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#Question:1
# Inputs
fck = float(input("Enter the value of characteristic compressive strength (MPa): ")
fy = float(input("Enter the grade of steel (MPa): "))
Es = float(input("Enter the value of Modulus of Elasticity of steel (MPa): "))
b = float(input("Enter the value of Width (mm): "))
d = float(input("Enter the value of effective depth (mm): "))
d1 = float(input("Enter the value of bar diameter (d1) (mm): "))
d2 = float(input("Enter the value of bar diameter (d2) (mm): "))
n = int(input("Enter the number of bars: "))

# Area of steel calculations
Ast1 = n * (0.7854 * (d1 ** 2))
Ast2 = n * (0.7854 * (d2 ** 2))
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)

# Moment 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)

# Actual Neutral Axis
xu = (0.87 * fy * Ast) / (0.36 * fck * b)
print("The value of Actual Neutral Axis (xu):", xu)

# Reinforcement check
if xumax > xu:
    print("UNDER REINFORCED")
else:
    print("OVER REINFORCED")

# By Comparing
x = float(input("Enter the value of Neutral Axis (mm): "))

# Moment of Resistance
Mu = 0.36 * fck *x* b * (d - (0.42 * x))*10 ** -6  # Ensure to multiply by 10^-6
print("The value of Moment of Resistance is:", Mu)
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Enter the value of characteristic compressive strength (MPa): 20
Enter the grade of steel (MPa): 415
Enter the value of Modulus of Elasticity of steel (MPa): 200000
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Enter the value of Width (mm): 230
Enter the value of effective depth (mm): 400
Enter the value of bar diameter (d1) (mm): 20
Enter the value of bar diameter (d2) (mm): 16
Enter the number of bars: 2
The value of area of steel (Ast1): 628.3199999999999
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): 2.7556874999999996
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 (mm): 191.666667
The value of Moment of Resistance is: 101.40930013192798
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#Question:2
# 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("Enter the value of Support Width in meters: "))
fck = float(input("Enter the value of Characteristics Compressive Strength (MPa): "
fy = float(input("Enter the value of grade of steel (MPa): "))
Es = float(input("Enter the value of Modulus of Elasticity (MPa): "))
LL = float(input("Enter the value of Live Load (kN/m²): "))
FF = float(input("Enter the value of Floor Finish (kN/m²): "))
Density = float(input("Enter the value of Density of RCC (kN/m³): "))

# 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 Factor
Ru = 0.36 * fck * ku * (1 - (0.42 * ku))
print("The value of Moment Resistance factor (Ru) is:", Ru)

# Assuming pt from fig.4 from IS 456:2007 page no.38
fs = float(input("Enter the value of Steel Stress of Service (MPa): "))

# 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: "))

# Correction Factors
k1 = float(input("Enter the value of Correction factor if span > 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 (

# Effective depth
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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  # Dead Load in kN/m²
print("The Dead load is:", DL)

# Total Load
Factor = float(input("Enter the value of partial Safety Factor: "))
TL = DL + LL + FF
print("The value of total load is:", TL)

Wu = Factor * TL
print("Wu =", Wu)

# Bending 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  # Convert Mu to N.mm
print("The value of Effective depth as per Moment criteria:", d2)

if d2 > d:
    print("Revise the Depth:")
else:
    print("SAFE")

# 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 *
print("Ast:", Ast)

# 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 (mm): "))
dia2 = float(input("Enter the value of bar diameter for Distribution steel (mm): ")

# Area of bar
Aol = 0.7854 * dia1 ** 2
print("The Value of Area of main steel bar (Aol):", Aol)

A02 = 0.7854 * dia2 ** 2
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print("The Value of Area of distribution steel bar (A02):", A02)

# Spacing Calculations
Spacing1 = Aol * b / Ast
print("The spacing for main steel bars is:", Spacing1)

Spacing2 = A02 * b / Astmin
print("The spacing for distribution steel bars is:", Spacing2)

# Check 1 for main steel
print("Check 1 for main steel")
if Spacing1 > 300:
    print("UNSAFE")
else:
    print("SAFE")

# Check 2 for main steel
print("Check 2 for main steel")
if Spacing1 > d:
    print("UNSAFE")
else:
    print("SAFE")

# Check 1 for Distribution steel
print("Check 1 for Distribution steel")
if Spacing2 > 300:
    print("UNSAFE")
else:
    print("SAFE")

# Check 2 for Distribution steel
print("Check 2 for Distribution steel")
if Spacing2 > 5 * d:
    print("UNSAFE")
else:
    print("SAFE")

# Approximated values of Spacing
S1 = float(input("Enter the value of spacing of main bars (mm): "))
S2 = float(input("Enter the value of spacing of distribution bars (mm): "))

Astprovided = Aol * b / S1
print("The provided steel area for main bars at section in mm² is:", Astprovided)

Astprodist = A02 * b / S2
print("The provided steel area for distribution bars at section in mm² is:", Astpro

# 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)  # Convert Vu to N
print("The value of shear stress is:", SStress)

# From table 20 IS 456:2007 page 73
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SStressmax = float(input("Enter the value of maximum Shear stress (MPa): "))
if SStress > SStressmax:
    print("Crushing will happen")
else:
    print("SAFE")

# Percentage Steel
pt = (100 * Ast) / (b * d)
print("The value of percentage steel is:", pt)

# From table 19 IS 456:2007 page 73
SS = float(input("Enter the value of Shear Stress (MPa): "))

# Depth factor
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 of span/d is:", ActDEF)

# Actual Deflection
MaxDEF = S * MF * k1 * k2 * k3 * k4
print("The permissible deflection is:", MaxDEF)

if MaxDEF > S:
    print("UNSAFE")
else:
    print("SAFE")

# 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 (MPa): "))
Ld = 0.87 * fy * dia1 / (4 * bondS * 1.6)
print("The value of Development length is:", Ld)

if La > Ld:
    print("SAFE")
else:
    print("Increase anchorage")
1
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The value of Moment Resistance factor (Ru) is: 2.7556874999999996
Enter the value of Steel Stress of Service (MPa): 240
Enter the value of Modification Factor: 1.2
Enter the value of span/d ratio: 20
Enter the value of Correction factor if span > 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
The Dead load is: 3.75
Enter the value of partial Safety Factor: 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: 306995.613395718
Revise the Depth:
The value of Minimum steel is: 180.0
Main Steel calculations
Ast: 364.7577413804497
Ast > Astmin, Hence SAFE
Enter the value of bar diameter for main steel (mm): 10
Enter the value of bar diameter for Distribution steel (mm): 8
The Value of Area of main steel bar (Aol): 78.53999999999999
The Value of Area of distribution steel bar (A02): 50.2656
The spacing for main steel bars is: 215.3209955264011
The spacing for distribution steel bars is: 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 value of spacing of main bars (mm): 210
Enter the value of spacing of distribution bars (mm): 270
The provided steel area for main bars at section in mm² is: 373.99999999999994
The provided steel area for distribution bars at section in mm² is: 186.1688888888
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 (MPa): 2.8
SAFE
The value of percentage steel is: 0.28058287798496134
Enter the value of Shear Stress (MPa): 0.378
Enter the value of depth factor: 1.3
The value of shear at section is: 0.4914
Shear Reinforcement not Required, SAFE
The value of span/d is: 23.076923076923077
The permissible deflection is: 24.0
UNSAFE
The value of Moment (M1): 129579959.05445163
The value of Anchorage length is: 7762015.161683324
Enter the value of Bond Stress (MPa): 1.2
The value of Development length is: 470.1171875
SAFE
```