

Housing Reconstruction after Two Major Earthquakes:
The 1994 Northridge Earthquake in the United States
and the 1999 Chi-Chi Earthquake in Taiwan

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ABSTRACT

The idea of pre-impact recovery planning has recently been promoted by federal and state governments, but very little research has been done to evaluate its effects on disaster recovery. This study compared two jurisdictions—the City of Los Angeles, California and Taichung County in Taiwan—in their recovery from earthquakes. Although the two cases also differ with respect to variables other than the presence of pre-impact recovery plans, the available data suggest that having a pre-impact recovery plan facilitates housing reconstruction and allows local officials to make more effective use of the “window of opportunity” after disaster to integrate hazard mitigation into the recovery process.

The disaster recovery period is a time with immense potential for confusion and conflict as different stakeholders pressure government to take actions directed toward divergent purposes. Such conflicts can produce major difficulties for the local government, including failure in recovery leadership (Rubin, 1985; Spangle Associates, 1997), ad hoc decision-making (Rubin, 1995), and poor coordination between departments (Rolfe and Britton, 1995). Moreover, many reconstruction finance programs neglect the needs of the poorest victims (Comerio, 1998; Bolin & Stanford, 1998) and a rush to restore the community to its preimpact pattern of social and economic functioning tends to reproduce its vulnerability to disaster (Schwab, Topping, Eadie, Deyle & Smith, 1998).

To overcome these problems, many observers have advocated that communities engage in pre-impact recovery planning. According to Wilson (1991), preparation of preimpact recovery plans provides local officials with time to consider how activities undertaken during the immediate aftermath will affect long-term recovery. Similarly, Geis (1996) suggested that the more recovery issues can be thought through in advance, perhaps by means of disaster scenarios, the greater will be the efficiency and quality of post-impact decision-making.

Pre-impact planning for post-disaster recovery has been minimal in the United States (Mileti, 1999), but it has become more common in the past decade. Recovery training courses and handbooks are provided by the United Nations (UN)¹, the Organization of American States (OAS)², the Federal Emergency Management Agency's (FEMA) Emergency Management

¹ UN Office for the Coordination of Humanitarian Affairs coordinated a series of training courses regarding rehabilitation and reconstruction. For more information, http://www.reliefweb.int/ocha_ol/index.html.

² The Organization of American States (OAS) promoted recovery planning after Hurricane Georges struck the eastern Caribbean. For more information, <http://www.oas.org/pgdm/>.

Institute³, and state governments. Nonetheless, pre-impact recovery planning is not a very common idea at the local level. Most communities, except some in California, Florida and North Carolina, are unprepared for the most basic challenges of disaster recovery such as restoration of infrastructure and immediate housing needs (Pettersen, 1999). So far, only Florida requires local plans for post-disaster recovery and that mandate applies only to coastal counties.

Despite the apparent promise of pre-impact recovery planning, only one study has been done to evaluate its effectiveness. Spangle Associates (1997) studied disaster recovery after the Northridge earthquake by interviewing city officials in Los Angeles, which had developed a long-term recovery and reconstruction (R&R) plan before the earthquake. The researchers found that few local officials referred directly to the R&R plan after the earthquake, but the planning process was very helpful. Many officials mentioned that they knew what their responsibilities were and what needed to be done after the earthquake because they had resolved these issues during the planning process. Similar to the findings on emergency response planning (e.g., Kartez and Lindell, 1987, 1990), the greatest benefit of disaster recovery planning was not the written plan itself, but the planning process.

Despite the promising evidence from the Spangle Associates (1997) study, further study is needed to determine if pre-impact recovery planning has a significant effect on disaster recovery. Two very important questions concern whether such plans accelerate housing recovery and whether they enhance hazard mitigation.

Accelerating Housing Recovery

Housing recovery passes through four stages in the aftermath of disaster: emergency shelter, temporary shelter, temporary housing and permanent housing (Quarantelli, 1982).

³ Emergency Management Institute, FEMA provides training courses such as course E-210: Recovery from Disaster, course E376 - State Public Assistance Operations etc. For more information <http://www.fema.gov/emi>.

Emergency shelter is usually established after a disaster at the instigation of individuals and households based on chance availability, convenience, proximity, and perceived safety (Bolin, 1993a). Temporary shelter is often sought in the homes of friends and relatives, but mass care facilities are also used (Tierney, Lindell & Perry, 2001). Temporary housing is sometimes available in vacant housing units within commuting distance of the stricken neighborhood but, in the United States, FEMA provides mobile homes when local housing stocks are insufficient (Bolin, 1993b). The last stage of housing reconstruction is permanent housing, which can be rebuilt on the same site or another site after the disaster.

Many factors contribute to a community's capacity to make rapid progress through these stages of housing recovery—the availability of undamaged housing in the community, economic conditions, the disaster management system, and local land use and building practices and, especially, the availability of financing. Comerio's (1998) study of housing reconstruction after the Mexico City earthquake, the Northridge earthquake and the Kobe earthquake in Japan concluded that in developing countries, most of the funds for housing reconstruction come from international aid. In developed countries, however, financing for recovery comes from a diverse set of domestic sources including insurance, savings, and borrowing from commercial sources. Unfortunately, housing reconstruction cannot rely exclusively on market forces because some segments of the victim population, especially ethnic minorities, lack savings, insurance, or information about where to get government loans (Peacock & Girard, 1997). Consequently, national treasuries are tapped for grants and loans.

