Learning from the Mexico City Earthquake: Dynamics of Vulnerability and Preparedness

The Case of Housing

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Introduction

A series of powerful earthquakes struck Mexico City from September 19th – 20th, 1985. The first tremor hit at 7:19 am, lasting for nearly two minutes and registered 8.1 on the Richter scale. Dozens of smaller but powerful after-shocks continued to consume the city, culminating in a final 7.5 magnitude quake, 36 hours after the first tremor. Even for this natural hazard prone urban center, the 1985 earthquake struck with an unprecedented force. The ensuing disaster killed between 3,050 and 10,000, injured between 14,000 and 50,000, and caused overall economic losses of an estimated $4 billion (US). The earthquakes destroyed thousands of both the city's modern and antiquated buildings and damaged 100,000 more, and the infrastructural destruction left two million residents of metropolitan Mexico City homeless. Yet the earthquake's severity resulted from more than its magnitude; because the majority of damage was concentrated in the city's historic center, which contained colonial monuments, key government offices, significant commerce, most of the City's cultural and educational institutions, and 20 per cent of the entire metropolitan area's population, the earthquake had "affected almost every principal cultural, political and economic institution in the city."

Many of those who died had, in fact, only suffered minimal wounds from the earthquake itself, but they were trapped alive and died during the slow, problem-plagued government rescue response. The earthquake struck at a particularly vulnerable economic moment - three years into the deepening 1982 debt crisis when Mexico was acting with particular fiscal austerity to mitigate the financial catastrophe. In the days following the earthquake, the Mexican populace watched as their government continued their pre-disaster economic policies, exemplified by rejecting foreign aid to prevent increasing the national debt . Simultaneously, citizens reported police protecting factory owners who rescued machinery rather than trapped workers. These actions, among others, convinced citizens that their government prioritized recuperating political and social control and minimizing economic losses over relieving the population's suffering. The government's minimal attention to humanitarian needs incited the population to take recovery into their own hands and facilitate immediate recovery. Many civil society groups emerged in the aftermath and assumed a wide range of activities, from rescuing victims to providing food, clothing and shelter. The emergence of an active civil society helped shape the reconstruction process, and empowered community participation to continue beyond earthquake recovery and become a force in Mexican civic and political life.

Mexico will continue to experience earthquakes, and geologists expect that one of severity comparable to 1985 will strike again. Twenty-two years later, is Mexico City prepared? Did the disaster trigger better planning and more coordination? During the next, inevitable earthquake, will buildings and infrastructure remain intact? Will government and civil society respond collaboratively and effectively? Have measures taken by government, NGOs, and citizens made the city more secure? This examination will begin to confront these questions

about Mexico City's urban security as it is related to earthquake risk. The housing sector is the focus for analysis as residential structures were especially vulnerable to the 1985 earthquake and achieving safe and secure housing is central to disaster recovery and urban security. By analyzing the post-quake context of housing recovery and planning measures taken since to reduce structural as well as social vulnerability, the nature of urban security in Mexico City is revealed as a dynamic and interdependent process situated in a constantly evolving landscape of risk. To accomplish this, the case study first explores Mexico City's environmental and geographic hazards, second, describes Mexico City's post-earthquake housing sector recovery and contribution to overall resilience and third, examines the measures adopted by Mexico City since 1985 to confront and mitigate the risks posed by earthquakes. The examination will show that in many ways, Mexico City is more prepared today to face another powerful earthquake, but the city's diverse, compounding and changing risks and vulnerabilities mean that another major disaster could again result in significant destruction and loss of life.

