

# **PROPOSALS TO IMPROVE THE EARTHQUAKE RESISTANCE OF TURKEY'S HOUSING**

A dissertation submitted in partial fulfilment of the requirements  
for the MSc in Development and Planning: Building and Urban Design in  
Development

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12 August 2004

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## ACKNOWLEDGEMENTS

Thanks go first to Professor Babar Mumtaz, who supervised my work on this dissertation. His friendly support and knowledge about Turkey greatly assisted the development of these analyses and proposals. Professor Mustafa Erdik of Bogazici University, Istanbul provided several useful contributions during our conversations in June, 2004.

Thank you also to the Marshall Aid Commemoration Commission, who has funded my postgraduate studies in the UK. The Marshall Commission also generously provided the resources for my trip to Turkey in June, 2004.

## CHAPTER I

# INTRODUCTION

In August and November 1999, when two destructive earthquakes shook Turkey in close succession, I had just begun my university education as a structural engineer. Images of collapsed homes and devastated Turks flooded the American press for a few days, piquing my interests in structures and their potential to impact people. When the media frenzy subsided, even as the death toll stabilised at more than ten thousand, I was left wondering, “Why?” And, “What can be done?”

It is evident from the images of devastation caused by these two earthquakes that buildings were not designed and constructed with sufficient care to withstand Turkey’s seismic events. Many structures collapsed under earthquake loading, killing their occupants. In both of the 1999 earthquakes, residential structures proved to be the most deadly; most victims died in their own homes. Closer inspection reveals that the insufficient seismic safety of Turkish residential construction is not just about poor engineering and the use of bad materials, but also about deeper, more systemic developmental conditions. Diffuse systems of liability and responsibility in Turkey’s engineering and contracting professions weaken accountability such that engineers, contractors, and municipal inspectors are rarely held responsible for their negligence or shoddy construction. Turkey’s municipal governments, appointed the task of enforcing building regulations and planning guidelines, are armed with insufficient resources, few skilled technical staff, and contradictory mandates from different central government ministries. As a result, unplanned development occurs with little regard for planning regulations; adherence to building codes, especially in residential construction, is rare. With a rapid rate of urbanisation and a corresponding high demand for housing, the building industry and many Turkish citizens do not prioritise earthquake safety in housing.

In its intimate causal links between developmental processes and the occurrence of so-called “natural disasters,” Turkey presents a stereotypical rather than unique case of a lesser-developed country. The role of economic, social and political conditions in the creation of disaster is remarkably similar to Bangladesh or the Caribbean islands though the hazard itself, floods and hurricanes respectively, differs. These observed world-wide patterns

provide the motivation for using the literature of disasters, hazards and vulnerabilities to provide the conceptual and analytical framework for understanding Turkey's earthquake disasters and for developing a set of proposals to mitigate the impact of seismic events.

The goal of the proposals developed is to increase the seismic resistance of Turkey's new and existing residential structures through structural mitigation. Their implementation is critical in light of the future earthquakes expected, particularly in the highly populated region around Istanbul. The identification of the multitudinous problems contributing to insufficient seismic safety in Turkish housing necessarily hints at the nature of the proposals that must be considered. In order to address the structural problem, the underlying contributors must be dealt with as well. For this reason a multifaceted set of proposals, simultaneously approaching the problem through each of the various levels of causality, is offered. The proposals outlined in detail include: a public education and marketing campaign, a training and accreditation programme for engineers and contractors, a system of subsidised housing and home improvement loans, modifications to municipal regulations and inspection regimes, and a restructuring of disasters and development legislation. The key to these proposals lies not in Draconian implementation, but through the institution of sufficient incentives to secure involvement of each of the major actors.

The dissertation continues in Chapter II with an identification of the conceptual background defining disasters, hazards and vulnerabilities and a discussion of the literature connecting disasters and development, which provides the intellectual framework for the analysis of causality in Turkey's seismic disasters. Chapter III presents the problems in Turkey's construction industry, legislation and underlying developmental conditions that create disasters out of Turkey's earthquake hazard and cause a large number of residential structures to collapse under earthquake loads. Responding to the characterisation of these problems, Chapter IV proposes a set of measures to increase the seismic resistance of housing in Turkey.

## CHAPTER II

# APPROACHES TO DISASTERS AND THEIR MITIGATION

### An Analytical Framework<sup>1</sup>

In its generalities, the problem of insufficient seismic safety of housing in Turkey reflects the broader conditions of disasters and underdevelopment in countries throughout the world. This chapter reviews the literature linking disasters and development and outlines the types of approaches that have been found to be successful and unsuccessful in responding to and mitigating “natural” disasters. This conceptual background provides the framework through which the problem of unsafe housing in Turkey, and the proposals in response to it, can be analysed.

### Defining Disasters

A *disaster* occurs “when a community suffers an exceptional, non-routine level of stress and disruption” that is triggered by an extreme natural event. (Smith, 2001, p7) Within the popular press disasters are often portrayed as natural events occurring outside the realm of human agency and causation. It becomes clear on closer inspection, however, that “natural” disasters are all actually the result of a complex interaction between environmental (“natural”) and social, political and economic conditions. In each disaster event, the relative contribution of these processes to disaster varies, but disasters always exhibit the “coincidence between natural hazards (such as flood, cyclone, earthquake and drought) and conditions of vulnerability.” (Maskrey, 1989, p1)

A *hazard* is defined as the “probability that in a given period in a given area an extreme and potentially damaging natural phenomena occurs”. (Maskrey, 1989, p1) Hazards impacting a particular city or country may include seismic activity, flooding, hurricanes or landslides. How this hazard affects people is determined by their *vulnerability*: “the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist

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<sup>1</sup> I submitted earlier versions of some paragraphs in this chapter for an essay for Y07 - The Urban Environment in the Context of Development (Jan, 2004).

and recover from the impact of a natural hazard.” (Wisner et al, 2004, p9) It is because of their vulnerabilities, not the hazard itself, that some people are more likely to experience damage, loss, and suffering following an extreme event. In this context, vulnerabilities reflect underlying societal and individual conditions related to physical, social and organisational capacities that “precede disaster, contribute to their severity, impede effective disaster response and continue afterwards.” (Anderson & Woodrow, 1989, p10) High vulnerability to disasters is often synonymous with poverty, and this accounts for the disproportionate suffering of poorer people after extreme weather, volcanic or earthquake events. Vulnerabilities may also manifest themselves along ethnic, age, geographic, or religious lines. The lack of ability to choose one’s risks is an important input to vulnerability; richer people, for example, may choose to take the risk to live in a steep hillside location, while other members of society may live in an equally dangerous site out of necessity. (Wisner et al, 2004) Vulnerabilities, like the underlying conditions they represent, vary dynamically as society changes.

The conceptual distinction between disaster, hazard and vulnerability weakens the idea of a “natural” disaster. The ground shaking resulting from an earthquake can be classified as an ‘act of God’. The impacts of the ground shaking on the people and structures in the affected region, however, are deeply influenced by underlying vulnerabilities and the socio-economic and political conditions of that society.

### **Linkages Between Disasters and Development**

At the broadest and most systemic level, vulnerabilities are the result of limited access to power and resources, which is rooted in global political and economic development systems. At the individual level, environmental and structural conditions in the home and neighbourhood are contributors to vulnerability. To describe these multiple layers of causality, Wisner et al (2004) propose a theoretical model of the creation of disasters in which root causes and dynamic pressures together create unsafe conditions that, when combined with a hazard, lead to disaster. Within this framework root causes are economic, demographic and political processes and their outcomes:

The concentration of economic power in a dominant minority, the introduction of centralising technologies which disappropriate resources from the majority and the



subsequent social, economic, political and territorial marginalisation of this majority are the mechanisms through which vulnerability emerges. (Maskrey, 1989, p33)

These root causes are compounded by dynamic pressures that “‘translate’ the effects of the root causes” into unsafe conditions. (Wisner et al, 2004, p53) Population growth, environmental degradation, urbanisation, structural adjustment policies, and climate change are examples of pressurising processes that may act to produce unstable conditions. (Maskrey, 1989; Smith, 2001) Vulnerable people live in fragile physical environments or within fragile local economies as a result of the combination of these processes, completely “exposed” should a hazardous event occur. Wisner et al’s model demonstrates why most of the deaths from “natural” disasters occur in countries with low human development indices and why, within these countries, it is often the poorest people who incur the highest losses in these events. (Wisner, 2003)

Through the impacts of global social, economic and political conditions on the effects of hazards and vulnerabilities, development and disaster are closely connected. Oliver-Smith describes the multi-dimensionality of disasters:

Disasters focus in uncommon intensity the widest possible variety of intersecting and interpenetrating processes and events of social, environmental, cultural, political, physical and technological natures. As disasters develop and occur, all dimensions of a social structural formation and the totality of its relations with the environment become involved, affected, and focused. (Oliver-Smith, 2002, p26)

As a result, dealing with disasters must be an integral part of the development agenda, because, in Hewitt’s (1995) words, “If there could be such a thing as sustainable development, disasters would represent a major threat to it, or a sign of its failure.” (quoted in Pelling, 2003b, p4) The impact (potentially positive or negative) of developmental conditions on disaster vulnerabilities must be explicitly recognised in policies and decision-making. The dynamics of development, including urbanisation and environmental degradation, have had the effect that “despite economic growth, greater levels of development can mean higher exposure to environmental hazard and potential or actual reversals in quality of life.” (Pelling, 2003b, p5) By upsetting existing conditions, disasters may provide a new opportunity for improved development policies and planning, but will more likely create significant setbacks to development initiatives. (Cuny, 1980a; Özerdem, 2003) The acknowledgement of the relationship between development and disasters is crucially important to policies aimed at mitigating or responding to disasters; it alters both the nature of the solution and the resources that are available within that solution.

