International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 05 | May -2017 www.irjet.net p-ISSN: 2395-0072

Analysis of Multi-Storey Building by Using Coupled Shear Walls

Sammed S. Rangolli [1], Dr.Vinod Hosur [2]

[1] *Post-Graduate Student, Dept. of Civil Engineering, KLS Gogte Institute of Technology, Belagavi, India*
[2], *Professor, Dept. of Civil Engineering, KLS Gogte Institute of Technology, Belagavi, India*

---***---

Abstract- *The growth of population and shortage of land in town areas are two major problems for all developing countries. In order to mitigate these two problems, the designer's choice to high-rise buildings, which are rapidly increasing in number, with various architectural configurations and use of structural materials.*
Due to frequent earthquakes occurring around the world, cause considerable damage to the large number of RCC high-rise buildings. This particular incident has shown that designers and structural engineers should ensure to offer adequate earthquake resistant provisions with regard to planning, design, and detailing in high rise buildings to withstand the effect of an earthquake. As an earthquake resistant system, the use of Coupled shear walls is one of the possible options.
Coupled shear walls consist of two shear walls interconnected by beams along their height. In this project natural period base shear, deflection, stiffness, for both static and dynamic analysis is been studied. In this project the software, ETABS 2003 is used for the analysis of the building

***Keywords*: Coupled Shear walls, Stiffness, E-tabs, Story shear, Natural period, Stiffness.**

1. INTRODUCTION

Coupled shear walls consist of two shear walls interconnected by beams along their height as shown in figure 1.1.The behaviour of coupled shear walls is mainly governed by the coupling beams. The coupling beams are designed for ductile inelastic behaviour in order to dissipate energy to provide damping during an earthquake. The use of coupled As an earthquake resistant system, the use of coupled shear walls is one of the potential options in comparison with special moment resistant frame (SMRF) and shear wall frame combination systems in RCC high-rise building0s. SMRF system and shear wall frame combination system are controlled by both shear behaviour and flexural behaviour whereas, the behaviour of coupled shear walls system is governed by flexural behaviour. However, the behaviour of the conventional beam both in SMRF and shear wall frame combination systems is governed by flexural capacity, and the behaviour of the coupling beam in coupled shear walls is governed by shear capacity.
The lateral loads on multistory buildings, are resisted by shear walls, due to their strength and stiffness. these walls have several openings such as elevators, windows, and doors, which divide a shear wall into m slender walls, connected by short beams. These beams are known as coupling beams. The use of the coupled wall system leads to a more efficient and economical structure system than single walls because properly designed coupled wall systems possess considerably higher strength, stiffness, and energy dissipation.

2. STRUCTURAL PROPERTIES OF RC BUILDING:

- Stories : G+19
- Story height: 3.5m
- Beam dimension : 230x850 (1st 5 stories)
  : 230x800 (2nd 5 stories)
  : 230x700 (3rd 5 stories)
  : 230x450 (4th 5 stories)
- Column dimension : 650x650 (1st 5 stories)
  : 550x550 (2nd 5 stories)
  : 500x500 (3rd 5 stories)
  : 450x450 (4th 5 stories)
- Shear wall thickness : 230mm
- Grade of concrete : M30
- Grade of steel : Fe-500
- Zone considered – V
- Importance factor:1
- Response reduction factor-5
- Dead load on the structure-1kN/m^2
- Live load on the structure- 3kN/m^2

2.1: Location of Coupled shear walls:

