Design And Analysis Of RC Shear Wall At Different Location On Multi-Storied Residential Building

A. Shiva Shankar [1] , S. Sunil Prathap Reddy [2]
[1]Dept of Civil Engineering
[2]professor,Dept of Civil Engineering
[1, 2]*Vaagevi College of Engineering, Bollikunta, Warangal, T.S*

Abstract- *In present days Earthquakes are one of the usual phenomena resulting in the collapse of infrastructure or building major damaging earthquakes have shown the vulnerability of building with soft storey. In order to improve the earthquake resistance of such RC building, the use of shear wall system are introduced in the structure. In this paper a model of building (G+5) has created using STAAD.PRO software, with this model shear wall is provided based on seismic analysis displacement and shear force were calculated by using static method. The results proved to be very accurate initially for all possible load combinations.*

Keywords- Multi-storey, RC structure, seismic analysis, RC shear wall, STAAD.PRO.

I. INTRODUCTION

On the surface of the earth Earthquake may occur on land or sea, at any place where there is a major fault. In this work the main focus is to analyze an R.C. structure by seismic coefficient method using IS 1893 (PART-1):2002. It has been observed that the lack of stiffness, faulty construction practices, mass irregularity and floating columns etc. are also the principal reasons of failure. In this work shear wall is provided symmetrically and the building frame considered is also symmetrical. It has been proven that this system provides efficient structural system for multi storey building in the range of 30-35 storey’s (MARSONO & SUBEDI, 2000). In the past thirty years of the record service history of tall building containing shear wall element, none has collapsed during strong winds and earthquakes (FINTEL, 1995). From the last thirty years the utilization of shear walls has been increased to such a scope that the stiffness of the building fulfills all the requirements. In this paper the design and analysis of a multi-storeyed building [G +5 (3 dimensional frame)] has been made using STAAD.Pro. It has state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification, STAAD. Pro is the professional’s choice. Initially we started with the analysis of simple 3 dimensional frames and manually checked the accuracy of the software with our results. The results proved to be very accurate. Model designed and analyzed for a G + 5 storey building [3-D Frame] initially for all possible load combinations.

II. LITERATURE SURVEY

Huge research work has been done in the direction of shear wall multi-storey building. Anshuman.S et.al [1] Compared design results of a Structure designed using STAAD and ETABS Software. Alfa Rasikan et.al [2] analyzed Wind behaviour of buildings with and without shear wall. Dr. Sudhir K.Jain et.al [3] gave notes on design examples of a six storey building. Arvind Vinayakrao Achole et.al [4] studied the behavior of building frame with steel plate shear walls. Ashis Debashis Behera et.al [5] studied 3-D analysis of building frame using staad.pro. Discontinuities of frame member and masonry infill walls are common causes of irregularities in RC frame building. Rahiman et.al [6] observed the most common type of vertical irregularity in many countries including India is buildings without masonry infill walls in the ground storey of RC frame building, which is commonly termed as open ground storey RC building. From the literature the effect of an R.C. shear walls on an R.C. Building when provided at different locations has evaluated using STTAD.PRO software.

III. MODELING AND ANALYSIS

Seismic responses of soft storey building with shear walls are considered along with soft storey at ground level are considered. The model G+5 building with shear walls as shown in figure.1

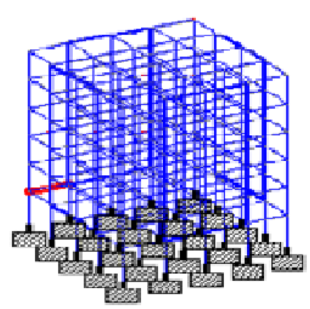

Figure: 1 building model with G+5

Concrete design:

The concrete design details are shown in figure 2. In which design standards and loads at different positions are shown in it. Also design parameters are shown in table 1 and 2.

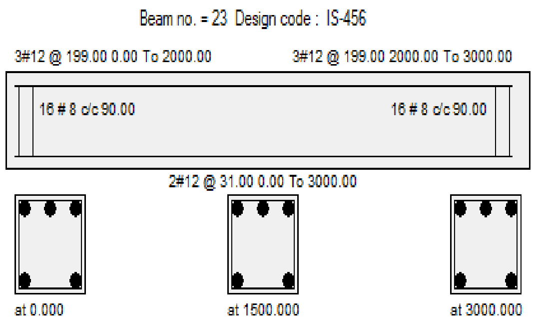

Table 1 Design loads

S.No	Mz Kn Met	Dist Met	Load
1	12.52	1.5	3
2	-21.21	0	3
3	-21.25	3	3

Table 2 Design parameters

S.No	Parameters	value
1	Fy(Mpa)	415
2	Fc(Mpa)	25
3	Depth(m)	0.229999525
4	Width(m)	0.229999536
5	Length(m)	2.99999308

STADD.Pro Output file of Beam

==

B E A M N O. 23 D E S I G N R E S U L T S

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 3000.0 mm SIZE: 230.0 mm X 230.0 mm

COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION 0.0 mm 750.0 mm 1500.0 mm 2250.0 mm 3000.0 mm

