International Journal of Interdisciplinary Innovative Research &Development (IJIIRD)
ISSN: 2456-236X
Vol. 05 Special Issue 01 | 2020

Comparitive Design study Of R.C.C Beam by using IS 456:2000 & Eurocode 2

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ABSTRACT

The fortified solid structures must be planned and developed by the arrangements of a structure code. A plan code a record that builds up the for the structure of a structure. Every nation has their own geological, land and climatic conditions. These conditions drives every nation to build up their own measures for the plan of fortified cement structures. Design codes are the most significant and essential instruments for auxiliary originator engineers. The plan codes don't give structure systems, however indicate the plan necessity and imperatives that must be fulfilled.. The decent variety of the arrangement of codes for nations overall turns into a difficult when designers need to move starting with one nation then onto the next. Consequently, the investigation of principle highlights shared traits and contrasts of the different codes of training is important to frame a typical stage for basic structure all through the world. This paper establishes a near investigation of the Indian code (IS456:2000) and European code (Eurocode 2 EN 1992-1-1).

***Keyword:** - IS456:2000, Eurocode 2 EN 1992-1-1, Beam*

1. INTRODUCTION

The correlation between the two codes is finished with the point of distinguishing huge contrasts both at the degree of estimations of count and at the degree of greatest and least estimations of plan and helpful miens. The Eurocode 2 is gotten from the British Standard BS8110. The Eurocode code 2 ends up being more mind boggling than the Indian Standard IS 456:2000. This manual will fill in as apparatus structure Design Engineers , understudies, and furthermore learning lovers who need to find out about the Eurocode 2 and IS 456:2000. This examination was do by methods for tables, so as to make the correlation progressively visual and straightforward. The correlation of the different plan helps for the various individuals from the structure was made to indicate the structure necessities and requirements that must be fulfilled. The auxiliary individuals to be looked at are pillars, sections, segments and footings.

1.1 Eurocodes

The EN Eurocodes are relied upon to add to the foundation and working of the inner market for development items and designing administrations by taking out the abberations that upset their free course inside the Community. Further, they are intended to prompt progressively uniform degrees of security in development in Europe. The EN Eurocodes are the reference configuration codes. After distribution of the National Standard transposing the Eurocodes and the National Annexes, every clashing standard will be pulled back. It is obligatory that the Member States acknowledge structures to the EN Eurocodes. In the Eurocode arrangement of European gauges (EN) identified with development, Eurocode 2: Design of solid structures (contracted EN 1992 or, casually, EC 2) determines specialized principles for the plan of concrete, fortified cement and prestressed solid structures, utilizing the breaking point state structure reasoning. It was affirmed by the European Committee for Standardization (CEN) on 16 April 2004 to empower fashioners across Europe to rehearse in any nation that receives the code. Eurocode 2 applies to the structure of structures and common works in plain, fortified and prestressed concrete. It conforms to the standards and necessities for the security and usefulness of the structures. The process of codifying EUROCODE II goes back to1975 in Treaty Of Rome when European Commissionasked CEN (Centre European de Normalisation) todraft structural design standards that could be usedacross the Common Market. It has been updated several times since then the latest update will beavailable by 2020

1.2 INDIAN STANDARD IS 456

This Indian Standard (Fourth Revision) was embraced by the Bureau of Indian Standards, after the draft concluded by the Cement and Concrete Sectional Committee had been affirmed by the Civil Engineering Division Council. IS 456-2000 Plain and Reinforced Concrete - Code of Practice is an Indian Standard code of training for general basic utilization of plain and strengthened cement. This standard arrangements with the general structure utilization of plain and fortified cement. This code utilizes the breaking point state configuration approach also working pressure configuration approach. It is composed for use in India. It gives broad data on the different parts of concrete.This Indian Standard (Fourth Revision) was received by the Bureau of Indian Standards, after the draft finished by the Cement and Concrete Sectional Advisory group had been endorsed by the Civil Building Division Council. This standard was first distributed in 1953 under the title 'Code of training for plain and fortified concrete for general structure development' and thusly changed in 1957. The code was further overhauled in 1964 and distributed under altered title 'Code of training for plain and fortified cement', subsequently extending the extent of utilization of this code to structures other than general structure development too. The third amendment was distributed in1978, and it included breaking point state way to deal with structure. This is the fourth correction of the norm. This amendment was taken up with the end goal of staying up to date with the fast improvement in the field of solid innovation and to get further adjustments/enhancements in the light of experience picked up while utilizing the prior rendition of the norm.