## Approaches to Dealing with Disasters

The potential death and destruction from disasters has motivated governments, individuals, and other community and non-governmental organisations, to institute measures designed to reduce the impact of that event, acting either in anticipation of or after the catastrophe. Disaster response and mitigation are motivated by the philosophy that “the *elimination* of disaster has become quite impossible, but ... some reduction of losses is not”. (Lewis, 1980, p33) The term *mitigation* “refers to measures which can be taken to minimise the destructive and disruptive effects of hazards and thus lessen the magnitude of a disaster.” (Maskrey, 1989, p39) Mitigation policies may include changes to building codes, construction practices, or land use control and zoning. By contrast, *disaster response* includes all measures taken after the event to reduce impact, such as providing adequate medical care to victims and assistance in rebuilding homes.

A military ideology has traditionally pervaded efforts to deal with disasters, advocating highly technical approaches such as advance warning systems and elaborate evacuation programmes. The majority of these efforts have been top-down, large-scale, sector-based and response oriented in character. (Maskrey, 1989) These characteristics reflect the desire of government and funding organisations for high profile and immediately quantifiable relief and reconstruction efforts to meet people’s short-term needs. (Lewis, 1980; Smith, 2001) These types of approaches have had significant shortcomings in dealing with disasters, minimising the importance of development in determining vulnerability to disaster and reinforcing conditions of underdevelopment. The resources devoted to response-oriented disaster policies are also economically questionable; prevention and mitigation are less costly than after-the-fact reconstruction. (Kelman and Pooley, 2004) By “projectising” disaster response and mitigation efforts, governments and aid agencies put disaster programmes at odds with processes at work in development. (Christoplos, 2003)

Recognising the deficiencies of the previous approaches to disasters and the growing awareness of the connecting between disasters and underdevelopment, scholars and policy makers in recent decades have increasingly emphasised process and development in disaster response and mitigation. In this context, risk reduction is seen as an integral component to sustainable development. (Wisner et al, 2004) The goals of these methods of dealing with

disasters are three: to respond effectively to disasters as they occur, to mitigate the impact of disasters through advance planning and structural changes, and to address underlying causes of vulnerability that contribute to disasters. Applying Wisner et al's (2004) framework of disaster causality again, these goals are consistent with strategies to analyse vulnerabilities and to target root causes, dynamic pressures and unsafe conditions. Lewis' proposed outline for disaster programmes aims to meet each of these criteria:

Short term measures may include relief and preparedness planning; medium term may include methods for improved construction of existing buildings and the implementation of improved siting and construction techniques for new buildings; long-term measures may include development and land-use planning and integration with development planning policies and programmes of all kinds. (Lewis, 1980, p33)

In tandem with the change in emphasis in disaster programmes there has been a growing awareness that because contemporary development occurs on a wide range of scales from local to global there is a corresponding necessity to integrate disaster policies made at various levels. (Cuny, 1980a; Pelling, 2003b)

To be successful these strategies rely upon the action of various stakeholders including the community, NGOs, public and private institutions, and international, national and local governments. In particular, the role of community coping and institutions is recognised to be critical. Despite deeper systemic and historical roots, disasters do act at defined places and, as a result, are "amenable to policies and projects that raise local capacities of resilience in addition to wider structural reforms in urban social, political and economic life." (Pelling, 2003a, p163) Community members have a right to know and understand the hazards they face and they are their own best resource for disaster mitigation and relief. Through public participation, which includes all members of the community, especially the most vulnerable, disaster management strategies are better able to build upon the existing capacities within the community. (Anderson & Woodrow, 1989) As Christoplos (2003) emphasises, however, the insistence on community participation in disaster management should represent the desire for inclusion and the recognition of the essential contributions of the local community, and not the need to make up for deficiencies in government funding or commitment.

Despite, or perhaps because of, the increased emphasis on community involvement in dealing with disasters there remains a strong need of assistance from government and other actors to provide resources and to create policies that proactively fight disasters. (Maskrey, 1989) Christoplos states that governments "bear the ultimate responsibility for the safety of their

citizens” and to fulfil this responsibility they must prioritise disasters within local and national political processes. (Christoplos, 2003, p103) NGOs have the capacity to work with and motivate governments by keeping human suffering and disasters on the global agenda and creating relationships with local civil society. (Christoplos, 2003) Furthermore, a community-based approach provides a role for NGOs to assist disaster mitigation and response by enabling and advising community groups, facilitating participatory activities and sharing experiences gained elsewhere in the world. Reflecting global trends in market economics, the private sector is now expected to play a significant role in disaster mitigation and response, particularly through the use of markets and insurance to spread risk. (Christoplos, 2003) Multilateral and bilateral development institutions are also being pressured to take a bigger part in the challenge of reducing the impact of disasters. Ultimately, the complexities of disaster and development processes demand multi-actor involvement; the challenge is to find a productive synergy among the different stakeholders and participants. (Christoplos, 2003)

There is agreement on the importance of broadening disaster response to address underlying vulnerabilities, yet it has been difficult to find commitment from the various actors involved. During the International Decade for Natural Disaster Reduction (1990 - 2000) significant international progress was made, sharing technical knowledge and supporting institution building and financial assistance. As a result, disaster aid and longer-term development aid are more often linked. Still, Wisner assesses the obstacles remaining: “The missing ingredient during the IDNDR was a moral imperative that can mobilize political will.” (Wisner, 2003, p51) The international community, national and local governments and NGOs lack commitment to lower-cost preventative measures. The short-term momentum created by catastrophic disaster events should be captured and applied to longer-term programmes as well. Disasters can provide the opportunity to create commitment, to demonstrate the efficiency of cost-benefit measures and “to educate political leaders and decision makers about the deeper causes of vulnerability and disasters.” (Wisner et al, 2004, p317)

## **Earthquake Disasters, Mitigation and Response**

The focus for the remainder of this dissertation is on a particular natural hazard, earthquakes, and their tendency to create disasters in Turkey. Earthquakes, which occur primarily along boundaries between the earth's tectonic plates, cause extreme ground shaking. Turkey's significant earthquake hazard is a result of the specific geologic conditions in that country. In seismically active locations such as those that exist throughout Turkey, earthquake events are unavoidable and occur without warning. However, what happens as a result of an earthquake is shaped very much by human action. Ground shaking does not always lead to structural collapse, which account for 95% of the fatalities from seismic activity. (Wisner et al, 2004, p277) The impacts of the shaking depend both on the magnitude of the severity of the event and the quality of land use planning, design and construction in the affected area.

Earthquakes are dramatic and often associated with a large loss of life so, when they occur, they attract a large amount of short-term attention and disaster aid. The challenge is to put planning for earthquakes and the reduction of vulnerabilities associated with earthquakes on local and national agenda before the ground starts shaking. Because of the strong link between the built environment's structural quality and site conditions and its performance in an earthquake, technical and social issues of housing design, land use planning, quality of construction and maintenance are of prime importance in increasing seismic safety. The guiding principle behind earthquake design is not to prevent structural damage, but to ensure that under earthquakes of the magnitude predicted as likely for that geographic location the structure will not collapse, maiming and killing its occupants. The search for improved seismic safety in housing recognises that due to the unpredictability of earthquake magnitude and epicentre (and other seismological factors) human losses can never be completely curtailed, but that through better quality design and construction these losses can be minimised. Advances, many of them highly technical in nature, have been generated by research in seismology, geology, social science and economy, and have raised awareness and urged some governments into action. As Shah sees it, the remaining problem is the "delivery" of these solutions to vulnerable people: "we have not done all that we could do in making the connection between those who are trying to help and those who need help." (Shah, 2003, p2) Proposals to increase earthquake safety must ensure that the technology or regulation designed to increase safety reaches and is appropriate for the people most likely to

be affected before the earthquake. During construction there is often little additional cost in improving a structure's earthquake resistance.

### **Applying this Framework to Turkey's Earthquake Disasters**

This framework for analysing disasters through the identification of hazards and vulnerabilities can be used to unpack the problem of Turkey's earthquake disasters. Consistent with the theoretical models and case studies in the literature on disaster, Turkey's earthquakes are the result of a natural hazard, and political, economic and structural conditions that have undermined safety in residential structures. By investigating the vulnerabilities and chain of causation that leads to disaster in Turkey, we can identify elements that are critical to a proposal to reduce the scale and impact of these seismic disasters.

