International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-4, February 2020

Effect and Behavior of Pre Engineered Building with Different Moment Resisting Frames

Sudheer Choudari, P. Padmanabha Reddy

***Abstract:** Mechanical improvement throughout the years has contributed monstrously to the upgrade of personal satisfaction through different new items and administrations. One such transformation was the Pre Engineered Buildings. In spite of the way that PEB frameworks are broadly utilized in modern and numerous other non private developments around the world, it is generally another idea in India. When contrasted with different nations Indian codes for building configuration are stringent yet more secure in structure of PEB.*

The undertaking extraordinarily manages Design and Detailing for Earthquake Loads (Section-12 of IS800:2007). Steel outlines will likewise be structured and point by point to give satisfactory quality, solidness and flexibility to oppose extreme seismic tremors in all zones without breakdown.

The undertaking fundamentally manages the examination of edges with and without area 12 burden mixes. Contrasted with the past code for example IS-800:1984, the heaviness of the structures is expanding when planned with the most recent code, IS-800:2007. In this way there is an expansion in cost of the structure. Be that as it may, when watched, the area 12 burden mixes are not administered for a similar structure planned with new code. Henceforth the areas might be diminished by fulfilling the base criteria according to the zone and decline in the cost parameter can be found by sorting the structure through which weight of structure can be decreased.

***Keywords:** NMF. OMF, SMF, W Crane, W mezzanine, Without Crane.*

I. INTRODUCTION

Pre Engineering Building is flexible structure frameworks and can be done inside workplace to serve any capacities and adorned remotely to accomplish alluring and special planning styles. It is presently used as regular structures and is extremely useful in the low ascent building plan. Pre designed structures are commonly low ascent structures can go up to 25 to 30 meters. Low ascent structures can be perfect for workplaces, houses, showrooms, shop fronts and so on. The use of pre built structures idea to low ascent structures is exceptionally practical and quick. The top of low ascent structures might be level or slanted.

Revised Manuscript Received on February 28, 2020.
***** Correspondence Author

Sudheer Choudari*, Assistant Professor, Department of Civil Engineering, Centurion University of Technology & Management, Odisha, India. E-mail: sudheerchoudari@cutmap.ac.in, Sudheer.13031@gmail.com

P. Padmanabha Reddy, Assistant Professor, Department of Civil Engineering, GVP College for Degree and PG Courses, Rushikonda, Visakhapatnam, India. E-mail: paddu116@gmail.com

For cladding of the Structure, roll-framed profiled steel sheet, tensioned texture, wood, precast solid, glass window ornament divider, stone work square or different materials might be utilized. A productively planned pre-built structure can be lighter than the ordinary steel structures by up to 30%. Lighter weight likens to less steel and a potential value reserve funds in basic system. Figure 1represents the components of PEB Structure. The Main components are a) Main Frame b) Purlins , Grits And Eave Struts c) Sheeting's and Insulation d)Paints and Finishes e) Doors and windows f) Ribbed Sheet Used for Roof and Wall Liners g) False Ceiling h)Partition Walls i) Flooring j) Columns and Rafters k) Z-Purlin And C-Purlin l)Hi-rib Roofing Sheets m)Curved Eaves.

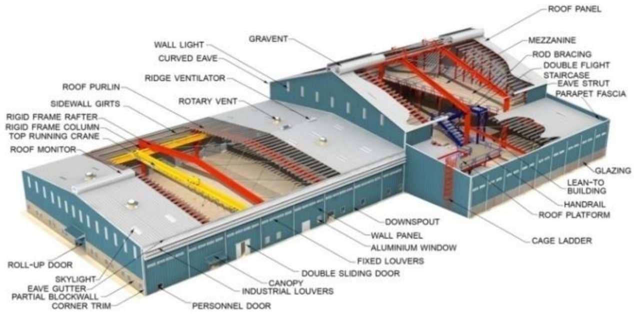

Figure 1: Components of PEB

1.1 Ductility:

Ductility might be portrayed as the capacity of a material to yield without break. As such malleability of a structure or its individuals is the ability to experience huge inelastic misshapenness without critical loss of solidarity or solidness. The pressure strain bend of a material likewise demonstrates the flexibility. It is the measure of perpetual strain, for example strain surpassing corresponding limit up to the point of crack. The limit of the structure to ingest vitality, with adequate distortions and without disappointment, is a truly attractive trademark highlight in any seismic tremor safe plan. The most extreme horizontal burden a structure can oppose in a seismic tremor is equivalent to the sidelong quality of the structure.

In this way, higher pliability demonstrates that the structure can withstand more grounded seismic tremors without complete breakdown.

- Ductility ought to be evaluated and equivalent consideration must be taken as quality and solidness.
- Plastic potential zone ought to be determined for unique minute opposing casings and segments are given either conservative or plastic because of high twisting minutes in that areas.

1.2moment Resisting Frames:

Steel outlines will be so structured and nitty gritty as to invigorate them sufficient and pliability to oppose extreme quakes in all zones characterized. Casings, which structure a piece of the gravity load opposing framework however are not proposed to oppose the sidelong quake loads, need not fulfill the prerequisites of this area, if they can suit the subsequent disfigurement without untimely disappointment.
Steel structures have frequently been planned utilizing flexible techniques. In any case, it is normal that such edges show inelastic conduct during extreme tremors. A portion of the examinations have demonstrated that the best execution among minute edges has a place with the ones which were planned dependent on the solid segment frail shaft reasoning.

A basic planner can pick whether the segments or the bars should yield first, it is commonly attractive to give solid sections and to permit earlier yielding of the pillars in flexure. The various sorts of casings utilized are as per the following:

1. Column disappointment implies the breakdown of the whole structure.
2. A frail segment structure, plastic mishapening is amassed in a specific story. Thusly, a generally huge pliability factor is required.
3. In shear-and flexural disappointments of segments, corruptions are more noteworthy than when bars yield.

