ESTABLISHING A SEISMIC RETROFIT POLICY: IMPLICATIONS FOR BUILDINGS WITH HISTORICAL SIGNIFICANCE IN THE LOWER MAINLAND OF BRITISH COLUMBIA.

by

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ABSTRACT

Earthquakes, such as the ones capable of affecting the Lower Mainland of British Columbia, can have a devastating effect on the environment that people live and work in. The purpose of this thesis is to examine methods of dealing with the hazards and problems created by existing, often historically significant, unreinforced buildings in earthquake-prone areas. Gaining an understanding of the complexity of this problem and the issues involved in establishing hazard mitigation policies gives insight into the policy-making process. The research indicates that a number of internal and external factors affect the formulation, adoption, and implementation of hazard mitigation policies. Despite limited awareness of the problem, low political salience of the issue, and limited resources in most communities, there are many steps that can be taken that will reduce the public's exposure to the risks created by unreinforced buildings and strengthen historically significant buildings that hold value, socially, economically, and culturally. Establishing more extensive mitigative measures, such as implementing a seismic retrofit policy, requires a decision-making process that must involve the people who live and work within that community. Each community, through a process of consultation with the stakeholders, needs to decide if it is in their interest to pursue hazard mitigation strategies to reduce the seismic risk. There is a need to integrate hazard mitigation strategies into the daily decision-making process of politicians and planners. The thesis concludes with some points for stakeholders to consider in designing policy to reduce the earthquake hazard that all the communities in the Lower Mainland of British Columbia face.

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DEDICATION

For Mark, my partner. Thank you for all the encouragement, support, and love you have given me.

CHAPTER 1

INTRODUCTION

A. Purpose.

Earthquakes can have a devastating effect on our built environment. Planners and politicians have a responsibility to protect the public from this hazard by setting standards for safety and implementing policies that will mitigate the effects earthquakes have on unreinforced structures. There should be a focus on unreinforced buildings that have historical significance because they are a seismic hazard and they are valuable both socially and economically. Existing buildings provide us with "a sense of place" and embody the history of the city. There is also a need to protect the people who live and work in and around these buildings and neighbourhoods.

Planners can influence the resilience a community has to the effects of an earthquake but must understand the interconnectedness of the urban system and the interaction of its parts in the event of an earthquake. Those who hold a stake in the built environment and its history, must integrate earthquake preparedness and mitigative measures into city policy-making. "A hazard mitigation strategy is a coordinated and consistant set of goals, policies, and tools for reducing or minimizing human and property losses from hazards and resulting disasters."[1]

Getting earthquake mitigation policies implemented is a complex problem involving many issues and stakeholders. Perceptions and values influence the decisions politicians and planners make regarding the acceptable level of risk and the valuation of

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[1] David R. Godschalk and David J. Brower, "Mitigation Strategies and Integrated Emergency Management," in Public Administration Review, Special Issue, 45, 1985, p. 69.

heritage buildings. Economic decisions must be made about the allocation of limited resources towards an issue that has little political salience. Technical decisions must be made based on a seismic event that cannot be predicted in terms of specific location, magnitude or effect. Social decisions must be made because the buildings facing the highest level of risk often contain the most socially and economically vulnerable residents and businesses. If planners, politicians, and the public are serious about saving lives and preserving the built environment, especially heritage buildings, then they must work together to change perceptions and implement an effective seismic retrofit policy.

The purpose of this thesis is to examine ways of dealing with the hazards and problems created by existing, often historically significant, unreinforced buildings in earthquake-prone areas. Discussing the context of the problem; identifying the relevant issues that influence decision-making; and considering strategies for policy implementation, will lead to conclusions about the effectiveness of a seismic retrofit policy as a tool for earthquake mitigation in the Lower Mainland of British Columbia.

The importance of this issue is reflected by the United Nations declaration that the 1990's is the International Decade of Natural Hazard Reduction.

B. Scope.

The Pacific Coast and in particular, the Lower Mainland of British Columbia lie in an active seismic zone, and without a seismic retrofit policy in place, our safety and our built environment are at risk every day. The findings and policy recommendations will be aimed specifically at Greater Vancouver, but could also be applied to Vancouver Island, Victoria, and other earthquake-prone areas in B.C.

The scope of this thesis is limited to studying the social and economic aspects of seismic retrofit of hazardous buildings. Most of these hazardous buildings are constructed of unreinforced masonry, built in the early part of this century prior to the adoption of local building codes that required earthquake-resistant design. These unreinforced buildings are extremely susceptible to damage and will pose a threat to life-safety in the event of an earthquake. The technical side of retrofitting, that is, repairing or strengthening an existing building to improve its seismic resistance, is best left in the hands of the engineers. Buildings with historical significance, especially designated heritage buildings, will require more specialized consideration and treatment. Historically significant structures are not only buildings with particular architectural significance, but may also have cultural significance. Cultural significance indicates the structure holds aesthetic, historic, or social value for the past, present or future generations within a community.

Several cities in the United States have implemented public policies intended to reduce the potential for loss of life and property caused by existing hazardous buildings. Regardless of the differences between the Canadian and American systems of government and law regarding policy-making, it is important to remember that the overall concepts of seismic retrofit policy will be the focus for the application of lessons

learned from other cities.

C. Assumptions.

There is consensus among geologists that south-western British Columbia and, in particular, the Lower Mainland, lie in an earthquake-prone area. It is also assumed that most of the existing structures built before the National Building Code required reinforcement of masonry do not meet today's seismic standards and are therefore hazardous. In the event of significant earthquake, the Lower Mainland stands to lose a large number of these buildings, many with historical significance. The damage and loss of these buildings poses a threat to both public safety and the historical and economic integrity in the Lower Mainland. It will be argued that there are gaps and inadequacies in existing policy regarding earthquake hazard mitigation for pre-code buildings with historical significance. This issue is not on the agenda for either the public, the planner or the politician because of the limited amount of resources available and a limited perception of the earthquake hazard that exists. General concepts and lessons regarding the implementation of a seismic retrofit policy can be taken from the experiences in other North American cities and applied to the Lower Mainland. Finally, it is assumed that implementing mitigative measures, such as a seismic retrofit policy, would reduce the threat to public safety and decrease the potential damage to existing buildings, buildings that are the economic, social and cultural fabric of our community.

CHAPTER 2

DEFINING THE CONTEXT OF THE PROBLEM

A. Introduction

Chapter Two will define the context of the problem that results from having unreinforced buildings in earthquake-prone areas such as the Lower Mainland. It is important to understand the possible effects an earthquake could have in the Lower Mainland. The discussion will include the current emergency management policies and legislation in B.C. and examine the actions and responsibilities taken at all levels of government. The chapter also includes a discussion about the changes in hazard mitigation policy and examines a number of emergency management policy types discussed in policy typologies put forth by both Lowi and Berke and Beatley. The role and responsibility of the planner in hazard mitigation is defined in the context of the issue at hand. The final focus of this chapter is on the impact earthquakes have on the historically significant buildings that exist in our community.

B. Earthquake Hazards in British Columbia.

We face many potential natural and technological hazards in British Columbia. Floods, forest fires, and earthquakes can all have large-scale impacts on lives and property. " At least once a week an earthquake of sufficient magnitude to be noticeable occurs somewhere in the province." [2] More severe earthquakes capable of causing more

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[2] Intra-agency Emergency Preparedness Committee, Provincial Government Emergency Management: Strategy for Response , (Province of British Columbia, August 1992), p. 3.

serious damage occur every 35 to 40 years. Geologists have also predicted that a major earthquake will hit south-western BC every 300 - 500 years. [3] The Lower Mainland must deal with the threat of a major earthquake and the probability that it would create severe multiple impacts on life and property throughout the region. Depending on the magnitude and rate of acceleration, earthquakes can trigger tsunamis, mudslides, flooding, slope failure, and collapse buildings and transportation structures. In essence, this would be like having several disasters at once and would stretch normal emergency response beyond its capabilities.

The southwest corner of British Columbia is an active, high-risk seismic zone due to interaction between four plates off the west coast. Off the west coast of Vancouver Island, the Juan de Fuca plate and the Pacific plate are spreading apart along the Juan de Fuca ridge. Further east the Juan de Fuca plate is sliding under the North American plate. The smaller Explorer plate is also sliding under the North American plate and the Juan de Fuca plate is sliding past it along the Nootka Fault. Finally, the Queen Charlotte fault bounds the Pacific and North American plates. [4] The following diagram illustrates the interplay of tectonic plates and fault zones in south-western British Columbia.

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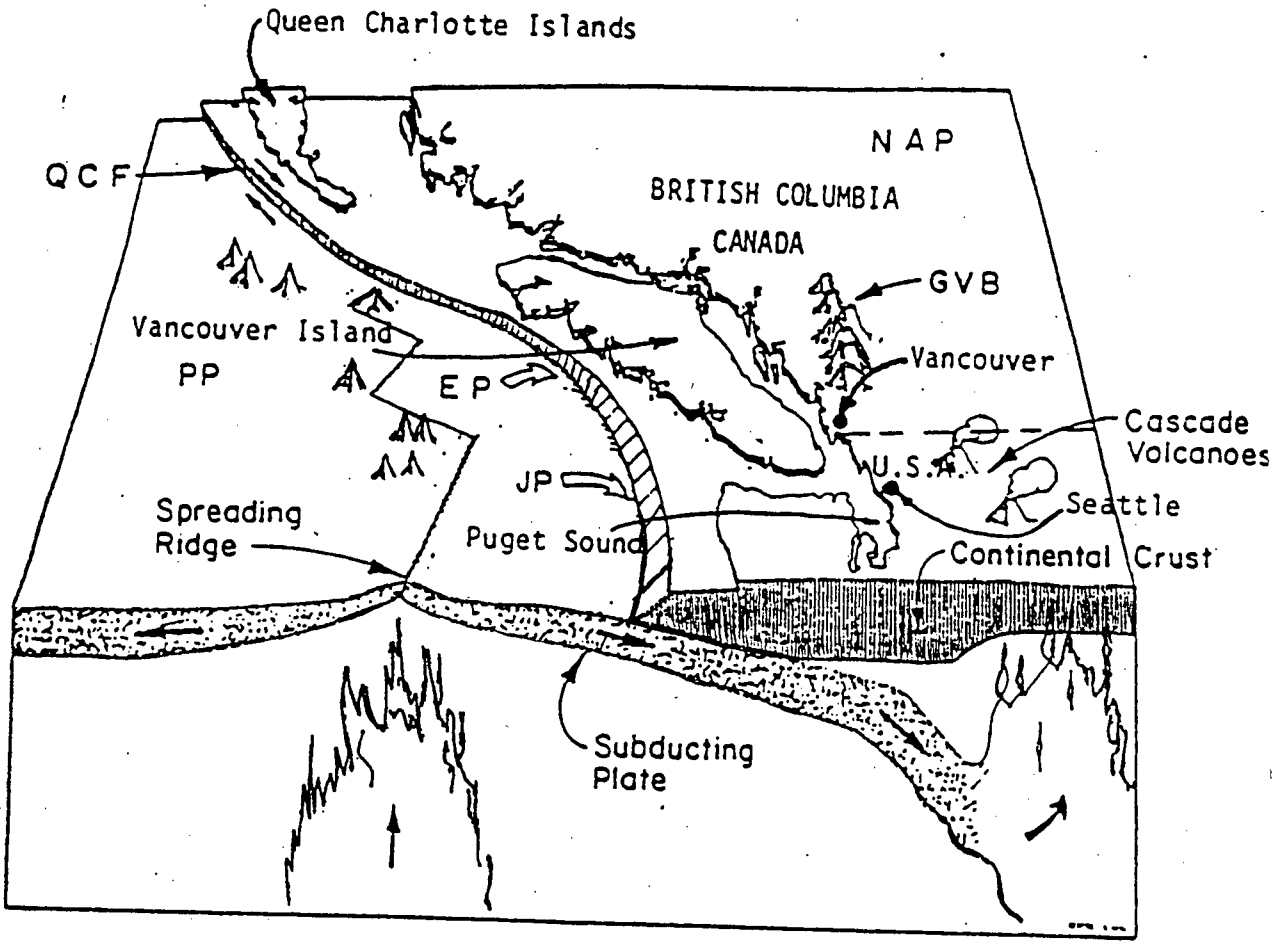
[3] Intra-agency Emergency Preparedness Committee, (1992), p. 3.

[4] B.C. Ministry of Energy, Mines and Petroleum Resources Information Circular 1991-6.

FIGURE 1 - JUAN DE FUCA SUBDUCTION ZONE



ADAPTED FROM RIDDIHOUGH (1978)

LEGEND:

PP – PACIFIC PLATE

EP – EXPLORER PLATE

JP – JUAN DE FUCA PLATE

NAP – NORTH AMERICA PLATE

GVB – GARIBALDI VOLCANIC BELT

QCF – QUEEN CHARLOTTE FAULT

Dr. Garry Rogers, a noted geologist from the Pacific Geoscience Centre, concludes that "earthquakes that may present a hazard to the area occur in three distinct source regions in this geological environment: crustal earthquakes, deeper earthquakes within the subducted plate, and very large subduction earthquakes on the boundary between the two lithospheric plates."[5] When a stress in this complex pattern of plates and faults builds up and is released suddenly an earthquake occurs. "More that 200 earthquakes are recorded each year on the Lower Mainland and Vancouver Island. Although most are too small to be felt, an earthquake capable of structural damage can be expected to occur somewhere in the region about once every ten years."[6] Current concern is that an earthquake measuring greater than 6.5 magnitude on the Richter Scale will occur in the subduction zone where the descending Juan de Fuca Plate and the overriding continental plate are supposed to slide over each other. When these plates get stuck on each other they can suddenly snap loose creating a 'mega-thrust' earthquake. The frequency of this kind of quake occurring in the Cascadia Subduction Zone west of Vancouver Island is once in several hundred years. Scientists now have convincing evidence that the subduction zone along the Juan de Fuca plate is locked and storing strain.[7] Like many other geologists, Garry Rogers tries to focus the attention of the media on the impact a catastrophic earthquake could have on B.C. He states that

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[5] Garry C. Rogers, "The Earthquake Threat in Southwest British Columbia," in Geotechnique and Natural Hazards, Symposium sponsored by Vancouver Geotechnical Society and Canadian Geotechnical Society, (Vancouver: May 6 - 9, 1992), p. 63.

[6] Energy, Mines and Resources Canada, "Earthquakes in Southwest British Columbia", Geofacts. (no date)

[7] City of Seattle Planning Department, Seismic Hazards in Seattle, (Seattle: June 1992), p. 8.

when this pent-up energy is released in an earthquake, seismic waves could cause extensive damage throughout southwestern B.C. "Nanaimo, Victoria, Vancouver and all the communities up the Fraser Valley would be hit at once. ...The total effect could be catastrophic." [8] It is possible that the Lower Mainland could experience an earthquake measuring above 8.0 on the Richter Scale, similar to the subduction zone quake, measuring 8.1, that occurred in Mexico City in 1985. Experts feel that within the last two or three years, the chance has increased from 50/50 to 70/30 or more for the earthquake to happen in the next 200 years.[9] The question is how prepared is the Lower Mainland for an earthquake of this magnitude if it happened tomorrow?

i. Possible effects of an earthquake in the Lower Mainland:

One key factor that determines the impact of an earthquake and the amount of damage that could occur is based on the underlying geologic and soil conditions. Much of the development that has occurred in the Lower Mainland is situated within the Fraser River delta. These delta soils are deep deposits made up of loose, soft soils that, during an earthquake, can magnify the shaking, causing buildings to shift and topple and soil to liquefy. Liquefaction is a common effect of earthquakes in low-lying coastal areas marked by soft soils and a high water table. The vibration of the soil during an earthquake compacts the soil and causes the water to flow upward, liquifying the sand

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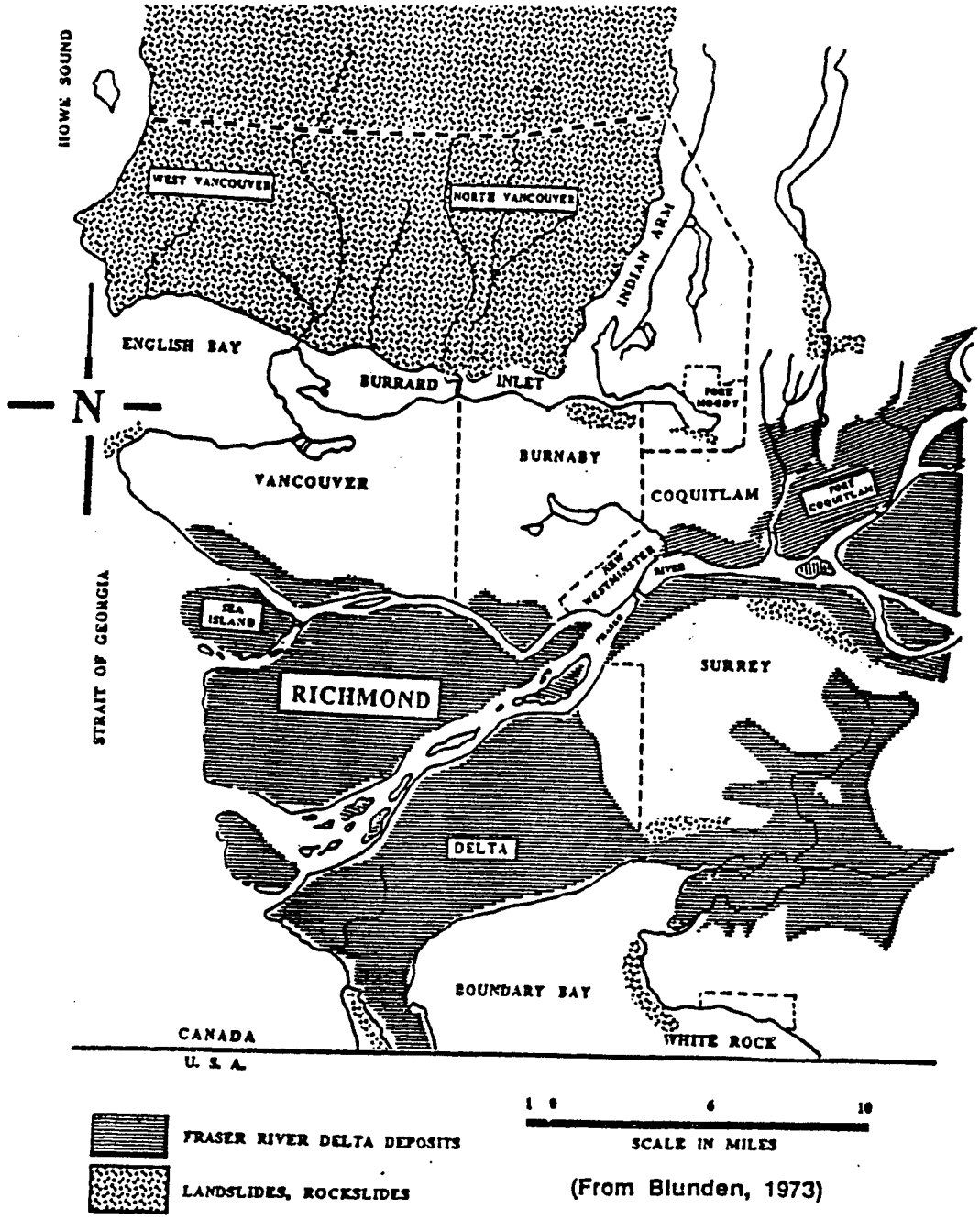
[8] Vancouver Sun, Wednesday, January 5, 1994, p. A2.

[9] Cooper, F.D. "The Prediction No One Wants to Hear: the Great 'Quake", Emergency Preparedness Digest, 14 (4), 1987, p. 3.

and mud into a kind of quicksand that is unstable for anything on built on top of it. These soil conditions intensify the effects of the earthquake and can result in severe damage to the infrastructure; tall, older buildings; and light wood structures. Much of the City of Richmond, BC, is built on delta deposits prone to liquefaction and flooding and they have acknowledged this fact in their Emergency Plan and in the establishment of more stringent building and development requirements. The geologic conditions of North and West Vancouver, built on the north shore of Burrard Inlet, would result in a different earthquake scenario. Development has occurred on the mountainous slopes and is divided by many stream and rivers flowing down from the forest above. The main hazard faced by the north shore is therefore, landslides and rockslides. Given the size of the Greater Vancouver Regional District (GVRD) and the varied nature of the geology and soil conditions, it is necessary to identify and mitigate the specific hazards that exist. This is difficult since each earthquake has an individual footprint, that is, specific characteristics of velocity, motion, duration etc. Secondly, each building responds differently to these earthquake characteristics depending on the strength of the structure and the materials it is constructed from, as well as on the soil and geologic structures it is built on. Critical facilities, like hospitals and firehalls, and dangerous land uses, such as chemical plants and oil refineries, also require special attention to ensure they can withstand the forces of an earthquake. If they have not already done so, each municipality in the GVRD needs to identify the hazardous areas and the critical facilities before they can take steps to mitigate hazards.

FIGURE 2 - MAP OF GREATER VANCOUVER AND THE FRASER DELTA



C. Current Policy in British Columbia :

i. Federal Government - actions & responsibilities:

Studying the decision-making structure and current emergency management policy in British Columbia and Canada will help illustrate the development of earthquake policy in the Lower Mainland. It is widely accepted that effective emergency management is based on active co-ordination and interaction between all levels of government: municipal, regional, provincial, and federal. To be effective, emergency management must encompass four aspects; preparedness, mitigation, response, and recovery. Since disasters impact the local level first, municipalities are responsible for initial response before it becomes either a provincial or federal concern. If the local government requires assistance with a response, they can request the province to assume responsibility. The local government can remain in charge of the response as long as they are capable of providing direction, control, and resources. The higher levels of government establish policies, set standards and provide funding, support, resources, and expertise to local governments to help them meet the public safety needs of the community. It is however, the local government that is mandated by legislation and given the responsibility for emergency management in British Columbia.

Emergency preparedness was initially tied to the Department of National Defense, beginning in 1948 with the establishment of a civil defense organization aimed at preparing citizens for nuclear attack. In 1957, an organization was created known as Canada Emergency Measures Organization (EMO). In 1966 the mandate was broadened to emphasize coordination of the federal response to peace time emergencies

caused by both natural and man-made disasters. [10] By 1974, the EMO had evolved into Emergency Planning Canada and on July 1, 1986 the name was changed to Emergency Preparedness Canada to reflect its expanded mandate. [11] The Emergency Preparedness Act, passed in 1988, repealed the War Measures Act and formally established the role of Emergency Preparedness Canada (EPC). "The purpose of Emergency Preparedness Canada is to advance civil preparedness in Canada for emergencies of all types, including war and other armed conflict, by facilitating and coordinating, among government institutions and in cooperation with provincial governments, foreign governments and international organizations, the development and implementation of civil emergency plans." [12] With respect to the development of civil emergency plans, EPC has several functions. In their effort to ensure a country-wide network of preparedness, EPC develops policies and programs, and provides education, training and coordination at the national, provincial and local level. They play a role in developing emergency plans for government agencies and have established research programs to reduce national hazards. As well, they have a role in guiding, monitoring and financing provincial and local programs. Through the Joint Emergency Preparedness Program (JEPP), roughly $6 million is spent annually by the federal government to help provinces and territories with emergency planning

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[10] Justice Institute of British Columbia, Emergency Social Services Directors Manual, (Vancouver:January 1993), p. 47.

[11] Dave Pollard, "The Role of Emergency Preparedness Canada" in Geologic Hazards in British Columbia, Proceedings of the Geologic Hazards 1991 Workshop, (Victoria, February 20-21, 1992), p. 115.

