hazardous for a disabled individual is never discussed.

One obvious reason for the shortage of more detailed, in-depth material is the lack of a data base to support generalizations. With some exceptions (see our discussion of fire research in Chapter IV), studies on disabled people in emergencies have simply not been done.

Community Preparedness Efforts

Based on a survey of California agencies conducted four years ago, CSTI concluded that existing emergency preparedness measures for disabled persons at the community level are rudimentary at best. CSTI's mail questionnaire, sent to community organizations and public safety agencies, asked whether or not the community had "planned, either formally or informally," to meet various disaster-related needs of disabled persons. As indicated in Table VI-1,

Has your community planned for the following?	*Yes*	*No*	*Don't Know*	*No Answer*
Notifying hearing or sight-impaired persons that an emergency exists	26.8%	53.6%	15.5%	4.2%
Assisting disabled people to safety	46.4%	32.7%	14.9%	5.6%
Providing assistive devices for emergency evacuations from public buildings	19.6%	54.8%	19%	6.6%
Emergency transportation for institutionalized disabled persons	33.9%	35.8%	21.4%	8.9%
Emergency transportation for noninstitutionalized disabled persons	29.8%	44%	19.6%	6.5%
Evacuation centers that are accessible to disabled persons	45.8%	14.9%	35.1%	4.2%
Medical supplies in evacuation centers	31.6%	30.4%	30.4%	7.8%
Training in techniques for managing the needs of the disabled in emergencies	13.7%	51.8%	23.1%	12.5%

Table VI-1

California Specialized Training Institute Survey Findings on Emergency Preparedness for Disabled Persons the 168 respondents reported that relatively little activity had taken place in their communities. For example, less than half the respondents could report that plans had been made for "assisting disabled persons to safety" in a disaster. Only about one-third thought that their communities had plans to provide emergency transportation to institutionalized disabled persons. Only about 13% reported that community emergency training efforts had focused on the disaster needs of disabled persons. Of the survey respondents in public safety agencies, approximately 70% said that community emergency plans either did not make provisions to assist disabled persons or would not prove workable in an actual disaster (Challenge Magazine, 1983; California Specialized Training Institute, n.d.).

Among community emergency response agencies, fire departments appear to be most aware of disabled members of the population. Fire departments typically attempt to locate and record information on persons who might need special assistance in the event of fire. This strategy--identifying persons with disabilities--is currently the most common approach to disaster preparedness for disabled persons. Respondents to the CSTI survey frequently reported ongoing efforts to identify disabled community residents, so that the appropriate agencies could respond in an emergency. A document published by the California Office of Emergency Services (1983), entitled "Emergency Evacuation of the Disabled and Elderly: Planning Guidelines," states (p. 1):

> It is necessary to identify the disabled in a given community or area of evacuation and establish a centralized and current system, so that they may be located in the event of a disaster . . . once the disabled are identified, the information should be computerized, preferably with a manual backup . . . so that the data can be easily retrieved in case of computer failure.

We have no information on how far communities have advanced in developing comprehensive lists of persons with disabilities. However, this approach seems to have some inherent limitations. Some disabled persons may be reluctant to identify themselves as such, even to emergency agencies, for fear that this information might lead to criminal victimization. Others consider identification programs an invasion of privacy with much potential for abuse. Identification efforts are likely to miss many severely disabled individuals, unless thorough community surveys are undertaken. To be useful, the information would also have to be regularly updated. Further, programs to identify and provide assistance to disabled persons in emergencies assume that disabled individuals want to be "rescued" in such situations; disabled persons increasingly view themselves as independent and self-sufficient; they may not wish to be seen as dependent in emergencies. Identification efforts also assume that there will be sufficient personnel to provide rapid assistance to all disabled victims that need it--an assumption that may prove unwarranted.

Disabled Persons in Institutional Settings

One of the objectives of this study was to assess plans and preparations for earthquakes in institutions that serve a high proportion of disabled persons. Several different types of institutions, including hospitals, vocational training centers for disabled persons, and schools for developmentally disabled individuals could be candidates for such a study. However, for three reasons, a decision was made to focus on nursing homes: 1) nursing homes provide round-the-clock, long-term care, rather than services for part of a day or for a short-term, and for this reason, residents can be said to face a greater degree of risk; 2) rather than being specialized, nursing homes serve persons with a variety of disabilities; 3) nursing homes represent a large and growing segment of the health care industry in the U.S.

The size of the nursing home population has increased dramatically in the last 25 years. Among the factors contributing to this growth are the increase in the number of elderly persons in the population, particularly those over 75; changes in Social Security, Medicare, and Medicaid regulations; and the need for alternatives to hospital and mental hospital treatment for chronically ill persons (Dunlop, 1979). By 1974, there were more beds in nursing homes in the U.S. than in general hospitals, and the nursing home occupancy rate was higher (Kane and Kane, 1980). An estimated 1.3 million persons in the U.S. reside in nursing homes; these numbers are expected to increase considerably in the future, because the size of the elderly population--particularly the over-75 segment--is increasing rapidly (General Accounting Office, 1983). At present, approximately 1.5% of persons aged 65-74 and 10% of those over 75 live in nursing homes (Kane and Kane, 1980).

The nursing home population consists overwhelmingly of disabled persons. In fact, the most important determinant of nursing home residency is dependency in routine daily living and personal care activities, such as eating, bathing, using the toilet, and dressing (General Accounting Office, 1983). The 1977 National Nursing Home

Survey found that only 9.6% of nursing home residents were not dependent in any of six major daily living activities (bathing, dressing, toileting, transferring, continence, and eating). The remainder were dependent in one or more areas, and 23% were dependent in all six (Vital and Health Statistics, 1980). Mental illness and cognitive disability are also important predictors of nursing home use, and a recent study found that mental illness and use of ambulation aids were also significant factors in predicting nursing home placement (Branch and Jette, 1982).

Like other health facilities in California, nursing homes are required to prepare written emergency plans and develop measures for both "internal" disasters, such as fires, and "external" disasters and mass casualty incidents. Title 22, California Administrative Code, Sections 72551 and 72553, provides details on the tasks that should be addressed and cites relevant authorities. Nursing homes thus have a legal mandate to engage in disaster planning and to conduct emergency preparedness drills. At the same time, they must focus on a variety of other tasks and functions which may take priority.

Nursing homes perform many of the same activities and are subject to the same safety regulations as general hospitals, and yet these two types of institutions differ in important ways. Kane and Kane (1980) note that compared to hospitals, nursing homes tend to be smaller, less technologically advanced, and less heavily staffed. Moreover, hospital staffs include more trained professionals than nursing home staffs. Unlike hospitals, nursing homes are usually proprietary; about 75% are operated for profit. Nursing homes tend to have a higher occupancy rate than hospitals; they are usually filled to capacity. These organizational characteristics are likely to affect both the manner in which emergency preparedness is approached and emergency response capability in nursing homes.

In the summer of 1985 there were 384 licensed nursing homes and intermediate care facilities in Los Angeles County, according to the County Department of Health Services Health Facility Roster (Los Angeles County Department of Health Services, 1985). As part of an effort to assess earthquake preparedness, face-to-face interviews were conducted with the directors of forty randomly selected nursing care facilities--just over 10% of the total. The interviews were conducted at the nursing homes during the months of June and July, 1985. Co-operation by nursing home directors was, by and large, excellent. One director on the initial list of facilities declined to be interviewed, and a substitute facility was randomly chosen. Interviews, which lasted about one hour, sought information on 1) the characteristics of the facilities, such as age and building type; 2) resident characteristics and staffing patterns; and 3) the earthquake hazard mitigation and preparedness measures that were in effect at the time of the interview (see Appendix III for a copy of the interview guide and the facility checklist that were used). Copies of representative disaster plans were also obtained. The sections that follow discuss our findings and conclusions concerning these facilities that care for disabled persons.

Facility Characteristics

The facilities in the survey ranged in size from 30 to over 400 beds. The most common bed capacity was 99 beds, reportedly because there are higher fees for licenses to operate facilities with 100 or more beds. Of the facilities in the sample, 28 had bed capacities of 99 beds or less. The majority of the facilities operated for profit; only three were nonprofit institutions.

Thirty-three of the nursing homes were single-building facilities, and the remainder had two or more buildings. All but one had less than six buildings on the site. The structures were relatively new. Of the 47 buildings for which the date of construction was known, 23 were built during or before 1962, and half this number were built between 1960-1962. Only three of the buildings involved in the study were constructed during or before 1930.

One building could not be classified according to type of construction. Of the 55 buildings that could be classified, 42 were of wood-frame construction; eleven were of reinforced masonry; and two were steel-frame buildings. The wood-frame buildings typically had stucco or stone on the outside. Approximately three-fourths of the buildings were single-story structures, and even in multistory structures, residents tended to have rooms on the ground floor. Rather than having been converted from other uses, the majority of the facilities (35) were originally constructed and continuously used as nursing homes. On the basis of this information, it appears that these nursing-care facilities would not be highly susceptible to structural earthquake damage.

Resident Characteristics and Staffing Patterns

At the time the interviews were conducted, the nursing homes were typically at or just below their resident capacity; no facility was less than 90% full. In almost all facilities, a very large proportion of residents were over 75 years of age. This age group makes up over 70% of the population of most nursing homes. Virtually all the remaining residents were 65 to 74 years old. An exception to this pattern were two facilities that serve developmentally disabled persons, most of whom were adolescents and young adults.

Facility directors were asked to indicate how many residents they would classify as having each of the six types of functional limitations that have been described elsewhere in this report: mobility, cognitive, hearing, communication, visual, and medical. Individual facilities differ in terms of the resident "mix," with particular kinds of limitations predominating in particular facilities; but at the same time there does seem to be a discernible frequency pattern for functional impairments. Mobility limitations (using a wheelchair, being bedridden, and the like) were the most common type of limitation reported, followed in descending order by cognitive, communication, hearing, visual, and medical impairments. On the average, facility directors indicated that about 75% of their residents had mobility limitations and approximately 50% had cognitive problems. Communications and hearing ability were limited for about 20% of the residents, and around 10% were classified as visually impaired. The smallest category consisted of those who were dependent on medical aids--typically 5% to 10% of the resident population in these facilities. Taking into account the fact that residents may be functionally limited in more than one area, it appears from these data that the majority of nursing home residents are at least moderately impaired and would require considerable assistance in the event of an earthquake.

