THE INFLUENCE OF SHEAR WALL SPOT IN OPPOSING EARTHQUAKE

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Abstract: Shear walls are one of the structural members which are characterized to resist the lateral loads such as wind and earthquake etc. The primary purpose of shear wall is to improve the lateral resistant of structure. From past 30 years history of earthquake, it has been projected that, building those are not having shear walls has experienced destructions during earthquake and heavy wind forces. The current study deals with the structural performance of RC framed building with shear walls at different locations. In this paper, a multi-level residential building studied for seismic activity and wall loads using STADD PRO. For presenting dynamic analysis, a material having linear static property as presumed. These examinations are taken out by contemplating a seismic zone III, and that zone III behaviour calculates by taking the medium Soil. A different response for dislocations of base shear, storey drift is plotted for a zone III.

***Keywords*: Seismic analysis, Displacement, Live load, STADD.PRO, Shear wall, Dead load, Multi-storey building, Stiffness.**

I. INTRODUCTION

RC multi-story buildings are designed for resisting both the vertical and horizontal load. A taller structure will undergo the greater lateral load. Every structural Engineer is met with the problem of giving sufficient strength and stability of these tall buildings against lateral load thus the effect of lateral loads like wind load, earthquake load and blast forces are attaining escalating importance. One of the solutions to give better stability for the structure is the utilization of shear wall[1]. Shear walls are the structural members which resists the lateral loads and gravity loads coming from other structural members. The provision of design of shear wall is done based on their high bearing capacity, rigidity, and ductility to resists the seismic loads. Shear walls are common requirements of lift wells and multi-storied buildings. However, they are also adopted in the construction of towers, commercial buildings, and apartments[2]. The objective of the present study is to investigate the effect of different isolators, dampers, and shear walls on the seismic performance of structures. The review will explore the possible applications of the devices in the prevention of damage and failure of buildings structures and bridges due to high seismic movements[3]. Apart from the focus of This paper in isolators the centre of our interest will be the shear wall and how it can be one important method to improve seismic response.

1.1 IMPORTANCE OF SEISMIC HAZARD ANALYSIS

Seismic hazard analysis is important in coming up with a reliable risk assessment. Seismic hazard analysis is principally used to produce seismic hazard maps. These maps provide important information used in putting in place mitigation measures against the effects of destructive earthquakes. They are widely applied by engineers to design highway bridges and buildings, among other infrastructural projects in areas that have high levels of seismic activity. Engineers use the maps to determine seismic importance factor and, therefore, design buildings that can over their lifetimes withstand ground motions resulting from seismic waves that exceed a set annual probability. Insurance companies also use the maps to determine rates for both commercial and residential properties in various places in the US. Additionally, government agencies like FEMA use the maps to help in determining allocation of disaster assistance funds to areas and communities that get damaged when earthquakes occur[4].

1.2 CONSEQUENCES FOR POOR OR LACK OF SEISMIC HAZARD ANALYSIS

Lack of seismic hazard analysis in a seismic hazard zone can have serious negative consequences for communities, businesses, and cities among other parties. Without reliable seismic hazard analysis, cities and businesses won't put in place effective mitigation measures against the consequences of a destructive earthquake. Consequences for such negligence include loss of life and injuries to people. Plus, there can also be property damage and interruption to business activity resulting in financial loss, penalties, fines, lawsuits, and contamination of the environment. As shown above, it is hugely important that cities in earthquake prone areas carry out an accurate seismic hazard assessment. Only when the hazard has been reliably assessed can risk be assessed too and included in designing of buildings and other infrastructural projects for the safety and security of those who use them[5].

1.3 Mechanical devices for seismic mitigation

Mechanical devices such as base isolators and dampers are way out in improving the performance of buildings and civil structures against strong seismic actions. Several isolators such as Elastomeric Bearings, High Damping Bearings, Lead Rubber Bearings, Flat Slider Bearings, Curved Slider Bearings or Pendulum Bearings, Ball & Roller Bearings and dampers such as Mass Dampers, Liquid Damper, Elasto-plastic Damper, Visco Damper, Magneto-rheological Damper, and Shape Memory Alloy Dampers have been prominently addressed in the literatures. Figure 1 illustrates different dampers and isolators used for improving seismic performance of structures[3], [6].

1.3.1 Base Isolation System

Base isolation is a state-of-the-art earthquake hazard reducer in which a structure is separated from the ground by means of a suspension system to mitigate the effect of seismic vibrations. Several base isolation systems have been developed in the field of earthquake engineering which is introduced in the seismic structures for better vibration control.

figure 1.1. base isolators [3]

1.3.2 Dampers

Dampers are vibration absorbers that reduce vibrations and shocks. It is a mechanical device that is intended to disperse the kinetic energy produced in a body or structure. Several dampers are being identified that finds promising applications in bridge piers, buildings, and civil infrastructures.

figure 1.2. dampers[7]

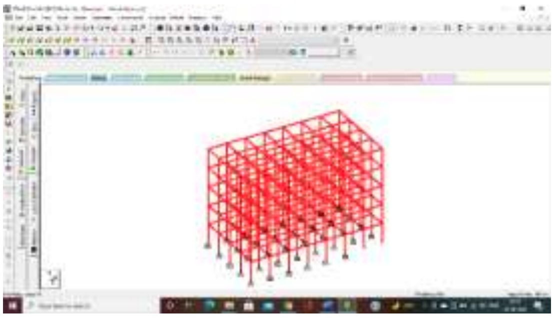
2. Modelling and method

For the analysis purpose, the Model of RC structure (G+4) story and 79.85 m x19.85 m plan area has selected which is in Pekanbaru. The ground to the (G+3) story height is 4 m and the roof height is 9 m. The grade of the concrete used is M20 and for the structural steel is Fe 400.