A City of Multiple Environmental Hazards

While the strength of the 1985 earthquake took Mexico City by surprise, earthquakes pose an ever-present threat. Mexico is one of the world's most seismically active countries, sitting atop the intersection of five tectonic plates.[1] Located in the center of the country directly above these faults, Mexico City is particularly vulnerable to any seismic movements and has suffered a recorded 340 earthquakes in the vicinity since Aztec times.[2] After a strong earthquake in 1957, the Mexican government implemented revised regulatory measures to comply with international building safety standards. Analysis of the destruction following the 1985 earthquake revealed that much of the more serious damage resulted because the continued tremors created harmonic resonance with many of Mexico City's buildings, even the most modern.[3] This resonance magnified the structures' sway and led to their structural failure and ultimate collapse. The combination of Mexico City's geological vulnerability with the magnitude, length and strength of the multiple tremors that comprised the 1985 earthquake created a catastrophe far beyond what the city or country had previously known.

Historically, Mexico's populace accepted natural calamities as part of ordinary life.[4] Hazards include periodic volcanic eruptions, hurricanes, fires, droughts and floods, in addition to earthquakes. Moreover the city is partially built on a lakebed of unstable saturated mud and clay soils and is responsible for the city's ongoing subsidence of up to 40 centimeters per year in some areas.[5] Many of these natural hazards contribute to increased earthquake risk, and amplify earthquake effects.[6] The lakebed's composition not only complicates the city's foundational stability, but also contributes to earthquake risk because it amplifies "seismic waves up to 30 times more than do the firmer soils of adjacent higher [city] zones."[7] The 1985 earthquake demonstrated how devastating that amplification could be since those city areas located directly on the lakebed fell victim to the most serious destruction.[8] The city's sinking compromises buildings' structural integrity and they become more vulnerable to

[1] Connolly, 2003

[2] Poniatowska, 1995, pxv

[3] Comerio, 1998, p129

[4] Puente, 1999, p311

[5] UNESCO, 2006, p 492

[6] Connolly, 2003, p13

[7] Puente, 1999, p305

[8] Comerio, 1998, p129

seismic movements. In addition, nearby active volcanoes can act as possible earthquake generators.[9]

Man-made hazards compound Mexico City's natural vulnerabilities. The City's extreme air pollution contributes to environmental vulnerability by indirectly increasing subsidence. High levels of ozone, for example, are linked to reducing growth of, and chlorophyll content in, the dominant species of pine trees that grow in the mountains surrounding the basin: "One of the main functions of these forests is the collection of water for the city. Thus atmospheric pollution may have a considerable impact on the water balance on the hill-slopes of the basin and consequently the availability and quality of water used for human consumption."[10] Additionally, overexploitation of aquifers in the Valley of Mexico means several areas of the city face chronic water shortages.[11] This overuse combined with the poor absorptive capacity of the clay topsoil also causes higher run off and subsidence.[12] Un-regulated land-usage that often takes places within the context of shelter seeking by the poor increases the city's environmental risks both because of dangers posed by the physical structures and the way the unregulated settlements interact with the habitat.[13] Technological emergencies, to which Mexico City is susceptible as an industrial base, add still another dimension to its vulnerabilities (see Table 1).[14]

Table 1: Summarized Table of Technological Disasters in Mexico from 1909 to 2006[15]

	# of Events	**Killed**	**Injured**	**Homeless**	**Affected**	**Total Affected**	**Damages US$**
Industrial Accident	31	1,107	9,494	20,660	776,766	806,920	1,075,000
Average per event		36	306	667	25,057	26,030	34,677
Misc. Accident	12	550	581	0	0	581	0
Average per event		46	48	0	0	48	0
Transport Accident	56	2,213	2,787	0	0	2,787	0
Average per event		40	50	0	0	50	0

Source: EM-DAT: The OFDA/CRED,Université Catholique de Louvain, Brussels, Belgium

[9] Puente, 1999, p305

[10] Kasperson et al., 1995

[11] *ibid*

[12] UNESCO, 2006, p.494. Flash flooding too is a growing problem related to land use changes, which cause more rainfall to be captured, and the basin cannot effectively drain even with the country's extensive drainage investment. Kreimer, et al, 1999

[13] Connelly, 2003, p13

[14] Puente, 1999, p311

[15] EM-DAT: The OFDA/CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium. Created on: Oct-17-2006. - Data version: v06.06. http://www.em-dat.net/disasters/Visualisation/profiles/tech-table-emdat.php?country=Mexico

Human impact on the environment in this way exacerbates seismic waves' potential destructive force. Thus, not only are water shortages more severe in the event of natural hazards, chronic problems of drainage, waste, water and air pollution multiply as natural and manmade management systems become incapacitated. Mexico City's man-made hazards are not unusual for metropolises, but the city's unique and vulnerable geographical position exacerbates these common urban risks.

