DESIGN COMPARISON OF DIFFERENT REINFORCED CONCRETE MEMBER USING DIFFERENT COUNTRY CODES

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Abstract : The aim of this thesis is to compare the design code of IS 456:2000 and BS 8110, in this comparison we consider different element in structure beam and column, we compare maximum compressive and tensile stress in beam, percentage of steel in column and we also compare which code is economical IS 456:2000 or BS 8110.

1. INTRODUCTION

In this current era one of the most important point is for human kind to tackle many forces while designing the structure, now a day due to global warming we are facing a very big climate change so we need a very good and high performance structure and designing is an art and science of understanding the behavior of structure members, it is subjected to load and we design them economy to give safety, serviceability and durability. Structure design is the very big task to investigate different things in the structure like stability, strength and rigidity of structures. Basic objective in the structural analysis and for designing is to produce an structure capable of resisting all load without failure during its life. Structural design of any structure involves stablishing the loading other types of design conditions, which is necessary to be supported by structures and must be considered in design. It is followed by the analysis and computation of an internal gross forces like (shear, thurst, bending moment and twisting moment) as well as creep, shrinkage, change in temperature, reactions produced by load, deflection, stress-strain behaviour, stress intensities and other design conditions.

2. REVIEW OF LITERATURE

In the present study, the research articles and journals that are studied for understanding of the work to be carried out are discussed and these papers are presented as per the reference of this study in this chapter.

- Temple Nwofer.et.al.(2015): - compare BS 8110and EC 2 for the design of a continuous reinforced concrete beam to find out the area of tension and shear reinforcement with the aim of determining which is most economic using Microsoft excel spreadsheet. In this study the self weight of the beam was taken as the dead load while the live load was assumed to be a unity. Table 6 shows the basic span/effective depth ratios for rectangular beams.

- A. C. Nwofer (2015):- Compare BS8110-97 and Eurocode2 for the design of reinforced concrete beam with a particular interest on the area of tension and shear reinforcement required from economical point of view. For the analysis and design, a six- span continuous beam from the roof of a three story shopping complex with the help of programmed excel spread sheet. The self-weight of the beam was taken as the dead load while the live load was assumed to be unity. They found that Eurocode2 require less amount of tension reinforcement at span as well as support as. The average percentage of both cases is 3.08% and -2.83% respectively. The percentage of shear reinforcement for BS 8110 is more than Eurocode2. For the combination of dead load and impose load are considered, average percentage difference for the span moments of the BS8110 exceed that of the Eurocode2 is more conservative in terms of the partial factor of safety for loading. For a combination of live and dead load considered in this study, the BS8110 required about 1.3% more of the ultimate design loads than that of the Eurocode2 .thus Eurocode2 is more economical design with the required margin of safety.

- S. Karthiga.et.al.(2015):- present the analysis and design of G+10 for seismic forces using four international building standards IS1893, Euro Code 8, ASCE7-10 and British Code using STAAD.PRO.V8i. After the design of building a pushover analysis was done in SAP2000 to check the seismic performance of building. After the analysis it was found that maximum shear is obtained from IS code and it undergo minimum displacement than other standards.

- Rajmahendra Manikaro Sawant.et.al.(2015):- assess the effectiveness of steel fibre along with shear reinforcement in the formation of high grade fibre reinforced concrete. Direct shear test using push off specimens is used to find out the shear strength of concrete. Shear stress (strength) is calculated as the ratio of shear load per unit area of shear plane. The study was carried out on M60 grade of concrete to find out the workability, density and shear strength with different volume of concrete. The shear strength increased up to 29.42% and 28.76% at 7 and 28 days respectively over normal concrete at 1.5% fibre content. Fibre content reduces the deformation at all load levels, reduced spalling, maintain the ductility and overall integrity of the structure.

- Swajit Gaud.et.al.(2016):- present a comprehensive literature review on the design strength of materials, stressstrain curve for concrete, steel and confined concrete, partial safety factor and limitations of grade of concrete and grade of steel reinforcement as per Indian Standards, American Standards, European Standards, New Zealand Standards and Japanese Standards. The effect of high grade concrete on material properties and stress block parameters is not mentioned in IS code. With respect to time, the material properties which affects the strength of concrete, curing temperature in respect to strength of concrete and tensile strength of concrete is not properly mentioned. Only New Zealand has minimum and maximum value of concrete strength in seismic environment which is 20N/mm2 and 70N/mm2 respectively. The provisions of IS code are more close to New Zealand standards. From the above standards it was found that the recommended concrete strength lie between 20MPa to 50MPa and for steel it lies between 420MPA to 500MPa. The use of high strength concrete and steel in building construction has many advantages such as, increased strength of structures, reduced strength of cross-sections, more durable material and therefore substantial savings.