### CHAPTER III

## PROBLEM IDENTIFICATION: THE INSUFFICIENT SEISMIC SAFETY OF TURKISH HOUSING

### Earthquake Disasters in Turkey

Turkey's geology and history of earthquakes provide incontrovertible evidence of the country's significant seismic hazard. The movement of Turkey's Anatolian block relative to the African, Eurasian and Arabian plates causes earthquakes to occur along the plate boundaries, or fault-lines. (Scawthorn and Johnson, 2000; USGS, 2000) The 1500 kilometre North Anatolian Fault is the most active fault zone in Turkey, but 90% of Turks live in seismically hazardous areas. (Özerdem and Barakat, 2000) A seismic map of Turkey is shown in Figure 1.

Historians have recorded earthquake disasters in Turkey for millennia. (See Figure 2.) The same cities, including Istanbul, Izmit, Adapazari and Yalova, have over centuries repeatedly suffered serious damage from seismic activity. (Scawthorn and Johnson, 2000) In the 20<sup>th</sup> Century, fifty-seven earthquakes throughout the country caused serious damage and an estimated 90,000 deaths. The deadliest of these was a Richter magnitude 8 earthquake that occurred on the eastern portion of the North Anatolian Fault at Erzincan in 1939 killing approximately 30,000 people. (Sezen et al, 2000; Bruneau, 2002) For seismologists, it is a certainty that the seismic hazard remains present in Turkey. Using different probabilistic and deterministic methods their estimations of future events vary, but most predict a high likelihood of a major earthquake event occurring in the highly populated west of the country around the Sea of Marmara within the next thirty years.

The propensity of seismic activity in Turkey to cause disaster is underscored by descriptions of destruction during the 17 August 1999 Marmara Earthquake.<sup>1</sup> This quake ruptured 110 km of the North Anatolian Fault, shaking a highly developed region of the country and

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<sup>1</sup> This magnitude 7.4 event is also known as the "Kocaeli" or "Izmit" earthquake. A second destructive earthquake, "Düzce", struck 12 November 1999, killing hundreds, but causing less overall damage.

causing at least 18,000 deaths and almost 50,000 hospitalised injuries, mostly in Golcuk, Adapazari and Yalova. In this earthquake, like most, the majority of the deaths resulted from structural collapses of residential buildings. 77,000 homes and businesses were reported to be destroyed; many more were in need of significant repair. (Özerdem and Barakat, 2000; Scawthorn and Johnson, 2000; Sezen et al, 2000; Daley et al, 2001; Durukal et al, 2002; Kasapoglu and Ecevit, 2003)

The structural collapses that have caused most of the fatalities from earthquakes in Turkey in the past decade are strikingly similar in their characteristics. In the Marmara Earthquake, thousands of mid-rise (three to six storeys) reinforced concrete frames with hollow clay tile infill collapsed.<sup>2</sup> Many of these structures were victims of the same common engineering mistakes and poor design decisions, including soft first storeys (without the infill tiles present in all the upper storeys), slender columns, and poor detailing of lateral and confining reinforcement. (Naeim and Lew, 2000; Scawthorn and Johnson, 2000) The liquefaction of soft, sandy soils in Adapazari, for example, caused several buildings to overturn. (USGS, 2000; Bruneau, 2002) These problems undermined the safety of the housing stock's response to earthquake loads. Photographs of residential structural failures in earthquakes in Turkey are shown in Figures 3 to 9. In addition to damage to residential structures, the Marmara Earthquake caused significant collapses in industrial and commercial facilities, but these were associated with a much smaller loss of life.

The impacts of earthquake disasters on human life and development in Turkey have been profound. Immediately after earthquakes, people need substantive and emotional support and a reliable source of information. Many victims of the Marmara Earthquake, who were largely urban dwellers and middle class, took refuge in makeshift structures of plastic and wood along major roads. Figure 10 displays an image of temporary post-earthquake shelter. Interviews of people living in these temporary communities found that forty percent of survivors believed their homes to be permanently destroyed and did not have a way of obtaining a structural inspection from a qualified person. Twelve percent of respondents had a family member injured in the earthquake. Most also lacked sufficient access to food, water, electricity and health facilities; in sixty-four percent of interviewed households at least one

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<sup>2</sup> See Appendix: Residential Construction in Earthquake Affected Areas in Turkey for a photographic survey of residential construction in Turkey.



person was ill. (Daley et al, 2001) Within a year after the earthquake the major humanitarian crises had subsided, but the earthquake continued to have a pernicious effect on overall quality of life. Kasapoglu and Ecevit (2003) researched household possessions after the Marmara event and found that one-year later households were less likely to have a TV, dishwasher, or an extra room to rent than before the earthquake. Measured through deaths of relatives, health problems, savings, and political party membership, Kasapoglu and Ecevit found that, “almost all social aid relations and links deteriorated.” (Kasapoglu and Ecevit, 2003, p348) Many people also reported an increase in anxiety and the “view that the world is not just”. (Kasapoglu and Ecevit, 2003, p349-350) The negative impacts are also felt at the macro scale. Kasapoglu and Ecevit (2003) estimated that 14,000 businesses closed as a result of the earthquake, leaving 150,000 people unemployed. Erdik (no date) cites a 5% decrease in GDP in 1999. In total, the 1999 earthquakes placed a huge financial burden on government, industry, the insurance sector and the public. (Gülkan, 2001) Through deaths, social trauma and economic disruption earthquake disasters have had widespread impacts on lives in Turkey.

The focus of this dissertation is on one particular aspect of earthquake disasters in Turkey, the lack of seismic safety of buildings. This emphasis does not imply that other aspects are insignificant; certainly some, like Turkey’s difficulty in mounting an effective and rapid response when earthquake disasters occur, deserve attention from researchers and policy makers. The scope has been limited to structures, in particular residential structures, because the collapse of these have proved both deadly and highly disruptive to people’s lives in past events. As a result of this concentration on structural inadequacy the proposed solutions emphasise mitigation and preparedness for new and existing structures, rather than response.

### **Contributions to Turkey’s Seismic Vulnerability**

A crucial first step in minimising Turkey’s earthquake destruction is an investigation of the various factors that translate the country’s seismic hazard into disasters. As is typically the case with disasters, earthquake vulnerabilities in Turkey are created by various levels of causality - from site conditions to macroeconomic stability- which are interrelated. The most direct causes of the collapse of a large number of residential structures, such as technical design flaws and poor construction, are themselves manifestations of deeper causes, such as

overlapping and contradictory government laws and responsibilities. When combined, these factors explain how ‘acts of God’ repeatedly become disasters in which thousands of structures collapse in Turkey.

Some of the residential structural failures in recent earthquakes in Turkey can be traced directly to poor site conditions at the particular location of that building. Most of the damage from a 1995 earthquake in Dinar, for example, was located where the soil is softer in the lower portion of the basin. (Tezcan and Ipek, 1996) Due to soil liquefaction Adapazari, Golçuk and Sapança sustained excessive settling and higher levels of damage compared to neighbouring towns during the Marmara Earthquake. Other structures have been adversely affected by their close location to fault-lines. (Naeim and Lew, 2000; Green et al, 2002) Turkey’s land use and zoning regulations are designed to minimise these risks, but planning authorities generally turn a blind eye to development that does not meet regulations. Green et al describe how “the location of small to moderate scale private development,” which includes most residential construction, “is recognized to have become largely uncontrollable by planning agencies.” (Green et al, 2002, p77) The poor living in squatter settlements, “gecekondus”, are even further outside this process. (Parker, 1995; Özerdem and Barakat, 2000; Green et al, 2002)

Technical design flaws, poor engineering and “deficient engineering practice” are directly responsible for structural collapses. (Tankut, 2001, p180) Engineers assessed Turkish building and seismic codes and found them to be up-to-date and consistent with international standards; Sezen et al conclude that for the common reinforced concrete framing system “the performance of buildings designed to either code [US 1997 Uniform Building Code and Turkey 1997 Building Code] should be similar if standards of construction are comparable.” (Sezen et al, 2000, p19) However, most existing structures are not built to these codes. Parker (1995) estimates that less than 25% of Turkish construction conforms to earthquake building regulations, and the percentage is probably smaller for residential construction. Ductile reinforcement details, described in Turkey’s 1975 earthquake code, were rarely observed in buildings inspected after the 17 August 1999 earthquake. Sezen et al’s (2003) team also found that spacing and angles of column reinforcement was frequently not in

accordance with the code, to the detriment of structural safety. EQE International's<sup>3</sup> appraisal of building collapses following 1999's earthquakes found:

Most of the buildings did not meet the design requirements of the code and included details that are not earthquake resistant ... Many buildings were knowingly allowed to be built on active faults and in areas of high liquefaction potential. Many buildings were not engineered, but built according to past experience. (quoted in Özerdem and Barakat, 2000, p431)

The quality of structures is highly uneven; common substandard buildings are interspersed with well-designed structures throughout Turkey.