The Case of Housing: Reconstruction for Resilience?

One year before the earthquake "planners estimated that Mexico City faced a housing shortage equivalent to 30 per cent of the existing…stock,"[16] forcing city dwellers to overcrowd the available housing and making it less safe for habitation. High capital city migration, low-wages, rent control policies, high cost urban construction, amongst other factors, had resulted in inadequate housing development and maintenance by both the private and public sectors. A post-earthquake study of one Federal District neighborhood revealed that on average before the disaster, eight to ten people lived in units of twenty-three square meters.[17] This already vulnerable sector suffered the worst earthquake damage in 1985 (see Table 2 and Chart 1).

Table 2: Types of Buildings Damaged and Destroyed

	Destroyed	**Severe Damage**	**Medium or Minor Damage**	**Total**
Residential	**577**	**1638**	**1530**	**3745**
Schools	43	206	454	703
Stores	161	171	134	466
Public Offices	38	82	55	175
Private Offices	28	69	73	170
Hospitals	5	22	14	41
Recreational	9	9	17	35
Manufacturing	7	6	6	19
Other	86	93	195	374
Total	**954**	**2296**	**2478**	**5728**

Source: Comerio, 1998

No residential losses had insurance coverage, forcing the government and citizens to bear the brunt of responsibility for housing reconstruction financing and management.[18] Amongst housing damaged by the earthquake, two kinds suffered the most: large multi-story apartment buildings which accommodated hundreds of residents and smaller apartment buildings called *viviendas*.[19] The government housing initiatives, the Multifamiliar Juarez in Colonia Roma, a periphery Capital City neighborhood and the Nuevo Leon building in the Nonoalco Tlatelolco

[16] Comerio, 1998, p134

[17] *ibid*, p134

[18] Berz and Smolka, 1989; Comerio, 1998, 136

[19] Known in English as tenements. Comerio, 1998, pp132-133

historic center complex, were the hardest of hit of the multi-story buildings.[20] Constructed in the 1950s and 1960s as low-cost alternatives to the overcrowded housing, these buildings offered a solution to Mexico's on-going housing shortage.[21] Yet decades later the over-sized structures proved to be amongst the most vulnerable to the earthquake's force, killing thousands of inhabitants and leaving thousands more homeless.[22] Post-quake analysis revealed that the use of sub-par construction materials and loose adherence to building standards contributed to the devastating collapses.[23]

Unlike the government high-rises which, pre-disaster, offered residents secure and comfortable living accommodations, the hard hit *viviendas,* were typically old and in poor condition, often lacking basic plumbing and sanitation services.[24] Many of these *viviendas* were "irregular" settlements either because they were built illegally or deteriorated to sub-standard levels.[25] Even of those considered formal and legal structures, many did not conform to the 1957 codes nor had adequate maintenance. Some of the irregularity and on-going neglect can be attributed to "absentee" landlords who had long neglected their properties, citing rent-control policies that removed market incentives for landlords to maintain or rehabilitate buildings. Despite the pre-earthquake dangers in the *viviendas*, "…inexpensive rents, strong family and community ties within the neighborhood and access to transportation, jobs and shopping made the conditions tolerable and the neighborhoods desirable."[26]

On October 4, 1985, in response to the overwhelming structural damage and to popular pressures to restore downtown housing,[27] the Mexican government formed the National Reconstruction Commission which, headed by the president, developed four government housing programs (See Table 3).[28] While providing some provisional housing for earthquake victims, the government prioritized permanent reconstruction over temporary shelter. In response to citizen pressure, the programs intended to include "broad-based decision-making capacity and the participation of academic, social, professional, and technical groups as well as community leaders."[29] *Renovacial Habitacional Popular* (Housing Renovation Program) or RHP, created with a presidential decree expropriating thousands of quake-damaged properties, was the most extensive government initiative, ultimately providing almost 50,000 new and rehabilitated housing units during its two-year mandate.[30] Forty per cent of RHP's funding came from the Mexican government, the remaining sixty per cent from World Bank