The crux of this paper is the comparison of the two prevailing concrete design codes regarding the design of RCC Structural loads or actions are forces, deformations, or accelerations applied to a structure or its components. Loads cause stresses, deformations, and displacements in structures. Assessment of their effects is carried out by the methods of structural analysis. Excess load or overloading may cause structural failure, and hence such possibility should be either considered in the design or strictly controlled. The table below illustrated the various load combination according to IS 456:2000 and Eurocode 2.

Table 1. Values of Partial safety factors for Loads

Load Combinations	IS 456:2000			Eurocode 2		
	DL	IL	WL	DL	IL	WL
DL + IL	1.5	1.5	--	1.35	1.5	--
DL + WL	1.5 or 0.9	--	1.5	1.0	--	1.5
DL + IL + WL	1.2	1.2	1.2	1.35	1.35	1.35

Notes: DL = Dead load, IL = Imposed load or Live load, WL = wind load

2. STRESS - STRAIN BLOCK DIAGRAM FOR SINGLY REINFORCED SECTION

The hypothesis of bowing for strengthened cement accept that the solid will break in the locales of elastic strain and that, in the wake of splitting, all the pressure is conveyed by the support. It is additionally expected that the plane segments of an auxiliary part stay plane in the wake of stressing, so that over the area there must be a straight circulation of strains. The figure shows the cross-area of a part exposed to bowing and the resultant strain and stress graph. The rectangular-allegorical pressure square speaks to the appropriation at disappointment when the compressive strains are inside the plastic range and it is related with the plan for a definitive cutoff state.

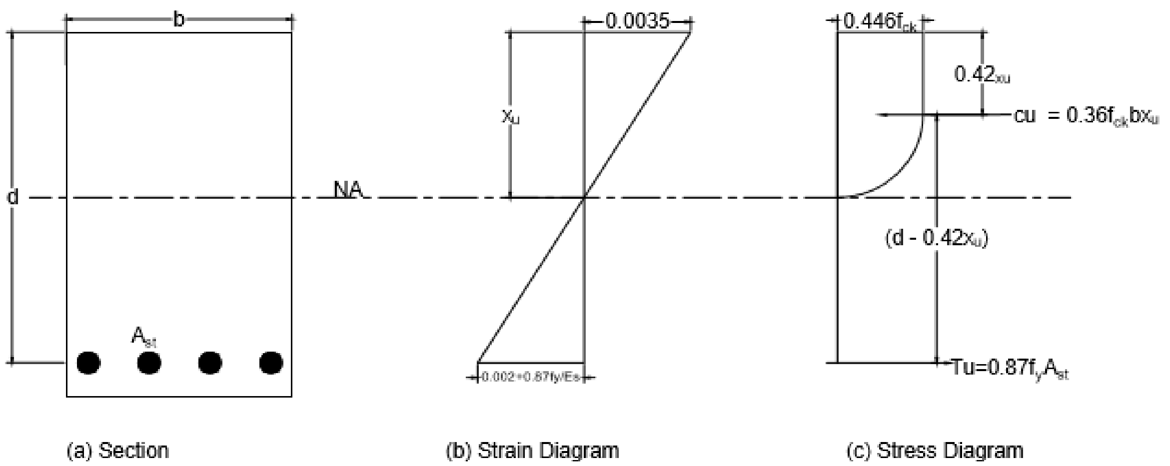


Fig -1: stress-strain block diagram IS456-2000

2.1 Depth of neutral axis

Depth of neutral axis is obtained by considering equilibrium of internal forces. Total compression, C_u = Total tension, T_u .

$\therefore 0.36 f_{ck} b x_u = 0.87 f_y A_{st}$

$$\therefore x_u = \frac{0.87 f_y}{0.36 f_{ck}} \times \frac{A_{st}}{b}$$ …………1

$$\therefore k_u = \frac{x_u}{d} = \frac{0.87 f_y}{0.36 f_{ck}} \times p_t$$ ………..1.1

$$\therefore A_{st} = \frac{0.36 f_{ck} b x_u}{0.87 f_{ck}} \quad or \quad p_t = \frac{0.36 f_{ck} k_u}{0.87 f_y}$$ ………..1.2

Where, $pt = Ast/bd$ = steel factor

2.2 Ultimate moment resistance

The moment of resistance M_{ur}, is obtained by taking moment of total compression, C_u, about resultant tension T_u and vice-versa. $M_{ur}=T_u \times Z_u$ …..(1.3)

$M_{ur}=M_u=0.87 f_y A_{st}(d-0.42 x_u)$ …..(1.4)

