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Research paper

Seismic Response and Analysis of RCC Block Shear Wall in Assymetric Building Using ETABS

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Abstract

Shear wall is the structural member which with stand the horizontal or lateral forces. The structures are subjected to dynamic loading which have an effect on in general. Our proposed plan is to save you the structural deformation because of dynamic loading. While partitions are situated in tremendous positions in a constructing, they may be very efficient in resisting lateral masses originating from wind or earthquakes. This paper provides designated analyses of experimental and analytical has accomplished end result has generated. Our undertaking focuses on reading the impact of twist, as a system-stage impact, on the displacement and strength demands of the building's separate seismic force resisting system (SFRS) wall components. The look at evaluates the individual wall contributions to the overall building response characteristics within both the elastic and the inelastic reaction phases.

Keywords: *Seismic response, Analysis, RCC Block, Shear wall, Assymetric, ETABS*

1. Introduction

Commonly a concrete frame is layout to face up to gravity load and made stiff by using providing brittle masonry filler wall within frame, therefore there may be greater opportunity that because of its extra stiffness, it'll entice more of the earthquake forces and fail in shear because of failure of brittle masonry. Consequently creation of shear wall in constructing which comes below seismic region avoids fall apart.

By using enhancing ductility and electricity dissipation ability within the structure, the caused seismic forces may be decreased, and a more reasonably priced shape acquired, or as an alternative, the chance of collapse reduced. Hence constructing with lateral load resisting machine comprising a twin device inclusive of ductile moment resisting space body and ductile flexural (shear) wall qualify for terribly low seismic caused forces.

They're typically used inside the structures to withstand the outcomes of gravity hundreds and storey shears. Shear walls are vertical elements inside the lateral force resisting system that transmit lateral forces from the diaphragm above to the diaphragm underneath or to the muse. Shear walls might also bearing partitions inside the gravity load system or they'll be additives in dual gadget framed a good way to resist most effective lateral masses.

2. Methodology

Fig.1 shows the methodology of the study

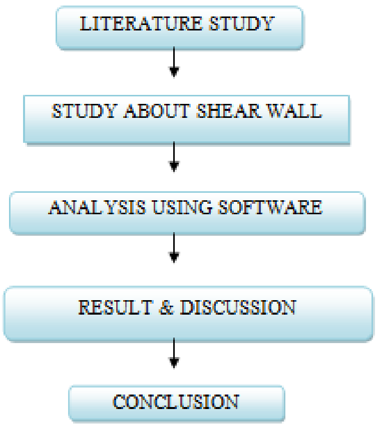

Fig.1: Methodology

3. Shear Wall

Shear walls are vertical components of the horizontal pressure resisting gadget. They may be commonly wooden frame stud partitions included with a structural sheathing fabric like plywood. While the sheathing is nicely fixed to the stud wall framing, the shear wall can face up to forces directed alongside the length of the wall. When shear walls are designed and constructed nicely, they'll have the power and stiffness to withstand the horizontal forces. Fig.2 indicates the typical shear wall.

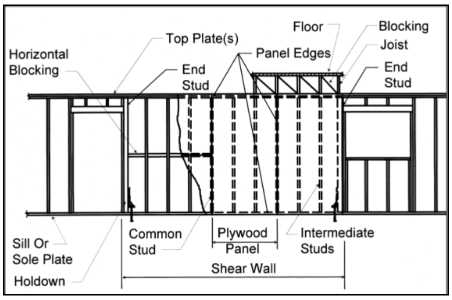

Fig.2: Typical shear wall

Fig.3 shows the rectangular structures.

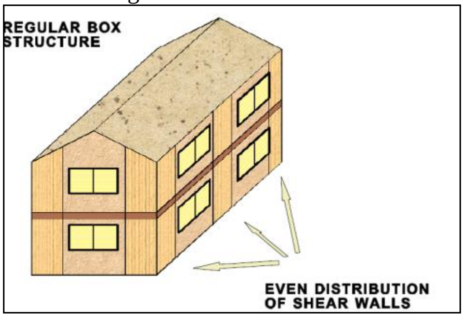

Fig.3: Rectangular structure

That's the reason why most retrofit work uses walls with continuous footings underneath them as shear walls. Fig.4 shows the horizontal alignment of cripple walls