The number of staff on duty in these institutions fluctuates with the daily schedule. Nursing care facilities generally operate on a three-shift basis, with day (7 a.m. to 3 p.m.), evening (3 p.m. to 11 p.m.) and night (11 p.m. to 7 a.m.) shifts. The largest number of staff (including clerical, administrative, food service, and resident-care personnel) are in the facility during the day shift. At this time, there may be as many as one staff member for every three residents, although a one to five ratio is more common. However, on other shifts, especially the night shift, there is much less staff coverage. It was not unusual for directors to report having one staff member on the premises for every 20 residents during the nighttime hours. If a major earthquake were to occur during the night or evening shifts, it is likely that staff would find it extremely difficult to handle various emergency tasks.

Mitigation and Preparedness Measures

The main part of the interviews focused on emergency planning and earthquake hazard mitigation in nursing care facilities. Table VI-2 summarizes the findings, which are discussed in more detail below.

Emergency Preparedness Activities

Of the 40 facilities contacted, 37 had formal, written disaster plans at the time of the interview. Disaster plans typically focused on multiple agents, including fires, earthquakes, floods, technological emergencies, bombings, sabotage, and war. When nursing home directors were asked why these disaster plans had been developed, the most frequently mentioned reasons were that plans are a requirement for licensing and that the staff at the facility had recognized the need.

It was very unusual to find facilities that had developed their own emergency plans. Instead, plans were prepared by outside private consulting firms that specialize in emergency planning for nursing homes. One particular firm had been responsible for developing emergency plans for 34 of the nursing homes studied. Thus, the plans of most facilities were very similar. (The assessment section later in this chapter includes a more detailed discussion of this approach to emergency planning.)

All the nursing homes interviewed reported having had several emergency drills (either fire drills or disaster exercises) in the last year. The disaster agent focused on most frequently was fire, which is understandable given the emphasis safety regulations place on the fire problem. The typical pattern is to conduct fire drills monthly, focusing on each of the three shifts in turn as required by law, and to hold one or two major disaster drills each year. In contrast with fire drills, the disaster drills usually only involve a single shift; staff members not present at the time of the drill are briefed about what took place. Like the disaster plans, fire drills and disaster exercises are usually under the direction of outside safety consultants who contract to perform this service.

As described by administrators, the disaster exercises held by the nursing homes varied in their complexity and degree of realism. Of the 39 facilities for which information on the nature of disaster drills was available, 18 reported conducting simple exercises involving only staff, not residents. These less realistic drills consisted of

	Yes	*No*	*Don't Know*
Does the facility have a written disaster plan?	37	3	
Has a disaster drill been conducted in the last year?	40	0	
Has any member of the staff attended a conference or training session on emergency response in the last year?	11	29	
Has the facility received printed material on emergency response in the last year?	20	20	
Have residents received training on what to do in an emergency?	8	32	
Have water heaters been secured to resist earthquake forces?	25	9	6
Have book cases been anchored to resist earthquake forces?	20	20	
Have breakable items been stored properly?	29	11	
Is the facility covered by earthquake insurance?	21	9	10
Are there procedures for notifying patients' relatives in an emergency?	37	3	
Are there plans for transporting patients to other facilities in an emergency?	35	5	
Are there plans for releasing patients to relatives in an emergency?	16	23	
Are there plans for transferring patients to shelters in an emergency?	21	19	
Is there an agreement with a physician to come to the facility in a disaster?	10	30	
Have special arrangements been made with the local fire department to provide assistance in an emergency?	7	33	

Table VI-2

Selected Responses to Questions on Earthquake Safety in Los Angeles County Nursing Homes (N=40) such actions as testing the telephone staff call-up system, checking on the status of emergency supplies, and simulating the movement of residents within the facility, with staff members playing the role of residents. Fifteen facilities reported conducting slightly more realistic disaster exercises in which residents participated and emergency activities were carried out in real time. For example, some drills involved internal evacuation--moving residents from one wing of the facility to another. Six of the nursing homes reported conducting exercises that more closely approximated some aspects of an actual disaster situation. Examples of activities carried out in these more realistic drills include the full evacuation of a significant number of residents from the facility and the tagging of residents for transfer to other facilities. Significantly, no examples were found of disaster exercises that attempted to take into account the likely effects of a major earthquake, such as loss of telephone service, disruption of utilities, and damage to the facility and its contents.

Other emergency preparedness activities were discussed in the interview. Eleven of the facility directors reported having sent a staff representative to attend an emergency preparedness conference or training course some time in the previous twelve months. In two cases, the training courses focused specifically on earthquake hazards. Directors also reported that there are periodic training sessions, conducted at the facility by staff development personnel or safety consultants, focusing on equipment safety, the use of fire extinguishers, and related topics. Exactly one-half of the directors reported receiving additional information on disaster preparedness and response; examples include a brochure on disasters from the Hospital Council of Southern California, a Red Cross film and printed materials on safety, and printed safety information sent by insurance companies. In 12 cases, this additional information reportedly focused specifically on the earthquake problem.

One question of particular interest in our project was whether nursing home residents were being instructed concerning actions to take in the event of an emergency, particularly an earthquake. Only eight of the 40 facilities reported having provided emergency information to residents; all eight of the nursing homes in this group indicated that they give instructions for earthquakes. As described in the interviews, these training activities for residents are rather general and sketchy. Residents are instructed, for example, not to go into corridors during a fire, to avoid glassed-in areas during earthquakes, and to wait for and follow instructions from staff members in all emergencies. One nursing home provided a copy of a one-page handout containing written instructions for residents concerning an earthquake; this was the most detailed set of written instructions for residents that we found.

Earthquake Hazard Mitigation and Preparedness Measures

Other questions in the interview focused on mitigation and preparedness activities that are particularly important for earthquakes, such as preparation for the loss of utilities, evacuation and transfer of residents to other facilities in case of structural damage, and mitigation of earthquake damage to building components.

All the facilities in the survey reported having a back-up source of power, typically a generator that runs on gasoline or natural gas. The directors of just over half (22) of the nursing homes reported that their facilities could operate on emergency power for 12 hours or less. Eleven nursing homes reportedly could function for a longer period--up to 48 hours; the remainder of the directors were unsure how long their emergency power would last. All but one facility reported having an emergency supply of water. Although the nursing homes tended not to have large inventories of bottled water on site, directors did seem to be aware of alternative sources of drinkable water, such as water heaters.

Those interviewed were asked whether the facility had a means of emergency communication, both inside the building and with outside agencies, that did not rely on the regular telephone system. Of the 40 nursing homes in the sample, 18 reported having a non-telephone-based system of communication within the facility; this was typically a public address system tied to the emergency generator or a set of walkie-talkies or radios. Only five of the facilities reported having a system for emergency communication with outside agencies that did not rely on telephones. Two of these organizations reported planning to use runners for such communication, and three indicated they would use radios.

Interviewees were also asked about various measures that could be undertaken to reduce earthquake damage to the building and its contents. Twenty-five directors reported that water heaters had been secured to reduce the chance of gas line breakage and fire; nine said that their water heaters had not been braced; and the remainder did not know whether this had been done. Twenty of the 40 interviewees indicated that shelves and bookcases had been bolted to the walls, and 23 indicated that heavy equipment such as typewriters had been anchored to prevent movement during an earthquake. Directors of 29 facilities reported that breakable items were being stored in cabinets with latches to reduce breakage if an earthquake were to occur; the remainder reported that this was not being done. Only 30 of the 40 directors knew whether their facility was covered by earthquake insurance; of this number, 21 said that they had such coverage.

The directors were asked a series of questions about what they would do to handle various problems that could arise in the event of a major damaging earthquake or other disaster. Asked about providing information about the disaster to relatives and close friends or residents, 37 indicated they had plans to notify relatives, and virtually all said that this would be done by telephone. Directors of 35 organizations indicated that some thought had been given to plans to transfer residents to other facilities if this was necessary; the majority of this group said residents would be transferred to other nursing homes, and the remainder planned to send residents to hospitals. None of the interviewees questioned whether such facilities would be operational and in a position to accept patients after a major earthquake. Sixteen directors said there were contingency plans for releasing residents to their relatives in cases where this was possible, and 21 indicated that some arrangements had been made to transfer residents to emergency shelters.

With regard to other special arrangements for disaster situations, directors of five of the 40 facilities indicated that agreements existed with one or more ambulance companies to assist with the transportation of residents in a disaster. Ten of the nursing homes had made arrangements to have a physician come to assist residents in an emergency; 30 had not. Seven nursing homes had arranged for assistance from the local fire department in the event of a major earthquake, and all but three of the nursing homes indicated that consideration had been given to calling back staff to provide additional assistance in the event of a damaging earthquake or other disaster. However, of these 37 organizations, 23 indicated that they would rely on a telephone call-back system. The remainder had let staff members know that they were expected to report to the facility in the event of a major emergency.

Assessment of Nursing Home Earthquake Preparedness

On the basis of the interviews and other documentary material, it is evident that facility safety--particularly fire safety--is a major concern in nursing care facilities. However, it appears that these institutions are not well prepared for a major damaging earthquake. This lack of preparedness stems mainly from the approach to planning that nursing homes have adopted and from inaccurate planning assumptions. These problems will be discussed in the sections that follow.