- C. U. Nwoji.et.al. (2017):- compare BS 8110 and Euro code (EC 2) to find outthe relatives gains and shortcomings of EC 2 and BS 8110 under loading analysis, ease of use and technical advancement. Loading summary for each span of the beam for the ultimate limit states and the serviceability limit states.

- Iqbal Rasool Dar (2018) :- The aim of this project is to compare the design codes of IS 456-2007, ACI 318-11code and Eurocode II. The broad design criteria (like stress strain block parameters, L/D ratio, load combinations, formula will be compared along with the area of steel for the major structural members like beams, slab, columns, footing to get an over view how the codes fair in comparison with each other. The emphasis will be to put the results in tabular and graphical representation so as to get a better clarity and comparative analysis.

- Muhammad Mostafijur Rahman.et.al.(2018):- compare the seismic design procedure for Bangladesh (BNBC1993), India (1893) and US (ASCE 7-10) to analyse, design and seismic performance of reinforced concrete buildings on the basis of the type of allowable analysis procedure, zoning system, site classification, fundamental vibration period of structure, response reduction factor, importance factor, minimum design lateral force, allowed story drift and design response spectra. Three dimensional non-linear dynamic analysis of designed structure were conducted. The structural performance of each building was compared in terms of roof displacement, inter storey drifts, and load carrying capacity of beam and columns and overall energy dissipation characteristics. The result shows that the Indian code performed better than when subjected to the ground motion that it is intended to represent the Indian design response spectrum.

- Neha Mumtaz (2019) :- . In this paper, a comparative study is presented for analysis and design of reinforced concrete building under seismic forces for four codal Guidelines (IS 1893:2002, Euro code 8, Japan-2007 and ASCE: 7-10) using Staad Pro. The comparative study includes the comparison building base shear, bending moment, shear force, percentage of steel, required area, displacement, and story-drift. For seismic Analysis and design, the building elements like beam and column is also compared using these countries RC building code.

3. METHODOLOGY AND MODELLING

This work comparative study of design parameters varis element of structure such as column, beam and slab done by RC building design codes of different countries. These codes are studied IS 456:2000 and BS 8110. Differences in important parameter noted and represented.

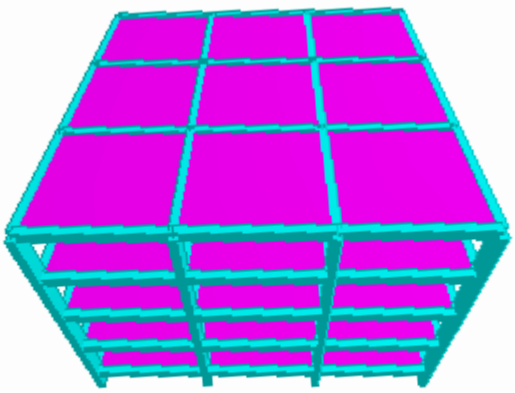
As we know there is practices for designing a structure. Structural design of building mainly based on national codes and international codes of practices. That codes provide guidelines to engineers in appraisal of structural scheme, the detail analysis and design. Experienced engineer and allied professionals they provide frame work for safety and serviceability in building design.

This paper reviewed a comparison of different design building codes like India, British . The considered code include IS 456:2000 from India, BS 8110 from British, It is the duty of structural engineers to provide designs that would lead to maximum performance and economy by employing the most efficient design method in accordance with a relevant design code available, in order to satisfy the requirements.

- **IS code:-** Indian standard(Fourth Revision) was adopted by the Bureau of Indian Standards, after they finalized by the Cement and Concrete and Concrete Sectional Committee had been approved by the Civil Engineering Division Council. This type of Standard was first published in 1953 under the little 'Code of plain and reinforced concrete for general building construction' subsequently revised in 1957. The code further revised in 1964 and published under title 'Code of plain and reinforced concrete', enlarging the scope use of code to structures other than general building construction . Third revision was published in 1978, and it included limit state approach to design. The fourth revision of the standard. This revision was taken up view to keeping with the rapid development in the field of concrete technology and to bring further modification/improvement in the light of experience gained while using earlier version.