Related to the problem of poor seismic design is the problem of poor quality construction, which is also widespread in Turkey. EQE International continued in their report: "Many of the buildings were built with poor and inappropriate construction materials and utilized poor workmanship." (quoted in Özerdem and Barakat, 2000, p431) In particular, concrete quality is sometimes inadequate, consisting of large aggregates and/or unwashed sand. (Tezkan and Ipek, 1996; Naeim and Lew, 2000) On-site modifications and poor quality construction can occur because there is little supervision at the construction site: "material quality, workmanship and detailing are poorly inspected or cross checked, or never inspected at all." (Earthquake Engineering Research Institute (1998) quoted in Özerdem and Barakat, 2000, p430)

Inadequate design and construction quality is linked to diffuse systems of liability and responsibility in Turkey's engineering and contracting professions. Turkey has had no system of qualification for professional engineers. Gülkan describes the system in which "any engineer who holds a current diploma, without regard for the (theoretical) degree of difficulty of the project can put his/her signature to any project." (quoted in Green et al, 2002, p8; Tankut, 2001) Earthquake engineering is not a required part of the engineering core curriculum at Turkish universities. (Tankut, 2001) The "technically responsible engineers" who must supervise on-site construction work are frequently employed directly by contractors and they are rarely a visible presence on the construction site. These supervisory engineers are moreover required only to report deviations from shop drawings in construction, and are not held responsible for construction problems unless there is evidence of premeditated malice. (Gülkan, 2001; Özerdem, 2003) The contracting profession is popularly seen as an easy way to earn a good living; as the Turkish construction industry

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<sup>3</sup> A risk management company.

boomed in the 1980s anyone could start a contracting and construction business. (Özerdem, 2003) Contractors have been accused of economising on concrete quality and the number of steel bars to increase their profit margin and were the first to be blamed for structural collapses in 1999. (Özerdem and Barakat, 2000; Özerdem, 2003) Indeed, there were a few court cases against building professionals after the Marmara Earthquake, but the court process is time consuming and cases are difficult to prove after evidence has been destroyed in an earthquake. Under current law, negligence in construction is treated in the same manner as negligence in a traffic accident and carries a maximum jail sentence of two years. (Green et al, 2002; Erdik, personal communication, 30 June 2004)

Municipalities are responsible for supervising building construction projects under Turkish law, but most have inadequate skills and resources to fulfil this task. In theory, the system of ensuring adherence to building codes and land use regulations works much as it does in the US and the UK; before a project begins, the architectural, structural and mechanical designs must be submitted to the municipal authority in order to obtain a construction permit.<sup>4</sup> In practice, municipalities have insufficient resources to hire a significant number of technical staff. (Tankut, 2001; Gülkan, 2002) As a result, most municipal planning offices employ no structural engineers and stamp plans as “received” without checking the technical considerations of the project. (Gülkan, 2001; Gülkan, 2002) Local governments are permitted to shut down construction sites if these plans do not meet their regulations, but problems are more regularly met with an institutional “averting of eyes”. (Gülkan, 2002, p20) Furthermore, municipalities are not liable for omissions or mistakes in development, and no legal action against officials has ever been taken. (Balamir, 2001; Gülkan, 2002) Municipalities and provinces are also responsible for zoning ordinances, new development and urban plans. Their influence, however, is rarely used to enforce planning regulations for environmental standards and disaster mitigation. Despite its intimate relation to development and urban planning, few local governments have explicitly considered disaster preparedness. (Coburn, 1995; Erdik, 1995; Balamir, 2001)

The inability or unwillingness of municipalities to commit to disaster preparedness and planning is compounded by overlapping and contradictory institutional responsibilities for

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<sup>4</sup> Some municipalities transferred responsibility for checking drawings to local branches of the chamber of Civil Engineers or Architects. This practice has not had a large impact on the overall efficiency or accuracy of the building regulation process. (Balamir, 2001; Gülkan, 2001)

disasters and development at the national, provincial and local government levels. The national Ministry of Public Works and Settlement is responsible for both the Development Law and Disasters Law. Planning responsibilities were transferred from this ministry to local governments in the 1980s. (Gülkan, 2001) The Development Law “has the declared intention of controlling the appropriate formation of settlements and buildings,” but it ignores financial and management issues and its mandate is weakened because provision of land, infrastructure, and technical oversight of construction projects are covered under other laws. (Gülkan, 2001, p193) Due to the rapidity of urban growth in the past decade enforcement of the Development Law has tended to follow rather than dictate development. (Gülkan, 2001) The Disasters Law aims “to provide a public intervention capacity and improvement in the efficiency of relief operations after disasters,” and focuses almost exclusively on the after-effects of disaster (especially on damage assessment and financing response). (Gülkan, 2001, p195) Significantly, the Disaster Law commits the government to replacing every home destroyed in a disaster event, contributing “to the myth of the omnipotent state that will intervene in the event of any disaster,” and making no distinction between authorised and unauthorised construction. (Özerdem and Barakat, 2000, p435) These amnesties for illegal construction have encouraged the development of unauthorised settlements. (Balamir, 2001; Gülkan, 2001; Erdik, 2004) To obfuscate institutional responsibility further the Ministry of the Interior is responsible for inspecting the municipalities’ implementation of the Development Law, but has no capacity to control plan-making, which is under the umbrella of the Ministry of Public Works. (Gülkan, 2001) The system of government responsibility and authority complicates even more in the case of post-disaster relief, when the Directorate of Civil Defence (under the Ministry of Internal Affairs) and the Turkish Emergency Management Directorate are given responsibility for post disaster co-ordination and planning, and provincial governors are granted special powers over public, private and military resources. (Balamir, 2001; Erdik, 2004) Municipalities, NGOs, and muhtars (neighbourhood administrators), who are best placed to incorporate citizen’s voices and community participation, have a passive role in disaster administration. (Erdik, 2004) Erdik describes the government and administrative system for disasters and development as “complex and complicated,” making “coordinating, planning, leading and organizing difficult and problematic.” (Erdik, 2004, p6)

At its deepest root cause insufficient seismic safety in Turkish housing is the result of macro economic and political forces. The devastation during the Marmara Earthquake is closely related to the recent rapid growth of this region of Turkey. The high rate of urbanisation, accelerated by Turkey's liberalising economy, created a large demand for inexpensive housing in urban areas in which earthquake safety was not the highest priority. (Özerdem, 2003) As a result, many migrants to the Marmara region reside in un-engineered three to six storey reinforced concrete buildings of the type that were particularly susceptible to collapse in the 1999 earthquakes. (Scawthorn and Johnson, 2000) Turkey's economic conditions, and in particular the country's persistent high inflation, also affected the quality of housing through the housing finance system. Because of sustained periods of significant inflation over the past 20 years, home mortgages have typically been available only with short-term, high interest conditions. As a result there has been very little home mortgage activity; Demir et al estimate that mortgages have accounted for less than 20% of the total payment toward new homes in Turkey. With a cash market for housing, many homes have been built through informal arrangements between landowners and builders and without the improved quality that may come with larger scale, industrialised residential construction. (Erdik, no date; Demir et al, 2003; Erdik, personal communication, 30 June 2004) Populist style politics and a lack of transparency have invited corruption, which has created a construction and planning culture in which disregard for building codes and regulations is acceptable. (Özerdem, 2003) According to Green et al,

A climate of authoritarian statism, wilful disregard for life safety, systematic human rights violations, and political corruption, in addition to the absence of state regulatory bodies and measures of quality assurance in the construction industry were found to be the most significant factors in destruction in the region. (Green et al, 2002, p1)

Finally, some scholars have put forth a cultural explanation attributing complacency regarding housing safety to fatalism and other factors in Turkish society. A Disaster Management Center Report (Middle East Technical University, Ankara) argued (1999), "It is not surprising that in a culturally fatalistic society, this makes consumers blasé with regard to the structural quality of buildings in which they entrust their own lives and their families to divine interpretation." (quoted in Özerdem and Barakat, 2000, p436) The attitude of fatalism is substantiated by religion and the interpretation of seismic events as 'acts of God', an interpretation reinforced by Islam's portrayal of judgement day as an earthquake. (Homan, 2003) However, religion and culture has not completely precluded individual preventative

action in Turkey. Kasapoglu and Ecevit (2003) interviewed 210 earthquake survivors to find if they had taken out earthquake insurance, had the structural condition of their house checked, taken lessons in first-aid, or attended any earthquake education meetings in response to the Marmara Earthquake. Their study found that 42.2% of people carried out at least one of these activities, showing some responsible behaviour. Not surprisingly, however, they found more fatalistic individuals to be less likely to engage in responsible behaviour. Individual preventative action is also discouraged by the large number of multifamily dwellings that may be partly owned by several different families. Erdik argues that the increasing idea of a house as a commodity weakens incentives for individual action because people are reluctant to invest in a structure they may sell in a few years. (Erdik, personal communication, 30 June 2004)

### **Toward a Set of Proposals**

Economic, political and social structures have made Turkey vulnerable to its earthquake hazards. Trends in housing and population pressurised the building industry to undermine the importance of structural safety in residential construction. Özerdem and Barakat rightly assess that blame for disasters such as those that occurred in 1999 should be spread throughout the building industry and Turkish society in general, asserting that “all those who have a role in the building process, from contractors and civil engineers to council inspectors and clients, played a part in making a disaster out of a natural hazard.” (Özerdem and Barakat, 2000, p426) Future earthquakes are expected in Turkey, and the focus of the policies and proposals discussed in the next chapter is how to alter these complex processes to improve the safety of housing with regards to this persistent hazard.