Planning Strategy

Copies of disaster plans were obtained from about one-quarter of the nursing homes surveyed. As noted earlier, a single company prepared most of the nursing home plans (the documents carry the company copyright), so the plans were nearly identical. While perhaps ensuring that a facility is in compliance with government safety regulations, relying on consultants to develop emergency preparedness measures and write disaster plans is not likely to result in emergency procedures that are appropriate and widely understood by staff. This is not to say that consultants should not be involved in the planning process; they have an obvious advisory role. However, for planning efforts to be meaningful, a potentially more successful approach would actively involve organizational personnel in the actual development of emergency procedures. If there is insufficient commitment to devising a plan on the part of an organization, the organization probably will not be committed to improving safety and emergency preparedness.

We found evidence of low organizational commitment to the emergency procedures that had been developed for the organizations we studied. For example, written guidelines provided by outside consultants stipulate that nursing home residents should receive training in emergency procedures, but this was seldom done. Guidelines also state that disaster exercises should be as realistic as possible, i.e., that they should closely approximate the disaster situation. However, as noted above, interviewees indicated that this is not standard practice.

The use of outside experts has probably had several unanticipated negative consequences. First, a "generic" approach to emergency preparedness has developed that has not given individual nursing care organizations an incentive to assess their own distinctive needs and problems. All nursing homes are treated as more or less equivalent for planning purposes, but it is likely that some nursing homes are more vulnerable to various hazards (e.g., floods, earthquakes) than others. In the case of earthquakes, a few of the facilities we visited were very old and may have relatively low resistance to earthquake forces. Some were undoubtedly closer to active faults and subject to higher peak ground accelerations than others. Nursing home administrators have not been made aware of the need to think through particular problems their facilities might have under various disaster scenarios and to tailor the organization's response to these conditions; instead, they have been provided with prepackaged solutions.

A second and related problem is that, for most disaster agents including earthquakes, little or no attention has been paid to pre-disaster mitigation measures. Preparedness documents developed by outside experts focus mainly on what to do at the time of the emergency and do not provide information on how damage can be minimized. In the case of earthquakes, for example, guidance is provided for what to do with patients during and immediately after ground shaking, ("move them away from windows," "keep them calm," etc.), but no instructions are provided about how to minimize hazards associated with nonstructural building components or earthquake-generated fires. As noted above, interviews with facility administrators indicate that in many cases these hazards have not been recognized or addressed.

Third, because facilities tend to adopt the same set of emergency procedures, plans all tend to have similar gaps and deficiencies. If a major community-wide disaster occurs for which written emergency procedures do not provide adequate guidance, the nursing homes that are affected can be expected to face the same problems. This will increase the demand for emergency assistance for these facilities as well as reduce their ability to assist one another.

Fourth, since each nursing home contracts with a safety service to provide assistance in complying with regulations, disaster preparedness ends up being approached on a facility-by-facility basis. Nursing homes have been given no incentive to engage in information sharing or collective disaster planning efforts. Nor is there evidence that nursing homes have attempted to coordinate plans with community-wide preparedness activities, despite the fact that regulations indicate that the "external" disaster plan "shall be developed with the advice and assistance of county or regional and local planning offices and shall not conflict with county and community disaster plans" (22 California Administrative Code, Section 72551).

Planning Assumptions

Besides these more global problems, which stem from the manner in which disaster planning has been undertaken, there are other difficulties that originate in the facilities' planning assumptions. For example, following legal requirements, plans typically make a distinction between "internal" (e.g., fires, explosions) and "external" disasters (floods, earthquakes). They also attempt to provide guidance for both kinds of emergencies as well as both general emergency instructions for staff and agent-specific instructions. However, they fail to take into account important distinctions among disaster agents that could affect emergency operations. A few examples are discussed below.

Scope of Impact. Except in a superficial way, nursing home disaster plans do not recognize the difference between disaster agents that affect only the facility and those that affect a larger area. For example, evacuation plans seem to assume that other medical and nursing care facilities in the area will be able to receive nursing home transfer patients. The possibility that other facilities may not be operational or filled to capacity because of a regional emergency is not considered. Similarly, many plans assume that the local fire department personnel will be available to assist with facility evacuation in all types of disasters. This may be a reasonable assumption in the case of a fire or explosion affecting a single facility--an occurrence that the fire department would be equipped to handle rapidly. However, plans do not take into account the fact that in an earthquake, fire department resources may be taxed because of extremely high demand. Nor do they consider the possibility that after an earthquake staff may not be able to reach the fire department to make their need for assistance known.

Distinctive Disaster Effects. Similarly, plans have not been developed with an awareness of how disaster agents differ in their impact on the facility and the community emergency system. This is particularly true in the case of earthquakes. For example, with many of the agents on which plans focus--fires, service interruption, bomb threats--it is reasonable to assume that emergency communication with outside agencies can be handled by telephone. In the case of an earthquake, telephone service is likely to be disrupted. Yet, nursing home plans rely overwhelmingly on the telephone as a means of communication in all types of disasters. Some plans assume that a facility's telephone might be tied up and recommend that a staff member go to a pay telephone to make calls, but none seem to recognize that the telephone system itself might not work for some time. Because nursing homes had not considered these kinds of problems with post-earthquake communication, they had not taken compensatory steps, such as obtaining radios.

The fact that special assistance might be required for some tasks after an earthquake (as opposed to other emergencies) is also not acknowledged in preparedness plans. For example, written plans state that the administrator of the facility is the individual who is authorized to determine whether or not a facility should be evacuated in an emergency. With some disaster agents, such as floods or fires, the decision may be relatively easy to make. In the case of an earthquake, however, an evaluation by a structural engineer or other qualified professional may be necessary before such a determination can be made. This information is not provided in the section of the standard plan that deals with earthquakes, and no guidance is given about how an administrator should go about obtaining an emergency assessment of the building. Typical disaster plans advise facility staff that aftershocks can be expected and that some may add to existing damage, but the implications of aftershocks for facility habitability are not discussed.

An underlying source of these problems may be that the facilities have adopted fire as the "prototype" disaster for planning purposes. This is understandable, since fires represent a major hazard. However, disaster agents have different characteristics. Preparedness planning tailored to a single agent may leave an organization unable to cope with other types of emergencies. Fires and earthquakes provide a good example.

The typical fire allows for some advance warning and affects a single facility or part of a facility. Community disaster response systems and emergency resources are usually not overwhelmed or adversely affected by such an event. Indeed, the hazard can be isolated or contained; through quick action, it is possible to prevent building occupants who are not in contact with fire and smoke from being exposed. Fire has a "one-time" impact; once victims have been removed and the fire brought under control, the threat to life and property ceases. Earthquakes, on the other hand, occur without warning. They affect not only individual buildings, but also a larger geographic area, and, as a consequence, the community emergency response system can be greatly taxed. If an earthquake results in the loss of key emergency resources, system response capabilities are reduced. Unlike many fires, earthquakes affect all parts of a building and all occupants at the same time. Further, because of the probability of aftershocks, residents remain at risk for a longer period of time.

There may be several reasons for the current state of emergency preparedness in these facilities. First, only one of the facility directors reported that the nursing home had been affected by a disaster or major emergency in recent times (this case involved a severe electrical storm in 1979). The lack of disaster experience probably means that disaster preparedness is not particularly salient for administrators. It also means that nursing homes have not had the opportunity to see how their emergency response measures operate in an actual crisis situation. Planning assumptions have thus gone untested. Second, in conducting the interviews, it became apparent that there is very high turnover in high management positions in these organizations; many of the directors interviewed were quite new and did not seem to have given much consideration to questions of earthquake safety. With this kind of turnover, earthquake preparedness apparently had not been given sustained attention. Third, not enough emphasis has been placed on raising the level of earthquake awareness and preparedness in these institutions. While nursing homes are required to prepare emergency plans and while there are guidelines that indicate what the plans should address, plans are not subject to outside review. Because of the lack of an organized effort to increase compliance and cooperation, nursing homes are not coordinating their preparedness efforts with other important community organizations (e.g., hospitals, the Red Cross, emergency medical service authorities, ambulance companies, local offices of emergency services), even though the law could be construed to require them to do so.

Summary

So far as we have been able to determine, the subject of disaster preparedness is greatly underemphasized in publications that target disabled persons. Similarly, the distinctive needs of disabled persons have been underemphasized in the literature on disaster preparedness, at least until recently. Moreover, communities surveyed in California report that few organized efforts have been made to provide assistance to non-able-bodied persons in emergencies.

Nursing homes serve a predominantly disabled clientele on a 24-hour basis. Such organizations obviously need to be concerned about the welfare of residents in emergencies. Our survey of a representative sample of Los Angeles County nursing homes indicates that, while emergency planning for fires has been extensive, relatively little attention has been paid to earthquake hazard mitigation and preparedness. Both nursing home directors and those responsible for developing emergency plans appear to be unaware of how earthquakes are likely to affect facility operations. Because a small number of consulting firms devise the plans for and conduct emergency exercises in nursing homes, facility plans tend to have common weaknesses.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

The previous chapters have considered the special problems that disabled persons face in earthquakes. The following are among the most important findings of our exploratory research:

1) Persons with disabilities make up a relatively large and ever-increasing segment of the U.S. population.
2) Disability is related to a number of sociodemographic variables, including age, ethnicity, race, and income level.
3) Little empirical data exist on the needs and capabilities of disabled persons in disasters.
4) Previous research suggests that disability may be an additional risk factor in earthquake-caused injury.
5) Disabled persons should be able to cope adequately during and after earthquakes, provided that they are given appropriate levels of support, both through modification of the built environment and through improved levels of emergency preparedness.
6) Earthquake effects are likely to create special challenges for disabled building occupants, particularly those with visual and mobility limitations, and little attention has been paid to preventing or reducing such problems. One major problem appears to be the failure to provide multiple building access and egress routes, thus limiting the options of disabled building occupants.
7) In the Los Angeles area, disabled persons are concentrated disproportionately in the sections of the city and the kinds of multifamily structures that are likely to sustain heavy damage in the event of an earthquake.
8) The fact that the built environment is unable to accommodate the needs of disabled persons in earthquakes means that such

persons are being exposed to a higher degree of involuntary risk than members of the nondisabled population.

