International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

A Comparative Study among Steel Building, Normal R.C.C Building and R.C.C Building with All around Shear Wall for Same Frame

Md. Noor-A-Islam[1], Ariful Islam[2], Md. Salehin Ferdous Kader[3], Md. Mostafizur Rahman[4]
[1,2]Faculty Member, Department of Civil & Environmental Engineering, Fareast International University, Dhaka-1213, Bangladesh
[3]Assistant Professor & Department Head, Department of Electrical & Electronic Engineering, Fareast International University, Dhaka-1213, Bangladesh
[4]Assistant Professor and Chairman, Department of Civil Engineering, Bangladesh University of Business and Technology

Abstract**—** *The principle objective of this research is to analyze and compare an 15 storied building for different types of building using ETABS version 9.6 and STAAD.Pro v8i. We designed three types of building for one is RCC with and without shear wall and the other steel building for all possible load combinations [dead, live, wind and seismic loads]. All dimension were same of this building. The design involves load calculations manually and analyzing the whole structure by ETABS and staad-pro. The response of different type building of same dimension has been studied for same condition. The structure was subjected to self-weight, dead load, live load, wind load and seismic loads under the load combination of BNBC. The supports at the base of the structure were specified as fixed. Codes of practice to be followed were also specified for design purpose with other important details. After completion of the analysis, we made compare on column force, column moment, story displacement and shown the variation of them. The results shows average column force and beam force.*

Keywords**—** *Three types of building, Compareism, Shear force,Bending moment, Ultimate load capacity ,point displacement.selenderness ratio.steel area,Graphical variation*.

I. INTRODUCTION

This research includes the design for conventional of normal RCC, RCC around Shear wall building and steel building of same frame. In this research comparison among conventional normal RCC & RCC Shear wall steel building is made on the basis of major materials requirements, capacity of carrying load and resisting moment of the slab.

The aim of the research is investigate the difference of various type of multistory building. To begin, we solved some sample issues using tools such as ETABS and STAAD-Pro, and then manually checked the accuracy of the results. The outcomes were satisfactory and accurate. In the initial phase of our project, we have done calculations regarding loadings on buildings and considered seismic and wind loads. Structural analysis is the study and prediction of the behaviour of structures using a set of physical rules and mathematics.

Significance of the study:

- ✓ To learn about ETABS and STAAD-Pro software analysis for all types of structure.
- ✓ To verify the analytical results.
- ✓ To compare the respective frame of RCC building without shear wall, RCC building with all around-shear wall, STEEL building.
- ✓ To compare the values of maximum moments, maximum shear forces & maximum displacements.
- ✓ To compare percentage of steel area with respect to gross area for RCC with and without shear wall buildings.

II. LITERATURE REVIEW

Normal RCC building: Reinforced concrete (RC) is a composite material in which the low tensile strength and ductility of concrete are compensated for by the addition of reinforcement with higher tensile strength or ductility [1].

RCC Building around Shear Wall: A shear wall is a structural system made of braced panels (also known as shear panels) that counteracts the effects of lateral load exerted on a structure in structural engineering. Code (where it is called a braced wall line) and Uniform Building Code, all exterior wall lines in wood or steel frame construction must be braced [2].

Steel Building: It is a general-purpose calculation engine for structural analysis and integrated Steel, Concrete, Timber and Aluminum design. To start with, we have solved some sample problems using STAAD Pro and checked the accuracy of the results with manual calculations. The outcomes were satisfactory and accurate. During the beginning stages of our project, we have done calculations regarding loadings on buildings and considered seismic and wind loads [3].

Overview of Structural parts of RCC Normal Building:

The most efficient floor system must be designed and implemented in order to create ideal building structures. Small modifications in a floor system's design can have a big impact on material prices, construction time, ultimate strength, running expenses, occupancy levels, and the building's final use [4].

Overview of Structural Parts of RCC around shear wall building:

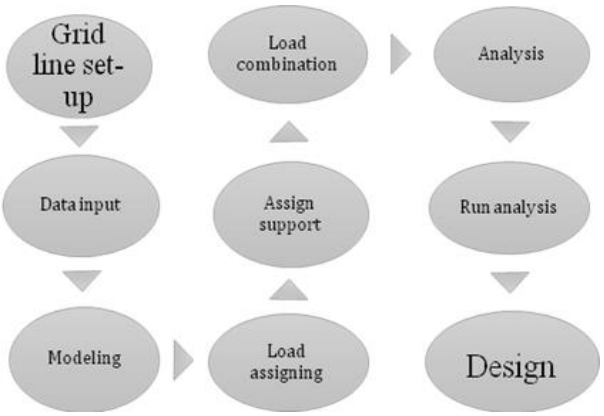
Shear building have been progressively updated during the last two decades, moving from linear static to nonlinear dynamic, enabling more realistic representation of global behavior, and different failure modes [5]. Different modeling techniques shear walls span from macro models such as modified beam-column elements, to micro models such as 3D finite element models [6].