TOP 334.88 0.00 0.00 0.00 335.67

REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

BOTTOM 0.00 93.75 187.54 93.75 0.00

REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION 0.0 mm 750.0 mm 1500.0 mm 2250.0 mm 3000.0 mm

TOP 3-12í 2-12í 2-12í 2-12í 3-12í

REINF. 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s)

BOTTOM 2-12í 2-12í 2-12í 2-12í 2-12í

REINF. 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s)

SHEAR 2 legged 8í 2 legged 8í 2 legged 8í 2 legged 8í 2 legged 8í

REINF. @ 90 mm c/c @ 90 mm c/c @ 90 mm c/c @ 90 mm c/c @ 90 mm c/c

----

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

SHEAR DESIGN RESULTS AT 349.0 mm AWAY FROM START SUPPORT

VY = 31.28 MX = 0.02 LD= 3

Provide 2 Legged 8í @ 90 mm c/c

SHEAR DESIGN RESULTS AT 349.0 mm AWAY FROM END SUPPORT

VY = -33.04 MX = 0.02 LD= 3

Provide 2 Legged 8í @ 90 mm c/c

==

Column:

The column designs are shown in figure 3. Design parameters and design loads are shown in table 3 and 4.

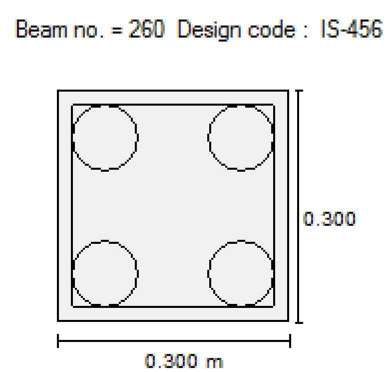

Figure 3: representing column designs

Table 3 Design parameters

S.No	Parameters	value
1	Fy(Mpa)	415
2	Fc(Mpa)	25
3	As Reqd(mm^2)	145
4	As(%)	0.50
5	Bar Size	12

Table 4 Design loads

Load	3
Location	End 1
Pu(Kns)	201.89
Mz(Kns-Mt)	10.89
My(Kns-Mt)	10.82

STADD.Pro Output file of Columon

==
====================

C O L U M N   N O.   250 D E S I G N   R E S U L T S

M25   Fe415 (Main)   Fe415 (Sec.)

LENGTH: 3000.0 mm CROSS SECTION: 300.0 mm X 300.0 mm COVER: 40.0 mm

** GUIDING LOAD CASE: 3 END JOINT: 150 SHORT COLUMN

REQD. STEEL AREA :   243.36 Sq.mm.

REQD. CONCRETE AREA: 30419.58 Sq.mm.

MAIN REINFORCEMENT : Provide 4 - 12 dia. (0.50%, 452.39 Sq.mm.)

(Equally distributed)

TIE REINFORCEMENT : Provide 8 mm dia. rectangular ties @ 190 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz : 1085.51 Muz1 :   40.01 Muy1 :   40.01

INTERACTION RATIO: 0.44 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)

WORST LOAD CASE: 3

END JOINT: 150 Puz : 1148.22 Muz :   49.60 Muy : 49.60 IR: 0.35

Shear wall design: Shear wall designed for analysis one of the surface of the wall is shown in figure 4 with different nodes and parameters. Table 5 and 6 are different nodes lengths and properties of shear wall material.

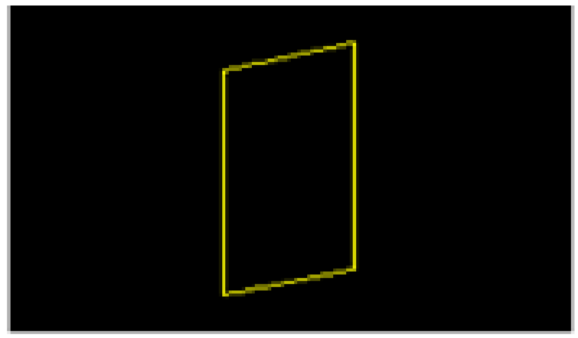

Figure 4: Shear wall

Table 5: different nodes lengths of shear wall

S.No	Node	X(m)	Y(m)	Z(m)	Length(m)
1	174	8.999981599	18.49996213	11.99997598	5.999988
2	149	8.895986469	3.499992930	11.99997598	14.99997
3	147	2.999939995	3.349956544	11.99997598	5.999988
4	172	2.899595856	18.49996213	11.99997598	14.99997

Table 6: properties of shear wall material

S.No	Properties	Values
1	Elasticity(kip/in^2)	3150.015625
2	Poisson ratio	0.17
3	Thickness ratio(m)	0.079999840
4	Density(kip/in^3)	8.680050086696×10^5
5	Alpha	1×10^5

IV. RESULTS

After designing the shear wall analysis is performed on it. To find out shear forces in different directions later these values are tabulated in table 7 and 8. From our analysis all the values are good in accepted range.

