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A Review on Behaviour of Columns of Steel Framed Structure with Various Steel Sections

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Abstract - Structural Analysis is a branch which includes in the assurance of conduct of structures so as to foresee the reactions of real structures, for example, buildings, trusses, bridges and so on. Under the enhancement of expected loading and outer condition amid the administration life of structure. Structural Analysis is a process in which behaviour of the structures and the responses when subjected to loads is predicted. In this review paper, behaviour of columns of steel framed structure with various steel sections is analyzed from various reviewed paper. From review various studies it concluded that tubular sections turns out to be efficient. All out sparing of practically 36% in expense is accomplished. Adequacy of Tubular section can be confirmed for various arrangement regions for different sorts of brackets. Basic individuals having bigger unsupported lengths can be allocated tubular sections will determine by and large economy.

***Key Words*: Structural Analysis, Tubular sections, column, Column stresses.**

1. INTRODUCTION

There are distinctive sorts structures which are being developed ordinary, for example, private buildings, business buildings, emergency clinics, institutional buildings and so on. Each building has its very own motivation and it is planned according to the prerequisites of the structure. Various types of structures are being erected everyday i.e. residential buildings, commercial buildings, institutional buildings etc. However, the structures are categorized i.e. Material Wise Categorization (Brick Masonry Structures, Steel Structures, Composite Structures, RCC Structures), Purpose Wise Categorization (Residential Structures, Storage Structures, Station Structures, Commercial Structures).

RCC framed structures are exceptionally normal and are frequently built in urban and rural zones where as steel structures are less basic as they required aptitude engineers and workers. Composite structures are uncommon and utilized just in complex circumstance. Private structures are the structures utilized for living purposes and loads are constantly present in these structures. Business buildings are the workplace and institutional buildings and are utilized just for business purposes. Capacity structures are the distribution centers which are utilized for putting away the merchandise and machines and they are generally developed of steel and composite structures.

Conventionally, the concrete structures were adopted mostly but now with the improved technologies and design methods, steel structures are steeling the market as they as light in weight and requires less time for construction phase. Different steel sections (such as T-Shape, I-shape, channels, angles etc) are welded or bolted together with the help of plates in order to erect the structures. As there is no requirement of curing period unlike concrete structures, steel structures can be erected within days. Sometimes, bracing systems (such as battens, lacings, struts etc) are used in order to give additional strength to the structures as they resist sway and gives stability. Traditionally, the concrete structures were received generally however at this point with the enhanced innovations and plan techniques, steel structures are steeling the market as they as light in weight and requires less time for construction stage. Distinctive steel areas, (for example, T-Shape, angles, I-shape, channels and so on) are welded or bolted together with the assistance of plates so as to erect the structures. As there is no prerequisite of curing period dissimilar to concrete structures, steel structures can be raised within days. In some cases, bracing frameworks, (for example, struts, lacings, battens and so on) are utilized so as to give extra strength to the structures as they oppose sway and gives stability.

Column, being the vertical member, is a compression member through which the loads from slabs and beams are transmitted to the foundation safely without any failure. In steel structure, any section can be used as column but the only thing matters is the placement of that section. I-sections, single channel sections, double Channel sections, hollow sections are the sections which can be used as a vertical member in different situations as they impart strength and durability in their own way. The vertical member i.e. column is a compression member by which loads from beams and slabs are send to the foundation without any risk and any failure. In steel structure, the main thing is placement of the section that can be used as column. I-sections, hollow sections, double Channel sections, single channel sections are the sections which can be act as a vertical member in distinct situations as they provide durability and strength.

1.1 Literature Review

M.G. Kalyanshetti et al. [1] analyzed the economy, load carrying capacity of all structural members and their corresponding safety measures. Economy is the main objective of this study involving comparison of conventional sectioned structures with tubular sectioned structure for given requirements. For study purpose superstructure-part of an industrial building is considered and comparison is made. Study reveals that, upto 40 to 50% saving in cost is achieved by using tubular sections.

