CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

In the construction of buildings, a network of ducts and pipes is necessary to accommodate essential services like electricity, sewage, air-conditioning, water supply telephone, and computer network. For aesthetic reasons, usually, these ducts and pipes are placed underneath the beam soffit and are covered by a suspended ceiling, thus creating a dead space. Designing a building in a more compact design, passing these ducts through transverse openings in the floor beams leads to a reduction in the dead space. For small buildings, the savings thus achieved may not be important, but for multi-storey buildings, any saving in story height multiplied by the number of stories can represent a substantial saving in total height, the length of air-conditioning and electrical ducts, plumbing risers, walls and partition surfaces, and overall load on the foundation.

It is clear that inclusion of openings in beams alters the simple beam behaviour to a more difficult one. Due to abrupt differences in the sectional configuration, opening corners are subject to high stress concentration that may lead to cracking improper from visual and durability viewpoints. The reduced stiffness of the beam may also give growth to undue deflection under service load and result in an extensive redistribution of internal forces and moments in a continuous beam. If special reinforcement is provided in satisfactory quantity with proper detailing, the, serviceability and strength of such a beam may be seriously affected. There are 5 chapters present in this report which are introduction, literature review, methodology, result and analysis and conclusion. This chapter, discuss the background of this study, problem statement, research objective, scope of study and the significant of this study.

1.2 BACKGROUND OF THE STUDY

In his wide experimental study, Prentzas (1968) considered openings of circular, rectangular, diamond, triangular, trapezoidal and even irregular shapes. Small openings are stated as those which are circular, square or nearly square in shape. However, the most common opening in practice is rectangular and circular. When the size of the opening is concerned, many researchers use the terms small and large without any definition or clear-cut demarcation line. In contrast, and according to Somes and Corley, a circular opening may be considered as large when its diameter exceeds 0.25 times the depth of the web. The author however feels that the principle of classifying an opening as either small or large lies in the structural response of the beam. When the opening is small enough to maintain the beam-type behaviour, or in other words, the opening may be termed as small if the usual beam theory applies. The opening may be classified as a large opening when beam-type behaviour ceases to exist due to the provision of openings.(Mansur, 2006)

By assuming the prevalence of Vierndeel action and seeing the fact that failure occurs after the creation of a four-hinge mechanism, Mansur, suggested certain conditions with which to classify the size of an opening as either large or small. It can be assumed that hinges form in the chord members at a distance of h/2 from the vertical faces of the opening. This is shown in Fig. 1, where h is the overall depth of a chord member, and the subscripts t and b refer to the top and bottom chords, respectively where the details of this will be discussed at literature review. When the length of opening I0 is less than or equal to hmax, it may be defined as a small opening. For large openings, I0 > hmax . In this definition, it is assumed that the members above and below the opening have sufficient depth to adapt the reinforcement scheme. In the case of circular openings, the circle should be changed by an equivalent square for the determination of the value of hmax.

1.3 PROBLEM STATEMENT

In present building constructions transverse openings in reinforced concrete beams are frequently provided for the channel of utility pipes and ducts. In order to accommodate essential services such as water supply, electricity and telephone lines these ducts are necessary. Passing these ducts through transverse openings in the floor beams leads to a reduction in the dead space and results in a more compact design. It is clear that presence of openings in beams changes the simple beam behaviour to a more difficult one. Due to unexpected changes in the sectional configuration, high stress concentration may lead to cracking unacceptable from aesthetic and durability viewpoints when the opening corners are subjected. The reduced stiffness of the beam may also give growth to extreme deflection under service load and result in a huge redistribution of internal forces and moments in a continuous beam. Unless different reinforcement is provided in enough quantity with proper detailing, the strength and serviceability of such a beam may be seriously affected.

1.4 OBJECTIVE

The objectives of this research are:

- To investigate the flexural behaviour of reinforced concrete beams with circular opening.
- To investigate the effect of different size of circular opening
- To observe failure of reinforced concrete beams with circular opening.

1.5 SCOPE OF STUDY

In order to achieve the objective of this study, beams were casted and tested. This scope of study for this research basically to study the flexural behaviour and failure characteristics. The number of samples to be prepared is 4 concrete beams and 6 cubes including control sample. The size of each beam is 2000 mm x 150 mm x 200 mm were cast for flexural strength test and 6 cubes 150 mm x 150 mm x 150 mm for compressive strength test.

CB was control beam; B1 had a size of 100 mm opening, B2 with 80 mm opening and B3 with 60 mm opening and placed at L/8 distance from support. The concrete grade of 30 and Ordinary Portland cement were used. All the four beams were casted using the same concrete; all the four beams have the opening at both the sides. All the beams were tested on the loading frame with three point load. Each beam was