Although financing is a critical influence, local jurisdictions have little control over this aspect of housing recovery. Nonetheless, there are a number of tasks that they can perform that affect the speed of housing recovery. First, local jurisdictions can plan the location of temporary

housing because resolving this issue can cause conflicts that can delay consideration of longer-term issues of permanent housing and distract policy makers altogether from hazard mitigation (Bolin and Trainer, 1978; Bolin, 1982). Second, local jurisdictions can plan how they will accomplish essential tasks such as damage assessment, condemnation, debris removal and disposal, rezoning, infrastructure restoration, temporary repair permits, development moratoria, and permit processing because all of these tasks must be addressed before the reconstruction of permanent housing can begin (Schwab, et al., 1998).

Pre-impact recovery plans also should address the licensing and monitoring of contractors and retail price controls to ensure that victims are not exploited and also should address the jurisdiction's administrative powers and resources, especially the level of staffing that is available. It is almost inevitable that local government will not have sufficient staff to perform critical recovery tasks such as damage assessment and building permit processing, so arrangements can be made to borrow staff from other jurisdictions (via pre-existing Memoranda of Agreement) and to use trained volunteers such as local engineers, architects, and planners. Finally, these plans also need to address the ways in which recovery tasks will be implemented at historical sites (Spennemann & Look, 1998).

Integrating Mitigation Policies into Recovery

The recovery period is a unique time to enact policies for hazard mitigation, which can be defined as advance action taken to reduce or eliminate the long-term risk to human life and property from hazards (Berke & Beatley, 1997; Godschalk, Beatly, Berke, Brower & Kaiser, 1999). These mitigation measures can be classified into three categories: community protection works, land use practices, and building construction practices (Lindell & Prater, in press). Community protection works include dams, levees, and drainage systems that protect an entire

area from hazard impact. Land use practices include land use regulation (zoning), and comprehensive plans that limit the amount of property in vulnerable areas. Building construction practices include structural designs and construction materials that reduce the vulnerability of the structures that are located in the hazardous areas.

Whatever mitigation measures planners seek to adopt, they must recognize that the time period immediately after impact is a window of opportunity (Kingdon, 1995) to enact mitigation policies, because policy makers can use a disaster as a “focusing event” that can be exploited to induce desired policy changes (Birkland, 1997). But the opening of the policy window does not automatically result in policy change. The public needs to pay attention to the problem, and have new groups participate in public debate on the mitigation issue in order to produce policy change (Prater & Lindell, 2000). Nor will the window remain open indefinitely. Kingdon has offered five reasons for the closure of a policy window. First, the window may close without action if no policy options are available for action at the appropriate time. Second, action on the problem may be taken and the problem resolved. Third, attempts may be thwarted, leading to a decrease in attention and finally a shift in political resources to other issues. Fourth, agency personnel may change and new personnel may be unwilling to back any proposed change. Finally, the events that caused the crisis eventually will fade from public awareness, allowing attention to shift to fresh issues. To take advantage of the window of opportunity that opens after a disaster, policy entrepreneurs must ensure that it closes because of the second reason (action taken and the problem resolved). Development of a pre-impact recovery plan can ensure that this happens, by conducting community hazard/vulnerability analyses, examining alternative mitigation measures (community protection works, land use practices, and building construction practices), and

identifying the appropriate financial and management tools for implementing the selected mitigation measures (Schwab, et al., 1998).

Essential Elements of Pre-impact Recovery Plans

The available research on recovery planning provides some general guidance on the elements that should be contained in pre-impact recovery plans. Based upon 14 case studies, Rubin (1985) concluded that personal leadership, ability to act and knowing what to do are three necessary elements to ensure an efficient community recovery. Wilson (1991) in his study on the Loma Prieta earthquake emphasized that recovery planning should be a continuing organization-wide process that has the full support and involvement of the top officials. Schwab and his colleagues (1998) considered that the purpose of planning for post-disaster recovery and reconstruction is to provide a vision for decision makers and a framework within which decisions will be made. The plan can provide decision makers with some general guidance and principles that they should follow to achieve long-term recovery goals. Comerio (1998) concluded that an ideal recovery policy would minimize the potential for damage by incorporating mitigation programs and, when damage occurs, link property owners to reliable sources of financial capital.

More specifically, Schwab et al. (1998) proposed that four basic functions be addressed in a community recovery plan: Organization and authority, short-term rehabilitative functions, land use, and regional coordination. The Organization of American States (2001) proposed a somewhat similar program of pre-impact recovery planning for the islands in the Caribbean and recommended the following four categories of activities: construction standards, household preparation, construction sector preparation, and policy development. Combining these concepts, a good pre-impact recovery plan can be defined as one that establishes a recovery task force and leading agency, lets stakeholders know their roles in disaster recovery, and identifies the

recovery financing programs for which different classes of residents are eligible. In addition, it informs people where recovery resources can be obtained, establishes agreement about long-term recovery goals, and integrates mitigation policy into the recovery process.

Research Hypotheses

To examine how pre-impact recovery planning affects housing reconstruction activities, this study will examine the following two hypotheses:

H₁: Having a pre-impact recovery plan will increase the speed of housing reconstruction.

The rationale for this hypothesis is that pre-impact recovery planning will shorten implementation time after disaster by developing policies and procedures and by acquiring implementation resources before they are needed. Furthermore, pre-existing recovery financing programs will provide victims with more rapid access to reconstruction loans and grants.

H₂: Having a pre-impact recovery plan will increase the extent to which hazard mitigation is integrated into the recovery process.