- **British code:-** This part bs8110 has been prepared by subcommittee B/525/2. It is revision of BS 8110-1:1985 which withdrawn BS 8110-1:1997 incorporates all published amendments made to BS 8110-1:1985. Amendment No. 1 (AMD 5917) published on 31 May 1989; Amendment No. (AMD 6276) published on 22 December 1989; amendment no 3 (AMD 7583) published on 15 march 1993; Amendment No. 4 (AMD 7373) published on 15 September 1993. It includes changes made by incorporating Draft Amendments no's 5 & 6 issued public comment during 1994 and 1995.Amendment No. 5 detailed the insertion of various reference to different cement used in concrete construction, covered by BS 5328 and recommendations of BS 5328 for concrete as a material to the point of placing, curing and finishing in the works. Amendment no. 6 dealt with the change the partial safety factor for reinforcement beam, from 1.15 to 1.05. it has been assumed the drafting of this British standard that the execution of provisions will entrusted to appropriately qualified and experienced people.

3.1 The modelling details of the buildings are as discussed below.



- The modelling of the buildings are done using Staad Pro v8i software.
- In this model we consider two structures.
- Model -1 G+3 structure is design by using IS 456:2000 code.
- Model -2 G+3 structure is design by using BS 8110 code.

Table (1) :- Multi-Storey Building Geometrical Dimensions

MEMBER DIMENSION	
COLUMN	**300 X 600**
BEAM	**400 X 300**
SLAB	**150mm**
BRICK INFILL IN WALLS	**230mm**
FLOOR HEIGHT	**2.5m**
TOTAL HEIGHT OF BUILDING	**9.9m**
TOTAL AREA OF BUILDING	**225m^2**
Unit weight of brick infill	**20 KN/m^2**
Unit weight of concrete	**25 KN/m^2**
Grade of rebar	**Fe550D**
Grade of concrete	**M 25**

4. RESULTS AND DISCUSSIONS

Different codes are analyzed and the difference of maximum tensile stress for beam, percentage of steel in column, average for longitudinal and transverse reinforcement for slab, total quantity of concrete, total weight of concrete, total cost of concrete and total cost of steel is represented in for of graphs.

