[Gajbe* *et al.*, 5(7): July, 2016] ISSN: 2277-9655
IC™ Value: 3.00 Impact Factor: 4.116

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

ANALYSIS OF SOFT STORY MULTISTORED STEEL STRUCTURE BUILDING

Pramod M Gajbe*, Prof. R. V. R. K. Prasad
* M.tech scholar: Structural Engineering Department of Civil Eng., K. D. K. C. E Nagpur
Department of Civil Engineering K.D.K.C.E Nagpur

DOI: 10.5281/zenodo.57050

ABSTRACT

This paper focusing on soft storey Multi-storey steel structure buildings, These building are becoming increasingly common and economical in developed and developing countries with the increase in urbanization all over the world. Many of these buildings do not have structural walls at ground floor level to increase the flexibility of the space for recreational use such as parking or for retail or commercial use. these buildings which possess storey that are significantly weaker or more flexible than adjacent storey are known as soft storey buildings, these are characterized by having a story which has a lot of open space. while the un obstructed space of the soft story might be aesthetically or commercially desirable, it also means that there are less opportunities to install shear walls, specialized walls which are designed to distribute lateral forces so that a building can cope with the swaying characteristic of an earthquake. Soft-storey is also called as flexible storey. a large number of buildings with soft storey have been built in recent year. but it showed poor performance during past earthquake. soft story's are subjected to larger lateral loads during earthquakes and under lateral loads their lateral deformations are greater than those of other floors so the design of structural members of soft stories is critical and it should be different from the upper floors. In this thesis " analysis of soft-storey for Multi-storeyed steel structure building in zone " 2 ", applying the analyse and explore the behaviour of soft-storey at different floor level of building under seismic load actions respectively.

KEYWORDS:Soft Storey IS1893 2002 , IS 456, IS- 800, Base Shear.

INTRODUCTION

A soft story building is a multi-story building with one or more floors which are "soft" due to structural design. Soft story buildings are characterized by having a story which has a lot of open space such as parking garages, or large retail spaces or floors with a lot of windows. This soft story creates a major weak point in an earthquake, since soft stories are classically associated with retail spaces and parking garages, they are often on the lower stories of a building, and the upper floors of most buildings are more rigid than their base floors. As a result, the seismic behaviors of the base and the upper floors are significantly different from each other. This phenomenon is called as the soft-story irregularity.

• If a building has a floor which is 70% less stiff than the floor above it, is considered as a soft story building. While the unobstructed space of the soft story might be aesthetically or commercially desirable, it also means that there are less opportunities to install shear walls, specialized walls which are designed to distribute lateral forces so that a building can cope with the swaying characteristic of an earthquake.

• Soft story also exists at intermediate floors too, floors which are "soft" due to structural design. These floors can be especially dangerous in earthquakes, because they cannot cope with the lateral forces caused by the swaying of the building during a quake. As a result, the soft story may fail, causing what is known as a soft story collapse.

Soft story building adopt steel structure

Steel is not just a material aimed at technical prowess! It has many qualities that make it the preferred material for architects. It is economical and provides great mechanical functionality; it permits the design of structures which are graceful, light and airy it streamlines construction site processes and offers rapid execution. A major advantage, however, is the infinite freedom for creation which it affords the architect. The combinations of different products lend themselves to rich and varied types of construction. When combined with glass, steel makes fabulous use of light and space such buildings, the stiffness of the lateral load resisting systems at those stories is quite less than the stories above or below .Large spans constitute one of the major benefits of steel structures, . Large spans facilitate future developments of the structural elements. The load-bearing frame is integrated in the exterior walls of the building in order to free up space. Large spans were once confined to industrial buildings or ware houses ,but are now very common in office or residential buildings .It is advisable to adopt the principle of load-bearing columns, rather than bearing walls,

Steel Structure Material
Steel structure offers exceptional qualities in terms of mechanical resistance. Of the most commonly used materials in construction, structural steel. These are classified, according to their composition. The main structural steel grades are ISMB 600 Girder for column member & for ISMB 500 for beam structural members.& Bracing is used with double angle of size 100x100x8 However the higher strength structural steel grade. is used more and more in construction. Analysis on the structural steel building with the aid of ETABS software. Determination of a soft storey for per floor up to 5 th floor