If mitigation is formulated as a long-term recovery goal during pre-impact recovery planning, it should increase the opportunity for integrating mitigation into housing reconstruction. One of the Kingdon's (1995) explanations for closure of the window of opportunity is that policy change attempts may be thwarted, leading a decrease in attention and a shift in political resource to other issues. Moreover, mitigation is likely to be overlooked due to competing demands that occur immediately after a disaster if it has not been integrated into pre-impact recovery planning.

Study Design

Earthquakes are infrequent events, so it is not possible to identify study sites that have had recent earthquakes and differ only with respect to their level of pre-impact recovery planning. Two recent earthquakes that struck reasonably comparable communities that vary with

respect to pre-impact recovery planning are the 1994 Northridge earthquake in Southern California and the 1999 Chi-Chi earthquake in Taiwan. The Northridge earthquake had a magnitude of 6.7 on the Richter scale, killed 57 persons and caused more than 7,000 injuries. The earthquake completely destroyed or substantially damaged over 65,000 housing units in a city with a population of 3.8 million and 1,337,706 housing units (U.S. Census Bureau 2000). Perkins, Boatwright, Chuaqui and Harrauld (1995) reported that 13,575 buildings were severely damaged (red tagged⁴) and another 37,711 were moderately damaged (yellow tagged). The direct economic loss was estimated to be at least \$25 billion (Office of Emergency Services, 1997).

The Chi-Chi earthquake, also called the 921 earthquake because it occurred on September 21, had a magnitude of 7.3 on the Richter scale, killed 2,417 people, and caused 11,305 injuries. The earthquake collapsed 10,366 housing units and damaged another 14,720 (921 Earthquake Post-Disaster Recovery Commission, 2003). According to the 2000 data from the Directorate General of Budget, Accounting and Statistics, the overall financial loss caused by the Chi-Chi earthquake was about 11.5 billion USD⁵. One of the most severely stricken jurisdictions, Taichung County, had a population of 1.6 million that suffered 113 deaths and 1,112 injuries during the earthquake. The county also suffered 18,608 buildings totally collapsed and another 18,771 buildings damaged (Taichung County Fire Department, 1999).

Both the Northridge earthquake and the Chi-Chi earthquake were the most destructive earthquakes in their respective countries in the past half-century, so they provide an opportunity to study how disaster recovery is implemented in one jurisdiction that did have pre-impact recovery planning (the City of Los Angeles in the US) and another jurisdiction that did not

⁴ Red tag means the building was rendered entirely uninhabitable. Yellow tag means the building needed further evaluation. Green tag means the building had experienced nonstructural damage and remained habitable.

⁵ All amount reported below have been converted to US dollars at the 1999 currency exchange of 1 USD= 32 NT.

(Taichung County in Taiwan). Specifically, Los Angeles had a pre-impact recovery plan that identified local government actions that needed to be taken, identified disaster recovery programs at the federal and state government levels, and formulated actions for integrating mitigation policy into the recovery process. By contrast, Taichung County had no pre-impact recovery planning and very few existing recovery programs. Thus, comparing these two jurisdictions will help to determine if a pre-impact recovery plan has a significant effect on housing reconstruction.

Analysis of approximately 90 official housing recovery-related documents and plans in Los Angeles and Taichung were examined to assess local plans according to the criteria described previously. Specifically, these are the extent to which each jurisdiction had: 1) established a task force and leading agency, 2) let stakeholders know their roles in disaster recovery, 3) identified the recovery financing programs for which different classes of residents were eligible, 4) informed people where recovery resources could be obtained, 5) established agreement about long-term recovery goals, and 6) integrated mitigation policies into the recovery process. The documentary data on the Northridge earthquake were supplemented with interviews conducted by Spangle Associates in 1995; similar interviews on the Chi-Chi earthquake were conducted with 25 Taiwanese government officers and planners by the senior author during 2002. The documents and interviews confirmed that there was a pre-impact recovery plan in Los Angeles, but not in Taichung.

The dependent variable for Hypothesis 1, the speed of housing reconstruction, was measured primarily by the time at which rebuilding permits were issued in each of the two jurisdictions. Additional data were gained through interviews with officers in the Department of

Building and Regulation, Department of Public Works, and Offices of Emergency Management, as well as articles in local newspapers such as the Los Angeles Times and Taipei Times.

The dependent variable for Hypothesis 2, the extent to which hazard mitigation is integrated into the recovery process, was measured by the extent to which hazard mitigation was included in housing recovery-related policies such as disaster recovery programs, land use planning, and comprehensive planning. The primary data sources were official documents from different levels of governments, supplemented by personal interviews with officers in the Planning Departments, Departments of Community Development, and Building Departments.

Housing Reconstruction Following the 1994 Northridge Earthquake

The City of Los Angeles R&R Plan had four central themes: planning, hazard mitigation, short-term recovery, and long-term reconstruction (City of Los Angeles, 1993, 1994). The plan assigned lead responsibility for each of 300 implementing actions to one or more departments or agencies within city government. This plan was a project of the Recovery and Reconstruction Division of the Los Angeles Emergency Operations Organization, which launched an innovative planning process for post-earthquake recovery and reconstruction in 1987. This planning process involved representatives from academic fields as well as a number of city departments and took quite some time. At the time of the Northridge earthquake, the R&R plan was on the agenda of the Emergency Operations Board for approval and was adopted five days after the earthquake.