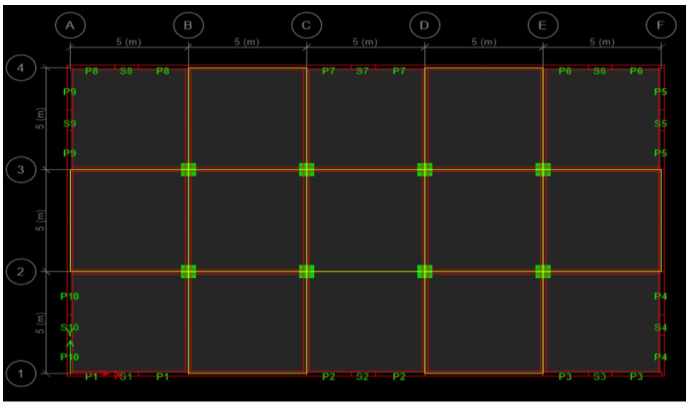

Fig 1.1:Coupled Shear wall plan layout

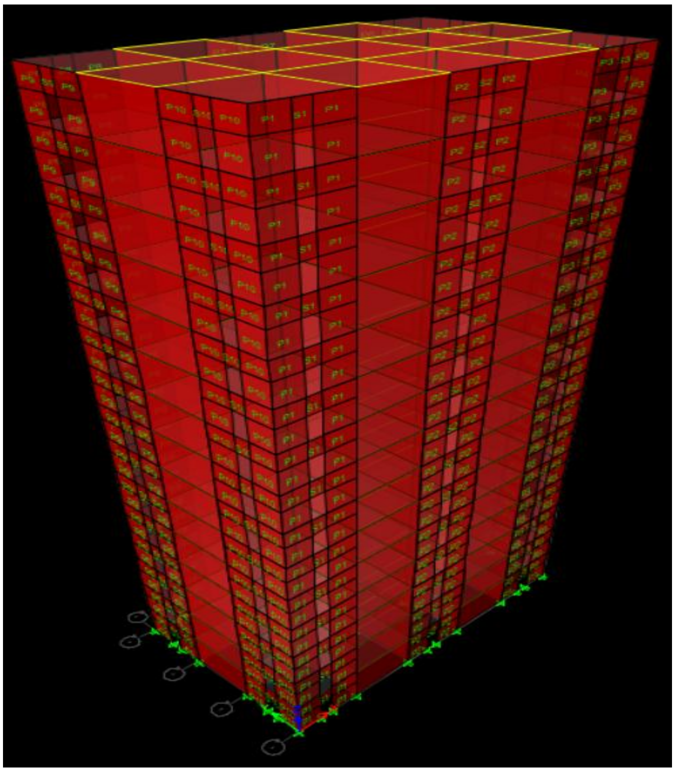

Fig 1.2:Coupled Shear wall 3d view

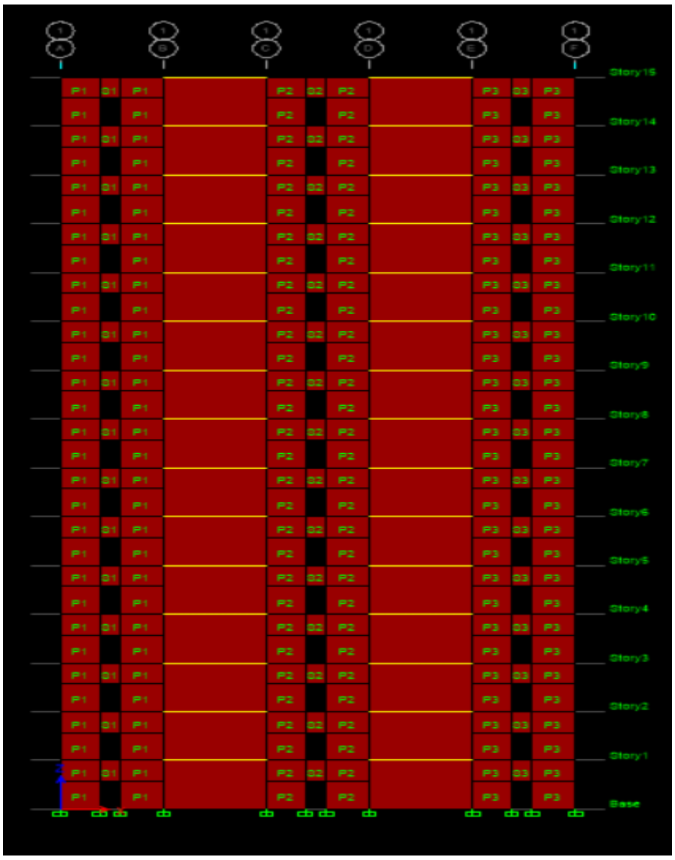

Fig 1.3:Elevation of Coupled shear wall structure

Table 1.0: Story shear in KN

Storey	Load	1st model	2nd model	3rd model
20	SPECX	295.34	658.96	629.592
19	SPECX	518.73	1332.14	1323.1127
18	SPECX	650.82	1982.91	1989.6185
17	SPECX	733.00	2605.91	2624.6077
16	SPECX	803.53	3199.63	3226.8519
15	SPECX	876.20	3772.24	3803.7997
14	SPECX	954.34	4321.68	4353.811
13	SPECX	1027.18	4842.1	4871.4358
12	SPECX	1092.15	5332.25	5355.999
11	SPECX	1149.42	5790.79	5806.9029
10	SPECX	1200.49	6221.16	6228.0239
9	SPECX	1249.65	6621.97	6618.3006
8	SPECX	1296.31	6987.28	6972.3827
7	SPECX	1344.01	7315.1	7288.5357