In the structure planned with solid segments and frail shafts, plastic pivots will eventually be framed at the base of the principal story sections. Thus, adequate pliability ought to be accommodated segments.

Minute opposing casings planned with flexible techniques utilizing equal static powers may experience enormous and unaccepted disfigurements and therefore numerous plastic pivots structure dispersedly in various pieces of the casing. A blend of pliability, weaknesses in intersections, and utilizing unreasonable methodologies in configuration, are the primary explanations behind the frail execution of Special Moment Resisting Frames in late tremors.

Moment Resisting Frame: Lateral forces can be resisted by connecting Beams and columns with moment resisting connections, which will result in flexure and shear. And they develop ductility by:

1. Flexural yielding of beams
2. Shear yielding of column panel zones
3. Flexural yielding of columns

,

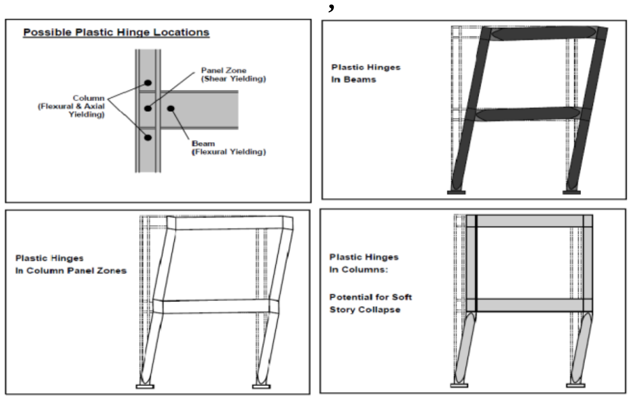

Figure 2: Possible plastic hinge locations in MRF under lateral load

1.2.1 Normal Moment Resisting Frames:

NMF are framed to designed as per Table - 1 load cases are considered and its associated specifications for section, bracing, load case, connection design, base plate design. For the design of NMF, minimum section used is semi-compact for column and slender for rafter. It is safe to provide a semi-compact section in critical zone as it is the zone with high bending moments and shear i.e. rafter column junction as shown in the figure below. This is considered to be most economical frame. Bracing design & bracing section are not required to satisfy section 12.

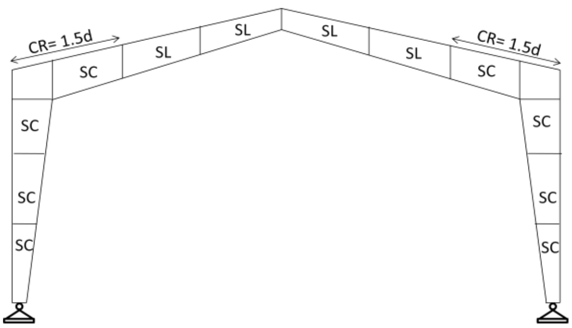

Figure 3: Minimum Section Criteria for NMF (Pinned Base)

SL: Slender **SC: Semi-compact**
CR: Critical zone

Load Combinations:

Earthquake loads will be calculated as per IS 1893(part1), without the reduction factors recommended in section 12.3 of IS 800:2007 may be used.

1.2.2 Ordinary Moment Resisting Frames (Omf):

Basic Moment Resisting Frames should be seemed to resist inelastic winding identifying with a joint insurgency of 0.02 radians without corruption in quality and strength underneath the full yield regard (Mp). OMF meeting the necessities of this section will be regarded to satisfy the vital inelastic mishapening. OMF won't be used in seismic zones IV and V and for structures with criticalness consider more noticeable than solidarity seismic zone III. OMF with unbendable moment affiliations should be planned to withstand a depiction of at any rate 1.2 events the full plastic preview of the related column. For OMFs, a semi-rigid momentaffiliation is permitted.

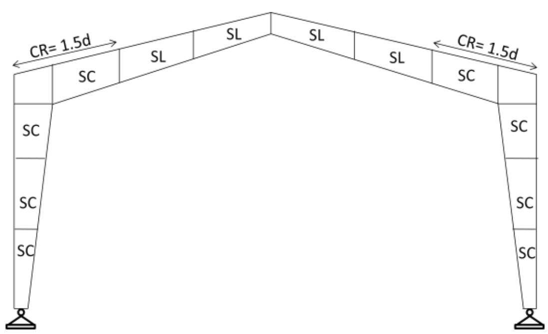

Figure 4: Minimum Section Criteria for OMF (Pinned Base)

SL: Slender **SC: Semi-compact**
CR: Critical zone

Load Combinations:

Quake loads will be determined according to IS 1893(part1), then again, actually the decrease factors prescribed in segment 12.3 of IS 800:2007 might be utilized. In the utmost state plan of edges opposing quake stacks, the heap blends will fit in with table as appeared underneath according to IS 800:2007. Notwithstanding these heap mixes segment 12 mixes are to utilized for OMFs as referenced underneath.

1.2.3 Special Moment Resisting Frames:

Outstanding Moment Resisting Frames should be seemed to withstand inelastic deformation contrasting with a joint turn of 0.04 radians without degradation in quality and robustness underneath the full yield regard (Mp). SMF can be used in each and every seismic zone. SMFs with unyielding moment affiliations should be expected to withstand a depiction of in any occasion 1.2 events the full plastic preview of the related shaft. The column to-area relationship of SMFs should be planned to withstand a shear coming about due to the load mix 1.2DL+0.5LL notwithstanding the shear coming about on account of the utilization of 1.2Mp a comparative path at each finish of the pole.

Bar and section territories should be either plastic or diminished; at potential plastic turn regions they should be plastic. SMFs should be arranged with strong fragment - feeble column thought and satisfy the condition:

$$\Sigma M_{pc} \geq 1.2\, M_{pb}$$

Where M_{pc} is the sum of moment capacity in columns above and below centre lines

M_{pb} is the sum of moment capacity in beams at the intersection beam and column centre lines.