[12] Pollard, (1992), p. 115.

projects.[13] Under its mandate, EPC monitors emergencies all over Canada but will only provide support and financial aid when the province requests assistance. Emergency Preparedness Canada has improved federal-provincial coordination by locating regional directors in most provinces. They also help provinces in the disaster recovery phase by providing post-disaster financial aid to help communities restore property and businesses.

EPC has developed a National Earthquake Support Plan in an effort to respond more effectively to a catastrophic earthquake in British Columbia. The Federal government, through EPC, provides support to the provincial and local response functions in a major disaster. The Canada Mortgage and Housing Corporation (CMHC) has given its best estimates for damage if a major earthquake hit the Lower Mainland. It cites, "about 10 - 30% of residential construction would become uninhabitable and 50 - 100% of unreinforced masonry buildings would collapse. Up to 60% of older schools and hospitals (pre-1940) that have not been strengthened, and many utilities would become unusable" [14] The prohibitive costs of this support encouraged Ottawa to increase pressure on B.C. to start thinking about preparedness and the consequences of an earthquake.

ii. Provincial Government - actions & responsibilities.

Each province determines its own legislation and approach to emergency preparedness. In August 1992, the Province of British Columbia developed a Strategy

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[13] Pollard, (1992), p. 117.

[14] Canada Mortgage and Housing Corporation, CMHC Report on the National Earthquake Plan, Workshop, (Vancouver, BC: March 29-30, 1989), Annex 1, p. 2.

for Response that laid out the provincial government's emergency management policies and outlined a strategy to enhance emergency response.[15] Key ministries were given responsibility for preparing response plans for the hazards they face. Planning is done in consultation with the Provincial Emergency Program (PEP) which operates under the authority of the Ministry of the Attorney General. This mandate comes from the powers and obligations set out in the new Emergency Program Act passed by the B.C. Legislature on July 20, 1993. "It replaces a 40 year old act designed to meet the needs of the Cold War [Sec. 29]."[16] The old Act was outdated and generally permissive legislation that did not give the municipalities any mandatory responsibilities for their own emergency planning. The Emergency Program Act clarifies the roles of both local government and the province in emergency preparedness, response, and recovery. Local authorities are now required to prepare emergency plans [Sec. 6(2)] and must establish and maintain an emergency management organization [Sec.6(3&4)].[17] The local authority also has the power to declare a state of local emergency [Sec.12] that would give the local authority more extensive powers to respond to and alleviate the effects of the disaster. For example, they can control travel, evacuate people, demolish structures, fix prices for rations, and utilize any property resources or equipment for the duration of the state of emergency [Sec. 13]. The province has the same powers when they declare a state of emergency. Furthermore, "during a declared state of Emergency, the Emergency

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[15] Intra-agency Emergency Preparedness Committee, Provincial Government Emergency Management: Strategy for Response, (Province of British Columbia, August 1992).

[16] Provincial Emergency Program, A Guide to the New Emergency Program Act, (1993).

[17] Provincial Emergency Program, (1993), pp. 4-5.

Program Act and its regulations prevail over all other provincial regulations and legislation [Sec. 26]." [18] Under the Act, local governments are given more extensive powers but they also face the obligation to carry out their own emergency planning. The Act does require the province to assist local governments by providing funding through grants, expertise and training. The Act does have some teeth in that the province can fine any ministry or local authority that contravenes the Act [Sec.27].

PEP responds when the emergency is beyond the capability of the local municipality or when assistance is requested. PEP has several key responsibilities during the response phase. They play a leadership role in emergency plan preparation by providing training and setting standards for content for emergency plans for local government.

Planning is coordinated through the Interagency Emergency Preparedness Committee (IEPC). As part of their effort to increase awareness and facilitate emergency planning, PEP provides advice and assistance by providing public information, training courses and exercises for government, industry, the public and emergency services volunteers. In the event of an emergency and at the request of the municipal government, PEP coordinates the provincial response by assessing what is needed in terms of logistical support, communication resources, and by establishing and operating an Emergency Operations Centre (EOC). In the event of an earthquake, the province's primary response functions are: medical; emergency social service; law and order; urban search and rescue; communications, utilities and transportation.

PEP also has a financial responsibility for emergency preparedness. In the

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[18] Provincial Emergency Program (1993), p. 7.

1993/94 fiscal year the province allocated $3.46 million dollars for the PEP Operating budget to deal with on-going program administration. [19] In addition, $0.8 million dollars was set aside to cover emergency response costs and nearly $1 million dollars has been set aside for flood disaster assistance. [20] The Disaster Financial Assistance Program (DFA) is a federal/provincial cost-sharing program that provides financial assistance to victims of disaster when insurance is unavailable or unaffordable. [21] Federal cost-sharing comes into play when the provincial response costs for the disaster exceed $1.00 per person. [22] In addition, there is a Joint Emergency Preparedness Program (JEPP), a cost-sharing program where provincial and municipal agencies can access federal funding up to 50% of the cost for approved projects. The focus of JEPP is research, planning and preparedness. There is a movement within the province towards more proactive planning and hazard mitigation before disasters occur. Emergency response and recovery have been the provincial focus in the past. However, these are reactive measures and costly in terms of lives lost, property damaged, and resources needed for recovery. This change is reflected in the new Emergency Program Act that puts the responsibility for preparedness and planning for emergencies in the hands of the local government. However, it remains to be seen if the province will enforce the regulations

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[19] Quoted from the Provincial Emergency Program Annual Report 1993/94 by Michele Skuce, PEP - Vancouver Zone, Sept 22, 1994.

[20] Quoted from the Provincial Emergency Program Annual Report 1993/94 by Michele Skuce, PEP - Vancouver Zone, Sept 22, 1994.

[21] Quoted from the Provincial Emergency Program Annual Report 1993/94 by Michele Skuce, PEP - Vancouver Zone, Sept 22, 1994.

[22] Quoted from the Provincial Emergency Program Annual Report 1993/94 by Michele Skuce, PEP - Vancouver Zone, Sept 22, 1994.

anticipated in the new Act, and whether the local government will find both the resources and the political will to implement mitigative strategies effectively.

Separate from the PEP Plan, but using existing emergency legislation, is the B.C. Earthquake Response Plan (BCERP). Through IEPC, the BCERP was drafted as a support plan, providing personnel, advice and equipment to any municipality upon request. It is a concept-based plan that uses a realistic threat of a subduction earthquake registering 8.0 - 9.2 on the Richter Scale, in the coastal region and a major quake (R 7.0 - 7.5) elsewhere. With this in mind it identifies earthquake hazards and risks in a general way, and focuses on decentralized command and control, and response functions.

In addition, the B.C. Seismic Safety Council, established in early 1989, is a task force reports directly to the Government of B.C. and includes members from: the municipal level, regional Emergency Planning Committee, GVRD, Union of B.C. Municipalities, Provincial Ministries, four Crown Corporations, news media, and five federal departments. The mandate of the Council is to define private sector, municipal, provincial and federal responsibilities during a major earthquake. They also establish criteria for hazard analysis and risk assessment; determine strategies and priorities for dealing with a quake; and finally, make recommendations regarding earthquake preparedness. It is important to note that this initiative for the BCERP was not taken by the province. It was the Association of Professional Engineers of B.C. who realized the importance of the earthquake threat and pushed for a province-wide plan. Government agencies have also started to get more involved with preparedness. School boards in the Province are conducting earthquake drills, preparing children, and surveying the structural safety of schools. However, as of December, 1993 the province has frozen funding for the seismic upgrading of Vancouver schools because of the

staggering $6 billion dollar cost involved.[23]

At the regional level, the GVRD plays a role in maintaining and coordinating communication linkages in the event of a disaster. However, only five regional districts in the Province have this power and have taken on this responsibility. Under pressure from the municipalities, the GVRD created a Regional Emergency Planning Committee and completed a soil analysis as the first phase of the Earthquake Damage Prediction Survey to identify vulnerable areas in the Lower Mainland. However, there is a question if the funding will be available from the province to complete the second phase that called for structural assessment. Before the role of the GVRD can be expanded in emergency planning, the responsibilities of regional government needs to be better defined.

iii. Local Government - actions & responsibilities.

Even prior to the passage of the new Emergency Program Act in 1993, local government in British Columbia had an important role to play in hazard management and emergency preparedness. Under the Municipal Act, the Province has delegated statutory authority to local government. The delegation of authority to the local level allowed municipal governments to exercise discretion and enabled them to determine their own degree of involvement in emergency planning. Amendments to the Municipal Act in 1985 resulted in new regulatory opportunities and requirements for hazard management. Local governments must address the issue of geotechnical hazards in their

[23] Vancouver Sun, December 6, 1993, p. A1.

development policies and permits. They have the power to designate areas, restrict the use of hazardous areas and can protect development from hazardous conditions [Sec. 945].[24] Regarding Development Permits, the municipality may "specify areas of land that ...must remain free of development ...[Sec. 976] and where the geotechnical engineer ...determines that the land may not be used safely for the use intended, the building inspector shall refuse to issue the building permit. [Sec. 734]"[25] These changes are focused more on new development but municipalities are given more statutory authority to determine the acceptable level of risk and public safety, a determination based on the nature of the hazard, the density of land use and the exposure to the hazard. Based on this analysis, municipalities have the power to set policies and enact bylaws, with public and provincial input, that will mitigate the hazards facing the municipality.

Many Canadian municipalities, under the authority provided by provincial legislation, are adopting bylaws that establish emergency plans.

> The Vancouver Emergency Plan was approved by City Council in 1979 and is a comprehensive, all-emergency plan which designates who is in charge, coordinates the emergency response, effectively uses resources and coordinates the emergency response of other municipalities, support agencies and other senior levels of government. The Plan is an umbrella document which outlines the emergency responsibilities and procedures in general terms, while departmental emergency plans specify detailed responsibilities and procedures. [26]

The policy followed by the City of Vancouver is general, reflecting the belief that

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[24] Peter W. Cave, "Hazard Acceptability Thresholds for Development Approvals by Local Government," in Geologic Hazards in British Columbia, (Victoria:1992), p. 15.

[25] Cave, (1992), p. 15.

[26] Peter Anderson, Nathan Edelson, Betty Hansen, Ruth Harding, Kari Huhtala, and Laurie Laughy, Hazard Management Planning in British Columbia: Issues and Challenges, (Vancouver: UBC, Centre for Human Settlements, 1990), p. 12.

specific hazards are too variable and unpredictable to plan for effectively. However, more recently, the City has realized that a great deal can be done to prepare in advance for earthquakes. The 1989 San Francisco earthquake has been the catalyst for big changes in emergency management, especially for earthquake planning in Vancouver. The City has been conducting structural assessments of all city-owned buildings and the School Board has assessed and identified the hazardous schools. Vancouver is taking some steps in earthquake preparedness. They are in the process of building saltwater pumping stations, conducting seismic safety surveys of both city-owned and privately-owned buildings, and are upgrading city-owned bridges to seismic standards. The City of Vancouver is making some progressive steps by increasing its focus on mitigative measures and developing preparedness programs aimed at the neighbourhood level. John Oakley, Vancouver's Emergency Planner, notes that all four phases, mitigation, preparedness, response and recovery, need to be strong and coordination is the key.[27]

However, there is still a great deal that can be done in terms of land use management, zoning, seismic retrofitting, and non-structural mitigative measure to reduce the level of risk facing the Lower Mainland. Several stumbling blocks exist that prevent the City from focusing further on mitigating the earthquake hazard. The issue of uncertainty and financial constraints creates a lack of political will to address the earthquake hazard specifically. The City has developed a general emergency response plan that focuses on minimizing public injuries and property damage. To be effective their emergency plan involves coordination among the major civic departments focusing on the management of communications, the design and development of transportation

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[27] John Oakley, lecture given at Emergency Social Services Director's course, (Vancouver: Justice Institute of BC, February 10, 1994).

routes for emergency services and evacuation, and the provision of available emergency support resources.[28] This Plan has not been tested during a real crisis and the question is, will the existing plan be effective to deal with an earthquake that is as catastrophic as the one expected to hit the Lower Mainland?

Despite the new opportunities for involvement, many municipalities are reluctant to allocate resources to implement broader hazard management strategies. Even if they understand the risks and acknowledge the hazards that exist, they are concerned about the costs, the liabilities, and the political implications. It is possible that by clarifying the role of local government, streamlining procedures and having greater knowledge about the hazards and more technical expertise and funding available, local government will take advantage of their legislated authority in hazard management and establish more proactive, mitigative strategies.

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[28] Anderson, Edelson, Hansen, Harding, Huhtala, and Laughy, (1990), p. 13.

D. Developments in Emergency Management Policy

It has been shown that it is possible to contain losses to life and property caused by earthquakes by implementing policies that emphasize proactive planning in all four elements of emergency management: preparedness, response, recovery, and mitigation.[29] It has been learned that it is not sufficient to be reactive and respond to disasters after they occur. Governments, taxpayers, and responders can not deal with the increasing recovery costs and number of people that are at risk from possible hazards.[30] It is no longer politically, socially, economically or morally acceptable to ignore this issue and the impacts that disasters have on our communities.

Ideally, once a problem is recognized and acknowledged, then policy should develop to deal with it. If safety becomes a community goal, the policies must ensure that: this goal is being met; that the community can respond to disaster; and that policies adopted do not increase the risk. As hazard issues are acknowledged and put on the political agenda, various policy approaches should be analyzed to determine their suitability within the existing political climate. Increased awareness about the scope of disasters and costs of the recovery; media attention on the issue; and recent events in other locations tend to bring the issue into greater focus in the policy arena. In addition, it is acknowledged that citizens have a right to safety and all levels of government have a responsibility to take efforts to reduce the level of risk that people live with.

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[29] William J. Petak, "Emergency Management: A Challenge for Public Administration," in Public Administration Review, Special Issue, 45, 1985, p. 3.

[30] Petak, (1985), p. 4.

However, hazard mitigation activities take on a different character than policy-making done for the preparedness, response and recovery phases of emergency management. Preparedness, response and recovery are viewed as more 'active' phases of policy-making. They tend to be more intense, exciting, urgent, news-worthy and therefore more politically salient. Hazard mitigation activities, on the other hand, are characterized by 'apathetic' politics. "Mitigation typically has low political salience and, as a result, is relegated to the backwaters of governmental agendas. Apathetic politics are marked by disagreement among public officials about what risks are involved, their costs, and what to do about them."[31]

The work done on hazard mitigation arose out of the school of thought known as human ecology. The focus of this school of thought is the relationship and adaptability of humans to their natural environment.[32] Much of the research done on hazard mitigation has been oriented towards planning and policy-making, but studies have tended to take either the process or the content approach but not both.[33] For example, Olson and Nilson (1982) take a content approach by identifying different planning measures to take to mitigate hazards and examine how they can be packaged effectively for implementation. Whereas Alesch and Petak (1986), use a process approach to study how policies are made and how various factors, such as advocates, interest groups and recent earthquakes influence the implementation process.[34] Berke and Beatley identify

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[31] Philip R. Berke and Timothy Beatley, Planning for Earthquakes: Risk, Politics, and Policy, (Baltimore: The Johns Hopkins University Press, 1992), p. 6.

[32] Berke and Beatley, (1992), p. 23.

[33] Berke and Beatley, (1992), p. 24.

[34] Berke and Beatley, (1992), pp. 24-25.

several problems inherent in separating content from process in the research done on hazard mitigation. First, the process literature does not draw on the content literature for viable mitigation strategies. Secondly, the content literature does not consider how the changes that occur in organizations and in the policy environment over time can affect the appropriateness of the mitigative strategies. Finally, the literature tends to underestimate the capacity of public agencies acting in an advocacy role to raise awareness, develop networks of support and influence the planning process.[35]

To ensure successful mitigation strategies are implemented, it is crucial that the content fits the process and vice versa. That is, the mitigative measures put forward by any community need to be appropriate at that time and respond to the variations in the policy arena, such as stakeholders demands, budgetary constraints, hazard characteristics, and technical and administrative capacity.[36] For example, a building retrofit strategy may have to be modified periodically to reflect changes in the local economy. Incompatibility between mitigation strategies and the political climate could be part of the reason why proactive strategies for earthquake preparedness and mitigation been ignored even after they were adopted. For example, earthquake engineers have developed new construction techniques but some U.S. communities have failed to include them in their building codes. Also seismic codes that are put on the books are often not adequately enforced.[37] From the research, it appears that the problem is political in nature, arising from differences in the types of policies; types of politics; strategies taken

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[35] Berke and Beatley, (1992), p. 25.

[36] Berke and Beatley, (1992), p. 26.

[37] Richard S. Olson and Douglas C, Nilson, "Public Policy Analysis and Hazards Research: Natural Complements," in Social Science Journal, 19 (January), 1982, p. 89.

during various policy stages, and from the separation of content from process during policy-making. A typology "can help determine which measures are likely to succeed or fail given variations in local political and economic conditions, as well organizational capacity." [38] Theodore Lowi's typology can be used to account for changes in hazard management policy over time.

i. Lowi's Policy Typology.

Theodore Lowi (1964) did some early work on creating an extensive typology of policies. His argument is that policies determine the politics used by decision-makers. [39] The policy choices that are made by decision-makers are also influenced by their perception of the issue and the role government should play in the process. Lowi sees government as a coercive force influencing either individuals or society. "In Lowi's four-cell typology, government coercion is either 'remote' or 'immediate', and impacting on either 'individual conduct' or the 'general environment of conduct'. The resulting policy types are distributive, constituent, regulative, and redistributive, reflecting rising potentials for political conflict." [40] The policy types proposed by Lowi are reflected in the approaches taken as emergency management policy has developed in North America.

Distributive policies were first implemented in the 1950's and they "are essentially

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[38] Berke and Beatley, (1992), p. 27.

[39] Theodore J. Lowi, "The Four Systems of Policy, Politics and Choice." Public Administration Review, Vol XXXII, 4, July-August, 1972, pp. 298-310.

[40] Olson and Nilson, (1982), p. 93.

non-coercive policies which confer advantages on specific beneficiaries (individuals, firms, towns), the burdens or costs of which are borne by the general revenue system and are thus (usually) only dimly perceived."[41] As such, there is little conflict over who receives the benefits because they are disaggregated and distributed at the individual level. In essence, the government socialized the environmental risk by redistributing money from taxpayers to the victims in order to restore the area to pre-disaster conditions. Containing or controlling the hazard with a technological fix is also a distributive policy approach. For example, controlling flood risk by building dams initially proved very attractive because of the employment opportunities but the result was high costs, adverse environmental effects and increased habitation in the hazard area. This has decreased the enthusiasm for structural solutions. The effect of a distributive policy is twofold: it absolves individuals of responsibility for the risk and conveys the message that it was okay to rebuild in hazardous areas.[42] These factors and the prohibitive costs, forced policy-makers at all levels of government to consider alternative strategies for managing natural hazard risk.

Constituent policies are also non-coercive but the focus is on groups rather than individuals. [43] These constituent groups are given power by the government of the day to set standards and establish strategies that they see fit. They are often professional organizations that are self-regulating themselves. For example, in 1970 after some

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[41] Olson and Nilson, (1982), p. 93.

[42] Peter H. Rossi, James D. Wright, and Eleanor Weber-Burdin Natural Hazards and Public Choice: The State and Local Politics of Hazard Mitigation, (New York: Academic Press, 1982), p. 50.

[43] Olson and Nilson, (1982), p. 94.

intense lobbying by the California Building Officials and the Structural Engineers Association, the State of California turned the writing of building codes over to a private organization known as the International Conference of Building Officials (ICBO).[44] Despite the fact that the policy was set by a private group of experts, all communities in the State had to accept and adopt the ICBO's Uniform Building Code. These groups of experts obtain power and survive because they can overcome any opposition that threatens their domain because opponents are likely non-experts who may be poorly organized, unprepared, and ill-informed.

Regulative policies "differ from the first two types in that they entail the likelihood of government coercion, with the object of coercion, the non-complying individual entity. This type of issue is characterized by substantial political conflict over relatively rigid standards."[45] Generally, there are at least two organized, opposing groups, with legitimate interests, that try to reach agreement or compromise by engaging in conflict resolution of the issue. The focus of policy-makers is on control of the impacts of hazards at the local level through increased regulation, effective land-use management, strict enforcement of building and construction standards, and greater preparedness and planning. This attempt at a behavioral fix is more cost effective and has fewer negative environmental impacts than technological fixes but it has met with mixed success because of problems with implementation at the local level. Differences in perception of the issue; the risk involved; the costs of land acquisition; the reluctance to give up development opportunities in already dense areas; and a heavy administrative

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[44] Olson and Nilson, (1982), p. 94.

[45] Olson and Nilson, (1982), pp. 94-95.

requirement placed on the already burdened local government, have resulted in conflict over regulatory measures.

Redistributive policies "are expected to have the greatest impact on the community because the objects of government coercion are whole segments of the population. Redistributive policies demand that benefits be provided to one set of interests at the expense of another."[46] The decision-making process is both elitist and intense. The stakes are high and the issues have a high potential for conflict. In an effort to minimize the disruptiveness of very controversial policies, decisions are made behind closed doors and policies agreed upon before they are announced publicly, thereby leaving little opportunity for public debate. For example, when the City of Los Angeles implemented their seismic retrofit policy in 1980, this is the approach they took. It quickly became a controversial issue that affected many stakeholders who perceived the costs and benefits of the policy from different perspectives. It illustrates what Lowi tries to show with his typology. Not only does the issue influence the way in which a policy decision is made, but the appropriate implementation strategy must also be determined for the current political climate. The four policy types suggested by Lowi are interactive and there can be shifts from one to another given the political climate. For example when distributive policies became too costly for the government to endure, they began to establish regulatory policies that reduced the exposure and impacts of the hazard.

The effort by higher levels of government to devolve the power for decision-making to the local level may cause further conflict. Upper levels of government who

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[46] Olson and Nilson, (1982), p. 95.

have a long history of dealing with all kinds of disasters throughout the whole country perceive them differently than local governments who deal with them infrequently and lack the administrative capabilities and the political will to deal with them effectively. There are several ways to remedy this situation. It is critical to improve inter-governmental coordination, change the risk perception of both the public and decision-makers, alter funding arrangements, create agencies for emergency management, and make preparedness a priority. It appears that the policy focus now is more on strategies that advocate mitigation of hazards. However, the implementation of these policies is critically dependent on the appropriateness of the policy and on the cooperation and active support of both local government and the public.

ii. Berke and Beatley's Typology:

Berke and Beatley simplify Lowi's work somewhat while still using the idea that the strategies a government adopts are either coercive or non-coercive. They classify a range of planning measures used in formulating mitigation strategies into three broad categories.[47] The first are regulatory measures, which are coercive because they attempt to control the activity of a specific interest group with regulations and requirements. Implementing a mandatory seismic retrofit policy is an example of a regulatory measure. It is a regulatory policy but Lowi chose to call the seismic retrofit policy adopted in Los Angeles a redistributive policy because the costs were borne by one group, the building owners, while the benefits of improved seismic safety were

[47] Berke and Beatley, (1992), p. 27.

redistributed to the entire city.

The second policy type put forth by Berke and Beatley are incentive measures. They are non-coercive since the aim of the policy is to induce change rather than regulate. For example the transfer of development rights is a way to encourage preservation of existing buildings. Finally, informational measures, educate people about the hazards they face and allow them to make more informed decisions. Identifying hazardous structures or requiring real estate disclosure about hazards are informational measures. This is a simpler typology but both Lowi and Berke and Beatley shed some light on the different strategies taken and the changes that have occurred on the mitigative side of emergency management. What is most important about these typologies is they attempt to classify the different approaches used to implement policies given the wide range of issues and interests involved in the policy-making arena. Like the effort to fit policy content and policy process, typologies attempt to determine what works and what does not given the existing political, economic and social climate.