9) Community emergency preparedness agencies are becoming aware of the needs of disabled persons, but effective programs to reach and assist this population in disasters, including earthquakes, have not yet been instituted.

10) Specialized facilities that care for disabled clients have adequate preparedness planning for localized emergencies such as fires but have not given sufficient consideration to community-wide disasters, particularly earthquakes.

These findings have implications for both policy making and practice in the earthquake hazards area. As is the case with other hazard reduction measures, new programs to assist persons with disabilities are part of a policy process that involves stakeholder groups with different interests (Petak and Atkisson, 1982).

Stakeholder Groups in the Policy Process

Three kinds of stakeholder groups are likely to become involved in the policy debate on earthquake safety for disabled persons. The first, which we term *loss-experiencing parties*, are those groups that bear the losses and costs arising from efforts to mitigate earthquake effects: disabled persons and the public at large. The second consists of *mitigation-involved parties*: state, federal, and local policy makers, developers of earthquake preparedness programs, insurance companies, and interested professionals. The third stakeholder group includes various *mitigation-constraining parties*: persons who are opposed to government-mandated programs, those who advocate reduction in government spending, those who believe that the needs of disabled persons in earthquakes are no more significant than those of the nondisabled, and those who believe no more can or should be done to improve earthquake hazard mitigation.

At present, stakeholder mobilization with regard to the issues discussed in this report appears to be very low. In order to lobby effectively in their own behalf, disabled persons must be aware of the earthquake hazard and organized as a constituency, and this has not yet occurred. Members of the general public can be expected to oppose hazard mitigation measures that they perceive as adversely affecting their interests. Policy makers at the federal, state, and local levels are the parties that would decide whether distributive or regulatory policies will be developed; however, they tend to respond to large constituencies and (if they are elected officials) to causes that will re-elect them. Policy makers respond vigorously mainly to what are seen as "high consequence" events, and they do not tend to give natural hazards high priority.

Mitigation and Preparedness Measures

Mitigation and preparedness measures appropriate to the problems faced by disabled persons in disasters which could become a focus for policy, include:

1) development of methods to identify and/or avoid situations prone to earthquake hazards;
2) development of appropriate earthquake forecasting and warning systems;
3) increased mobilization of resources for earthquake response;
4) development of educational programs for disabled persons, emergency planning and response personnel, and the general public;
5) constituency-building activities, such as conferences, task forces, and public relations efforts;
6) development of legislation to increase the safety of disabled persons in the built environment; and
7) provision of financial assistance to persons with disabilities, to increase their ability to cope with the hazard.

Some of these measures focus specifically on members of the population who are disabled. Others are programs or activities that would increase safety levels for all community residents, regardless of whether or not they are disabled. Before these and other hazard mitigation measures can be implemented, a number of constraints must be overcome.

Constraints on the Policy Process

Various kinds of constraints will influence which measures are adopted and how these measures are implemented. One set of constraints involves issues. State and federal regulatory powers are constrained by specific constitutional prohibitions. As in other areas, state and local regulatory legislation may be traced to "police power"--valid governmental actions undertaken to protect the health, safety, and welfare of a community. Earthquake safety for disabled persons would seem in principal to be included under the police power rubric, but in practice this may not be the case. To be enacted, statutes and regulations must be constitutionally valid, reasonable, and not overly burdensome. Legislation involving disabled persons can resist challenge if it appears to reflect appropriate multijurisdictional planning and coordination activity and if it can demonstrate a clear linkage between the proposed policy and some comprehensive hazard management program.

The question of government liability with respect to earthquake losses has not yet been tested in the courts. However, it is now widely believed that governments can be found liable for failing to take action to reduce known hazards (Building Seismic Safety Council, 1985). It could be argued that government has a special obligation to protect the safety of persons with physical limitations on the grounds that such persons constitute a high-risk group.

Sociopolitical factors constitute another set of constraints on the policy process. As noted earlier, hazard awareness on the part of the disabled population is a necessary condition for policy making. Beyond this, support by pressure groups, the general public, and important political figures and agencies is also required. However, there is typically little support for loss-avoiding natural hazard management policies, and with an issue such as this one, which is apparently very low in salience, gaining support may be difficult. It is likely that the interventions that can be portrayed as benefitting all members of the population, not just disabled persons, have the highest probability of receiving political support.

The issue can also be analyzed in the context of value constraints. There is usually little challenge on value grounds to natural hazards policies that offer special protection to "dependent populations." California's Field Act and Hospital Seismic Safety Act, which focus on public schools and hospitals, respectively, are examples of special state initiatives on behalf of children and the infirm. Governmental entities, individuals, and groups are expected to guide their decision making and behavior so as to avoid inflicting injury and/or damage on other parties, unless some overwhelming public good is served by the course of action. These values may be seen as supporting governmental intervention to increase the safety of disabled persons in earthquakes. However, American values also hold that opportunities for personal choice should be preserved, and governments should intervene in people's personal lives only when required by some dominant public purpose. This position could be consistent with nonintervention or inaction on earthquake safety issues.

Other value-laden issues that are likely to be raised in debates centering on hazard mitigation policies for disabled persons include the following: Shall the death or injury of an individual exposed to a catastrophic event such as an earthquake be given a higher value than the death or injury of an individual exposed to a noncatastrophic occurrence? Once made aware of the risks posed by a natural hazard, should individuals be expected to internalize losses incurred as a result of a natural event? Should voluntary risk taking with a low probability of causing injury to others be prevented by government intervention? How should the costs of hazard reduction be distributed in the population and among levels of government?

Policies for disabled members of the population are also likely to be shaped by administrative constraints, a category of constraints that includes both organizational and institutional practices and the availability of human and material resources. Numerous organizational entities should have a role in policy development and implementation regarding seismic safety and programs for disabled persons: federal, state, and local governments; legislative bodies; planning and regulatory agencies; design professionals; organizations that develop building codes; disaster preparedness agencies; and related organizations. A comprehensive approach is needed to address various aspects of the problem, but virtually no integrative efforts have been made to date. Even if such integration were initiated, organizations and governmental jurisdictions would, no doubt, differ on which mitigation strategies they favor. Moreover, governmental entities typically have rather small staffs and little money for disaster preparedness and may lack the staff expertise to develop specialized programs for disabled persons.

Finally, any approaches to addressing the problems of disabled persons in earthquakes must necessarily take place within the context of more general attempts to reduce earthquake hazards for all community residents. Earthquake hazards, like other issues that are candidates for inclusion on the public policy agenda, go through cycles of attention and neglect. When major earthquakes occur that engage the attention of the public and policy makers and when groups that have a stake in earthquake hazard reduction are well mobilized, there is a higher probability that new earthquake safety measures will be adopted. Efforts to provide more assistance and support to persons who have physical impairments and to other groups at risk are most likely to succeed when overall interest in the earthquake problem is high.

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Appendices

APPENDIX I

DEVELOPMENT OF THE COALINGA SURVEY INSTRUMENT:
INTERVIEW PROTOCOLS FOR DISABLED BUILDING OCCUPANTS
WHO EXPERIENCED THE EARTHQUAKE OF MAY 2, 1983

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Introduction

The purpose of the Coalinga survey was to identify the relationships between 1) the seismic performance of various building types and building components, 2) the special capabilities and limitations characteristic of disabled building occupants, and 3) the responses of such occupants to the performance of various types of buildings and components in an actual earthquake. In order to explore these relationships, an interview format was developed which could be used to reconstruct the spatio-temporal sequences of the actions taken by disabled persons who experienced the Coalinga earthquake of May 2, 1983. Because Coalinga is a very small and isolated community with relatively few disabled persons, it was not possible to survey a large enough sample of respondents to permit a statistical analysis of response patterns in terms of disability or building type. However, since the May 2 earthquake was the most recent severe seismic event from which any occupant response data could be collected, a field study was initiated in order to provide detailed illustrations of some of the disability and building related aspects of coping with natural disasters.

The interview protocols used in the Coalinga survey were based upon prior research which has attempted to reconstruct sequences of occupant behavior during building fires (Keating, Loftus, and Manber, 1983; Keating and Loftus, 1984) and earthquakes (Arnold et al., 1982; Archea and Kobayashi, 1984). Together, these earlier studies have paved the way for a) reconstructing the sequence of actions taken by building occupants during emergencies and b) linking those sequences to building performance.

Reconstructing Sequences of Behavior During Fires

In their work on reconstructing behavior during fires, Keating and Loftus have found that a combination of narrative and interrogatory interview techniques works best from the standpoints of completeness and accuracy (Keating, Loftus, and Manber, 1983; Keating and Loftus, 1984). Basically, they found that the narrative or free-recall approach allowed the subjects to fully account for both the typical and atypical aspects of their own personal experiences--free from the a priori assumptions or expectations of the interviewer. On the other hand, the interrogatory approach was more structured and thus, enabled the interviewer to help the respondents organize their accounts in ways that were compatible with prior research findings and conceptual frameworks prevailing in the behavioral sciences. By sequencing the narrative and interrogatory approaches (in that order), Keating and Loftus have found that they are able to capitalize on the advantages of both techniques, while overcoming most of their respective disadvantages (Keating, Loftus, and Manber, 1983).

This sequence of narrative responses, followed by a more structured interrogation on the part of the interviewer, has been labeled the Behavioral Sequence Interview Technique (BSIT). Keating and Loftus have undertaken extensive studies to validate the BSIT approach in Seattle and New York City. They summarize their method as follows:

> In the first phase of the interview, the witness is invited to recount his or her story of the fire free from interference or questions by the interviewer (narrative mode). During the second phase of the interview, the respondent and the interviewer cooperatively generate a comprehensive account of the respondent's behavior during the fire using a standardized format (interrogatory mode). The narrative or free-recall phase is administered prior to the more structured mode to capitalize on research findings . . . which have demonstrated more accuracy and completeness when this sequence of interview methods were employed. Additionally, this sequence of interviewing avoids the bias that can be created in the interrogatory phase by the use of specific questions and language by the interviewer. (Keating and Loftus, 1984, p. 5)

In general, Keating and Loftus found that, while the narrative approach was more accurate, it was generally less complete than the interrogatory approach which often precluded data unique to specific cases. They also found that when the two approaches were used in sequence, the most complete and accurate account was obtained--especially when the interviews were conducted some time after the incident. In addition, they found that in order to assure the most thorough reconstruction of the behavior engaged in during a fire, the respondents had to be articulate and have good memories (Keating and Loftus, 1984).

