

Consideration of Seismic Design of Multistoried Steel Structure

S.M. Dhawade¹ and P.S. Pajgade²

¹*Department of Civil Engineering, Prof Ram Meghe College of Engineering & Management, Anjangaon Bari Road, Badnera-Amravati, (M. S.) INDIA.*

²*Department of Civil Engineering, Prof Ram Meghe Institute of Technology & Research, Anjangaon Bari Road, Badnera-Amravati, (M. S.) INDIA.*

Abstract

Structural design is a process to achieve dimensions of elements of structure to satisfy strength and stiffness for its intended use and life. Structural design does not evolve into a unique solution. It is an art and skill which acquires by experience and guesswork. The process is started from deciding the structural configuration on the basis of planning and functional requirement, estimation of various types of external forces that the structure is likely to be subjected during its lifetime, analyzing the structure for all possible and odd combinations of forces to arrive for design action, selection of dimensions to satisfy strength of material as well as safe functioning conforming to relevant codal provisions. In this process, in the end, there can be several strong and safe designs, but the one which is safe, strong and at the same time most economical by weight and hence by cost is most desirable and acceptable.

This work entitled the 'Consideration of Seismic Design of Multistoried Steel Structure' and in this, the steel structure is the moment resisting frame with deck system for floors and brick work for wall. Study showed the design of column using different types of Indian steel section such that I-section, double I-section, face to face channels section with IS 800:1984. Using above sections, the seismic design of (G+1), (G+3), & (G+6) steel frame done by STAAD-Pro. Also considering all important design parameter in STAAD-Pro. It is concluded that used double I-section with optimum weight per meter is most economical instead of single section with maximum weight per meter. The RCC frame (G+1) also designed by STAAD-Pro and

compared with Steel frame having face to face channel section for columns.

Keywords: Stiffness, Moment resisting frame, Deck system.

1. Introduction

Steel structures have, in general, been able to withstand severe earthquake shaking without collapses, owing to their intrinsic ductility. Steel itself is considered a good earthquake resistant material because of its large strength-weight ratio. A nearly equal behavior pattern under tensile and compressive load enhances its performance under cyclic loading.

Moment resisting frames are rectilinear assemblages of beams and columns, with the beams rigidly connected to columns. Their primary source of lateral stiffness and strength are the bend rigidly and strength of the frame members. Dissipative zones form in a large number and they are concentrated in discrete regions at the ends of the members, the so-called plastic hinges, which dissipate energy through a quite stable bending cyclic behavior. In order to maximize the energy dissipation capacity, plastic hinges have to develop in beams and at the column base. The corresponding failure mode is called 'global collapse mechanism'. Moreover moment frames are also preferred for their architectural versatility: there are no bracing elements which block wall opening and the maximum flexibility for space utilization is provided.

2. Design of Steel Frame by Staad-Pro.

The relevant data taken for analysis and design of steel frame as below:

1. Plan 5 m x 6m
2. Depth of foundation = 1.5 m
3. Floor to floor height = 3.2 m
4. Depth of deck slab for steel frame (Including finishing) = 125 mm
5. Depth of slab for RCC frame (Including finishing) = 200 mm
6. Weight of deck profile for 1.0 mm thick deck = 0.103 KN/m²
7. Live load on floor = 3.0 KN/m²

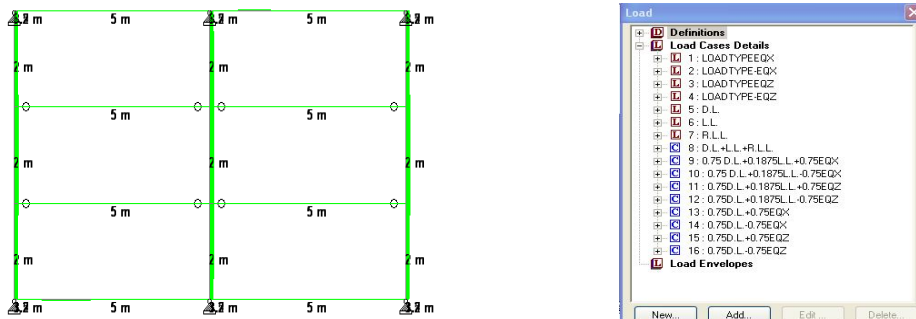


Figure 1: Plan for design of all types of Models & Load window in STAAD-Pro. (Clause No. 3.4.2.1, 3.9.2.1 of IS: 800-1984).

