Assignment 5: Applications of Python in the field of Reinforced Cement Concrete

DATE

**1. Find the ultimate moment carrying capacity of singly reinforced beam section 230 mm x 400**

**mm (effective) reinforced with 2#16 and 2#20 on tension side. Materials M20, fe415**

**2. Design one way simply supported slab of 3 m effective span having support width of 230**

**mm.**

**Given that LL is 4 KN/m and floor finish being 1.8 KN/m. Materials M20, fe415.**

* 1. **INPUT**
     1. **# To find the ultimate moment carring capacity of singly r/f beam**
     2. **fck = float(input("Enter the value of charateristics compressive strength:"))**
     3. **fy= float(input("Enter the grade of steel:"))**
     4. **Es = float(input("Enter the value of Modulus of Elasticity of steel:"))**
     5. **b= float(input("Enter the value of Width: "))**
     6. **d= float(input("Enter the value of effective depth:"))**
     7. **d1 = float(input("Enter the value of bar diameter (d1):"))**
     8. **d2 = float(input("Enter the value of bar diameter (d2):"))**
     9. **n=int(input("Enter the number of bars")) 10. Ast1= (n\*0.7854\*d1\*d1)**

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

1. **print ("The value of area of steel (Ast1):", Ast1)**
2. **print ("The vaiue of area of steel (Ast2):", Ast2)**
3. **# Total area of steel**
4. **Ast = Ast1 + Ast2 # Corrected variable name from Astl to Ast1**
5. **print ("The value of area of steel (Ast):", Ast)**
6. **# Neutral Axis Factor**

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

1. **print ("The value of Neutral axis factor (ku):", ku)**
2. **# Momenent of Resistance factor 21. Ru= 0.36\*fck\*ku\*(1-(0.42\*ku))**
3. **print ("The value of Moment of Resistance factor (Ru):", Ru)**
4. **# Maximum Neutral Axis:**
5. **xumax = ku\*d**
6. **print ("The value of maximum neutral axis (xumax):", xumax)**

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

1. **print ("The value of Actual Neutral Axis (xu):", xu)**
2. **if xumax>xu:**
3. **print ("UNDER REINFORCED") # Indented this line**
4. **else:**
5. **print ("OVER REINFORCED") # Indented this line**
6. **# By Comparing**
7. **X = float(input("Enter the value of Neutral Axis:")) # Added missing closing parenthesis**
8. **# Moment of Resistance**
9. **Mu = 0.36\*fck\*X\*b\*(d-(0.42 \*X)) \* 10\*\*-6 # Corrected variable name from x to X, added missing closing parenthesis, and corrected the exponent**
10. **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:191.666667

The value of Moment of Resistance is: 101.40930013192798

* 1. **INPUT**
     1. **# Design of Slab**
     2. **# Given Data**
     3. **span = float(input("Enter the value of effective span in meters: "))**
     4. **b = float(input("Enter the value of width of slab in mm: ")) # Width in mm**
     5. **bs = float(input("Enter the value of Support Width in meters: "))**
     6. **fck = float(input("Enter the value of Characteristics Compressive Strength: "))**
     7. **fy = float(input("Enter the value of grade of steel: ")) # Grade of steel**
     8. **Es = float(input("Enter the value of Modulus of Elasticity: "))**
     9. **LL = float(input("Enter the value of Live Load: "))**
     10. **FF = float(input("Enter the value of Floor Finish: "))**
     11. **Density = float(input("Enter the value of Density of RCC: "))**
     12. **# Design Constants**
     13. **# Neutral Axis Factor**

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

1. **print("The value of Neutral Axis Factor (ku) is:", ku)**
2. **# Moment of Resistance Factor**

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

1. **print("The value of Moment Resistance Factor (Ru) is:", Ru)**
2. **# Assuming pt 0.5 from fig.4 from IS 456:2007 page no.38**
3. **fs = float(input("Enter the value of Steel Stress of Service: "))**
4. **# From Graph find out the Modification Factor**
5. **MF = float(input("Enter the value of Modification Factor: "))**
6. **# From Clause 23.2.1 Select span/d Ratio**
7. **S = float(input("Enter the value of span/d ratio: "))**
8. **# Correction Factors**
9. **k1 = float(input("Enter the value of Correction factor if span > 10m (k1): "))**
10. **k2 = float(input("Enter the value of Tension r/f correction factor (k2): "))**
11. **k3 = float(input("Enter the value of Compression r/f correction factor (k3): "))**
12. **k4 = float(input("Enter the value of correction factor in case of flanged section (k4): "))**
13. **# Effective depth**

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

1. **print("The value of effective depth as per deflection criteria is:", d1)**
2. **# Define Effective depth and overall depth Assuming value of cover**
3. **d = float(input("Enter the value of Effective depth in mm (d): "))**
4. **D = float(input("Enter the value of Overall depth in mm (D): "))**
5. **# Load Calculations**
6. **# Self Weight of slab**
7. **DL = D \* Density / 1000**
8. **print("The Dead load is:", DL)**
9. **# Total Load**
10. **Factor = float(input("Enter the value of partial Safety Factor: "))**
11. **TL = DL + LL + FF**
12. **print("The value of total load is:", TL)**
13. **Wu = Factor \* TL**
14. **print("Wu =", Wu)**
15. **# Bending Moment Calculations (Mu)**
16. **Mu = Wu \* span \* span / 8**
17. **print("The Value of Bending Moment (Mu) is:", Mu)**
18. **# Check for effective depth**

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

1. **print("The value of Effective depth as per Moment criteria:", d2)**
2. **if d2 > d:**
3. **print("Revise the Depth:")**
4. **else:**
5. **print("SAFE")**
6. **# Minimum Steel Calculations**