Substituting the value of x_u from equation (1) we get,

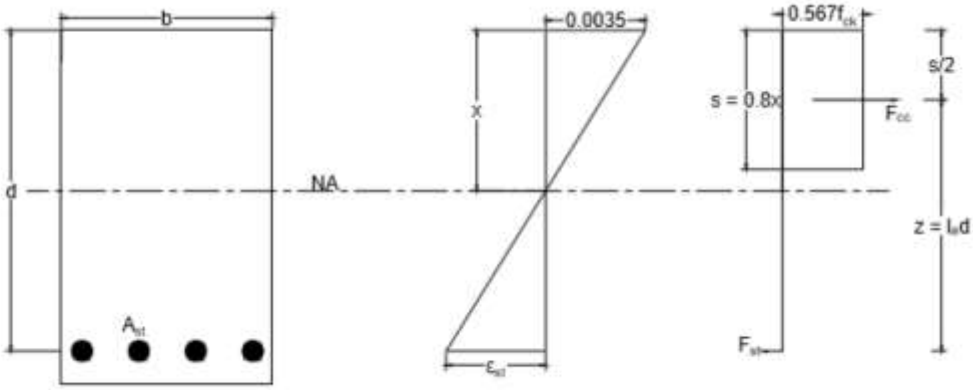
$$M_{ur} = M_u = 0.87 f_y A_{st}\left(1 - \frac{f_y}{f_{ck}} \times \frac{A_{st}}{bd}\right)$$ …..(1.5)

The solution of the above equation gives Ast as:

$$A_{st} = \frac{0.5 f_{ck}}{f_y}\left[1 - \sqrt{1 - \frac{4.6 M_u}{f_{ck} b d^2}}\right]$$ …..(1.6)

3. STRESS - STRAIN BLOCK DIAGRAM FOR EUROCODE 2

The Eurocode 2 uses the proportionate rectangular Stress square. It is as disentangled option to the rectangular-illustrative circulation. This disentangled pressure circulation will encourage the examination and give progressively sensible structure conditions, specifically when managing non rectangular segments.



(a) Section (b) Strain Diagram (c) Stress Diagram

Bending of the section will induce a resultant tensile force Fst in the reinforcing steel and a resultant compressive force in the concrete Fcc which acts through the centroid of the effective area of the concrete in compression as shown in the. For equilibrium, the ultimate design moment, M, must be balanced by the moment of resistance of the section so that

M =Fcc × z = Fst × z …..(2)

Fcc = stress × area of action

F_{cc} = 0.567 f_{ck} × bs and z – s / 2 …..(2.1)

So that substituting in equation (2)

M = 0.567 fckbs × z

and replacing from equation (2.1)

M = 1.134 fckb (d−z) z ……(2.3)

Rearranging and substituting K=M/bd2fck

(z/d)2−(z/d)+K/1.134=0

z=d[0.5+√0.25−K/1.134] …..(2.4)

In equation (2)

Fst=(fyk/γs)As with γs=1.15

Fst=0.87fykAs

Hence A_s=M/0.87fyk×z ….(2.5)

The lower limits of z_{bal} = 0.86d and z_{bal} = 0.82d are when the depth of the neutral axis equals 0.35d and 0.45d respectively, which are the maximum values allowed by the code for singly reinforced section in order to provide a ductile section that will have gradual tension type failure. The limit of 0.82d corresponds to concrete grades not greater than or equal to C35/45 and the limit of 0.86d applies to the concrete grades greater than C35/45.
With z = 0.82d, from equation (2.3) $M_{bal}=1.134f_{ck}b(d-0.82d)\times 0.82d$
Or
$M_{bal}=0.167f_{ck}bd^2$ ….. (2.6)

4. BEAM ACCORDING TO IS 456

Clause 23- Effective Depth
Effective depth of a beam is the distance between the centroid of the area of tension reinforcement and the maximum compression fibre, excluding the thickness of finishing material not placed monolithically with the member and the thickness of any concrete provided to allow for wear. This will not apply to deep beams.
Initially the effective span is computed depending on the supporting conditions.

a) For simply supported slab or beam which is not built integrally with its supports, and for continuous slab or beam having breath of support less than ½ of clear span. Effective length = L = (c/c distance between the supports or clear span + effective depth) whoever is less.
b) For continuous sab or beam having breadth of support greater than 1/12 of clear span or 600mm whichever is less, the effective span shall be taken as under:
    (i) For end span with one end fixed and the other continuous or for intermediate spans, Effective span = L = clear span between supports.
    (ii) For end span with one end simply supported and the other continuous, Effective span = L = (clear span + ½ effective depth of slab / beam or clear span + half the width of discontinuous support) whichever is less.
c) For Cantilevers
    (i) Effective span = L = Length of a cantilever to the face of the support + half the effective depth.
    (ii) Cantilever at the end of continuous beam : Effective span = L = Length of cantilever to the centre of support.
d) Continuous frame: Effective span = L = distance between the centre of supports .