The Northridge earthquake emerged as a focal point of political discourse, stimulating claims of disaster needs that were publicly promoted at both the state and national level (Bolin & Stanford, 1998). Because the earthquake occurred during a congressional election year, politicians at the federal and state levels immediately converged on the impact area. The policies that were subsequently announced had many political implications, especially for Democratic

President Clinton and Republican Governor Wilson. President Clinton declared the Northridge earthquake a national disaster on the afternoon of 17 January, resulting in a very rapid mobilization at the federal level. FEMA Director James Witt, Transportation Department Secretary Federico Pena, and HUD Secretary Henry Cisneros all arrived in Los Angeles by the evening of the first day. On 19 January, Secretary Pena committed to 100% federal coverage of repairs to interstate highways for six months without the usual requirement of 25% matching state funds. Secretary Cisneros also immediately disbursed \$129 million in Community Development Block Grants, as well as 20,000 Section 8 housing certificates for low-income victims, without awaiting preliminary loss estimates (Bolin & Stanford, 1998).

Some financial programs for housing reconstruction were available from government agencies after the earthquake. These included FEMA's Temporary Housing Program, Additional Living Expense Program, Minimum Home Repair Program, and Individual and Family Grant Program; HUD's Section 8 Rental Vouchers Program, Community Development Block Grants (CDBGs) and Affordable Housing Program (HOME) Grants; SBA's Assistance Loans for Homes and Personal Property, Physical Disaster Loan; the IRS's Tax Disaster Assistance Program; and the City of Los Angeles Housing Department's Rehousing Grants.

In addition, households could rely on private sources such as personal savings, insurance, and commercial loans. However, data from the National Income and Product Accounts indicates that the savings rate in the US for the period from 1994 to 1997 was in the range of 2-7%. A savings rate this low suggests that personal savings could not provide a major source for housing reconstruction. Indeed, data provided by the U.S. Office of Management and the Budget, the Governor's Office of Emergency Services, and the California Department of Insurance indicated that private insurers paid out almost 65.3% of the major housing reconstruction funds after the

Northridge earthquake. SBA loans contributed another 20.7%, and FEMA and HUD grants contributed 7% each (See Figure 1).

Figure 1 about here

At the time of the earthquake, Los Angeles had a new mayor and a new planning director who were unfamiliar with the R&R Plan. Indeed Spangle Associates reported that their interviews with 39 staff members from 11 different departments and the city council revealed that less than half of their interviewees claimed to know about the R&R plan at the time of earthquake. Nonetheless, this does not mean that the R&R Plan had no impact on housing recovery because departments that participated in the R&R planning process had changed their departmental response plans and, therefore, knew what they needed to do after the earthquake even though they were unaware of the R&R Plan itself. Moreover, many departments had deployed recovery preparedness checklists that could accelerate the speed of housing reconstruction. These recovery preparedness policies are listed in Table 1.

Table 1 about here

Among the 19,229 approvals of housing rebuilding permits by the LA Building and Safety Department at the end of November 1996, 95.69% were single-family dwellings, 1.63% were apartment buildings, and 1.16% were condominiums. Figure 2 shows the percentage of the building permits during the entire period from January 1994 to January 1997 that were issued during each month. The baseline level of permit issuance can clearly be seen in the period from January 1996 to January 1997, whereas the effects of reconstruction can be seen in the months

quake), with a steep decline over the next 13 months after the quake. This is followed by another 12 months of shallow decline to an asymptotic level of permit application.

Figure 2 about here

There was evidence of preparation for hazard mitigation at the local level because, prior to the earthquake, the Department of Building and Safety had drafted an ordinance to require the retrofit of tilt-up buildings. This was submitted to the city council during the window of opportunity immediately after the earthquake and enacted. There also was attention to hazard mitigation through federal programs as well. The city used existing federal recovery finance programs such as HUD's Community Development Block Grant program to promote hazard mitigation. Moreover, the FEMA Hazard Mitigation Grant Program provided grants to implement long-term hazard mitigation measures after a major disaster declaration. After the Northridge earthquake, this money was mostly used for public buildings such as hospitals and classrooms.

HUD's Office of Policy Development and Research (1995), which conducted an earthquake mitigation report after the Northridge earthquake, concluded that federal mitigation resources were mismatched with local recovery needs. Almost 80% of the damaged residential units were multifamily housing and low-cost rental housing was particularly affected, but recovery programs were designed to serve middle-class owners of single-family dwellings. Moreover, the HUD report also found that most existing mitigation programs and resources were designed to address structural mitigation needs. The authors concluded that attention to nonstructural mitigation methods might provide greater safety to risk area residents.

Housing Reconstruction Following the 1999 Chi-Chi Earthquake

Taiwan is a highly centralized state in which the national government has established a standard building code and standard urban planning procedures for the entire nation, but each jurisdiction may add regulations to fit its own needs. The building code is very strict because the entire island of Taiwan is vulnerable to earthquakes, but code implementation is rather lax. Some constructors have skimmed on work and stinted on material, which has made the buildings weaker than designed. Moreover, Taiwan had not had a catastrophic earthquake in more than 50 years, so all levels of government lacked experience with post-earthquake housing reconstruction and none had a pre-impact recovery plan. Because of the serious damage caused by the earthquake, the central government assigned responsibility for recovery to a new agency called the 921 Earthquake Post-disaster Recovery Commission, but this was not done until nine months after the earthquake⁶

Because Taiwan is a highly centralized state, most of the local governments except Taipei City need the central government's grants to construct infrastructure or implement welfare policies during normal times, not to mention during the post-disaster recovery period. Within a few days to two months after the Chi-chi earthquake, the central government developed a series of programs to help victims. Some of these programs, which were restricted to Chi-Chi earthquake victims, were criticized for being crude and inconsistent—flaws attributable to their rapid development and implementation. These programs included cash payments for households with deaths, injuries, or missing persons; or for complete or partial housing collapses. In addition, the Taiwanese government (15%) and private sector (65%) and the Japanese government (20%) provided prefabricated housing provided at no cost as temporary housing.