MATERIALS AND METHODS
Aim of this unique project is to study the load deflection behaviour of soft storey for multi-storey steel structure buildings when subjected to lateral loading and to develop a representative seismic performance assessment procedure for soft storey buildings subject to different levels of ground shaking. the effect of soft story on structural behaviour of high rise buildings and seismic response of soft story structures. Also compare the soft story structural response of high rise building with various. As the infill walls are not regarded as a part of load carrying system, generally engineers do not consider their effects on the structural behaviour. Therefore, In this study, effect of infill walls on structural behaviour, especially for the soft story, is investigated in order to increase the level of knowledge and awareness .A comparative study was performed on 3-D analysis model created in ETABS [15], a commercial computer program for the analysis of structures. Earthquake Effect on Soft-Storey for steel structure Building Symmetrical constructions in both plan and height show better resistant an earthquake than those that do not have this symmetry. Since the presence of a soft storey which has less rigidity than other storey's spoils the perpendicular symmetry of the construction and if this fact was not taken into consideration, it causes the construction to be affected by the quake. Because the columns in this part are forced by the quake more than the ones in the other parts of the building. & the walls increase the rigidity at a certain degree in the construction. There is 15 % difference of rigidity between a storey with walls and the one without any walls. During an earthquake more moment and shear strength fall on the columns and walls in the entrance floors than the one in the upper storey's. If the walls that exist in other storey do not exist in the entrance floor, these columns are forced more those in other storeys. Due to the fact that there is less rigidity in soft storey .To transfer lateral load from floor diaphragm to the foundation suitable vertical elements are required. They may be moment resisting frames, bearings or laterally much stiffer than moment resisting frames. It is necessary to design the frame for at least 25% Soft storey attracts plastic deformation resulting in the collapse of the building. Many such failures due to soft storey were observed for a good seismic performance it is necessary to have high redundancy, thus even after failure of one of the member the structure may not fail. If they are monolithically connected to each other and if yielding takes place in one of them then redistribution of forces takes place. Criteria for earthquake resistant design of structure I S 1893 : 2002 model created in ETABS [15], a commercial computer program for the analysis of structures. Earthquake Effect on Soft-Storey for Multi-storeyed steel structure Building Symmetrical constructions in both plan and height show a better resistance during an earthquake than those that do have this symmetry.

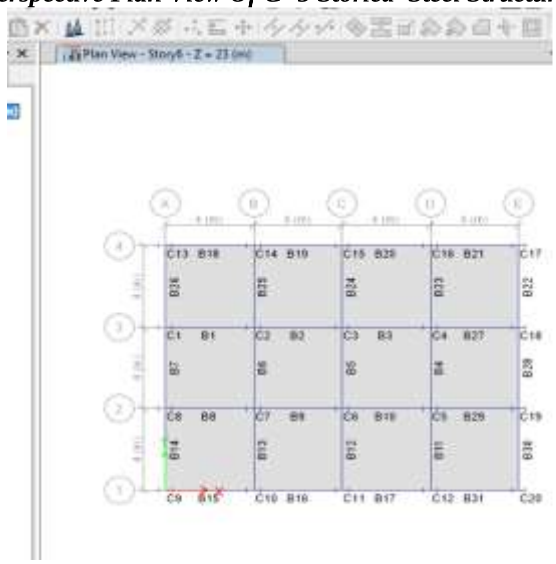
Structural Description
The steel structure Building analysed is a G+5 structure, 18 meter tall located in 2 nd zone of india with a gross area of 192 square meter. The analysis of building with soft-storey at different floor level is carried out for seismic design respProperties Of Steel Structure Buildings In modelling building steel structure frame, the following material properties and geometrical properties was used for beam, columns, masonry infill. Normal weight concrete was chosen for finite element analysis of building frames respectively.