6	SPECX	1397.87	7603.47	7564.8833
5	SPECX	1461.03	7855.42	7804.3494
4	SPECX	1531.76	8069.09	8004.22
3	SPECX	1596.98	8235.16	8156.1779
2	SPECX	1643.63	8348.88	8256.8665
1	SPECX	1663.32	8405.07	8304.142

Storey	Load	1st model	2nd model	3rd model
20	SPECX	35.97	278.82	639.3
19	SPECX	30.43	238.37	270.15
18	SPECX	13.13	202.72	315.17
17	SPECX	2.78	161.77	327.45
16	SPECX	0.61	95.5	126.48
15	SPECX	2.19	89.83	134.68
14	SPECX	1.96	97.68	161.93
13	SPECX	2.71	90.94	110.21
12	SPECX	2.57	85.86	168.3
11	SPECX	2.14	70.63	99.28
10	SPECX	0.79	69.55	102.81
9	SPECX	0.96	78.37	90.49
8	SPECX	0.4	78.42	126.43
7	SPECX	2.28	78.74	132.68
6	SPECX	3.44	69.78	92.2
5	SPECX	3.44	73.33	98.99
4	SPECX	2.5	88.31	159.71
3	SPECX	8.08	95.52	128.17
2	SPECX	12.84	102.93	178.04
1	SPECX	14.06	107.44	157.58