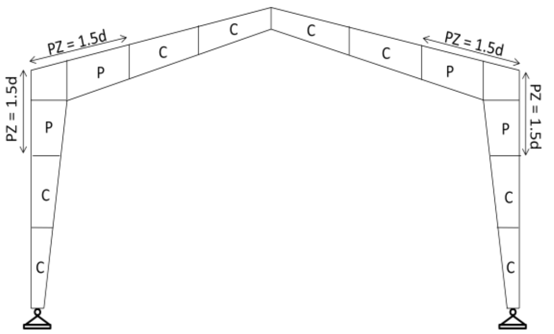

Figure 5: Minimum Section Criteria for SMF (Pinned Base)

C: Compact P: Plastic PZ: Potential zone

Load Combinations:

Reaction decrease factors for propositions outlines are taken according to Table 23 of IS 800:2007.

II. MODELLING OF FRAMES

The Modelling of frames are done in Staad Pro Software which is Finite Element Modelling background gives the best output accurately.

Length of the member = 3 m.
Aspect Ratio: h/w = 0.2
Bay width = 7.5 m
Internal wind coefficient, C_{pi} = ±0.2 as %opening is <5%

Wind Load Calculations done As per IS: 875-Part3

III. TEST STAAD OUTLINE MODELS FOR AN ORDINARY MOMENT RESISTING FRAME, ALONGSIDE CRANE AND WITH MEZZANINE ARE DEMONSTRATED AS FOLLOWS

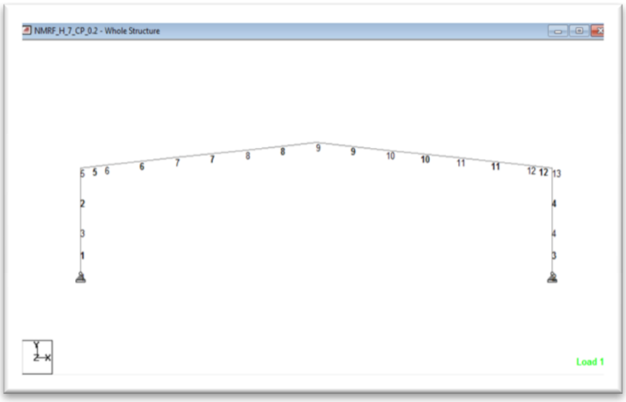

Figure 6: STAAD model for SMF without mezzanine and without crane

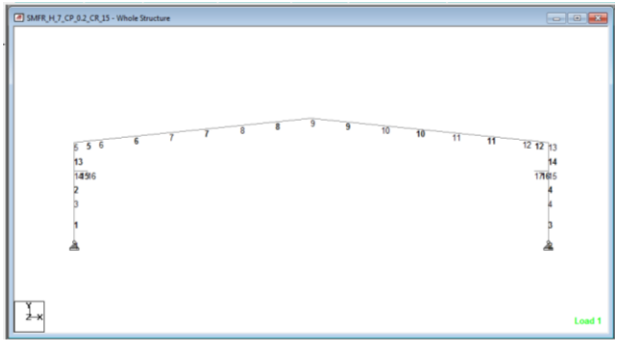

Figure 7: STAAD model for SMF with crane and without mezzanine

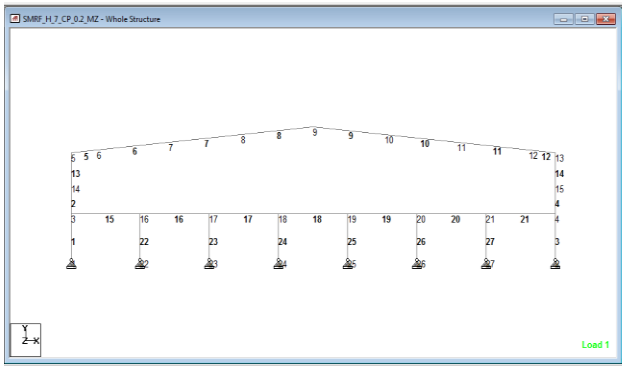

Figure 8: STAAD model for SMF with mezzanine and with crane

The documentations in the tables and figures of this section are utilized to speak to the accompanying things.

NMF – Normal moment resisting frame
OMF – Ordinary moment resisting frame
SMF – Special moment resisting frame
NMF/OMF/SMFW CRANE – Frame with crane
NMF/OMF/SMF W MZ – Frame with mezzanine

NMF/OMF/SMF W/O CRANE – Frame without crane

IV. DISCUSSIONS AND RESULTS:

4.1 Comparison of casing weight for various edges without crane loads, with crane loads (5T) and with mezzanine and their rate distinction.

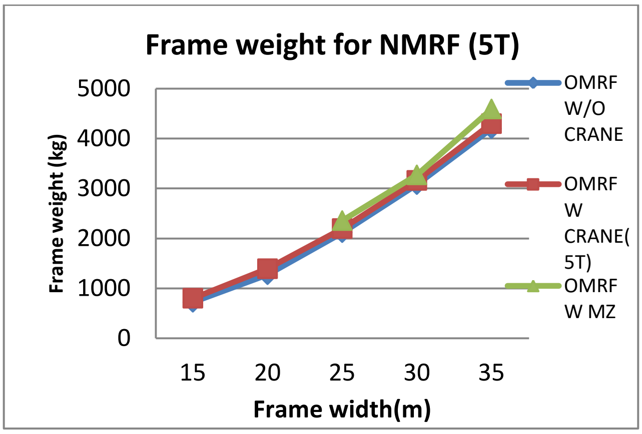

Figure 9: correlation of edge weight for NMF without crane loads, with crane loads (5T) and with mezzanine and their rate contrast

