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#Q1:
# 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 value 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)
# Mom-nent 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)
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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 value 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): 2.7556871999999996
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:191.666667
The value of Moment of Resistance is: 101409300131927.98
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#Q2:
# Design of Slab
# Given Data
# Effective span is already given in question
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("Entert the value of Support Width in meters:"))
fck = float(input(" Enter the value of Characteristics Compressive Strength:"))
fy = float(input("Enter the value of grade of steel:"))
Es = float(input("Enter the value of Modulus of Elasticity is:"))
LL = float(input("Enter the value of Live Load:"))
FF = float(input("Enter the value of Floor Finish:"))
Density = float(input("Enter the value of Density of RCC:"))
# Design Constants
# Neutral Axis Factor
ku = 0.0035 / ((0.0055) + (fy / (1.15 * Es)))
print("The value of Neutral Axis Factor (ku) is:", ku)
# Moment of Resistance Facor
Ru= 0.36*fck*ku*(1-(0.42*ku))
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print("Check 2 for Distribution steel")
if Spacing1> 5*d:
    print("UNSAFE")
else:
    print("SAFE")
print ("'Approximated values of Sapcing:")
S1=float(input("Enter the value of spacing of main bars:"))
S2=float(input("Enter the value of spacing of distribution bars:"))
Astprovided=ao1*b/S1
print("The provided steel area for main bars at section in mm^2 is:", Astprovided)
Astprodist=ao2*b/S2
print("The provided steel area for distribution bars at section in mm^2 is: ", Astprodist
# Check for Shear
Vu = (Wu*span/2)-(Wu*((bs/2)-(d/1000)))
print("The value of SF at a Section is:", Vu)
SStress = (Vu*1000)/(b*d)
print("The value of shear stress is:", SStress)
# From table 20 IS 456:2007 page 73
SStressmax = float(input("Enter the value of maximum Shear stress:"))
if SStress>SStressmax:
    print("Crushing will happen")
else:
    print("SAFE")
#Percentage Steel
pt =(100*Ast)/(b *d)*120
print("Enter the value of percentage steel is:", pt)
# From table 19 IS 456:2007 page 73
SS= float(input("Enter the value of Shear Stress is:"))
k= float(input("Enter the value of depth factor:"))
Shear=k*SS
print("The value of shear at section is", Shear)
if SStress>Shear:
    print("Shear Reinforcement Required")
else:
    print("Shear Reinforcement not Required, SAFE")
# Check for Deflection
ActDEF = span*1000/d
print("The value od span/d is:", ActDEF)
# Actual Deflection
MaxDEF = S*MF*k1*k2*k3*k4
print("The permissible deflection is:", MaxDEF)
if MaxDEF>S/d:
    print("SAFE")
else:
    print("UNSAFE")
# Check for Anchorage Length
M1 = 0.87*fy*Ast*(d*((fy*Ast)/(fck*b)))
print("The value of Moment (M1)", M1)
lo = 8*dia1
La = 1.3*(M1/Vu)+10
print("The value of Anchorage length is:", La)
# Development Length
bonds = float(input("Enter the value of Bond Stress:"))
Ld = 0.87*fy*dia1/4*bonds*1.6
print("The value of Development length is:", Ld)
if La>Ld:
    print("SAFE")
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Enter the value of effective span in meters:3
Enter the value of width of slab in mm:1000
Entert the value of Support Width in meters:0.23
Enter the value of Characteristics Compressive Strength:20
Enter the value of grade of steel:415
Enter the value of Modulus of Elasticity is:200000
Enter the value of Live Load:4
Enter the value of Floor Finish:1.8
Enter the value of Density of RCC:25
The value of Neutral Axis Factor (ku) is: 0.4791666666666667
The value of Moment Resisteance factor (Ru) is: 2.7556874999999996
Ent er the value of Steel Stress of Service:240
Enter the value of Modification Factor:1.2
Enter the value of span/d ratio:20
Enter the value of Correction factor if sapn> 10m (k1):1
Enter the value of Tension r/f correction factor (k2):1
Enter the value of Compression r/f correction factor (k3):1
Enter the value of correction factor in case of flanged section (k4):1
The value of effective depth as per deflection criteria is: 125.0
Enter the value of Effective depth in mm (d):130