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[20] The Nonoalco Tlatelolco development, at that time, was the largest housing development in Latin America and included 102 apartment buildings, 12,000 units and 120,000 residents. The Multifamiliar Juarez included 19 buildings with 1,200. Comerio, 1998, p133

[21] At the time of the earthquake an analysis of Tlatelolco residents revealed that many were professionals who had moved to the complex to benefit from the subsidized rental prices that in fact, while low, still remained too expensive for many poor city inhabitants. Cuauhtémoc et al, 2005, p203

[22] *ibid,* p133

[23] Davis, 2004, p268

[24] Pre-quake, an estimated 63 % of these *viviendas* lacked toilets. *ibid*

[25] "The causes of illegality, however, have included a variety of closely interlinked conditions: unauthorized land development, non-fulfillment and inexistence of building permits, initial and sometimes permanent lack of urban services . . .dubious or inexistent original and subsequent property titles, the operation of alternative property jurisdiction… And, of course, the definition of illegality depends on legislation, which is in constant evolution." Connelly, 2003, p13

[26] Comerio, 1998, p137

[27] Poniatowska, 1995, pxvii

[28] Comerio, 1998, p138

[29] *ibid*

[30] World Bank Independent Evaluation Group, 2001

loans, which provided the Bank with significant advisory capacity through the recovery process.[31]

Table 3: Summary of Reconstruction Programs[32]

Program	Minor Repair	Upgraded	New or Rebuilt	Total Housing Units
RHP	490	6220	42090	48800
Tlatelolco	6346	4214	730	10560
Fase I	16077			16077
Fase II		4439	5153	12000
NGOs				74456
Total Units				94,893

Source: Comerio, 1998

The other three post-disaster programs had important roles in the recovery, primarily in the areas of repair and credit provision. The recovery program in the seriously damaged Tlatelolco complex directly rose from resident pressure on authorities to repair their damaged public housing units and resulted in rehabilitation, structural strengthening, and the demolition and reconstruction of over 10,500 units.[33] Considered a model for government and citizen cooperation in disaster recovery, reconstruction included lowering nine of the high-rise buildings to three stories to reduce future earthquake risk.[34] The two credit programs, known as Fase I and Fase II, which operated often in cooperation with RHP, NGO housing programs and/or private agencies, offered credit and financing directly to families for rehabilitation and reconstruction.[35]

While RHP in particular received international recognition for the speed and extent of the reconstruction effort and its particular attention to redesigning housing and transferring "ownership in accordance with the immediate housing needs, property rights claims and cultural and historical significance of the affected areas," the program in fact did not always sufficiently fulfill what earthquake victims needed. [36] The logic that had drawn residents to the centrally-located *viviendas* did not change post-quake and survivors' incentives to stay only increased in the wake of the disaster because more than ever they needed easy access to their economic livelihoods and the support of community social networks. Yet reconstruction on-site had significant complications resulting from ambiguities in ownership and tenure, and private landlords' refusal to invest in what they considered worthless properties, which meant many damaged apartment buildings remained standing in their impaired states even while RHP constructed new housing alternatives outside the center.[37] Residents organized and "decisively rejected alternative housing proposals, including one to move the entire refugee population to a new town site ten kilometers away," and many chose to remain in dangerous

[31] Comerio, 1998, p141

[32] *ibid*, p142

[33] *Ibid*, p141

[34] *ibid*

[35] *ibid*, p142

[36] Davis, 2004, p258

[37] *ibid*, p259

damaged buildings in the city center because they could maintain their community and their proximity to downtown. [38]