Table 1.2: Story displacement in mm

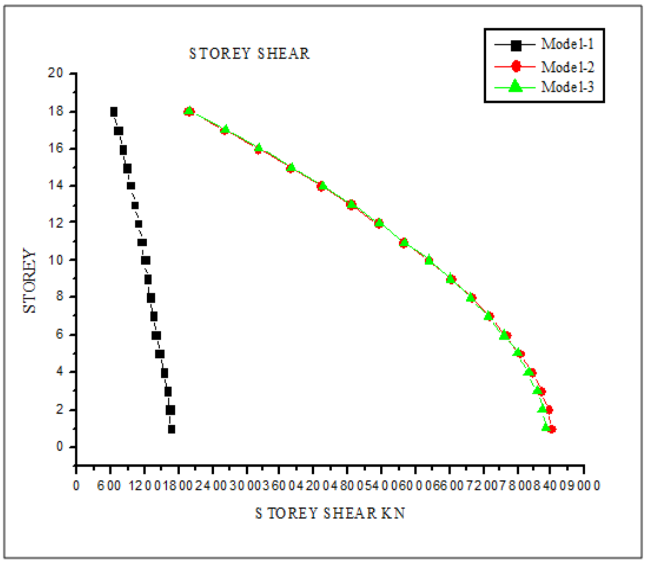

Fig 1.4:Story shear vs story

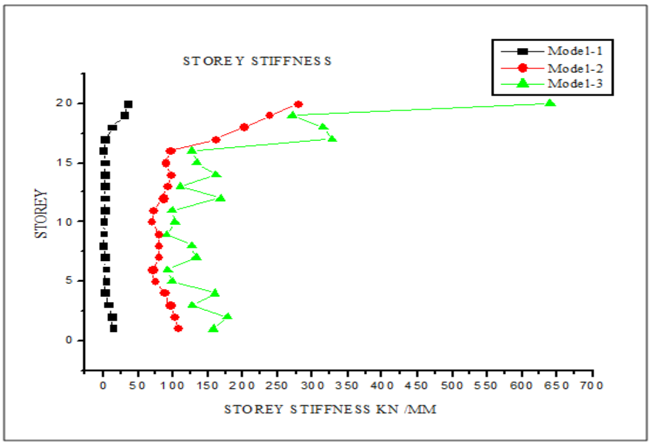

Fig 1.5:Story stiffness vs story

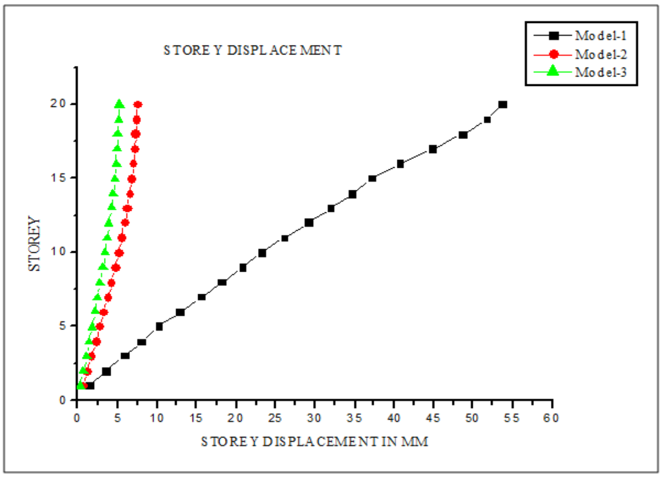

Fig 1.6:Story displacement vs story

Table 1.3: Story shear in KN

Storey	Load	1st model	2nd model	3rd model
20	SPECY	285.55	658.96	634.72
19	SPECY	496.44	1332.14	1330.67
18	SPECY	616.05	1982.91	1996.52
17	SPECY	687.80	2605.91	2629.54
16	SPECY	750.27	3199.63	3230.06
15	SPECY	815.19	3772.24	3805.73
14	SPECY	884.48	4321.68	4354.46
13	SPECY	948.25	4842.10	4870.74
12	SPECY	1005.30	5332.25	5354.37
11	SPECY	1056.75	5790.79	5804.82
10	SPECY	1103.82	6221.16	6225.32
9	SPECY	1149.57	6621.97	6614.22
8	SPECY	1192.91	6987.28	6966.2
7	SPECY	1237.46	7315.10	7280.01
6	SPECY	1288.91	7603.47	7553.93
5	SPECY	1350.84	7855.42	7790.67
4	SPECY	1421.14	8069.09	7987.72
3	SPECY	1486.27	8235.16	8137.29
2	SPECY	1532.71	8348.88	8236.37
1	SPECY	1552.07	8405.07	8282.71

Table 1.4: Story stiffness in kN/mm

Storey	Load	1st model	2nd model	3rd model
20	SPECY	31.10	237.16	612.29
19	SPECY	26.85	207.47	300.97
18	SPECY	11.39	176.90	164.16
17	SPECY	2.02	143.53	162.51
16	SPECY	0.64	84.43	124.22
15	SPECY	1.51	79.92	89.81
14	SPECY	1.91	87.12	108.16
13	SPECY	2.10	81.18	108.87
12	SPECY	1.70	76.88	82.93
11	SPECY	1.41	63.04	74.86
10	SPECY	0.49	62.49	79.03
9	SPECY	0.89	70.30	92.28
8	SPECY	0.44	70.46	95.44
7	SPECY	2.38	70.83	79.77
6	SPECY	3.61	62.80	74.36
5	SPECY	3.63	66.11	99.22
4	SPECY	2.24	79.86	94.97
3	SPECY	8.12	86.24	100.97
2	SPECY	12.32	92.95	131.83
1	SPECY	13.82	97.72	115.87

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 05 | May -2017 www.irjet.net p-ISSN: 2395-0072

