Paper RCD

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Q.NO 3

ANS. Mechanics of Rcc Beam

1. Mechanics is both quantitative and qualitative.
2. Qualitative mechanics deals with the nature of the effect stress
3. Quantitative mechanics deals with the formulation obtained using the established laws for instance equilibrium
4. The formulation of design equations for axial, flexure, shear and torsional stresses is based on the mechanics of reinforced concrete and will be taught in these respective topics.

Q.NO2

ANS. **Given data**

$\mathbf{Fc}'$=3ksi

Fy =40 ksi

Dimension

B=12"

D=20"

Soluation

Step no 1 calculation of factor $M_{n\ max}$

P_{mzx} single=0.0203

A_{smax} single=p_{max} bd= 4.87in^2

Factor M_{max} single =2.948.88in-kip

Step no 2

Moment to be carried by compression steel

M_u extra = m_u –factor M

3500-2948.88=551.12IN-KIP

STEP NO 3

Find Er ′and fs′

D=20≥12.3”,and for d=2.5”

D’/d is o.125≤0.20 for grade 40 steel so compression steel will yield stress in compression steel f’s =fy Alternatively

E s’=(0.003-0.008d’/d)

Es ‘=(0.003-0.008x2.5/20=0.002 greater than Ey 40/2900=0.00137

A_s Es’ is greater then Ey’ so the compression steel will yield

Step no 4

Calculation of As’ and Ast

As’=M_u extra (factor Fs’(d-d))=55.12(0.90x40x(20-2.5)=2.46in^2

Total amount of tension reinforcement (Ast) is

Ast =As(max)single+As’=4.87+2.46=7.33in^2

Using #8 bar with bar area As=0.79in^2

No of bar to be provded on tension side

Ast/Ab=7.33/0.79=9.28

No of bar to be provided on compression side

Ast/Ab=2.46/0.79=3.11

Provid 10#8(7.9in^2 in 3 layer on tension side

4#8(3.16in^2 in 1 layer on compression side

Step no 5

Ensure that d’/d greater o.2 for grade 40 so that section of bar does not creat compressive strees lower then yield

With to side reinforcement of 4#8 bar in single layer d=19.625 and 2.375

D’/d 2.375/19.625=0.12 greater o.2 ok

Step no 6

Ductility requriment ; Asy ≤Asmax

As which is total steel area actually provided as tension reinforcement must be less than Astmax

Astmax=Asmax single xAs f’s /f’y

Astmax single is fixed number for   the case under consideration and As’ is steel area actually placed on compression side

Asmax single =4.87in^2; As’=4x0.79=3.16in^2

Ast=7.9in^2

Ast 7.9 in^2 less than As max ok

Step no 7

Q.No 1

Solution

Bmax =L/16=30x12/16=22.5” say 24

Let b =h/2=24/2=12”

D=effective depth

D =h-c.c = factor, d l/2 factor main steel

D =24-1.5-3/8-1/2(1) = 21.5”

Beam self load =300lb/ft

Pu=1.2(D.L)+1.6(L.L)

  =1.2(1000+300)+(1.6(1100) =3320lb/ft

M =wl^2/8=3320(30)^2/8= 373500 lb-ft

M $_u$=448200 lb-in=4482 k-in

Trail no 1

As=M$_u$/0.9xfy(d-a/2)

A= Asfy/0.85fc’b

Amax

A=0.2d

A=(o.2)(21.5)=4.3” say 5”

As=4482/0.9x60(21.5-5/2) =4.36in square

No of bars= total area of steel /area of bar

=4.57in/π/4$(5/8)^2$

No bar= 15 bars

For 5#bar =4.57/π/4$(8/8)^2$

For bar 5#bars=6 bar

Ductility check

Formula As/bd

4.57/12x21.5=0.017

Smix =200/fy =200/6000=0.003 ok

Smix =0.85xfc’/fy (es/es+o.oo4)

Smix= 0.85x(4/60) (0.85)(0.003/0.003004=0.02

Omega reuried=0.017

Omega max=0.003

Omega min=0.02

Omega min greater omega req greater omega mix

0.02 greater 0.017 greater 0.003