Chart 1 Maximum Compressive Stress In Beam

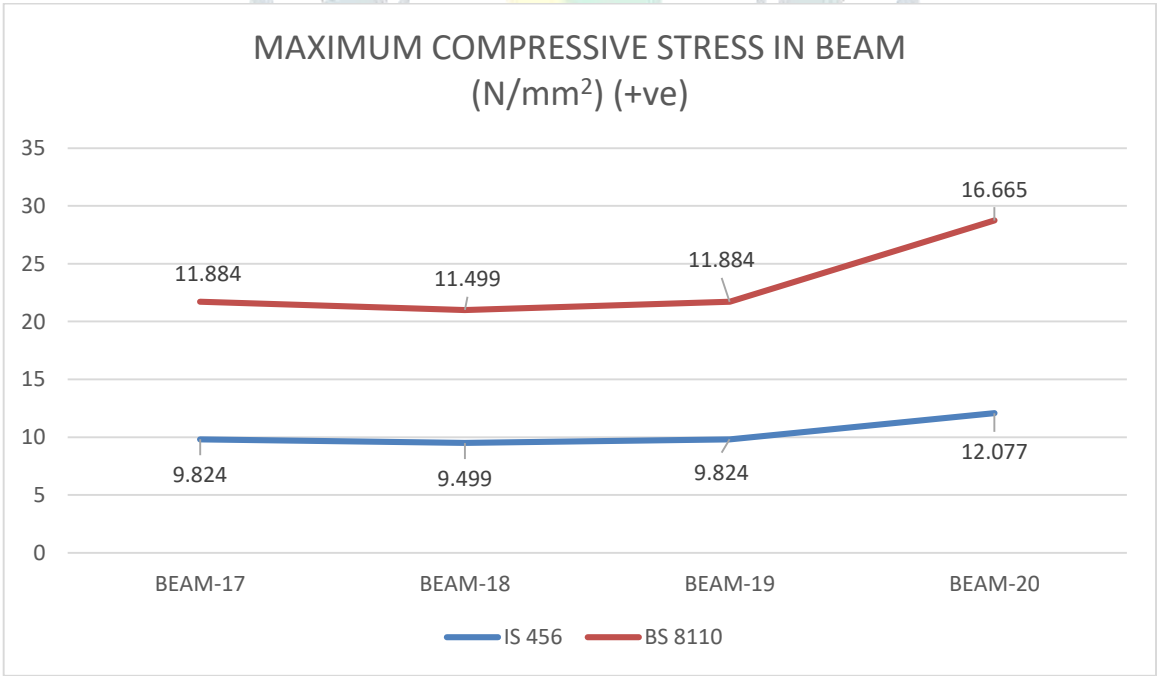


Chart 2 Maximum Tensile Stress In Beam

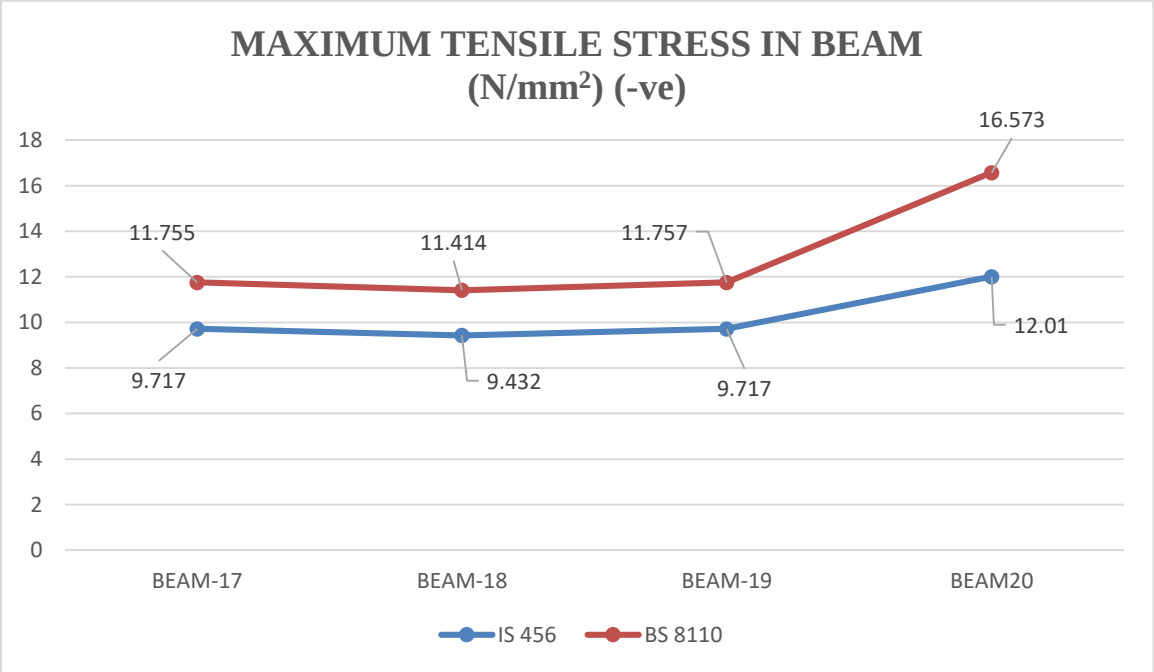


Chart 3 Percentage Of Steel In Column

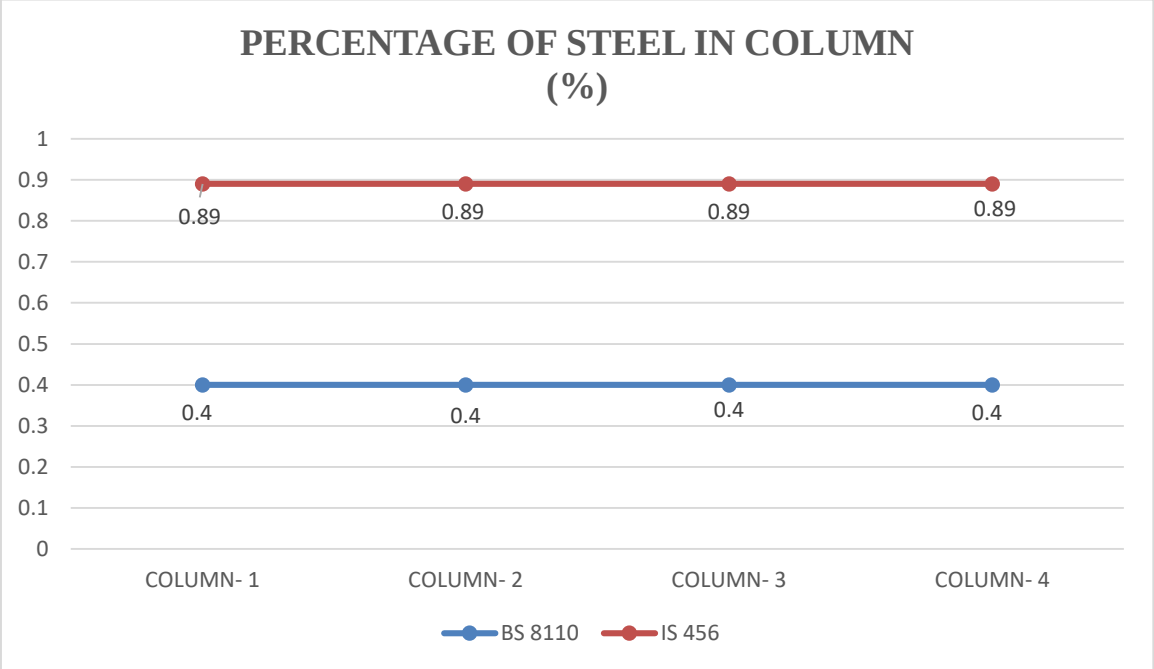


Chart 4 Total Volume Of Concrete

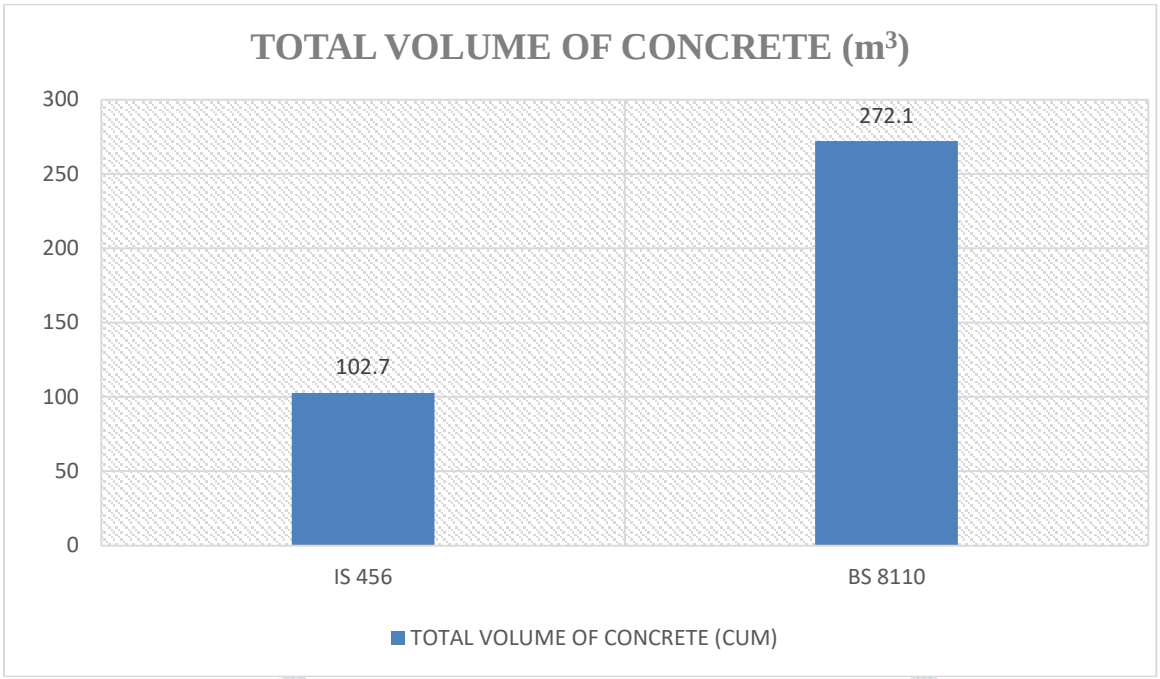


Chart 5 Total Weight Of Steel

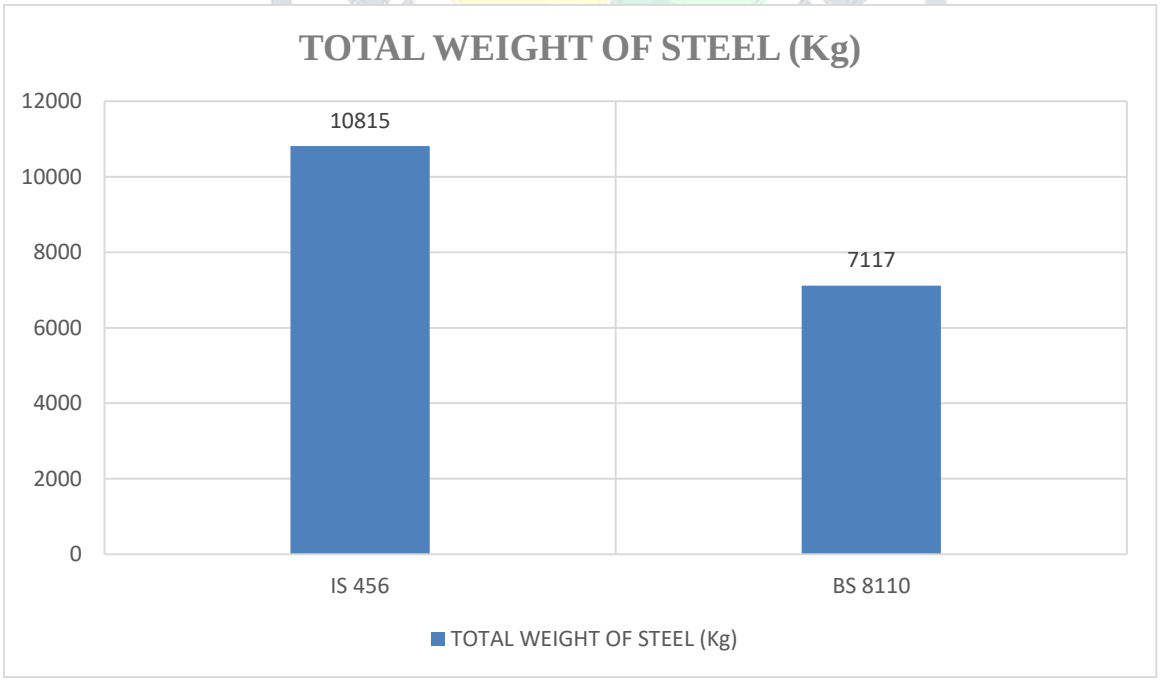


