Chapter 2

Case Studies in Latin America (Antofagasta, Guayaquil, Tijuana)

Carlos Villacis and Cynthia Cardona, GeoHazards International (GHI), United States

Introduction

In 1996, the United Nations secretariat of the International Decade for Natural Disaster Reduction (IDNDR) launched the RADIUS initiative to assist in reducing the effects of seismic disasters in urban areas, particularly in developing countries. Working in close collaboration with local people in nine cities around the world, the project evaluated the seismic risk of those cities, prepared risk management plans based on those evaluations, and most importantly, raised awareness of the local community on seismic risk. Significant progress was made towards incorporation of the entire community in risk management activities. Citizens and institutions participated actively throughout the project, and committed efforts were made to set up conditions that will allow the establishment of long-term initiatives to reduce seismic risk. The project made good use of existing information and counted on the knowledge, insight and expertise of local people to ensure that the results reflect local conditions.

This report describes the implementation and achievements of the RADIUS initiative in the Latin American cities of Antofagasta (Chile), Guayaquil (Ecuador) and Tijuana (Mexico). GeoHazards International, a non-profit organization working to reduce earthquake risk in the world's most vulnerable communities, was in charge of the implementation of RADIUS in Latin America.

The RADIUS initiative

The RADIUS case studies were designed with the specific objective of initiating long-term risk management processes in the cities where the project was implemented. The case studies had three main tasks:

- Assessment of the city's seismic risk and development of an earthquake scenario describing the effects of a probable earthquake on the city;
- Preparation of an action plan based on the results of the risk assessment, describing activities to reduce the city's seismic risk; and
- Creation of conditions that will facilitate the institutionalization of risk management activities in the city.

In order to produce realistic results and raise the awareness of the communities on the seismic risk, the project ensured that representatives of all sectors of the society were actively involved throughout the project. Furthermore, the project ensured that the general public was well informed about the project's achievements and activities through coordination with the local media.

The project's main activities were collection of existing data, estimation of potential damage, and preparation of an action plan. Because the active participation of the community was crucial to the project's success, the programme of activities included repeated meetings in which key representatives of the community were first informed about the project's progress and then were asked to comment.

RADIUS in Latin America

Three cities were selected in Latin America for the RADIUS initiative: Antofagasta (Chile), Guayaquil (Ecuador) and Tijuana (Mexico). These three cities make up an interesting and diverse group. Antofagasta is a relatively small city of 220,000 inhabitants, whose existence is dependent on mining. Antofagasta last experienced a destructive earthquake (Ms 7.3) in 1995.

Guayaquil is a large city of 2.1 million inhabitants that contributes 2 percent of Ecuador's total GNP. It last experienced a destructive earthquake (Ms 7.9) in 1942.

Tijuana is a relatively young city, intermediate in size (1.25 million inhabitants), that has not experienced a destructive earthquake since its founding approximately a century ago.

While there are several differences among these three cities, they experience similar problems, such as significant amounts of traditional construction, modern construction built without the use or enforcement of building codes, vulnerable critical facilities (schools, hospitals, etc.), lack of earthquake awareness within the community, and little support from local government for risk management activities. Figure 1 shows some basic information for the three cities.

Risk evaluation

Damage that could be caused by a probable earthquake was estimated for each of the three cities. The hypothetical earthquakes, based on studies of the local and regional seismology, adopted for the analysis were the following:

- Antofagasta (Ms 8.0, epicentral distance 60 kilometres)
- Guayaquil (Ms 8.0, epicentral distance 200 kilometres)
- Tijuana (Ms 6.5, epicentral distance 10 kilometres)

Figure 2. Working session with representatives of the Federal and Municipal Education Systems of Tijuana.

Estimation of potential damage was first carried out as a theoretical estimation and then as a non-theoretical estimation. The theoretical estimation was made by combining the seismic intensity distribution, estimated for the adopted earthquake, with the inventory of the city's structures and infrastructure. This was performed using vulnerability functions developed to reflect the seismic behavior of each city's structures. The non-theoretical estimation was performed through a series of interviews with the officials in charge of the city's systems and services (figure 2). The information collected in these interviews allowed for the characteristics of the city's systems to be included in the damage estimation. Figure 3 shows the estimated damage to the roads for Antofagasta.

The estimation results for Antofagasta indicate that 6 percent of the residential buildings, where 15,000 people live, would be destroyed and 37 percent of the buildings, providing housing to 85,000 people, would suffer severe damage. As a result, more than 3,000

City	Population (in millions)	Annual growth	Area (km^2)	Contribution to the country's economy
Antofagasta	0.22	3.0%	90	6.5% of the country's GNP and 31% of its exports
Guayaquil	2.10	3.2%	340	20% of the country's GNP and 60% of its exports
Tijuana	1.25	6.02%	250	3.8% of the country's GNP

Figure 1. Basic information on the three RADIUS cities in Latin America.