Table 1.5: Story displacement in mm

Storey	Load	1st model	2nd model	3rd model
20	SPECY	58.3	8.25	6.9
19	SPECY	55.9	8.19	6.8
18	SPECY	52.5	8.08	6.7
17	SPECY	48.3	7.93	6.5
16	SPECY	43.7	7.72	6.3
15	SPECY	39.9	7.47	6.1
14	SPECY	37	7.18	5.8
13	SPECY	34.1	6.85	5.5
12	SPECY	30.9	6.48	5.2
11	SPECY	27.6	6.07	4.8
10	SPECY	24.5	5.62	4.4
9	SPECY	21.8	5.15	4
8	SPECY	19.1	4.64	3.6
7	SPECY	16.3	4.11	3.2
6	SPECY	13.4	3.55	2.7
5	SPECY	10.5	2.97	2.2
4	SPECY	8.2	2.39	1.8
3	SPECY	5.9	1.80	1.3
2	SPECY	3.6	1.19	0.8
1	SPECY	1.4	0.57	0.4

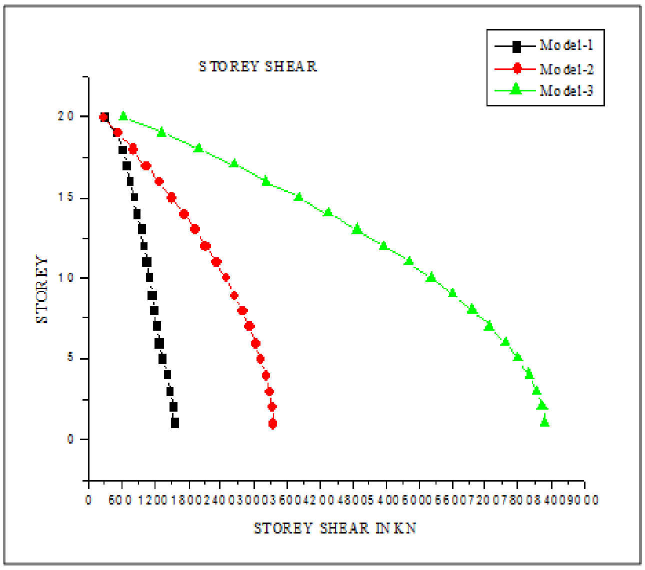

Fig 1.7:Story shear vs story

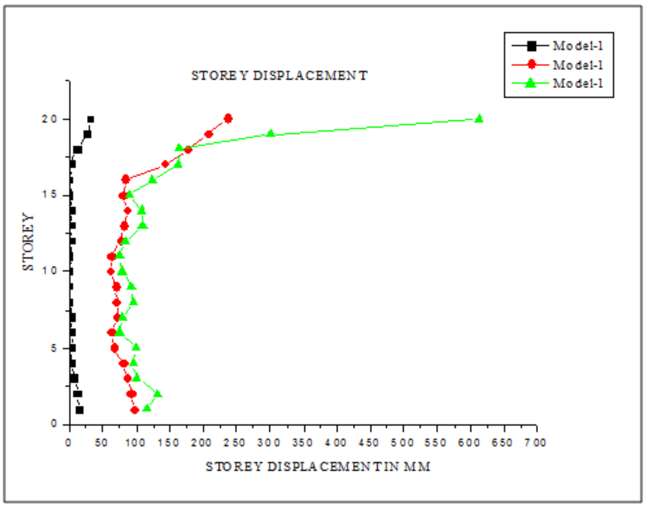

Fig 1.8:Story stiffness vs story

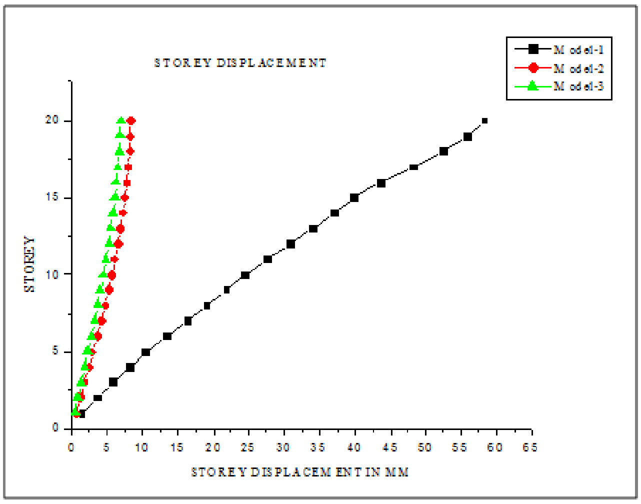

Fig 1.9:Story displacement vs story

2.3 Results and Discussion:

The given bare frame structure without masonry infill and with masonry infill compared with coupled shear wall structure with masonry infill and is analyzed using ETABS 2003. Equivalent Static Analysis and Response Spectrum Analysis are carried out for structure modeled .The coupled shear wall structure with masonry infill is analyzed by considering the stiffness due to shear wall with openings.A analysis is necessary for the walls with openings in the centre of the walls where Coupling beams are capable of bearing the shear, and are subjected to deformations.

- Comparing natural period For model coupled shear wall structure with masonry infill the natural period observed to be decrease compared to model with bare frame and model with bare frame with masonry infill since the stiffness has increased due to provision coupled shear wall with brick infill the stiffness of storey has increased therefore the natural period has decreased.

- Comparing the base shear for coupled shear wall structure with masonry infill and compared to model with and without infill the base shear values are increased.
- Observing the decreased in deflection at the top for model coupled shear wall structure with masonry infill compared to model with and without infill. since stiffness is increased compared to other model
- Decrease of storey shear has observed for model coupled shear wall structure with masonry infill compared to model with infill and is more compared to without infill structure due to increase in seismic weight .
- Observing increase in storey stiffness for model coupled shear wall structure with masonry infill compared to model with and without infill due to decrease in displacement
