CHAPTER I

INTRODUCTION

The structure and its components in a building could be damaged due to environmental agents, service loads, poor construction technologies, seismic events, low cycle fatigue, freeze thaw cycles, corrosion, etc (Pela and Benedetti 2011). If the structures and its components is damaged, then it will be harmful for people or for the environment itself. This is the reason why retrofitting process is needed in order to get the good performance of the structure and its components.

There are many types in order to do the retrofitting process, in which one of them is called jacketing techniques. Jacketing techniques is chosen more often than the other retrofitting techniques of its less time consuming and less cost (Wu et al. 2014 ; Zhou et al. 2015 ; Panjehpour et al. 2016 ; Peled et al. 2007 ; Ilki et al. 2008). There are three techniques that have been used commonly in jacketing techniques : concrete jacketing, steel jacketing and fibre reinforced polymer (FRP) jacketing.

Although these three techniques are proven to increase the performance of the structure but these techniques also have their own weaknesses. Concrete jacketing has a high number of dead load (Rodriguez and Park 1994 ; Priestley et al. 1996) and cost (Ma et al. 2016), steel jacketing has low resistance to corrosion (Engindeniz et al. 2005 ; Vandoros and Dritsos 2008 ; Li et al. 2009) and FRP jacketing tends to have a decreasing in bond strength if it is used in a large scale (Hadi 2004 ; Hadi et al. 2013 ; Lam and Teng 2003). To deal with these problems, the use of ultra-high performance concrete (UHPC) is being considered. The use of

UHPC itself is proven to overcome those three jacketing techniques such as less or no cost due to its durability, good bond strength and workability, etc (Wu et al. 2018 ; Jose et al. 2018).

1.1. Research Motivation

By using ultra-high performance concrete (acting as overlay concrete) as a retrofitting tools for the normal concrete or substrate concrete, the important factor that needs to be ensured is the bond strength at the interface of the overlay concrete and substrate concrete. It needs a strong and good bonding in order to achieve more durable reinforced concrete structures (Tayeh et al. 2012). It is also proven that the value of bond strength is greater if the substrate concrete or normal concrete is retrofitted by using UHPC (Tayeh et al. 2012 ; Harris et al. 2014 ; and Al-Osta et al. 2017). There are several factors affecting the bond strength at the interface between the overlay concrete and substrate concrete. But there are limited on researches which discusses the overall factors affecting the bond strength.

The building structures might suffer damages caused by the seismic events and it needs to be retrofitted. The use of mechanical connectors also may play an important role in order to do the retrofitting process (Iverson and Hawkins 1994 ; Muguruma et al. 1995 ; Arslan et al. 2006 ; Senel and Palanci 2013 ; Brunesi et al. 2014). The use of mechanical connections is proven to resist the displacement and rotation caused by the damaging structures and earthquake. Because of that, the use of mechanical connectors might be considered.

1.2. Research Objectives

After knowing that the bond strength and mechanical connectors play an important role in order to do the retrofitting, then the objectives of this thesis are :

i. Identifying and choosing the suitable method for the preparation to ensure the good bond strength between overlay and substrate concrete
ii. Identifying and choosing the best parameters on using the mechanical connectors for the embedment

1.3. Research Method and Process

A literature review is done in order to finish this thesis. Sixteen papers are selected in order to discuss the factors affecting the bond strength at the interface between the old concrete and new concrete and six papers are selected in order to discuss the parameters of applying mechanical connectors. This research process is shown in Figure 1.1.

There are five steps in order to carry out this research process such as :

i. Conducting the research objectives.
ii. Doing the literature review on retrofitting, jacketing techniques, ultra-high performance concrete, bond strength and mechanical connectors.
iii. Doing the methodology review of each paper in factors affecting bond strength
iv. Analyzing each factor affecting the bond strength at the interface between old concrete and new concrete.
v. Analyzing the use and number of mechanical connectors

vi. Summarizing conclusions and suggestions.