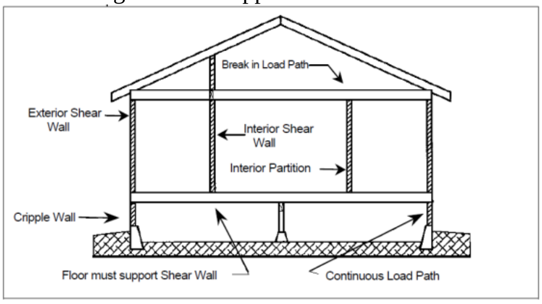

Fig.4: Horizontal alignment of cripple walls

Fig.5 shows the Vertical offset of shear walls

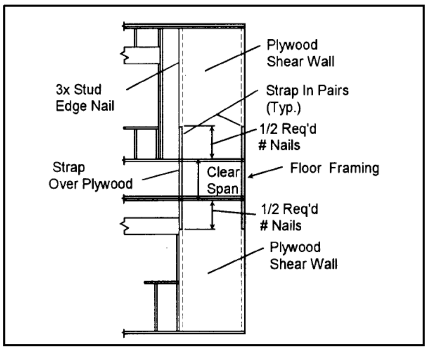

Fig.5: Vertical offset of shear walls

Another sort of alignment problem happens whilst the ends of shear walls do now not align from tale to tale. This situation creates the need for additional framing members and connections in the walls for hold down devices. Holdown gadgets ought to switch the uplift from the shear wall to framing contributors which can withstand it. Whilst complete top studs aren't available, unique connections have to be delivered. These connections indicate duty or correctness to gather sufficient of the structure's framing to face up to the uplift.

4. Earthquake

Earthquakes have many different outcomes except vibrating the systems in response to floor shaking at its basis. These different results may even exceed that because of vibration. Unfortunately, the technique in their estimation and the desired steps for the layout are considered outdoor the scope of structural engineering. Distinctive seismic resistant layout codes have provisions to recollect the vibration of structures. However, these codes do not have any provision to take care of other results. but, structural engineers should be aware of the intensity of the dangers so that you can taking precautionary measures both within the layout of systems, advising customers in selecting right websites in such zones or making them aware about the significance of right preservation of the systems and other considerations the clients need to observe up at the same time as using the designed structures. The different direct and indirect effects of earthquakes are mentioned in the following section.

1. Direct Seismic Effects
2. Indirect Seismic Effects

5. Software

The modern version of ETABS continues in that subculture, incorporating structural detail terminology this is used on a day by day basis (columns, beams, bracings, shear partitions etc.), opposite to the commonplace civil engineering programs that use terms along with nodes, contributors etc. additionally, it offers many computerized features for the formation, evaluation and design of the structural gadget in an green, fast and smooth manner. Evaluation and design of building systems with a structural device which includes beams, slabs, columns, shear walls and bracings. Distinct substances can be assigned to the structural factors within the identical version inclusive of steel, RC, composite or some other user-defined cloth. Easy and automated era of gravity and lateral masses (seismic and wind hundreds) while as compared with other FE standard evaluation packages.

6. Analysis Results

Fig.6 shows the ETABS modeling

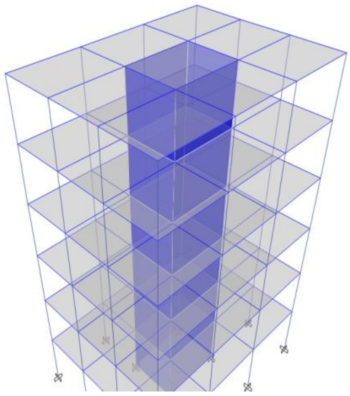

Fig.6: E TABS modelling

6.1. Structure Data

This area provides model geometry information, including items such as story levels, point coordinates, and element connectivity.

6.1.1. Storey Data

Table 1 shows the storey data

Table 1: Storey data

Name	Height mm	Elevation mm	Master Story	Similar To	Splice Story
Story6	3500	21000	Yes	None	No
Story5	3500	17500	No	Story6	No
Story4	3500	14000	No	Story6	No
Story3	3500	10500	No	Story6	No
Story2	3500	7000	No	Story6	No
Story1	3500	3500	No	Story6	No
Base	0	0	No	None	No

6.2. Loads

This area provides loading information as applied to the model.