E. Role of Community and Emergency Planners in Hazard Mitigation.

Ideally, when a community has identified and acknowledged the hazards they face, they confront the issue, take positions, and decide on a suitable policy to follow. The reality of the planning process for establishing hazard mitigation policy is not always as rational and orderly as this. The research done by Petak and Alesch (1986) on a number of local seismic retrofit policies illustrates that the process by which most plans and policies are adopted and implemented does not conform to the rational approach. "These researchers' characterization of emergency planning suggests that people do not first clearly recognize hazards problems and then seek solutions to them. The processes of problem definition and solution development do not occur in sequence. Problems and solutions exist independently." [48] In addition, various factors and issues facilitate and constrain the recognition of the problem and the solutions proposed. Planners, in general, have a role to play in identifying problems and developing compatible plans and policies to solve them. Planners' perceptions of issues influence the decisions that are made and the policies put forward to both the public and the politician. Planning is a decision-making process that examines policy issues and assesses alternative solutions to the problem at hand. Both planning and policies cannot be fixed, but rather, they must be flexible and adapt to new circumstances.

With the hazard management issue being perceived from a more integrated and interdisciplinary perspective, emergency planners have been given a larger role to play in policy development and implementation. Hazard management must be incorporated

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[48] Beatley and Berke, (1992), pp. 28-29.

with the other factors considered when making community planning decisions. This means that community planners and emergency planners need to laise with each other in the policy-making arena. Effective hazard mitigation must include an understanding of the interaction of the components within the entire urban system. It is the role of both community and emergency planners to bring these components together and act as facilitators for all the interest groups involved in the decision-making process. Planning for disasters must identify the hazards, consider variables such as the scale, and the possible context the disaster could take, such as when it could occur and where it could impact. Planning decisions are also based on the level of reasonable risk acceptable for that community. It is important to note that the decisions made regarding policies are influenced by how hazards and risks are perceived by politicians, planners, and the community. The influence that risk perception and the political salience of the hazard management issue will be discussed further in a separate section.

The goals of urban planning are often the same goals that emergency planners strive for when improving seismic safety. Both are concerned with population densities, protection of facilities and provision of services, and the continuation of economic activity. Community planning and hazard mitigation are both proactive and long-term processes. The planning process in earthquake-prone cities should take seismic safety into account as it would any other factor in the environment. Community planners are making decisions about the use of land and the people who live on it and therefore can play a role in reducing the potential impact of an earthquake. They can facilitate this process by incorporating some additional information into the factors they consider when making decisions.

First, emergency planners must assess the seismic vulnerability of their city.

There are several elements of the urban system that must be looked at when determining how vulnerable a city is to an earthquake. The first element is the design and strength of man-made structures and systems of the city and secondly, where they are located. Finally, the activity pattern of the population, its distribution and density, and the time of day determine the impact an earthquake can have on an integrated urban system. In terms of seismic safety, "city design can significantly influence community resilience to earthquakes...[and] it is possible to design to minimize seismic risk."[49] One goal of emergency planners is to increase a community's resiliency, that is, its ability to absorb shocks and return as quickly as possible to a state of normalcy. Planners should focus mitigative efforts on areas in the community where buildings are the most vulnerable, facilities that are most critical, and on the populations with special needs. These areas have a lower resilience and will require more resources to recover from disaster.

Seismic microzonation studies is a tool for planners to use that identifies more precisely the location of hazardous geological and soil conditions within a city. Areas of potential slope failure, soils subject to ground motion amplification, landslides, or liquifaction should be mapped and used as an additional resource for land-use and development decisions. When land-use planners incorporate this information into their decision-making process they can create a safer city.

Identification of the hazardous areas and the vulnerable buildings and populations are the first step emergency planners can take in earthquake preparedness. It allows

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[49] Susan G. Heikkela, (ed.) Urban Scale Vulnerability, Proceedings of the U.S. - Italian Colloquium on Urban Design And Earthquake Hazard Mitigation, (Rome: October 12 - 16, 1981), p. 12.

planners to educate the public and get involved in setting priorities in their effort to mitigate the hazards. However, they also have a key role to play in the response, rebuilding and recovery process after a disaster. In terms of immediate disaster response, emergency planners should have strategies in place ready to deploy aid to vulnerable areas, preplan for alternative communication systems, set up programs for financial assistance, and have resources available for search and rescue and emergency social services. Community and emergency planners also have a role in rebuilding communities after disasters. They need to interact to develop strategies for community economic recovery and business resumption as well as establish prearranged avenues for citizen input into redevelopment decisions.

Table 1 shows a number of planning measures that can be taken by both community and emergency planners in an effort to mitigate the earthquake hazards in a community. [50]

[50] Adapted from Berke and Beatley, (1992), p. 10.

TABLE 1 - PLANNING MEASURES FOR EARTHQUAKE HAZARD MITIGATION

PLANNING-

* Comprehensive or land use plan that includes an earthquake component.
* Recovery/reconstruction plan.

PURPOSE: TO IDENTIFY HAZARDOUS AREAS AND ADOPT MITIGATION POLICIES THAT GUIDE DEVELOPMENT AND REDEVELOPMENT IN HAZARDOUS AREAS.

DEVELOPMENT REGULATIONS-

* Zoning ordinance.
* Subdivision ordinance.
* Fault setback ordinance.

PURPOSE: TO CONTROL THE TYPE, LOCATION AND DENSITY OF DEVELOPMENT IN HAZARDOUS AREAS.

BUILDING STANDARDS-

* Building code.
* Special seismic resistance building standards.
* Retrofit standards for existing buildings.

PURPOSE: TO STRENGTHEN EXISTING DEVELOPMENT AND REQUIRE NEW DEVELOPMENT TO WITHSTAND SEISMIC FORCES.

LAND AND PROPERTY ACQUISITION-

* Transfer of development potential from one site to another.
* Acquisition of underdeveloped lands.
* Acquisition of development rights.
* Building relocation.
* Acquisition of damaged buildings.

PURPOSE: TO REMOVE EXISTING DEVELOPMENT OR PREVENT FUTURE DEVELOPMENT IN HAZARDOUS AREAS.

CRITICAL AND PUBLIC FACILITIES POLICIES-

* Capital improvements programs.
* Location requirements for critical facilities (hospitals, schools, police and fire stations).
* Location of infrastructure (streets, waterlines, gaslines) in less hazardous

PURPOSE: TO DIRECT NEW DEVELOPMENT AWAY FROM HAZARDOUS AREAS (OR AT LEAST DO NOT ENCOURAGE IT).

TAXATION AND FISCAL POLICIES-

* Impact tax to cover additional public costs of building in hazardous areas.
* Reduced or below-market taxation for open space or non- intensive uses in hazardous areas.

PURPOSE: TO MAINTAIN LOW DENSITY IN HAZARDOUS AREAS.

INFORMATION DISSEMINATION-

* Public information program.
* Hazard disclosure requirements.

PURPOSE: TO INFORM THE PUBLIC AND THOSE INVOLVED IN REAL ESTATE TRANSACTIONS ABOUT HAZARDS.

F. Possible Impacts of Earthquakes on Historically Significant Buildings

i. Effects of Earthquakes on URM Buildings.

Several factors determine how well a building performs in an earthquake and the extent of damage to that building. Each earthquake has specific characteristics, such as duration of shaking, ground acceleration (lateral forces), ground displacement (vertical movement), and velocity, that affect locations differently. The impact the earthquake has is influenced by the geological and soil conditions around and under each building. Other important factors in building performance are the design of the structure and the construction methods and materials used to build it.

Unreinforced masonry buildings (URMs) were generally built before the Uniform Building Code (UBC) in the US and National Building Code of Canada (NBC) required structural reinforcement. URM's have a tendency to fail because of a lack of vertical and horizontal strength in the masonry walls and because of the deterioration of the mortar holding the bricks together. Built around the turn of the century, most URM's have similar construction. They are typically brick, beginning with several widths of brick at the bottom of the load bearing walls and tapering to fewer widths in the upper stories. Most have timber framing of floors, interior walls and foundation joists and beams that are susceptible to rot and decay. The bricks are held together with mortar that tends to become brittle and deteriorate with time and lack of maintenance. Most importantly, these buildings have no reinforcement to tie the parts of the building together and this increases the possibility of failure or separation of the building elements during an earthquake. A building has little resistance to the lateral forces of an earthquake when

the building elements such as; parapets, chimneys, walls, and unreinforced foundations, are not tied together. Failure of these elements can affect the life-safety of the occupants, and people on the street, and threaten the structural integrity of the buildings.

The lesson that URMs are hazardous has been learned especially well in California. In the 1933 Long Beach earthquake, 86% of URMs failed in some way and this earthquake caused a change in the public policy in California.[51] URM buildings were no longer constructed and rudimentary earthquake-resistant design was required for all non-residential buildings. However, the lessons about the hazards of existing URM buildings continued with subsequent earthquakes. In San Fernando, 1971, 50% of pre-1934 masonry suffered moderate to severe damage.[52] In Coalinga, the 1983 earthquake caused 31 million dollars of damage, where 30 of 40 URMs were more than 60% damaged.[53] And in 1989, the Loma Prieta earthquake has exceeded 2 billion dollars in damage and destroyed blocks of the downtown in Santa Cruz, Watsonville, Los Gatos and parts of the South-of-Market area in San Francisco.[54] Despite the early recognition of the hazards posed by existing URM buildings in California, there was no concerted effort to reduce the hazard until 1981. The State called upon local governments to adopt ordinances requiring that URM buildings be strengthened. Historic buildings were given their own California State Historical Building Code to follow that also required

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[51] William Spangle and Associates, Strengthening Unreinforced Masonry Buildings in Los Angeles: Land Use and Occupancy Impacts of the Los Angeles Seismic Ordinance, (Sunnyvale, CA: Consolidated Publications Inc., 1990), p. 15.

[52] Spangle, (1990), p. 15.

[53] Spangle, (1990), p. 15.

[54] Spangle, (1990), p. 15.

retrofit of the building to reduce the earthquake hazard. However, not all communities adopted these ordinances and the 1983 Coalinga quake, the 1987 Whittier quake, and the 1989 Loma Prieta quake provided proof that the lack of a program greatly increased the damage level, particularly in historical central business districts.[55] These events, illustrated by Santa Cruz, reiterated that building collapse does not only kill and injure occupants and passers-by, but it leaves many people homeless and disrupts business and the economy.

In comparison, Vancouver's buildings conform to the National Building Code of Canada. New buildings designed to conform to the requirements of the 1990 NBC, should be able to resist a moderate earthquake without significant damage and a major earthquake without collapse. [56] However, the current code has some deficiencies. In Vancouver, a city lying in a region of high seismicity, the NBC code requirements for earthquake resistant design of engineered buildings are lower than required in San Francisco. The code does not address development on soft soil deposits, or consider the possibility of a subduction zone earthquake. [57] Although it is beyond the scope of the NBC, there is no consideration given to existing buildings designed before codes were in place or those designed to meet old codes, now considered to be inadequate. [58] "It is

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[55] John Kariotis, Mike Krakower and Nels Roselund, The Engineers' View. Loma Prieta: Historic Buildings, Earthquake Damage and Seismic Strengthening , (Oakland, CA: Preservation Foundation, 1991), pp. 4-5.

[56] National Research Council of Canada, Supplement to the National Building Code of Canada 1990, (Ottawa: National Research Council of Canada, 1990), p. 202.

[57] City of Richmond, Earthquake Design in the Fraser Delta, Task Force Report , (June 1991), p. 5.

[58] J.H. Rainer, A.M. Jablonski, K.T. Law, and D.E. Allen, "The San Francisco Area Earthquake of 1989 and Implications for the Greater Vancouver Area," in Canadian Journal

strongly recommended that these factors be addressed, and that existing construction be evaluated and retrofitted where necessary. This includes the continued examination and revision, where necessary, of applicable building regulations." [59] Given the inherent danger of URM buildings and the fact that they are the most common type of historic building the search must continue for ways to mitigate these hazards and implement seismic strengthening policies.

ii. URM building development over time:

Most of the URM buildings, many considered to have historic significance, were built around the turn of the century during periods of growth and speculation. During periods of economic slowdown many cities had a large number of vacant URM buildings that were not maintained. The level of deterioration was found to be pervasive in URM buildings in a study done on the seismic hazards in seven small towns in the U.S. Pacific Northwest. [60] Few of the buildings in these towns have undergone any significant rehabilitation since they were built.

> The economy of the towns influenced both the level of expenditure by owners on rehabilitation and the level of enforcement by building officials within the community. Owners could not expend more than they could expect to return from rent in a building and building officials could not realistically require an owner to expend more than that owners resources

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of Civil Engineering , 17 (5), October, 1990, p. 811.

[59] Rainer, Jablonski, Law, and Allen, (1990), p. 811.

[60] National Science Foundation, Earthquake Hazards Mitigation Program, Seismic Hazards in Unreinforced Masonry Buildings in the Pacific Northwest: Findings on the Structural Conditions of Unreinforced Masonry Buildings in Seven Study Towns, (1985), p.ii.

allowed to retrofit the building to reduce potential hazards. [61]

There is a direct relationship between the strength of the local economy and the level of maintenance and rehabilitation of existing buildings. The level of deterioration not only increases the potential seismic hazards but reduces the basic structural integrity of the structure and threatens the longevity of buildings as economic and cultural resources.

As traditional industries waned and the preservation movement developed in the early 1970's, many communities looked towards increasing tourism as a means of economic development. Towns such as Santa Cruz, California; Port Townsend, Washington; and areas such as Vancouver's Gastown and Seattle's Pioneer Square were rehabilitated to capitalize on the lucrative tourist industry. Financial incentives and tax reform helped encourage preservation, but generally, there was no requirement for seismic strengthening when a building was rehabilitated. Much of the rehabilitation that was done was cosmetic and very little structural reinforcement was done on the whole building especially if the rents did not cover the costs of retrofit and the codes were not enforced. In the study done on towns in the Pacific Northwest, several factors affected the enforcement of seismic building codes. In many cases, the local government had not established a policy to correct potentially hazardous conditions caused by existing buildings. If a policy had been established, many local building officials lacked the knowledge to enforce the seismic provisions of the building code, and secondly, the town's economy was often dependent on the continued use of these buildings. [62] Building values were based on the amount of rentable space and the income generated

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[61] National Science Foundation, Earthquake Hazards Mitigation Program, (1985), p. 15.

[62] National Science Foundation, Earthquake Hazards Mitigiation Program, (1985), p. 14.

from the occupants, rather than on the historical value or structural integrity of the building itself. If the market could absorb the higher rents to cover the costs, the owner might decide to renovate the building rather than demolish it especially as more financial incentives became available for preservation and the costs of demolition increased. However, since many of the upper floors of these buildings remained unoccupied, they remained unrenovated. In some cases, partial demolition of upper stories occurred, destroying both the architectural character of the building and reducing space that could be potentially used for housing. More importantly, the guidelines and incentives established to encourage preservation did not address the engineering or structural aspects necessary for seismic retrofit of existing buildings. However, despite URM buildings being destroyed by previous earthquakes, by attrition or by demolition to make way for redevelopment, many have survived into the 1980's and 90's. They often serve as landmarks providing a sense of history in the older sections of cities and play a role in providing space for both commercial use and housing. In many cases, where it was economically viable, URM buildings have been improved upon and renovated. However, unless the hazard posed by these buildings has been recognized and a seismic retrofit policy has been established and enforced, the hazards have gone unmitigated, threatening both life-safety and the economic livelihood in earthquake-prone communities. The following diagram illustrates all of the factors that affect and influence the degree of hazardousness that URMs pose.

FIGURE 3 - FACTORS THAT AFFECT THE POTENTIAL SEISMIC HAZARDS [63]

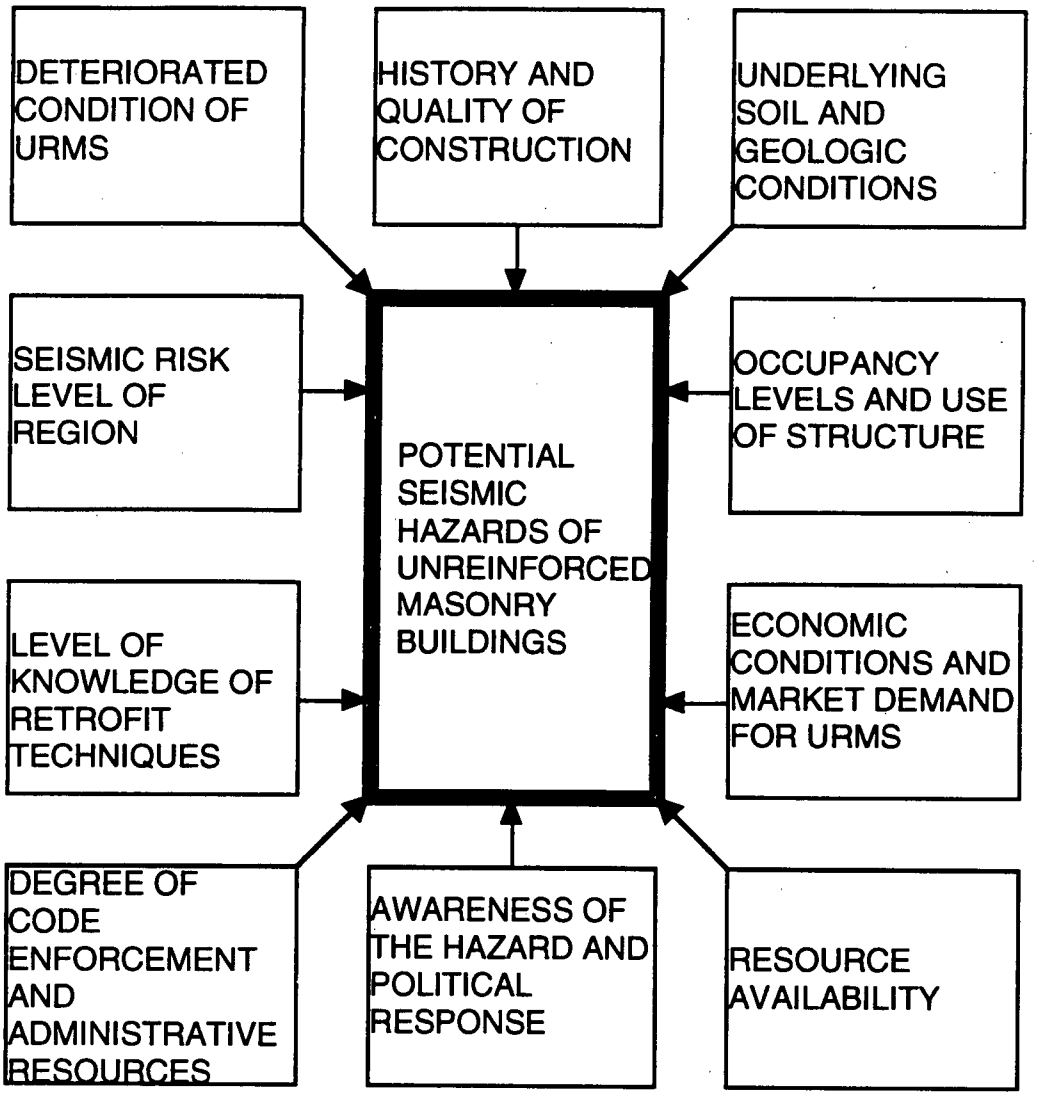

FIGURE 3

[63] Adapted from National Science Foundation, Earthquake Hazards Mitigiation Program, (1985), p. 19.

iii. Potential earthquake impacts in Vancouver.

As with most North American cities established before the turn of the century, Vancouver has a large stock of older unreinforced masonry buildings, many with historic value. Areas such as Vancouver's Gastown, Yaletown, and Chinatown, and the downtown core of New Westminster, have many potentially hazardous buildings. The older buildings in these areas are vulnerable and could be heavily damaged even in a moderate quake. This has been acknowledged because "since 1989, the City of Vancouver has increasingly required a seismic evaluation of a building before issuing building permits and approving changes to the classification of building licences. The evaluations make no distinctions between heritage and non-heritage buildings, and lump nearly all heritage type buildings together under the URM classification." [64] However, the costs of renovating and retrofitting buildings to current seismic standards and the limited rents they receive often deter the owners from making any changes, essentially "freezing" any renewal and restoration. Unless the building is designated as "heritage" or in a designated "heritage district", demolition is often seen as a viable and justified end to many of these buildings since they are perceived to be unsafe and uneconomical. The answer to the upgrading issue lies in the development of an alternate building code designed specifically to meet the special needs of older buildings with heritage value. It is often very costly and difficult to bring these pre-code buildings up to current fire, electrical, accessibility, and seismic standards. Rather, the focus should be on tying the building together while maintaining architectural integrity. More research is needed on

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[64] Michael Kluckner, Paving Paradise: Is British Columbia Losing Its Heritage? (Vancouver: Whitecap Books, 1991), p. 96.

the construction methods and material used in the past and the strengths inherent in the building materials. This helps determine why have some buildings in other cities survived through several major earthquakes and some have not. Each building needs to be studied individually in terms of structural configuration, symmetry, soil and geologic conditions, and by use and occupancy levels to determine its retrofit requirements and priority in the process. Refining the analysis and looking at each building on a case-by-case basis may reduce the amount of upgrading required. In addition, alternative code requirements would require seismic retrofit of these buildings while offering both grants, low-interest loans, and tax incentives. Michael Kluckner, a leading preservationist in Vancouver, suggests that the city could help owners by "imposing a ten year assessment freeze on renovated buildings, except for an inflation adjustment, and by then phasing in a new assessment over a five year period." [65] Secondly, it has been suggested that an accelerated write-off on the capital cost of a heritage building (as done in the U.S.) would help. Finally by allowing a write-off of all the expenses of retrofitting in a single year would also encourage rehabilitation. [66] Currently, the provincial Heritage Conservation Branch is looking into the possibilities of writing an alternate historic building code that will establish standards for buildings with historical significance.

A City report done in 1991 called for further study of the buildings at risk during an earthquake after it was estimated that "more than 2,000 privately-owned buildings in Vancouver are at risk of being seriously damaged or destroyed." [67] In 1991, the

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[65] Kluckner, (1991), p. 100.

[66] Kluckner, (1991), p. 101.

[67] Vancouver Sun, March 16, 1991, p. B16.

Director of Permits and Licensing, Roger Hebert, "said only 150 of the 2,000 at-risk buildings in Vancouver have been brought up to seismic standards." [68] A consulting firm submitted the report in 1992 that used a magnitude 7 quake as its base. They determined, "30,000people live in "vulnerable buildings" and that at least 8,000 dwelling units in Vancouver could be seriously damaged or completely destroyed".[69] The report stated that it would cost $40 million to $45 million to strengthen city-owned buildings at risk, such as City Hall, police stations, firehalls, theatres, libraries, and low-income seniors housing.[70] This estimate does not cover the cost of upgrading hospitals and schools which fall under provincial responsibility. Nor does it cover the costs of upgrading privately-owned buildings, an issue that the City of Vancouver is currently studying. When presented with the evidence, seismic upgrading appears to be a very daunting and expensive task for any city to undertake. However, when the cost of replacing the buildings, roads and infrastructure after the earthquake is considered, the costs of mitigating hazards before an earthquake occurs do not seem so high. This does not even consider the important issues regarding the potential loss of life, the loss economic viability and a community's sense of place, In a recent article in the Vancouver Sun, UBC Commerce professor, Peter Nemetz "estimated damage from such a hugh quake [R 8.0] could total $50 billion to $95 billion in the Lower Mainland alone. He has estimated that a moderate quake, similar to the one that hit Los Angeles in January 1994, could cause $13 billion to $26 billion in damage if it occurred near

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[68] Vancouver Sun, March 16, 1991, p. B16.

