# CHAPTER II
# LITERATURE REVIEW

This chapter contains several reviews of the previous studies related to this research. These studies attempted to apply HAZUS methodology in several places in Indonesia.

## 2.1. Building Risk Assessment in Palbapang Village, Bantul

Aswandono (2011) analyzed the use of HAZUS methodology in building replacement cost for seismic risk assessment in Indonesia practice especialy in Palbapang Village Bantul. The study area is a densely populated mix of urban and rural communities. The building categories according to HAZUS which represent the building in study area are Unreinforced Masonry (URM), Reinforced Masonry (RM2), Steel moment Frame (S1) and Wood Light (W1). The result of the study shows that URM was considered as the most vulnerable and required the highest replacement cost while S1 required the lowest replacement cost.

## 2.2 Buildings Vulnerability Study in Bantul Subjected to Earthquake

Bawono (2016) compared typical residential buildings in Bantul with the type of building in the United States. This study takes reference from the data of damaged houses caused by Yogyakarta earthquake May 27, 2006. This study analyzed houses that have the same type of building, namely houses with retrofitted walls. The collected data are the characteristics of houses and the damages. The data on house defects were taken using media images or interviewing the house owners. The probability of damage was determined by using FAHP (Fuzzy Analytic Hierarchy Process). This study concluded that houses in Bantul tend to be of type W2 if they were compared to all types of HAZUS buildings. However, when they are compared to HAZUS buildings with retrofitted walls, they tend to be of URML type.

## 2.3 House Seismic Vulnerability and Mitigation in Yogyakarta

Winarno (2011) summarized an assessment of earthquake vulnerability of houses in an earthquake-prone area of Yogyakarta City. Besides that, the study also revealed the principal reasons why the identified vulnerability happened and highlighted some mitigation strategies. The house data were collected just before the Yogyakarta earthquake May 27, 2006 through field survey on 402 houses. In addition, in depth interview with their owners or occupants and a focus group discussion with several experts were held to complement the earlier data collection. The overall houses were categorized into 5 types: mud bricks/MD, bricks (BR), reinforced bricks (RBR), reinforced concrete (RC), and others (OT). The results have revealed that 84.8% houses in Yogyakarta were non-engineered houses and very vulnerable to earthquake and most of them were BR and RBR. Such vulnerability has occurred because of (1) lack of knowledge by builder, (2) lack of awareness, and (3) the absence of political commitment. The prominent mitigation strategies are (1) a wider political commitment of the government and legislature board, (2) a greater awareness of earthquake-related matters by all stakeholders to the building processes, and (3) the necessary knowledge and competencies by designers and builders to deliver earthquake-resistant construction end-products. These findings have opened the precious window that the seismic performance improvement of houses in major Indonesian cities is indispensable.

## 2.4 Fragility Curves for Residential Buildings in Developing Countries

Khalfan (2013) proposed a methodology for developing empirical fragility curves using ground motion data in the form of USGS ShakeMaps. The methodology has been applied to a case study consisting of damage data collected in Bantul Regency, Indonesia in the aftermath of the May 2006 Yogyakarta earthquake in Indonesia. Fragility curves for nonengineered single-storey unreinforced masonry (URM) homes have been derived using the damage dataset for three ground motion parameters; peak ground acceleration (PGA), peak ground velocity (PGV), and pseudo-spectral acceleration (PSA). The fragility curves indicate the high seismic vulnerability of non-engineered URM homes in developing countries. There is a probability of 80% that a seismic event with a PGA of only 0.1g will induce significant cracking of the walls and reduction in the load carrying capacity of a URM home, resulting in moderate damage orollapse. Fragility curves as a function of PGA and PSA were found to reasonably represent the damage data; however, fits for several PGV fragility curves could not be obtained. The case study illustrated the extension of ShakeMaps to fragility curves, and the derived fragility curves supplement to the limited collection of empirical fragility curves for countries. Finally, a comparison with an existing fragility study highlights the significant influence of the derivation method used on the fragility curves. The diversity in construction techniques and material quality in developing countries, particularly for non-engineered cannot be sufficiently represented through simplified or idealized analytical models. Therefore, the empirical method is considered to be the most suitable method for deriving fragility curves for structures in developing countries.