STUDY OF EFFECT OF BRACING ON CRITICAL STOREY OF HIGH RISE FRAME STRUCTURE

Lekhraj Pandit[1],R. R. Shinde[2]
[1]P.G. Student, [2]Assistant Professor, lekhraj.p009@gmail.com ,+917276646045
Civil Engineering Department, Late G.N. Sapkal College of Engineering, Maharashtra, India

Abstract— A Bracing is a system that is provided to minimize the lateral deflection of the structure. The use of braced frames has become more popular in high rise structure and also in seismic design of structure. So this thesis aims to investigate the performance of steel bracing steel structure. In this project a steel building model is taken, this model is compared in different aspects such as axial force and bending moment in column and story displacement. Using different sections as bracing at critical storey Among these numbers of trials which type of bracing at critical section is more suitable from the observed results would be selected for the structure
Keywords— Bracing system, concentric and eccentric bracing, lateral storey displacement, Column forces, column moment.

INTRODUCTION

A Braced Frame is designed primarily to resist wind and earthquake forces in a structural system. These braced frames are made of steel members. Steel braced frame is the structural systems used to resist lateral loads in the multistoried buildings. Lateral loads are often resisted by using braced frame but they can interfere with some architectural components. The steel braces are usually placed in vertically aligned spans lateral loading. The main aim of study has been to identify the type of bracing which causes minimum storey displacement such contributes to greater lateral stiffness to the structure. This system allows a great increase of stiffness with a small amount of added weight, and thus it is very effective for the existing structure in which the poor lateral stiffness is the main problem.

METHODOLOGY

This study involves linear analysis of steel building.by using e-tab software. Structural steel of grade Fe 345 and Fe 250 Mpa

MODEL DESCRIPTION

A 15m x 20m plan area is selected for the study same model for different configurations are prepared for different Pattern and Sections of bracing.

Table 1:

Name of parameter	Value	Unit
Number of stories	11	NOS
Storey height	3.5	M
Total height of the structure(above GL)	38.5	M
Length in long direction	20	M
Length in short direction	15	M
Thickness of Deck	200	MM
Dead Load (1) Wall	12.6	KN/M
(2) Floor finish	2	KN/M²
Live load	5	KN/M²

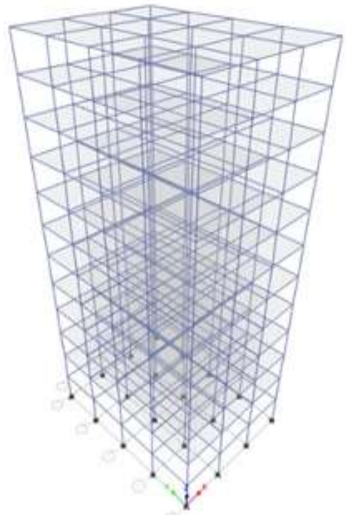

Figure 1:3D view of building

Figure 2:Plan

MODEL DESCRIPTION

Model 1: Normal building.

Model 2: Building with unidirectional bracing (ISA 130X130X15).

Model 3: Building with X bracing (ISA 150X150X15).

Model 4: Building with unidirectional bracing 2 ISA placed back to back (2ISA 65X65X65)

Model 5: Building with unidirectional Bracing ISMB 225.

Model 6: Building with V bracing (ISA 110X110X12).

Model 7: Building with bracing at corner (ISA 90X90X10).

Model 8: Building with unidirectional eccentricity (2ISA 65X65X6 back to back).

Model 9: Building with 1000 mm eccentricity at top (2ISA 65X65X6 back to back).

Model 10: Building with V bracing with both side eccentricity (2ISA 65X65X6 back to back).