[69] Vancouver Sun, March 14, 1992, p. C8.

[70] Vancouver Sun, March 14, 1992, p. C9.

Vancouver." [71]

Closer examination of the seismic retrofit policies in other cities will illustrate the need for all levels of government to get more involved with putting hazard mitigation on their political agenda and implementing proactive mitigative strategies to reduce the earthquake hazard in British Columbia. Evidence from other earthquake-prone cities will show that seismic retrofit of hazardous buildings has had significant effects on reducing the number of lives lost and the costs of property damage. Upgrading structures is something that can be done incrementally starting with those buildings that pose the most immediate risk to the most vulnerable people. Garry Rogers, a geologist with the Pacific Geoscience Center, states that, "you can't fix them all tomorrow because its too expensive, but you need a sensible plan over a couple of decades. ... No government has yet had the guts to do that." [72] If the costs are prohibitive for extensive seismic upgrading, it makes sense to start with buildings which pose the most immediate risk to the most vulnerable people. This is an important step for cities in British Columbia to take towards protecting lives and property with effective hazard mitigation while giving consideration towards preservation of buildings with historical significance.

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[71] Vancouver Sun, January 18, 1994, p. A3.

[72] Vancouver Sun, January 5, 1994, p. A2.

CHAPTER 3

ISSUES AFFECTING DECISION-MAKING AND POLICY IMPLEMENTATION

A. Introduction.

Once the problem is defined, the issues and factors that influence the decision-makers involved in establishing a mitigative strategies can be discussed. Chapter Three illustrates the cultural and socio-economic value inherent in existing buildings, and identifies reasons for protecting historically significant buildings. Implementing a seismic retrofit policy would strengthen these buildings and help protect the people who live and work in them. In addition, the responsibility that local government has for the life-safety of the public will be discussed. The second major issue is how the political and economic landscape influences the decisions that are made and the policies that are implemented. More specifically, perceptions of risk, the political salience of the issue, and limited resources are discussed as some of the reasons why the public, planners and politicians have neglected this issue.

B. Reasons for Protecting Existing Buildings.

i. Cultural value.

Prior to establishing mitigative policies to reduce seismic vulnerability, the community must recognize the hazard that URMs pose and acknowledge the value of historical buildings. They must make a commitment to preserve existing buildings with historical significance for the cultural value they hold as well as for ensuring greater

community safety. Every town and city has some historically, architecturally, and culturally significant structures. They give the community its 'sense of place' and provide a cultural orientation for both residents and visitors. Preservationists have long held that this creates a sense of continuity and identity for the community. The Provincial Heritage Conservation Branch recognizes this in its definition of heritage conservation. Heritage conservation "is not just about 'saving' this or that old building, but it is about the management of continuity within a context of change."[73] The elements of our cultural heritage all constitute a "trust", held now for people and for future generations to come. Hence, those who hold the trust, such as provincial and local government officials, have a responsibility to protect it and take actions to mitigate any hazards.

It has taken some time for the philosophy behind preservation to evolve to this concept that cultural heritage is held in trust for future generations. Prior to the 1960's in North America, heritage sites were treated as a collection of curios and preservation was viewed as an extension of museum curatorship. However, in the late 60s and early 70s several changes occurred. There was increased concern about the effects of large-scale urban renewal and increased awareness of the value of heritage sites. Communities began to focus on creating livable cities and managing growth. Political concern and lobbying by newly formed preservation foundations, such as Heritage Canada, led to government intervention to save historic landmarks. The designation of significant buildings and heritage areas is a tool used to protect against demolition and ensure maintenance of the site. Designation of a building as a historic site, was viewed in a negative light because of its restrictive nature for redevelopment and the lack of

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[73] Heritage Conservation Branch, Heritage Planning: A Guide for Local Government , (Victoria: Province of British Columbia, 1992), p. 7.

economic resources for rehabilitation. Many historically significant buildings were demolished because building owners feared heritage designation. Building owners viewed designation as limiting the economic value and their right to use the property as they wanted. It limited the development potential of the property in a time when densities were increasing in downtown areas. Building owners might be compensated for these losses with payments, density bonuses, or transfers of density potentials to other sites (density transfers). These were often controversial and expensive policies for local governments to follow.

However, recent changes in heritage legislation have made more economic incentives and tax advantages available to those who restore or retrofit historically significant buildings. In British Columbia for instance, the Heritage Conservation Statutes Act of 1993, amends the Heritage Conservation Act followed since 1977. The new Act is citizen-driven and addresses the needs and concerns of an increasing number of stakeholders. It gives local government greater power in determining community heritage conservation policies and calls for integration with the community planning process. The new legislation safeguards the rights of property owners by ensuring their investment in heritage property is protected and they are compensated if designation results in a loss of property value. Local governments now have a variety of financial and non-financial incentives available to support heritage preservation. The new Act has provisions to deter and punish the destruction of heritage resources and encourages provincial ministries to take on a stewardship role by considering heritage issues in their decision-making processes.[74] Despite this commitment to heritage conservation by the

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[74] _____, An Introduction to the Heritage Conservation Statues Amendment Act, 1993. (Province of British Columbia, September 1993).

provincial and local government, in order for a building to be retained in this age of redevelopment pressure, the owner must want to participate. The same holds true for seismic strengthening. It takes more than the adoption of a preservation philosophy, the financial incentives and technical assistance have to be available to encourage owners to participation.

Designated heritage buildings, by the strictest definition, are generally historical monuments, valued for their cultural associations and architectural interest. "A historic building is supposed to say, (through its appearance), something specific about a period in time. If that appearance is uncharacteristically altered, then history is altered and defaced." [75] The overriding concern with this level of preservation is historical authenticity and architectural integrity. However, to protect buildings in earthquake-prone areas there is a need to "focus on preserving the structural integrity of historic buildings otherwise the building may not be around long enough to make any lasting statement." [76] Preservation should therefore focus on maintaining the physical fabric and structural integrity of the building as well as the architectural details. However, seismic work done on historical monuments, often calls for special construction skills and strengthening techniques that are expensive and time-consuming. Most communities can justify this expense for only a few special heritage buildings. This is the reason municipalities need to do an inventory of their heritage resources. This requires classifying and prioritizing buildings with historic value. The City of Vancouver has around 2400 buildings in its inventory.

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[75] National Science Foundation, Seismic Hazards in Unreinforced Masonry Buildings in the Pacific Northwest, Conference Proceedings , (1985), p. 78.

[76] National Science Foundation, Earthquake Hazard Mitigation Program, (1985), p. 78.

> Just over two hundred were classified as A's, that is, buildings that were considered to be of primary historical and architectural importance. The balance were B's which were important individual buildings that did not make the A grade, and C buildings, those usually of heritage character and part of a streetscape. [77]

Prioritizing buildings based on their heritage value determines where the money should be spent and allows for greater flexibility in decision-making. In addition, it reduces the number of buildings that the city is obligated to protect through zoning, tax breaks, compensation and incentives. Having an inventory on-hand after a disaster strikes, helps planners establish priorities for recovery activities. The natural response to any disaster is to start cleaning up right away and this can lead to the unnecessary demolition of historic resources. As with emergency planning, heritage planning is also a process of decision-making that should be integrated within the overall community planning system. Having a plan in place for post-disaster recovery, building officials trained in damage assessment for historic buildings, and strong ties established between the preservation community and local government, will reduce demolitions and ensure a preservation philosophy is part of rebuilding after a disaster.

ii. Socio-economic Value:

Doing an inventory of historic resources allows for a distinction to be made between historical monuments and historically significant buildings that provide a community with architectural interest, vitality, and a sense of place. The latter are existing buildings, with some historic character, that function as homes and businesses in

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[77] Kluckner, (1991), p. 18.

the community. They are often the heart and soul of the community, both socially and economically. Often the oldest parts of town, these neighbourhoods have become run down and buildings are left to deteriorate. Revitalization projects, such as Heritage Canada's Main Street program and the renewal of Vancouver's Gastown, have been successful at putting new life into downtown areas, stimulating economic growth and increasing tourism. Many communities have proven that rehabilitation attracts new businesses, strengthens the local tax base, and creates more jobs because it is more labour-intensive than new development. [78] Retaining the original structure is not as crucial as it is with historical monuments, and this allows for more creative use of existing space. This also means the repair and strengthening of existing buildings is not as constrained or expensive as it is with designated heritage buildings.

Integrating a social perspective into the planning process broadens the definition of 'heritage' planning. This broader concept of 'urban conservation' is not limited to the preservation of historic buildings or districts, but includes the retention of viable existing neighbourhoods. The emphasis is on retaining and revitalizing the urban environment to encourage continued use of existing buildings and to ensure stability, safety and security for those who live and work in the community. Michael Seelig suggests that the criteria used to designate heritage buildings can also be used for area conservation. "Areas of unique and consistent architectural expression, areas which were comprehensively developed during a period of historical significance, and areas that display homogeneity or other valuable aesthetic of historical characteristics should be considered for

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[78] National Science Foundation, Earthquake Hazard Mitigation Program, (1985), p. 80.

conservation." [79] Preservation can go beyond being a quality-of-life and cultural issue. It is also a movement against the increasing trend towards redevelopment and the attitude that buildings and communities are disposable. Rather, existing buildings can be viewed as a resource to be recycled. Preservation protects the hearts of towns and cities where we have not only historical assets but a socio-economic investment as well.

However, despite the many positive economic and social benefits urban revitalization provides, there can also be negative impacts on the community if the rehabilitation or retrofit process does not consider the people who live and work in these areas. In earthquake-prone areas, life-safety of the citizens is not the only concern behind the implementation of seismic retrofit policies. By minimizing property damage, these policies are also designed to reduce the economic losses that could occur in an earthquake.

> Life-safety is something we have a great deal of concern about, but in reality our economic loss is what was recognized by the City of Los Angeles when they adopted a hazard reduction ordinance, a mandatory reduction ordinance based essentially on reduction of loss of utility in a central city after an earthquake event. [80]

It stands to reason that by minimizing the threat of property damage, the threat to life-safety will also be reduced. Planners must consider those areas of the city and populations that may be more vulnerable to earthquake damage. For example, a study done on vulnerable buildings and special needs populations in Seattle, showed that URM buildings in the central city are often older apartment buildings and residential hotels

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[79] Michael Y. Seelig, Time Present and Time Past: Proposals for Area Conservation in Vancouver, (Vancouver: Department of Social Planning, City of Vancouver, 1973), p. 17.

[80] National Science Foundation, Earthquake Hazard Mitigation Program, (1985), p. 33.

occupied by low-income, elderly or foreign-born tenants.[81] With a large number of URMs present in a neighbourhood there is a greater potential for damage and a corresponding level of social disruption in the event of an earthquake. If there is a large number of people with special needs, a disaster can mean increased demands for assistance, especially for low-cost replacement housing. If planners are aware of the location of the most vulnerable buildings and populations, they can formulate hazard reduction policies more effectively to meet the needs of the people they are designed to help.

If the socio-economic make-up of the community is not considered in the decision-making process, revitalization and retrofit policies can have the same ill-effects on low-income housing as many urban renewal projects had on communities in the 1970's. When neighbourhoods are revitalized, residents and businesses are sometimes displaced because of increased rents imposed by owners to cover the rehabilitation costs. Gentrification results when those who can afford to pay the increased rents for the rehabilitated buildings push existing residents out of the area. The continued loss of affordable housing is a serious concern given the rising level of homelessness in our cities.

> People will get kicked out of their homes just as surely as if we had actually torn the building down. ...Our concern with seismic risks and historical preservation has to go beyond structures. It has to go to people and the social structure there. You've got to take into consideration the financial realities and come up with substantial financial aids to permit

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[81] Patricia Bolton, Carlyn Orians and Lynn Miranda, Vulnerable Buildings and Special Needs Populations , (Seattle: Battelle Human Affairs Research Centers, December 1990), p. 2.

people to continue living in these areas.[82]

Initially designed to create a healthier and safer environment, it came to light that urban renewal projects had some negative socio-economic impacts on the community. Future rehabilitation and retrofit programs need to keep these lessons in mind.

A mandatory seismic retrofit policy, known as the Los Angeles Earthquake Hazards Reduction Ordinance, was enacted in 1981, required owners to strengthen nearly 8,000 buildings over a ten year period. Along with it several policies were implemented to reduce the social displacement and the loss of affordable housing. "However, the neighbourhood impacts of the Los Angeles program to strengthen URM's were not as great as anticipated. ...And in no case do the impacts approach those of an earthquake like the recently experiences Loma Prieta earthquake." [83] For example, after the Loma Prieta earthquake, many property owners in Santa Cruz could not afford to repair damage without financial assistance or economic incentives, given the lost business, income, rents and jobs that resulted from earthquake damage.[84] This, in turn, impacts on a city's tax base and results in lost revenues and the ability to function. Merritt concludes that when historic buildings are lost through earthquake damage or by

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[82] Chester Hartman in Living With Seismic Risk: Strategies for Urban Conservation, Proceedings of a Seminar, Richard E. Reed (ed), (Washington, D.C.: American Association for the Advancement of Science, 1977), pp. 69-70.

[83] Martha Blair-Tyler and Penelope Gregory, "Neighbourhood Impacts of the Los Angeles Seismic Ordinance" in Proceedings of the Fourth U.S. National Conference on Earthquake Engineering Volume 1, (Palm Springs, May 20-24, 1990), p. 198.

[84] John F. Merritt, History at Risk. Loma Prieta: Seismic Safety and Historic Buildings, (Oakland: California Preservation Foundation, 1990), pp. 7 - 8.

demolition, a city loses a financial investment as well as its cultural inheritance. [85]

However, the impacts that did occur when the Los Angeles Retrofit Ordinance was implemented affected those least able to respond to them. Both the tenants and buildings impacted are economically marginal. The owners cannot support additional debt and the tenants tend to be the elderly, the poor, and ethnic minorities, who already pay a substantial proportion of their income towards rent. Most owners had considered but rejected demolition because the cost of demolishing and constructing a new building were greater than the costs of strengthening. Their decision to strengthen was based on whether or not the local market could sustain higher rents. To prevent this from impacting too severely on the tenants a rent stabilization program was enacted that regulates rents covering about 80% of the city's rental stock. Owners can apply for rent increases to recover the costs of seismic retrofit over a 5 year period. In 1988, the average of all rent increases approved for seismic work was $64 a month. [86] Since 1987, LA has adopted several moratoria for various periods of time to prevent rent increases, demolitions, and evictions. The main focus is to protect the single-room occupancy hotels (SROs), the city's housing of last resort. As well, the City of LA provides relocation assistance to tenants evicted during the retrofit or by demolition. Those tenants who are forcibly displaced and do find housing often end up paying a higher proportion of their income on rent. The consequences of having to spend a greater portion of your income on rent might have a greater impact on a person's health and well-being than some of the urban problems and hazards that revitalization and retrofit

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[85] Merritt, (1990), p. 8.

[86] Spangle, (1990), p. 32.

are designed to reduce. The health of the community now becomes an issue. "What is the good of possible future safety if you have to spend that higher proportion of your income for housing when you don't really have enough left for medical care or decent diet, recreation and all the other things that lead to decent and healthy living? " [87] This takes the preservation issue beyond saving existing buildings for aesthetic reasons. These are the types of issues and questions that decision-makers need to consider when establishing policies to reduce the hazards posed by existing buildings. There is no doubt that special policies and codes must be designed to protect designated heritage buildings. However, there are also social and economic considerations to be addressed when establishing policies that affect people who live and work in existing buildings, buildings that may or may not have heritage character. It is important to look at the lessons learned in other cities as they attempted to implement policies designed to reduce the hazards created by existing buildings in earthquake-prone regions.

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[87] Chester Hartman, Living With Seismic Risk, (1977), Richard E. Reed (ed), pp. 63-64.

C. The Political and Economic Landscape.

i. Perceptions of hazards, risk, and uncertainty.

"A hazard is defined as a dangerous situation which, by virtue of its existence, creates a risk of disaster."[88] Earthquake-prone communities face many hazards, such as the destruction of buildings and infrastructure or loss of life due to the impacts of a seismic event. Seismic risk is the probability of the occurrence of these consequences.[89] In seismic risk analysis for existing buildings, "risk is often defined as a combination of four factors: (a) hazard, (b) exposure, (c) vulnerability, and (d) location."[90] Hazard refers to any possible geological or technological disaster potentials. Exposure refers to the health and safety of the public in the face of the hazard, and more specifically to the number of occupants and the duration of time they occupy the hazardous building. Vulnerability is associated with the expected performance of the building, and location is the proximity of the building to the potential source of the disaster.[91] Henry Lagorio states that to "identify high risk buildings, all four of these factors must be considered. Buildings of potentially vulnerable construction types, thus, may not all be of high risk such as those for example located in an area not even remotely exposed to an

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[88] Anderson, Edelson, Hansen, Harding, Huhtala, and Laughy, (1990), p. 2.

[89] Leon Reiter, Earthquake Hazard Analysis: Issues and Insights, (New York: Columbia University Press, 1991), p. 3.

[90] Henry J. Lagorio, "Existing Buildings: Assessing Earthquake Effects" in Designing for Earthquakes in Southern California: A Workshop for Architects and Other Building Team Members, American Institute of Architect, (Los Angeles: FEMA, 1989), p. 238.

[91] Lagorio, (1989), p. 238.

earthquake source."[92] It is useful to be able to identify those buildings that are of higher risk since this is one of the first steps in setting priorities for mitigating hazards.

Another vital aspect of a successful risk reduction program is to understand how a community perceives the risk they are exposed to. Everyone sets thresholds of risk that they find acceptable and tolerable for themselves. However, these thresholds will vary depending on the subject, the hazard, and the individual's perception of the issue. Like Lagorio, Barclay Jones concludes that different thresholds may be set, offering differing degrees of protection for different buildings depending on their valuation.[93] However, a great deal of debate is generated over what is an acceptable level of risk to live with and 'how safe is safe enough'?

Research has documented that more experience with a specific hazard increases the accuracy of the hazard perception.[94] Media attention and dramatic reporting also influence perception and awareness of hazards. Advocates of hazard mitigation can take advantage of the 'windows of opportunity' that open up while an event is fresh in people's minds.

The attitude that 'it can't happen here' and uncertainty caused by the inability to predict low-probability events makes it difficult to put earthquake preparedness on any political agenda. In their discussion on the qualitative aspects of risk perception, Coburn and Spence have found "that the abstraction of risk is more easily accepted than the

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[92] Lagorio, (1989), p. 238.

[93] Barclay Jones, "Preventing Damage" in Protecting Historic Architecture and Museum Collections From Natural Disasters, (Boston: Butterworths, 1986), p. 180.

[94] Risa I. Palm, Natural Hazards: An Integrated Framework for Research and Planning, (Baltimore: The Johns Hopkins University Press, 1990), p. 35.

personalization of risk. 'It'll never happen to me' is a common attitude in both richer and poorer societies. Complex issues relating to risk and personal injury are handled psychologically be rejecting them."[95] They conclude that four factors are important in the perception of risk: exposure; familiarity; preventability; and the level of 'dread'. Preventability is the degree to which a hazard is perceived as controllable or its effects preventable. Dread is the horror of the hazard, namely the scale and consequences of the event.[96] If risk is perceived to be threatening enough, there is a desire to take action and put it on the political agenda to do something to reduce the risks.

Differences in risk perception explains why communities in the Lower Mainland have been slow to implement emergency management strategies. In Vancouver, "there is no strong collective recollection of what it is like to be in an earthquake so all the impressions of risk are intellectual, and that type of persuasion doesn't move people very much." [97]

ii. Political salience of the hazard mitigation issue.

Ideally, decisions about acceptable levels of risk are made by the stakeholders involved; the public, their political representatives, and the experts in the field. In principle, experts gather information, and give technical advice to the politicians who, in

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[95] Andrew Coburn and Robin Spence, Earthquake Protection, (Chichester: John Wiley & Sons, 1992). p. 316.

[96] Coburn and Spence, (1992), p. 317.

[97] F.D. Cooper, "The Prediction No One Wants to Hear: The Great 'Quake", Emergency Preparedness Digest, 14 (4), 1987, p. 3.

turn, set policy that reflects the opinion of the public they represent. The reality of the policy arena is quite different. Setting policy is difficult given the differing interests, and perceptions of risk and the uncertainty involved with hazard issues. However, with increasing numbers people exposed to low-probability/high consequence disasters and governments having to bear the costs of recovering from disasters, they are implementing more regulatory policies. The policies that are established tend to reflect the thresholds of risk that a community considers acceptable and reasonable. For example most current seismic buildings codes are intended to protect life and reduce (not eliminate) property damage. Reducing the risk of earthquakes by establishing a more rigorous code, such as the seismic retrofit ordinance implemented in Los Angeles in 1981, came from the stakeholders having a heightened perception of the risk, and an increased awareness of the hazard and the costs of involved in recovery. However, in other cities, like Vancouver, denial or lack of awareness of the risk limits the public pressure on decision-makers to establish policies to mitigate the earthquake hazard. Therefore, a critical component of any hazard mitigation program is to increase the awareness of both the public and the politicians by educating them about the risks the community faces.

However, other factors can limit implementation of hazard mitigation policies. Decision-makers see other problems as more immediate and demanding on already limited resources. "Rossi et al., found through 2000 interviews with policy-makers that natural hazards problems were of very low importance and political salience, rated lower than concern over pornography." [98] As a result of competition for limited resources, society and its managers are always making trade-offs, and the decisions made to ignore

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[98] David R. Godschalk and David J. Brower, "Mitigation Strategies and Integrated Emergency Management", Public Administration Review, (Special Issue, 45, 1985), p. 70.

earthquake hazards illustrate the underlying values of society. In addition, those who advocate hazard management are often not politically powerful and unless the elites perceive themselves as being adversely affected by hazards they do not apply political pressure for policy change. It is possible for those with power and access to the media to manipulate public perception of risk.

Many policy-makers question the role of government intervention in hazard mitigation and whether the government has a responsibility to protect citizens from known hazards. That is, do they have a responsibility to protect people through regulation and enforcement of strict codes and standards or are they only responsible for disaster response and recovery? The question sometimes asked by decision-makers is: should the citizens have the right to choose for themselves if they want to live with risk? It is a different situation when the issue of heritage preservation is brought into the scenario. Government has a responsibility to ensure the safety of the heritage buildings it holds in trust for future generations. It is critical for decision-makers to discuss these issues. Decisions must be made about how much of the responsibility and cost should be borne by the government, by society, and by owners. Each community must determine the extent to which government should intervene in order to reduce, redistribute or remedy environmental hazards.

Another common problem slowing down policy implementation is the fear that the citizenry will cede their own responsibility for their well-being to the government if the government takes charge. In this sense they absolve themselves from responsibility and rely on the government to take mitigative actions. Individuals have a major role to play in emergency preparedness and this role should not be relinquished. There is a need to integrate individual earthquake mitigation efforts and education strategies with

the policies put in place and the actions taken by government.

Another limitation facing government, particularly at the local level, is the lack of information, technical skills, and institutional and administrative capabilities to deal with the increasing complexity and number of hazards that communities face. There is an overriding fear that policies put in place to mitigate hazards may have adverse effects and even create new hazards. There is a need for more scientific research to facilitate better response and control of earthquake hazards.