- For a model coupled shear wall structure with masonry infill storey displacement is less compared to other structure bare frame with and without infill since stiffness is more compared to other model.

2.4 Conclusion:

- The natural period for model no.3(coupled shear wall with brick infill) is minimum among the three different models considered
- The base shear values for model 2 and 3 are almost comparable and compared to model 1 base shear value is increased.
- The displacement is least for model no.3 as compared to the other models because of increased stiffness.
- The storey shear is less for model no 3 as compared to model no.2 and is more as compared to model no.1 in both x and y direction.
- The storey stiffness is more for model no.3 as compared to other models in both x and y direction.
- The performance of model no.3 (coupled shear wall with brick infill) is better as compared to other two models.

2.5 References:

1. **J.C.D. HOENDERKAMP**, "The Influence of Single Shear Walls on the Behaviour of Coupled Shear Walls in High-rise Structures", Vol. 25, No. 3, October 1998.
2. **Harries KA, Moulton JD and Clemson RL** (2004). "Parametric study of coupled wall behaviour – implications for the design of coupling beams". Journal of Structural Engineering, ASCE. 130(3), pp. 480-488
3. **Stafford Smith B, Hoenderkamp JCD and Kuster M** (1984), "Generalized Method for Estimating the Drift in High-Rise Structures". Journal of the Structural Division, ASCE. 110(7), pp. 1549-1562
4. **Subedi, N. K.** (1991). "RC coupled shear wall structures Analysis of coupling beams." J. Struct. Engrg, ASCE, 117(3), 667-680.
5. **Hassan, M. and El-Tawil, S**, "Inelastic dynamic behaviour of hybrid coupled walls", Journal of Structural Engineering, ASCE, 130(2004) 285-296.
6. **Eljadei A.** "Performance based design of coupled wall structures". Ph.D. Dissertation. University of Pittsburgh; 2012. 221p.
7. **B.Stafford Smith and D.P.Abergel**, "Approximate Analysis Of High Rise Structures Comprising Coupled walls and Shear Walls", Building and Environment, Vol. 18, pp 91-96, 1983.

BIOGRAPHIES

Sammed S.Rangolli
Post-Graduate Student,
Department of Civil Engineering
KLS Gogte Institute of Technology,
Belagavi,India-590008

Dr.Vinod Hosur
Professor,
Department of Civil Engineering,
KLS Gogte Institute of Technology,
Belagavi, India- 590008