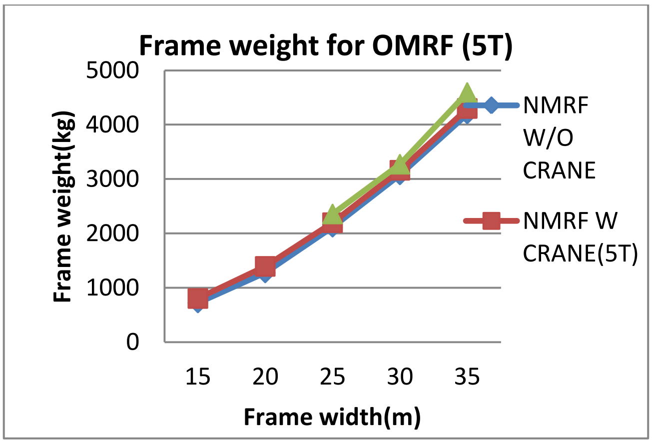

Figure10: Correlation of casing weight for OMF without crane loads, with crane loads (5T) and with mezzanine and their rate distinction

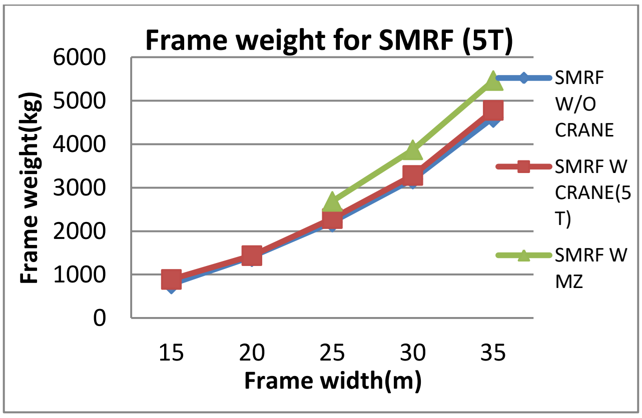

Figure11: Examination of edge weight for SMF without crane loads, with crane loads (5T) and with mezzanine and their rate distinction

4.2 correlation of Base shear with crane loads(5T):

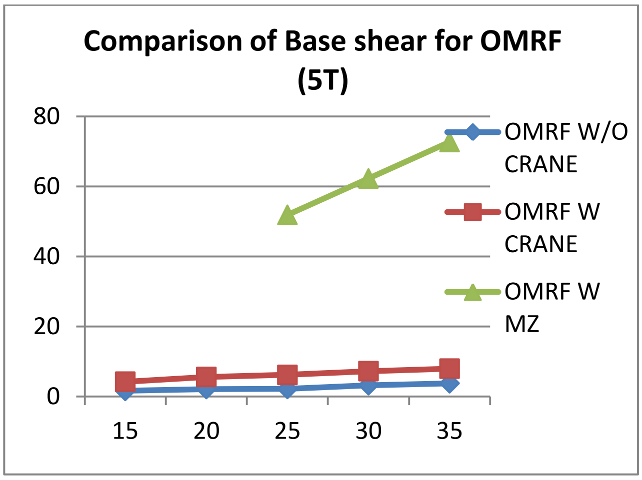

Figure 12: Comparison of Base shear values for OMF with crane loads(5T)

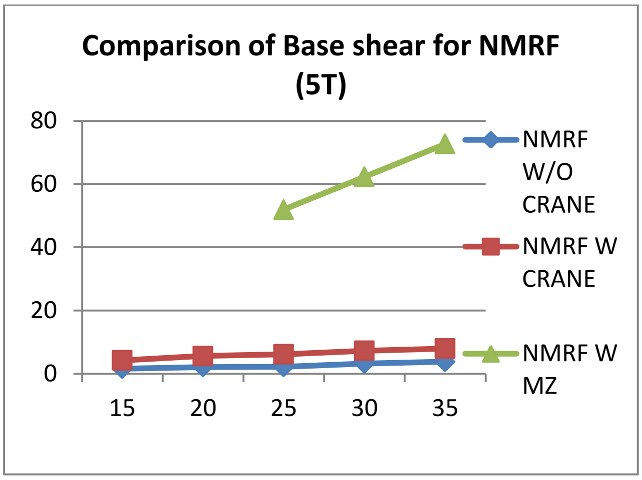

Figure 13: Comparison of Base shear for NMF with crane loads(5T)

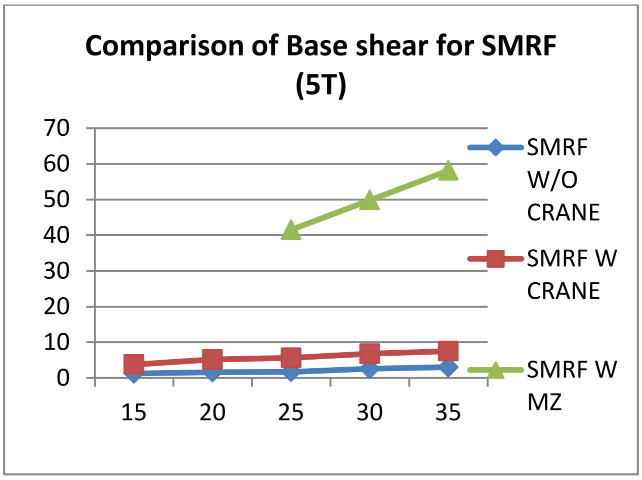

Figure 14: Comparison of Base shear for SMF with crane loads(5T)

Observations:

1) Difference in base shear estimations of Special and standard minute opposing casings is under 1.5KN.
2) Base shear estimations of SMF is seen to be not exactly OMF.

