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Disaster Prevention Planning in Rimac District

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Introduction

The Republic of Peru located on the central western coast of South America shares the seismicity and hazards of the countries located along the Circumpacific belt. A two thousand kilometer long subduction zone resulting from the introduction of the Nazca plate beneath the South American plate makes 80% of Peru's 1'250,000 km² territory, home of 95% of its 25 millions inhabitants highly seismically active. So earthquake hazard is a national problem which hinders sometimes dramatically, the country's social and economical development.

The country has a long history of destructive earthquakes. The two most destructive earthquakes during five centuries of documented historical data were: the October 28, 1746, earthquake when Lima was completely destroyed , and Callao the nearby sea port city was destroyed by the seismic vibration and then razed by tsunami waves which killed 97% of its 5,000 inhabitants; and the May 31st, 1970, Ancash earthquake, when according to official data the death toll was 67,000, of which about 40,000 were killed under the debris of their own adobe homes. The direct losses were set at more than US\$ 500 million.

One of the most difficult existing problems is how effectively to reduce the earthquake vulnerability of the weak adobe constructions existing in hazardous and decadent old sections of important cities as Lima, located in the world's seismically active areas.

The problem is socio economic, legal and technical. Low income people living in small apartments, inside various typed of weak buildings made of unreinforced masonry or adobe, do not want to move to other locations, because most of them have their jobs and educational facilities nearby, so the entire family saves time and transportation expenses in their daily life.

In most of the developing countries the legal ownership situation of old buildings after two or more generations is unclear, and the low rentals make the maintenance of those buildings of practically non-existent, and it the possibility upgrading weakened and deteriorated buildings is even more remote, mainly because of the high cost.

After many years of investigations Metropolitan Lima's most vulnerable areas were identified and delimited. They are: the old section located in downtown Lima and Rimac, and Callao.

Objectives

The main objectives of the study are:

- To propose a qualitative methodology for the seismic vulnerability evaluation of buildings. This includes social and physical aspects.
- To propose an evacuation plan in case of a strong earthquake for the different zones of the district.
- To propose prevention and mitigation measures for health and educational facilities

There were also studied the socio-economic and legal ownership context of the areas where the building under study were located. Also, theoretical estimates of the seismic strength of those buildings were made. One of the aims was to determine the most critical areas inside the buildings, to prepare emergency plans.

General Information of Rimac District

Name of the District	RIMAC
Province	LIMA
State	LIMA
Establishment	02/02/1920
Percent of the Lima Historical Core	40%
Fecha de Creación	02/02/1920
Capital	RIMAC
Altitude	161 m.o.s.l
Population estimate	211679
Area(Km ²)	11,87
Population density (Hab/Km ²)	17 833,1