2.1 Models taken for study

Model 1: (G+1) Steel frame using Single I-section for column, **Model 2:** (G+3) Steel frame with double I-section for column. **Model 3:** (G+6) Steel frame with double I-section for column. **Model 4:** (G+3) Steel frame with face to face Channel section for column. **Model 5:** (G+6) Steel frame with face to face Channel section for column.

3. Result

The analysis & design has been done in STAAD-Pro software using IS:800-1984. The result shown in STAAD-Pro i.e. postprocessing result of Beam-Unity Check of each steel frame and its discussion on comparatively study with using different types of Indian Steel section for column and the best performance of double I-sections and face to face channel section in multistoried steel structure.

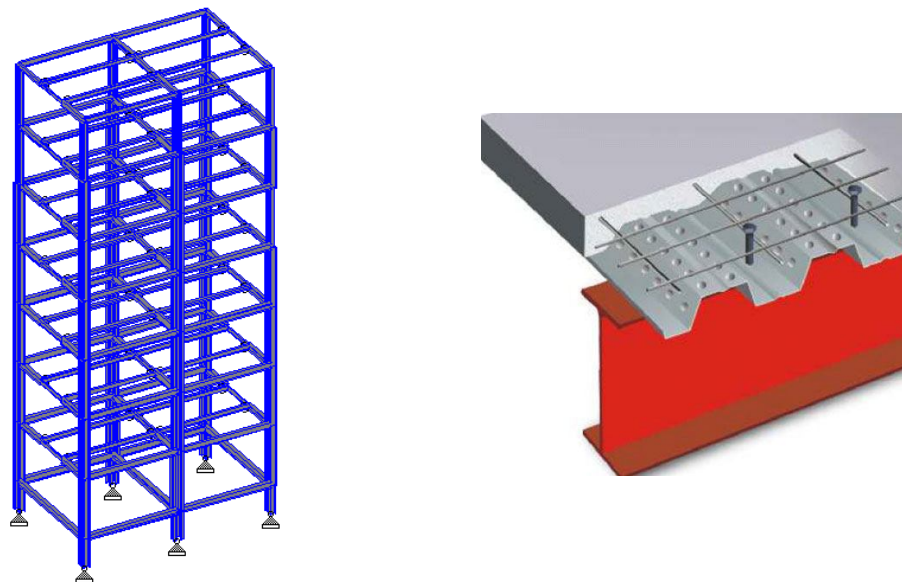


Figure 2: Seismic design of (G+6) Steel frame with face to face Channel section for column by using STAAD-Pro. (Model 6) & deck system used in all types of Models.

4. Conclusions

1. Model 1 deals with the designs of steel frame (G+1) using single I-section for columns. In this design, columns are required with very heavy single I-sections such as ISWB 600 of weight per meter 145.1 Kg/m.
2. When RCC slab was used in Model 1 i.e. (G+1) steel frame with single I-section used for columns, the section for column required is heaviest section such as ISWB 600A.
3. When tube or pipe sections were used in Model 1 then standard sections were not sufficient for column.

4. Floor decking system was used in steel frame, it is light weight.
5. Floor decking systems also serve as a formwork for slab casting.
6. In Model 2 i. e. (G+3) steel frame with double I-section for columns having 0.15 m spacing between flange to flange, all columns designed with section ISWB 250 with weight per meter 40.9 Kg/m. In case of single I-section for above Model 3, even heaviest section was unsafe.
7. In Model 3 i.e. (G+6) steel frame with double I-section used for columns, columns sections required were ISWB 200 & ISWB 300.
8. In Model 4 i.e. (G+3) steel frame with face to face channel section for columns. With this arrangement, the section of columns required were heavy section such as ISMC 350.
9. In Model 5, the columns designed with face to face channel sections, the maximum available section i.e. ISMC 400 was not found sufficient for some of the columns.
10. Orientation of column is important for single column section. If columns are properly oriented with major axis then design will be economical.
11. Steel frame compared with RCC frame, time saving in construction of steel frame is very much.
12. Steel buildings are having maximum scarp value while in case of RCC buildings scrap value is negative.

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