## CHAPTER IV

# PROPOSALS TO INCREASE THE SEISMIC RESISTANCE OF HOUSING IN TURKEY

### Alternatives for Action

Residential construction that is unsafe in earthquakes has significantly contributed to the human and economic losses the Turkish people have suffered in recent seismic events. The proposals that will be set out in this chapter aim to address this fundamental problem, improving both existing and new housing.<sup>1</sup> As detailed in the previous chapter, the problem of insufficient seismic resistance in housing is actually the manifestation of a conglomeration of underlying vulnerabilities and causes, including poor quality construction and design, lack of supervision of contractors and engineers, and disparate and contradictory institutional responsibilities for planning, development and disaster management. A multifaceted proposal of prevention and mitigation, approaching the seismic vulnerability of Turkey's housing stock through several of these underlying contributors is likely to be the most successful at achieving a general improvement in performance of residential structures during earthquakes.

There are a variety of different types of proposals that could be implemented in Turkey, or similarly in other disaster-prone countries in the world where housing safety is inadequate. Broadly speaking, these could include methods of stricter regulation of building codes and the construction industry, education and public awareness programmes, or improvements to the institutional framework and legislation regarding disasters and development. The first section of this chapter includes a summary of steps that have been taken in Turkey since the disasters in 1999, and an evaluation of their progress. Using this discussion and the layered analysis of the problems from the previous chapter, a set of proposals is presented in the second section. The chapter concludes with an evaluation of what these proposals can and cannot expect to achieve.

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<sup>1</sup> The Appendix, Residential Construction in Earthquake Affected Areas in Turkey, surveys the common types of construction and housing in Yalova and Iznik, Turkey.



### Steps Taken since 1999

Since the devastating Marmara and Düzce Earthquakes in 1999, the Turkish government and various NGOs have taken actions to increase the safety of housing and to reduce the impact of future earthquakes. These steps include the implementation of a mandatory system of earthquake insurance, the modification of the building inspection system to include extra-governmental Building Inspection Firms, the institution of an expert system of professional qualification in engineering, slow movement toward change in institutional arrangements and disaster legislation, and the establishment of a public education programme. In addition, the city of Istanbul has plans to begin an ambitious urban planning and retrofit programme.

In theory, earthquake insurance is designed to be a loss-sharing strategy, allowing policyholders to spread the costs of the potential risk of dealing with disaster over many years. (Cuny, 1983; Smith, 2001) Turkey's Disaster Law, however, provides little incentive for homeowners to take out their own insurance; in the case of a disaster the government essentially insures everyone by promising to replace destroyed houses. (Tankut, 2001; Yalçın, 2001) After the 1999 earthquakes, this policy cost the Turkish government US\$6 billion. In response to these high costs, the Turkish government implemented mandatory earthquake insurance for all residences in 2000. An annual premium of TL 40 million (per household) insures damage up to TL 28 billion from ground shaking, fire, explosion or landslide following a seismic event. The Turkish Catastrophe Insurance Pool (a legal public entity) is a management board only; it subcontracts out the right to sell the earthquake insurance to authorised companies who earn a commission for sales. The only mechanism for enforcement is through infrequently used real estate and mortgage lending institutions and the uptake of these policies has been slow; by July 2002 2.4 million of 11 million households had purchased the insurance. Most of the purchasers so far live in areas designated as Hazard Zone 1, the most severe. (Yalçın, 2001; Gülkan, 2002; Özerdem, 2003)

The Turkish government has earned praise for the institution of a "relatively anonymous earthquake [insurance] administration," setting the insurance funds aside from the day-to-day operational budget. (Balamir, 2001, p221) The general optimism<sup>2</sup> that earthquake insurance can be an impetus for better housing construction, expressed in statements like Özerdem's

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<sup>2</sup> See for example Burby and May, 1999; Smith, 2001; Özerdem, 2003.

that, “It is likely that insurance companies would refuse to provide insurance for a building that is not earthquake proof,” however, seems unfounded. (Özerdem, 2003, p207) The tariff charged for insurance does differ among three different construction types (steel or reinforced concrete, masonry and other), but these distinctions are too unsophisticated to provide an incentive for better seismic construction. (Yalçın, 2001; Gülkan, 2002) Charging premiums of between \$50 and \$70 per year and operating through a network of subcontractors, the insurers do not have the skills or resources to institute the inspections required of a system in which the quality of seismic construction and rates are correlated. (Erdik, personal communication, 30 June 2004) Moreover, the funds collected under the insurance scheme can be used only for compensation, and not the mitigation. The weak enforcement mechanisms fail to discourage free riders. (Gülkan, 2002) For a policy to increase housing safety in earthquakes, the Turkish government must look elsewhere.

A second change in recent years has been the introduction by the Turkish government of private Building Inspection Firms (BIFs) to control construction projects and activities. For all structures larger than 180 square metres, BIF architects and engineers (who are to be affiliated with a professional organisation) must approve a project before local authorities will allow construction to commence. These firms are paid four to eight percent of the building cost for their services. BIFs are co-ordinated by the local Director of Public Works and Settlement and representatives of the municipality and related professional chambers, and are liable for construction defects and damage occurring from disasters for ten years after construction. (Balamir, 2001) It is too early to evaluate the BIFs on their success improving the building inspection and supervision process in Turkey. However, an improved regulatory system is an important element of the multifaceted approach to increased seismic safety that is presented in the following section.

The government has also issued a decree regarding “Proficiency in Constructional Professions,” requiring an engineer to have a minimum of five years of professional practice, attend training sessions and pass written exams as qualifications to work on services that “require competence.” (Balamir, 2001, p 226) The decree does not define what services require competence. (Balamir, 2001) To begin, all engineers and architects with twelve years of professional experience are awarded the “expert” title. (Erdik, no date) A professional qualification for engineers, of the type that exists in the US and Western Europe, is probably

essential to overhauling the building industry. However, the qualification system put in place thus far is insufficient to improve residential construction; “expert” status will not be needed to design a housing structure. (Erdik, personal communication, 30 June 2004) To improve its effectiveness further modifications to the qualification system are needed.

Slow movement is being made toward restructuring the framework of Turkey’s disaster and development legislation. The provincial governors’ action plans for disaster response have been prepared with more attention to detail since 1999. In addition, the Ministry of Public Works and Settlement has begun executing a programme funded by the UN, “Improvement of Turkey’s Disaster Management System,” that aims to develop pilot projects to strengthen institutions to deal with disasters. (Gülkan, 2001) The World Bank is similarly funding a programme to redesign Turkey’s disaster laws. (Gülkan, 2001) These efforts amount to a feeble step in the right direction.

A Disaster Preparedness Education Program, known as AHEP<sup>3</sup>, is co-ordinated by Bogazici University together with UNDP, USAID, Local Agenda 21, the American Red Cross and other international supporters. According to its organisers, “The main function of AHEP is to develop and widespread public education programs about disaster preparedness.” (Alniacik, email communication, 5 July 2004) To accomplish these goals, AHEP has developed training programmes to teach the general public about basic disaster preparedness and response, non-structural mitigation, and the structural condition of their own home. SASS, the Structural Awareness for Seismic Safety Training Programme, aims “to inform people about earthquake safe buildings, to show how designer, builder and user behaviors may effect the earthquake resistance of buildings and to encourage people to be advocates of building earthquake safe buildings.” Topics covered in the course include “the ground we build on,” structural systems and load paths, good materials and construction, and building maintenance. (Alniacik, email communication, 5 July 2004) AHEP also distributes public education materials and plans “disaster days” and other fairs; a “Family Plan” document, which outlines earthquake survival and planning techniques, has been distributed to 1.5 million school children in Istanbul. (Alniacik, email communication, 5 July 2004; AHEP, no date) Graphics, from AHEP’s public awareness materials, are displayed in Figure 11. In a different programme other NGOs, the Turkish Crescent and the American Red Cross are

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<sup>3</sup> AHEP stands for Afete Hazirlik Egitim Projesi.

working with local offices of emergency management, neighbourhood groups, and business organisations to increase preparedness at the community level. (Erdik, no date)

In the four years since their programme began AHEP has developed several training programmes and a range of educational materials related to earthquake safety. According to their own surveys, the training programmes have been well received, but the attendance of AHEP training seminars is not particularly high, reaching less than 2000 total participants to date. (AHEP, no date) The Minister of Education's plans to ensure that one teacher at each school has attended AHEP's basic disaster preparedness training has not yet come to fruition. AHEP is still working to incorporate celebrities, civic organisations, professional associations and government agencies to expand and institutionalise its activities.