As with all research, the objective of the Keating and Loftus work has been to obtain data that will permit statistical analysis in terms of a specific conceptual framework. More specifically, they have focused on the sequence of actions that people take in fires, the key decisions to pursue a specific course of action which break the overall sequence into discrete episodes (see Lerup, Cronrath, and Liu, 1980), and the rationale that led to each decision. Given its cognitive decision-making orientation, the BSIT is not directly sensitive to explicit aspects of building design or performance and thus, contributes little to developing a detailed understanding of how a person's physical surroundings influence his or her actions during emergencies.

Reconstructing Sequences of Behavior During Earthquakes

In their study of the Imperial County Services Building, Arnold and his coworkers used a self-administered questionnaire to reconstruct the response patterns of the occupants of that building to the El Centro earthquake of October 15, 1979. Their objective was to establish where people were at the time of the main shock, what they were doing at that time, and the nature of their initial responses to the earthquake (Arnold et al., 1982). Since they used a multiple-choice questionnaire, their approach would most closely fit Keating and Loftus' definition of an interrogatory mode. Although there is no way to determine whether or not Arnold's findings suffered from the incompleteness that Keating and Loftus attribute to this mode of questioning, it is interesting to note that between 65 and 95% of the responses to their questions fell within the choices listed on the questionnaire. In fact, the only instances in which more than 10% of the respondents used the "other" category or added items that were not among the choices given were for questions that encouraged multiple answers.

In an attempt to broaden their reconstruction of potential earthquake responses, Archea and Kobayashi used a combination of the narrative and interrogatory interview formats similar to that suggested by Keating and Loftus. The purpose of their research was to determine the amount of activity that the occupants of dwellings engaged in during the 30 seconds of peak ground motion associated with the off-Urakawa earthquake of March 21, 1982 (Archea and Kobayashi, 1984). They were specifically concerned with reconstructing the spatio-temporal sequence of activities pursued as accurately as possible. To this end, in addition to combining narrative and interrogatory interview formats, Archea and Kobayashi used specific spatial markers to localize and cross-validate the temporal sequences recalled by their respondents.

After obtaining basic demographic and state-of-the-household data at the onset of their interviews, Archea and Kobayashi asked three independent series of questions pertaining to a) the respondent's own actions during the period of strongest ground motion, b) the respondent's observations of any structural or nonstructural displacement during this period, and c) the respondent's observations of the actions taken by other people who were present during this same period (Archea and Kobayashi, 1984).

In order to maximize the accuracy of the respondent's accounts, all interviews were conducted in the spaces actually occupied at the time of the March 21 earthquake and, insofar as possible, each subject actually walked through the entire sequence of actions or observations reported, as each of the three scenarios was being reconstructed. A key aspect of this intensive re-enactment was to identify the specific vantage points from which all damage and activity was observed and to use these vantage points to fix the respondent's locations in space, thereby refining the spatio-temporal sequence reconstructed for his or her own actions. As each subject walked through the sequence of actions and vantage points encountered during the earthquake, his or her path of travel, the locations at which each of the actions reportedly took place, and the points from which each of the events occurring around the respondent had reportedly been observed were plotted on measured floor plans of each dwelling which were prepared by two research assistants during the conduct of the remainder of the interview.

Within each of the three series of questions asked by Archea and Kobayashi, a combination of narrative and interrogatory approaches was used. In a departure from the Keating and Loftus strategy, a few sharply focused questions were asked at the beginning of each series to bracket the time frame at issue (e.g., Where were you when the earthquake began?, Where were you when the earthquake ended?, etc.). Once these spatio-temporal markers had been established, the respondents were asked to recount everything else they did or saw during this period. These narrative responses were simply listed in the order recalled, including any elaboration provided by the respondent. After this free-recall phase was completed, a series of focused questions was asked to assure that nothing had been left out (e.g., Did you attempt to do anything that you were unable to do?). After all of the events had been listed, the interviewer and the respondent put them in order, using the actual locations and vantage points reported as guides to the plausibility of the spatial and temporal sequence (Archea, 1985).

The Archea and Kobayashi approach used four distinct strategies to assure the completeness and accuracy of the spatio-temporal sequences being reconstructed. First, they used an open-ended narrative account of recalled activities to assure that a fairly complete record was obtained at the outset. To make sure that this first approximation was as complete as possible, they prodded the respondents in areas where omissions were most likely to occur--like actions that had not been completed. Second, they established the precise location of each action within rooms or other spaces, and used these locations to check the plausibility of the order in which the respondent recalled that things had happened. Third, they established the precise vantage points from which specific events had been observed, and used these to correct or fine-tune the spatio-temporal sequence reconstructed for the respondent's own actions. For example, if the respondent claimed to have seen something fall in a location that was not visible from the reconstructed path of travel, the interviewer would probe until it was clear whether or not the reported event had actually been seen (as opposed to heard) during the earthquake or if the path actually followed had been different than the one initially reconstructed. Finally, the respondents actually walked through the entire sequence of actions and vantage points identified through the successive phases of the interview, thereby gaining an opportunity to reconcile what they had remembered with direct experience.

Given these multiple opportunities to correct the respondent's subjective recall, given the detail of the sequences reconstructed in the Urakawa study, and given the consistency of the accounts generated by separate respondents in that study, it would appear that the Archea and Kobayashi method creates a very thorough account of responses to emergencies in time and space. Although this approach is very intensive in terms of interviewer and respondent time, this level of effort may be necessary in order to accurately reconstruct complex sequences of behavior long after an earthquake has occurred.

The issue of accurately and completely reconstructing events through post-incident interviews is more than a matter of memory loss or recall ability over time. For example, no interviewer can presume that he or she will be the first person to whom a respondent will recount what actually happened during a fire or an earthquake--even if the interview is conducted on the day of the event. It is far more likely that these experiences will initially be shared with the first and most significant people encountered immediately after the event has occurred. These would include family members, friends, and casual bystanders. In each telling of what happened, it can also be assumed that the respondent will not only attempt to remember the most critical events and concerns, but also attempt to explain his or her role in the ultimate outcome of the incident (e.g., "I did try to keep the lamp from falling on her, but I just couldn't reach that far.").

Thus, the task of the interviewer is not just to jar the respondent's memory, but also to unpack the circumstances actually experienced from the self-serving explanations of what those circumstances ultimately led to. To this end, the elaborate spatial referents and re-enactments that the Archea and Kobayashi method is predicated upon would appear to be justified. To summarize:

> On the assumption that people create accounts of their experiences in disaster situations to justify their contributions to the final outcome, the subjects were initially encouraged to report what they did or saw just as they remembered it. The remaining questions were ordered in such a way that successive responses would refine and correct the data on the sequence in which each of the reported actions actually occurred. Specific questions were asked about the locations at which each activity took place or was attempted and the vantage points from which damage or the behavior of others was observed. (Archea and Kobayashi, 1984, p. 1103)

With regard to its applicability to the Coalinga survey, the Archea and Kobayashi approach appeared to require movement and other efforts on the part of the respondents which would be an imposition on many disabled people and to take too long to administer (especially for disabled respondents). It also required the availability of the sites in which the behavior reported actually occurred, which often would not be possible in Coalinga. On the other hand, this method does illustrate the value of using explicit spatial referents to fine-tune and validate the sequences of activities recalled by the victims of earthquakes, fires, or other types of building emergencies.

The Coalinga Survey

In structuring the Coalinga interview format, the combination of narrative and interrogatory formats suggested by Keating and Loftus was used, together with an approximation of the explicit spatial referencing system developed by Archea and Kobayashi. Given the concern for limiting the length of the interviews, it was felt that this combination of approaches would produce accounts that would be sufficiently complete and accurate to reveal any linkages between the behavior of disabled respondents and both the nature of their disabilities and the performance of the buildings they had been in at the time of the earthquake. The complete rationale for each portion of the Coalinga survey instrument is described below.

Consent to Participate (Figure 1): At the beginning of the interview, the interviewer read a brief statement which introduced himself or herself as a member of a research team working for the University of Southern California and asked if the respondent would be willing to

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Hello, my name is ___________. I am a member of a research team working for the University of Southern California. I would like to ask you some questions about the earthquake which occurred on May 2, 1983. Will you help us by answering the questions?

Yes _____
No _____

We are interviewing a cross-section of people such as yourself who were affected by the earthquake on May 2 last year. We are interested in finding out what you did during and immediately after the shaking period. We are interested in learning about the conditions under which disabled people in buildings are affected by earthquakes. We intend to develop recommendations on how to lessen the problems caused by earthquakes based on this study. Your participation is completely voluntary. All of your answers will be kept strictly confidential. Do you have any questions before we begin?

59. Would you be willing to help us by reviewing and making comments on the findings of our study? Y N

Figure 1: Consent to Participate

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answer questions about the May 2, 1983 earthquake. After agreeing to participate, the respondent was read a short paragraph describing the scope and intent of the survey. Finally, in conjunction with standard procedures regarding informed consent and the privacy rights of human subjects, the respondent was reminded that his or her participation was completely voluntary and told that all responses to the interviewer's questions would be kept strictly confidential. The respondent was also encouraged to ask questions about the study before the interview began.