III. METHODOLOGY

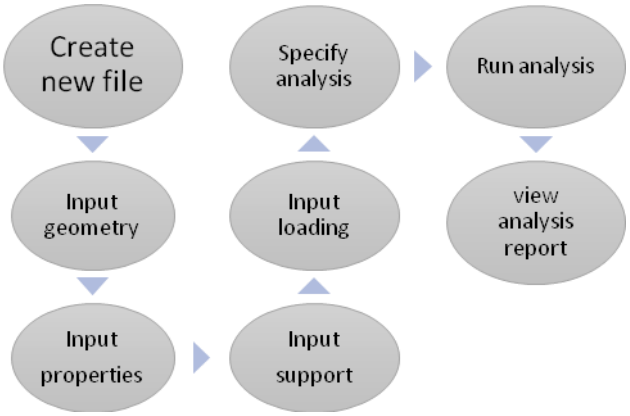
ETABS-

Md. Noor-A-Islam, Ariful Islam, Md. Salehin Ferdous Kader & Md. Mostafizur Rahman "A Comparative Study Among Steel Building, Normal R.C.C Building and R.C.C Building with All Around Shear Wall for Same Frame," *International Research Journal of Advanced Engineering and Science*, Volume 7, Issue 1, pp. 249-252, 2022.

International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024



STAAD-PRO-



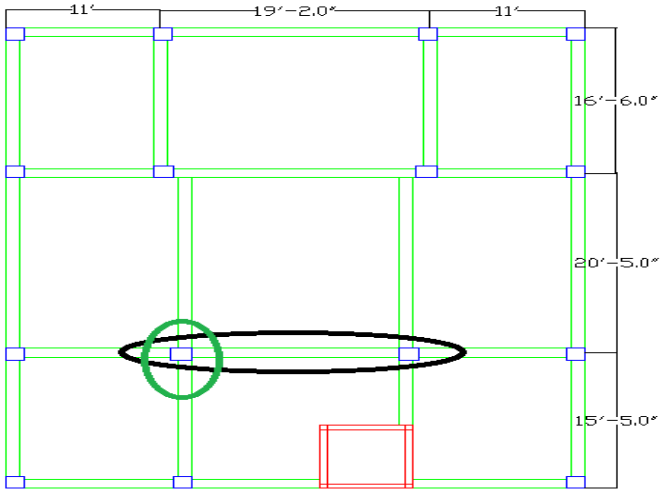


Fig. 1. Typical floor plan

Model image after analysis:- ETABS & STAAD- PRO are used to analysis this this research [7]. These are the model image which we shown below-

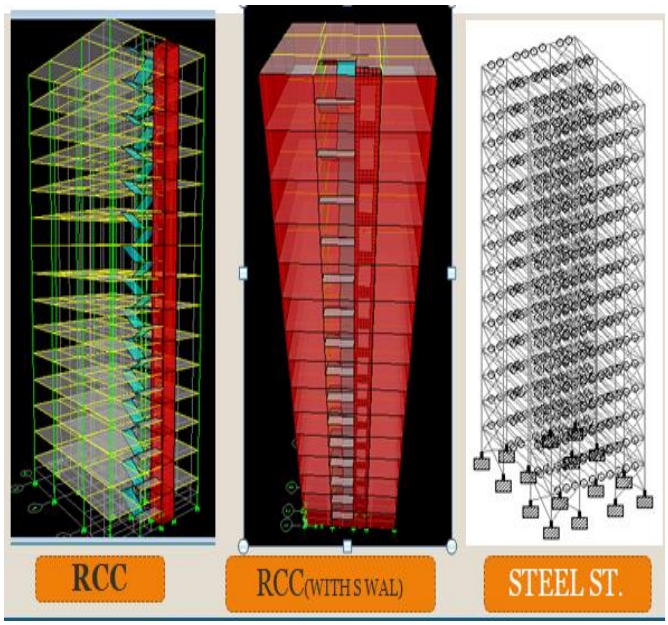


Fig. 2. Image of model

Data Analysis and Specifications:

According to BNBC Code, we provide all the required load, like earthquake load, wind load, dead load, live load, and analysis the seismic load [8].