Enter the value of Overall depth in mm (D):150
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print("The value of Moment Resisteance factor (Ru) is:", Ru)
# Assurming pt 0.5 from fig.4 from IS 456:2007 page no.38
fs=float(input("Ent er the value of Steel Stress of Service:"))
# From Graph find out the Modification Factor
MF=float(input("Enter the value of Modification Factor:"))
#From Clause 23.2.1 Select span/d Ratio
S= float(input("Enter the value of span/d ratio:"))
26 # Correction Factors
k1=float(input("Enter the value of Correction factor if sapn> 10m (k1):"))
k2= float(input(" Enter the value of Tension r/f correction factor (k2):"))
k3= float(input("enter the value of Compression r/f correction factor (k3):"))
k4= float(input(" Enter the value of correction factor in case of flanged section (k4):")
# Effective depth
d1= (span*1000)/(S*MF*k1*k2*k3*k4)
print("The value of effective depth as per deflection criteria is:", d1)
# Define Effective depth and overall depth Assuming value of cover
d = float(input("Enter the value of Effective depth in mm (d):"))
D= float(input("Enter the value of Overall depth in mm (D):"))
# Load Calculations
# Self Weight of slab
DL = D*Density/1000
print("The Dead load is:", DL)
# Total Load is
Factor=float(input("Enter the value of partial Safety Factor is: "))
TL = DL + LL + FF
print("The value of total load is:", TL)
Wu=Factor*TL
print("Wu=", Wu)
# Bendingf Moment Calculations (Mu)
Mu= Wu*span*span/8
print("The Value of Bending Moment (Mu) is:", Mu)
# Check for effective depth
d2= (Mu*1000000/(Ru*b))**0.5
print("The value of Effective depth as per Mornent criteria", d2)
if d2>d:
    print("Revise the Depth:")
else:
    print("SAFE")
d = float(input ("Enter the value of Effective depth in mm (d):"))
print("Minimum Steel Calculations")
Astmin = 0.12*b*D/100
print("The value of Minimum steel is:", Astmin)
print("Main Steel calculations")
Ast=((0.5*fck*b*d)/(fy))*(1-((1-((4.6*Mu*1000000)/(fck*b*d*d)))*0.5))
print("Ast:", Ast)
print("Check for Ast")
if Ast<Astmin:
    print("Take Ast=Astmin")
else:
    print("Ast>Astmin, Hence-SAFE")
dia1 = float(input("Enter the value of bar diameter for main steel:"))
dia2 = float(input(" Enter the value of bar diameter for Distribution steel:"))
#Area of bar
ao1 = 0.7854* dia1* dia1
print("The Value of Area of main steel bar (ao1):", ao1)
ao2= 0.7854* dia2*dia2
print("The Value of Area of main steel bar (ao2):", ao2)
# Sapcing Calculations
Spacing1 = ao1*b/Ast
print("The sapcing for main steel bars is;", Spacing1)
Spacing2 = ao2*b/Astmin
print("The sapcing for distribution steel bars is;", Spacing2)
print("Check 1 for main steel")
if Spacing1>300:
    print("UNSAFE")
else:
    print("SAFE")
print("Check 2 for main steel")
if Spacing1>3*d:
    print("UNSAFE")
else:
    print("SAFE")
print("Check 1 fon Distribution steel")
if Spacing1>300:
    print("UNSAFE")
else:
    print("SAFE")
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The Dead load is: 3.75
Enter the value of partial Safety Factor is: 1.5
The value of total load is: 9.55
Wu= 14.325000000000001
The Value of Bending Moment (Mu) is: 16.115625
The value of Effective depth as per Moment criteria: 24.182911883998223
SAFE
Enter the value of Effective depth in mm (d):130
Minimum Steel Calculations
The value of Minimum steel is: 180.0
Main Steel calculations
Ast: 1909.7862604263207
Check for Ast
Ast>Astmin, Hence SAFE
Enter the value of bar diameter for main steel:10
 Enter the value of bar diameter for Distribution steel:8
The Value of Area of main steel bar (ao1): 78.54
The Value of Area of main steel bar (ao2): 50.2656
The sapcing for main steel bars is; 41.12502096567998
The sapcing for distribution steel bars is; 279.25333333333333
Check 1 for main steel
SAFE
Check 2 for main steel
SAFE
Check 1 fon Distribution steel
SAFE
Check 2 for Distribution steel
SAFE
Approximated values of Sapcing:
Enter the value of spacing of main bars:210
Enter the value of spacing of distribution bars:270
The provided steel area for main bars at section in mm^2 is: 374.0
The provided steel area for distribution bars at section in mm^2 is:  186.1688888888889
The value of SF at a Section is: 21.702375
The value of shear stress is: 0.16694134615384615
Enter the value of maximum Shear stress:2.8
SAFE
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