All of the material presented at the beginning of the interview was worded to convey the impression that, by having experienced the May 2 earthquake, the respondent had become uniquely qualified to provide information that might help other people confronted with similar circumstances in the future. This notion that the expertise rested with the respondents, rather than with the interviewer, was reinforced by the last question in the survey (question 59), which asked whether or not the respondent would be willing to review and make comments on the findings of the Coalinga survey.

Respondent Characteristics (Figure 2): The first series of eight questions was intended to identify the basic demographic characteristics and functional capabilities of each respondent. The first two questions pertaining to the respondent's sex and age were included to permit classification of the respondents in any subsequent tabulations or analysis. (Note that the respondent's sex was not asked, but merely noted by the interviewer.)

The next three questions (2-4) were included to get a sense of the respondent's attitude toward and understanding of his or her own disability. Question 2 was specifically included to determine whether or not the respondent acknowledged any function limitations. Question 3 was an open-ended attempt to elicit the medical descriptors of the respondent's disabilities (whether these had been acknowledged as disabling or not) and a general sense of what these conditions meant with regard to everyday functioning. The fourth question regarding how long the reported condition(s) had existed was included in order to reveal if longer periods of adaptation to a particular disability had had any impact on the respondent's ability to cope with the 1983 earthquake. In addition to bearing on any statistical analysis, these three questions were asked at the beginning of the interview in order to give the interviewer a frame of reference for interpreting responses to subsequent questions.

Questions 5 through 7 were intended to determine what the respondent's disabilities meant in terms of everyday functioning. In question 5, the respondent's were asked whether or not they were normally capable of performing each of ten routine motoric and perceptual tasks. These tasks--which included moving from one location to another, opening and closing doors, watching television, and finding one's way around the town or building--were adapted from the National Health Interview Survey and

0. Sex M F

1. Age ______

2. Do you regard yourself as disabled? Y N

3. (If yes) Describe your disability.

____

____

4. How long have you had this condition? _____

5. Under normal conditions can you . . .

   a. Move from one location to another without assistance? Y N

      (Does this require the use of walking aids? Y N
      ________________________________)

   b. Get out of a bed or chair without assistance? Y N

   c. Open and close doors by yourself? Y N

   d. Walk up or down stairs easily? Y N

   e. Read the newspaper? Y N

   f. Watch television across a room? Y N

   g. Hear normal conversations? Y N

   h. Recognize your relatives or friends? Y N

   i. Find your own way around your home/building? Y N

   j. Express what you mean? Y N

6. Describe any other difficulties that you have in moving around. ____

____

7. Describe any other difficulties that you have in recognizing or interacting with others. ______________________

____

Figure 2: Respondent Characteristics

instruments used by the California Department of Developmental Services. Questions 6 and 7 were simply open-ended attempts to identify any motoric or perceptual limitations which had not been reported in response to question 5.

Respondent's Situation at the Onset of the Earthquake (Figure 3): This second series of thirteen questions was intended to characterize the situation that the respondent had been in at the time the May 2 earthquake began. Questions 8 through 14 were ordered to identify the precise location of the subject at the time of the earthquake. Question 8 identified the part of Coalinga or the specific building the respondent had been in. Question 9 sought the address of that location or building (if the respondent had been in a building) so that photographs and other records of damage could be used to key aspects of building type and building performance to the remainder of the survey data in subsequent analyses. Questions 10 and 11 were intended to determine the respondent's familiarity with that building as a function of duration of occupancy and frequency of use, respectively. Questions 12 through 14 were intended to establish the precise location of the respondent within a specific room and on a specific level of that building (if applicable).

Questions 15 through 17 were intended to determine what the respondent had been doing before the earthquake started (up to the time that the shaking began); whether he or she had been standing, sitting, or in some other position; and how long he or she had been so engaged. Questions 18 through 20 were included to ascertain whether or not other people had been with the respondent at the onset of the earthquake and the relationship of any such people to the respondent. With regard to a sample of disabled respondents, the last two series of questions were thought to be especially important for characterizing a) their actual levels of functioning just prior to the earthquake and b) the availabili-

---

8. Where were you when the May 2, 1983 earthquake began?
____
____

9. Could you give us the address of this house/building?
____
____

10. How long have you lived/often have you gone there? ________

11. How much time did you spend there on a typical day/visit?
____

12. What room/area were you in when the earthquake began?
____

13. Where were you in that room/area?
____

14. What floor/level of the house/building were you on? ________

15. What were you doing when the earthquake began? ________
____

16. What position were you in?
standing sitting lying
walking reclining other ____________

17. How long had you been doing ( ) in this position? ______

18. Was anyone else with you? Y N

19. (If yes) Who? ____________________

20. What was this person's relation to you? ____________

Figure 3: Respondent's Situation at the Onset of the Earthquake

ty of others whose assistance might have been needed during such an unforseen event.

Respondent's Sense of Vulnerability (Figure 4): The third series of questions was intended to determine how the respondents perceived the earthquake and their own vulnerability to it. Question 21 focused on the specific cues that had alerted the respondent to the earthquake--an issue of special interest for persons with perceptual disabilities. Question 22 asked what the respondent had done when he or she first recognized that an earthquake was occurring. The response to this question was tentatively assumed to have been the first action taken in the spatio-temporal sequence developed in the following sections of the interview and thus, was entered in the table accompanying question 27 (see below).

Questions 23 through 25 attempted to determine the respondent's sense of his or her vulnerability and to use this assessment as a subjective indicator of the time frame for which coping with the direct effects of the earthquake was the most salient from the respondent's point of view. Question 23 asked specifically whether or not the respondent had felt that he or she was in any danger during the earthquake. Question 24 asked what the respondent had been the most worried about (a veiled attempt to determine whether or not such concerns had been disability-related). Question 25 used the termination of the reported sense of vulnerability to determine the point in time that the earthquake itself ceased to be the major focus of the respondent's concern. Question 26 asked where the respondent had been at that point in time--a question

---

21. What was it that first alerted you to the earthquake?
____

22. What did you do first? ____________________
____

23. Did you feel that you were in danger? Y N
24. What were you most worried about? ______________
____

25. When did you first realize that you were out of danger?
____

26. Where were you then? ____________________
____

Figure 4: Respondent's Sense of Vulnerability

---

intended to establish the approximate distance that had been traversed during the critical moments of the earthquake and to bracket the end-point of the spatio-temporal sequence of actions generated through the next two series of questions.

<u>Narrative Account of the Respondent's Experiences During the Earthquake (Figure 5)</u>: Having determined the first (question 22) and last (question 26) points at which the physical transformations created by the May 2 earthquake had been the exclusive focus of their concerns, the respondents were asked to list all of the other things which they had done between these initial and final points in time. These actions were simply listed in the order recalled by the respondent in the left-hand column of the table accompanying question 27. This was the open-ended narrative portion of the interview which Keating and Loftus found to be so essential for eliciting a complete account of what had actually happened.

Many of the more interrogatory questions which preceeded question 27 were placed earlier in the interview in order to a) establish a clear frame of reference for the interviewer's use in attaching significance to the actions listed by the respondent and b) to bracket the time frame

---

27. What other things did you do from the time that you first noticed the earthquake to the time that you realized that you were out of danger?

Action	*	H/P	Problem	A	S	E	Order

Figure 5: Narrative Account of the Respondent's Experiences During the Earthquake

---

during which the earthquake had been the most critical part of the respondent's world. All of the actions recalled by the respondent were listed by the interviewer, who then probed for additional information when previous answers suggested that this might be appropriate or necessary.

<u>Elaboration and Sequencing of the Respondent's Experiences (Figure 6)</u>: After the complete list of actions recalled had been entered in the left-hand column of the table (see Figure 5), a series of interrogatory questions was asked to further elaborate the list and to establish the order in which things had actually happened. Question 28 asked which of the actions listed had occurred while the ground was still shaking. These were marked with an asterisk (*) in the second column of the table. By asking how long the respondent thought the shaking had lasted in question 29, the plausibility of his or her responses to question 28 could be estimated and probing questions asked, if necessary.

The next six questions attempted to determine the specific role that the respondent's disabilities had played in the actions reported. Question 30 was intended to identify the most difficult action which the respondent had engaged in during the critical moments of the earthquake and why it had been so difficult. This action (if any) was noted by an "H" in the third column of the table (see Figure 5) and the nature of the problem cited was then elaborated within the wide column to the right of the "H". In some instances, it was expected that this question would also reveal an action that had not initially been included in the response to question 27. Question 31 simply attempted to identify any other problems that had been encountered during this critical period (marked with a "P" in the third column of the table) and to describe the nature of each problem cited. Question 32 was an extension of the previous two questions and was deliberately phrased to disclose actions that might have been left out of the list generated in response to question 27. Questions 33 through 35 attempted to identify the nature of any assistance that had been provided to the respondent during the critical moments of the May 2 tremor. Each action for which assistance was provided was marked with an "A" in the fifth column of the table. These three questions were also worded to disclose additional actions through explicit associations with any assistance provided by other people. As a group, questions 30 through 35 were intended to relate the respondent's activities during the critical moments of the earthquake to

28. Which of these things did you do while the ground/building was still shaking? (*)
29. How long do you think the shaking lasted? ______________
30. What was the hardest thing for you to do? (H) Why was this a problem? (Problem)
31. What else did you have problems with? (P) What was the problem? (Problem)
32. Did you attempt to do anything that you were unable to do? (Action) Why couldn't you do this? (Problem)
33. Did anyone assist you with any of the actions that you took during or immediately after the earthquake? (A)
34. Who helped you? ______________
35. What did they do? ______________
36. Were you struck or injured by anything during the earthquake? (Action)
37. Where did this occur? ______________
38. What were you struck by? ______________
39. Where did this ( ) come from? ______________
40. Were you able to avoid being struck by anything? Y N
41. How were you able to avoid being struck? ______________
____
42. Were you able to do things by yourself during the earthquake that you would ordinarily require assistance with? (S)
43. Of all the things that you did during the earthquake, which were the easiest? (E)
44. In what order did the actions that you took during the earthquake occur? (Order)

Figure 6: Elaboration and Sequencing of the Respondent's Experiences

his or her disabilities and to develop a more complete account of what had actually taken place during that period.