A. E. Hassaballa et al. [2] investigated the performance of existing buildings if exposed to seismic loads. The frame was analyzed using the response spectrum method to calculate the seismic displacements and stresses. The results obtained, clearly, show that the nodal displacements caused drifts in excess of approximately 2 to 3 times the allowable drifts. The horizontal motion has a greater effect on the axial compression loads of the exterior columns compared to the interior columns and the compressive stresses in ground floor columns were about 1.2to 2 times the tensile stresses. The values of shear forces due to L/C3 in beams B805, B806 and B807 were found to be about four times the values due to L/C1.The maximum values of compressive and tensile stresses in beams are approximately equal. Bending moments in beams and columns due to seismic excitation showed much larger values compared to that due to static loads. The analysis was performed for static and seismic loads. The Seismic analysis used horizontal input motion of earthquake with moderate horizontal peak ground acceleration (PGAH). A total time of vibration of 8 seconds was considered. The results of the analysis are shown in figure 1 and figure 2.

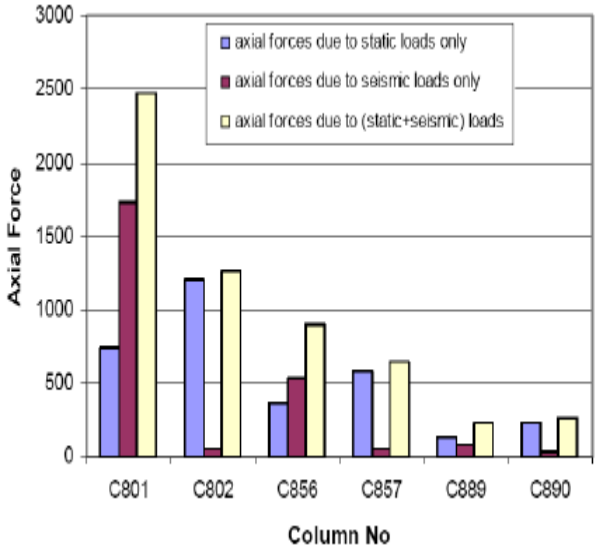


Fig -1 Column Axial Forces of the Studied Frame

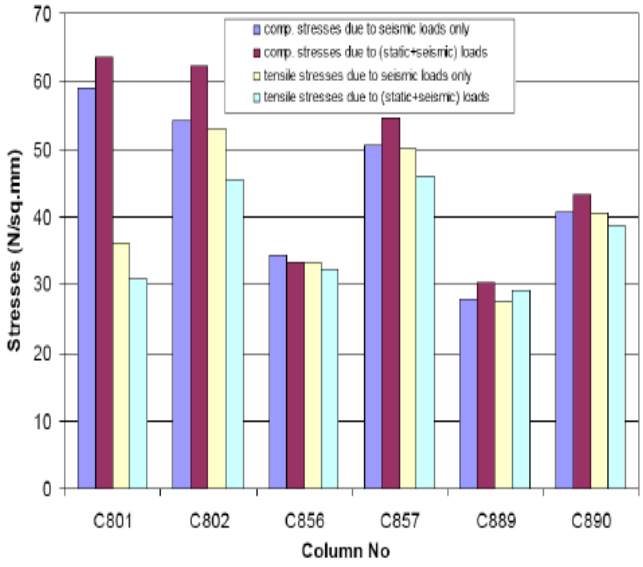


Fig- 2. Column stresses of the Studied Frame

MananD.Maisuri et al. [3]designed and analyzed multi span industrial shed with truss and portal frame and all checks for both of the sections is made with draft code IS 800:2007 and IS 806 for limit state design of given problem with conventional and tubular steel sections respectively. Manually analyzed data is checked by structural software STAAD PRO V8i.The result obtained by the both types of sections is tabulated in form of consumption of steel for truss and portal frame.

Rakesh R. Nora et al. [4] is to regarding the economy, load carrying capacity of structural member. This study involving comparison between sectioned structural members for given requirement of superstructure part of a industrial building. Study reveals that, upto30% to 40% saving in cost is achieved by using tubular sections.

Yash Patel et al. [5] comprise the conventional structures with tubular structure. Results show that up to 15 to 25% saving in expense is accomplished by using tubular sections. Analysis of shed's elements was carried out by Staad Pro V8i computer software, with manually applying Indian Standards. Several excel sheets for various structural elements like Purlin, Roof Truss, compression member, Tension member etc. were carried out using Microsoft office excel. Lastly estimation sheet is prepared for each Conventional Roof Truss section as well as Tubular roof truss section.