⁶ In the first nine months, similar task forces (not specialized agencies) were also organized by the central government.

Victims who didn't stay in temporary housing could apply for housing rent relief or a 30% discount on the purchase of public housing. There also were employment programs, a health insurance subsidy, and subsidized home loans, as well as tax deductions and exemptions.

Financing was as important a factor influencing housing reconstruction after the Chi-Chi earthquake as it was with the Northridge earthquake. Because only about 2% of the population had earthquake insurance, victims' major funding sources were personal savings and public relief/loans (see Figure 3). In Asian societies, the saving rate is usually very high—as high as 26.2% at the time of earthquake (Taiwan Directorate General of Budget, Accounting and Statistics, 2000). Therefore, most victims used their savings—as well as government payments for death, injury, or housing collapse—for housing reconstruction. They also could apply for a low-interest housing reconstruction loan from the Central Bank through commercial banks, but many people complained that it was difficult to get these low-interest loans because of stringent conditions attached to the mortgages.

Figure 3 about here

The factors that influenced housing reconstruction in Taichung were very similar to those in Los Angeles except for two unique conditions. First, the quake caused a shift in the geodetic survey reference points that delayed the rebuilding of some collapsed buildings until new cadastral maps could be developed. Second, there was a complicated pattern of land ownership because some parcels, especially in rural areas, had been occupied without title for many years. Reconstruction on these properties was delayed until clear titles could be established.

In total, the central government announced 61 special ordinances and programs to speed housing reconstruction after the Chi-Chi earthquake. These ordinances can be classified into

three types: streamlined procedures for housing reconstruction, housing reconstruction financial programs, and incentive mechanisms to encourage housing reconstruction (see Table 2). The policies of streamlining procedures for housing reconstruction included expediting building codes, and urban planning and renewal procedures. In addition to the Housing Collapse Relief and Housing Reconstruction Loans that the Central Bank provided through commercial banks, the central government also established some policies for housing reconstruction finance such as relief for demolishing collapsed buildings and relief from housing design fees. Incentive mechanisms that encouraged housing reconstruction included procedures to make new cadastral maps in the impact area and the establishment of a real estate ownership conflict mediation committee. In general, these housing reconstruction policies are quite similar to those adopted in Los Angeles, but were adopted significantly later—from ten days to more than one year after the earthquake. Nonetheless, most of them could have been prepared before the earthquake and adopted at that time or immediately afterward.

Table 2 about here

Data from the Taichung County Department of Building Regulation show that the peak period of housing reconstruction was between March and July 2000, about 7 to 11 months after the earthquake, with the peak month in May 2000 (see Figure 4). The line in Figure 4 fluctuates during the peak period due to the meeting schedule of the building permits review panel. For example, some building permit applications submitted in late April were not reviewed and issued until May.

Figure 4 about here

The reconstruction speed for totally collapsed condominium housing was far slower than other types of buildings because of difficulty in reaching consensus on reconstruction among condominium owners. Moreover, the longer it took for the owners to reach consensus, the more difficult it was for them to reach agreement. The old ordinance required two thirds of the collapsed-condominium owners to agree to rebuild, but it was very difficult to reach this threshold. The central government amended this ordinance to lower the threshold from two-thirds to one-half almost four months after the earthquake. By June, 2002, only about 30% of these condominiums were under construction or had been rebuilt.

Mitigation Issues in Housing Reconstruction

Taiwanese officials do not appear to have considered mitigation to be an important issue during the housing reconstruction period. In Taichung County, eight townships completed recovery plans within 6-10 months after the earthquake, but none of them mentioned mitigation issues. Instead, the interviews indicated that reconstruction speed, and especially reconstruction financing, was the major issue. Government officials were under severe pressure from victims who wanted to rebuild their housing as soon as possible and they were especially vulnerable to these demands because a presidential election was scheduled for six months after the earthquake.

Local governments' neglect of hazard mitigation might also have been caused by the central government's *Working Guidelines for Post-Earthquake Reconstruction Planning*, which mentioned some mitigation activities that the central government would perform before developing a recovery plan (Council for Economic Planning and Development, 1999). This misled local governments into that believing that the central government would take sole responsibility for mitigation, so they didn't consider this activity to be a part of their responsibility during recovery.

Two mitigation policies were adopted by the central government, the first of which was to increase the earthquake-resistant building code standards in the impact area. Taiwan is classified into two earthquake-risk zones and Taichung County was originally classified in the low risk area, which had a less stringent earthquake-resistant building code. After the earthquake, the central government reclassified the impact area into the high-risk zone and began enforcing the higher standard building code 40 days after the earthquake. Another mitigation-related policy was to prohibit building along the earthquake fault line. Fifty days after the earthquake, the central government announced a building moratorium within 50 meters of the Chi-Chi earthquake fault line for the remainder of the year. A new policy establishing a permanent building prohibition was announced on Dec 31, 1999, but it narrowed the distance from 50 to 15 meters because mitigation was no longer a high enough priority to overcome political pressure from the victims living in the risk area.