Design Code:

- American Concrete Institute (ACI) - 2008.
- Bangladesh National Building Code (BNBC) - 2010.

Loadings:

- Dead Load (DL)= 60 psf
- Live Load (LL) =40psf
- Floor Finish (FF) = 25 psf
- Wind Speed = 210 Kmph [For Dhaka]

Case study:-

No of story-15, column size-18"x16" beam size-14"x16"

Materials Properties:

- Yield Strength of Reinforcement, $f\,y$ = 60,000 psi [For RCC]
- Yield Strength of Steel, $f\,y$ = 50,000 psi [For STEEL]
- Concrete Compressive Strength, $f\,'c$ = 4,000 psi

The published load combination equations are

- 1.4D+1.7L
- 1.05D+1.275L+1.275Wx
- 1.05D+1.275L-1.275Wx
- 1.05D+1.275L+1.275Wy
- 1.05D+1.275L-1.275Wy
- 1.4D+1.4L+1.4Ex
- 1.4D+1.4L-1.4Ex
- 1.4D+1.4L+1.4Ey
- 1.4D+1.4L-1.4Ey

IV. RESULT & DISCUSIONS

This Data analysis & Graphical shape:

Md. Noor-A-Islam, Ariful Islam, Md. Salehin Ferdous Kader & Md. Mostafizur Rahman "A Comparative Study Among Steel Building, Normal R.C.C Building and R.C.C Building with All Around Shear Wall for Same Frame," *International Research Journal of Advanced Engineering and Science*, Volume 7, Issue 1, pp. 249-252, 2022.

International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Beam Data(maximum beam shear in-kip)

STOREY	R.C.C(kip)	R.C.C(with shear wall)	STEEL(kip)
1	19.72	15.83	35.82
2	19.58	15.76	35.79
3	19.56	15.46	35.69
4	19.63	15.74	35.63
5	19.47	15.67	35.96
6	19.41	15.61	35.06
7	19.37	15.28	35.95
8	19.63	15.29	35.64
9	19.54	15.48	35.12
10	19.45	15.32	34.35
11	19.62	15.88	34.29
12	19.32	15.53	34.98
13	18.81	15.22	34.37
14	18.26	15.11	34.12
15	18.47	15.42	34.63

Graphical shape(maximum beam shear-kip)

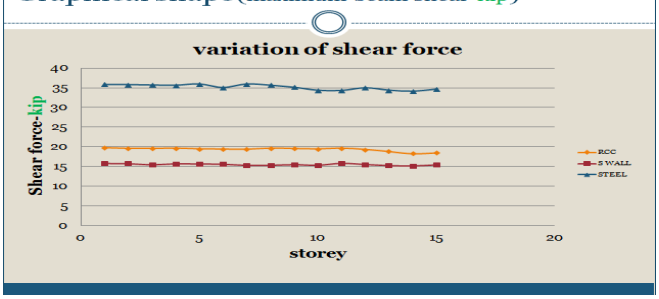


Fig. 3. Variation of maximum shear force (Beam)

Beam Data(for maximum moment in kip-inch)

STOREY	RCC(kip-inch)	RCC OUTER S WALL(kip-inch)	STEEL ST.(kip-inch)
1	382.85	343.19	750.57
2	379.52	341.62	744.95
3	376.48	339.97	739.93
4	373.47	337.93	737.17
5	362.36	331.36	737.39
6	357.89	324.6	736.01
7	355.48	322.08	734.14
8	351.89	318.35	731.17
9	350.34	317.09	729.16
10	348.46	312.55	727.02
11	344.37	310.44	726.95
12	342.53	308.74	723.78
13	341.25	306.41	720.23
14	340.95	305.29	718.25
15	338.68	300.27	711.5

Graphical shape(maximum beam moment in kip-inch)

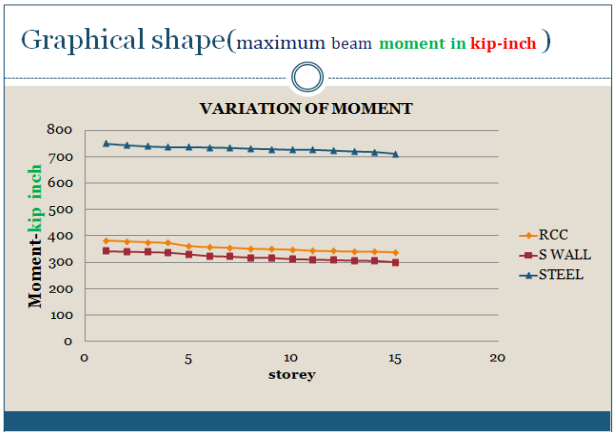


Fig. 4. Variation of maximum moment (Beam)

