Assignment 4: Applications of Python in the field of Concrete Technology

DATE:

**Design concrete mix as per IS 10262**

**Grade of designation: M40, Type of Cement: OPC 43, Maximum size of aggregates: 20 mm, Minimum cement content: 320 kg/m, Maximum cement content: 450 kg/m', Maximum water cement ratio: 0.45, Workability: 100 mm (slump). Exposure condition: Severe, Method of placing of concrete: Pumping, Aggregate type: Crushed angular type aggregates, Chemical admixture type: Super- plasticizer, Specific Gravity of cement: 3.15, Specific gravity of fine aggregates: 2.74; confirming the grading as per Zone-I, and that of Course aggregates: 2.74, Moiture absorption by aggregates: Nil,**

INPUT :

1. **# Input values**
2. **fck = float(input("Enter the value of characteristic compressive strength (MPa): "))**
3. **Gca = float(input("Enter the value of specific gravity of CA: "))**
4. **Gfa = float(input("Enter the value of specific gravity of FA: "))**
5. **Gc = float(input("Enter the value of specific gravity of Cement: "))**
6. **Water\_Density = float(input("Enter the value of Water Density (kg/m^3): "))**
7. **AGG\_Size = float(input("Enter the nominal size of Aggregate (mm): "))**
8. **Nature\_of\_AGG = input("Nature of Aggregates (Sub-Angular/Gravel/Round): ")**
9. **Slump = float(input("Enter the value of workability of concrete (mm): "))**
10. **Admixture = input("Type of Admixture (Plastisizer/Super-plastisizer): ")**
11. **Exposure\_Condition = input("Exposure Condition (Mild/Moderate/Severe/Very Severe/Extreme): ")**
12. **Concreting = input("Type of Concreting (Plain/Reinforced): ")**

13. Zone = int(input("Zone (1/2/3/4): "))

1. **# Target Mean Strength**
2. **sigma = { 16. 10: 3.5, 17. 15: 3.5,**

|  |  |
| --- | --- |
| **18. 20:** | **4,** |
| **19. 25:** | **4,** |
| **20. 30:** | **5,** |
| **21. 35:** | **5,** |
| **22. 40:** | **5,** |
| **23. 45:** | **5,** |

24. 50: 5

25. }

1. **if fck not in sigma:**
2. **raise ValueError("Invalid characteristic compressive strength value.")**
3. **ft = fck + sigma[fck] \* 1.65**
4. **print("Target Mean Strength: ", ft, "MPa")**
5. **# Maximum free Water Cement Ratio**
6. **WC\_ratio = {**
7. **"Plain": { 33. "Mild": 0.6,**

34. "Moderate": 0.6,

35. "Severe": 0.5,

1. **"Very Severe": 0.45,**
2. **"Extreme": 0.4 38. },**

39. "Reinforced": { 40. "Mild": 0.55,

41. "Moderate": 0.5, 42. "Severe": 0.45,

1. **"Very Severe": 0.45,**
2. **"Extreme": 0.4**

45. }

46. }

1. **if Concreting not in WC\_ratio or Exposure\_Condition not in WC\_ratio[Concreting]:**
2. **raise ValueError("Invalid Concreting type or Exposure Condition.")**
3. **WC\_ratio\_value = WC\_ratio[Concreting][Exposure\_Condition]**
4. **print("W/C Ratio:", WC\_ratio\_value)**
5. **# Minimum Cement Content**
6. **Min\_Cement\_Content = {**
7. **"Plain": { 54. "Mild": 220,**

55. "Moderate": 240,

56. "Severe": 250,

1. **"Very Severe": 260,**
2. **"Extreme": 280 59. },**

60. "Reinforced": { 61. "Mild": 300,

62. "Moderate": 300,

63. "Severe": 320,

1. **"Very Severe": 340,**
2. **"Extreme": 360**

66. }

67. }

1. **if Concreting not in Min\_Cement\_Content or Exposure\_Condition not in Min\_Cement\_Content[Concreting]:**
2. **raise ValueError("Invalid Concreting type or Exposure Condition.")**
3. **Min\_Cement\_Content\_value = Min\_Cement\_Content[Concreting][Exposure\_Condition]**
4. **print("Minimum Cement Content:", Min\_Cement\_Content\_value, "kg/m^3")**
5. **# Water Content**
6. **Water\_Content = { 74. 10: 208,**

