#Roshan Chawan 22CV013

# To find the ultimate moment carring capacity of singly r/f beam

fck = float(input("Enter the value of charateristics compressive strength:"))

fy= float(input("Enter the grade of steel:"))

Es = float(input("Enter the value of Modulus of Elasticity of steel:"))

b= float(input("Enter the value of Width: "))

d= float(input("Enter the value of effective depth:"))

d1 = float(input("Enter the value of bar diameter (d1):"))

d2 = float(input("Enter the value of bar diameter (d2):"))

n=int(input("Enter the number of bars"))

Ast1= (n\*0.7854\*d1\*d1)

Ast2= (n\*0.7854\*d2\*d2)

print("The value of area of steel (Ast1):", Ast1)

print("The vaiue of area of steel (Ast2):", Ast2)

# Total area of steel

Ast = Ast1 + Ast2

print ("The value of area of steel (Ast):", Ast)

# Neutral Axis Factor

ku = 0.0035/(0.0055 + (fy/(1.15\*Es)))

print ("The value of Neutral axis factor (ku):", ku)

# Momenent of Resistance factor

Ru= 0.36\*fck\*ku\*(1-(0.42\*ku))

print("The value of Moment of Resistance factor (Ru):", Ru)

# Maximum Neutral Axis:

xumax = ku\*d

print("The value of maximum neutral axis (xumax):", xumax)

xu = (0.87 \*fy\*Ast)/(0.36\*fck\*b)

print ("The value of Actual Neutral Axis (xu):", xu)

if xumax>xu:

    print("UNDER REINFORCED")

else:

    print("OVER REINFORCED")

# By Comparing

X = float(input("Enter the value of Neutral Axis:"))

# Moment of Resistance

Mu = 0.36\*fck\*X\*b\*(d-(0.42 \*X)) \* 10\*\*-6

print("The value of Moment of Resistance is:", Mu)

Output:-

Enter the value of charateristics compressive strength:20

Enter the grade of steel:415

Enter the value of Modulus of Elasticity of steel:200000

Enter the value of Width: 230

Enter the value of effective depth:400

Enter the value of bar diameter (d1):20

Enter the value of bar diameter (d2):16

Enter the number of bars2

The value of area of steel (Ast1): 628.32

The vaiue of area of steel (Ast2): 402.1248

The value of area of steel (Ast): 1030.4448

The value of Neutral axis factor (ku): 0.4791666666666667

The value of Moment of Resistance factor (Ru): 2.7556874999999996

The value of maximum neutral axis (xumax): 191.66666666666669

The value of Actual Neutral Axis (xu): 224.66310086956523

OVER REINFORCED

Enter the value of Neutral Axis:191.666

The value of Moment of Resistance is: 101.40903614369086

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# Design of Slab

# Input Data

span = float(input("Enter the value of effective span in meters: "))

b = float(input("Enter the value of width of slab in mm: "))

bs = float(input("Enter the value of Support Width in meters: "))

fck = float(input("Enter the value of Characteristic Compressive Strength (fck): "))

fy = float(input("Enter the value of Grade of Steel (fy): "))

Es = float(input("Enter the value of Modulus of Elasticity (Es): "))

LL = float(input("Enter the value of Live Load (LL) in kN/m²: "))

FF = float(input("Enter the value of Floor Finish in kN/m²: "))

Density = float(input("Enter the value of Density of RCC in kN/m³: "))

# Design Constants

ku = 0.0035 / ((0.0055) + (fy / (1.15 \* Es)))

print("The value of Neutral Axis Factor (ku) is:", ku)

Ru = 0.36 \* fck \* ku \* (1 - (0.42 \* ku))

print("The value of Moment Resistance factor (Ru) is:", Ru)

# Assuming pt = 0.5%

fs = float(input("Enter the value of Steel Stress under Service Load (fs): "))

MF = float(input("Enter the value of Modification Factor (MF): "))

S = float(input("Enter the value of span/depth ratio (S): "))

# Correction Factors

k1 = float(input("Enter the value of Correction factor if span > 10m (k1): "))

k2 = float(input("Enter the value of Tension reinforcement correction factor (k2): "))

k3 = float(input("Enter the value of Compression reinforcement correction factor (k3): "))

k4 = float(input("Enter the value of correction factor in case of flanged section (k4): "))