Table 2: PROPERTIES of channel section place back to back (Fe 345 Mpa)

	Depth(mm)	**Flange width(mm)**	**Thickness of flange (mm)**	**Thickness Of Web (mm)**	**Back to back Distance (mm)**
Bottom 3 storey	400	150	20	18	215
Middle 4 storey	300	100	20	18	165
Above 4 storey	225	50	12	10	120
Beam	ISMB 350	140	14.2	10.1	

Table 3: PROPERTIES of channel section place back to back (Fe 250 Mpa)

	Depth (mm)	**Flange width (mm)**	**Thickness of flange (mm)**	**Thickness Of Web (mm)**	**Back to back Distance (mm)**
Bottom 3 storey	550	200	30	25	260
Middle 4 storey	350	125	18	15	200
Above 4 storey	27	75	12	10	160

Beam	ISHB 300	250	10.6	7.6	

RESULTS AND DISCUSSION.

Table 4: REDUCTION in Lateral Deflection in %(of all models compare with most efficient section –M8)

SECTIONS	Fe 345		Fe 250	
	X %	Y %	X %	Y %
M2	0.3	0.4	29.55	30.29
M3	1.29	1.37	30.73	31.69
M4	1.52	1.54	31.68	32.45
M5	0.3	0.4	29.31	30.29
M6	1.82	1.94	31.78	32.7
M7	4.1	4.69	35.93	36.12
M9	10.85	13	13.12	14.07
M10	6.45	5.65	34.75	35.36

1. **AXIAL FORCE**

Table 5: PERCENTAGE increased/decreased in Axial forces in column C1 at 8th storey (critical storey) comparison of Fe250 with Fe345

SECTIONS	Percentage increased/decreased
M2	4.11
M3	-5.36
M4	-2.60
M5	5.75
M6	25.82
M7	6.63
M8	-3.61
M9	10.23
M10	2.48

Table 6: PERCENTAGE increased/decreased in Axial forces in column C9 at 8th storey (critical storey)comparison of Fe250 with Fe345

SECTIONS	Percentage increased/decreased
M2	2.80
M3	6.88
M4	5.69
M5	8.58
M6	7.90
M7	6.29
M8	3.23
M9	-2.04
M10	-4.33

Table 7: PERCENTAGE increased/decreased in Axial forces in column C10 at 8th storey (critical storey)comparison of Fe250 with Fe345

SECTIONS	Percentage increased/decreased
M2	7.00
M3	-13.32
M4	9.33
M5	9.07
M6	15.00
M7	14.52

M8	11.14
M9	10.05
M10	11.00

2. BENDING MOMENTS

Table 8: PERCENTAGE increased in bending moments in column C1 8th storey (critical storey) COMPARISON of Fe250 with Fe345

SECTIONS	Percentage increased
M2	57.89
M3	40.35
M4	40.35
M5	52.13
M6	26.32
M7	20.80
M8	48.87
M9	28.07
M10	24.06

Table 9: PERCENTAGE increased in bending moments in column C9 8th storey (critical storey) COMPARISON of Fe250 with Fe345

SECTIONS	Percentage increased
M2	117.13
M3	108.51
M4	114.98
M5	93.43
M6	120.37
M7	117.13
M8	111.21
M9	115.52
M10	139.22

Table 10: PERCENTAGE increased in bending moments in column C10 8th storey (critical storey)comparison of Fe250 with Fe345

SECTIONS	Percentage increased
M2	114.44
M3	101.07
M4	93.05
M5	127.27
M6	97.33
M7	134.22
M8	82.35
M9	97.33
M10	98.40

Table 11: QUANTITY of Steel Required For Various Types Of Sections Used In Bracings at critical storey

Bracings	**Quantity Of Steel Used For Bracing**
Sections	**Total Weight In Kg**
Unidirectional Bracing (ISA 130x130x15) =190 M	5491
X Bracing (ISA 150x150x15) =380 M	12768
Unidirectional Bracing 2isa Place Back To Back (65x65x6) =380 M	2926
Unidirectional Bracing ISMB 225 =380 M	5928
V Bracing (ISA 110x110x12) =270 M	5292
Bracing At Corner (ISA 90x90x10) =255 M	3417
Unidirectional Eccentricity (2isa 65x65x6)=330 M	2541
Building With 1000 Mm Eccentricity At Top (2isa Back To Back 65x65x6) =472 M	3635
Building With V Bracing With Both Side Eccentricity (2isa Back To Back 65x65x6) =452 M	3480

Discussion

1. Lateral Displacement-

After observing the storey displacement results from analysis it has been found that lateral storey displacement in longer direction is greatly reduced by the bracing system.. It has also been noted that eccentric. bracing reduces storey displacement considerably. Therefore it can be said that eccentric bracing provides greater lateral stiffness to the steel structure than concentric bracing. Maximum reduction in deflection in x direction is 10.85% , 35.93% and in y direction 13% , 36.12% for Fe 345 and Fe 250 respectively.