Despite these limiting factors, recent changes in the perception of earthquake risk in the Lower Mainland has led to increasing demands for changes in public policy. There is a greater call to reduce the costs in terms of humans killed and injured, and limit the economic loss and property damage that would result.

iii. Costs of establishing a seismic retrofit policy.

The cost issue can be examined both in terms of post-earthquake recovery costs and in terms of costs to take action to mitigate the effects of earthquakes before they occur. The economic impact an earthquake can have on an urban area can be extensive, in terms of both damage and recovery costs. For example, the property damage from the 1989 Loma Prieta earthquake that struck the San Francisco Bay region has been estimated to range as high as $8 to $10 billion dollars.[99] The recovery costs in terms of government aid and increased taxes are not included in this estimate. However, despite the staggering costs of recovering from an earthquake, decision-makers are still

[99] Henry J. Lagorio, Earthquakes: An Architects Guide to Nonstructural Seismic Hazards, (New York: John Wiley and Sons, Inc., 1990), p. 292.

reluctant to commit public resources to mitigate low-probability disasters, like earthquakes, even though the consequences are costly when they occur.

> In dealing with the question of risk, policy-makers often make what amounts to non-decisions. It is more politically acceptable to gamble that a hazard event will not happen than to incur the long-term costs of emergency preparedness, even if that means when a disaster strikes, the community may have to absorb greater costs than the expense a program would be. In short, decision-makers have a strong tendency to discount the future costs of natural disasters.[100]

Given the uncertainty of the issue, the quantifiable costs of mitigation are seen to outweigh the unquantifiable benefits. It is difficult for politicians, focused on the short-term future, to make decisions when the benefits from emergency preparedness may only be realized over the long-run. "Mitigation costs (economic, fiscal and political) are upfront and highly visible, while mitigation benefits are diffuse and realized in the future if at all. In the wake of a disaster however, salience rises dramatically." [101]

Actions have been taken in other cities to reduce the vulnerability of people and property to future seismic events and there are many tools available that local government can adopt to decrease the potential losses from an earthquake. Establishing a seismic retrofit policy to reduce the vulnerability of high-risk unreinforced masonry buildings has been tested. However, there is the problem of who pays the costs and who enjoys the benefits of safety particularly when funding comes from outside of political/economic boundaries. Before implementing a seismic retrofit policy, addressing the issue of cost is critical. Excessive costs could force owners to consider demolition or place excessive rent increases on tenants. The costs of seismic strengthening are direct

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[100] Bruce B. Clary, "The Evolution and Structure of Natural Hazard Policies", Public Administration Review, (Special Issue, 45, 1985), p. 24.

[101] Godschalk and Brower, (1985), p. 70

costs paid outright or with borrowed money by the owner. The owners may also be impacted by the loss of rental income and/or the use of the building during construction.

With the costs for seismic upgrading in Los Angeles, being higher than expected, ranging from $7 - 12 per foot (or $4,000. - 7000. per unit), difficulty with funding was the major cause of non-compliance. [102] To offset this, the State of California assists owners with financing rehabilitation work by providing tax exempt revenue bonds. [103] However, owners have called for more assistance through low-interest loans and grants for engineering services. They also felt the process of getting funding, loan approval, and technical assistance should be simplified. Financing may be difficult for owners to obtain if the building is economically marginal. Banks are often reluctant to make construction loans for rehab work on these properties. If they do make the loan, they may require more extensive upgrading since it is in the bank's interest to see the building retrofitted beyond life-safety requirements so it remains viable and functional after an earthquake.

> To protect its interest, a bank wants a building to meet all codes, if the rents that determine a building's value cannot be raised because of the building's location, a renovated building may have no greater market value after seismic rehab. For such a case the cost of the rehabilitation may exceed the value of the building. Faced with this situation, a mandatory rehab ordinance leaves owners with some hard choices. [104]

As noted above, in Los Angeles the cost of the seismic portion of the work ranged

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[102] Mary Comerio, "Seismic Safety - At what Price?" in Proceedings of the Fourth U.S. National Conference on Earthquake Engineering, Volume 1, (Palm Springs, California, May 20 - 24, 1990), p. 203.

[103] Spangle, (1990), p. 32.

[104] Building Systems Development Inc. Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: A Handbook and Supporting Report , (San Mateo, California: FEMA, 1989), p. 66.

from $7. - $12. per square foot (or $4000. - $7000. per unit). However, the total cost of rehabilitation ranged from $12. - $45. per square foot (or $10,000. - $20,000. per unit).[105] This indicates that additional money was spent on architectural upgrading and cosmetic work in some cases. "Clearly some architectural work is a necessary part of seismic repair, but typical seismic costs should be approximately 80% of the total rehab costs."[106] Cost will also vary with the occupancy level, use, and the structural characteristics of the building as well as the local construction market. For example in a study done on San Francisco, it was found that seismic upgrading costs per square foot will likely be higher than in Los Angeles. It is estimated that the seismic portion of the work will be $10. - $25. per square foot depending on the building type and code requirements. [107] This is because the construction and labour costs are higher in San Francisco, the building sites are more difficult, and the buildings are not free-standing. Like Los Angeles, many of the buildings are in economically marginal areas and the many "Mom and Pop" owners have a hard time qualifying for loans so financing may be difficult. Hence, the real cost of a seismic retrofit program must therefore include a public committment to financing as well as the development of policies for housing displaced tenants and rent control.

The question of who pays for seismic retrofit is asked most frequently. However, one should also ask; if no one pays, who bears the loss if an earthquake damages or

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[105] Comerio, (1990), p. 203.

[106] Mary C. Comerio, Seismic Costs and Policy Implications: The Cost of Seismic Upgrading in Unreinforced Masonry Buildings and Policy Implications for Maintaining an Affordable Housing Stock, (San Francisco: George Miers and Associates for the City of Los Angeles, Community Development Department, Rent Stabilization Division, 1989), p. 3.

[107] Comerio, (1990), p. 201.

destroys the buildings and infrastructure of a community. The insurance industry in British Columbia is becoming more aware of the risks from earthquakes and given the impact of large-scale disasters and the potential economic losses they may face, many insurers have raised their premiums and deductables. In 1992, the insurance industry in BC, prompted by concerns about a subduction zone earthquake, commissioned a study to look at the potential economic losses resulting from a magnitude 6.5 earthquake hitting the Lower Mainland. "The final tally is staggering: total direct and indirect economic losses of $14.3 to $32.1 billion, with potential insured losses to $6.7 to $12.7 billion." [108] With losses like this, many firms would not be able to pay claims and would likely face insolvency. Many people would end up paying their own costs of rebuilding and depending on disaster assistance from the government. It appears that should government decide to mitigate the hazards and take on the task of long-term, proactive earthquake planning by establishing programs like, seismic retrofit, they may not have to bear such huge recovery costs after an earthquake. In addition, it is important to note that while insurance may be able to replace a structure it can not replace the loss of cultural heritage in a community.

Using a single criteria for decision-making, such as direct cost of retrofitting or the costs of recovery, has several problems inherent in it. The indirect impacts cannot be quantified in the same way that costs are. The main problem with using decision-making tools like cost/benefit analysis is that it attempts to value intangible benefits and quantifiable costs. It diverts our attention away from the problems that motivate our concern, that being the loss of life, injury to people, and damage to the environment,

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[108] Jennifer White, "When the Earth Moves: Seismic Insurance in BC", in The BC Professional Engineer, (August, 1994), p. 41.

economy, and cultural fabric they live and work in. These socio-economic impacts cause emotional as well as physical pain and these are also the issues that will determine the success or failure of a mitigation program.

However, another approach to the problem of assigning values can be integrated into the decision-making process. A relatively new discipline, known as social impact assessment (SIA) has emerged that assesses the potential socio-economic impacts of policies, such as a seismic retrofit program. "SIA has been defined as the identification, analysis, and evaluation of the social impacts resulting from a particular event. A social impact is a significant improvement or deterioration in people's well-being or a significant change in an aspect of community concern." [109] The City of San Francisco took this approach when it was assessing various seismic retrofit programs. During the three step SIA process, the evaluation stage does not reduce all impacts down to a single dimension, such as cost. Rather, it "displays all the implications of a policy option in a forum that generates rational debate on the policy and defuses rigid, single issue attacks."[110] However, for SIA to be effective, it must be integrated into the planning process early enough so the impact assessment and ensuing public discussion can actually influence the decision-making process. SIA is an attempt to go beyond using cost as the basis for making decisions. It acknowledges that there are issues involved that have social and moral impacts on our communities and these must be considered by decision-makers if they want to implement successful hazard mitigation strategies.

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[109] Building Systems Development Inc., (1989), p. 71.

[110] Building Systems Development Inc., (1989), p. 71.

D. Local Government Responsibility for Life-Safety.

It has been shown that when the public is aware a risk exists, there is an increased demand for government to take action. In a study done by Turner, Nigg and Paz, they found that people in California look to all levels of government to deal with the earthquake hazard.[111] Over 60% of respondents were concerned with people living in unsafe structures or unsafe locations and of that 60%, over 19% specifically named old/unsafe/pre-1934 buildings as a concern.[112] When asked for suggestions for actions that government could take, 35.8% suggested structural safety measures.[113] This is reinforced when respondents were asked about where money should be invested. Investment in areas of structural safety were considered important by the respondents, with 65% and 48% respectively, giving evaluations of 'very important' to both enforcing building safety codes and granting loans to strengthen unsafe structures.[114] As this study suggests, the public support and interest is there for hazard reduction measures for buildings, but the public may be unwilling to see other programs and services cut to provide for this funding. This is the true test of how willing a community is to accept hazard reduction measures such as a mandatory seismic retrofit ordinance. In the study done by Turner, Nigg and Paz, respondents placed improvements in public education, police protection, hospitals and health care as higher priorities for funding than

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[111] Ralph H. Turner, Joanne M. Nigg and Denise Heller Paz, Waiting for Disaster: Earthquake Watch in California, (Berkeley: University of California Press, 1986), p. 201.

[112] Turner, Nigg, and Paz, (1986), p. 197.

[113] Turner, Nigg, and Paz, (1986), p. 206.

[114] Turner, Nigg, and Paz, (1986), pp. 209-210.

earthquake-hazard reduction strategies.[115] On the positive side this study shows there is support for hazard reduction strategies but there is difficulty implementing them given the limited resources available and the various needs of a community.

With the recent legislative changes in emergency planning policy that gives local government more responsibility for ensuring the safety of the public, the question of liability is on many lips of many players. The liability issue and the consequences of non-enforcement of building codes involves the building owner, the architect, the developer, the contractor, the public, and the city. By ignoring the seismic hazard that exists, many local governments are in fact setting a policy. By adopting a "do-nothing" or "hands-off" policy, many believe they are less liable for damage or injuries caused during an earthquake. However, contrary to this, the U.S. courts have found that liability does exist if a relationship exists between the injured party and a public entity. The relationship is based on the public duty doctrine. "A duty exists if a government agent is under statutory obligation to abate a specific known and dangerous condition but fails to do so. A duty exists if a government agent fails to abate a known hazard" [116] For example, the local government clearly has a duty to protect people in unreinforced masonry buildings and the people on the street from this known earthquake hazard. However, if cities establish a policy and take a hands-on approach to mitigate the hazard they limit their liability, as in the case of the State of California. The building owner also has a legal obligation or duty to maintain the building in a reasonably safe condition

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[115] Turner, Nigg and Paz, (1986), p. 211.

[116] National Science Foundation, Earthquake Hazards Mitigation Program (1985), Seismic Hazards in Unreinforced Masonry Buildings in the Pacific Northwest: Findings on the Structural Conditions of Unreinforced Masonry Buildings in Seven Study Towns, p. 47.

since a relationship exists between the owner and the tenant. Architects, engineers and contractors also have a standard of conduct to adhere to. Negligence can be established if a duty existed and was not performed. For example, in the U.S., if an architect did not follow established engineering practices to minimize the hazards to life and property, including neighbouring property, then it can be argued he has been negligent. [117]

The question that must be addressed is what is a "reasonable duty of care". Government agents and building officials are given the use of discretion in decision-making and interpreting and enforcing the codes. However, "in the absence of specific guidelines, no official in his right mind is going to exercise that discretion because what that means is that he takes on himself the responsibility if something goes wrong." [118] As case law develops, the extent of what is a reasonable duty of care for the local government will become better defined. It remains to be seen what impact this U.S. case law will have on liability issues in Canada.

In British Columbia, it is possible for the government and the owner to make an agreement that the owner can use the hazardous property as long as the government won't be sued and found liable for damage, injury, or death that occurs. Such waivers are known as "save-harmless" covenants and can be "registered as legal incumbrances against the title of the property pursuant to Section 215 of the Land Title Act."[119]

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[117] National Science Foundation, Earthquake Hazards Mitigation Program, (1985), p. 47.

[118] National Science Foundation, Earthquake Hazards Mitigation Program (1985), Seismic Hazards in Unreinforced Masonry Buildings in the Pacific Northwest: Findings on the Structural Conditions of Unreinforced Masonry Buildings in Seven Study Towns, Conference proceedings, p. 133.

[119] Peter W. Cave, "Hazard Acceptability Thresholds for Development Approvals by Local Government," Geologic Hazards in British Columbia, Proceedings of the Geologic Hazards '91 Workshop, (Victoria, February 20-21, 1992), p. 20.

However, because these are private agreements between the owner and the government, third parties, such as visitors to the property and the public, are not part of the agreement. In short, they "will be exposed involuntarily to the hazard while not being party to the agreement. Their statutory rights to protection cannot be transferred by these agreements."[120] The liability issue is somewhat blurry because the case law is still developing. However, it is clear that the government does have an obligation to protect the statutory rights of the public from the proven hazards that are known to exist within the community. Each local government must examine the liability issue regarding existing, hazardous structures within their community. If they accept their responsibility, they must address the question of how to build political and economic support for hazard mitigation policies, how to meet the needs of all the stakeholders and still implement effective strategies will be discussed in the following chapter.

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[120] Cave, (1992), p. 20.

CHAPTER 4

STRATEGIES FOR IMPLEMENTATION OF A SEISMIC RETROFIT POLICY

A. Introduction.

Chapter Four discusses various seismic retrofit policy options available and looks at the success and failure of strategies used in other cities. The lessons learned elsewhere can be valuable information during the policy-making process. The policy-making process itself and the role of the stakeholders in that process are critical components in implementing effective and acceptable hazard mitigation strategies. Finally, the criteria used by decision-makers for setting priorities, assessing policy options, and allocating resources are also key components in the implementation of a seismic retrofit policy.

B. Seismic Retrofit Policy Options.

i. Retroactive vs triggered ordinances.

Seismic retrofit ordinances are generally grouped into two types, either retroactive or triggered. A triggered ordinance requires that seismic upgrading be done on a building when it is undergoing major renovations or intensification of use. The ordinance is part of the local building code and is enacted by local government to gradually improve the overall seismic performance of the building stock within a

community.[121] However, when buildings are renovated, not only do they have to bring the structure up to seismic standards, but often they must upgrade plumbing, mechanical and electrical systems to current codes, as well as meet current regulations for fire and handicapped access. Granted, these are all valid upgrading concerns, but the costs of renovation can become so prohibitive that owners leave buildings alone to deteriorate further. A study by Burke and Perbix found that the cost of meeting seismic requirements for buildings in Seattle's Pioneer Square was in the range of 7 to 20 percent of the construction cost for the entire renovation.[122]

Retroactive ordinances apply to existing buildings and generally consist of four parts.[123] First, a target group of buildings is identified, for example, the ordinance applies to all URMs built before 1933. Secondly, priorities for retrofit are set based on the level of risk associated with use and the type of building. Third, strengthening requirements and code requirements are established based on the existing strength, materials, and configuration of each building. Finally, a time frame for owners to comply with the ordinance is set.

ii. Retrofit ordinance alternatives.

The first alternative is to have no seismic retrofit requirements at all for existing buildings. There is a hope that natural attrition or demolitions will gradually remove

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[121] Lagorio, (1989), p. 246.

[122] Padraic Burke and Todd Perbix, "An Economic Perspective: Seismic Codes in Pioneer Square," in APT Bulletin, Journal of Preservation Technology, XX (2), 1988, p. 57.

[123] Lagorio, (1989), pp. 245-246.

most of the hazards before the next earthquake.

Secondly, There are a number of 'minimum program' options available. They do not necessarily save lives but rather they are the first step in increasing awareness and establishing more extensive strengthening programs. Table 3 refers to three types of minimum programs and they all involve preparing an inventory of hazardous buildings. This identifies the scope of the problem in terms of the number and type of buildings at risk. When building owners are notified about their hazardous buildings and signs are posted for the public record, it is hoped that public pressure and/or liability and insurance concerns will convince the owner to upgrade the building. This is also known as an 'embarrassment' ordinance.[124] After the inventory has been completed and information gathered on the hazards, the local government may decide to develop a mitigation program. Hazard mitigation programs require planning and this places the issue in the public forum and opens it up to discussion and debate. Each community should review their own circumstances and adapt the program to meet the community's needs in terms of scope, priorities and time limit. This will depend on the number of buildings involved and the resources available. It is important to note when hazard mitigation planning is a requirement, the issue is placed in the public forum and is opened up for discussion, debate, and political advocacy.

Third, a voluntary seismic upgrading program can be established and is often encouraged with technical support and financial incentives. Buildings may be evaluated and rated in terms of earthquake resistance. In the effort to develop a reliable inventory, building owners may be required to have a structural analysis done to gather

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[124] Lagorio, (1989), p. 246.

more definitive information about the hazardousness of the building. In addition to life safety and concern for preservation, economic concerns greatly influence the decisions of an owner to retrofit a building. Owners have several options open to them regarding existing buildings:[125]

Option 1 Do nothing, absorb risk/liability, maintain status quo.

Option 2 Retrofit and strengthen existing building.

Option 3 Adaptive reuse combined with seismic retrofit.

Option 4 Demolish building and leave as open space/parking.

Option 5 Demolish building and construct a new one.

Option 6 Sell building.

The fourth policy option is to implement a mandatory seismic retrofit policy. As Table 3 indicates there are several mandatory retrofit alternatives available and the differences between them relate to the extent of seismic strengthening required. The most basic alternative, is known as 'anchoring'. This requires a relatively low level of seismic strengthening where unreinforced walls are anchored to the floors and roof so the building is tied together and moves as a unit in an earthquake.[126] While anchoring has proven benefits, engineers are reluctant to suggest that this measure alone is an effective mitigation program. Anchoring is often used as the first stage in a two-stage program and 'buys time' until more extensive measures are in place.

Other retrofit options, such as the single-stage program, require more extensive

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[125] Lagorio, (1989), p. 242.

[126] Recht Hausrath and Associates, Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings: Socioeconomic and Landuse Implications of Alternative Requirements , (Oakland: Recht Hausrath and Associates, 1990), p. 41.

strengthening and all the seismic strengthening may have to be done at once. This can place an economic hardship on the building owner and result in a political backlash reaction to the program. In addition to tying the building together with anchors, owners may have to brace the building to improve stiffness and rigidity with emphasis on lower floors and soft stories; to extend bracing elements to upper floors; to provide horizonal diaphragms; to decrease building mass and/or loads; and improve site conditions. In Los Angeles, the retrofit ordinance for URMs required more extensive strengthening in terms of installation of plywood shear walls, structural steel reinforcement, new masonry or concrete walls in some cases, and the removal and replacement of finishes. The costs for more extensive strengthening are greater than the anchoring alternative. However, as noted earlier, cost also depends on whether a building has historically significant architecture, and whether or not the building remains occupied during the retrofit.

Another option is to develop a combined, two-stage program, making one part mandatory to protect life-safety for example by requiring that wall anchoring be done as a minimum requirement. If this is done immediately owners can be given a longer time frame to comply with more extensive strengthening requirements. Further strengthening beyond anchoring can be made optional depending on use and occupancy. The Los Angeles Ordinance later allowed owners to choose the anchoring option as the first step in a two-stage process. However, these programs are more difficult to administer and increase both direct and indirect costs for the government and owners.

Finally, the code level that buildings are expected to comply to is set by the policy. The presence of historic buildings complicates the implementation of either voluntary or mandatory retrofit programs and makes the writing of seismic strengthening provisions more difficult. There is some debate over whether historic buildings should

be included or excluded in retrofit programs. If historic buildings are excluded from retrofit programs or retrofited to meet lower standards, they will continue to pose a hazard to the public and could be lost altogether in the event of an earthquake. In an effort to protect historic property and life-safety, it is recommended that historic buildings be included in the retrofit program, however they should be assessed on a case-by-case basis.[127] Buildings that are historically significant require special attention paid to the architectural details during the retrofit process. In addition, there is a need for the community to clearly define their concept of "historic" and the level of preservation they want to achieve. This requires a recognition of the similarities and differences between historic and other existing buildings because they need "(1) to define a class of historic buildings requiring special treatment for earthquake hazard abatement, and (2) to identify within that class the needs for additional methods of earthquake hazard abatement" [128] The design criteria set for historic buildings should go beyond the minimum requirement for life-safety. Priorities should be set within the class of historic buildings that reflect variables such as the existing strength of the building and its use and occupancy levels. With older buildings designed of variable materials and to different standards, each with its own inherent strengths and weaknesses, steps should be taken to adopt alternative, architecturally-sensitive, and creative strengthening techniques that apply to historic structures.

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[127] Applied Technology Council, ATC-28, Development of Recommended Guidelines for Seismic Strengthening of Existing Buildings, Phase I: Issues Identification and Resolution , (Redwood City, CA: FEMA, 1991), p. 80.

[128] Rene W. Luft, "Preservation and Rehabilitation of Historic Buildings," Issue Paper No. 9. Proceedings: ,Workshop on Reducing Seismic Hazards in Existing Buildings , (Tempe, Arizona: Fema, 1985), p. 141.

There are two types of codes applied to buildings. Prescriptive codes prescribe uniform standards for all existing buildings but they may not be sensitive to historic buildings. However, they are enforceable and ensure a consistent application of standards. Performance-oriented codes, such as the California State Historic Building Code, serve the same purpose of reducing hazards, however, they allow engineers and architects to devise innovative solutions that preserve historic qualities of the building.[129] A key point in setting an policy in place that is sensitive to historic buildings is to find a balance between retention of the historic fabric of existing buildings and the reduction of earthquake hazards. There must be an acknowledgment of the fundamental relationship that exists between the structural components and the architectural qualities of a building

There is a need to gather technical information about historic buildings and disseminate it among architects, engineers and local building officials. This resource can also be called upon during the response and recovery phases after an earthquake. Having a cadre of local building inspectors, engineers and architects with knowledge of historical buildings will prevent needless demolition of buildings with historical significance in the days following an earthquake. By establishing a 'rebuilding mentality' and having a policy in place that firmly expresses the preference to repair structures, a city can support heritage preservation. To make conditions more favourable to repair of historic buildings after an earthquake, owners will need access to technical assistance, financial aid and economic incentives.

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[129] Merritt, (1990), p. 26.

TABLE 2 - TYPES OF SEISMIC RETROFIT PROGRAMS [130]

1. Minimum Programs

    (a) inventory and notification

    (b) inventory, notification and posting

    (c) inventory, notification, and mitigation planning

2. Voluntary Programs

    (a) inventory, notification, engineering studies and public information

3. Mandatory Programs

    (a) minimum anchoring

    (b) two-stage programs, reduced force levels

    (c) single-stage program, reduced force levels

    (d) full or special code compliance

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[130] Adapted from Building Systems Development Inc., (1989), p. 77.