Discussion

The patterns of housing reconstruction in the City of Los Angeles and Taichung County support a positive answer for the first hypothesis of this study—having a pre-impact recovery plan appears to increase the speed of housing reconstruction. Comparison of Tables 1 and 2 shows that the central government in Taiwan and the city government in Los Angeles adopted similar policies for housing reconstruction, but the adoption time in Taiwan was one week to two months later than in Los Angeles. Moreover, local government officials in Taiwan took an even longer time to become familiar with the new policies and their implementation procedures. This is consistent with the data in Figures 2 and 4, which show that housing reconstruction in Taichung County peaked about five months later than in Los Angeles despite the similarity between the two jurisdictions in the types of policies they ultimately adopted for housing

reconstruction. At six months, the percentage of total permits issued was twice as high in Los Angeles as in Taichung (45% vs. 22%, respectively); at 18 months, there was still a significant difference (92% vs. 68%, respectively). This supports the contention that the development of a pre-impact recovery plan accelerates housing recovery, but does not indicate whether all, or only some, of the six elements identified in the introduction are essential (or even if the list is complete). Thus, further research is needed to identify the specific mechanisms by which pre-impact recovery plans affect housing recovery.

There also is support for the second hypothesis; having a pre-impact recovery plan appears to increase the extent to which hazard mitigation is integrated into the recovery process. In its pre-impact recovery plan, the Los Angeles Department of Building and Safety had prepared a draft ordinance to requirement retrofit of tilt-ups, which was passed by the city council immediately after the Northridge earthquake. By contrast, pressure to address issues of housing restoration in Taiwan seem to have limited the amount of attention given to hazard mitigation in the early stages of the recovery process. By the time an attempt was made to finalize restrictions on building zones around the Chi-Chi earthquake fault line (approximately three months after the earthquake), the window of opportunity had closed. One could argue that other opportunities for hazard mitigation were squandered in Taiwan because of local government's misconception that this would be the central government's responsibility, but this supports the hypothesis rather than contradicts it. According to the second element in the list of requirements for a good pre-impact recovery plan, a well-written pre-impact recovery plan lets stakeholders know their roles in disaster recovery. Had pre-impact recovery plans been established, local governments would have understood their responsibilities for hazard mitigation.

The difference in the fates of the tilt-up retrofit ordinance in Los Angeles and the earthquake fault building restrictions in Taiwan suggests that having a pre-impact recovery plan makes more effective use of the window of opportunity (Kingdon, 1995; Prater & Lindell, 2000). However, further study is needed to examine the length of time that the window of opportunity is opened by different disasters. Lindell and Perry (2000) have reported that studies of risk area residents show that concern about disasters decays relatively rapidly, but additional research is needed to determine whether this also is true for the political elites that are involved in the passage of legislation.

Although not explicitly hypothesized, this study also calls attention to the need for planners to understand the disaster demands that they need to plan for. As noted by HUD's Office of Policy Development and Research (1999), most of the federal resources for hazard mitigation were used for public buildings or single-family buildings, but those hardest hit were the lower income residents living in multifamily buildings. Clearly, plans should be responsive to the victims' needs that actually arise in disasters.

This study is a comparative case analysis, so the results must be interpreted cautiously because the observed differences in the speed of policy adoption and housing reconstruction might be due to unmeasured relevant variables (James, Mulaik & Brett, 1982). One obvious difference between the two events is that Taichung County is a subdivision of a significantly more centralized national government than is Los Angeles. However, existing research suggests that a centralized government would facilitate emergency response, and perhaps disaster recovery (Prater & Wu, 2002). However, Taiwan—the more centralized form of government—had a slower response and recovery. This suggests that centralization facilitates

first be formulated. Indeed, centralization might delay formulation of policies because it is easier to establish agreement in smaller jurisdictions (lower levels of government) than at the national level.

Another plausible rival hypothesis is that housing recovery was initiated more rapidly in Los Angeles because victims of the Northridge had more rapid access to the funds needed to pay contractors. Contrary to this explanation, the Taiwanese relied heavily on personal savings whereas the Americans financed recovery mostly with insurance. One would expect that the personal savings could be accessed more rapidly than insurance, so access to financing also cannot account for the differences in the speed of recovery from the two events.

Another possible explanation for the difference between Los Angeles and Taichung in the rate of housing recovery is that the city of Los Angeles learned from previous earthquakes that had taken place in or near the city (i.e., San Fernando, 1971; Coalinga, 1983; Whittier Narrows, 1987; Loma Prieta, 1989). It is possible that this previous experience with earthquakes added to the pre-impact recovery planning process and, indeed, might have motivated it. However, it seems unlikely that previous earthquake experience substituted for such planning.

The evidence supporting positive effects of pre-impact recovery planning on housing recovery and adoption of hazard mitigation measures suggests that communities should begin to develop such plans. Unfortunately, the development of pre-impact recovery plans could be impeded by a low level of local capacity. Prater and Wu (2002) reported that Taiwanese counties are strongly dependent upon funding from the central government and, consequently, have only a small number of county employees per 1,000 residents. Such low administrative intensities, which also exist in some parts of the United States, make it difficult for local planners to invest the time needed to develop pre-impact recovery plans. One way of

overcoming this limitation is for land use planners to establish linkages with their counterparts in emergency management. Such collaboration would benefit land use planners because it would allow them to coordinate their pre-impact recovery planning more closely with the communities' emergency response plans. It would also benefit emergency management coordinators because Lindell, Sanderson and Hwang (2002) found that land use planners had higher skill levels than emergency management coordinators in most forms of emergency management information technology ranging from word processing to hazard modeling. Thus, land use planners could help emergency management coordinators to improve their information technology skills significantly, at the same time developing closer linkages between emergency response planning and disaster recovery planning.