International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-4, February 2020

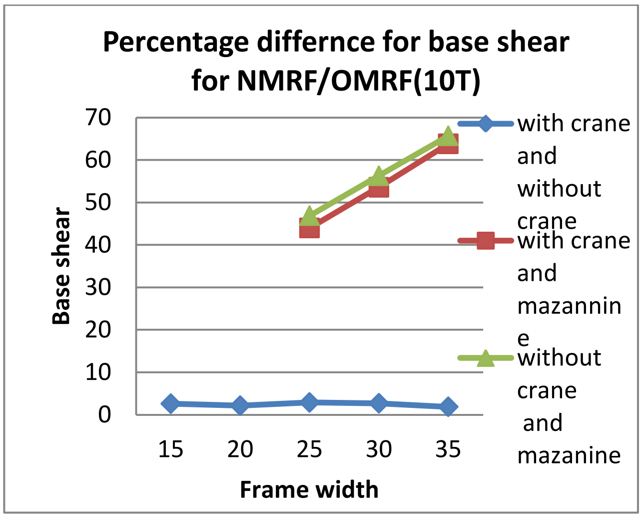

Figure15: correlation of rate distinction for Base shear for NMF/OMF (10T)

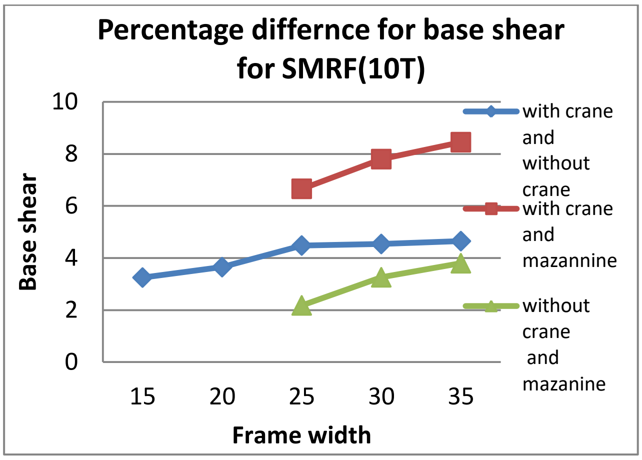

Figure 16: correlation of rate distinction for Base shear for SMF(10T)

Table 1: correlation of rate distinction for Base shear for NMF/OMF (10T)

Span	Percentage difference Base shear for NMF/OMF (10T)		
(m)	with crane and without crane	with crane and mezzanine	without crane and mezzanine
15	2.62		
20	2.16		
25	2.91	44.01	46.92
30	2.72	53.59	56.31
35	1.89	63.83	65.72

Table 2: correlation of rate contrast for Base shear for SMF (10T)

Span	Percentage difference for Base shear for SMF (10T)		
(m)	with crane and without crane	with crane and mezzanine	without crane and mezzanine
15	3.25		
20	3.65		
25	4.48	6.66	2.18
30	4.54	7.8	3.26
35	4.65	8.45	3.8

Observations:

1) Base shear estimations of SMF are seen to be roughly 1/third not exactly OMF.

2) Increase in outline weight from OMF to SMF is underneath 10 % and it is affordable.

Table 3: Examination of edge weight for various edges without crane loads, with crane loads(10T) and with mezzanine and their rate distinction.

SPAN	**HEIGHT**	**FRAMES WEIGHT WITHOUT CRANE (10T)**			
(m)	(m)	NMF Without CRANE	OMF Without CRANE	SMF without CRANE	%
15	3	721.5	721.6	785.1	8.8
20	4	1273.7	1273.7	1412.5	10.8
25	5	2115.7	2115.7	2208.2	4.4
30	6	3078.2	3078.2	3199.4	3.9
35	7	4199.2	4199.3	4614.1	9.8
		FRAMES WEIGHT WITH CRANE (10TONS)			
		NMF With CRANE	OMF With CRANE	SMF With CRANE	%
15	3	818.54	818.54	895.67	9.42
20	4	1440.1	1440.1	1480.27	2.79
25	5	2267.65	2267.65	2351.94	3.72
30	6	3217.62	3217.62	3350.78	4.14
35	7	4388.55	4388.55	4825.68	9.96
		FRAMES WEIGHT WITH MAZZANINE			
		NMF With MZ	OMF With MZ	SMF With MZ	%
25	5	2357.89	2357.89	2685.35	13.8
30	6	3273.63	3273.63	3871.93	18.27
35	7	4593.4	4593.4	5464.68	18.96

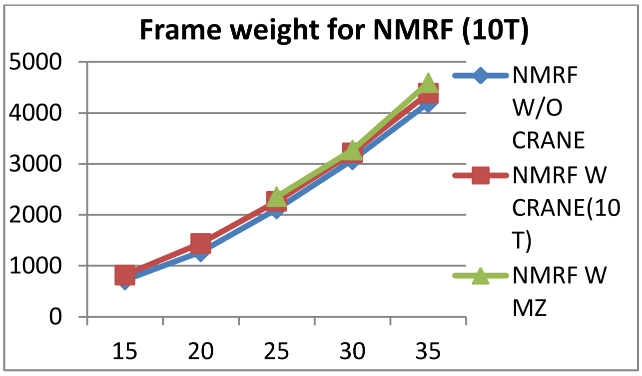

Figure17: Comparison of edge weight for NMFwithout crane loads, with crane loads(20T) and with mezzanine and their rate contrast.

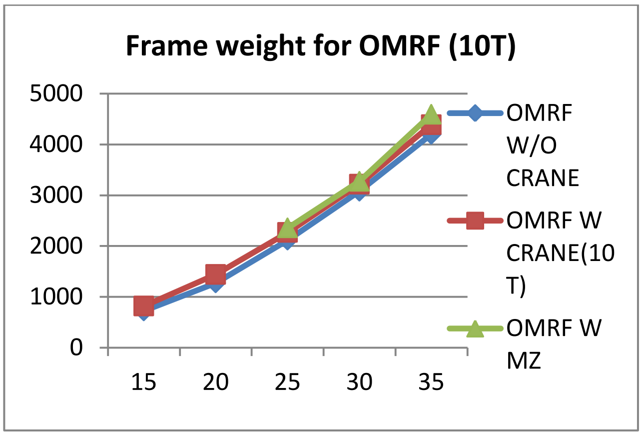

Figure 18: Comparison of edge weight for OMF without crane loads, with crane loads(20T) and with mezzanine and their rate contrast..