# Effective Depth as per Deflection Criteria

d1 = (span \* 1000) / (S \* MF \* k1 \* k2 \* k3 \* k4)

print("Effective depth as per deflection criteria (d1):", d1)

# Provided Effective Depth and Overall Depth

d = float(input("Enter the value of Effective depth (d) in mm: "))

D = float(input("Enter the value of Overall depth (D) in mm: "))

# Load Calculations

DL = D \* Density / 1000  # Self-weight of slab

print("The Dead Load (DL) is:", DL)

Factor = float(input("Enter the value of partial Safety Factor: "))

TL = DL + LL + FF

print("The Total Load (TL) is:", TL)

Wu = Factor \* TL

print("Factored Load (Wu) is:", Wu)

# Bending Moment

Mu = Wu \* span \* span / 8

print("Bending Moment (Mu) is:", Mu)

# Check Effective Depth from Moment

d2 = (Mu \* 1000000 / (Ru \* b)) \*\* 0.5

print("Effective depth required as per Moment (d2):", d2)

if d2 > d:

    print("Revise the Depth: NOT SAFE")

else:

    print("SAFE")

# Minimum Steel Area

Astmin = 0.12 \* b \* D / 100

print("Minimum Steel Area (Astmin):", Astmin)

# Main Steel Calculation

Ast = ((0.5 \* fck \* b \* d) / fy) \* (1 - ((1 - (4.6 \* Mu \* 1000000) / (fck \* b \* d \* d)) \*\* 0.5))

print("Required Steel Area (Ast):", Ast)

if Ast < Astmin:

    print("Take Ast = Astmin")

    Ast = Astmin

else:

    print("Ast > Astmin, Hence SAFE")

# Bar Details

dia1 = float(input("Enter the bar diameter for main steel in mm: "))

dia2 = float(input("Enter the bar diameter for distribution steel in mm: "))

# Area of Bars

ao1 = 0.7854 \* dia1 \* dia1

print("Area of one main steel bar (ao1):", ao1)

ao2 = 0.7854 \* dia2 \* dia2

print("Area of one distribution steel bar (ao2):", ao2)

# Spacing Calculations

Spacing1 = ao1 \* b / Ast

print("Spacing for main steel bars:", Spacing1)

Spacing2 = ao2 \* b / Astmin

print("Spacing for distribution steel bars:", Spacing2)

# Checks for Main Steel Spacing

print("Check 1 for Main Steel:")

if Spacing1 > 300:

    print("UNSAFE")

else:

    print("SAFE")

print("Check 2 for Main Steel:")

if Spacing1 > d:

    print("UNSAFE")

else:

    print("SAFE")

# Checks for Distribution Steel Spacing

print("Check 1 for Distribution Steel:")

if Spacing2 > 300:

    print("UNSAFE")

else:

    print("SAFE")

print("Check 2 for Distribution Steel:")

if Spacing2 > 5 \* d:

    print("UNSAFE")

else:

    print("SAFE")

# Provided Steel Area

S1 = float(input("Enter the spacing for main bars (S1) in mm: "))

S2 = float(input("Enter the spacing for distribution bars (S2) in mm: "))

Astprovided = ao1 \* b / S1

print("Provided steel area for main bars (Astprovided):", Astprovided)

Astprodist = ao2 \* b / S2

print("Provided steel area for distribution bars (Astprodist):", Astprodist)

# Shear Check

Vu = (Wu \* span / 2) - (Wu \* ((bs / 2) - (d / 1000)))

print("Shear Force (Vu) at section:", Vu)

SStress = (Vu \* 1000) / (b \* d)

print("Shear Stress at section (SStress):", SStress)

SStressmax = float(input("Enter the maximum Shear Stress from code (SStressmax): "))

if SStress > SStressmax:

    print("Crushing will happen")

else:

    print("SAFE")

# Percentage Steel

pt = (100 \* Ast) / (b \* d)

print("Percentage of steel (pt):", pt)

# Design Shear Strength

SS = float(input("Enter the design shear stress (SS) from table: "))

k = float(input("Enter the value of depth factor (k): "))