Column Data(maximum Shear force in kip)

STOREY	RCC(kip-inch)	RCC OUTER S WALL(kip-inch)	STEEL ST.(kip-inch)
1	13.87	7.64	32.66
2	13.5	4.02	31.67
3	13.09	4.3	32.52
4	12.58	4.11	32.02
5	11.85	3.96	31.08
6	11.03	3.79	29.09
7	10.1	3.59	28.75
8	9.1	3.37	27.77
9	8.02	3.14	25.72
10	6.87	2.84	23.36
11	5.67	2.53	21.64
12	4.56	2.18	19.2
13	3.56	1.78	16.34
14	2.5	1.47	13.53
15	1.99	0.18	12.41

Graphical shape (maximum column Shear in kip)

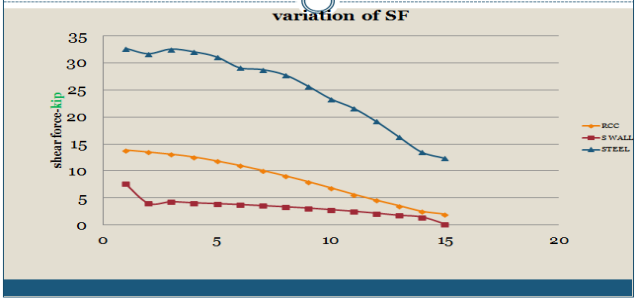


Fig. 5. Variation of maximum shear force (Column)

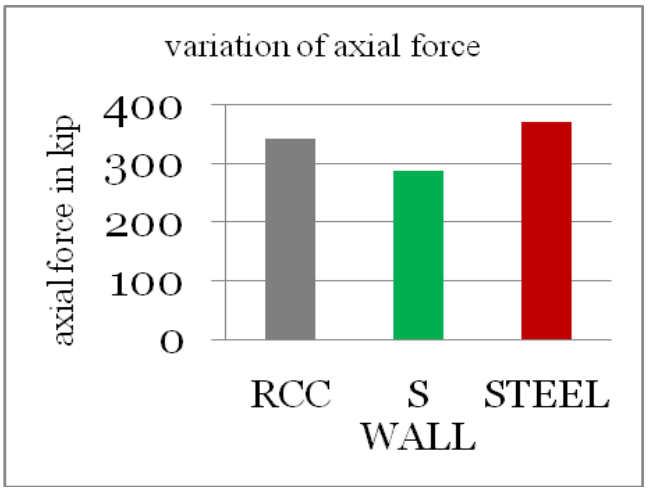


Fig. 6. Variation of axial force

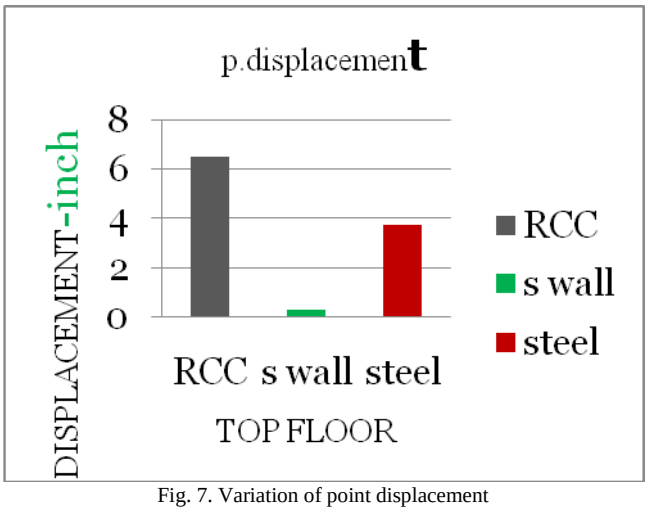


Fig. 7. Variation of point displacement

Md. Noor-A-Islam, Ariful Islam, Md. Salehin Ferdous Kader & Md. Mostafizur Rahman "A Comparative Study Among Steel Building, Normal R.C.C Building and R.C.C Building with All Around Shear Wall for Same Frame," *International Research Journal of Advanced Engineering and Science*, Volume 7, Issue 1, pp. 249-252, 2022.