C. Lessons Learned by Other Cities.

While it appears that adoption and effective implementation of seismic hazard mitigation strategies is difficult given the political and economic landscape, other cities have successfully formulated and implemented effective and acceptable mitigative measures.

i. Los Angeles.

Los Angeles is considered one of the leaders in seismic hazard mitigation. Californians know from past experience the impacts an earthquake can have on large urban centres and the potential loss of lives and property. In 1981 the Los Angeles ordinance was adopted and its purpose was to establish minimum earthquake standards for existing buildings and to reduce the risk of death and injury in the event of an earthquake. The ordinance applied to all pre-1934 unreinforced masonry buildings except for detached residential buildings having fewer than five units.[131] This meant building owners were financially responsible for strengthening almost 8,000 buildings by the end of 1992. The program has been a success in terms of compliance, but it has not been without its share of growing pains. The policy-making process took nearly eight years to complete before the ordinance was passed. Los Angeles knew it's unreinforced masonry buildings were hazardous, especially those built before 1934, but they took a

[131] D.J. Alesch and W.J. Petak, The Politics and Economics of Earthquake Hazard Mitigation: Unreinforced Masonry Buildings in Southern California, Program on Environment and Behavior, Monograph #43, (Boulder: Institute of Behavioral Science, University of Colorado, 1986), p. 79.

greater interest in earthquake hazard reduction when Long Beach implemented their ordinance soon after the devastating San Fernando Valley earthquake in 1971. The poor performance of unreinforced masonry buildings in the San Fernando earthquake was a catalyst for city council members to request that LA analyze the feasibility of adopting a building rehabilitation program to enhance seismic safety in 1973.

The first few years were marked by political debate over the ordinance and concerns about the costs of upgrading old buildings in marginally economic areas where loans for repair were unlikely. The city began to look into the possibility of federal and state grants, low-interest loans and tax incentives to reduce possible economic hardships for owners. Liability concerns were raised at a public hearing about an interim solution that proposed signs be posted on hazardous buildings. By 1977, the issue was so politically charged that the city had to rethink the ordinance and appointed the Earthquake Safety Study Committee to find our more about the numbers and types of buildings involved, the costs of retrofit options, and methods of financing retrofit.
In 1977 an ordinance known as the Earthquake Hazard Reduction in Existing Buildings was drafted and presented to Council. It outlined the target group of URMs built before 1934 and set a time frame for compliance based on the priority given to the buildings.[132] 'Essential buildings' were those required for emergency use following an earthquake, such as hospitals and fire stations. Strengthening would have to begin on essential buildings as soon as owners were notified. 'High-risk buildings' were defined as large open buildings with 100 or more occupants using the building more than 20 hours per week. The proposal gave them 6 months to begin to comply with the strengthening

[132] Alesch and Petak, (1986), pp. 68-69.

requirements. 'Medium-risk buildings' were given 18 months and they were buildings with 20 or more occupants that were not already listed as essential or high-risk. 'Low-risk buildings, which were all other URMs had five years to comply. Concern for buildings with historic or cultural value led to their exclusion from the ordinance so they could be dealt with under the existing State Historical Building Code. [133]

The city held another public hearing, outlined the proposal and put forward four questions to those who attended. The questions acknowledge key issues that need to be addressed by policy-makers in any city.

> 1. Can the city, which has this information, ignore its moral and legal responsibility to protect the lives of its citizens to the best of its ability?
>
> 2. Can the city in good conscience mandate a program for landlords, most of whose tenants are in the lower income categories, that involves costly rehabilitation?
>
> 3. Can the city in good conscience dislocate people from their affordable housing either temporarily or permanently, realizing both the cost of rental housing and a very low vacancy rate?
>
> 4. Should the City of Los Angeles decide not to enact the proposed ordinance due to the lack of solutions for the previous two concerns, does it become liable in the event of a disaster for being conscious of the problem and still not taking any action? [134]

There were no conclusions reached at the hearing and concerns continued about the costs.

In 1980, the proposed ordinance was adjusted to lessen the financial and social impacts of the ordinance on owners and tenants. A 'dual time-phased' concept was

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[133] Alesch and Petak, (1986), p. 73.

[134] Alesch and Petak, (1986), pp. 71-72.

proposed that gave the owners a choice. "They could either strengthen their buildings to conform to the ordinance within three years of notification or, if they anchored unreinforced masonry walls properly within one year of notification, depending on the building classification, an additional four to ten years would be permitted for full compliance." [135] The City Planning Department issued a statement expressing concerns about the possible effects of the ordinance, specifically: the loss of housing stock; the dislocation of tenants; the impacts on commercial activities; and the loss of cultural resources. However, they felt the benefits of the ordinance outweighed the costs and possible impacts. In their statement, planners anticipated the following benefits from the ordinance:

> 1. The hazard to life in the event of a major earthquake would be substantially alleviated, with perhaps a five-fold reduction in anticipated casualties.
>
> 2. Buildings that might otherwise collapse or be damaged beyond repair under moderate ground shaking could be expected to sustain only moderate damage and remain serviceable.
>
> 3. Essential facilities that are within the scope of this proposal and needed to cope with the immediate effects of an earthquake would be more likely to survive the earthquake in a functional condition.
>
> 4. Buildings not worth repairing would eventually be demolished, conceivably making the land available for more productive use.
>
> 5. Rehabilitation of the older buildings could make them and their neighbourhoods more attractive, improving their competitive position relative to newer areas.
>
> 6. The needed repair or demolition of 8,000 buildings would provide work for the construction industry.[136]

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[135] Alesch and Petak, (1986), pp. 73-74.

[136] Alesch and Petak, (1986), pp. 75-76.

With the endorsement of the Planning Department, and the political wrangling of inside advocates, the City moved forward with the ordinance and passed it in 1981. The eight years it took to pass the ordinance illustrates the political and administrative obstacles involved in implementation of a seismic hazard mitigation program for a large urban centre.

The following conclusions can be made about the Los Angeles ordinance. Since the LA ordinance offered the dual time frame for compliance this acted as an incentive for owners to install wall anchors within one year. Giving the owners this choice assured increased safety more quickly and encouraged rehabilitation over the long run rather than demolition. Demolition was not an option for many owners given that the costs to demolish and rebuild often exceeded the costs of strengthening. In addition, new development had to meet on-site parking requirements and involved a reduction in the density allowed.[137] In some cases, where the market demand for upper story space was weak, upper floors were removed, reducing housing space and changing the architectural character of the building.

The architectural character was also affected by seismic work when outside anchor bolts were used; windows were bricked over; or parapets were removed. Owners of designated heritage buildings were often required to use more expensive techniques for strengthening. As with other building owners, heritage owners had no financial assistance except for the 20% federal tax credit for historic preservation which is

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[137] William Spangle and Associates, Strengthening Unreinforced Masonry Buildings in Los Angeles: Land Use and Occupancy Impacts of the Los Angeles Seismic Ordinance, (Sunnyvale: Consolidated Publications Ltd., 1990), p. 12.

amortized over a 30 year period.[138]

When the ordinance was implemented there were no financial provisions made to assist owners with the costs of strengthening or for relocation allowances for dislocated tenants. Spangle has come to some conclusions in his research on the impacts of this aspect of the Los Angeles ordinance. Owners made the decision to strengthen, sell, or demolish based on the ability of the market to bear rent increases that would recoup the costs of retrofit. While they passed on what they could to tenants, most owners paid the costs out-of-pocket but felt low-interest loans should have been available.[139] Increased rents meant the displacement of many businesses and residential tenants and a loss of low-income housing.

About one third of the owners permanently displaced tenants during retrofit. In the rest of the cases, tenants were either temporarily removed or occupied the building during retrofit.[140] With tenants in residence, it costs the owner more, disrupts tenants, takes longer to complete, however, this ensures an income flow during retrofit. Owners had difficulty finding skilled structural engineers and contractors competent in seismic retrofit. They felt this would have made the process run smoother and reduced construction time and cost overruns. In 1986, tenants who were evicted because of retrofit work or demolition were eligible for relocation assistance paid by the owner. By 1987, LA had adopted several moratoria on both demolitions and rent increases. The rent stabilization program was designed to regulate rents and ensure the limited supply

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[138] Spangle, (1990), p. 83.

[139] Spangle, (1990), pp. 11-13.

[140] Spangle, (1990), p. 11.

of affordable housing is maintained. To help owners out financially the City of Los Angeles exempts seismic work from property tax reassessments and the State of California authorized $200 million in tax exempt revenue bonds to finance retrofit work statewide. [141]

The Los Angeles ordinance illustrates the political and administrative obstacles that must be overcome for the implementation of an effective mitigative strategy for a large urban centre. The implementation process for Los Angeles had three unique characteristics. The public hearings allowed stakeholders to express their concerns; there were seismic safety advocates acting both inside and outside of city council; and the San Fernando Earthquake in 1971 acted as a catalyst to push the program forward. The ordinance has been successful in terms of compliance and retrofitted buildings have performed well in recent earthquakes. Building owners' complaints focused on the administration of the ordinance rather than on the purpose of the ordinance. Spangle's research shows that the impacts in terms of change in land use and tenancy have not been as great as expected and certainly not as great as the impacts an earthquake would have on the City of Los Angeles. Los Angeles has shown its commitment to the long process of improving seismic safety and it has not softened its policy, but rather, adapted it to fit the political and economic needs of the community.

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[141] Spangle, (1990), p. 32.

Given the lessons learned with the Los Angeles ordinance, Spangle puts forth several recommendations for other cities to follow in the design and implementation of seismic retrofit programs: [142]

> 1. Establish priorities for strengthening by area. That is, establish priorities on risk classification based on structural and/or occupancy characteristics and based on neighbourhood characteristics.
>
> 2. Coordinate seismic strengthening with redevelopment - give these areas in transition higher priority and use this as an opportunity for strengthening.
>
> 3. Plan for housing low-income tenants at the outset, before displacement from seismic work occurs.
>
> 4. Make full use of land-use regulations such as, zoning, parking requirements, density bonuses and other incentives to encourage strengthening.
>
> 5. Set priorities for preservation and develop a program to assist owners of historic buildings.
>
> 6. Consider grants or loans to defray engineering costs and consider options to ensure local engineers and contractors are trained in seismic strengthening.
>
> 7. Develop an interagency plan for coordination and administration of the program after all of the relevant agencies have been involved in writing the ordinance.

ii Palo Alto.

The City of Palo Alto, California, located south of San Francisco, with a population of 55,000, lies in an earthquake-prone area close to the San Andreas and Hayward faults. Palo Alto has implemented an innovative program to deal with the

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[142] Spangle, (1990), pp. 13-14.

earthquake hazard created by older, seismically-vulnerable buildings. In 1986 the city adopted the Seismic Hazard Identification Program which "mandates the preparation and filing of seismic engineering reports and relies on the creation of incentives for voluntary retrofitting."[143] It is interesting to follow the policy-making process that led up to the implementation of this successful program. The city itself had taken steps to purchase hazardous areas that limited development and allowed the city to focus on other hazards such as vulnerable buildings. In 1976, Palo Alto made a strong statement about its concern for seismic safety when the comprehensive plan called for a seismic structural analysis of all high occupancy buildings and buildings of more than two stories.[144] By 1982 an outside consultant hired by the city and the city's chief building officer had put together a stiff mandatory retrofit ordinance that tested how serious the city council was about seismic safety. Despite considerable opposition, a citizen-run Seismic Hazards Committee was formed that represented the various interests of the community. The 1983 Coalinga earthquake and a public education program pushed the committee to keep the idea of a mandatory retrofit provision. Again it was criticized because it did not recognize the possible economic impacts on the building owners and tenants. Building owners saw a mandatory approach as impractical given that most tenants had long term leases and retrofitting would work better if it occurred when the buildings were sold, the use changed, or the leases expired. Given the uncertainties about the costs involved and the lack of definite information about the extent of the structural deficiencies, the Seismic Hazard Committee took a different approach.

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[143] Timothy Beatley and Philip Berke, "Seismic Safety Through Public Incentives: The Palo Alto Seismic Hazard Identification Program," in Earthquake Spectra, 6 (1), 1990, p. 57.

[144] Beatley and Berke, (1990), p. 59.

In 1984, the committee recommended a voluntary retrofit program be implemented that required engineering studies be completed to assess the seismic stability of buildings and that the findings be disclosed to the public. City council modified this proposal somewhat by reducing the number of buildings involved and exempting URMs with six or fewer occupants or ones that were smaller than 1900 square feet.[145] Historic buildings were given an additional 18 months to submit engineering studies. City council adopted the voluntary approach in 1986 arguing that if it did not result in retrofitting then they could implement a mandatory requirement. The ordinance affected 99 structures in three building categories.[146] The first category included all URMs and owners had 18 months to submit an engineering report. The second type had 24 months to submit reports and this included all pre-1935 buildings other than URMs with 100 occupants or more. Third, owners of all buildings with 300 occupants of more constructed between 1935 and 1976 had 30 months to submit reports. Once the reports were in, each owner had to submit a letter that indicated what they intended to do to correct any seismic deficiencies in their buildings. There was a penalty imposed for failing to submit either the engineering report or the letter of intent. It was hoped that this, combined with public disclosure about the hazardous buildings and the owner's concern about liability and insurance would encourage them to retrofit the building. In addition, owners only had to bring the building up to 1973 code requirements if they decided to retrofit. By using the 1973 Uniform Building Code instead of 1985, cost was reduced without compromising life-safety requirements. The

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[145] Beatley and Berke, (1990), p. 62.

[146] Beatley and Berke, (1990), p. 64.

1985 code is designed to not only prevent building collapse but it also reduces property damage and protects the structure therefore leaving it usable. Using the 1973 code reduced costs and the ordinance was focused on protecting people at risk from earthquake hazards of existing buildings rather than on protecting property. As well, the zoning bylaw specified owners be given density bonuses with relaxed parking requirements if they upgraded the building seismically. The program in Palo Alto has been quite successful in terms of compliance with the engineering study requirements and the flexibility offered to the owners has influenced the level of retrofit.

The reasons for success, according to Beatley and Berke, depend on each community's particular political, economic and social circumstances. [147] In the case of Palo Alto, there were stakeholders who recognized the problem hazardous buildings posed and they resolved to improve the seismic safety of their community. Many of those who recognized the problem and their responsibility for it were elected officials and administrative personnel. Having both a committed citizens seismic committee and a number of active seismic safety advocates influenced the implementation process. Building owners and developers often had a different perception of the problem and who held the responsibility for the reducing earthquake risks, especially given the costs involved. The Palo Alto ordinance is a compromise between these two different groups of stakeholders. "It did not mandate retrofit, but rather allowed each building owner to cost it out for him or herself; to decide when and where retrofit was appropriate and through what economic means it should occur." [148] Reducing the scope of the

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[147] Beatley and Berke, (1990), p. 67.

[148] Beatley and Berke, (1990), p. 69.

program; staggering the time frame; and using the less stringent 1973 building code, further reduced opposition. The political and economic atmosphere of the City of Palo Alto may have been a factor in the implementation of the ordinance. Beatley and Berke characterize it as a highly educated, affluent, progressive city in comparison to the rest of the United States. [149] Most of the hazardous buildings were commercial and industrial uses in downtown locations therefor rehabilitation was supported by development and market conditions. In addition, implementation was spurred on by several other factors. The State of California was pushing local government to establish retrofit ordinances at the local level; windows of opportunity were created by the Coalinga quake in 1983 and the Mexico City quake in 1985; and by the implementation of other retrofit models, such as the one in Los Angeles. All of these factors operating within the political, social, and economic context of Palo Alto were instrumental in making the implementation of a voluntary seismic retrofit ordinance a success. However, it might be inappropriate to transfer the Palo Alto experience to a community with many URMs used for housing low-income tenants without public sector participation, financing, and incentives available to owners, tenants and the municipality. [150]

iii. Seattle.

Given the geographic proximity to Vancouver, the geologic similarity of the earthquake hazard, and many buildings of similar age and construction, it is interesting

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[149] Beatley and Berke, (1990), pp. 57, 70 -72.

[150] Building Systems Development Inc., (1989), p. 79.

to study the situation in Seattle. Unlike Vancouver, Seattle has had first hand experience with earthquakes rocking Puget Sound. With a long history of seismic activity, the most recent quakes were the Olympia earthquake in 1949 measuring 7.1 on the Richter Scale, and the Seattle-Tacoma earthquake in 1965 measuring M 6.5.[151] There is the possibility that Vancouver and Seattle could both experience the same subduction zone earthquake. This has some policy implications for seismic design requirements in our region. Most of the current information about seismic design is based on the California experience where earthquakes have very high rates of ground acceleration. However, earthquakes with high ground acceleration are not as likely in Washington or British Columbia. Rather, this region would more likely experience a subduction zone earthquake characterized by a longer duration of shaking with a larger amount of energy released. [152]

Despite the awareness of the risk Seattle faces and their experience with past earthquakes, Perbix and Burke believe that Seattle is in a "confused state of affairs in seismic retrofit, code development and design philosophy." [153] They are calling for a more defined seismic retrofit design philosophy that establishes a seismic code designed for the specifics of older buildings, that can be applied incrementally, and considers the use and occupancy of the building.[154] In a recent study of cities in Washington and

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[151] City of Seattle Planning Department, Seismic Hazards in Seattle, (Seattle: Planning Department, 1992), p. 11.

[152] City of Seattle, (1992), p. 13.

[153] T. W. Perbix and P. Burke, "Toward a Philosophy of Seismic Retrofit: The Seattle Experience," in Earthquake Spectra, 5 (3), August 1989, p. 558.

[154] Perbix and Burke, (1989), p. 567.

Oregon, Peter May found that in the most vulnerable cities, such as Seattle, there is a good potential for continued innovation for upgrades of existing buildings but retrofit provisions could prove to be more difficult to implement. [155]

> The political-economic climate is such that building officials for these jurisdictions doubt that retrofit programs requiring seismic upgrading could be instituted. As stated by one official: 'We have kicked the idea [of a retrofit program] around at administrative levels, but it won't fly politically and there are difficulties in establishing appropriate standards. [156]

However, private developers have taken steps to include seismic retrofit in the renovation of many of the historically significant buildings in the Pioneer Square District in downtown Seattle. After fighting the urban renewal movement to demolish the economically and physically deteriorating buildings in Pioneer Square, a citizen-sponsored preservation ordinance was passed in 1971 declaring Pioneer Square a historic district. The area is 25 square blocks and includes 150 buildings of which 140 have historic value.[157] The ordinance was amended to give special consideration to historic buildings regarding compliance to the structural codes of the city. This political decision allowed for a great deal of flexibility in interpreting the Uniform Building Code so long as the politicians reiterated this periodically to city officials in the Building Department. Because the structural guidelines for seismic retrofit were not formally established, this

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[155] Peter J. May, "Earthquake Risk Reduction: Implementation Prospects for the Puget Sound and Portland Areas," in Proceedings of the Fourth U.S. National Conference on Earthquake Engineering - Volume 1, (Palm Springs: EERI, May 20-24, 1990), p. 261.

[156] May, (1990), p. 262.

[157] Arthur Skolnik in Living With Seismic Risk: Strategies for Urban Conservation, Proceedings of a Seminar, Richard E. Reed (ed.), (Washington, D.C.: The American Association for the Advancement of Science, 1976). p. 128.

created inconsistency and uncertainty especially given the City bureaucracy and the various engineers and architects involved. "More often, the adequacy of the negotiated solution is based entirely on the specific renovation experience of the structural engineer along with complete understanding of the building official. The consequence of this policy is more political and bureaucratic than technical and safety-oriented."[158]

The ordinance was also amended in 1974 to include an anti-neglect clause. This put pressure on building owners to, at a very minimum, maintain the property.[159] This required parapets to be braced, walls to be tied and anchored with through bolts; all exterior appendages and brick to be secured to the building; and deteriorated mortar and foundations to be repaired. When building owners could not afford to cover the cost of these requirements, the city abandoned enforcing this part of the ordinance and reduced the maintenance standards.[160] Overall, the rehabilitation program was successful at making Pioneer Square a viable part of the city. Thousands of construction jobs were generated, over 150 new businesses opened up and there was over 1000 percent increase in the tax base between 1970 and 1975.[161]

Given that private enterprise, many of them large developers, were going to rehabilitate the buildings, the city knew rents would increase to offset the costs and people would be forced out and uses would change. Therefore, they developed an action

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[158] Perbix and Burke, (1989), p. 565.

[159] Skolnik, (1976), p. 129.

[160] Northwest Institute for Historic Preservation, Conference Proceedings on Seismic Hazards and Mitigation Strategies for Older and Historic Unreinforced Masonry Buildings in Small Towns in Oregon and Washington, (November 8 - 10, 1984), pp. 45-47.

[161] Skolnik, (1976), pp. 123, 135.

plan for low-income people that included subsidized rent in other housing units and built transient dormitories for the street people of the area.

It is interesting to note that the City of Seattle Planning Department has published a recent study outlining future planning activities that work towards developing a seismic hazard reduction plan.[162] They call for vulnerability analyses to be done on soils, buildings and lifelines so that priorities for hazard reduction plans can be set. As Vancouver is doing, Seattle is doing a risk assessment of city-owned buildings, critical facilities, lifelines and bridges. They are also developing seismic hazard reduction policies that may include changes to land use policies, zoning regulations, development applications, and the Building Code. They are taking steps but given their previous experience with earthquakes, it seems Seattle is at the same stage as Vancouver.

Based on his research in the Puget Sound area, Peter May puts forward several implementation strategies for communities to take whenever new information about the earthquake risk in this region comes to light. [163] The first strategy is to disseminate new hazard information to the public through workshops, publications etc. This is easily implemented and communities need to know this essential information to push government to reduce risk. However, only those communities with a favorable political and socio-economic climate and the technical and administrative capacity will respond to the new information.

The second strategy is to seek revisions in building codes and land use regulations. However, there are three limitations to this strategy. First, it is difficult to

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[162] City of Seattle, (1992), pp. 35 - 39.

[163] May, (1990), pp. 266-268.

revise codes and legislation at the local level. Secondly, changes will only affect new construction and it is unlikely to apply retroactively to the retrofit of existing buildings. The third difficulty is local governments exercise these codes at their own discretion.

The third implementation strategy is to influence local government practices by holding workshops, demonstrations and offering technical assistance to local building officials and planners. This strategy does not require policy changes and communities with the greatest needs can be targeted. The final strategy consists of efforts to influence the practices of private engineers and architects towards focusing on risk reduction in design. However, this target group may be difficult to change given the pressures they are under to compete in the market for projects. May suggests that these strategies to reduce earthquake risk can be implemented when new information comes to light and a change in perceptions is required. It is important to keep in mind that the political and economic landscape of each community will greatly influence the adoption of risk reduction measures.

iv. What should Vancouver do?

As discussed in Chapter Two, the City of Vancouver is becoming increasingly aware of the earthquake risk and is making some strides in reducing the hazards created by existing structures. In addition to conducting structural surveys of city-owned buildings and doing seismic upgrading on bridges and infrastructure, they are doing an inventory of privately-owned buildings. However, this is unlikely to go anywhere while there is still low political salience of this issue, limited government resources and a limited perception of the earthquake hazard. The first step before developing a hazard

mitigation program is to increase awareness and cultivate advocates who can get the issue on the political agenda when windows of opportunity open. Once the inventory is completed, the City will have a better idea of the scope of the problem existing buildings pose. They can begin to make decisions regarding the need for seismic upgrading requirements, set priorities, and establish a time-frame. Rather than jumping into a mandatory retrofit program, it would be in the best interest of the stakeholders to examine the issue in a public forum and start developing a long-term, incremental mitigation program. Critical facilities, high- occupancy buildings and the most historically significant buildings should receive top priority and more inntensive, possibly mandatory, seismic upgrading.