Questions 36 through 41 were intended to relate the respondent's actions to the performance of the building during the earthquake. Question 36 asked if the respondent had been struck or injured by anything during the critical moments of the earthquake. Unless such incidents had previously been entered, all affirmative responses to question 36 were added to the tabulation of actions developed in response to prior questions. The next three questions asked where this incident had occurred, what the respondent had been struck or injured by, and where this object had fallen from (if known). Questions 40 and 41 addressed the possible avoidance of falling or shifting objects during the critical moments of the earthquake. Collectively, these six questions served to characterize the respondent's level of functioning under earthquake conditions, to fix some of his or her actions in space, and to trigger associations with additional actions that might have been taken.

The remaining questions in this series were intended to complete and sequence the account of actions taken by the respondent during the earthquake. Question 42 focused on any actions which the respondent normally would have required assistance for, but had been able to accomplish during the earthquake without assistance (marked with an "S" in the sixth column of the table). This was a specific reference to a notion that disasters may lead people to perform at higher levels than they would be capable of under routine circumstances. Question 43 simply completed the series of probes begun in question 28, by asking which had been the easiest things to do during the earthquake (marked with an "E" in the seventh column of the table). By focusing on events that had not been very challenging, this disarming question was specifically intended to disclose any minor actions that had been left out of the respondent's account up to this point.

After all of the actions reported in response to questions 27 through 43 had been listed in the table (see Figure 5), question 44 asked the respondent to identify the order in which all these things had occurred. This sequence was recorded in the extreme right-hand column of the table (see Figure 5). By the time questions 27 through 43 had been answered, it was assumed that the interviewer would have developed a fairly clear picture of the order in which things had taken place. Thus, question 44 was intended to serve as a reconfirmation of the temporal sequence which had already been established. However, while explicating this sequence it was still possible to add actions that would have been essential for the execution of those already listed, or to combine separately reported aspects of what would obviously have been singular actions.

By this point, a completely sequenced account of what the respondent had done during the critical moments of the May 2 earthquake should have been established. The remaining two series of questions sought explanations for how the respondent had behaved during the earthquake and an assessment of the impact that the earthquake experience has had on the respondent's subsequent behavior.

<u>Effects of Prior Experience or Training (Figure 7)</u>: The next ten questions attempted to characterize the respondent's preparedness for the

May 2 earthquake. Questions 45 and 46 were included to determine a) how surprised the respondent had been at what happened during the earthquake and b) what he or she had expected to be different from what had actually happened. Question 47 asked whether or not the respondent had previously experienced an earthquake (as strong as the May 2 quake). This was an attempt to reveal possible linkages between any previous earthquake ex-

---

45. Did things happen during and after the earthquake in the way that you had expected?
46. (If no) What had you expected? ______________________

---

47. Had you been in a strong earthquake before? Y N
48. (If yes) Were you disabled at that time? Y N
49. (If yes) Did your experience in this other earthquake help you cope with the May 2, 1983 earthquake? Y N
50. (If yes) How did it help? ______________________

---

51. Had you been told what to do in an earthquake? Y N
52. (If yes) What had you been told? ______________________

---

53. Were there any unusual circumstances that affected you during the May 2, 1983 earthquake? Y N
54. (If yes) What were these?

Medication	batteries recharging
Hearing aid off	renovations underway
Glasses off	other ______________

Figure 7: Effects of Prior Experience or Training

---

perience and the expectations reported in response to questions 45 and 46. Questions 48 through 50 attempted to ascertain whether or not previous experience (if any) had helped the respondent cope with the May 2 event and how the history of his or her disability was related to any such experience.

Questions 51 and 52 attempted to link the respondent's expectations with any prior training or information that he or she had been given about what to do in an earthquake. Questions 53 and 54 focused on any unusual personal or situational circumstances that might have overridden the effectiveness of the respondent's previous experience or prior training at the time of the May 2 earthquake. As a group, questions 45 through 54 characterize the respondent's overall preparedness for an earthquake--providing possible explanations for some of the actions or inactions reported earlier in the interview.

Impact of the Earthquake on Subsequent Behavior (Figure 8): The final series of four questions was intended to determine what impact the May 2 earthquake had had on the respondent's preparations for or expectations of similar events in the future. Question 55 asked how the respondent had reacted to the (unspecified) aftershocks following the May 2

55. How did you react to the aftershocks following the May 2, 1983 earthquake? ______________________

56. What will you do if another earthquake strikes? __________

57. Have you or your family made specific preparations for a future earthquake? Y N

58. (If yes) What preparations have you made? __________

Figure 8: Impact of the Earthquake on Subsequent Behavior

event. This question provided a context for interpreting the respondent's attitude toward earthquakes at the time the interview took place and also redirected his or her attention away from the initial tremor that had been the singular focus of the rest of the interview. Question 56 was far more explicit in asking what the respondent planned to do if another earthquake should occur in Coalinga. This was intended to give a clear view of how conscious he or she was of a continuing vulnerability to incidents of this kind. Questions 57 and 58 attempted to determine whether or not the respondent had converted any of his or her concerns about future earthquakes into a specific plan of action. As a group, the last four questions were worded to reveal whether the respondents regarded the May 2 earthquake in Coalinga as a singular event that was totally behind them or as an indicator of a continuing vulnerability on his or her part.

Assessment

Overall, the Coalinga Survey Instrument capitalizes on the earlier research of Keating and Loftus (1984) and of Archea and Kobayashi (1984) to reconstruct as accurate and complete an account as possible of the actions disabled people took in response to the earthquake of May 2, 1983. It focuses directly on the sequences of actions that had actually been taken by the respondents during the most critical portion of the tremor, on the role that their disabilities and prior experience had played in the conduct of those activities, and indirectly on the limitations that building performance had introduced during this process. If detailed reports of damage had been obtained, it may have been possible to address the impact of building performance more directly.

In sum, the Coalinga protocols provide a working format for structuring the data necessary to describe the interrelationships between building performance, the functional capabilities of disabled building occupants, and the opportunities for such occupants to engage in self-protective behavior during a major natural disaster, such as an earthquake.

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APPENDIX II

CHECKLIST FOR ESTIMATING EFFECT OF EARTHQUAKE INDUCED NONSTRUCTURAL DAMAGE ON SURVIVABILITY OF DISABLED BUILDING OCCUPANTS

Guna Selvaduray
San Jose State University

Name of facility:

Address:

Named individual(s) in charge of safety? Yes....No....

If Yes, Name............Title............
Name............Title............
Name............Title............

Total area of site:

Number of buildings:

Number of stories (for each building, if more than one building:

Type of construction (of each building, if different):

Total floor area per building:

Maximum number of occupants (Total):

Current number of occupants (Total):

Breakdown of percentage of occupants according to their disability types:

Sight:	Communication:
Mobility:	Cognitive:
Hearing:	Medical:

Number of occupants per floor:

Building #:.....	Floor...........Occupants.........
	Floor...........Occupants.........
	Floor...........Occupants.........
Building #:.....	Floor...........Occupants.........
	Floor...........Occupants.........
	Floor...........Occupants.........

Total number of employees: Shift 1: Time:......to.....Staff...........
Shift 2: Time:......to.....Staff...........
Shift 3: Time:......to.....Staff:..........

Number of employees per floor:

	Building #	Floor #s
Shift 1:		
Shift 2:		
Shift 3:		

Number of employees on call:

5 p.m. to 11 p.m.
11 p.m. to 8 a.m.

General Safety

Does the facility have a written Organizational Disaster Plan?...........

Who wrote this? In-house...... Consultant......
Government Agency......

When was it written?..........

Has it been revised and updated?..........

If Yes, at what intervals is it revised and updated?..........

Can a copy be made available for this study?..........

For each building: Sprinkler system: Yes..... No.....

Location of fire extinguishers:

Smoke Detectors:

Other early warning systems:

Closest Fire Dept.:
Preplanning done with Fire Dept?
In-service training?
If Yes: Type of training:.......................
Provided by:............................
Frequency:..............................
Participants:...........................

Elevator (if more than one story):......
Number per building:......
Elevator fitted with earthquake safety device?

Power (Electricity)

Standby Generator?
Location:
Water cooled?
Water supply:......Days......Hours
Fuel type?
Fuel supply:.......Days......Hours
Anchored?
Automatic start-up?
Vulnerability to EQ:
Standby generator connected to selected circuits?
Emergency lighting (battery pack lighting):

Communications

Location of main switchboard:
Number of phones on each floor:
Minimum and maximum distance to each phone:
Does each occupant have some means of reaching central
switchboard without leaving room?
External communications: Telephone only?
Emergency communications provisions:
Reception only......
Reception and transmission......
Means of transmission............

Water supply

Standby water supply:
Storage system:
Vulnerability of storage system to EQ:
Quantity of supply: gals. days.:

Sanitary system:
Back-up sanitary system:
Vulnerability to EQ:

Emergency Transportation

Closest care facility to which occupants can be moved:

Means of transfer:
Expect impediments to transfer? e.g., highway overpasses or bridges, etc. that can collapse?

Have any arrangements been made with another company, agency, etc. for emergency transportation of occupants?

Do these arrangements provide for people with special needs, e.g., people on life support systems?