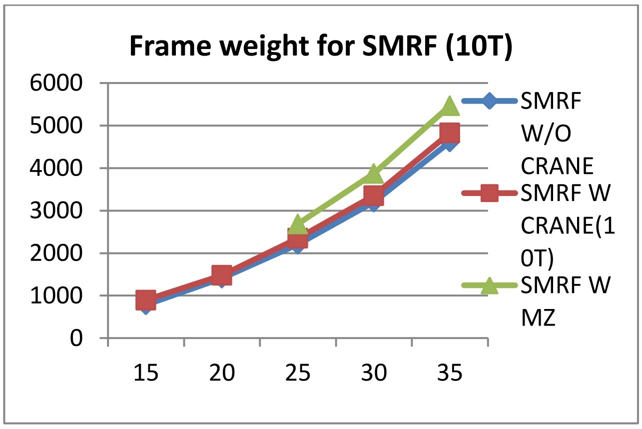

Figure 19: Comparison of edge weight for SMF without crane loads, with crane loads(20T) and with mezzanine and their rate contrast.

Table 4: Comparison of frame weight for different frames without crane loads, with crane loads(20T) and with mezzanine and their percentage difference.

SPAN	HEIGHT	FRAMES WEIGHT WITHOUT CRANE			
(m)	(m)	NMF Without CRANE	OMF Without CRANE	SMF Without CRANE	%
15	3	721.57	721.57	785.12	8.80
20	4	1273.73	1273.73	1412.48	10.89
25	5	2115.69	2115.69	2208.23	4.37
30	6	3078.19	3078.19	3199.38	3.94
35	7	4199.25	4199.25	4614.05	9.88
		FRAMES WEIGHT WITH CRANE (20TONS)			
		NMF With CRANE	OMF With CRANE	SMF With CRANE	%
15	3	997.89	997.89	15	3
20	4	1552.56	1552.56	20	4
25	5	2233.02	2233.02	25	5
30	6	3155.31	3155.31	30	6
35	7	4466.49	4466.49	35	7
		FRAMES WEIGHT WITH MAZZANINE			
		NMF With MZ	OMF With MZ	SMF With MZ	%
25	5	2357.9	2357.9	25	5
30	6	3273.63	3273.63	30	6
35	7	4593.4	4593.4	35	7

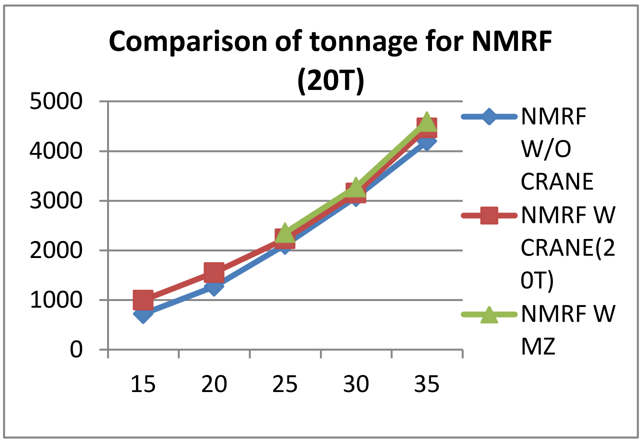

Figure 20: Comparison of edge weight for NMF without crane loads, with crane loads(20T) and with mezzanine and their rate contrast.

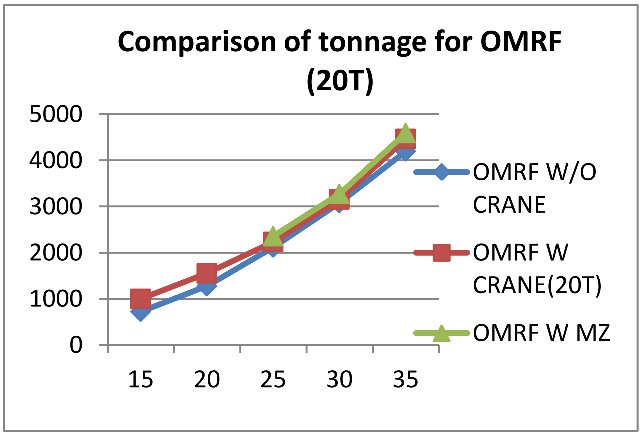

Figure 21: Comparison of frame weight for OMF without crane loads, with crane loads(20T) and with mezzanine and their percentage difference.

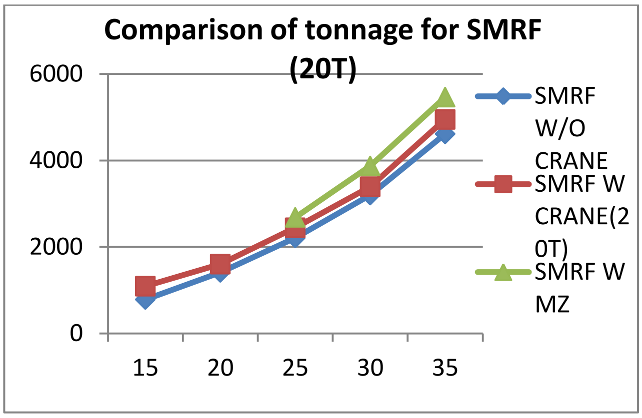

Figure 22: comparison of frame weight for NMF without crane loads, with crane loads(20T) and with mezzanine and their percentage difference.