Since 1999 the Istanbul Metropolitan Municipality has proposed an extensive plan for urban design and retrofit of the entire city of Istanbul in light of what is seen as an impending earthquake threat in that city. It represents "an integrated plan to synchronize all physical, financial, legal, organizational measures with the aim of developing risk management methods according to causal structures and spatial distributions of hazards and risk." (Erdik, 2004, p5) Under this plan structures will be evaluated on a block-by-block basis to delineate those areas that need rehabilitation. (Erdik, personal communication, 30 June 2004; Erdik, 2004) According to the Master Plan (developed by a consortium of universities), the "palette of solutions" includes "reinforcement, reconstruction of individual buildings, preservation of historical urban fabric and regeneration of urban areas..." (Erdik, 2004, p3) The plan's documentation states that residents should be given some choice as to what happens to their block: whether they receive safer housing nearby, compensation or assistance in retrofitting their existing structures. The exact nature of the choices that will be offered and the channels used to communicate with communities are as yet undetermined. It is envisioned that private sector funding may be secured where land is more valuable than the residential structures by selling the land to commercial interests and applying the profits to the construction of safer housing elsewhere. These programmes will require the development of a new metropolitan Land Development Agency and a Real Estate Investment Trust. The metropolitan municipality hopes to encourage the co-operation of NGOs, especially in aspects of participatory decision-making. (Erdik, personal communication, 30 June 2004; Erdik, 2004)

To date, this programme is in its nascent stages with work focusing on the development of a master plan for a pilot project in a one by two-mile region near the airport. According to the architects of the scheme, the success of the pilot and the broader project depends upon capturing commercial viability and social acceptability. (Erdik, personal communication, 30 June 2004) These problems, as well as challenges administering a programme this large, however, may be insurmountable. It is difficult to see how either the government or the private sector will be able to fund the rehabilitation on a citywide scale; in commercially attractive areas, the private sector may be eager to buy land with poor residential housing, but elsewhere securing their involvement will be near impossible. As yet, there has been little consideration of what will be done when residents do not like the scheme and its options. Given the general lack of qualification in the building professions, the training, management and administration of building inspectors will also prove to be an enormous task.

### **Proposals for Safer Housing in Turkey**

Using the vulnerabilities identified as contributors to the lack of seismic safety in Turkish housing, and responding to the progress that has been made by the Turkish government and NGOs in addressing these issues, a set of proposals has been developed to enhance the safety of Turkey's residential structures. The analysis of the underlying contributors to insufficient seismic safety makes it clear that any set of proposals needs:

1. To encourage individuals and households to demand better housing
2. To encourage engineers and contractors to provide better design and construction services

And,

3. To create an institutional framework that recognises the linkages between disasters and development and supports both (1) and (2).

The package of proposals described below uses these three components as mechanisms through which the objective of safer new and existing houses can be obtained. Their success in achieving this end will be measured by survival numbers in future seismic events in Turkey, and in the development of preventative and mitigation skills among community members and the government. (Aysan et al, 1995)

A public education and marketing campaign, and a training and accreditation programme for engineers and contractors are critical components of this building improvement programme. Targeted, subsidised housing and home improvement finance can provide an additional financial incentive to safer housing. These programmes are designed such that participation by individuals and building professionals is voluntary, but they create incentives to encourage their involvement. It is also recognised that modification of municipal regulations and inspection regimes and restructuring of government legislation regarding disasters and developments are essential.

#### *Public Education and Marketing Campaign*

The primary goal of the public education programme is to encourage individual homeowners and residents to prepare responsibly for earthquakes. Through slowing demand, an oversupply of housing, and increasing commodification of the housing market, potential housing consumers are likely to have the choice between several different houses. (Erdik, personal communication, 30 June 2004) A public education programme can provide people with the necessary information to make an informed decision about the seismic safety of their home, and combine this with other important information about preparing for and responding to an earthquake. In this sense, an education campaign developed for the general public serves the purpose of encouraging voluntary compliance with disaster mitigation measures. It directly targets the consumer complacency and culture of fatalism that play a contributory role in the creation of earthquake disasters in Turkey. The cultural expectation of post-disaster assistance from the Turkish government must also be addressed.

The need for better public sharing of information about seismic disasters is stressed in several studies on Turkey; Kasapoglu et al assert,

Education is an important agency contributing to the acquisition of modern values and attitudes...For sections of Turkish society that have experienced the trauma of an earthquake disaster, emphasis should be placed on educational issues in order for people to develop responsible behaviour that will prepare them to be less affected by future earthquakes. (Kasapoglu et al, 2004, p244)

Özerdem makes the same point, but focuses on the empowering role for consumers:

In Turkey, where the population is business and initiative oriented the existence of 'demand' plays a significant role in socio-economic and political inter-relationships. If people showed as much interest in the earthquake safety of their apartments as they show in the type of tiles, doors, and taps used, then it is more likely that building contractors would stick to the rules. (Özerdem, 1999, p179)

The two earthquakes in 1999 renewed public awareness in seismic activity and structural mitigation, at least temporarily. Some newspaper advertisements for new homes now market their seismic safety. In Istanbul, a number of concerned citizens moved northward to distance themselves from the fault in that city (though many have since moved back, inconvenienced by their increased distance from Istanbul's centre). (Erdik, personal communication, 30 June 2004) The education programme aims to enhance this public awareness and translate this awareness into effective structural mitigatory action.

Schools provide an important venue for teaching public awareness about seismic design and disaster preparedness. Because many school-aged children (especially those between the ages of six and ten) already attend government-run schools, they provide a target audience that is easy for a government-implemented programme to reach. (Metz, 1995; Wisner, 2003) In fact, proposals have been made to train at least one teacher at each of Turkey's primary and secondary schools in disaster preparedness and response. A needed next step is for the government to embrace these proposals wholeheartedly, committing to teacher training and dissemination of student curriculum, to ensure their success. NGOs and institutions do exist to assist with this task; AHEP, for example, is willing to do the teacher training at little or no cost, and has already developed curricular materials that could be used with few modifications. The creative application of disaster preparedness and housing safety to other subjects of study in the curriculum can also be encouraged. Schools in Vietnam held poetry and drawing competitions about the Campaign for Typhoon Resistance Building. (Norton, 1995)

A systematic education programme for the general public is necessarily more difficult. Adults are logistically and intellectually harder to reach. The challenge is to develop a general education campaign that is accessible to as many people as possible, while encouraging community participation and ownership of the programme. It is essential that the Turkish central government provide resources and commitment to fulfil a co-ordinating role. The best method of reaching people, however, is incorporating this educational programme through existing community organisations and religious groups. Logistically, "communicating to key institutions can be easier than communications to individuals." (Wisner, 2003, p332) In a model that could be applied in a modified form Turkey, the Bangladeshi government has a programme that trains Imams and other community leaders

about AIDS, reproductive health and the environment, including flood protection. (BSS, 2003) By systematically providing training and resources about disaster preparedness and education (perhaps of the type already developed by AHEP) information is delivered to the institutions that are closest to and most influential with the country's citizens. The task of overcoming ingrained perceptions about earthquakes and preparedness can only be achieved through organisations that people already trust, particularly because of the discernible lack of trust between the government and its citizens. In this way the education programme is consistent with the goals of empowering local communities and civil society, and facilitating participation in disaster management activities.

Experiences in disaster preparedness and reconstruction elsewhere in the world have found that visual and hands-on programmes enhance these information-sharing activities. Demonstration structures have been used with success in Guatemala, Peru and Vietnam as prototypes for safe design. The use of these buildings varied in these programmes; like in Vietnam, in Turkey it seems that these could function as well-designed public buildings such as schools, health centres and libraries, especially as public buildings have performed poorly in past events. (Anderson and Woodrow, 1989; Maskrey, 1995; Norton, 1995) The demonstrative quality of these buildings can be further exploited by using them explicitly as educational tools, incorporating informational displays about their construction and designing in such a way that the structural system is clearly visible. Disaster preparedness fairs, of the type that AHEP has already organised in Ankara and Istanbul, can also help to spread information about preparedness and seismic mitigation. More localised activities may include public showings of videos, or photography and art exhibitions. (Norton, 1995)

The public education programme should be instituted in tandem with a marketing and advertisement campaign, aiming to spread awareness about the other initiatives that form the part of the package to increase the seismic safety of Turkish housing. These advertisements will increase the usefulness of public education about seismic risks by linking it to a mechanism through which an individual can improve the seismic resistance of their house, such as the accreditation scheme discussed in the next section. The marketing campaign should be targeted to reach those who are most likely to be moving or buying a new house. This could be accomplished by hanging posters advertising accreditation and safety certification programmes on telephone poles and other surfaces near construction sites and in



rapidly growing areas, and through leaflets and posters displayed at all real estate agents, money lending institutions and municipalities. This type of carefully channelled marketing has been successful in several countries in campaigns against littering and forest fires. In Vietnam, posters were found to be an effective method of communicating the typhoon risk. (Norton, 1995) This focused marketing effort can be combined with public service advertisements about structural mitigation and disaster preparedness, designed for a wider audience. TV, radio and newspapers reach much of the public, and have had considerable impact in general safety awareness elsewhere.<sup>4</sup> (Cory, 1995b) A campaign of this magnitude requires, at the very least, government financial support.

