CHAPTER 1

INTRODUCTION

1.1 GENERAL

Shear wall is a vertical structural element that provides strength to restrain the building from axial load and lateral force such as wind, earthquakes or blast. Shear walls are more preferable in high rise building such as apartment, condominium, office tower or wall of lift and so on. The best position of shear wall were structurally is in the center of each half of the building. However, it is rarely practical. Therefore, the shear walls were usually positioned at the ends Shear walls are usually perforated for architectural purpose like windows. However, the openings of the shear wall has create disturbance against the stress distribution.

Therefore, the shear wall is analyzed by using the finite element analysis with non-linear static analysis to study the changes of the behavior of the shear wall such as stress distribution, cracking position and so on. The finite element analysis is conducted by using ANSYS 12.0 software. With the aids of the software, the structure can be design in a virtual experiment and the materials can be tested. The engineers can analyze the safety, strength, comfort and therefore the result is cost-effective.

1.2 PROBLEM STATEMENT

Squat shear wall is used as structural element to restrain axial load and lateral loads. Unlike slender shear wall, squat shear wall usually failed by shear before by drift effect from lateral forces. These failures are not preferable as it always occurs after elastic deformation and may fail the whole building structure. The stress distribution of shear wall is same as a column when resisting axial load and beam when resisting lateral load. However, with the presence of opening on the shear wall, it has caused disturbance towards the stress distribution. Therefore, the size and positioning of the shear wall shall be considered and analyzed during design phases.

1.3 OBJECTIVE OF STUDY

The main objectives are to study:

i. The effect of different opening size of shear wall to stress distribution and crack pattern under different types of static load.
ii. The effect of different location of opening on the shear wall to stress distribution and crack pattern under different types of static load.

1.4 SCOPE OF STUDY

In this study, the dimensions of all shear walls model are 3.1m width x 3.1m height x 0.300m thick. The concrete and steel reinforcement properties are referred to previous study done by (Musmar 2013). The concrete material properties are listed in the Table 1.1. Smeared steel reinforcement is used and the properties are listed in Table 1.2. The steel plate is used when applying the several types of forces. The Elastic modulus and Poisson's ratio of the steel plate is same as the steel reinforcement (Kachlakev et al, 2001; Wolanski, 2004. The element selected in this study is SOLID65 for concrete while LINK8 for reinforcement steel. The real constants are set and the cross section of the concrete and steel are to be defined.

All the models are labeled with SW-n where n is the number of sample. The SW1 is the solid shear wall while the other 7 are the shear wall with opening. SW2, SW5, SW6, SW7 and SW8 have the same size of opening but different on different location of the shear wall. SW2, SW5 and SW6 are increased by 0.3 m in both width and height ascendingly. The Table 1.3 has shown the detail dimensions of the shear walls model while the Figure 1.1 shows the model of the shear wall with the dimension. Positive value of horizontal distance represent that the direction is to the right and vice versa. Positive value of vertical distance represent the direction is to the up and vice versa. All the models with different type of opening are also shown in Figure 1.2.

Table 1.1: Material properties of concrete

Material Model	Linear Elastic
Modulus of Elasticity, Es	25743MPa
Poisson's Ratio	0.3
Open Shear transfer Coefficient, βt	0.2
Closed Shear transfer Coefficient, βc	0.9
Unaxial Cracking Stress	3.78 MPa
Uniaxial Crushing Stress f́c	30 MPa

Table 1.2: Material properties of steel

Material model prior to initial yield surface	Linear elastic
Elastic Modulus, Es	200 GPa
Poisson's Ratio	0.3
Yield's Stress, fy	412 MPa
Material model beyond initial yield surface and up to failure	Perfect plastic

Source: Musmar (2013)

Table 1.3: Detail dimension of shear walls model

Sample	Opening height, h (m)	Opening width, b (m)	Horizontal distance from the right, x (m)	Vertical distance from the top, y (m)
SW1	-	-	-	-
SW2	0.9	0.9	0	0
SW3	1.2	1.2	0	0
SW4	1.5	1.5	0	0
SW5	0.9	0.9	-0.5	0
SW6	0.9	0.9	0	0.5
SW7	0.9	0.9	0.5	0
SW8	0.9	0.9	0	-0.5