Gauri G. Kakpure et al. [6] presented a review of the previous work done on multistoried buildings for earthquake analysis. The focuse on static and dynamic analysis of buildings. Design parameters such as Displacement, Bending moment, Base shear, Storey drift, Torsion, Axial Force were the focus of the study. It was found that, the difference of values of displacement between static

and dynamic analysis is insignificant for lower stories but the difference is increased in higher stories and static analysis gives higher values than dynamic analysis. Static analysis is not sufficient for high rise buildings and it's necessary to provide dynamic analysis. Building with re-entrant corners experienced more lateral drift and reduction in base shear capacity compared to regular building.

Mr. V T Hulwane et al. [7] comprises the hollow sections with conventional sections on economy point of view. The study work is to analysis steel truss by considering the load combinations as per IS codes and finding out forces in members. Then design members of steel truss for analyzed load combinations for conventional steel members. For same load combinations design same steel truss with tubular sections. Make an excel program to check the correctness of calculation work and try other dimensions of truss to compare between conventional steel members and tubular steel members. The comparative report prepare before arriving at the final conclusion.

Siddharth R Pawar et al. [8] are designed, fabricated and tested five types of innovative hollow steel section (HSS) column. The present work is divided in two broad parts such that in the first part, the study of the behavior of the innovative corrugated steel column under axial loading using UTM was conducted, this part being called experimental work. In the second part, the results of the practical experiments are checked with theoretical results which are obtained by analytical method by using computer software ANSYS. The results obtained from experimental testing and computer analysis are compared and validated. The comparison of corrugated hollow column with conventional hollow column is done to know the advantages of innovative column over conventional column.

S. Pradeep et al. [9] studied seismic behaviour of reinforced concrete framed buildings with columns of different heights within on storey. For this study an MS Excel sheet was developed in which 20 cases of varying slope by small increments which can formulate the mode shapes, frequency, time period, storey drift, base shear, etc. The results were compared. Using STAAD Pro v8i, 4 reinforced concrete frames on plane ground were modelled. Then the analysis was carried out for gravity as well as seismic loading. Models were created for the above cases when placed on sloped terrain. Comparison for various results like time period, base shear, spectral acceleration, response spectrum, stress in columns were done. The reinforcement detailing of all the above 8 models were done using STAAD Pro v8i, which were used as input data while doing the modelling in ANSYS 12. All the above mentioned 8 models were modelled in ANSYS 12 with element material as SOLID65. The volume ratio and orientation angles were entered as obtained from STAAD Pro v8i concrete design results. Monotonic loading was applied to the models and results like load displacement hysteresis curve, stress on members, deflected shapes, etc. were extracted. The results show that when a reinforced concrete framed structure is built on a sloping terrain, the short columns tend to fail easily. Shear cracking pattern appeared at the beam column joint of short columns. Long column being more ductile takes up lesser lateral force when compared to the short columns. Comparing the results for models, it shows that the base shear almost doubled for the building on sloped ground when compared with the building in plane ground both in the x and z directions (Model 1 & 2). In other models also, base shear was found more in case of sloped ground than in normal ground buildings. The value was 55% more in average for frames in sloped ground as shown in Figure 3.

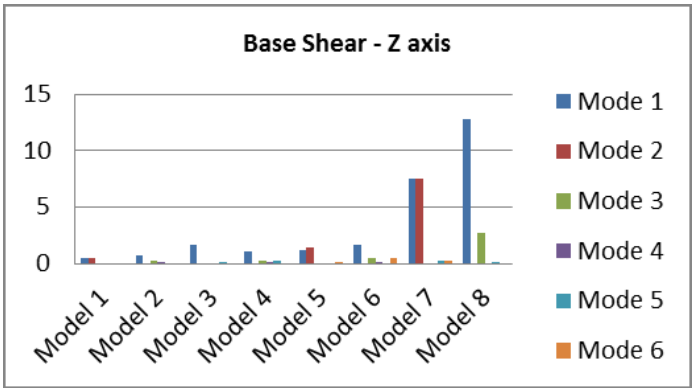
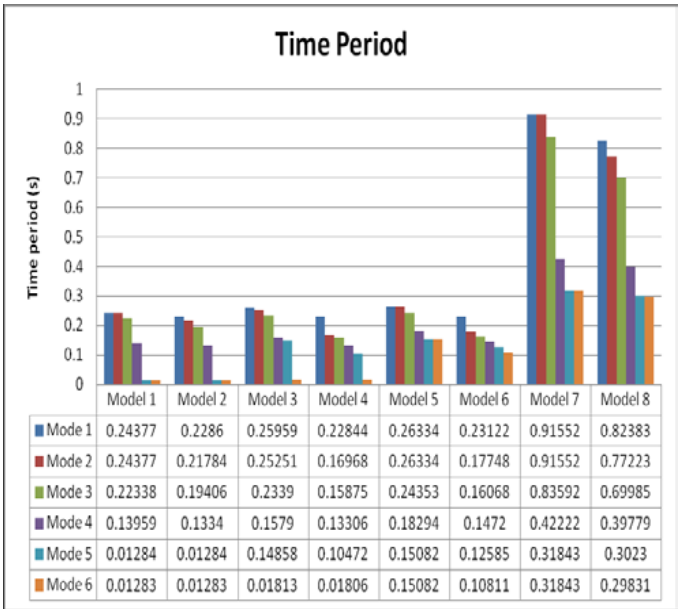