In practice the centre to centre distance between the supports is taken as an effective span for simplicity and on the safer side.

Clause 23.1.2- Effective with of flange
The effective width of flange should not be greater than the breath of the web plus half the sum of the clear distances to the adjacent beams on the other side.

Clause 23.2 – Control of deflection
The limitations of the deflection are stipulated in this article, it is stated that it shall not adversely affect the appearance or efficiency of the structure or finishes or partitions.

Clause 26.5.1- Minimum and maximum longitudinal reinforcement
This clause deals with areas of minimum and maximum longitudinal reinforcement in a beam.

Clause 26.3 – Spacing of Reinforcement
for the purpose of this clause, the diameter of a round bar shall be its nominal diameter, and in the case of bars which are not round or in case of deformed bars or in crimped bars, the diameter shall be taken as the diameter of a circle giving an equivalent effective area.

Clause 26.5.1.3 Side face reinforcement
The IS 456 provides the surface reinforcement when the depth of the beam exceeds 750mm, and it shall be provided along the two faces.
Clause 26.5.1.6 Shear reinforcement
The minimum shear reinforcement is provided in the form of stirrups, where the maximum shear stress calculated is less than the half permissible value. For the design of shear reinforcement the clause 40 will as well come into picture.

Clause 265.1.5 Spacing of shear reinforcement
This clause mention the maximum shear reinforcement measured along the axis of the member.

Clause 26.5.1.7 Torsion reinforcement
This clause mentions the limitations for a member designed for torsion. The clause 40 gives conditions specifying when a member should be designed for torsion.

4.1 BEAMS ACCORDING TO EUROCODE2

The chapter 9 of the Eurocode 2 gives the detailing and of members and particular rules for the design of beams.

Clause 9.2.1.1 – Minimum and maximum reinforcement areas
Sections containing reinforcement less than the minimum reinforcement should be considered as unreinforced. The cross-sectional area of tension or compression reinforcement should not exceed the maximum reinforcement area outside lap locations.

Clause 9.2.1.2 – Other detailing arrangements
In monolithic constructions, even when simple supports have been assumed in design, the sections at support should be designed for a bending moment arising from partial fixity of at least β_1 of the maximum bending in the span.

Clause 5.3.2.1- Effective width of flange
In T beams the effective flange width, over which uniform conditions of stress can be assumed, depends on the web and flange dimensions, the type of loading, span, the support conditions and the transverse reinforcement.

Clause 7.4 – Deflection control
The deformation of a member on a structure shall not be such that it adversely affects its proper functioning or appearance

Clause 9.2.2 Shear reinforcement
The shear reinforcement may consist of a combination of links enclosing the longitudinal tension reinforcement and the compression zone, and bent-up bars. (1) The shear reinforcement should form an angle α of between 45_0 and 90_0 to the longitudinal axis of the structural element. (2) The shear reinforcement consists of a combination of. -links enclosing the longitudinal tension reinforcement and the compression zone bent-up bars - cage, ladders, etc. which are cast in without enclosing the longitudinal reinforcement but are properly anchored in the compression and tension zones.

Clause 9.2.3 Torsion reinforcement
The torsion links should be closed and anchored by mean of laps or hooked ends, and should form an angle of 90_0 with the axis of the structural element.

Clause 9.2.4 Surface reinforcement
It may be necessary to provide reinforcement either to control cracking to ensure adequate resistance to spalling of the cover.

5. CONCLUSION

In this investigation we made essential correlation of IS 456-2000 and Eurocode 2.0 for R.C.C. shaft. Here we made some end.

- For the plan of most fortified solid structures it is regular to initiate the plan for the conditions at a definitive breaking point state, which is then follow by checks to guarantee that the structure is satisfactory for as far as possible state without extreme diversion or splitting of the solid.
- After creation the structure computation for bar, in view of this examination, it was reasoned that the IS 456 and Eurocode 2 are for the most part identical and the contrasts between the codes are about negligible, in spite of the fact that the Eurocode 2 is marginally more preservationist than the IS 456:2000.

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