Surface X:

Table 7: showing results of shear wall in X-direction

S.No	Height m	Fx N	Fy lbf/ft	Fxy N	Mx kip – in	My lb-in/in	Mz kip – in	Qx N	Qy lbf/ft	Fx N
1	0.600	-14654.79315	-1144.53486	24564.57793	-0.00265	-0.08640	-458.03672	-0.48995	-0.86736	-14654.79315
2	1.200	-18454.84107	-989.59548	29556.08808	-0.00539	-0.06756	-439.38756	-1.31281	0.01249	-18454.84107

3	1.800	-17834.53228	-980.90796	8991.43450	-0.01006	-0.06793	-341.33057	-0.48991	0.29063	-17834.53228
4	2.400	-28284.37993	-1116.50550	-26328.47958	-0.03690	-0.09827	-1073.20553	-0.48983	1.10260	-28284.37993
5	3.000	-5432.98877	-1453.97856	-5225.98951	0.00291	-0.26589	182.18249	-20.43436	2.85626	-5432.98877
6	3.600	-27966.93175	-1115.02095	29409.87763	-0.02685	-0.10043	-1101.59475	-7.49946	0.07518	-27966.93175
7	4.200	-17625.50558	-975.29785	12636.66030	-0.017617	-0.06724	-355.85399	-6.05423	0.05675	-17625.50558
8	4.800	-15896.52344	-995.81658	-7600.22679	-0.00802	-0.06561	-364.53916	0.48990	0.30106	-15896.52344
9	5.400	-14654.74341	-1144.53416	-24564.56641	-0.00265	-0.08640	-458.03372	0.48988	-0.86736	-14654.74341

Surface Y:

Table 8: showing results of shear wall in Y-direction

S.No	Height m	Fx N	Fy lbf/ft	Fxy N	Mx kip – in	My kip - in	Mz kip – in	Qx N	Qy lbf/ft
1	-13.500	-197.93521	-143395.79491	-0.00722	0.13496	0.22624	0.00005	-0.00000	-45.01913
2	-12.000	-183.68391	-153287.08275	1505.04000	-0.12001	-0.19409	-141.87754	0.08773	-48.73709
3	-10.500	-156.21768	-151147.12649	-5.38312	0.00527	0.01900	11.79596	0.00000	-49.64615
4	-9.00	-86.16860	-128080.73320	1258.66621	-0.14425	-0.23504	62.08149	0.05184	-56.87703
5	-7.500	-46.61871	-114604.66313	-3.02798	-0.00328	0.02023	7.74494	--0.00018	-58.55019
6	-6.000	-54.69419	-92830.66282	20.06335	0.00109	0.00160	5.84181	--0.00018	-56.53387
7	-4.500	-19.46969	-71279.03258	-0.78128	0.00608	-0.05096	4.69476	-0.00021	-54.54500
8	-3.000	-22.84863	-48503.25053	28.95927	-0.04403	-0.06715	3.12072	0.00070	-67.92035
9	-1.500	-9.61638	-25832.50686	1.33191	0.05275	0.14310	1.96441	0.00480	-81.12387

V. CONCLUSIONS

1. The system, designed and detailed properly is very ductile and has relatively large energy dissipation capability. As a result, steel shear walls can be very efficient and economical lateral load resisting systems.
2. STAAD PRO has the capability to calculate the reinforcement needed for any concrete section
3. The default design output of the beam contains flexural and shear reinforcement provided along the length of the beam.
4. Columns are designed for axial forces and biaxial moments at the ends. All active load cases are tested to calculate reinforcement. Column design is done for square section. Square columns are designed with reinforcement distributed on each side equally for the sections under biaxial moments and with reinforcement distributed equally in two faces for sections under uni-axial moment.

VI. ACKNOWLEDGEMENTS

We are grateful to Dr.S.Sunil Pratap Reddy Professor & HOD Department of Civil Engineering Vaagdevi College of Engineering for the help in completion of this work. I would like to thank Management of Vaagdevi College of engineering for providing helpful support.

REFERENCES

[1] Prashanth.P,Anshuman.S, Pandey.R.K, Arpan Herbert “Comparison of design results of a Structure designed using STAAD and ETABS Software” *IJCSE, Volume 2, No 3, 2012*

[2] Alfa Rasikan, M. G. Rajendran “Wind behaviour of buildings with and without shear wall” *IJERA, Vol. 3, Issue 2, (2013), pp.480-485*

[3] Dr. Sudhir K Jain (IIT Kanpur) and Dr. R.K. Ingle (VNIT, Nagpur) “Explanatory Examples for Ductile Detailing of RC Building” *IITK-GSDMA-EQ22V3.0*

[4] Arvind Vinayakrao Achole, Dr. G.N. Ronghe “Behaviour of building frames with steel plate shear walls” *VNIT NAGPUR (2006)*

[5] Ashis Debashis Behera, K.C. Biswal “3D Analysis of building frame using Staad Pro*.” NIT ROURKELA.*

[6] Rahiman G. Khan and Prof. M. R. Vyawahare (2013), “Pushover analysis of tall building with soft storey’s at different levels*”, International Journal of Engineering Research and Application, ISSN: 2248-9622, Vol.3, pp. 176-185.*