57. Astmin = 0.12 \* b \* D / 100

1. **print("The value of Minimum steel is:", Astmin)**
2. **# Main Steel calculations**

60. Ast = (0.5 \* fck \* b \* d) / (fy) \* (1 - (1 - (4.6 \* Mu \* 100000 / (fck \* b \* d \* d)) \*\* 0.5))

1. **print("Ast:", Ast)**
2. **# Check for Ast 63. if Ast < Astmin:**
3. **print("Take Ast = Astmin")**
4. **else:**
5. **print("Ast > Astmin, Hence SAFE")**
6. **dia1 = float(input("Enter the value of bar diameter for main steel: "))**
7. **dia2 = float(input("Enter the value of bar diameter for Distribution steel: "))**
8. **# Area of bar**

70. ao1 = 0.7854 \* dia1 \* dia1

71. print("The Value of Area of main steel bar (ao1):", ao1)

72. ao2 = 0.7854 \* dia2 \* dia2

73. print("The Value of Area of distribution steel bar (ao2):", ao2) 74. # Spacing Calculations

1. **Spacing1 = ao1 \* b / Ast**
2. **print("The spacing for main steel bars is:", Spacing1)**
3. **Spacing2 = ao2 \* b / Astmin**
4. **print("The spacing for distribution steel bars is:", Spacing2) 79. # Check 1 for main steel**
5. **if Spacing1 > 300:**
6. **print("UNSAFE")**
7. **else:**
8. **print("SAFE")**
9. **# Check 2 for main steel**
10. **if Spacing1 > d:**
11. **print("UNSAFE") 87. else:**
12. **print("SAFE")**
13. **# Check 1 for Distribution steel 90. if Spacing2 > 300: 91. print("UNSAFE") 92. else:**
14. **print("SAFE")**
15. **# Check 2 for Distribution steel**
16. **if Spacing2 > 5 \* d: 96. print("UNSAFE") 97. else:**
17. **print("SAFE")**
18. **# Approximated values of Spacing**
19. **S1 = float(input("Enter the value of spacing of main bars: "))**
20. **S2 = float(input("Enter the value of spacing of distribution bars: "))**
21. **Astprovided = ao1 \* b / S1**
22. **print("The provided steel area for main bars at section in mm^2 is:", Astprovided)**
23. **Astprodist = ao2 \* b / S2**
24. **print("The provided steel area for distribution bars at section in mm^2 is:", Astprodist)**
25. **# Check for Shear**

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

108. print("The value of SF at a Section is:", Vu)

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

110. print("The value of shear stress is:", SStress)

|  |  |
| --- | --- |
| **111.** | **# From table 20 IS 456:2007 page 73** |
| **112.** | **SStressmax = float(input("Enter the value of maximum Shear stress: ")) 113. if**  **SStress > SStressmax: 114. print("Crushing will happen") 115. else:** |
| **116.** | **print("SAFE")** |
| **117.** | **# Percentage Steel** |
| **118.** | **pt = (100 \* Ast) / (b \* d)** |
| **119.** | **print("The value of percentage steel is:", pt)** |
| **120.** | **# From table 19 IS 456:2007 page 73** |
| **121.** | **SS = float(input("Enter the value of Shear Stress: "))** |
| **122.** | **k = float(input("Enter the value of depth factor: "))** |
| **123.** | **Shear = k \* SS** |
| **124.** | **print("The value of shear at section is:", Shear)** |
| **125.** | **if SStress > Shear:** |
| **126.** | **print("Shear Reinforcement Required") 127. else:** |
| **128.** | **print("Shear Reinforcement not Required, SAFE")** |
| **129.** | **# Check for Deflection** |
| **130.** | **ActDEF = span \* 1000 / d** |
| **131.** | **print("The value of span/d is:", ActDEF)** |
| **132.** | **# Actual Deflection** |
| **133.** | **MaxDEF = S \* MF \* k1 \* k2 \* k3 \* k4 134. print("The permissible deflection**  **is:", MaxDEF) 135. if MaxDEF > S: 136. print("SAFE") 137. else:** |
| **138.** | **print("UNSAFE")** |
| **139.** | **# Check for Anchorage Length** |
| **140.** | **M1 = 0.87 \* fy \* Ast \* (d - (fy \* Ast) / (fck \* b))** |
| **141.** | **print("The value of Moment (M1):", M1)** |
| **142.** | **lo = 8 \* dia1** |
| **143.** | **La = 1.3 \* (M1 / Vu) + 10** |
| **144.** | **print("The value of Anchorage length is:", La)** |
| **145.** | **# Development Length** |
| **146.** | **bonds = float(input("Enter the value of Bond Stress: "))** |
| **147.** | **Ld = 0.87 \* fy \* dia1 / (4 \* bonds \* 1.6) 148. print("The value of Development**  **length is:", Ld) 149. if La > Ld: 150. print("SAFE") 151. else:** |
| **152.** | **print("Increase anchorage")** |

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 Characteristics Compressive Strength: 20 Enter the value of grade of steel: 415

The spacing for distribution steel bars is: 279.25333333333333 SAFE

UNSAFE SAFE SAFE

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**

**The value of percentage steel is: 0.35685849989499424 Enter the value of Shear Stress: 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**

**SAFE**

**The value of Moment (M1): 20162227.393167816**

**The value of Anchorage length is: 1207753.1899097753 Enter the value of Bond Stress: 1.2**

The value of Development length is: 470.1171875

Enter the value of Modulus of Elasticity: 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 Resistance Factor (Ru) is: 2.7556874999999996 Enter 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 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: 76.473082008588 SAFE

The value of Minimum steel is: 180.0 Ast: 463.9160498634925

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 distribution steel bar (ao2): 50.2656 The spacing for main steel bars is: 169.29787193849066