Chart 6 Total Cost Of Concrete

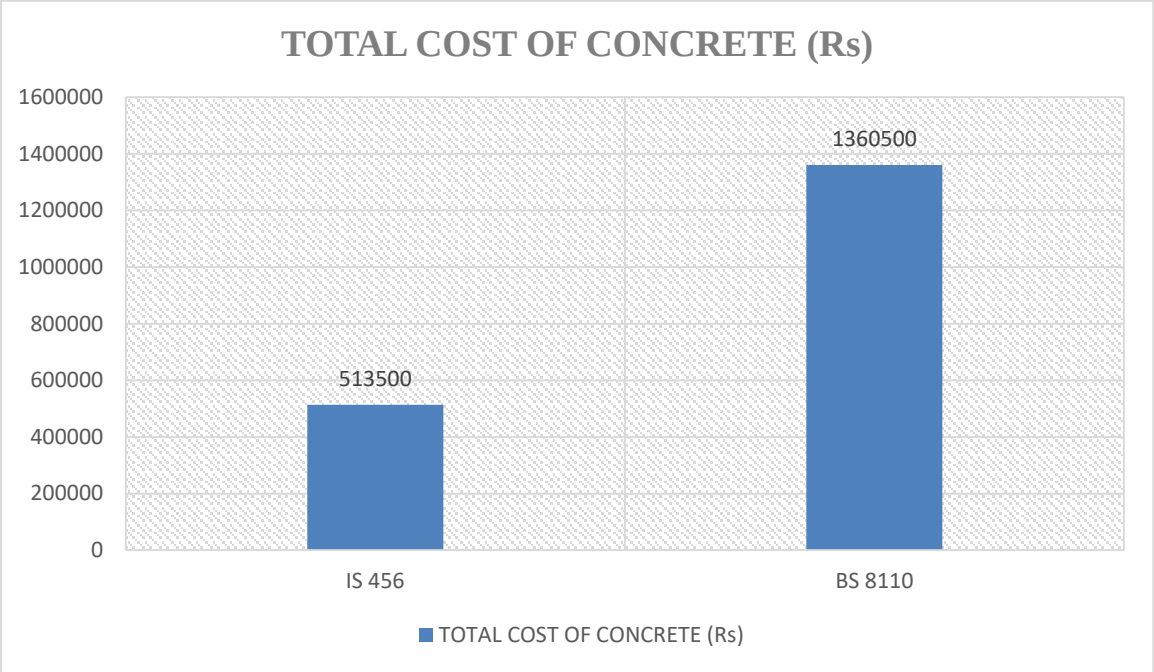
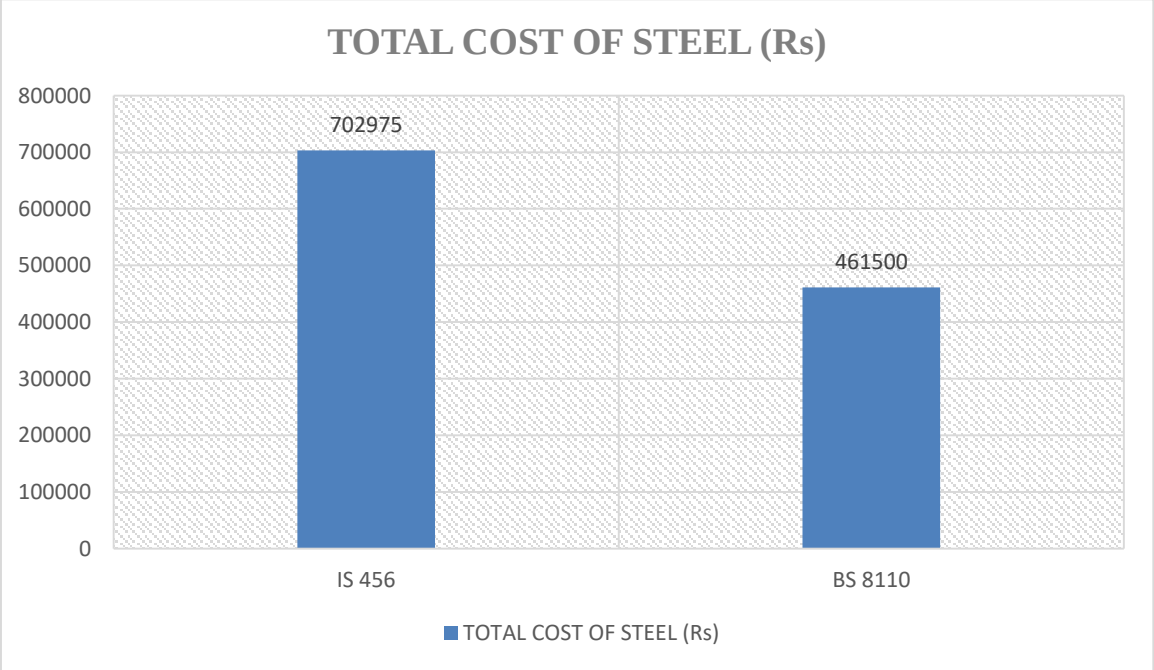


Chart 7 Total Cost Of Steel



5. CONCLUSIONS

After comparing the codes and by keeping the live load and dead load same for both codes, we find out that Percentage of steel in column is least for BS 8110 and is maximum for IS 456:2000. Maximum compressive and tensile stress in beam is least for IS 456:2000 and maximum for BS 8110. Total volume of concrete is least for IS 456:2000 and maximum for BS 8110. Total weight of steel is least for BS 8110 and maximum for IS 456:2000. Total cost of concrete is least for IS 456:2000 and maximum for BS 8110. Total cost of steel is least for BS 8110 and maximum for IS 456:2000. This clearly show that IS 456:2000 Indian code have upper hand in this comparison.

6. FUTURE SCOPE OF WORK

Future scope in this work is comparison of beam and column with wind and seismic load while considering this load how our structure response in IS 456 2000 code and BS 8110 code. There is scope also on comparison with slab to find how slab is perform when we use IS 456 2000 and BS 8110.

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