Source: INEI

LAND USE

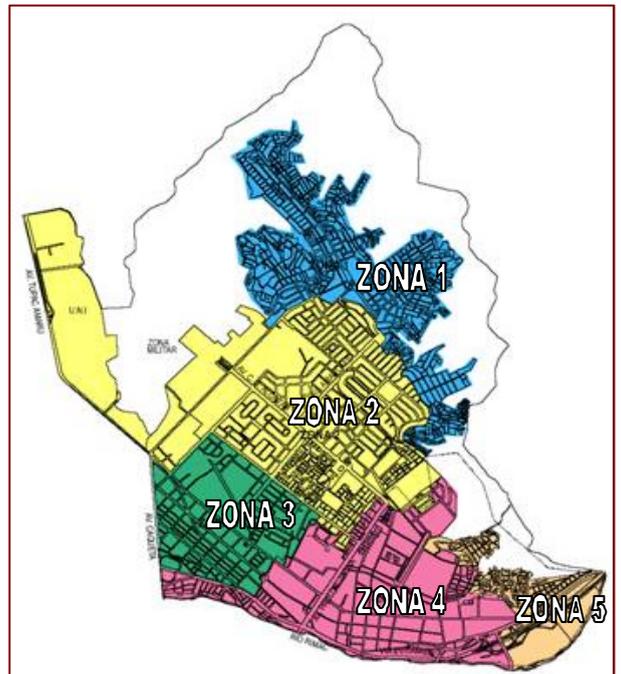
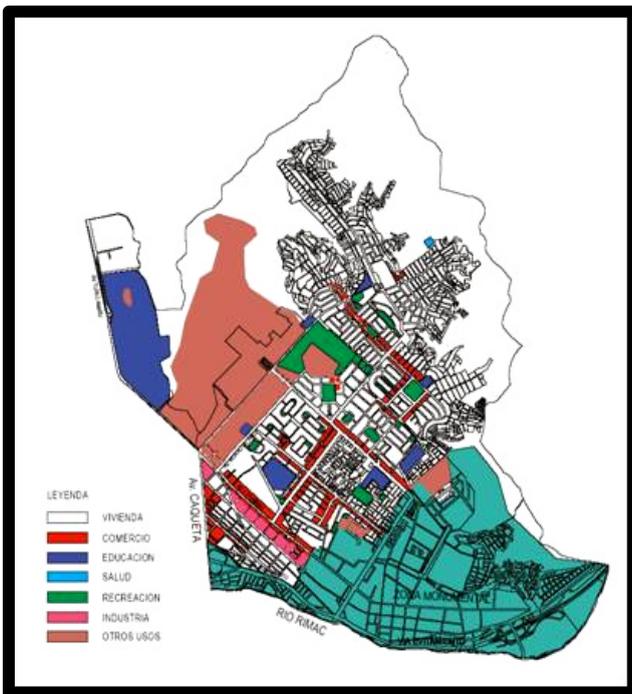
The Rimac municipality defined six land uses:

- Housings
- Commerce
- Education
- Health
- Recreation
- Factory
- Other Uses

ZONES OF DISTRICT

The Rimac municipality defined five:

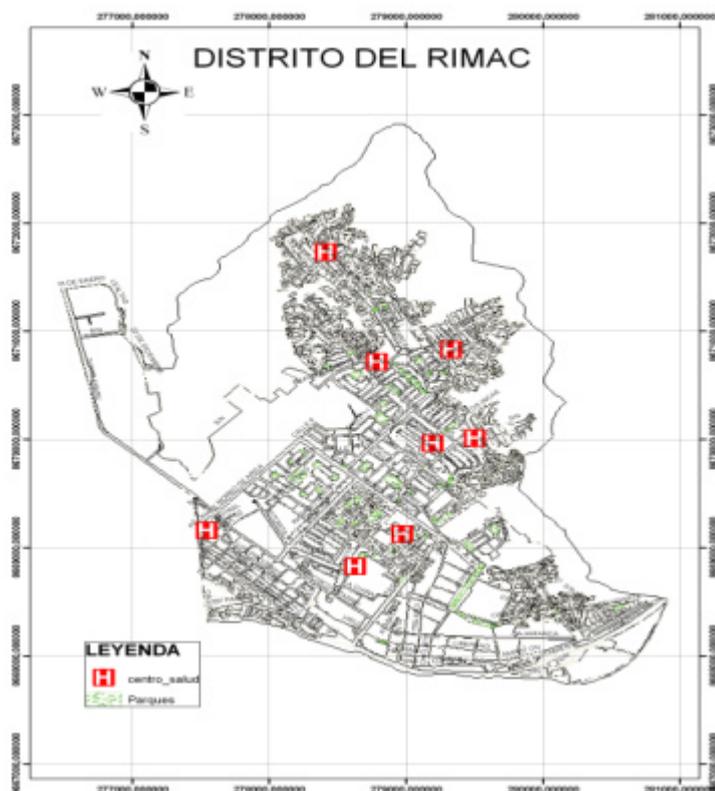
- ZONE 1 New Human Settlements
- ZONE 2 Urbanization
- ZONE 3 Neighboring area of the historical center
- Zone 4 Historical Center
- Zone 5 Old Slumses and others.



ZONE	AREA (%)	BUILDINGS (%)	POPULATION (%)
1	19.69	21.85	24.6
2	39.03	26.17	28.1
3	13.42	20.21	17.1
4	22.38	25.93	23.1
5	5.48	5.84	7.1
TOTAL	100	100	100

Health Facilities Studied

We are working with eight health facilities. They are located in different zones of Rimac District.