The public education and marketing campaign will likely start small in the feasibility stage, with the expectation of increasing in scale and scope when more funding is available and the problems in implementation have been ironed out. However, the project must not be allowed to become stuck in the initial stages for too long, as seems to have happened with AHEP's training and education programmes. The success of the education at schools, general education programme and targeted marketing campaign depends upon a purposed move from pilot project to widespread implementation.

#### *Training and Accreditation for Engineers and Contractors*

The training and accreditation programme for engineers and contractors is designed to address the problems of technical design flaws, "deficient engineering practice," and poor quality construction observed in the Turkish construction industry. As such, the objectives of programme are to better educate engineers, to recognise and provide incentives for good construction and engineering, and to develop a better understanding of mistakes that are commonly made in residential construction. To accomplish these goals, there must be improvements in the education and training of new engineers and provisions to examine the qualifications of practising engineers and contractors.

Turkish academics recognise that a thorough evaluation of the university curriculum for civil engineers is needed. Tankut (2001), for example, would like to see earthquake engineering included in the core civil engineering curriculum of every university in the country. Universities and engineering departments need to commit themselves to subjecting their

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<sup>4</sup> By 1995, almost every household in Turkey had a TV, a radio or both. (Metz, 1995)

curricular deficiencies to scrutiny, recognising the role of civil engineering graduates in structural collapses. The Turkish Council of Higher Education, which controls funding, curricula, staffing, should make structural engineering education a priority. (Metz, 1995)

For already practising engineers and contractors training courses linked to an accreditation system should be instituted. In objective, this programme is similar to the “expert” status in civil engineering that has recently been developed by the Turkish government. To be effective at improving residential construction, however, the professional qualification system must be wider in scope, encompassing not only engineers, but also contractors, and ensuring that the qualification earned is relevant to residential construction. In addition to offering a qualification for the highest level of design as the expert status does, this accreditation should have a second level establishing proficiency to design or construct residential buildings. Accreditation provides a qualification for building professionals applicable to new and retrofit, residential and commercial construction.

The criteria for accreditation will most likely be a combination of an examination and training and, if desired, adherence to an ethical code. The short training courses about the basics of seismic design and construction, administered separately for engineers and contractors, must be as accessible as possible. Training programmes that are too time-consuming or expensive create disincentives to participation in the accreditation programme. It is ideal if information from training courses is easily transferable back to the workplace; supplements could include a user-friendly guide to standards and design or a manual for field inspections. Either the government or professional contracting and engineering associations could administer a programme of this type. The Turkish Contractors Association, which states their objective as, “to contribute to the achievement of an economically productive, socially responsible and environmentally sound development in the construction industry,” is well-situated to play a role, with its member companies accounting for about 70% of domestic contracting work in Turkey. (TCA, no date) There is also an Association of Turkish Consulting Engineers and Architects. (ACTEA, no date) In other countries, accreditation of building professionals is generally done by professional organisations under government supervision with some government funding. By ensuring that processes of examination and accreditation are standardised and prioritising transparency and openness in these processes the accreditation system will be equipped to fight corruption.

Like the public education programme, participation in this accreditation scheme should be voluntary, but with sufficient incentives to encourage involvement. For this reason, the accreditation programme, its significance, and its logo must be heavily marketed. Widespread advertising and marketing of the type discussed in the previous section can be used to incite consumer demand for the safer housing product. The increase in training and accreditation will only be successful if it provides those builders who have had it with a competitive edge over those who have not. In Yemen, after the 1982 earthquake, the Dhamar Building Education Project felt that their training of builders was fairly unsuccessful because individuals did not choose to hire the builders who had undergone the training. (Cory, 1995b)

It would also be worthwhile if a professional system of evaluating collapses and their causes could be instituted outside the court system. At this time, many structural failures are not investigated because of the inability of the Turkish legal system to handle the number of post-earthquake investigations needed. By establishing an evaluation programme to be conducted by accredited building professionals, engineers and contractors involved in faulty construction could be punished through the institution of fines and loss of professional qualification. This is a large task, and it may be some time before organisations of engineers and contractors are well developed enough to take it on. Choosing cases to investigate at random could diminish the workload. Safeguards, including transparency and openness in the proceedings, would be essential to keep the evaluation process free from corruption.

#### *Subsidised Housing Finance*

A policy of subsidising certain mortgage and home improvement loans would give consumers an additional financial incentive to buy a safe house or retrofit their existing dwelling. Under this system, preferential loan conditions, with lower interest rates, a longer repayment term, and modified conditions for loan qualification, are offered to consumers. The loaned money can be used for retrofitting, extensions, new construction or house purchase, provided that accredited engineers and/or contractors did the work or, in the case of the purchase of an existing structure, an inspection was carried out by a qualified professional.<sup>5</sup> As housing finance is difficult to obtain in Turkey except for short, high interest loans, this would serve as an added impetus for consumers to use the accreditation

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<sup>5</sup> The exact conditions of the loan may depend on which activity (retrofitting, extensions, etc.) that it is used for.

service. Contractors and the construction industry would benefit because these loans would support an infusion of money into the construction industry. The policy also addresses the problem that retrofitting can be expensive, but provides other advantages such as preserving the built fabric for socio-cultural reasons. (Gülkan, 2001) Clearly, a well-defined system accrediting engineers, contractors and their work is integral to this type of differential loan policy. This programme also requires a significant source of capital from either the Turkish government or external funds like the World Bank. The funds needed could be reduced by limiting the amount loaned to any individual or by offering the loans only in particular areas with a high concentration of vulnerable structures. (Cuny, 1980b)

Subsidised loan policies in the context of disasters have a number of precedents. After the 1999 earthquakes, the Turkish government offered special loans for repair of certain damaged structures with long repayment terms and a certain portion (about US\$5000) available at low interest. (Erdik, no date) Similarly, when a cyclone devastated coastal Andhra Pradesh in 1977 the Indian government mandated that lending institutions relax qualifying requirements for loans for rebuilding, and the government Housing and Urban Development Corporation subsidised loans by 33.3%. (Reddy, 1995) The El Salvadoran government used funds from USAID to subsidise interest rates for loans for reconstruction and damage repair after an earthquake in 1986. (Clark, 1995) The loans proposed for Turkey are wider in scope – including retrofitting, extensions, new construction, and mortgages – than these examples, but operate on the same principle of assisting people financially to live in safer structures.

#### *Modification of Municipal Regulations and Inspection Regimes*

Modification of municipal regulations and inspections is necessary to enable municipalities to reassert control over land-use planning and building inspection. As described in the third chapter, building codes are up-to-date,<sup>6</sup> but municipalities have insufficient resources and expertise to perform the task of enforcing these codes. Local governments must respond to “demands for enforcement of regulations concerning construction practices to minimize risk, quality control during new construction, and retrofitting of buildings and houses at risk.”

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<sup>6</sup> By all accounts the substance of Turkey’s building and seismic codes is consistent with those used around the world. A few modifications, however, would be beneficial. Sezen et al (2000) state that the code should require ductile detailing in moderate and severe seismic zones; currently there is an option of designing either using ductile detailing or increased strength. According to Aysan and Oliver (1987), the codes need to improve their incorporation of provisions for extensions and retrofitting.

(Özderdem and Barakat, 2000, p433) The problem of enforcement of building codes is not unique to Turkey and elsewhere resources and training have been identified as the key necessary inputs for improving local government enforcement. (Burby and May, 1999)

Municipalities' building inspections responsibilities have been delegated to the new Building Inspection Firms (BIFs) that work with the municipality and accept liability for structures. These must be developed, however, to avoid some of the pitfalls experienced by the municipal inspections system. Firstly, BIFs must have responsibility for residential structures and seismic retrofitting work. If some housing is excluded (because of the minimum size for consideration by BIFs etc.) from the examination of plans and construction these changes can not be expected to improve the quality of housing construction. In order to expedite the planning process BIFs will likely find it necessary to employ staff members that are not trained in engineering or construction. Training and manuals dictating the best way of inspecting plans and construction sites are needed. (Cory, 1995a; Gavieta and Onate, 1997) All efforts must be made to avoid bribery and corruption; the BIFs and, in the case of oversight and negligence, individual employees should be held responsible for their work. By charging for their services, the BIFs should have sufficient resources for their inspection work.