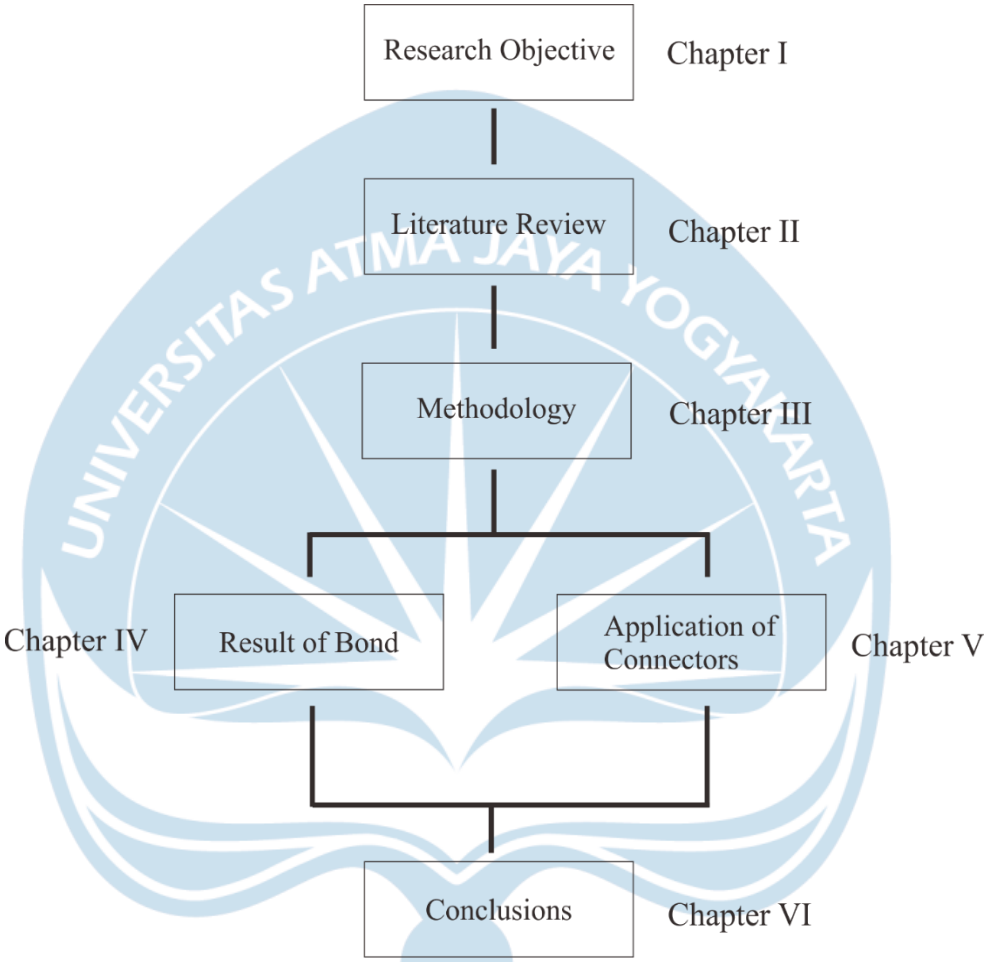

Figure 1.1. The Research Process

1.4. Research Limitation

In this research study, some limitations are being conducted and they are summarized in below:

1. This research is just focusing on the bond performance between the overlay and substrate concrete.

2. The numerical calculations are not being considered.
3. This research is based on the experimental result in the selected paper.
4. The detail on doing the retrofitting process are not being considered.
5. Not all paper selected is discussing the performance of bond between conventional concrete and UHPC.
6. The test setup in doing the experiments are not being considered.
7. The considerations of using mechanical connectors are limited.
8. The value of the bond strength of each research experiments cannot be compared because of the difference in test setup.
9. This study only focus on the method that been used by the researchers papers in order to get a suitable solutions.

1.5. Research Benefit

The results of this research study are to make the readers know the suitable method to ensure the bond performance between the old concrete and new concrete and best parameters in order to selecting the design mechanical connectors. Hopefully, the good bond between overlay and substrate concrete can be achieved so that the performance of the structures members by doing retrofitting process can be enhanced.