1 CHAPTER I

INTRODUCTION

1.1 Background

Cultural identity always correlate with the historical buildings (Mendes et al., 2020). Through historical building, people could study a lot about a certain culture. Historical buildings also a solid evidence of an important event in the past since it already exists more than thousand years ago. Historical buildings come in many shapes. One of the most common shape of historical building is masonry structures. Constituent of masonry structures are vary, raging from stone, brick, adobe, and other natural material (Lourenço, 2002; Mendes et al., 2020; Roca et al., 2010). Masonry structures have peculiar properties compare to modern structure (Idris et al., 2009; Lourenço et al., 2011; Psycharis et al., 2019).

Indonesia is a home for thousands of masonry structures in the world. Many ancient masonry structures are stand still nowadays and some are already in ruins. One of the most important masonry structures in Indonesia is *Candi Prambanan,* which suffer from 6.3 SR magnitude of Yogyakarta Earthquake in 2006. After the great earthquaw2ke, a lot of masonry structure parts are collapse and internal fracture of the masonry structure was formed (Baba, 2007; Hanazato et al., 2017; Koseki et al., 2007).

Hence *Candi Prambanan* as an example of masonry structures are vulnerable to natural disasters such as an earthquake (Lourenço, 2002;

Mendes et al., 2020; Thavalingam et al., 2001). The damage of the masonry structures may severe and irrecoverable. Hence, it is important to assess the stability of the masonry structure towards the earthquake load. By assessing the durability and stability of masonry structure, preventive actions could be taken in case the massive earthquake struck again.

Basically, there are two ways can be conducted to assess the masonry structure. Those are experimental test and numerical test. The dimension of *Candi Prambanan* is relatively high and it need longer time to build the specimen of *Candi Prambanan* according to real dimension. Sophisticated laboratory equipment and more cost also needed. To sum up, experimental test is not feasible.

The other way can be conducted is numerical test. Nowadays, engineers tend to use this method to solve their problems. Numerical test can be conducted without having the physical specimen on site, also the equipment and cost is lower than the experimental test. The main advantages is, numerical test can be conducted repeatedly and saving more time.

1.2 Research Motivation

Numerical method already developed and research about the numerical method towards earthquake load already conducted. However, less of the numerical method analyze the behavior of *Candi Prambanan* under earthquake load. Therefore, study related to numerical method for masonry structure is important to find out the suitable numerical method to

assess *Candi Prambanan* based on the information of the structure and condition of the *Candi Prambanan* itself.

The important element in masonry structure are block and joint. After choosing a certain numerical method as the proposed method, basic principles and assumptions towards the joint must be studied to obtain understanding about the failure of the masonry structure.

1.3 Research Objectives

1. The objectives of this thesis is choosing the suitable numerical method to assess and predict the behavior of *Candi Prambanan* under earthquake load.
2. The basic principles and assumption in modelling the joint of the chosen numerical method.

1.4 Research Method and Process

Literature review is conducted to finish this undergraduate thesis 14 papers are used to discuss and compare the existing numerical method in assessing the masonry structures, as well as the advantages and limitations along with the validation of the numerical method result using the experimental result. Decisively, using the literature review, the comparison between the numerical methods could be obtained. The process of this research is mentioned in flowchart on Figure 1.1.

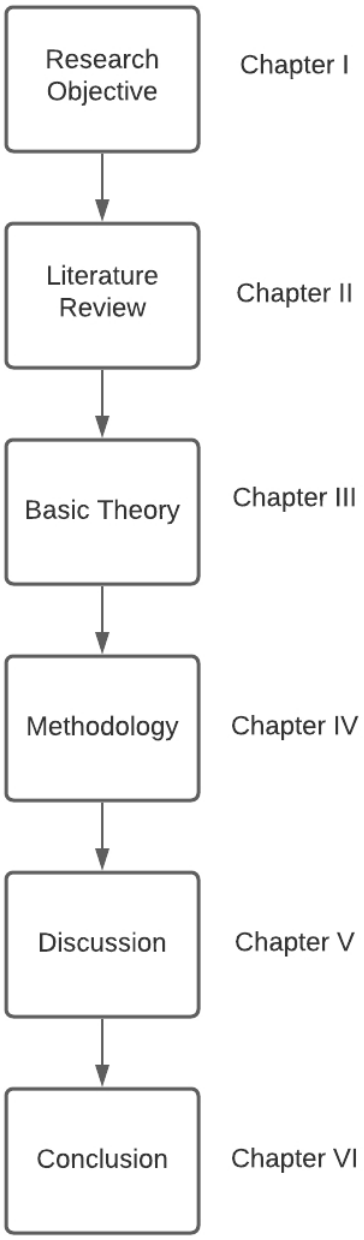

Figure 1.1 Process of the research

1.5 Scope of Research

The scope of research is literature review related to various numerical test conducted by another authors. Hence the result of this study is based on the result from literature review.

1.6 Research Benefit

The result of this research will give new understanding to the readers about the comparison of existing numerical method in assessing the masonry structures hence the readers know the suitable numerical method to handle. Furthermore, the result of this study is expected to help the preservation effort for *Candi Prambanan* from seismic hazard.