Just as NGO's filled in the gaps left by the government in the larger disaster response, community organizations stepped in to meet citizen's needs and independently contributed over 7,000 new housing units (both reconstruction and repair).[39] These groups both openly partnered with government projects to help realize the housing mandate and acted in opposition when the programs seemed to work against citizen's interests. Three housing groups played particularly significant roles: the *Asembleas de Barrios, Coordinadora Nacional del Movimiento Urbano Popular* (CONAMUP) and the *Coodinadora Unica de Damnificados* (CUD).[40] These agencies worked to combat what they perceived as the reinforcement of social inequities perpetuated through government-sponsored housing reconstruction. While NGOs officially operated independently from government reconstruction bodies like RHP, groups that partnered with the government typically achieved more on behalf of the urban poor than those that tried to seek resources on their own. [41] Their mobilizations included actions like advocating for rebuilding and rehabilitation within existing residential communities, particularly those center city, instead of removing citizens to periphery areas[42] and taking over condemned housing to publicly demonstrate that families being evicted had no immediate options for shelter and that the current policies did not sufficiently consider short term needs in the longer-term reconstruction process.[43] Indeed, the coordinated action of NGOs who "boldly demanded a 'right' to housing" left a lasting impression not just on the current federal administration but on subsequent governments.[44] Moreover they maintained pressure to construct new housing in derelict sections of the city.[45]

Even though roughly 100,000[46] families benefited from the variety of government and NGO post-earthquake housing programs in the first few years after the disaster, many Mexico City residents never received sufficient services, dealt with extended homelessness or lived in damaged buildings that remained in precarious conditions.[47] In general, the public shared the sentiment that the government paid greater attention to the middle-class areas of the city damaged by the earthquake rather than the poorer tenement areas of downtown.[48] This has been explained as both resulting from prioritizing the City's wealthier members but also as resulting from a lack of long-term strategic vision for recovery and resilience for all citizens. Whether intentional or an unintended consequence of short and medium term planning, some of the reconstruction policies and programs implemented can be held responsible for reproducing pre-existing inequities that had previously created and perpetuated many of the city's vulnerabilities.[49]

Twenty years later, has the country improved its disaster preparedness and recovery mechanisms?

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[38] Comerio, 1998, p138

[39] Comerio, 1998, p.142

[40] Fox, 1992, p180

[41] *Ibid*

[42] Cuauhtémoc et al, 2005, p.180

[43] Fox, 1992, p180

[44] *ibid*

[45] Davis, 2004, p270

[46] Comerio, 1998, p142

[47] Davis, 2004, p259

[48] *ibid*

[49] *ibid*, p264

Post-Earthquake Preparedness Measures

> *Disasters are at times tragedies but at the same time opportunities. Seen in retrospect, I am convinced that Mexico has taken advantage of the opportunity.*

-Roberto Quaas Weppen, Director of Mexico's National Center for Disaster Prevention (CENAPRED)[50]

In the two decades since the earthquake, Mexico has taken significant steps towards addressing risks related to earthquakes and other hazards. Many of these are technological advancements in earthquake monitoring, plans to improve structural resistance to earthquake tremors and citizen readiness programs. Efforts have included establishing scientific advisory committees and revised standards for civil works, pursuing advances in engineering, retrofitting schools to withstand earthquakes, implementing evacuation simulation programs,[51] and launching a hospital disaster readiness initiative.[52] Mexico City, along with sister cities in the Americas Cluster Cities project, are following a precedent set by Bogota, Colombia to further technological capacities to set new risk reduction priorities within time and budget constraints.[53] This includes developing their capacity for Geographic Information Systems (GIS) and modeling in order to assess and anticipate risk.[54] Motivated by active community involvement during the 1985 recovery, the government has also added mechanisms to incorporate citizens' voices into public debate and decision-making, creating the Ministry of Social Development (*Secretaria de Desarrollo Social* – SEDESOL) in 1987 to improve communication and cooperation between government and civil society.