ISSN: 2277-9655
Impact Factor: 4.116

Subheading

- •Symmetry Condition s: symmetrical regular steel structure Building.
- •Plan dimensions : 12mX 16 m.
- •Column Size Up to 5 th Floor: ISMB 600
- •Beam Size : ISMB 500
- • Double Angle Bracing Size : 100 x 100x 8
- •Slab Thickness : 120 mm
- •Typical floor Height : 3m
- •Plinth level Height : 2 m
- •Number-Of-Floors : G+5 Floor
- •Support Condition : Fixed & For Bracing pinned
- •Type of Soil : Medium Type
- • Zone : II

Figure: Perspective Plan View Of G+5 Storied Steel Structure Building



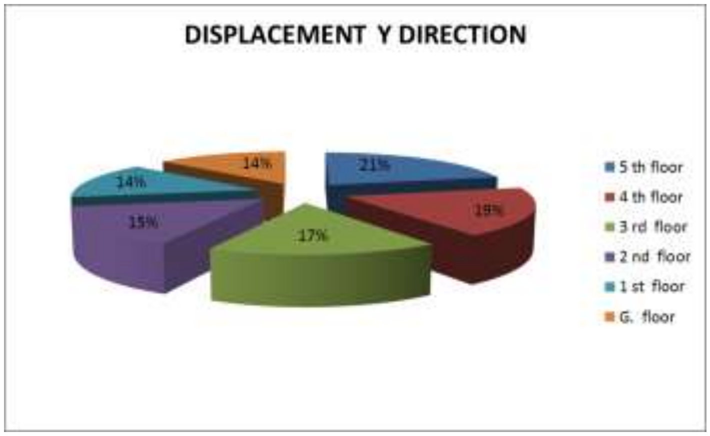
Load combination as per IS 1839-2000 for steel structural building

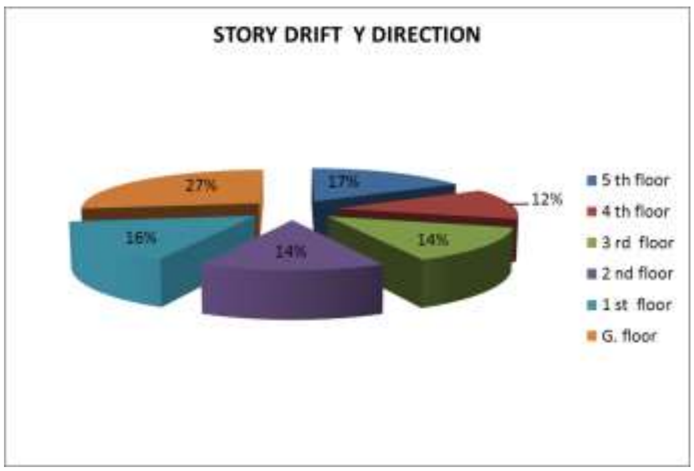
DL+LL
1.7DL+1.7LL
(1.7DL+1.7EQX)
(1.7DL-1.7EQX)
(1.7DL+1.7EQY)
(1.7DL-1.7EQY)
(1.3DL+1.3LL+1.3EQX)
(1.3DL+1.3LL-1.3EQX)
(1.3DL+1.3LL+1.3EQY)
(1.3DL+1.3LL-1.3EQY)

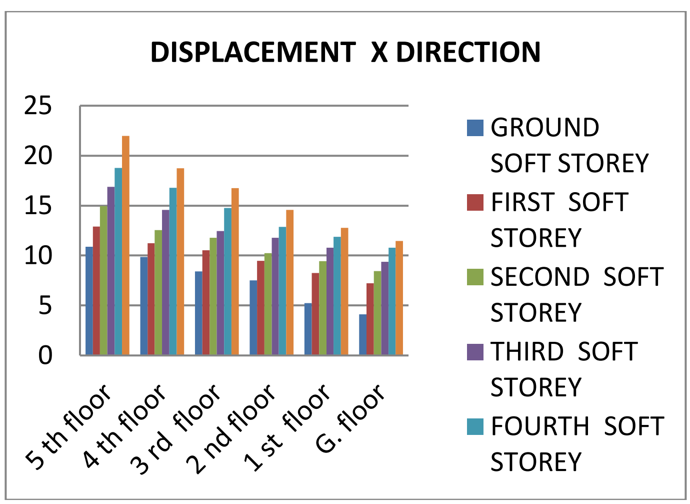
Seismic Analysis Method:

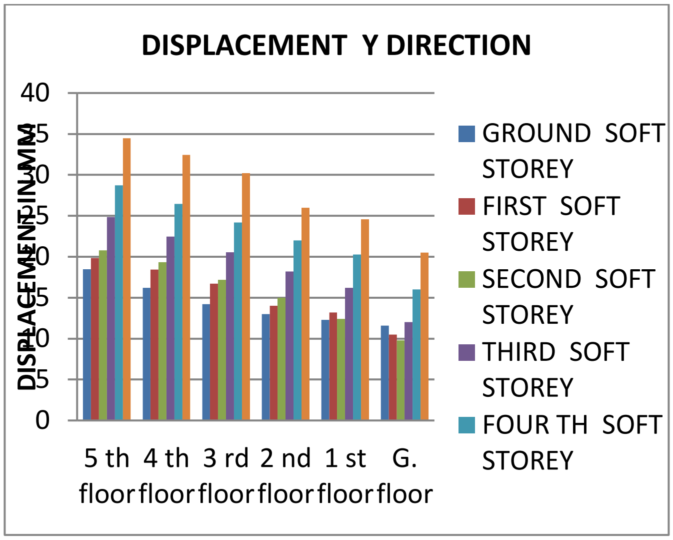
When a structure is subjected to earthquake, it responds by vibrating. An earthquake force can be resolved into three mutually perpendicular directions-the two horizontal directions (x and y) and the vertical direction (z). This motion causes the structure to vibrate or shake in all three directions; the predominant direction of shaking is horizontal. All the structures are primarily designed for gravity loads-force equal to mass time's gravity in the vertical direction. Because of the inherent factor of safety used in the design specifications, most structures tend to be adequately protected against vertical shaking. Vertical acceleration should also be considered in structures with large spans, those in which stability for design, or for overall stability analysis of structure

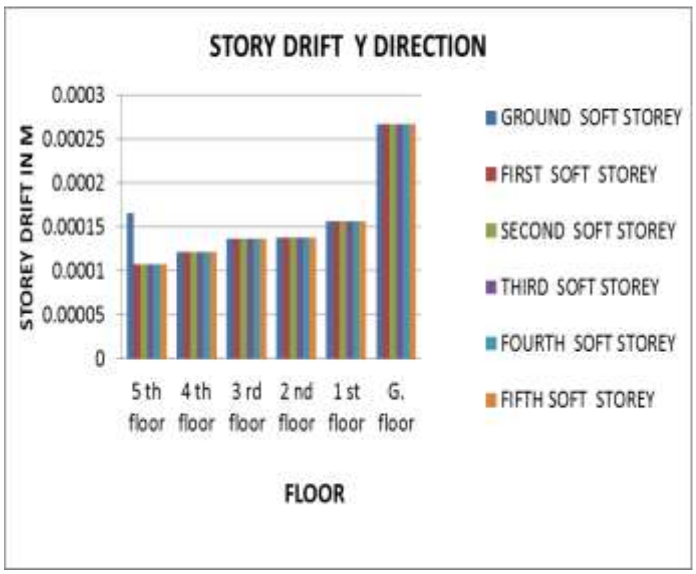
Displacement Graph For Soft-Storey @ Different Floor In percentage

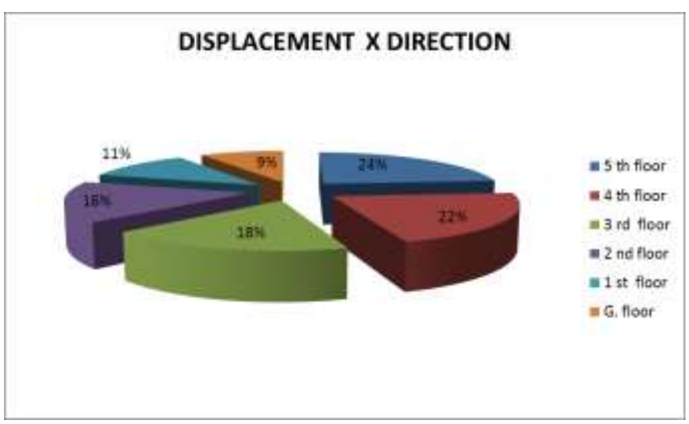







DISPLACEMENT Y DIRECTION
40
0
5 th floor
4 th floor
3 rd floor
2 nd floor
1 st floor
G. floor
GROUND SOFT STOREY
FIRST SOFT STOREY
SECOND SOFT STOREY
THIRD SOFT STOREY
FOUR TH SOFT STOREY