6.2.1. Load Patterns

Table 2 shows the load patterns

Table 2: Load patterns

Name	Type	Self-Weight Multiplier	Auto Load
Dead	Dead	1	
Live	Live	0	
Seismic	Seismic	0	IS1893 2002

6.2.2. Load Cases

Table 3 shows the load cases

Table 3: Load Cases – Summary

Name	Type
Dead	Linear Static
Live	Linear Static
Seismic	Linear Static

6.3. Analysis Results

This area provides analysis results.

6.3.1. Structure Results

Table 4 shows the base reactions.

Table 4: Base Reactions

Load Case/Combo	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m
Dead	0	0	9588.1004	43146.452	-57528.6027	0
Live	0	0	0	0	0	0
Seismic 1	-825.6126	0	0	0	-13622.2722	3715.2565
Seismic 2	0	-825.6126	0	13622.2722	0	-4953.6753
Seismic 3	-825.6126	0	0	0	-13622.2722	4086.7822
Seismic 4	0	-825.6126	0	13622.2722	0	-5449.0429
Seismic 5	-825.6126	0	0	0	-13622.2722	3343.7309
Seismic 6	0	-825.6126	0	13622.2722	0	-4458.3078
DWal1	0	0	14382.1507	64719.678	-86292.904	0
DWal2	0	0	14382.1507	64719.678	-86292.904	0
DWal3 Max	0	0	11505.7205	68122.469	-69034.3232	4904.1386
DWal3 Min	-990.7351	-990.7351	11505.7205	51775.7424	-85381.0498	-6538.8515
DWal4 Max	990.7351	990.7351	11505.7205	51775.7424	-52687.5966	6538.8515
DWal4 Min	0	0	11505.7205	35429.0158	-69034.3232	-4904.1386
DWal5 Max	0	0	14382.1507	85153.0863	-86292.904	6130.1732
DWal5 Min	-1238.4188	-1238.4188	14382.1507	64719.678	-106726	-8173.5643
DWal6 Max	1238.4188	1238.4188	14382.1507	64719.678	-65859.4958	8173.5643
DWal6 Min	0	0	14382.1507	44286.2698	-86292.904	-6130.1732
DWal7 Max	0	0	8629.2904	59265.2151	-51775.7424	6130.1732
DWal7 Min	-1238.4188	-1238.4188	8629.2904	38831.8068	-72209.1507	-8173.5643
DWal8 Max	1238.4188	1238.4188	8629.2904	38831.8068	-31342.3342	8173.5643
DWal8 Min	0	0	8629.2904	18398.3986	-51775.7424	-6130.1732

Table 5 shows the storey stiffness.

