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Design of RCC Beam By using C Programming

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Abstract - *Beam design is done mainly by manual method or using design and analysis software. In this article, a C coding has been done for the design of a simply supported reinforced concrete beam. To design beam limit state method adopted. Computer is very useful in the engineering works. The solution could be an appropriate use of computer programming. The programming helps to solve various civil engineering difficulties. Indian standard design procedure has been followed, and the clauses in the IS 456:2000, has been followed during the coding. This coding has done to reduce the calculation time in the manual calculations, to obtain the accuracy in the result calculations. All the dimensions are to be submitted in millimeters only.*

Key Words: **Simply supported beam, Limit state method, C language, IS 456:2000.**

1. INTRODUCTION

Computers are a vital part of the civil engineering industry. It is used to do work in an appropriate manner. A knowledge of programming is always useful for us. Also Civil engineers are required to develop software like as AutoCAD, STAAD.Pro, SAP2000, ETABS, PrimaVera, but CS engineers do not possess the requisite domain knowledge. That's why according to our civil requisite we are doing this project.

Languages such as Python, C , C++ or MATLAB (one of them is enough, no need to learn all) are useful for Civil engineers in automating tasks related to analysis and design of structures or other problems involving maths. C/C++ is more difficult to use due to complex syntax. The advantage of use of C/C++ is that this programming language is more compact and has a faster runtime speed.So in this project we will design RCC Beam by using c language.

In the method of design based on limit state concept, the structure shall be designed to withstand safely all loads liable to act on it throughout its life; it shall also satisfy the serviceability requirements, such as limitations on deflection and cracking. The acceptable limit for the safety and serviceability requirements before failure occurs is called a limit state.

Beam is a horizontal structural member which is used to carry vertical load ,shear load and sometime horizontal load. It is major component of building structures. We have developed program for simply supported beam condition. The two types of simply supported beam are below.

Singly Reinforced Beam

Consider a rectangular section of a reinforced concrete member of width b and total depth D reinforced with total area of reinforcement Ast only on tension side. Such a section is often called a singly reinforced section.The depth d of centroid of the tension reinforcement Ast below the compression face is called as effective depth of the section.

Doubly Reinforced Beam

Sometimes the size of RCC beam has to be restricted due to design considerations, but the same section is required to resist the moment greater than that of balanced section. By adding steel on the both zone of the tension and compression we obtain additional moment of resistance. Thus, to increase the strength moment of a beam with limited dimensions, a doubly reinforced beam is provided. This type of beam will be considered necessary when, sectional dimensions are restricted due to requirements of headroom, appearance, etc. and the strength of given singly reinforced section is inadequate.

2. METHODOLOGY

This project is to develop a C program for design of RCC beam. In that the major part of this project is based on C language. To develop this program " Turbo C " Software is essential. Important knowledge for this project that is divided into four parts: (1) Literature Review (2) Study of C language (3) Theory of Design of Reinforced concrete beam and (4) Develop a program.

The literature review is a search for keywords about research in applied computer language for civil engineering such C/C++, computer program.One of the literature reviews is developing program for Analysis of

standard beam conditions by C programming. Whereas, someone did Analysis by STAAD-PRO and Design of Structural Elements by MATLAB. But in this project we will design RCC beam by developing C Program.

In this project, We refer to IS - 456:2000 standard. Besides, we learn about the fundamentals of C language to be used to develop the program.

3. DESIGN CONSIDERATIONS

There are some certain steps and procedures to be followed to design the beam.

a) For singly reinforced beam

1) Calculation of depth

Required depth (dreq)= √Mu/Rumax*b
OverallRequireddepth (Dreq)= dreq+dia/2+clear cover
Provided depth (dprov)= D-dia/2-clear cover.