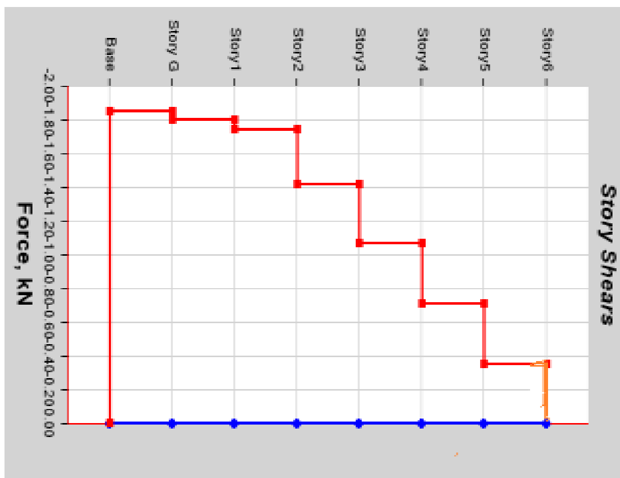

STORY DRIFT Y DIRECTION
STOREY DRIFT IN M
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
5 th floor
4 th floor
3 rd floor
2 nd floor
1 st floor
G. floor
FLOOR
GROUND SOFT STOREY
FIRST SOFT STOREY
SECOND SOFT STOREY
THIRD SOFT STOREY
FOURTH SOFT STOREY
FIFTH SOFT STOREY


DISPLACEMENT X DIRECTION
24%
22%
18%
16%
11%
9%
5 th floor
4 th floor
3 rd floor
2 nd floor
1 st floor
G. floor

ISSN: 2277-9655
Impact Factor: 4.116

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
X	0.28	3846.4315	153.8573
Y	0.667	3846.4315	125.4939
X + Ecc. Y	0.28	3846.4315	153.8573
Y + Ecc. X	0.667	3846.4315	125.4939
X - Ecc. Y	0.28	3846.4315	153.8573
Y - Ecc. X	0.667	3846.4315	125.4939



Base Shear Tabular Static Analysis

Story	Elevation	X-Dir
	M	**kN**
Story5	**20**	**70.071**
Story4	**17**	**44.8454**
Story3	**14**	**25.2256**
Story2	**11**	**10.9722**
Story1	**8**	**2.743**
Story G	**5**	**0.48**

ISSN: 2277-9655
Impact Factor: 4.116

Story	**Elevation**	**X-Dir**
	M	**kN**
Base	**2**	**0**

Story Shear Displaying Value For Eqx For Soft Storey At first to fifth Floor In Zone – 2

Story	**Elevation**	**Y-Dir**
	M	**kN**
Story5	20	57.1535
Story4	17	36.5783
Story3	14	20.5753
Story2	11	8.9495
Story1	8	2.2374
Story G	5	0.57
Base	2	0

RESULTS AND DISCUSSION

Using Etabs-15 Software The Soft-Storey For Steel Structure Building In Zone-2 Is Analysed For Different Floor Levels I.E. (Soft-Storey @ Ground Floor, up to 5^{th} Floor,). From The Limited Study Done An Attempt Has Been Made To Draw The Following General & Specific Conclusion.

The result of the present study shows that soft-storey floor will have very determinant effect on structural behaviour of building floor wise and structural capacity under lateral loads. Displacement and relative story drifts are affected at the top storey by the structural regularities

Scope For Further Study

The present study is confirmed to anlysis of soft storey for Multi-storeyed steel structure building in zone-2 for different floor levels, the study may however be extended to soft-storey with openings at different location & with percentage .

Formulae:

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 2]	Z = 0.16
Response Reduction Factor, R [IS Table 7]	R = 5
Importance Factor, I [IS Table 6]	I = 1

Site Type [IS Table 1] = II

ISSN: 2277-9655
Impact Factor: 4.116

Seismic Response

Spectral Acceleration Coefficient, S_a /g [IS 6.4.5] $\frac{S_a}{g} = 2.5$ $\frac{S_a}{g} = 2.5$

Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2] $A_h = \frac{ZI\frac{S_a}{g}}{2R}$

Tables:

FLOOR	LOAD COMBINATION	GROUNG SOFT STOREY	FIRST SOFT STOREY	SECOND SOFT STOREY	THIRD SOFT STOREY	FOURTH SOFT STOREY	FIFTH SOFT STOREY
5 th Floor	1.7DL+1.7EQY Max	10.86	12.056	14.56	16.53	18.75	21.75
4 th Floor	1.7DL+1.7EQY Max	9.86	11.23	12.56	14.56	16.78	18.75
3 rd Floor	1.7DL+1.7EQY Max	8.42	10.52	11.78	12.45	14.75	16.75
2 nd Floor	1.7DL+1.7EQY Max	7.52	9.456	10.25	11.78	12.86	14.56
1 st Floor	1.7DL+1.7EQY Max	5.25	8.24	9.45	10.78	11.89	12.785
G Floor	1.7DL+1.7EQY Max	4.125	7.23	8.46	9.36	10.78	11.45

Table 9. Comparison table for motoring mode

FLOOR	***LOAD COMBINATION***	***GROUNG SOFT STOREY***	***FIRST SOFT STOREY***	***SECOND SOFT STOREY***	***THIRD SOFT STOREY***	***FOURTH SOFT STOREY***	***FIFTH SOFT STOREY***
5 th Floor	***1.7DL+1.7EQY Max***	***18.46***	***19.85***	***20.78***	***24.86***	***28.74***	***34.46***

ISSN: 2277-9655
Impact Factor: 4.116

4 th Floor	***1.7DL+1.7EQY Max***	*16.2*	*18.42*	*19.35*	*22.46*	*26.44*	*32.44*
3 rd Floor	***1.7DL+1.7EQY Max***	*14.2*	*16.7*	*17.2*	*20.56*	*24.2*	*30.2*
2 nd Floor	***1.7DL+1.7EQY Max***	*13*	*14*	*15*	*18.2*	*22*	*26*
1 st Floor	***1.7DL+1.7EQY Max***	*12.3*	*13.3*	*12.4*	*16.2*	*20.26*	*24.56*
G Floor	***1.7DL+1.7EQY Max***	*11.6*	*10.5*	*9.8*	*12*	*16*	*20.5*

CONCLUSION

- The Soft-Storey For Steel Structure Building In Zone- 2 Is Analysed For Different Floor Levels I.E. (Soft-Storey @ Ground Floor up to 5th Floor,). From The Limited Study The Following General & Specific Conclusion.
- The result of the present study shows that soft storey floor will have very determinant effect ground floor to top floor on structural behaviour of building and structural capacity will reducing under lateral loads. Displacement and relative story drifts are affected by the structural regularities.
- Displacement: The displacement in the structure due to seismic effect for soft storey at different floor is increasing floor to floor & displacement is max in top storey at every floor tabulated below
- Storey drift: The drift in the structure due to seismic effect for soft storey at different floor is increasing floor wise I,e in ground floor ground soft storey is maximum, similarly up to 5 th floor . As per Indian standard, Criteria for earthquake resistant design of structures, IS 1893 (Part 1): 2002, the storey drift in any storey due to service load shall not exceed 0.004 times the storey height.

ACKNOWLEDGEMENTS

It give me great pleasure and a sense of utmost fulfillment to present this project for my M tech Exam . I express a deep sense of thoughtful and gratitude to all those who have helped directly or indirectly in different way the conduct of progress my respective work

First and foremost , I keep on record my deepest sense of gratitude and obligation to my guide Mr R.V.R.K . Prasad

REFERENCES

[1] IS : 456 – 2000 – Code of practice for plain and Reinforced concrete.
[2] IS:1893(part 1) – 2002 : Criteria for Earthquake resistant Design of structures
[3] IS: 875(part 1) – 1987 – Code of practice for design loads (Other than earthquake) for buildings and structures – Dead loads.
[4] IS: 800-2007 – General construction in steel structure

ISSN: 2277-9655
Impact Factor: 4.116

[5] British Standards Institution (2001). "BS 5950-1:2000: Structural use of steel work in building, Part 1: Code of practice for design – Rolled and welded sections," London, UK.

[6] British Construction Steelwork Association/Steel Construction Institute Fe (2002). "Joints in Steel Construction: Simple Connections," London, UK. ACI 374.1-05 Acceptance Criteria for Moment Frames Based on Structural Testing Collapse in Multi-Storey Buildings," Buildings and Structures, Proceedings of the Institution of Civil Engineers, 160(SB4), Izzuddin, B.A., Vlassis, A.G., Elghazouli, A.Y., and Nethercot, D.A. (2007). "Assessment of Progressive