Table 5: Storey stiffness

Story	Load Case	Shear X kN	Drift X mm	Stiffness X kN/m	Shear Y kN	Drift Y mm	Stiffness Y kN/m
Story6	Seismic 1	269.5376	0.6	421447.631	0	0	0
Story5	Seismic 1	522.299	0.7	775743.63	0	0	0
Story4	Seismic 1	684.0662	0.7	1038632.494	0	0	0
Story3	Seismic 1	775.0603	0.6	1320042.159	0	0	0
Story2	Seismic 1	815.5021	0.4	1812809.817	0	0	0
Story1	Seismic 1	825.6126	0.2	3596231.455	0	0	0
Story6	Seismic 2	0	0	0	269.5376	0.8	331851.586
Story5	Seismic 2	0	0	0	522.299	0.9	602212.601
Story4	Seismic 2	0	0	0	684.0662	0.9	795591.061
Story3	Seismic 2	0	0	0	775.0603	0.8	998614.323
Story2	Seismic 2	0	0	0	815.5021	0.6	1359414.334
Story1	Seismic 2	0	0	0	825.6126	0.3	2698856.77
Story6	Seismic 3	269.5376	0.6	421447.631	0	0.01196	0
Story5	Seismic 3	522.299	0.7	775743.63	0	0.02143	0
Story4	Seismic 3	684.0662	0.7	1038632.494	0	0.02827	0
Story3	Seismic 3	775.0603	0.6	1320042.159	0	0.0321	0
Story2	Seismic 3	815.5021	0.4	1812809.817	0	0.03405	0
Story1	Seismic 3	825.6126	0.2	3596231.455	0	0.02678	0
Story6	Seismic 4	0	0.01196	0	269.5376	0.8	331851.586
Story5	Seismic 4	0	0.02143	0	522.299	0.9	602212.601
Story4	Seismic 4	0	0.02827	0	684.0662	0.9	795591.061
Story3	Seismic 4	0	0.0321	0	775.0603	0.8	998614.323
Story2	Seismic 4	0	0.03405	0	815.5021	0.6	1359414.334
Story1	Seismic 4	0	0.02678	0	825.6126	0.3	2698856.77
Story6	Seismic 5	269.5376	0.6	421447.631	0	0.01196	0
Story5	Seismic 5	522.299	0.7	775743.63	0	0.02143	0
Story4	Seismic 5	684.0662	0.7	1038632.494	0	0.02827	0
Story3	Seismic 5	775.0603	0.6	1320042.159	0	0.0321	0
Story2	Seismic 5	815.5021	0.4	1812809.817	0	0.03405	0
Story1	Seismic 5	825.6126	0.2	3596231.455	0	0.02678	0
Story6	Seismic 6	0	0.01196	0	269.5376	0.8	331851.586
Story5	Seismic 6	0	0.02143	0	522.299	0.9	602212.601
Story4	Seismic 6	0	0.02827	0	684.0662	0.9	795591.061
Story3	Seismic 6	0	0.0321	0	775.0603	0.8	998614.323
Story2	Seismic 6	0	0.03405	0	815.5021	0.6	1359414.334
Story1	Seismic 6	0	0.02678	0	825.6126	0.3	2698856.77

6.3.2 Modal Results

Table 6 shows the modal periods and frequencies.

Table 6: Modal Periods and Frequencies

Case	Mode	Period sec	Frequency cyc/sec	Circular Frequency rad/sec	Eigenvalue rad^2/sec^2
Modal	1	0.294	3.397	21.3429	455.5191
Modal	2	0.257	3.893	24.4618	598.3781
Modal	3	0.219	4.566	28.6862	822.8962
Modal	4	0.073	13.668	85.8793	7375.2591
Modal	5	0.073	13.71	86.142	7420.4398
Modal	6	0.062	16.001	100.54	10108.2905
Modal	7	0.044	22.642	142.2625	20238.6238
Modal	8	0.035	28.513	179.1543	32096.2809
Modal	9	0.032	31.257	196.396	38571.3898
Modal	10	0.03	33.156	208.3274	43400.295
Modal	11	0.026	39.118	245.7835	60409.5107
Modal	12	0.024	42.508	267.0844	71334.0915

Table 7 shows the modal participating mass ratios (Part 1 of 2)

Table 7: Modal participating mass ratios (part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
Modal	1	0.294	0	0.72	0	0	0.72	0
Modal	2	0.257	0.7155	0	0	0.7155	0.72	0
Modal	3	0.219	0	0	0	0.7155	0.72	0
Modal	4	0.073	0	0	0	0.7155	0.72	0
Modal	5	0.073	0	0.1949	0	0.7155	0.9148	0
Modal	6	0.062	0.2022	0	0	0.9177	0.9148	0
Modal	7	0.044	0	0	0	0.9177	0.9148	0
Modal	8	0.035	0	0.056	0	0.9177	0.9708	0
Modal	9	0.032	0	0	0	0.9177	0.9708	0
Modal	10	0.03	0.0542	0	0	0.9719	0.9708	0
Modal	11	0.026	0	0	0	0.9719	0.9708	0
Modal	12	0.024	0	0.0203	0	0.9719	0.9911	0

Fig.7 shows the stress diagram

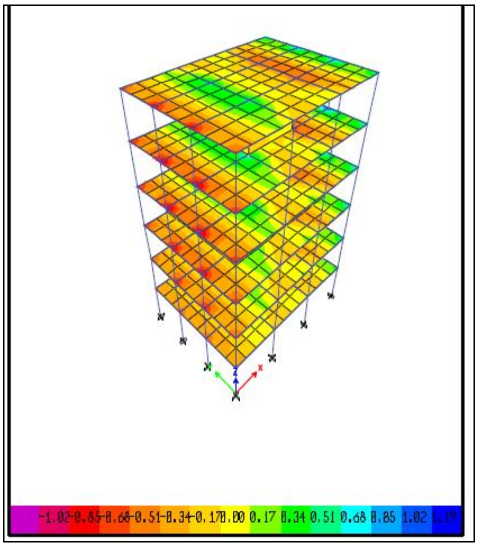

Fig.7: Stress diagram

6.3.3. Etabs 2015 Shear Wall Design

Table 8 shows the Pier details.