2) Calculation of Ast

Ast=0.5*fck/fy(1-√1-(4.6*Mu/fck*b*dprov))*b*dprov
Number of bars = Ast/π/4*dia^2

3) Calculation of Shear Reinforcement

Nominal shear stress i.e. Tv is calculated by IS 456:2000(Clause no.40.1)
Ptlim= Ast/b*1/dprov*100
Design shear strength of concrete i.e. Tc is calculated from Table no.19 in IS 456:2000.
Tcmax has taken from Table no.20 in IS 456:2000.
Comparing Shear stresses -
Tv<Tv/2 - No need of shear reinforcement
Tv<Tc - Nominal shear reinforcement is required
Tcmax>Tv>Tv - Shear reinforcement is required
Calculation of spacing in shear reinforcement
Minimum of -
Sv1= 0.75*dprov
Sv2= Sv2=0.87*fy*Asv*1/0.4*1/b
Sv3=300

b) For Doubly reinforced beam

1) Calculation of Mulim

For Fe250 - Mulim=0.149*fck*b*dprov*dprov
For Fe415 - Mulim= 0.138*fck*b*dprov*dprov
For Fe500 - Mulim=0.133*fck*b*dprov*dprov

2) Check for Singly or Doubly reinforced section

If Mulim is less than Mugiven then it is Doubly reinforced section. And if Mulim is greater than Mugiven then it is Singly reinforced section.

3) Calculation of Ast

Ast1 is calculated by following formula
Mulim = 0.87*fy*Ast1*(dprov-0.42*xumax)
Ast2 is calculated by, Mu1= Mugiven- Mulim
Mu1= 0.87*fy*Ast2*(dprov- cc- dia/2)
Now, Ast= Ast1+Ast2

4) Calculation of Asc

Asc is calculated by following formula
Mu1= fsc*Asc*(dprov- cc- dia/2)

5) Calculation of shear reinforcement

Nominal shear stress i.e. Tv is calculated by IS 456:2000(Clause no.40.1)
Ptlim= Ast/b*1/dprov*100
Design shear strength of concrete i.e. Tc is calculated from Table no.19 in IS 456:2000.
Tcmax has taken from Table no.20 in IS 456:2000.
Comparing Shear stresses -
Tv<Tv/2 - No need of shear reinforcement.
Tv<Tc - Nominal shear reinforcement is required.
Tcmax>Tv>Tv - Shear reinforcement is required.

6) Calculation of spacing in shear reinforcement

Minimum of -
Sv1= 0.75*dprov
Sv2= 0.87*fy*Asv*1/0.4*1/b
Sv3=300

Results

```
Enter value of width of beam = 300

Enter value of overall depth of beam = 300

Enter value of clear cover = 20

Assume diameter of bar =16

Enter value of ultimate moment =87000000

Enter value of shear force =60000

Effective depth = 272.00
Select grade of concrete
1.M20
2.M25
3.M30
Select option =1

Select grade of steel
1.Fe250
2.Fe415
3.Fe500
Select option =2
```

Fig 1. Input

```
It is Doubly Reinforced Section
Ast1 = 781.29
Ast2 = 292.19
Area of steel= 1073.48
Area of steel in compression= 299.71
Number of Bar = 6.00
Number of Bar = 2.00
Tv =0.735294
ptlim=1.315543
Tc= 0.710487
Shear reinforcement is required
Provide 6mm diameter 2 legged vertical stirrups
Spacing for vertical stirrups=169.212112
```

Fig 2. Output

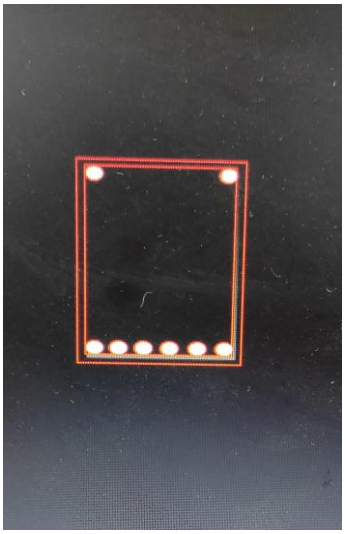

Fig 3.Layout of bars

4) CONCLUSIONS

C programming helps to reduce lengthy calculations. Results obtained very accurately with minimum time by using C programming. The program run successfully with reasonable speed and accuracy, thus achieving the basic aim of carrying out this work. New software can be invented by users according to our requisit. The programming environment selected in the project work, is found quite user friendly due to manual errors are avoided.

5) ACKNOWLEDGEMENT

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BIOGRAPHIES

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