

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 INTRODUCTION**

Beam is the structural element which is able to withstand the load primarily by resisting against bending. The opening in the reinforced concrete beam is a facility that is necessary to accommodate services such as electricity, sewage, water supply, computer network, telephone, and air-conditioning. By passing these ducts may cause to a reduction in the dead space and results in a more compact design. Usually for small buildings, this may save in cost but maybe not significant, and for the big buildings like a multi-storey, a large amount of saving in total length, height of electrical ducts and overall load on the foundation can be represented by any saving in storey height multiplied by the number of stories. So, the designer has to redesign by reducing the height of the structure, which leads to an economical design. This design which has opening in beams shows that the simple beam behaviour can be alter to a more complex one.

In his extensive experimental study, Prentzas (1968) considered that openings can be in various shapes which are circular, rectangular, diamond, triangular, trapezoidal and even irregular shapes. However, the most common shape in practice are circular and rectangular openings. The one of the factor that concerned is size of opening, which is the terms small and large are using by many researchers without any definition or clear-cut demarcation line. From a survey of available literature, it has been noted (Mansur and Tan, 1999) that the essence of such classification lies in the structural response of the beam. When the opening is small enough to maintain the beam-type behaviour or, in other words, if the usual beam theory applies, then the opening may be termed as small opening. In contrast, large openings are those that

prevent beam-type behaviour to develop. Thus, beams with small and large openings need separate treatments in design.

This thesis contains 5 chapters which are the introduction, literature review, research methodology, result and discussion and the last one is the conclusion and recommendation. This chapter presents the background of study, problem statement, objectives, scope of study, significance of study and the conclusion for the beam with rectangular opening.

## **1.2 BACKGROUND OF STUDY**

The beam with web opening is necessary to pass these ducts through transverse openings in the floor beams webs. An opening in the web of a reinforced concrete beam may cause too many problems in the beam behaviour such as reduction in the beam stiffness, excessive cracking, excessive deflection and reduction in the beam strength. The size of opening is one of the factors to maintain the beam type behaviour. Then, the location of the opening on reinforced concrete beams such an important in the result of cracking when it is compressed with the load.

There are also a lot of studies dealing with the effects of opening on the T-beams, precast beams and deep beams; however, results are very limited on rectangular beams with web opening. It is because of the limited depth of the rectangular RC beams and importance of introducing the opening in these beams.

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A lot of previous researchers are studied about the beam casted with the opening especially in rectangular web opening on beam. A rational design method for reinforced concrete beams with large rectangular opening that are subject to bending moment and shear force used by Mansur et-al In 1985. And also Nassef et-al studied the effect of openings located in the shear zones on the behaviour of reinforced concrete beams In

1985. Then, the effect of introducing a transverse opening on the behaviour and strength of reinforced concrete beams under predominant shear on the basis of observed structural response are studied by Mansur In 1998. In 2002 Carina N., Martina S.H. studied the behaviour of R.C beams with large openings in shear zone, In 2007. Abdel-Shafy studied the effect of opening dimensions and positions on the static behaviour of high strength R.C perforated beams.

### **1.3 PROBLEM STATEMENT**

In the construction site for building, a lot of renovations have been made to plumbing or duct work systems. So, the structural elements like beams were either cut or removed to make sure these changes not are affected to the structural integrity of the building. The beams must be properly done with the opening before construct on building. This condition will make it a trouble when the small mistakes done. It is obvious that transverse openings through beams are a source of potential weakness. When the service systems are pre planned and the sizes of openings required achieving the necessary layout of pipes and ducts are decided upon well in advance, adequate strength and serviceability may be ensured by following the method described in the preceding section.

Other than that, it also leads to a lot of problems in the beam behaviour such as reduction in the beam stiffness, excessive deflection, excessive cracking and reduction in beam strength. Then, the beam must have the specific size of opening before construct the beam. It can cause the higher cost needed when it done with trial and error procedures. The strength of beam with web opening must be tested at first to make sure there is no any failure cause on site.