One way for land use planners to forge these ties with emergency managers would be to become involved in their jurisdictions' Local Emergency Planning Committees (LEPCs—Lindell & Meier, 1994; Lindell, Whitney, Futch & Clause, 1996). LEPCs were established by federal law to develop multi-agency plans for toxic chemical emergency response, but their functioning is similar to disaster planning committees that have been organized informally by emergency management coordinators to prepare their communities for a wide range of hazards (Drabek, 1987). Existing research indicates that land use planners rarely participate in LEPCs, but increasing their involvement could help these organizations to expand their roles beyond the statutory obligations by addressing disaster recovery and hazard mitigation as well as emergency preparedness and response (Lindell, et al., 1996). In turn, this would achieve the important goal of developing the horizontal linkages in the community that are needed to ensure an effective disaster recovery (Berke, 1995; Berke, Kartez & Wenger, 1993).

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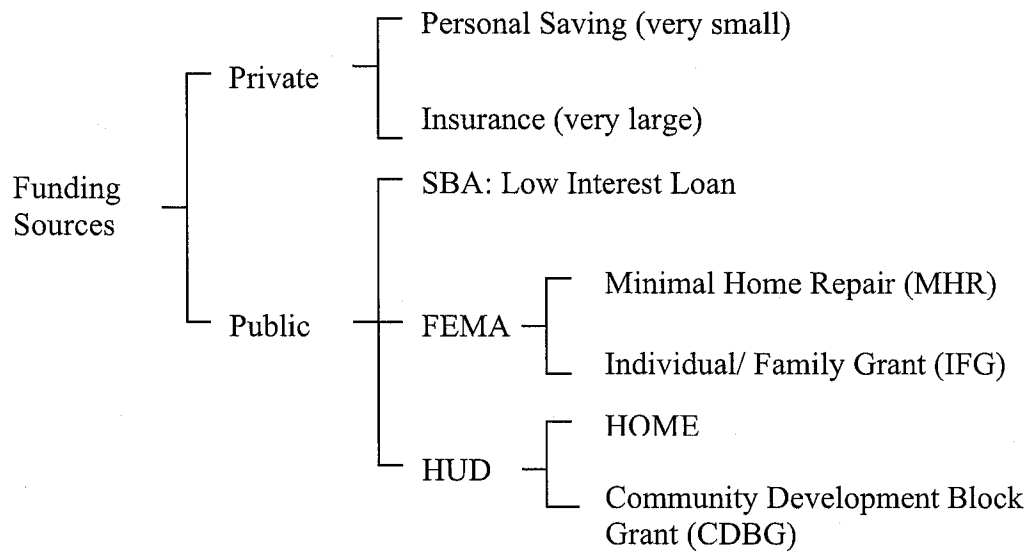


Figure 1: Funding Sources for Housing Reconstruction after the Northridge Earthquake

Table 1: Actions That Los Angeles Departments Took to Increase the Speed of Housing Reconstruction

Department	Actions Increasing the Speed of Housing Reconstruction
Building and Safety	<ul style="list-style-type: none"> • Establish criteria for emergency demolition contracts • Establish due process and procedures for demolition • Prepare pre-incident agreements • Set up a damage assessment system • Expedite building permits • Establish one-stop processing • Create parcel data base
Community Redevelopment	<ul style="list-style-type: none"> • Review and revise qualifying criteria for the city's neighborhood revitalization tools • Streamline procedures for redevelopment area expansions or additions
Housing	<ul style="list-style-type: none"> • Prepare emergency regulations • Identify staff in other departments who understand loan processing • Have procedures to adopt emergency regulations • Develop loan guidelines and procedures • Obtain pre-approval on loan procedure from federal agencies • Develop and implement city loan program • Identify available housing
Planning	<ul style="list-style-type: none"> • Update procedures to expedite permits • Insure consistency of R & R Plan with Safety Element • Prepare procedures, forms, list of R & R Division members • Determine criteria for balancing post-event work priorities
Emergency Operations Board	<ul style="list-style-type: none"> • Request formation of ad hoc committee on R & R, assist utilities in restoration, initiate demolition and debris removal program.
Chief Legislative Analyst	<ul style="list-style-type: none"> • Lobby for and support National Earthquake Insurance Program

Sources: Recovery and Reconstruction Plan, City of Los Angeles, California, 1994; Interview data, Spangle Associates, 1995.