Table 5: comparison of Base shear values for different frames with crane loads(20T)

SPAN	HEIGHT	BASE SHEAR values WITHOUT CRANE		
(m)	(m)	NMF	OMF	SMF
15	3	1.6	1.6	1.29
20	4	2.2	2.2	1.6
25	5	2.2	2.2	1.8
30	6	3.3	3.3	2.56
35	7	3.79	3.79	3.1
		BASE SHEAR values WITH CRANE (20TONS)		
		NMF	OMF	SMF
15	3	4.26	4.26	3.78
20	4	5.61	5.61	5.18
25	5	6.19	6.19	5.66
30	6	7.27	7.27	6.8
35	7	7.98	7.98	7.54
		BASE SHEAR values WITH MAZZANINE		
		NMF	OMF	SMF
25	5	51.9	51.9	41.5
30	6	62.3	62.3	49.8
35	7	72.7	72.7	58.1

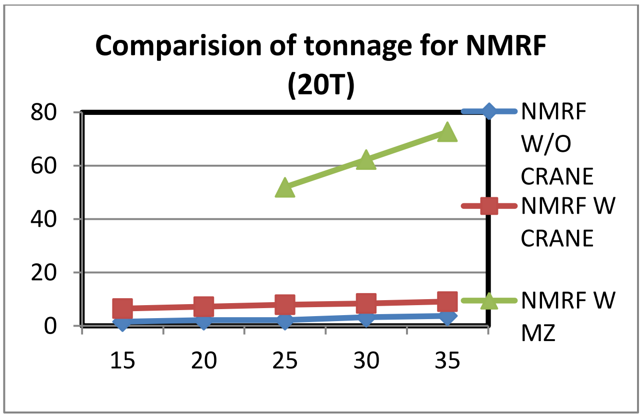

Figure 23: comparison of Base shear values for NMF with crane loads(20T)

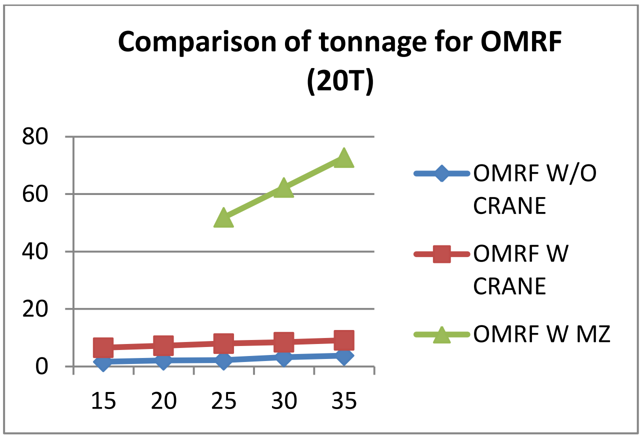

Figure 24: comparison of Base shear values for OMF with crane loads(20T)

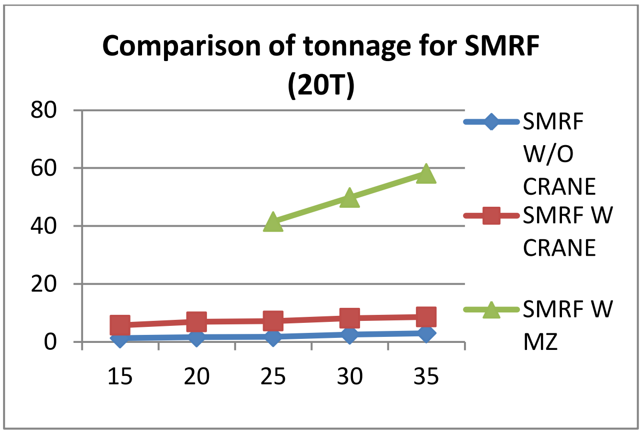

Figure 25: comparison of Base shear values for SMF with crane loads (20T)

V. CONCLUSIONS

1) The improvement should be possible by lessening the web profundity and rib width.
2) If the segment is bombing in twisting we have to expand the spine zone.
3) If the segment is inadequate in shear limit we have to build the web zone.
4) By expanding or diminishing the web region twisting minute limit of the area doesn't get affected.
5) Base shear and the administering load blend don't contrast when we consider Sec 12.2.3 (IS800-2007) load mixes alongside Table 4 (IS800-2007) load mixes.
6) Base shear esteems have definitely expanded for the casing with mezzanine as the DL and LL acting because of mezzanine is included the seismic weight.
7) For none of the edge area 12 (IS 800:2007) load mixes are administering.
8) Less than 5% expansion in outline weight is seen between outlines without crane and with 5MT crane.
9) Less than 10% expansion in Frame weight is seen between outlines without crane and with 10MT crane.
10) Maximum diversion esteems have been diminished in outlines with crane, with mezzanine when contrasted with the casings without crane.