2. Bending Moment

it has been observed that value of bending moment in column C1 (exterior) is more than value of bending moments in column C9 and C10 (interior columns).at critical storey.

Conclusions

- Steel Bracing is one of the advantageous concepts to be used in a high rise structure to reduce lateral displacement and also to strengthen damage structure.
- Lateral storey displacements are greatly reduced by the use of eccentric bracing, as compared toconcentric bracing system.
- Comparing the weight of bracing for critical storey, Buildingwithunidirectional eccentricity (M-8 2ISA 65X65X6) provides most economical solution as compare with other sections used in bracings.(Ref table no 4.36)
- If we compare Fe 250 and Fe 345 then it shows saving of 1000kg for Fe 345 grade.
- At critical storey there is reduction in bending moments for interior column(C9 C10) but not much variations find out in exterior column.(C1)
- For control of Lateral displacement the eccentric bracing is found most suitable one under the present study.

References

[1] ZasiahTafheem, ShovonaKhusru “Structural behavior of steel building with concentric and eccentric bracing: A comparative study” Volume 4, No 1, 2013 ISSN 0976 – 4399

[2] D.C. Rai, S.C. Goel “Seismic evaluation and upgrading of chevron braced frames” Journal of Constructional Steel Research 59 (2003) 971–994

[3] Di Sarno,A.S. Elnashai “Bracing systems for seismic retrofitting of steel frames” Journal of Constructional Steel Research 65 (2009) 452–465

[4] Egor P Popov & Michael D. EngelhardtJinkoo Kim and Junhee Park “Seismic behavior factors of buckling-restrained braced frames” Structural Engineering and MechanicsVolume 33, Issue ,3, 2009, pp.261-284

[5] Mohsen Tehranizade, TourajTaghikhani, Mahdi Kioumarsi, Leila Hajnajafi “Comparative Study on Seismic Behavior of SCBF with Comparative Study on Seismic Behavior of SCBF with EBF” Systems 2007 AEES Conference.

[6] O.S. Bursia, b K.H. Gerstleb, A. Sigfusdottirb, J.L. Ziturb “Behavior and analysis of bracing connections for steel frames” Journal of Constructional Steel Research Volume 30, Issue 1, 1994, Pages 39–60

[7] Feng Fu “Response of a multi-storey steel composite building with concentric bracing under consecutive column removal scenarios” journal of Constructional Steel Research 70 (2012) 115–126

[8] G. Federico, R.B. Fleischman, K.M. Ward “Buckling control of cast modular ductile bracing system for seismic-resistant steel frames” Journal of Constructional Steel Research 71 (2012) 74–82

[9] Jesumi, M.G. Rajendran “ Bracing System for Steel Towers” ISSN: 2248-9622 Vol. 3, Issue 2, March -April 2013, pp.729-732

[10] M.A. Youssef, H. Ghaffarzadeh, M. Nehdi "Seismic performance of RC frames with concentric internal steel bracing" Engineering Structures 29 (2007) 1561–1568

[11] AdilEmreOzel, Esra Mete Guneyisi"Effects of eccentric steel bracing systems on seismic fragility curves of mid-rise R/C buildings: A case study"Structural Safety 33 (2011) 82 – 95

[12] Massumi, M. Absalan "Interaction between bracing system and moment resisting frame in braced RC frames" archives of civil and mechanical engineering 13 (2013) 260 – 268

[13] Hendramawat A Safarizki, S.A. Kristiawan and A. Basuki "Evaluation of the Use of Steel Bracing to Improve Seismic Performance of Reinforced Concrete Building"Procedia Engineering 54 (2013) 447 – 456