Shear = k \* SS

print("Permissible Shear Strength (Shear):", Shear)

if SStress > Shear:

    print("Shear Reinforcement Required")

else:

    print("Shear Reinforcement not Required, SAFE")

# Deflection Check

ActDEF = span \* 1000 / d

print("Actual span/depth (span/d):", ActDEF)

MaxDEF = S \* MF \* k1 \* k2 \* k3 \* k4

print("Permissible span/depth (MaxDEF):", MaxDEF)

if MaxDEF > ActDEF:

      print("SAFE")

else:

    print("UNSAFE")

# Anchorage Length Check

M1 = 0.87 \* fy \* Ast \* (d - ((fy \* Ast) / (fck \* b)))

print("Moment for Anchorage (M1):", M1)

lo = 8 \* dia1

La = 1.3 \* (M1 / Vu) + 10

print("Required Anchorage Length (La):", La)

# Development Length

bondS = float(input("Enter the Bond Stress: "))

Ld = (0.87 \* fy \* dia1) / (4 \* bondS \* 1.6)

print("Development Length (Ld):", Ld)

if La > Ld:

    print("SAFE")

else:

    print("Increase Anchorage Length")

Output:-

Enter the value of effective span in meters: 3

Enter the value of width of slab in mm: 1000

Enter the value of Support Width in meters: 0.23

Enter the value of Characteristic Compressive Strength (fck): 20

Enter the value of Grade of Steel (fy): 415

Enter the value of Modulus of Elasticity (Es): 200000

Enter the value of Live Load (LL) in kN/m²: 4

Enter the value of Floor Finish in kN/m²: 1.8

Enter the value of Density of RCC in kN/m³: 25

The value of Neutral Axis Factor (ku) is: 0.4791666666666667

The value of Moment Resistance factor (Ru) is: 2.7556874999999996

Enter the value of Steel Stress under Service Load (fs): 240

Enter the value of Modification Factor (MF): 1.2

Enter the value of span/depth ratio (S): 20

Enter the value of Correction factor if span > 10m (k1): 1

Enter the value of Tension reinforcement correction factor (k2): 1

Enter the value of Compression reinforcement correction factor (k3): 1

Enter the value of correction factor in case of flanged section (k4): 1

Effective depth as per deflection criteria (d1): 125.0

Enter the value of Effective depth (d) in mm: 130

Enter the value of Overall depth (D) in mm: 150

The Dead Load (DL) is: 3.75

Enter the value of partial Safety Factor: 1.5

The Total Load (TL) is: 9.55

Factored Load (Wu) is: 14.325000000000001

Bending Moment (Mu) is: 16.115625

Effective depth required as per Moment (d2): 76.473082008588

SAFE

Minimum Steel Area (Astmin): 180.0

Required Steel Area (Ast): 364.7577413804497

Ast > Astmin, Hence SAFE

Enter the bar diameter for main steel in mm: 10

Enter the bar diameter for distribution steel in mm: 8

Area of one main steel bar (ao1): 78.54

Area of one distribution steel bar (ao2): 50.2656

Spacing for main steel bars: 215.32099552640113

Spacing for distribution steel bars: 279.25333333333333

Check 1 for Main Steel:

SAFE

Check 2 for Main Steel:

UNSAFE

Check 1 for Distribution Steel:

SAFE

Check 2 for Distribution Steel:

SAFE

Enter the spacing for main bars (S1) in mm: 210

Enter the spacing for distribution bars (S2) in mm: 270

Provided steel area for main bars (Astprovided): 374.0

Provided steel area for distribution bars (Astprodist): 186.1688888888889

Shear Force (Vu) at section: 21.702375

Shear Stress at section (SStress): 0.16694134615384615

Enter the maximum Shear Stress from code (SStressmax): 3.8

SAFE

Percentage of steel (pt): 0.28058287798496134

Enter the design shear stress (SS) from table: 0.378

Enter the value of depth factor (k): 1.3

Permissible Shear Strength (Shear): 0.4914

Shear Reinforcement not Required, SAFE

Actual span/depth (span/d): 23.076923076923077

Permissible span/depth (MaxDEF): 24.0

SAFE

Moment for Anchorage (M1): 16123682.812500006

Required Anchorage Length (La): 965839.2079207924

Enter the Bond Stress: 1.2

Development Length (Ld): 470.1171875

SAFE