Mexico has also established monitoring and warning systems to detect earthquakes, volcanoes, and tropical storms, like the 1991 Seismic Alert System (SAS) and directly credits the 1985 earthquake with prompting new protection schemes and disaster prevention institutions[55]. The most important of these include the National Civil Protection System (Sinaproc) in 1987 to coordinate preparedness and disaster response[56] and the National Center for Disaster Prevention (CENAPRED) in 1988, housed at the National Autonomous University of Mexico, to link the world of research and policy.[57] In 1996, the Mexican government created the Fund for Natural Disasters - *Fondo para Desastres Naturales* (FONDEN), composed of three separate funds in infrastructure, agriculture and individual assistance, to serve as a financial instrument of the Civil Protection System and directly address the critical resource constraints that result during natural catastrophes, such as having to divert budgets previously determined for other national priorities to tackle disaster-caused problems.[58] In order to increase the ability of FONDEN to fulfill these responsibilities, in 2002 the World Bank supplied FONDEN with US$ 404 million funds, earmarked for recapitalization and disaster management activities.[59]

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[50] Cuauhtémoc et al, 2005, p270 [authors' translation from the original Spanish]

[51] *ibid*, p294

[52] Kreimer et al, 1999

[53] The Americas Cluster Cities project includes Quito, Ecuador and Los Angeles, USA in addition to Bogota, and Mexico City. See Earthquakes and Megacities Initiative, 2005

[54] *ibid*

[55] Cuauhtémoc et al, 2005, p226

[56] http://www.proteccioncivil.gob.mx/Portal/PtMain.php?nIdHeader=2&nIdPanel=5&nIdFooter=22

[57] Kreimer et al, 1999

[58] Earthquake Engineering Research Institute (EERI), 2003

[59] UN/ISDR, 2004, p351

The international community has also directed attention to Mexico City's disaster risk. The World Bank is involved in assessing disaster risk in Mexico, making recommendations to mitigate that risk, and helping to support the process. Based on the equation: Disaster = Hazard x Vulnerability,[60] and the idea that vulnerability "is generally a function of location or construction,"[61] the World Bank advises that Mexico should take a three-step approach: identify its risks, mitigate their damage, and transfer the risk to insurance companies and capital markets.[62] The Mexican government is correspondingly focusing on four key areas:

- "Strengthening insurance sector regulatory requirements and supervision;
- Establishing a broad-based pooled catastrophe funding structure with efficient risk transfer tools;
- Promoting public insurance policies linked to programs for loss reduction in the uninsured sectors; and
- Strengthening the risk assessment and enforcement of structural measures such as zoning and building code compliance."[63]

These steps contribute to a greater overall awareness about earthquake risk within the government and the population at large. However, are these programs effective? Is Mexico City better prepared?

An earthquake (7.6 on the Richter scale) in the southwestern state of Colima on January 21, 2003 tested the measures implemented by Mexico to improve its disaster readiness. A reconnaissance team from Earthquake Engineering Research Institute (EERI) visited the municipalities of Colima, Manzanillo, Tecomán, Comala, Coquimatlán, Villa de Álvarez, Ixtlahuacan, and Armería the day after the earthquake, investigating the earthquake's effects as well as the government's response. The team described the response as "rapid and well-managed."[64] After the earthquake, members of all levels of government, academic institutions, NGOs (such as the Mexican Red Cross), and volunteers from professional associations, and search and rescue groups met daily to ensure a comprehensive response.[65]

One month after the disaster, 11,009 out of 13,493 reported damaged structures had been inspected and fifty-six disaster assistance centers had been set up by the Mexican military to provide food, shelter, medical assistance, and information to victims.[66] Only twenty-one people died in the Colima earthquake and more damage could have been expected.[67] Colima tested both rescue coordination and FONDEN's ability to quickly disperse recovery funds. At the time of EERI's report, the government pledged approximately US$ 14 million for recovery programs for housing, small businesses, unemployment assistance, and the tourism industry.[68] The Colima experience suggests that the coordinating mechanisms Mexico implemented post-1985 improved disaster response, but Colima's scale was small compared to a potential event in Mexico City. The federal state of Colima is home to 562,277 people

