CHAPTER 1

INTRODUCTION

1.1 GENERAL

In the construction industry, steel and concrete are the vital and most used construction materials in this era. A lot of research had been done in order to determine the factors affecting the shear strength and relative slip of composite structure. The most important factor in a structure is the bonding between steel and concrete in it as they need to be strongly bonded into one unit in order to transfer load effectively to the sub-structure. Incorporating steel into concrete is a brilliant idea as concrete is strong in terms of compression but possess weak tensile strength, whereas steel has strong tensile strength where the incorporation steel into concrete produces stronger concrete with high tensile and compressive strength. In order to promote the bonding between concrete and steel, stud shear connectors are used where it resist longitudinal shear forces on the surface between steel and concrete, helps the concrete slab to bond stronger with the steel beam and prevent them from separating.

There are quite a few types of shear connectors used in the construction industry; headed stud connector, perfobond ribs, T-rib connector, T-connector, bar connector, and channel connector. All the connector can be category into two basic form, rigid and flexible where rigid shear connectors resist shear force using its front part by shearing and they have trivial deformations in the propinquity of ultimate strength. Unlike rigid shear connectors, flexible shear connectors use shearing, tension or bending at the connection point of steel beams to resist shear forces.
Headed stud is one of the flexible connector and is most commonly used in Malaysia. It contributes to the shear transfer and connect composite structure. This type of studs is installing by electronic welding which is easily installation and low cost. Much research has been carried out to determine the factor affecting the strength of headed stud. The push-out test were used to investigate the behaviour of headed stud in composite structure. In the high shear area, using the higher capacity shear connectors as large studs would reduce the number of studs and thus reduce welding time. Small number of large studs could help to reduce the deterioration of concrete slabs and enhance the safety of field workers because of the large space on the top flange.

1.2 PROBLEM STATEMENT

Nowadays, the bridge structure is very common in developing country. The composite structure is the main component for bridge structure. Shear connector is most important component present in composite structure where it connects the steel and concrete in the composite structure. According the statistics by OSHA, (2015) in United States, there is around 4579 workers killed due to their job in year 2014, which means every week, there is about 90 workers died due to site hazard and approximately 13 fatalities every day. However, the alarming fact is that out of the 4251 workers killed on their job in private industry on 2014, 20.5% of it is from the construction industry, which means 872 fatalities in construction industry in 2014. There are a lot hazards that leads to this large number of fatalities but one of the leading cause is due to lack of working space that leads to the fall of the workers that caused fatality.

There are a few solutions to this problem, one of it is using larger shear studs in composite bridge as using larger shear studs will reduce number of headed studs used which eventually provides more working space for the workers. According to Lee et al (2005), the use of headed stud greater than 25mm in diameter could provide considerable advantages and conveniences in composite bridges where in the high shear area, using the higher capacity shear connectors as large studs would reduce the number of studs and thus reduce welding time. However, the existing Eurocode 4 only can determine from 19mm to 25mm diameter.
1.3 OBJECTIVES

The main purpose of conducting this research is to discover the effect of changes in stud diameter to the maximum shear resistance of stud.

i. To determine the shear resistance between concrete and steel structure connecting with difference size of headed stud.

ii. To analyses the stress distribution on different size of diameter and fatigue failure mode on headed stud.

1.4 SCOPE OF STUDY

The scope of study is mainly focus on the behaviour of the headed stud in composite structure. This research is conducted using Abaqus 6.14 student version software where finite element modelling is used to the modelling of steel concrete composite structure. There are 5 models of the pull-out test has been model with 22mm, 25mm, 27mm, 29mm and 31mm. The model is analysing by using ABAQUS version 6.14. The standard push out test model is set up according to the Eurocode 4 as shown in Figure 1.1. The size of concrete is 200mm x 300mm x 650mm and the model consist of 8 stud connectors. The steel reinforcement diameter is 12mm. The total height of stud is 150mm. The spacing between studs are 100mm and 250mm. The thickness of I beam is 14mm. The height and width of I-beam are 260mm. The concrete cover is 30mm.

![Figure 1.1: Schematic diagram (a) Front view (b) Side view (c) Top view](image-url)