CHAPTER 1

INTRODUCTION

1.1 GENERAL

Column is a primarily structural compression member that is designed to withstand and transmit axial load in a structure. A column transmits loads from roofs, beams and slabs to the foundation of a structure and finally to the supporting ground below the foundation. Ultimate limit state is the major consideration in the design of column. Generally, columns can be divided into two categories, which are braced column and unbraced column. A braced column will consider only axial force as the lateral loads are supported by shear walls or bracing. Whereas unbraced column will take both axial and horizontal forces into consideration.

From the aspect of architecture, a column can be described as a post or a pillar. Column can be used to support roofs or beams, but they can also be solely decorative. However, the column should be properly constructed in a proper scale and shape. A variety of column styles and designs have evolved over the centuries. Generally, there are two types of columns, namely Greek order column and Roman order column are used to add the aesthetic value of the building. Some of the commonly found examples are Doric column, Ionic column, Corinthian column, Tuscan column and Composite column.

In construction, openings and holes are drilled to place ducts and pipes for accommodation of services such as electricity, water supply, telecommunication, air conditioning and so on. Besides that, sometimes core drilling method is used to examine and estimate the in-situ concrete strength of reinforced concrete column. The presence of such openings may influence the performance of reinforced concrete column, especially from the aspect of load carrying capacity. Therefore, finite element

analysis is conducted to analyse the changes in behaviour of reinforced concrete column by using ANSYS software.

1.2 PROBLEM STATEMENT

Nowadays, drilling transverse openings for the pipes and ducts to pass through the reinforced concrete column has become one of the common practice adopted by some contractors. However, during the design stage of reinforced concrete column, the column is designed without taking the presence of openings into consideration. Therefore, practice of drilling openings in the reinforced concrete column could be very dangerous as this could cause the failure of column and lead to severe structural damage. The presence of opening will have significant influence on the behaviour of reinforced concrete column by reducing the cross sectional area of column, which will lead to loss of load carrying capacity, ductility and stiffness of column.

Many studies have been done to investigate the behaviour of reinforced concrete beam and slab with openings. Nevertheless, the effect of transverse openings on the behaviour of reinforced concrete column is still lack of study so far. Hence, this paper aims to study reinforced concrete column with transverse openings.

1.3 OBJECTIVE OF STUDY

The objectives of study are as follows:

i. To investigate deflection of reinforced concrete column having opening with different sizes and opening in different locations.
ii. To investigate crack patterns of reinforced concrete column having opening with different sizes and opening in different locations.

1.4 SCOPE OF STUDY

Study was conducted on columns specimens with square cross-section of 300 mm x 300 mm and 3800 mm height. The dimension of column is shown in Figure 1.1.

Finite element analysis was conducted to study the behaviour of the reinforced concrete column using ANSYS software.

To model the columns, two types of elements were selected. SOLID65 element was chosen to model the concrete of the column whereas LINK8 element was chosen to model the reinforcement steel. Normal concrete was selected as the concrete used to cast the column in ANSYS. The properties of concrete and steel are shown in Table 1.1.

The parameters included in this study were size of openings and the position of openings in the reinforced concrete column. Finite element analysis was carried out on 9 column models. All the column models were labelled as C1 to C9. C1 is a control model, which is a solid reinforced concrete column without opening.

Table 1.1 Properties of concrete and steel

Young's modulus of concrete	24020 MPa
Poisson's ratio of concrete	0.2
Open shear transfer coefficient of concrete	0.2
Closed shear transfer coefficient of concrete	0.8
Uniaxial cracking stress of concrete	3.36 MPa
Uniaxial crushing stress of concrete	25 MPa
Young's modulus of steel	210000 MPa
Poisson's ratio steel	0.3
Yield stress steel	360 MPa

All column models were reinforced with longitudinal reinforcement of 4H20, transverse reinforcement of shear links with 6 mm diameter and 250 mm spacing. Concrete cover of 30 mm was designed for all of the column models. The main reinforcement arrangement of column samples is shown in Figure 1.1. The detailed specifications of column models are shown in Table 1.2.