Table 8: Pier details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
Story6	P1	6000	4500	14000	250	0.774

Table 9 shows the material properties.

Table 9: Material properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	413.69	413.69

Table 10 shows the design code parameters.

Table 10: Design code parameters

$Γ_S$	$Γ_C$	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Table 11 shows the Pier Leg Locations, Length and Thickness

Table 11: Pier Leg Locations, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	4000	3000	8000	3000	4000	250
Top	Leg 2	8000	3000	8000	6000	3000	250
Top	Leg 3	4000	6000	8000	6000	4000	250
Top	Leg 4	4000	3000	4000	6000	3000	250
Bottom	Leg 1	4000	6000	8000	6000	4000	250
Bottom	Leg 2	8000	3000	8000	6000	3000	250
Bottom	Leg 3	4000	3000	8000	3000	4000	250
Bottom	Leg 4	4000	3000	4000	6000	3000	250

Table 12 shows the Flexural Designs for P_u, M_{u2} and M_{u3}

Table 12: Flexural Designs for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	8750	0.0025	0.0087	DWal8	228.182	8.2526	0	3500000
Bottom	8750	0.0025	0.0087	DWal8	503.7256	-24.463	-279.4445	3500000

Table 13 shows the shear design.

Table 13: Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg1	625	DWal5	108.6581	60.8281	128.3651	234.5209	953.9739
Top	Leg2	625	DWal6	81.4936	183.0154	-91.0722	175.8907	715.4804
Top	Leg3	625	DWal5	52.7573	60.8281	128.3651	233.224	952.677
Top	Leg4	625	DWal6	69.0495	183.0154	-91.0722	175.6019	715.1917
Bottom	Leg1	625	DWal5	183.9686	210.4249	128.3651	236.2681	955.7211
Bottom	Leg2	625	DWal6	179.902	31.3757	-91.0722	178.1737	717.7635
Bottom	Leg3	625	DWal5	239.8693	210.4249	128.3651	237.565	957.018
Bottom	Leg4	625	DWal6	167.4579	31.3757	-91.0722	177.885	717.4748

Table 14 shows the boundary element check.

Table 14: Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg1	0	DWal5	164.5589	-238.853	0.52	6
Top–Right	Leg1	0	DWal5	164.5589	60.8281	0.26	6
Top–Left	Leg2	0	DWal6	93.9377	-32.7026	0.21	6
Top–Right	Leg2	0	DWal6	93.9377	183.0154	0.61	6
Top–Left	Leg3	0	DWal6	164.5589	-60.8281	0.26	6
Top–Right	Leg3	0	DWal6	164.5589	238.853	0.52	6
Top–Left	Leg4	0	DWal5	93.9377	-183.0154	0.61	6
Top–Right	Leg4	0	DWal5	93.9377	32.7026	0.21	6
Bottom–Left	Leg1	0	DWal6	295.7701	-210.4249	0.61	6
Bottom–Right	Leg1	0	DWal6	295.7701	63.0265	0.39	6
Bottom–Left	Leg2	0	DWal6	192.3461	-135.7371	0.62	6
Bottom–Right	Leg2	0	DWal6	192.3461	31.3757	0.34	6
Bottom–Left	Leg3	0	DWal5	295.7701	-63.0265	0.39	6
Bottom–Right	Leg3	0	DWal5	295.7701	210.4249	0.61	6
Bottom–Left	Leg4	0	DWal5	192.3461	-31.3757	0.34	6
Bottom–Right	Leg4	0	DWal5	192.3461	135.7371	0.62	6

7. Conclusion

From our project we conclude that shear wall is highly safe when ii is experimentally and analytically tested and implemented. It generated results are compared and concluded for maximum optimum level of output.

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