REFERENCES

1. Bertero VV. "Earthquake-resistant design of building structures in the United States", *Journal ofEarthquake Spectra*, No. 4, **2**(1986) 825-58.
2. Mahin SA. "Lessons from damage to steel buildings during the Northridge Earthquake",*Journal of Engineering Structures*, No. 4, **20**(1998) 261-70.
3. Nakashima M, Inoue K, Tada M. "Classification of damage to steel buildings observed inthe 1995 Hyogoken-Nanbu earthquake", *Journal of Engineering Structures*, No. 4,**20**(1998) 271-81.
4. Krawinkler H. "New trends in seismic design methodology", *10th European Conference onEarthquake Engineering, Duma*, 1995, pp. 821-30.
5. Krawinkler H. "Challenges and progress in performance-based earthquake engineering",*International Seminar on Seismic Engineering for Tomorrow-In Honor of ProfessorHiroshi Akiyama*, Tokyo, Japan, 1999.
6. Xue Q. "Need of performance-based engineering in Taiwan: a lesson from the Chichiearthquake", *Journal of Earthquake Engineering and Structural Dynamics*, **29**(2000)1609-27.
7. Bertero VV, Anderson C, Krawinkler H, Miranda E. "Design Guidelines for Ductilityand Drift Limits, Report No. UBC/EERC-91/15", Earthquake Engineering ResearchCenter, University of California at Berkeley, 1991.
8. Nassar AA, Osteraas JD, Krawinkler H, "Seismic design based on strength and ductilitydemands", *10th World Conference on Earthquake Engineering*, Madrid, Spain, 1992, pp.5861-66.
9. Vidic T, Fajfar P, FischingerM,"Consistent inelastic design spectra: strength anddisplacement", *Journal of Earthquake Engineering and Structural Dynamics*, **23**(1994)507-21.
10. Takewaki I," Design oriented approximate bound of inelastic responses of a structureunder seismic loading", *Journal of Computers and Structures*, No.3, **61**(1996) 431-40.
11. Gioncu V. "Ductility criteria for steel structures", *Journal of Constructional SteelResearch*, No.3, **46**(1998) 443-44.
12. Osman A, Ghobarah A, Korol RM, "Implications of design philosophies for seismicresponse of steel moment frames", *Journal of Earthquake Engineering and StructuralDynamics*, **24**(1995) 127-43.
13. Park R, Pauley T. "Reinforced Concrete Structures", John Wiley and Sons Inc., 1975, NewYork.
14. Popov EP. "On California structural steel seismic design", *Journal of Earthquake Spectra*,EERI, No.4, **2** (1986) 703-27.
15. Schneider SP, Roeder CW, Carpenter JE,"Seismic behavior of moment resisting steelframes: analytical study, *Journal of Structural Engineering*, ASCE, No. 6, **119**(1993)1866-84.
16. Goel SC, ItaniA,"Seismic resistant special truss moment frames", *Journal of StructuralEngineering*, ASCE, No. 6, **120** (1994) 1781-97.
17. Bondy KD," A more rational approach to capacity design of moment frames columns",*Journal of Earthquake Spectra*, EERI, No. 3, **12**(1996) 395-406.
18. Wakabayashi M, " Design of Earthquake-Resistant Buildings", McGraw-Hill, Paris, 1986.
19. Schneider SP, Roder CW, Carpenter JE,"Seismic behavior of moment-resisting steelframes: experimental",*Journal of Structural Engineering,* ASCE, No. 6,**119**(1993)1885-902.
20. Takanashi K, Ohi K, "Shaking table tests on 3-story braced and unbraced steel", world conference on earthquake eng., San Francisco, CA, IV, 1984, pp.491-498.
21. Lee HS, "Revised rule for concept of strong-column weak-girder design", *Journal ofStructuralEngineering*,No. 4, **122** (1996) 359-64.
22. Goel SC, Leelataviwat S, "Seismic design by plastic method", *Journal of EngineeringStructures*, Nos. **4-6** (1998) 465-71.
23. Neal BG, Symonds PS,"The rapid calculation of the plastic collapse load for a framedStructure", Proceedings of the Institutions for Civil Engineers, No. 1, **58** (1952) Part 3.
24. Goldberg DE, Samtani MP, "Engineering optimization via genetic algorithm, in Will,K.M (Eds)", *Proc. the 9th Conference on Electronic Computation*, ASCE, Feb 1986, pp.471-82.
25. HajelaP,"Genetic search- an approach to the nonconvex optimization problem", *AIAAJournal*, No. 7, **28**(1990) 1205-10.
26. Adeli H, Cheng NT,"Integrated genetic algorithm for optimization of space structures",*Journal of Aerospace Engineering*, ASCE, No. 4 ,**6**(1993) 315-29.
27. Rao SS, Pan TS. and VenkayyaVB,"Optimal placement of actuators in activelycontrolled structures using genetic algorithms", *AIAA Journal*, No. 6, **29**(1991) 942-43.
28. Leelataviwat S, Goel SC, StojadinovicB,"Energy-based seismic design of structuresusing yield mechanism and target drift", *Journal of Structural Engineering*, No. 8,**128**(2002) 1046-54.
29. Leelataviwat S, Goel SC, StojadinovicB,"Drift and yield mechanism based seismicdesign and upgrading of steel moment frames", Rep. No. UMCEE 98-29, Dept. of Civiland Environmental Engineering, University of Michigan, Ann Arbor, Michigan, USA.
30. Baker J, Heyman J,"*Plastic Design of Frames, Fundamentals,* Vol. 1, Cambridge University Press, Cambridge, 1969.
31. Beedle Lynn S, "*Plastic Design of Steel Frames",* John Wiley & Sons, USA, 1958.
32. DESIGN OF STEEL STRUCTURES BY N. SUBRAMANIAN (Based on limit state method of design as per IS 800:2007).
33. IS 800:2007, "INDIAN STANDARD GENERAL CONSTRUCTION IN STEEL CODE OF PRACTICE", (Third Revision).
34. IS 1893, "INDIAN STANDARD CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES", PART 1 GENERAL PROVISIONS AND BUILDINGS (Fifth Revision).
35. IS 875, "INDIAN STANDARD CODE OF PRACTICE FOR DESIGN LOADS (OTHER THAN EARTHQUAKE) FOR BUILDINGS AND STRUCTURES", PART 3 (WIND LOADS) (Second Revision).
36. ECCS Manual on "DESIGN OF STEEL STRUCTURES IN SEISMIC ZONES", First edition, 1994.

AUTHORS PROFILE

Sudheer Choudari, M.E,(Structural Engineering), (PhD) Assistant Professor, Department of Civil Engineering, Centurion University of Technology & Management
Publications: Published 6 Papers in International Journals.
Experience: Having 7 Years of Experience in Teaching and Industry.
Membership: 1. International Association of Engineers (IAENG); 2. IJERP Membership.
Mail Id: sudheerchoudari@cutmap.ac.in, Sudheer.13031@gmail.com

P. Padmanabha Reddy, B.Tech, M.E(Geotechnical Engineering), AMIE, (PhD) Assistant Professor, Department of Civil Engineering,
GVP College for Degree and PG Courses, Rushikonda, Visakhapatnam.
Publications: Published 4 Papers in International Journals.
Experience: Having 6.5 Years of Experience in Teaching and Industry.
Mail Id: paddu116@gmail.com