No	NAME	AGE	WORKERS	ANNUAL POPULATION ASSIGNED	MONTHLY POPULATION ATTENDED
1	CIUDAD Y CAMPO	1960	33	31,311	2,040
2	LEONCIO PRADO	*****	*****	*****	*****
3	RIMAC	1945	64	53,000	2,500
4	SAN JUAN DE AMANCAES	1985	19	17482	2,000
5	FLOR DE AMANCAES	1993	17	*****	600
6	CAQUETA	*****	*****	*****	*****
7	VILLA LOS ANGELES	1988	11	13,604	*****
8	MARISCAL CASTILLA	1985	11	15,026	2,400

HEALTH ESTABLISHMENT: LOS ANGELES

This establishment presents a structural vulnerability, very badly state of the ceiling of the cellar because it has humidity problems and badly drainage, and also it has deficiencies in the constructive process.



HEALTH ESTABLISHMENT : VILLACAMPA

This establishment presents a non structural vulnerability such as fissure in wall and beam. The building next to it presents wall where use of different constructive materials without confinement and the leaning from a column.



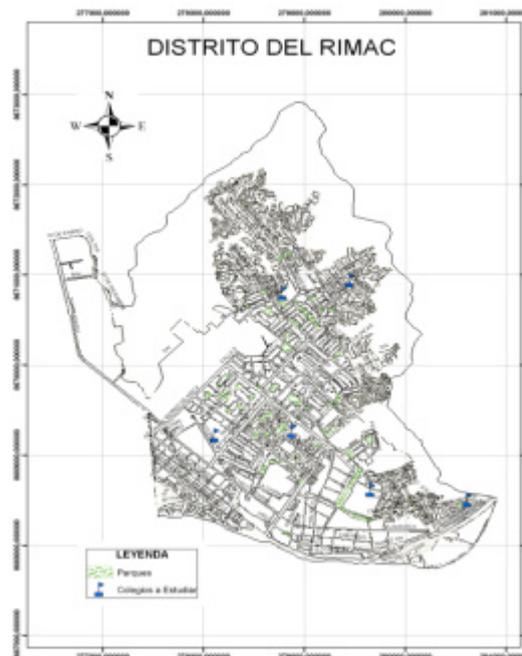
HEALTH ESTABLISHMENT : CIUDAD Y CAMPO

This establishment presents a functional and organizational vulnerability, presents obstructed routes of evacuation. It's very dangerous in case of the occurrence of earthquakes.



School Facilities Studied

We are working with six school. They are located in different zones of Rimac District.



SCHOOL FACILITIES STUDIED

RIMAC STATISCAL DATA

Nº	NAME	Director	AGE	STUDENTS
1	Mariscal Ramón Castilla Nº 2002	Teofila Enciso Tribeños	1971	1,020
2	José Felix Bogado Nº 2063	Jorge Urbano Durand	1980	900
3	Carlos Pareja Paz Soldan	Juan Esquerre Castañeda	1961	568
4	Esther Cáceres Salgado	Gustavo Alcarraz	*****	*****
5	C.N. Ricardo Bentin	Jacinto Salazar Aguado	1951	1,700
6	CE Nº 3006	Maria del Carmen Veintemilla	*****	*****

EDUCATIVE INSTITUTION

MARISCAL R. CASTILLA Nº 2002

If city Lima will have an earthquake of great magnitude, the patios and green areas will be zones of temporary refuge and attention of emergency. This establishment presents a non structural vulnerability such as fissure in wall and badly constructive process.



EDUCATIVE INSTITUTION

ESTHER CACERES

This establishment presents in a pavilion serious humidity problems in walls and columns. It presents good signals in the patios for a possible evacuation.



EDUCATIVE INSTITUTION

JOSE FELIX BOGADO Nº 2063

This establishment presents problems in the joints, because people changed the tecknopor for brick units.



CONCLUDING REMARKS

- 86% of the total of housing evaluated was built before the first Peruvian Seismic code.
- Most of the buildings of the historical core of Rimac presents several damages due to poor maintenance of its structure, the process of inadecuaded use, and because of previous earthquakes.
- Health and educational public facilities presents medium and high level of seismic vulnerability. As well of proposing emergency plans it is necessary to start a rehabilitation process of its structure.