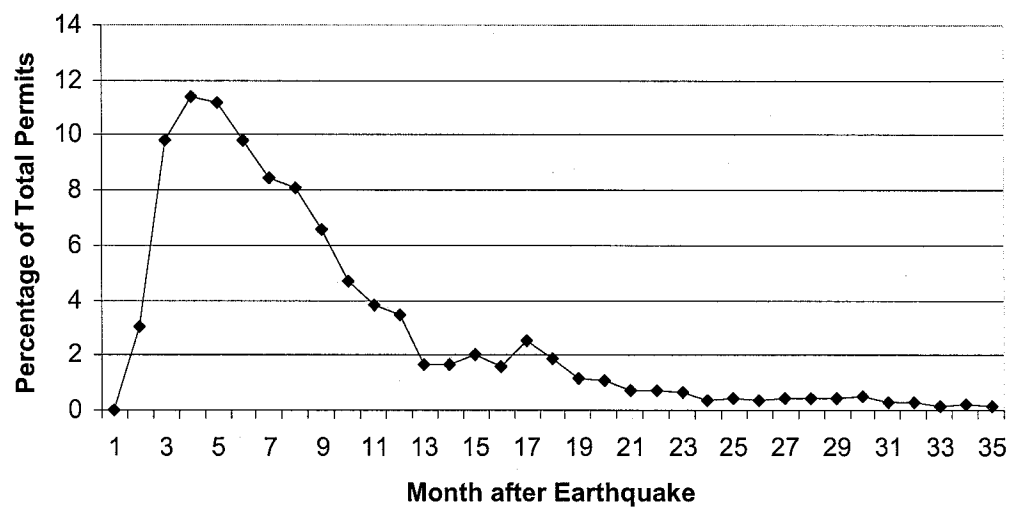


Figure 2: Rate of Housing Recovery in Los Angeles

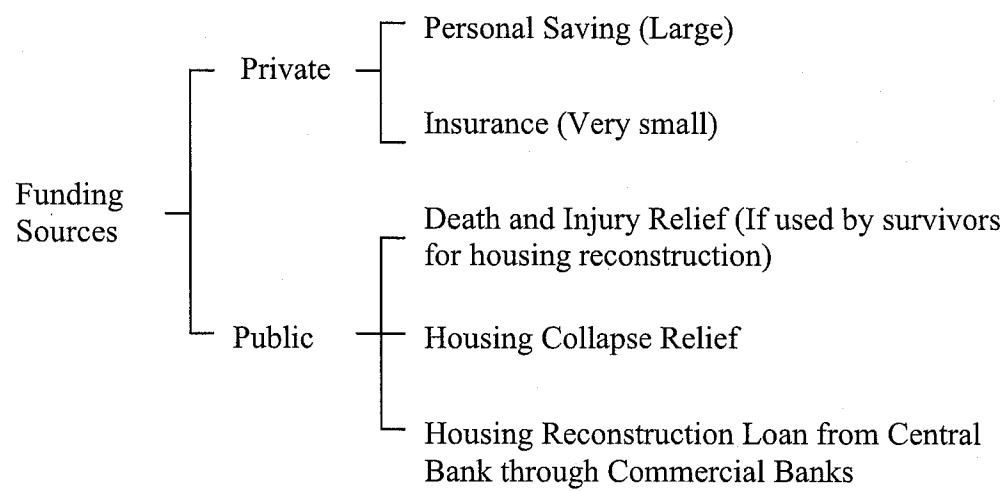


Figure 3: Funding Sources for Housing Reconstruction after Chi-Chi Earthquake

Table 2: Major Policies for Housing Reconstruction after Chi-Chi Earthquake

Major Policies for Housing Reconstruction	Time of Adoption
Procedures for streamlining housing reconstruction	
• Expedite building permits	10 days after the earthquake
• Streamline procedure for urban planning	55 days after the earthquake
• Streamline procedure for urban renewal	66 days after the earthquake
Housing reconstruction financial programs	
• Relief for tearing down totally collapsed buildings	140 days after the earthquake
• Relief for housing design fee	183 days after the earthquake
• Relief for farmer's housing reconstruction	118 days after the earthquake
Incentives to encourage housing reconstruction	
• Procedure to make new cadastral maps in the impact area	139 days after the earthquake
• Establishment of real estate ownership conflict mediation committee	216 days after the earthquake

Sources: Collections of Programs and Ordinances for 921 Earthquake Housing Reconstruction, 921 Earthquake Post-disaster Recovery Commission, 2002

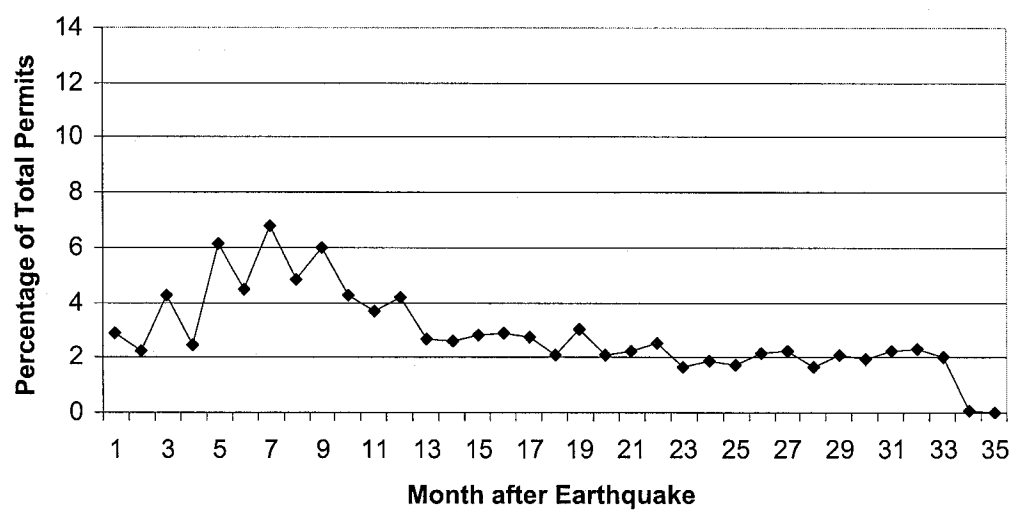


Figure 4: Rate of Housing Recovery in Taichung