Following the inventory and engineering studies, building owners can be notified of the seismic strengths and weaknesses of their buildings. If owners decided to do major renovations this should act as a trigger that requires seismic upgrading as part of the renovation. Developing financial incentive and low-interest loan programs would encourage voluntary upgrading. However, to reduce the hazard more effectively an anchoring program should be established that requires owners to tie the building together. This has proven to be an effective and inexpensive way to improve seismic safety in a community. This could be part of the solution Vancouver needs to reduce injuries and damage in an earthquake given our current political and socio-economic situation. Hazard mitigation efforts are being made in the Lower Mainland, but it is a slow process that requires committment and perseverance.

It is not appropriate to speculate about what Vancouver should do in this forum. The role of the stakeholders in the policy-making process cannot be negated. The stakeholders should be making the policy decisions and setting the criteria they will use

to evaluate each mitigative strategy on the table. As the next section indicates, there are many aspects to consider if and when a seismic retrofit policy is implemented.

D. Implementation of a Seismic Retrofit Policy.

i. The policy process.

Leung defines a policy as "a concrete expression of values, which involves the distribution of resources and powers. A policy has three components: objectives, strategies and outcomes."[164] Objectives reflect the values of the stakeholders and these are translated into specific goals to be achieved. Before objectives can be set it is critical to resolve the conflict between stakeholders who have different values and perspectives. This is the key to a successful policy-making process. Strategies are the means and steps taken to implement the objectives. This includes the specifics of the program: how the resources are allocated; the timing; and the level of performance to be achieved.[165] Outcomes are the predicted or actual consequences of the policy decisions and actions. The outcomes are evaluated to determine if the policy has met its objectives. These components are incorporated into the four stages of policy planning and evaluation put forth by Leung.[166]

1. Issues are identified and values established.

2. Values are translated into policy objectives.

3. Strategies are devised and resources mobilized to implement the

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[164] Hok Lin Leung, Towards a Subjective Approach to Policy Planning and Evaluation: Common-Sense Structured, (Winnipeg: Ronald P. Frye and Company, 1985), p. 39.

[165] Leung, (1985), p. 29.

[166] Leung, (1985), p. 31.

objectives.

4. Outcomes of the implementation of the policy are evaluated against the objectives.

The policy-making process put forth by Beatley and Berke for mitigating earthquake hazards fits Leung's basic outline. As Figure 4 indicates, the first stage identifies the issue, in this case environmental risk, produced from the interaction between seismic hazards and the built environment. The critical value is community safety. Once a problem is identified, the next step is to get the issue on the governmental agenda and initiate policy. This is a difficult stage in the process given the low political salience of a low probability/high consequence event such as an earthquake. In addition, as Figure 5 and Table 3 indicate, a variety of internal and external factors influence the process from this stage forward. If the issue is given priority, policy objectives are set. In this case, reducing the hazard and the impacts earthquakes have on people's lives and property, is the objective. The third stage involves the formation and adoption of mitigative strategies, such as establishing a seismic retrofit policy. "In formulating the appropriate combination of measures, public officials seek strategies that balance expected risk, effectiveness in reducing risk, political acceptability to various interest groups, and cost. The decisions within this stage implicitly answer the question, What is an acceptable level of risk?" [167] If the mitigative measures accomodate the interests of the stakeholders and are technically, politically and economically viable, the policy is adopted. If not, the policy is revised or not pursued any further. The final

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[167] Beatley and Berke, (1992), p. 29.

stage in the process is implementation of the strategy. This stage also includes on-going evaluation of the program to determine its effectiveness in mitigating the earthquake hazard and reducing the level of risk. As Figure 5 illustrates, a number of internal and external factors influence the policy-making process. The activities of the stakeholders and the environment they are operating within either constrains or facilitates the policy-making process. Interaction of the politicians and city officials; the presence of advocates; the priority given to other issues; and the availabilty of resources, are factors influencing the political process internally. The process is influenced from the outside by factors such as: the perceptions of the various stakeholders; windows of opportunity; the political culture; and the socio-economic conditions of the community. These internal and external factors are noted in Table 3. The policy-making processes proposed by both Leung, and Berke and Beatley are frameworks that earthquake hazard mitigation can operate within. They acknowledge how much the values and perceptions of the stakeholders and the internal and external factors influence the process. Figure 4 and 5 are adapted from Berke and Beatley and this will illustrate their concept more clearly.

FIGURE 4 - CONCEPTUAL FRAMEWORK OF PLANNING RESPONSE TO EARTHQUAKE HAZARDS. [168]

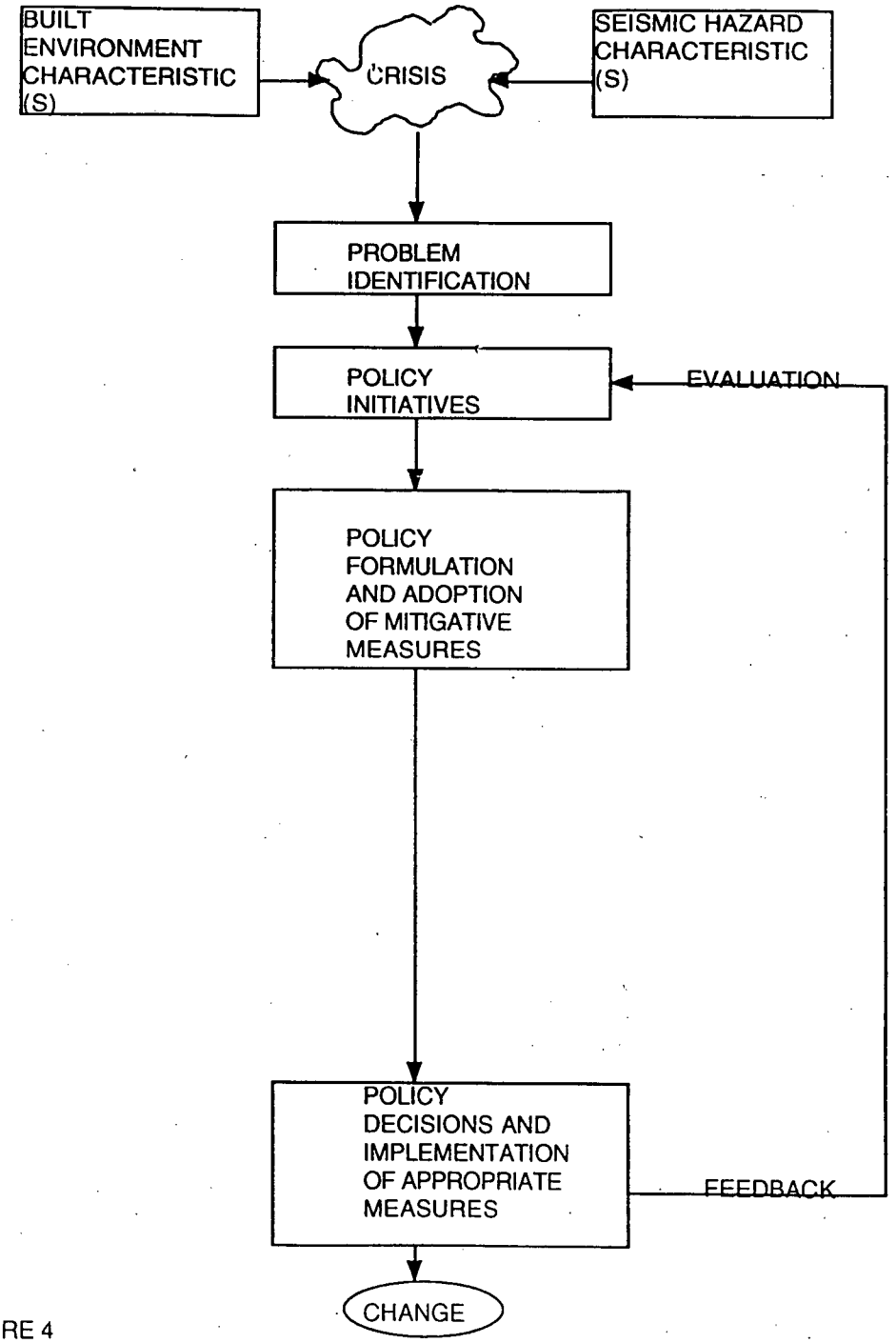

FIGURE 4

[168] Adapted from Berke and Beatley, (1992), p. 30.

FIGURE 5 - INTERNAL AND EXTERNAL FACTORS THAT AFFECT THE POLICY-MAKING PROCESS [169]

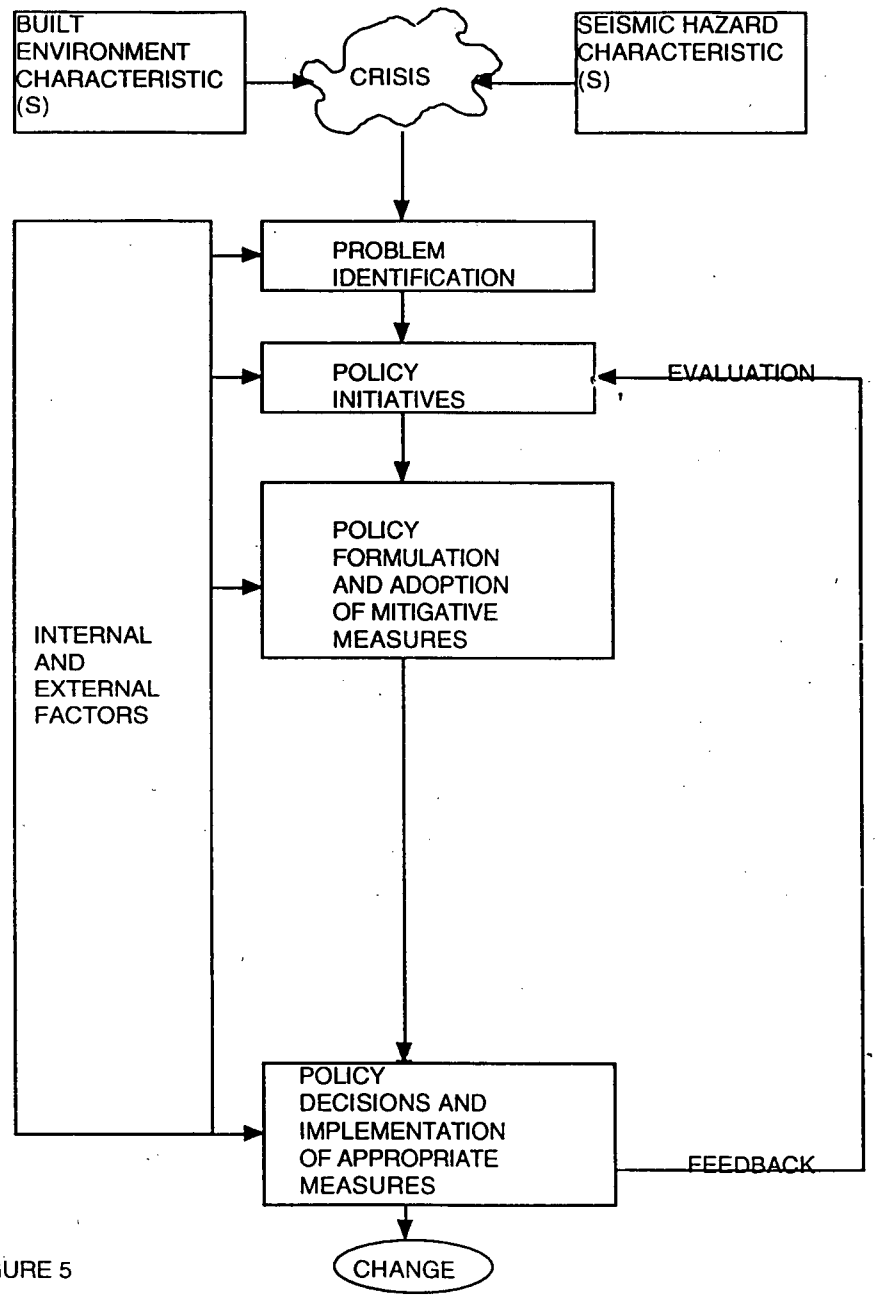

FIGURE 5

[169] Adapted from Berke and Beatley, (1992), pp. 30-31.

TABLE 3 - INTERNAL AND EXTERNAL FACTORS THAT INFLUENCE THE POLICY-MAKING PROCESS [170]

INTERNAL FACTORS:

* Participant interaction and coordination
* Advocates
* Linkage of seismic issues to conventional issues
* Resources

EXTERNAL FACTORS:

* Problem recognition by stakeholders
    - General public
    - Real estate interests
    - Elected officials
    - Staff
* Windows of opportunity
* Political culture
* Socio-economic conditions

[170] Adapted from Berke and Beatley, (1992), pp. 30-31.

ii. Who makes the decisions - the stakeholders.

The key to successful problem definition and policy implementation is to identify the different stakeholder groups and their values at the outset of the process, and develop a package of strategies that is customized to meet the needs and interests of the stakeholders. The actors in the policy-making process include those who design and implement the policies, those who are interested in the issue, and those who will be affected by the policy and its consequences. "These actors may not be involved directly in the formulation and deliberation of a policy but through political, social and private channels of expression and control, available to them individually or as groups, may register their preferences and alter the power structure of the decision hierarchy, thus affecting the outcome of the policy-making process."[171] Leung also identifies the subjective nature of the process in terms of the value/policy relationship. The values, opinions, and perceptions held by each actor involved in the process can vary over time and with each issue put forward.[172]

William Petak has identified three types of stakeholders in his research on natural hazard mitigation.[173] The first group of stakeholders are known as the 'loss experiencing parties'. They are the ones exposed to the hazard and the ones who bear the costs that arise with mitigative efforts. They are the residents, building owners, financial institutions and taxpayers. The second group, known as the 'mitigation involved

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[171] Leung, (1985), p. 25.

[172] Leung, (1985), p. 55.

[173] William J. Petak, "Natural Hazard Mitigation: Professionalization of the Policy Making Process," in International Journal of Mass Emergencies , 1984, p. 291 - 292.

parties', must make the basic decisions to mitigate hazards and ensure policies are enforced. This group includes the policy-makers, planners, building officials, and technical experts. Finally, the 'mitigation constraining parties', are the groups who oppose and constrain the policy process. By including these groups of stakeholders and channelling their input into policy-making, more effective mitigation strategies can be developed and implemented. Petak also recognizes that as hazard mitigation becomes a more complex and professionalized field, support from the technical community and experts is critical especially in the areas of risk assessment, and hazard reduction. [174]

Beatley and Berke have found in their case studies that stakeholders often have different perspectives on the issue of hazard mitigation. [175] The different perspectives arise from both factual and value disagreements. Factual disagreements exist over the details of mitigation strategies. Issues such as the possible magnitude and seriousness of the seismic threat, and the likely impacts and costs of different mitigation programs under consideration, are factual in nature. Basic value disagreements occur over the validity of the issue itself and whether or not hazard mitigation should even be on the political agenda. Value disagreements occur over: whether the risk from earthquakes is great enough to justify major expenses to reduce or mitigate it; other social issues are seen as more important; and whether dealing with seismic risk is a public responsibility or not. [176] Most factual disagreements between stakeholders can be overcome with information sharing and discussion. However, many value disagreements can not be

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[174] Petak, (1984), p. 292.

[175] Beatley and Berke, (1992), p. 175.

[176] Beatley and Berke, (1992), p. 175.

overcome as they reflect deeply held beliefs and attitudes of stakeholders with different perspectives and interests. This reinforces the idea that the development of acceptable mitigation programs comes out of an interactive learning environment, creative compromise, and politicking on the part of all major stakeholders. This also indicates that advocates of hazard mitigation will never be able to convince everyone that it is the right issue to commit time and scarce resources to. There will always be people who oppose actions and policies on the grounds that the issue holds no validity or relevance to them. However, there are those who will support the concept of risk reduction if they are given the opportunity to be aware of and understand the issue and the impacts involved with the earthquake hazard.

E. Criteria for Evaluating Policy Decisions.

If the stakeholders decide that community safety is a value they wish to uphold and earthquake hazard reduction is their objective, then they will determine the type of strategy most appropriate to mitigate the risks communities face. The criteria decision-makers use to make decisions and set policy is, therefore, very important. When decision-makers ask questions, such as the ones to follow, it helps them determine the appropriateness of the policy and improve the design and implementation of the policy. It illuminates possible problems and allows for an understanding of the concerns of all affected parties. Finally these criteria help set the boundaries the policy will operate within. When evaluating alternative emergency management policies and strategies, it is critical to focus attention on the formulation of appropriate policy as well as on the technical and financial aspects.

i. Foster's fourteen criteria.

Foster has put forward fourteen criteria and strategy-related questions for the decision-makers to ask themselves when determining policy choices in emergency management. [177]

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[177] Adapted from Harold D. Foster, Disaster Planning: The Preservation of Life and Property, (New York: Springer-Verlag, 1980), p. 28.

TABLE 4 - FOSTER'S FOURTEEN CRITERIA

CRITERIA	STRATEGY-RELATED QUESTIONS
1. Equity	Do those responsible for creating the hazard pay for it's reduction? Where there is no man-made cause, is the cost of response fairly distributed?
2. Timing	Will the beneficial effects of this strategy be quickly realized?
3. Leverage	Will the application of this strategy lead to further risk reducing actions by others?
4. Cost to government	Is the strategy the most cost-effective or could the same results be achieved more cheaply by other means?
5. Administrative efficiency	Can it be easily administered or will its application be neglected because of difficulty of administration or lack of expertise?
6. Continuity of effects	Will the effects of the application of this strategy be continuous or merely short term?
7. Compatibility	How compatible is this strategy with others that may be adopted?
8. Jurisdictional authority	Does this level of government have the legislated authority to apply this strategy? If not, can higher levels be encouraged to do so?
9. Effects on the economy	What will be the economic impacts of this strategy?
10. Effects on the environment	What will be the environmental impacts of this strategy?
11. Hazard creation	Will this strategy itself introduce new risks?
12. Hazard reduction potential	What proportion of the losses due to this hazard will this strategy prevent? Will it allow the safety goal to be reached?
13. Public and pressure group reaction	Are there likely to be adverse reactions to implementation?
14. Individual freedom	Does the strategy deny basic rights?

ii. Questions by Petak, & Beatley and Berke.

Petak puts forward similar questions for policy-makers to ask themselves during the decision-making process.[178]

* What policy problem is the policy to address?

* Who are the policy makers and special interest groups with authority to determine the relative importance of these problems. Furthermore, these problems may become further complicated by side effects produced by policy implementing activities.

* Is political support and agreement possible on any defined set of problem-solving alternatives?

* Is adequate funding available to implement the several policy alternatives?

* What social, economic and environmental impacts will result from the defined policy alternatives, and what problems will be defined by various special interest groups as being associated with those policy alternatives?

These questions must be asked and answered during the policy-making process. Beatley and Berke take a similar approach, suggesting that mitigative measures be evaluated on six criteria: (1) effectiveness at reducing seismic vulnerability; (2) political acceptability; (3) public cost; (4) private cost; (5) administrative cost and complexity; and (6) ease of enforcement.[179] It is critical that the problem be clearly defined at the outset or the policy may fall short during the implementation phase.

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[178] Petak, (1984), pp. 289-290.

[179] Beatley and Berke, (1992), p. 139.

iii. Leung's subjective approach.

The question remains: how do you ensure 'good' policy-making given the stakeholder's subjective points-of-view, and circumstances and priorities that may change over time? Policies should be flexible and continually re-evaluated for appropriateness. In addition, policy-makers need to start with a good understanding of the issue. This requires a clear definition of the issue brought about by looking at the facts; what the perspective of each actor emphasizes; and the urgency of the issue. Further understanding comes from knowing the role and mandate of each player and the influence this has on the values they espouse. This will establish a frame of reference for policy-makers to operate within. Policy initiatives can now be analyzed for effectiveness using three criteria that evaluate issues influenced by subjective values and perspectives. These criteria are: consistancy; adequacy; and dependency. Consistancy tests the internal logic of the policy, without which a policy loses direction and accountability. [180] That is, all the values, objectives, strategies and outcomes should be consistant with one another. If there are contradictions or discrepencies between these elements the policy needs to be re-evaluated. Policy-makers should use a consistant point-of-view; consistant information; reflect consistant values; and operate from consistant assumptions and concepts. Being consistant still allows for change, however, the entire value/policy relationship should be revised to suit the new circumstances.

The second criteria for policy evaluation is adequacy. When a policy is

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[180] Leung, (1985), p. 79.

implemented, resources must be mobilized. The adequacy test is an economic test which examines the resource implications of a policy. "The quantity, quality, and timing of the resources should be necessary and sufficient for the attainment of the values. The purpose of the test is to ensure that the resources are used efficiently, that is, there is neither duplication or underprovision."[181] The test looks at the internal logic of the policy and examines the economic relationship that exists between the values, objectives, strategies and outcomes. By determining what resources are neccessary and sufficient for an effective policy, maximum and minimum resource limits are set for the policy-makers to operate within. A policy that uses its available resources efficiently is important given the limited resources and budgetary constraints most local governments face.

The third criteria put forth by Leung tests a policy for its political viability and how practical it is to implement. This is the dependency test. A policy initiative is dependent on other people for both its legitimization and its implementation. Policy-makers need to know who will support the policy to give it legitimacy, and also support it during implementation. If a policy is not politically acceptable and is not implemented properly, it is stigmatized as a failure. Policy-makers should therefore be aware of where the other players stand on the issue and whether they will support or oppose the policy. "The purpose of the dependency test is to ensure that supports are developed and oppositions overcome for policy legitimization, and cooperation and coordination of people and organizations are secured and desirable responses are generated for policy implementation."[182]

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[181] Leung, (1985), p. 95.

[182] Leung, (1985), p. 108.

Leung's approach to policy evaluation is based on the idea that each actor has different perspectives and subjective values that influence the policy-making process. He suggests these three tests: consistancy; adequacy; and dependency, should be used to examine how effective the policy will be. Respectively, these tests look at the logic behind the policy; the economic implications; and the role others will play in legitimization and implementation of the policy. These tests evaluate how well the subjective interests of the various stakeholders are reflected by the policy that is adopted. The approach he proposes seeks answers to the following questions: [183]

1. What is being pursued by the actor in the policy?
2. Is it being pursued effectively?
3. At what cost, human, organizational, and material?
4. Will it be accepted and successfully implemented?

The approach is limited because it is often difficult to identify the different stakeholders involved, the values they hold, and resolve the major philosophical conflicts between them. Leung does offer a common-sense approach to policy-making and attempts to increase the awareness of policy-makers to how much subjective values influence the process. Figure 6 illustrates Leung's concept and where it fits into the policy process adapted from Berke and Beatley.

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[183] Leung, (1985), p. 115.