[60] Kreimer et al, 1999, p17

[61] *Ibid*, p13

[62] *ibid*, p17

[63] Guerra-Fletes, et al, 2006

[64] Reporting of damaged structures was mostly by public teams doing rapid visual assessments, Earthquake Engineering Research Institute, 2003

[65] *ibid*, p9

[66] *Ibid*

[67] *Ibid*

[68] *Ibid*, p11

(est. 2005), whereas estimates for Metropolitan Mexico City exceeds 20 million and the scale of a disaster there would put significantly more pressure on response systems. [69]

While many vulnerabilities from 1985 have been minimised, new vulnerabilities constantly emerge. Returning to the Mexico City housing sector example, a closer look at the state of housing and the implementation of vulnerability reduction strategies manifests the complexity and evolutionary nature of the risk landscape, and indicates that Mexico City may not be prepared in the event of another severe earthquake. "Irregular" settlements, for example, occupy approximately half of the urban area, and are home to sixty per cent of the metropolitan population.[70] This means that the housing for more than half of Mexico City's residents does not follow housing regulations. Therefore, plans that only focus on official housing procedures and new housing construction do not affect the majority of the population. In addition, this irregularity also determines property insurability. Before the 1985 earthquake few residential structures had insurance coverage and little has changed nationwide. For instance, in 1998, 150,000 houses out of 16 million were insured, and fifty per cent of housing stock was not insurable because building materials were not solid or did not have access to potable water.[71]

Moreover, building codes and laws that focus on new constructions have limited impact on improving the safety of the City's existing housing, regular or irregular, because "most of the city is already built, and what happens within these built up areas will determine the quality of habitat for most of the metropolitan population.[72] While Mexico City implemented policies of "regularization," devising and distributing land titles, inputting infrastructure and services to already existing structures, regularization is often incomplete and not lasting. Without effective maintenance, regular structures quickly become unstable and irregular again.[73] This back and forth between regular and irregular states reflects the reality that vulnerability-reducing regulations may not reach large classes of housing nor will be effective long term without continued enforcement.

Beyond structures, vulnerability is inherently related to socioeconomic factors, perhaps at a level equal in importance to location and construction. The contemporary context of ongoing social, economic, and political shifts is highly relevant to Mexico City's disaster vulnerability, and critical to the effectiveness of macro-level mitigation strategies. For example, while contributing to an increasingly internationally competitive national economy that is undergoing a shift from being based primarily in manufacturing to one based on services, Mexico City is also experiencing a demographic transition of spatial polarization of the poor.[74] Between 1980 and 1990, migration from the federal district to the periphery created numerous neighborhoods on the outskirts less stable than those at the center.[75] The danger and reality is that the poor will be left out of initiatives that decrease disaster vulnerability and increase resiliency if focus is placed largely on macro-level adjustments. These strategies must take into consideration vulnerabilities relating to social, economic, and political status.

[69] http://www.citypopulation.de/Mexico.html

[70] Connolly 2003, 13

[71] Kreimer et al, 1999, p17

[72] Connolly, 2003, p14

[73] *Ibid*

[74] OECD, 2004

[75] Puente, 1999, p300

What is Achievable in the Context of Mexico City, a Mega-City of Multiple Risks?

As previously mentioned, events that are potential disasters occur regularly in Mexico City. The vigilance and resources required to meet these physical risks combined with the dynamic social, economic, and political processes at work is perhaps incalculable. United Nations University expert Srikantha Herath advises a paradigm shift that can be applied across the spectrum of disaster risks, from "fail-safe" to "safe-fail" infrastructure design. Dr. Herath asserts that cities must acknowledge that the absolute elimination of risk is impossible; disasters will strike, therefore the mechanisms that one puts in place to mitigate risk must help build resilience in the city by being able to "fail safely," minimizing impacts in the likely event they will fail. Moreover, efforts that reduce vulnerability and build coping capacity should receive increased support and attention. [76] These strategies must be closely scrutinized to ensure that the voices of citizens are given fair hearing, ensuring that the role of civil society is protected and supported. According to the World Bank, public education on disaster risk mitigation and insurance is critical to reduce risk towards the goal of creating a "culture of safety."[77] This is ideal in a city like Mexico City where complete mitigation of risk is at best unlikely. Knowledge can only take people and communities so far if structural forces deny them the ability to act.