Table (1) Building description.

Particular	RC structure
Number of stories	G+5
Height	3 m (Ground to G+3) 9m (G+4)
Grade of concrete	M20
Grade of steel	Fe 400
Shear wall thickness	0.3 m
Seismic Design Category	D (as per SNI 1726:2012)
Type of soil	Medium soil
Importance Factor, I.e.	1.25

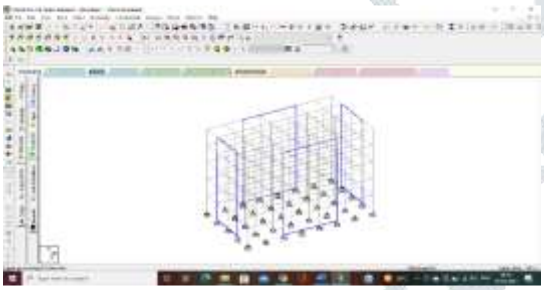
Structure Model can be seen in Figure 1. Model 1 is RC structure without shear wall. Shear wall the added to the structure in various location as shown in Figure 2. In Model 2, shear wall located near the core of the structure symmetrically, for Model 3 shear wall located at the peripheral of the structure symmetrically and for Model 4 shear wall located at outer location of structure asymmetrically. [3]4



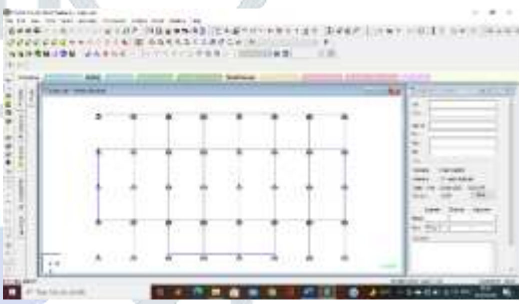
A. Isometric view

B. Top View

Figure 2. Structure Model 1 (without shear wall)



C. Isometric View



D. Top View

Figure 3. Structures with shear wall;) Model 3 structure (shear wall at peripheral symmetrically)

2.1 Lateral loading

Lateral loading consists of earthquake loading which has been calculated by program and using the response spectrum analysis. Earthquake analysis completed by using the rules in code SNI 1726: 2012 (based of IBC 2009) By inputted the spectral response curve, program will calculate the earthquake load. For Pekanbaru, the value of acceleration response, Ss = 0.435 and S1 = 0.273, then the spectral response.

III. Results and discussion

Result obtained from the analysis are recorded in tabular and graphic form for the 4 Model of structures for comparison of maximum natural period, displacement, and story-drift.[8]

3.1 Maximum natural period

Table 2 The natural period of all Model structures.

Model	T-max	Reduction Percentage
1	1.690	-
2	0.669	60.41
3	0.751	55.55
4	0.694	58.90

It has been found that the maximum natural period is in Model 1 structure without shear wall. Shear wall gives high stiffness to the structure that can reduce the period of structure. It has been found that the Model 2, Model 3, and Model 4 shows the shorter natural period of structures compared to the Model 1. Model 2 shows the shortest period among the other Models.[4]1

3.2 Displacement

Lateral displacement of all Model structures as shown I n Table 3 and Figure 4.

X-Direction					Y-Direction			
Story	model 1 mm	Model 2 mm	Model 3 mm	Model 4 mm	Model 1 mm	Model 2 mm	Model 3 mm	Model 4 mm
Roof	229.68	89.2	106	93.2	221.76	65.2	115.6	73.2
Story 3	113.96	44.8	49.6	46	103.84	32.8	54.4	42
Story 2	79.64	26	27.2	26.4	72.6	19.6	30.8	26.8
Story 1	35.2	9.6	9.2	9.6	32.56	7.6	11.2	11.2

From the above results it can be observed that the maximum displacement occurred in Model 1 structures. Shear wall can reduces lateral displacement of structures as it can see in Model that uses shear wall. The maximum reduction of displacement is obtained for Model 2 structure .

3.3 Story-drift

Story-drift of all Model structures as shown in Table 4.

	X-Direction				Y-Direction				
Story	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4	Allowable Drift
Roof	115.72	44.4	56.4	47.2	117.92	32.4	61.2	31.2	103.85
Story 3	34.32	18.8	22.4	19.6	31.24	13.2	23.6	15.2	46.15
Story 2	44.44	16.4	18	16.8	40.04	12	19.6	15.6	46.15
Story 1	35.2	9.6	9.2	9.6	32.56	7.6	11.2	11.2	46.15

From the above result it can be found that the maximum story-drift occurred in Model 1 structure. It is found that the drift in the roof even higher than the allowable drift which is permitted by SNI 1726:2012 (Figure 5). Utilization of shear wall reduces story-drift below the allowable drift. It is found that Model 2 structure gives the optimum performance to reduce the story-drift.

IV. Conclusions

The improvement in seismic performance of the structures has always been a challenging task for researchers and scientists. The mitigation of damage of civil infrastructures due to high seismic vibrations is a matter of major concern to be taken care of. The present review emphasizes on different methods for improving the seismic performance of structure. Based on this study, it has been observed that the utilization of shear wall can contribute in increasing stiffness of structure. It reduces the natural period of structure, lateral displacement, and story-drift significantly. Position of shear wall need to be considered carefully because it gives difference performance to resisting earthquake load. In this investigation, it is found that the optimum location for the structure is Model 2 structure (shear wall at the core symmetrically).

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