International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Providing steel area:

Type	As(sq.inch)	% of gross area
RCC	4.628	1.81
RCC s.wall	2.88	1.00

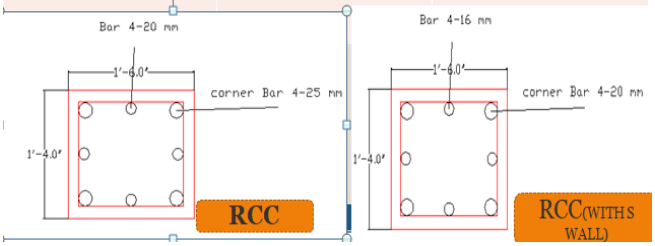


Fig. 8. Required steel area for column

Type	As			% of gross area		
RCC	.966	.31	.937	.50	.16	.49
	.566	.485	.576	.30	.25	.30
RCC s.wall	.546	0.135	.439	.24	.06	.20
	.271	.424	.299	.12	.19	.13

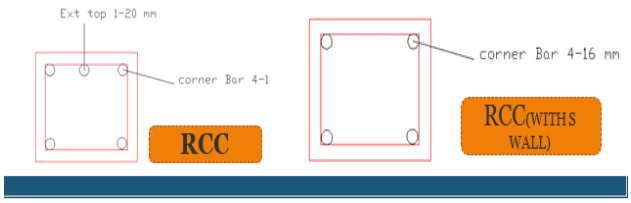


Fig. 9. Required steel area for beam

In here shown that, normal RCC building column carried steel more than RCC around shear wall building column. Therefore, around shear wall keeps an important role in here to provide steel.

V. CONCLUSIONS

- For beam, Shear forces in shear wall around building provides less values than normal RCC and steel building, and also More shear reinforcement were required for RCC building than shear wall around building. Same as also for moment.
  Effects of moment on steel building large among all three building.
- For column, Shear forces in shear wall around building provides less value than normal RCC and steel building. Effects of shear forces on steel building large among all three building.
  Moment in shear wall around building provides less value than normal RCC and steel building.
- Steel building column provides maximum ultimate load capacity and around shear wall building column provide minimum ultimate load capacity among all types of building.
- Shear wall around building provides very low displacement and RCC building provide maximum displacement among three types of building.

VI. RECOMMENDATIONS

- It would better if the analysis of the three types of buildings would done in the same upgraded software.
- It would better to use upgraded software like STAAD-PRO, SAP, ABACUS, ANSYS etc.

REFERENCES

[1] Darwin, David, et al. Design of Concrete Structures. New York, Ny, Mcgraw-Hill Education, 2020.
[2] Ferguson, Phil M, et al. Reinforced Concrete Fundamentals. New York, Wiley, 1988.
[3] Everard, Noel J, and Mazal Holocaust Collection. Schaum's Outline of Theory and Problems of Reinforced Concrete Design. New York, Mcgraw-Hill, 1993.
[4] N Krishna Raju. *Advanced Reinforced Concrete Design*. New Delhi, Cbs, 2016.
[5] Housing And Building Research Institute (Dhaka, Bangladesh, and Bangladesh Standards and Testing Institution. *Bangladesh National Building Code, 1993*. Dhaka, Housing and Building Research Institute And Bangladesh Standards And Testing Institution, 2008.
[6] Aci Committee 318. *Building Code Requirements for Reinforced Concrete (ACI 318-77)*. Detroit, Mich., American Concrete Institute, 1982.
[7] "Analysis & Design of Flyover by Using Staad. Pro V8i." International Journal for Modern Trends in Science and Technology, vol. 7, no. 03, 19 Apr. 2021, pp. 272–279, 10.46501/ijmtst0703041. Accessed 19 July 2021.
[8] "Seismic Analysis of Multi-Storied Building with Shear Walls Using ETABS-2013." *International Journal of Science and Research (IJSR)*, vol. 4, no. 11, 5 Nov. 2015, pp. 1030–1040, 10.21275/v4i11.nov151322. Accessed 7 Dec. 2019.

Md. Noor-A-Islam, Ariful Islam, Md. Salehin Ferdous Kader & Md. Mostafizur Rahman "A Comparative Study Among Steel Building, Normal R.C.C Building and R.C.C Building with All Around Shear Wall for Same Frame," *International Research Journal of Advanced Engineering and Science*, Volume 7, Issue 1, pp. 249-252, 2022.