The reconstruction and recovery of Mexico City and reduction of vulnerability are as much about larger issues of accountability, democratic change and social justice, as they are about the implementation of regulations and technological monitoring innovations. One of the most vital tasks towards civil protection for a government is to be prepared to carry out relief and recovery efforts immediately following disaster; be it conflict, economic disaster or environmental disaster, and to return as much "normalcy" to citizens lives as possible. The fact that "most residents in Mexico City felt denied both in the immediate aftermath as well as years down the road directly affected the recovery efforts and their longer-term impact on the city."[78] Civil protection is the first phase of recovery and sets the stage for a return to "normalcy," which is both the goal of the government, who is interested in recovering the economy, and the citizens, who seek a return to normal life.

In a twenty year retrospective symposium hosted by the National Autonomous University of Mexico, government officials, academics and other Mexican disaster experts gathered together to debate the successes and failures of the 1985 recovery and evaluate the country's preparedness and resilience for future disasters. No one opinion prevailed amongst the different actors, but many participants reiterated key points including:

- Government/civil society partnership is integral for effective preparedness and disaster response. The 1985 quake forever changed the dynamics of community and authority relationships and citizen participation must remain an integral part of future disaster planning.
- While recent disaster preparedness systems represent a great achievement, government must work to maintain preparedness as a national priority. As the 1985 earthquake moves farther into the past and more of the population has no memory of the event, there is risk that disaster investment will become less important to the public.

[76] United Nations University, 2006

[77] Kreimer et al, 1999, p22

[78] *Ibid*

- Systems must remain effective. The public has become skeptical of expensive programs like the Seismic Alert System and therefore initiatives like these must be evaluated for their on-going value.[79]

The housing example reveals that even in the context of significant preparedness progress in terms of technological advancement, new systems' implementation, citizen education and participation, socio-economic factors still increase vulnerability and interfere with a country's ability to mitigate disaster. When discussing Mexico's current state of vulnerability and preparedness, former government official and academic Mario Garza divided vulnerability into four categories; educational, technical, economic and social and argued that since 1985, the country has advanced in the first two areas, remained the same in the third, but is more vulnerable in the fourth.[80] He explained:

> *In relation to social vulnerability, we are more vulnerable, overall because of the high index of poverty in the population. This type of vulnerability is linked to physical and spatial, therefore we are more vulnerable precisely because of the high population density and the large quantity of high risk settlements that proliferate in the metropolitan zone.* [81]

Mexico City's preparedness depends on its fundamental social structures as much as its disaster systems. Keeping in mind that "planning is not managing," the city's housing must be *managed. Planning* incorporates specific response plans while *management* is a strategic comprehensive approach towards recovery.[82] From a management perspective, disaster prone cities like Mexico City should maintain a housing recovery plan as part of a broader vision of reducing social inequities and increasing the City's resilience in anticipation of the next disaster.

Reducing vulnerability in Mexico City is a perennial challenge. If the next big earthquake hits tomorrow, it is probable that there would be an enormous death toll and significant structural damage. It is also likely that some of the lessons of 1957, and of 1985 would apply once again – policies can go only so far towards prevention if people do not have the means to act on them. However, in both their dynamism and their recurrence, hazards in Mexico City are predictable. The key to increasing Mexico City's resiliency is to understand vulnerability as an evolving and interdependent process, which must constantly be reassessed, and to simultaneously mitigate multiple disaster risks, and to do so at multiple levels.

[79] Cuauhtémoc et al, 2005, p285

[80] *Ibid*, pp277-78

[81] *Ibid*, p278 [authors' translation from the original Spanish]

[82] Quarantelli, 1995, pp18-19

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