Buildings constructed by accredited engineers and/or contractors, and with successfully completed BIF evaluations should be awarded a certificate of safety. As with the accreditation programme, this certificate and the significance of safety attached to it should be given emphasis in public advertisements and marketing campaigns. A prominently displayed plaque on residential and commercial buildings earning the certificate can also increase awareness about the programme and structural safety.

Municipalities do still need more resources and better training for their staff. The backlog in planning and development has not yet been addressed. If more money is not available from government sources it may be necessary to implement a system of fines relating to zoning and planning regulations to provide a source of revenue. More effective enforcement of planning and zoning is also dependent on a re-examination of Turkey's development and disasters legislation, which is discussed in the next section.

*Restructuring of Disasters and Development Laws*

A complete restructuring of Turkey's legislation on disasters and development is necessary to replace vagueness in institutional responsibility with an institutional framework that recognises the links between disasters and development, gives primacy to mitigation and preventative actions, and institutionalises community participation. Overhauling the system is imperative, but contentious because of the political inertia supporting the status quo, and this may account for the slow progress in the last five years despite government lip service supporting organisational change. In order to carry out this restructuring a total evaluation of existing laws and the country's administrative structure is necessary.

It is fairly obvious that disaster preparedness and mitigation deserves significantly enhanced formulation in either the Disasters Law or the Development Law. Up to this point, the pre-disaster planning done is disparate from development planning, significantly reducing its effectiveness. Gülkan (2001) suggests that disaster preparedness be included with the development legislation, and that the existing limited comments on prevention be removed from the Disasters Law. The likelihood of success of each of the proposals discussed previously will be greatly improved by removing the Disasters Law's disincentive to quality seismic construction, in the form of the promise to rebuild all authorised and unauthorised construction after disasters. The Turkish government's omnipresent authoritative and financial post-disaster role needs to be re-evaluated in the context of new methods of intervention, including structural mitigation and the now mandatory earthquake insurance. Amendments to development laws needed also include an overall upgrading of planning supervision. An effective spatial planning system is an essential complement to disaster preparation. (Gülkan, 2001) This integration of disaster and development needs to be institutionalised at all levels. As an example, plans submitted to the municipality or Building Inspection Firm should be expected to comply with both development and disaster laws. (Balamir, 2001) Finally, this legislation is in need of a much greater incorporation of community participation. By transferring some of the decision-making regarding disasters and development from central to local and municipal governments people will be more willing and able to participate in these important processes.

### **Evaluating this Set of Proposals**

As with any set of policy proposals it is important to be realistic about what the package of proposals presented can and cannot expect to achieve. The initiatives discussed in this chapter will not provide a quick fix. Instead, if instituted they launch a general campaign to steadily improve the overall seismic safety of housing in Turkey in the spirit of Coburn's observation:

The Turkish government and local planners cannot unilaterally make cities safe for everyone. It requires awareness, motivation, and self-protecting action by a range of groups including the local government, the construction industry, private sector companies and community groups. (Coburn, 1995, p93)

The task of making residential construction safer is a steady challenge, yet other natural, social, economic and political factors may give this proposed programme a boost. Having these programmes in place, when another earthquake does strike the momentum of post-disaster relief will provide substantial opportunities for more widespread and committed implementation. (Aysan et al, 1995) Macroeconomic improvements could also reinforce the progress made by this set of proposals. With Turkey's government considering joining the European Union, it seems likely that the country's macroeconomic stability, and with it inflation and other important indicators, will be less volatile in this coming decade than in the previous one. Lower inflation may lead to an increase in the range of housing finance options and the number of industrial-scale housing developments, both of which are expected to have an overall positive effect on the structural quality of housing. (Erdik, personal communication, 30 June 2004) Similarly, slowing urbanisation, which has been observed in the last few years and is likely to continue, will diminish the overall rate of housing construction that has contributed to a disregard of seismic resistance.

Because most of these proposals are voluntary their success depends in large part on whether the actors can be enticed to participate fully. The Turkish government's active involvement is essential, yet it may be reluctant to commit to participation. In challenging the Development Law, Disasters Laws and organisation of ministries and authority surrounding disaster mitigation and response, the programme threatens the status quo. The cliché that money spent on disaster prevention goes farther than that spent on disaster response cannot be repeated often enough within the earshot of government officials. The involvement of individual Turks is also crucial to this programme, as one of the main aims is to convince citizens to be proactive about the seismic condition of their own housing. Whether or not the

socio-cultural contributions toward fatalism and blasé behaviour can be targeted through education and marketing policies remains to be seen. Though unfortunate, further disasters in Turkey, particularly in the country's highly populated western urban areas, are likely to assist this transformation of public opinion. The private sector, especially the building industry, must be convinced that adhering to seismic and building codes is in their own interests, as well as that of their clients. By creating the demand for safe housing and a system of accreditation and certification that can supply this safe housing the goal is to make building professionals' involvement financially beneficial.

The opportunities for success in this package of proposals are strengthened by its two-fold approach. These proposals aim to create the desire for safer, seismic-resistant housing among the Turkish public, and provide the mechanism of accreditation and Building Inspection Firms through which this desire can be realised. The other suggestions, such as the modifications to legislation on disasters and development, alter the underlying political and legal conditions to help these proposals achieve their objective.



## CHAPTER V

# CONCLUSIONS

The collapse of residential structures during earthquakes continues to inflict significant damage and suffering on the Turkish people and their country's economy. The package of proposals developed in the previous chapter aims to improve the seismic resistance of new and existing homes in order to minimise these losses in future seismic events. The proposals try to meet this objective in several ways, principally by launching a public education and marketing campaign together with a training and accreditation programme for building professionals to simultaneously encourage the growth of consumer demand for earthquake-resistant housing and provide a mechanism through which safer housing can be achieved. The provision of subsidised housing finance in conjunction with use of the accreditation programme offers a further financial incentive. Institutionally, improvements to the municipal planning and inspections system, and much-needed changes to the legislative and authoritative framework governing disasters and development are desirable supports to the implementation of these programmes.

A review of the literature and case studies on “natural” disasters and the evidence of the continued creation of earthquake disasters demonstrates that the approaches used by the Turkish government and the Turkish people in dealing with their earthquake threats are insufficient to reduce the risk of significant harm. By focusing legally and financially on post-earthquake response, the country's leadership limits its ability to minimise the impact of ground shaking on its people, structures and economy. Through complacency, the general public and the building industry have allowed many residential structures to be built disregarding seismic codes. In contrast, by working together to cultivate partnerships and to address the underlying contributors to poor quality residential construction, the government, NGOs, the Turkish building industry and the general public could lessen the impact of future seismic disasters. These are lessons applicable to countries suffering from “natural” disasters around the world.

It is not to be expected that the implementation of the package of proposals developed will change the condition of housing and construction in Turkey overnight. These are first steps,

increasing awareness about structural mitigation in Turkish society, and creating a societal and institutional system in which safer housing is a realistic goal. The burden of financial and institutional commitment to these programmes lies with the Turkish government. NGOs and professional organisations can play a supporting role in the development of educational materials and training programmes and NGOs are crucial in their ability to liaise with communities. But, success depends on the government making deeper changes to its legislative system, institutionalising community participation in disaster management, and giving priority to these changes. Together, the Turkish government and its citizens can convince each other that structural mitigation and preparation for future earthquakes are in their collective interests.

## APPENDIX

**RESIDENTIAL CONSTRUCTION IN EARTHQUAKE  
AFFECTED AREAS IN TURKEY**

*Figures A1 and A2* Typical reinforced concrete construction with hollow clay tile infill walls.  
Izmir, June 2004.<sup>1</sup>

<sup>1</sup> All photos in this Appendix taken by Abbie Liel.



*Figure A3* Multifamily dwelling (reinforced concrete with hollow clay tile walls) under construction. The structures on either side have a similar structural system that has been covered by the building's paint and façade. Yalova, June 2004.



*Figure A4* Low rise residential construction. Yalova, June 2004.





*Figures A5 and A6* Multi-family, medium rise residential construction. Yalova, June 2004.



*Figure A7* Extension of an existing structure with reinforcing bars sticking out in preparation for another storey. Iznik, June 2004.



*Figure A8* Extensions in progress. Iznik, June 2004.



*Figure A9* Reinforced concrete construction with hollow clay tile infill walls. The first and second floors of the building are occupied while construction work continues in the ground and upper floors. Iznik, June 2004.



*Figure A10* Residential structure in varying states of completion. Approximately 25% of construction in Yalova exhibited these characteristics of informal construction. Yalova, June 2004.





*Figures A11 and A12* Mixed use: commercial on ground floor, residential on upper floors. The much larger windows and openings on the ground floor may adversely affect the structure's seismic performance, though the quality of design and construction is largely hidden. Yalova, June 2004.





*Figure A13* House using more traditional construction materials of brick, wood and stone.  
Iznik, June 2004.

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