Fig – 3 Base shear for building on plane and slope ground

The time period value was 10 % less for frame in sloped ground. As the time period is less, the chance of failure is more for building constructed on sloped ground as shown in Figure 4.



	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Mode 1	0.24377	0.2286	0.25959	0.22844	0.26334	0.23122	0.91552	0.82383
Mode 2	0.24377	0.21784	0.25251	0.16968	0.26334	0.17748	0.91552	0.77223
Mode 3	0.22338	0.19406	0.2339	0.15875	0.24353	0.16068	0.83592	0.69985
Mode 4	0.13959	0.1334	0.1579	0.13306	0.18294	0.1472	0.42222	0.39779
Mode 5	0.01284	0.01284	0.14858	0.10472	0.15082	0.12585	0.31843	0.3023
Mode 6	0.01283	0.01283	0.01813	0.01806	0.15082	0.10811	0.31843	0.29831

Fig – 4 Time period for the building on plane and slope ground

Shaik Kamaluddhin et al. [10] had analysed the G+12 building for finding the shear forces, bending moments, deflections details for the structural components of building (such as Beams, Columns & Slabs) to develop the economic design. ETABS is also leading design software in present days used by many structural designers. Here I have also analysed the same structure using ETABS software for the design. Finally I made an attempt to define the economical section of G+12 multi-storeyed building using STAAD.Pro and ETABS comparatively. Bending Moment Diagram from Analysis are shown in figure 5.

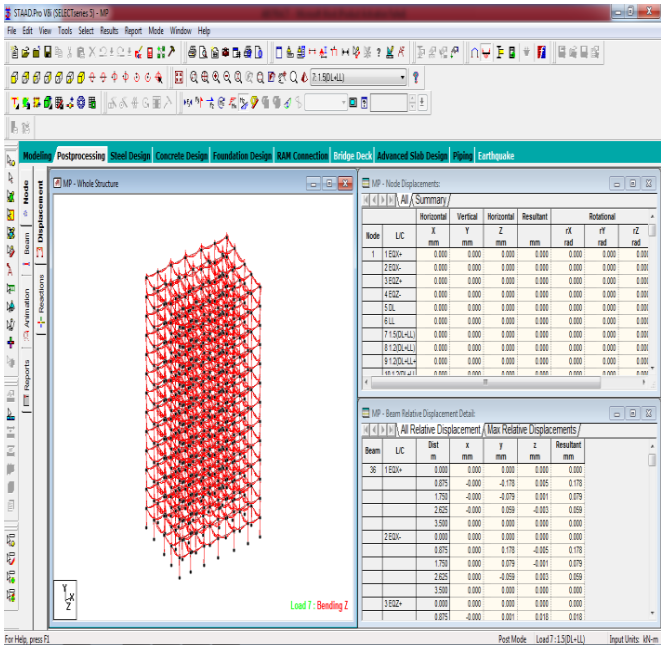


Fig – 5 Bending Moment Diagram

3. CONCLUSIONS

It can be clearly seen that many research work has been carried out on different steel sections with respect to conventional and tubular sections. Following are the results of literature review:

- Tubular sections prove to be economical as they save almost 50 % to 60 % cost.
- The structural members having larger unsupported lengths can be assigned tubular sections which will derive overall economy.
- The consumption of steel of whole industrial building can be reduced by deciding appropriate geometry of truss and by using hollow steel section with compare to conventional steel section.

But further research can be done on columns of steel structure having conventional steel sections and tubular steel sections.

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