Individual Rooms

Residence time:......hours/day
Glass windows: Yes.... No....
If Yes, Plate..... Laminated..... Tempered..... Drapes.....
Special provisions to prevent EQ shattering......
Life support systems: Yes.... No....
If Yes, Power Supply: AC Mains.... DC....
Battery back-up....
Door: Normally open.... closed....
Communications:............
Other items that could cause damage:

Lounge

Residence time:........hours/day
Glass windows: Yes.... No....
If Yes, Plate..... Laminated..... Tempered..... Drapes.....
Special provisions to prevent EQ shattering......
TV? Yes.... No....
If Yes, anchored?.....
Vending machines? Yes.... No....
Smoking permitted? Yes.... No....
Other items that could cause damage:

Evacuation Route

Routes identified? Yes.... No....
Does each occupant have two means of exit?.....
Possibility of exits being blocked?.....
Number of doors each occupant has to pass through to exit building.....
Are these doors normally open..... or closed.....
Emergency exits marked?......
Emergency lighting provided?......
Need to use stairways?......
Is stairway alternate to elevator?......
Possibility of stairway being blocked?......
Percentage of occupants who can use stairways:......
Items located along evacuation route that could block it?......
If Yes:

Number of people needed to evacuate occupants (per floor):....
Means provided for evacuation of occupants?......
Length of time required to evacuate occupants:......
Evacuation training:......
Evacuation exercises:......

Evacuation Site

Location within site?..........
Distance from building:..........
Overhead cables?..........
Underground gas pipelines?..........
Post-disaster audit system?..........
If Yes, method:..................
Emergency medical supplies available?......
If Yes, quantity available:......Days......Hours
Storage system:..........
Vulnerability of storage system to earthquakes:..........

General Nonstructural

Nonstructural components anchored:

Stability configuration of nonstructural components if unanchored:

- h less than d
- h less than 2 x d
- h greater than 2 x d

Light fixtures hung on T-bars or fixed to structural components?

Extent of glass usage in building construction:

Measures taken to prevent glass damage:

Anchoring of building utilities:

HVAC: Is it necessary for functioning of facility?
If yes, is it connected to emergency standby generator?
Special provisions made for emergency HVAC:

Use of life support systems:
Dependent on power?
If yes, emergency power provisions:

Water heaters: Anchored?......
Flexible pipe connections?......

Bottled gases used?......
Oxygen.... Nitrogen.... Hydrogen....
Other...............................
Is storage practice earthquake safe?......

Computers used for record keeping?
Mini-computers..... Main-frame.....
Mini-computers protected?.....
Main frame and sub-floor protected?.....

Storage of medicines and drugs:
Primarily glass jars?.....
Cabinets containing drugs anchored?.....
Doors on all cabinets?.....
Doors normally closed?.....
Drug and medicine containers prevented from falling down or spilling over?.....

APPENDIX III

INTERVIEW GUIDE FOR DIRECTORS OF NURSING HOMES
AND INTERMEDIATE CARE FACILITIES

FACILITIES INTERVIEW

Name of facility: ______________________

Address of facility: ______________________

Telephone: ______________________

Name of interviewee: ______________________

Position: ______________________

Approximate size of site (in city blocks, or, if smaller, size of lot):

____

Approximate amount of open space, relative to building size:

____

Number of buildings in facility:

____

FILL OUT BUILDING CHECKLIST FOR EACH OCCUPIED BUILDING---RESIDENCES, RECREATIONAL BUILDINGS, OFFICE BUILDINGS, ETC.

FACILITIES INTERVIEW GUIDE

1. What is the bed capacity of this facility?

   _____ No. beds

2. How many residents do you have at present?

   _____ No. of current residents

3. How many of the residents are

   over 75 _____ 65 to 74 _____

4. This study focuses especially on people who have different kinds of disabilities or chronic health problems that limit what they can do physically. Of those who are currently residents here, about how many have each of the following six kinds of physical limitations:

mobility limitations (e.g., bedridden, in wheelchairs	_____	DK _____
hearing impairments	_____	DK _____
cognitive or mental disabilities (e.g., mental illness, Alzheimer's disease)	_____	DK _____
communications problems (e.g., muteness)	_____	DK _____
visual impairments	_____	DK _____
limitations due to needing special medical equipment (e.g., respirators, oxygen)	_____	DK _____

   (If interviewee states "don't know" in majority of categories): In general, how capable are your residents of carrying out basic everyday living activities, such as getting around, dressing without assistance, and so on?

5. How many staff members are present at the facility during each shift in the workday?

   #1: Time: ____________ Staffing: ______________________________
   #2: Time: ____________ Staffing: ______________________________
   #3: Time: ____________ Staffing: ______________________________

6. When was the facility built? (If the facility contains more than one occupied building, determine when each occupied building was constructed.)

	Description	Year built
Bldg. #1:		
Bldg. #2:		
Bldg. #3:		

7. What was the original use of the facility?

_____ Same as current use
_____ Other use(s): ______________________

8. What is the annual operating budget for the facility?

Ann. budget (in thousands) _____________
(Ask for a copy of the annual report, if one exists.)

9. To your knowledge, has this facility ever been involved in a major disaster or serious emergency?

_____ Yes _____ No

(If Yes)
(a) When was that?
_____ Year

(b) What type of a disaster was it? (Obtain brief description of event, including agent, amount of damage, casualties and fatalities.)

10. Does the facility have a formal (i.e., written) emergency plan?

_____ Yes _____ No (go to f)

(If Yes)
(a) If possible, may I have a copy? I will be glad to pay for the cost of reproduction.

(b) When was the plan developed? _____ Year

(c) When was it last revised? _____ Year

(d) Why was the plan developed? (Probe: licensing requirements, need identified by public safety organizations, disaster experience)

(e) What types of emergencies does the plan include? (List)

(If No)
(f) Are there special procedures that members of the staff are expected to perform in an emergency?

11. Has the facility had an emergency drill in the last year (fire drills OK)?

_____ Yes _____ No

(If Yes)
Can you describe the drill? (Note what sort of exercise; whether staff only or staff and residents took part; what outside agencies, if any, were involved; whether drill was a simulated emergency exercise, "paper" drill, or what.)

12. Has anyone from the facility attended a conference or training course on emergency preparedness in the last year?

_____ Yes _____ No

(If Yes)
Can you tell me a little about the training? Who sponsored it? Who attended? How long was the training course?

13. Has anyone from here sought or received other information on disaster response--brochures, for example?

_____ Yes _____ No

(If Yes)
(a) What sort of information was received?

(b) Was there anything on earthquakes specifically? What?

14. Have residents been given any training (either by staff or by outside trainers) in what to do in case of a disaster?

_____ Yes _____ No

(If Yes)
(a) Can you describe the training briefly?

(b) Has any of the training involved how to respond in the event of an earthquake?

_____ Yes _____ No

(If Yes)
What have the residents been trained to do?

Now, I have a few questions about this facility.

15. Does the facility have a back-up power supply, in case there is a power failure?

_____ Yes _____ No

(If Yes)
What kind of a power supply is it? How long will it operate?

16. Do you have an emergency supply of water, for use if your water is cut off?

_____ Yes _____ No

(If Yes)
What is the source of your water? Is it drinkable? How long do you expect it to last?

17. Do you have any communications equipment for use in a disaster, other than the telephone?

(a) for internal communication in this facility?

_____ Yes _____ No

(If Yes)
What type of equipment?

(b) for communicating with those outside this facility?

_____ Yes _____ No

(If Yes)
What type of equipment is it?

18. Have you taken any of the following measures to make the building and its contents safer in the event of an earthquake?
(Check those measures which have been taken)

_____ Securing water heaters
_____ Bolting shelves and bookcases to the walls
_____ Anchoring heavy equipment (e.g., typewriters)
_____ Storing breakable items in cabinets with latches
_____ (if wood-frame structure) Bolting the building to its foundation

19. Is this facility covered by earthquake insurance?

_____ Yes _____ No

(If Yes)
Can you briefly describe what type of coverage you have?

20. If the facility were severely damaged and unable to continue operations as a result of an earthquake or other disaster, what arrangements have been made for the following tasks: (Describe in detail, writing down interviewee's own words whenever possible)

(a) Notifying relatives and friends of residents about what has happened.

(b) Transferring residents to other facilities, if necessary.

(c) Releasing residents to their relatives.

(d) Transferring residents to emergency disaster shelters.

Next, I am going to ask about other special arrangements this facility might have that could be used in an emergency, such as a major earthquake.

21. Do you have an ambulance company on contract that would come to transport injured residents to the hospital?

_____ Yes _____ No

22. Have arrangements been made to have a physician come here to assist in the event of a major emergency?

_____ Yes _____ No

23. Do you have any special arrangements with the local Fire Department, for them to come and assist you and the residents in the event of an earthquake?

_____ Yes _____ No

24. About how many of your staff have

CPR training _____ First aid training _____

25. Have you developed procedures for calling back staff in the event of an earthquake or other major disaster?

_____ Yes _____ No

END OF INTERVIEW

BE SURE TO TRY TO OBTAIN A COPY OF THE DISASTER PLAN. IF PLAN IS NOT OBTAINED, EXPLAIN WHY---REFUSED, UNAVAILABLE, PROMISED TO MAIL, DOESN'T EXIST, ETC.

INTERVIEWER IMPRESSIONS:

Please include your own observations about the interview below.

Was interviewee relaxed, candid? Were there any special circumstances that might have affected the nature of the responses? Is there any other information about the tone and conduct of the interview that you believe might be useful in interpreting these data?

BUILDING CHECKLIST

To be filled out through observation, with assistance from facility director or some other knowledgeable person. Could be filled out in the course of a tour of the facility. Be sure to inform interviewee that information requested on the buildings is confidential, and that data will be reported in such a way that it will not be possible to identify any particular facility.

Type of Construction (Check one):

- Unreinforced masonry ____
- Reinforced masonry ____
- Wood-frame ____
- Wood-frame with stucco, stone ____
- Tilt-up ____
- Cast-in-place concrete ____
- Steel-frame ____

Date of construction: ________

Number of stories: ________

Primary building use:

____ Used by residents on a 24-hour basis

(If used on 24-hour basis)
Story (or stories) on which residents are located ____

____ Occupied, but primarily during part of the day (administrative offices, daytime recreational facility)

Other building features (check which are present):

- Elevator ____
- Unusual building configuration (describe in space below) ____

- Sprinkler system ____
- Smoke detectors ____

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Institute of Behavioral Science #6, Campus Box 482
University of Colorado
Boulder, CO 80309-0482

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