Chapter 15
Evacuation Plan in the Case of an Earthquake for a Peruvian Urban Slum

Miguel Eduardo Ramírez Huamán
Pontificia Universidad Católica del Perú, Peru

Miguel Ángel Rodríguez Anticona
Pontificia Universidad Católica del Perú, Peru

Jonatán Edward Rojas Polo
Pontificia Universidad Católica del Perú, Peru

ABSTRACT

Lima is a city of 10 million inhabitants, and 60% of its population lives in slums settlements. Due to its location in the Circum Pacific Belt of Fire, this is a high-seismic activity area. Despite this fact, there is a serious lack of urban planning and natural disaster planning. El Progreso sector located in Carabayllo, a Lima district in Peru, was selected as the case study because it is one of the slum settlements with the highest potential risk as it is located in a basin surrounded by hills due to the effects of informal constructions (such as ceilings). Filled with rocks and walls, their slopes have suffered much more deterioration than in other hillsides. In addition, this area is prone to debris avalanches, rock fragments, debris flows, among other geologic hazards. The proposal presents a mathematical model based on analyze a risk function through inhabitants' time evacuation, which may replicate in different urban context in real time in order to guide and ensure the most efficient evacuation.

INTRODUCTION

Peru is located on an area of high seismic activity, called "Pacific Ring of Fire", in which approximately 85% of worldwide seismic activity are present (Tavera, 2014), for this reason Peru is permanently exposed to earthquakes, e.g. in Misti volcano area, Arequipa on the XI Mercalli Modified scale (INDECI, 2006). During a lapse of 325 years, from 1552 to 1877, there was a record of fourteen large-scale earthquakes, of which at least six were greater than 8 on the Richter scale (INDECI, 2004).

DOI: 10.4018/978-1-5225-8160-4.ch015

On the other hand, Lima is the capital of Peru, its surface represents 0.22% of the Peruvian territory; however, it concentrates 32% of the national population (INEI, 2014). Additionally, destructive earthquakes have shaken the Peruvian capital in the years 1908, 1932, 1940, 1966 and 1974, with magnitudes varying between 7.0 ° and 8.2 ° in the Richter scale (Kuroiwa et al, 2002). Within Metropolitan Lima, Carabayllo districts is some larger of its 43 districts, within a slum called El Progreso, as shown in Figure 1.

Slums is as human settlements that meet the following characteristics (UN, 2003): inadequate access to drinking water, inadequate access to sanitation and other infrastructure, poor structural quality of the houses, overcrowding and state of residential insecurity.

This work is organized as following; in the section 2 there will be a review of the literature on evacuation for pedestrians, in the section 3, the analysis of the diagnosis of the area studied, in the section 4, the development of the model and its recommendations, in the section 5, future directions for research and the section 6, conclusions.

BACKGROUND

Pedestrian evacuations play a crucial role (Hoogendoorn et al, 2014) under post disaster, because they allow reducing the number of victims and injuries (Bohannon, 2005), by facilitating that victim abandoning the areas of greater danger (Horner et al, 2011). The impact of a disaster can be road blockages, stampedes, buildings collapse, fires, etc (Yamamoto & Li, 2017). The types of evacuation are classified by the size of the area of the danger zone (Fang et al, 2012), and for the time of warning before the disaster (Chiu et al, 2007), independently if the latter are by natural or anthropic origin.

Figure 1. Geographical location of Slum El Progreso