FIGURE 6 - LEUNG'S THREE TESTS FOR POLICY EVALUATION [184]

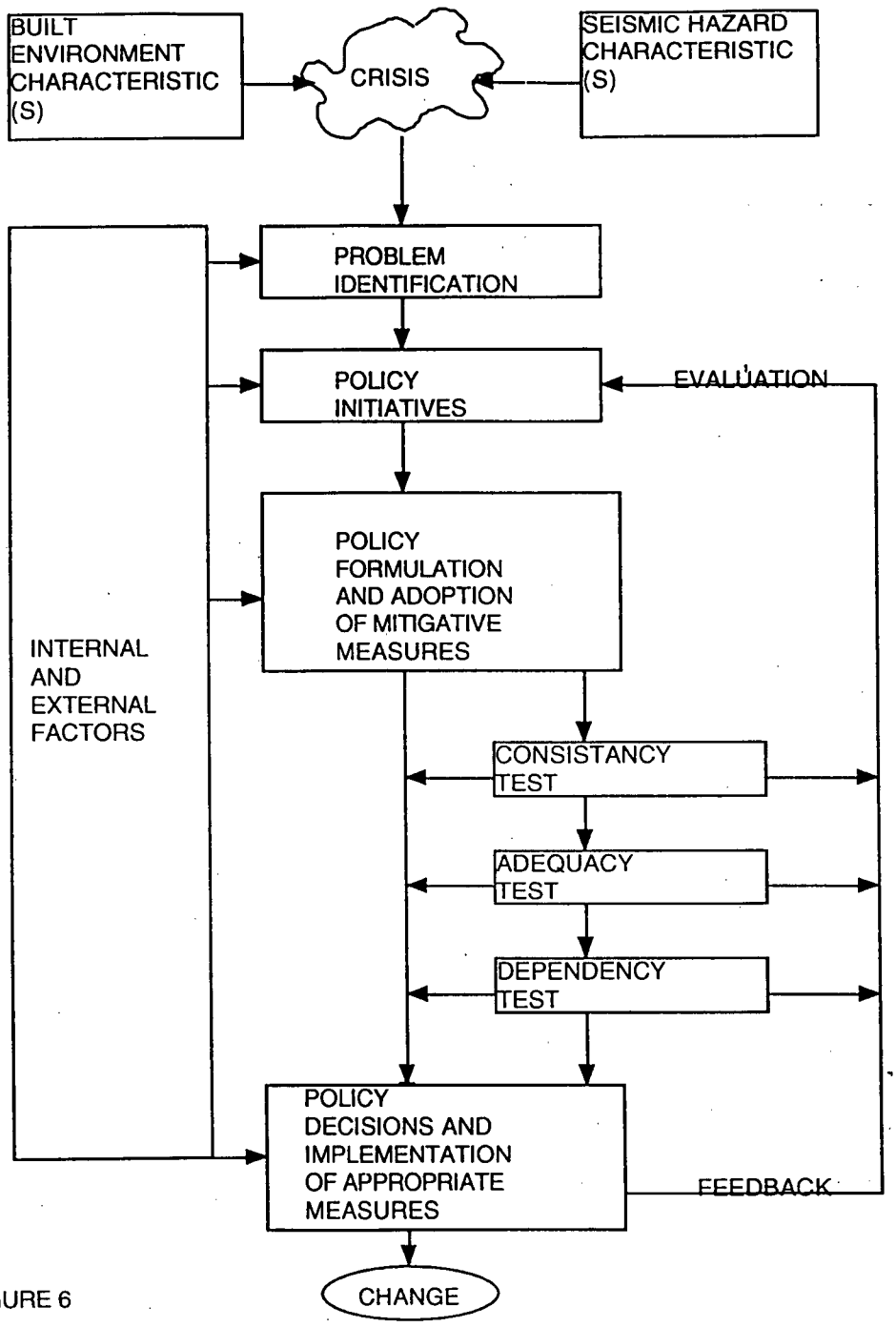

FIGURE 6

[184] Adapted from Leung, (1985), p. 110.

iv. Smith's committment to action.

Acknowledging that using a single criterion, such as cost, for decision-making has been criticized to some extent, the next step is to base decisions on more that one criteria, such as the those laid out above by Foster, Petak, Beatley and Berke, and Leung. However, P. J. Smith takes this criticism a step further to suggest that using multiple criteria for decision-making is also inherently flawed.[185] As Smith sees it there are several problems with using multiple criteria for decision-making: trade-offs are still being made over the long-term; issues and values, such as a community's need for security and society's economic and cultural integrity, cannot be measured; and there will always be a conflict of interests between different groups of stakeholders with different priorities.[186] Decisions that are made are breached by several factors. First, a particular interest group may be influencing the decision more than the others. Second, the uncertainty of the hazard and risk issue means the impacts that result from the decision are also uncertain. Third, there is individual bias in the perception of risks. Finally, there is a reliance on expert opinion and this can lead to an alienation of the public and politicians.

An alternative is to change the way we perceive decision-making. This requires a different definition of "decision". Smith proposes that "decision is the process of building commitment to one of a number of possible actions in the face of empirical problems; this includes building the commitment to manage the not-wholly controllable scenarios

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[185] P. J. Smith, "Redefining Decision: Implications for Managing Risk and Uncertainty," in Disasters, 14(3), 1990, p. 231.

[186] Smith, (1990), p. 231.

that may result from the choice."[187] In this definition there are two criteria to be considered but not traded-off: the value of the outcomes and consequences; and the manageability of those consequences. This alternative paradigm is based on a "process of building commitment to a course of action ...including commitment to manage its (unknown) consequences."[188] New paradigms such as Smith's emerge due to the persistent failure of the old ones to explain or solve problems. Problems, such as hazard mitigation, are basing their solutions on decisions where either single or multiple criteria, are traded-off against each other. Smith sees building a commitment to a course of action as a more rational and functional decision-making tool for handling issues of uncertainty that involve several interest groups. "Decision-making embracing this view of decision would be interested in exploring the varying perceptions, held by conflicting groups, of the nature of the problem and of the outcome envelopes of possible options, as well as the expected values of those outcomes. They would also wish to involve those affected in the process."[189] This is necessary to ensure commitment to a policy or a course of action.

It is difficult to move towards a new type of decision-making process especially given how limited resources force policy-makers to make trade-offs and use various criteria for making decisions. However, Smith does reiterate the value of considering the interests of all the stakeholders involved and how policy-makers need to build commitment to a course of action - a commitment to reduce hazards in our community.

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[187] Smith, (1990), p. 234.

[188] Smith, (1990), p. 230.

[189] Smith, (1990), p. 238.

Drawing what we can from the other approaches outlined above, several crucial issues stand out in examining the criteria used for evaluating policies. It is useful for policy-makers to ask themselves questions such as those laid out by Foster, Petak, Beatley and Berke. This will clarify the problem to be solved, help identify the actors, determine where problems may exist with the policy, and set the parameters the policy will operate within. However, given the controversial and complicated nature of the earthquake hazard mitigation issue, and how the perceptions of the stakeholders influence the process, Leung's acknowledgement of the subjective nature of the process and the three tests to evaluate policies is also very valuable as is Smith's idea of building a committment to take action.

CHAPTER 5

CONCLUSIONS ABOUT THE IMPLEMENTATION OF AN APPROPRIATE SEISMIC RETROFIT POLICY FOR THE LOWER MAINLAND

A. Introduction.

The conclusion will summarize the discussion surrounding the problem and the issues and offer advice to the stakeholders and decision-makers involved in the design and implementation of an appropriate seismic retrofit policy for the Lower Mainland. Areas that require further study will also be indicated.

B. Summary.

British Columbia faces many hazards, but the threat posed by earthquakes requires special attention because the effects of a major earthquake will be severe and will impact the entire region. The resulting costs in terms of lives lost and property damaged will force all levels of government to acknowledge the problem. Policies have been established to deal specifically with the earthquake hazard, especially at the federal and provincial levels of government. It is however, the local government that has the mandate and responsibility for emergency management. This responsibility is laid out in both the Municipal Act and the new Emergency Program Act. It remains to be seen if the Province will enforce this legislation and whether local government will allocate the resources needed for effective emergency planning. Local government has a responsibility to ensure the safety of the public. Planners have a role to play in determining what are effective hazard mitigation policies for their community. They

have several tools at their disposal to improve seismic safety but hazard mitigation strategies must be integrated into the overall community planning process if they are going to be effective.

Increased awareness about the costs and nature of disasters have led to changes in emergency management policy approaches over time. This evolution is illustrated by the typology of hazard mitigation policies put forth by both Lowi and Berke and Beatley. The typologies are useful because they acknowledge that the measures taken and the policy-making process must be integrated and flexible given the issue and the socio-economic and political climate the stakeholders are operating within.

Existing buildings, especially those with historical significance, have proven value, culturally, economically and socially. The benefits derived from maintaining and revitalizing buildings have a positive impact on our communities. However, unless a seismic retrofit policy is included in the revitalization process, the hazards to lives and property remain unmitigated in earthquake-prone areas. There are several issues that need to be considered in any seismic retrofit ordinance. The first is to keep the costs down by providing incentives, such as technical assistance, grants and low-interest loans, for building owners. To reduce the socio-economic impacts on the tenant, rent stabilization programs and demolition controls need to be implemented. There needs to be a coordinated effort between funding agencies and regulatory agencies, such as building departments and rent stabilization programs, to ensure both owners and tenants receive fair and equal treatment. Consideration should be given to populations that are most economically vulnerable; the elderly, the poor and ethnic minorities. Integrating a social impact assessment (SIA) program into the decision-making process will acknowledge that other issues, such as retaining the social and cultural fabric of our

communities, is just as important as cost in determining the effectiveness and suitability of a hazard mitigation program for a community.

A seismic retrofit ordinance should work towards saving the existing affordable housing stock while protecting the most vulnerable and valuable buildings. Conducting a building inventory and prioritizing buildings with historical significance are the first steps for planners to take in their commitment to preserve the built environment. Developing an alternate building code for historical buildings is another step in this incremental process. As well, heritage groups need to be involved in the planning process for rebuilding the community after a disaster occurs. By acknowledging responsibility for the heritage buildings local government hold in trust and by incorporating a preservation philosophy into emergency management and community development plans will help protect historically significant buildings for future generations and the people who live and work in them today. The risk of living in seismically vulnerable communities is becoming too high, but we also cannot afford to destroy our communities in an effort to save them.

Many constraints must be overcome before hazard mitigation policies can be formulated and adopted by decision-makers. There is a need to increase public awareness and change perceptions to acknowledge the earthquake risk that exists in the Lower Mainland. The attitude that "it can't happen here" must change. There is a split between actual and perceived risk. The actual levels of seismic risk that a community faces is generally greater than what the public and politicians perceive the risk to be. Although public education programs are increasing awareness about the earthquake hazard, the level of perceived risk is still quite low in the Lower Mainland. This trend will likely continue until Vancouverites have an experience to draw on or events occur in other cities since

perception of risk is largely influenced by past personal experience with the hazard. Hazard mitigation advocates should be prepared to take advantage of any windows of opportunity that open when earthquakes impact other cities. Some other major stumbling blocks for adopting mitigative strategies for earthquakes are: the conflict with other values; the lack of resources and the unwillingness to pay the costs in the short-run in order to benefit in the long-run; the complexity and unpredictability of the earthquake hazard; the limitations on the advocates pushing for policies; the questions of liability and the role/responsibility of government; and the lack of co-ordination between the different levels of government. Even if the hazards and risks are acknowledged by the stakeholders, all these factors place hazard reduction policies as a low priority on the policy-maker's agenda. Increased awareness about the costs and the nature of disasters have led to recent changes in hazard mitigation policy. Local government does have a responsibility to ensure the safety of the public and the public is looking to the government to take steps to mitigate the hazards in their community. The issue of how to build political and economic support for hazard mitigation policies and what implementation strategies are the most effective requires further discussion. There is a need for better information-sharing between the experts and local government officials, politicians, and the public. In an effort to reduce uncertainty and contradictory information, the experts need to find areas of agreement and come to some kind of consensus on the technical aspects of mitigative measures. This will increase awareness of the issue and allow for more effective decision-making. In addition the question of who has responsibility for hazard mitigation must be addressed. The various levels of government must clarify their roles and ensure that policies do not conflict or contradict each other. Stakeholders should determine the type of strategy followed to mitigate

community risk.

> The final choice of loss reducing strategies is political and will eventually depend on the weight placed on safety by elected officials as compared with the emphasis given to other goals that society is also attempting to achieve, such as economic growth and environmental quality.[190]

Should they decide that hazard mitigation is an issue they wish to address, several seismic retrofit policy options exist that local government can pursue depending on the political and socio-economic conditions of the community. They can establish minimum programs that encourage retrofit once a building inventory is completed and owners are notified. There are a variety of voluntary and mandatory programs or combinations of the two available. It is important for local government to complete the inventory, set priorities, and establish a time frame and code requirements. Buildings with historical significance should be given special consideration and can comply to an alternative historic building code. Part of establishing a seismic strengthening program is to ensure that technical and financial assistance is available for building owners. Another critical issue is our communities must deal with the reality of limited resources. Priorities need to be set to facilitate the allocation of resources over a period of time. The question of who pays for mitigative measures and any financing arrangements needs to be addressed at the outset of the policy-making process. Tenants who may be displaced or face rent increases to cover the retrofit costs must also be considered in the policy-making process. Alternative housing and rent control programs should be included from the outset. These are some of the lessons that have been learned when seismic work has been done in other cities. The study of Los Angeles, Palo Alto, and Seattle provides valuable insight and information about what strategies worked and where some of the problems

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[190] Foster, (1980), p. 25.

occurred when seismic strengthening policies were implemented.

A discussion about what Vancouver should do is not appropriate at this point. The decisions lie with the stakeholders who initiate the policy-making process. The stages of policy-making put forth by Leung and Berke and Beatley, are influenced by a number of internal and external factors. Internal factors include: what is happening in the political arena; the presence of advocates; the availability of resources; and the priority given to other issues. External factors also influence the process. These include: the perceptions and interests of the stakeholders; windows of opportunity that may arise with seismic events elsewhere; and the social, economic and political climate of the community. The role stakeholders play in the decision-making process greatly influences the resulting policy. Petak has identified three types of stakeholders: loss experiencing parties; mitigation involved parties; and mitigation constraining parties.

When the stakeholders decide on a mitigation strategy, they must determine if it will be an effective and appropriate policy for the community it is designed to serve. The criteria they use to make the decisions and set the policy are very important. Several researchers, specifically, Foster, Petak and Berke and Beatley have put forward questions and criteria that decision-makers should apply to their policy choices. Leung addresses the fact that stakeholders are operating from subjective points of view and within a context that is continually changing. This has a significant impact on the policy-making process. His approach addresses these concerns by using three criteria to assess policy decisions: adequacy; consistency; and dependency. P.J. Smith makes an interesting contribution by critiquing the use of single and multiple criteria for decision-making. Smith suggests that these methods are inherently flawed and the only way of getting beyond this is to change the policy-making process to one of building commitment to a

course of action.

Despite the constraints limiting the implementation of hazard mitigation policies, especially in terms of seismic strengthening for buildings, changes are occurring and steps are being taken to reduce the risk that communities live with. The gradual shift in policy towards mitigative measures is a positive sign that a more holistic integrated approach to hazard management is possible. Several recommendations can be made to help further this process especially with regards to the preparedness and mitigation phases of emergency planning.

"The policy process and intergovernmental system must not be divorced from each other if one is to understand the constraints upon successful implementation of emergency management policy."[191] Most importantly, planning for disasters must not be separated from day-to-day decision-making and must be on-going and proactive. Since these are political decisions and trade-offs are being made between risk and safety, the public has a right to be informed and involved in the planning process. The first step is to assess the existing hazards and risks the community faces and to educate the public so they can participate and make more informed policy decisions. Citizens are placing greater demands on decision-makers to fulfil their right for safety in their community. It will be a challenge for planners to achieve a more integrated, efficient and effective system of hazard mitigation. If this can be achieved the risks created by unreinforced existing buildings in earthquake-prone areas will be reduced. This will improve community safety and help protect the historically significant buildings.

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[191] Mushkatel, Alvin H. and Louis F. Weschler (1985) " Emergency Management and the Intergovernmental System", Public Administration Review, Special Issue, 45, p. 49.

C. Points to Consider in Policy Design.

i. For Local Government.

* Once the local government has acknowledged that earthquakes are a hazard to their community, and they decide to take action, there are several steps they should take before they establish policies to mitigate the hazards.

* Determine the seismic risk and vulnerability of existing buildings by doing a inventory that assesses the age and construction of the each building; it's inherent strengths and weaknesses; the underlying soil and geologic conditions; and it's use and occupancy level. The degree of strengthening required will vary depending on these variables. Buildings should be prioritized based on the degree of hazardousness, the use, and the occupancy level.

* Identify acceptable level of risk/reasonable level of safety demanded by the public.

* Promote and adapt mitigation strategies that are appropriate for local seismic risks. Strategies should be flexible and continually assessed to fit the socio-economic and political situation for each community over a period of time.

* If a seismic retrofit policy is decided upon, determine the type of ordinance that is most appropriate for the community: retroactive or triggered; voluntary or mandatory or a combination of both; set a time frame for compliance and establish the code level

buildings should be retrofitted to meet.

* Involve all major stakeholders, including the public, in the policy-making process to ensure that an effort has been made to respond to the wide variety of interests and to build local support for hazard mitigation. This will help build communication networks and foster cooperative relationships between stakeholders.

* Establish a committee to represent all the various social and economic stakeholders and locate sources of information that can be used during the development of strengthening guidelines.

* Cultivate and support advocates both inside and outside of the government structure by identifying and supporting those with a strong commitment to hazard mitigation.

* Be prepared to take advantage of any windows of opportunity that may open when disasters in other communities occur. These events capture the attention of the media, the public and politicians alike and create a more supportive political climate for implementing local seismic reduction policies.

* Have an ongoing public education program in place to increase the awareness of seismic hazards and keep the issue on the political agenda.

* Promote the 1990s as the International Decade for Natural Disaster Reduction and use this as a catalyst for change.

ii. For building owners.

* Owners are primarily concerned about the economic impacts of a seismic retrofit ordinance. It would help them if there was increased flexibility for compliance in terms of more time, therefore relax the ordinance if they pursue anchoring in the interim. However, if financing is arranged, they are more likely to accept more stringent seismic requirements.

* Ensure owners have a voice in the policy-making process as they hold considerable political power and their concerns need to be addressed. [192]

* Provide owners with access to contractors, engineers and architects who can provide advice on seismic retrofit costs and techniques. The Los Angeles experience taught us that it is very helpful if these services are provided by and/or subsidized by the local government.

iii. For funding arrangements.

* Provide national and provincial funding to local governments for the study of and revitalization of historically significant buildings and the urban context they exist within.

* Provide tax incentives and low-interest loans to building owners to encourage

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[192] Alesch and Petak, (1986), p. 173-177.

revitalization and seismic retrofit.

* Offer incentives to insurers and lending institutions so they promote seismic retrofit to building owners.

* Ensure post-disaster emergency funds are directed to appropriate agencies and accomplish what they are supposed to accomplish.

iv. For planners.

* Make seismic safety a part of the community planning process. Linking seismic hazard reduction measures with land-use management, and local planning and development considerations, means policies can be integrated into on-going processes.

* After an earthquake occurs and damage is assessed, ensure the public participates in the planning process for repairing and rebuilding the community. Establish the standard that rebuilding must meet in advance and include replacement of low-income housing in the plan.

v. For building a preservation ethic:

* Do an inventory of historic resources. Use this information to set priorities and

establish a time frame for a strengthening program. Keep this information current and accessible to refer to during a disaster.

* Build a commitment towards a preservation ethic in the community by educating the public, building professionals and politicians about the cultural and socio-economic value of existing buildings with historical significance.

* Determine the objective of preservation - creating monuments to the past or ensuring continued use of existing buildings.

* Cultivate and support the work of advocates - make it their job to initiate policies, and educate local politicians, city officials, owners, builders, and the public about retrofit techniques and mitigative measures used to upgrade buildings and reduce the seismic hazard.

* Develop a seismic retrofit program that includes buildings with historical significance. However, they should be assessed on a case-by-case basis to ensure their inherent strengths and weaknesses are recognized and to consider the architectural and cultural merits of buildings with historical significance. Priorities should be set and special funding arrangments should be considered to cover the additional costs involved in the retrofit of historic buildings.

* Encourage owners and local government to establish a long-term routine maintenance program for older buildings in an effort to keep them strong and prevent further

deterioration.

* Build disincentives in the system and/or place a moratorium on the demolition of buildings with historical, cultural, architectural, or community significance.

* Have a plan in place for rebuilding after an earthquake and a cadre of trained engineers and local building inspectors that are aware of and sensitive to historical resources.

* After an earthquake allow more time for engineers and building inspectors to do damage assessments and estimate repair costs before demolition decisions are made regarding buildings with historical significance.

* Encourage local government to streamline procedures so building owners have access to emergency funds and technical advice to facilitate repair of buildings.

* To discourage unnecessary demolitions in the initial days of panic immediately after an earthquake, encourage local government to make a "preservation whenever possible" policy statement that encourages repair of buildings, especially those that might be historically significant. To develop ongoing support that will carry over in the event of a disaster, preservationists should establish relationships and consult with emergency planners, responders, and local government before an emergency since they often hold a great deal of power once an emergency is declared.

* Develop mediation and building evaluation processes for demolitions before an earthquake takes place to reduce the conflict that may occur between owners, government officials, and preservationists.

D. Areas of Further Study.

Within the broad topic of emergency management, the hazard mitigation issue is a relatively new field of study, drawing interest from engineers, architects, urban planners, geologists, economists, political scientists, and sociologists. These are just some of the people involved, each bringing unique perspectives and expertise to the research arena. There are several issues that require further study when the focus is placed specifically on the establishment of a seismic retrofit policy. The first topic is more technical research is required to determine the most effective methods of seismic strengthening of buildings. Since this depends on the study of building types, construction materials, and geologic conditions, this should remain in the hands of the architects, engineers and geologists.

Another problem is the political system that hazard mitigation policies are made in is very complex and requires a great deal of further study to determine what is the most effective and fair method of policy-making given the large number of stakeholders with a wide range of interests and perspectives. The role that windows of opportunity and advocates play in increasing public awareness of the hazards, and the process behind improving the political salience of the issue to get it on the policy-maker's agenda are also critical areas requiring further research. It is also important to devote attention to the successes and failures of policy-making processes followed by other communities. Case studies can focus on the role of the stakeholders, how well their needs are met, and determine what criteria are most effective in setting and evaluating policies.
Thirdly, the economics of the issue, specifically, the costs of various hazard mitigation strategies needs further study to assess both the impacts of policies and the feasibility of

implementing them. Case studies will reveal the true costs of retrofitting buildings before an earthquake versus the costs involved with rebuilding and recovery after a quake.

The fourth major area of research involves a number of social concerns arising from the impacts of earthquakes and hazard mitigation strategies on the public. Specifically, there is a need to look more deeply into the impacts of a seismic retrofit policy on affordability, occupancy and use of buildings; the loss of housing; demolitions; and what values are placed on historically significant buildings within a community. Research into the concept of building a commitment towards heritage preservation in a community could prove to be valuable to community development. Preservationists doing research with architects and engineers, can help develop alternative building codes for historical buildings and ensure seismic retrofit is sensitive to buildings with historical significance.

The role of the planner in hazard mitigation needs clarification but they do have both the skills and the mandate to get involved in the developing hazard mitigation strategies that will be effective for their community. Planners need a better understanding of the role they can play in mitigating the hazards that earthquakes pose to people and their environment.

Further studies are required that relate specifically to the earthquake hazard in the Lower Mainland. Municipalities need to do an inventory to determine where the seismically hazardous buildings are and whether or not they are historically significant. This is necessary for setting priorities. They need to find out who the stakeholders are and where they stand on the issue. After bringing the stakeholders together to set policies and establish criteria to evaluate those polices they need to develop a hazard

mitigation strategy and implement it.

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