75. 20: 186,

76. 40: 165

77. }

1. **if AGG\_Size not in Water\_Content:**
2. **raise ValueError("Invalid Aggregate Size.")**
3. **Water\_Content\_value = Water\_Content[AGG\_Size]**
4. **if Slump == 75:**
5. **Water\_Content\_value += Water\_Content\_value \* 0.03**
6. **elif Slump == 100:**
7. **Water\_Content\_value += Water\_Content\_value \* 0.06**
8. **elif Slump == 125:**
9. **Water\_Content\_value += Water\_Content\_value \* 0.09**
10. **elif Slump == 150:**
11. **Water\_Content\_value += Water\_Content\_value \* 0.12**
12. **elif Slump == 175:**
13. **Water\_Content\_value += Water\_Content\_value \* 0.15**
14. **elif Slump == 200:**
15. **Water\_Content\_value += Water\_Content\_value \* 0.18**
16. **if Nature\_of\_AGG == "Sub-Angular":**
17. **Water\_Content\_value -= 10**
18. **elif Nature\_of\_AGG == "Gravel":**
19. **Water\_Content\_value -= 20**
20. **elif Nature\_of\_AGG == "Round":**
21. **Water\_Content\_value -= 25**
22. **if Admixture == "Plastisizer":**

|  |  |
| --- | --- |
| **100.** | **Water\_Content\_value -= (0.1 \* Water\_Content\_value)** |
| **101.** | **elif Admixture == "Super-plastisizer":** |
| **102.** | **Water\_Content\_value -= (0.2 \* Water\_Content\_value)** |
| **103.** | **print("Water Content:", Water\_Content\_value, "kg/m^3")** |
| **104.** | **# Cement Content** |
| **105.** | **Cement\_Content = Water\_Content\_value / WC\_ratio\_value** |
| **106.** | **print("Cement Content:", Cement\_Content, "kg/m^3")** |
| **107.** | **print("As per IS 456:2000, Maximum allowed Cement Content is 450 kg/m^3")** |
| **108.** | **if Cement\_Content > 450:** |
| **109.** | **Cement\_Content = 450** |
| **110.** | **print("Cement Content (adjusted):", Cement\_Content, "kg/m^3")** |
| **111.** | **# Volume Calculations** |
| **112.** | **Vol\_Cement = Cement\_Content / (Gc \* Water\_Density)** |
| **113.** | **print("Volume of Cement:", Vol\_Cement, "m^3")** |
| **114.** | **Vol\_Water = Water\_Content\_value / Water\_Density** |
| **115.** | **print("Volume of Water:", Vol\_Water, "m^3")** |
| **116.** | **Vol\_AGG = 1 - Vol\_Water - Vol\_Cement** |
| **117.** | **print("Volume of Coarse Aggregates and Fine Aggregates:", Vol\_AGG, "m^3")** |
| **118.** | **# Zone ID** |
| **119.** | **Zone\_ID = {** |
| **120.** | **1: {10: 0.44, 20: 0.60, 40: 0.69},** |
| **121.** | **2: {10: 0.46, 20: 0.62, 40: 0.71},** |
| **122.** | **3: {10: 0.48, 20: 0.64, 40: 0.73},** |
| **123.** | **4: {10: 0.50, 20: 0.66, 40: 0.75}** |
| **124.** | **}** |
| **125.** | **if Zone not in Zone\_ID or AGG\_Size not in Zone\_ID[Zone]:** |
| **126.** | **raise ValueError("Invalid Zone or Aggregate Size.")** |
| **127.** | **Fraction = Zone\_ID[Zone][AGG\_Size]** |
| **128.** | **if WC\_ratio\_value == 0.5:** |
| **129.** | **Fraction = Fraction** |
| **130.** | **elif WC\_ratio\_value == 0.45:** |
| **131.** | **Fraction += 0.01 \* Fraction** |

1. **elif WC\_ratio\_value == 0.4:**
2. **Fraction += 0.02 \* Fraction**
3. **elif WC\_ratio\_value == 0.55:**
4. **Fraction -= 0.01 \* Fraction**
5. **elif WC\_ratio\_value == 0.60:**
6. **Fraction -= 0.02 \* Fraction**
7. **print("Coarse Aggregate Fraction:", Fraction)**
8. **Vol\_CA = Vol\_AGG \* Fraction**
9. **print("Volume of Coarse Aggregate:", Vol\_CA, "m^3")**
10. **Vol\_FA = Vol\_AGG - Vol\_CA**
11. **print("Volume of Fine Aggregate:", Vol\_FA, "m^3")**
12. **Mass\_CA = Vol\_CA \* Gca \* Water\_Density**
13. **print("Mass of Coarse Aggregates:", Mass\_CA, "kg")**
14. **Mass\_FA = Vol\_FA \* Gfa \* Water\_Density**
15. **print("Mass of Fine Aggregates:", Mass\_FA, "kg")**
16. **# Ratios**
17. **print("Weight Batching")**
18. **print(f"{Cement\_Content/Cement\_Content:.2f} : {Mass\_FA/Cement\_Content:.2f} :**

{Mass\_CA/Cement\_Content:.2f} : {Water\_Content/Cement\_Content:.2f}")

1. **print("Volume Batching:")**
2. **print(f"{Vol\_Cement/Vol\_Cement:.2f} : {Vol\_FA/Vol\_Cement:.2f} :**

{Vol\_CA/Vol\_Cement:.2f} : {Vol\_Water/Vol\_Cement:.2f}")

OUTPUT:

Enter the value of characteristic compressive strength:40 Enter the value of specific gravity of CA: 2.74

Enter the value of specific gravity of FA: 2.74

Enter the value of specific gravity of Cement: 3.15 Enter the value of Water Density: 1000 Enter the nominal Size of Aggregate: 20

Nature of Aggregates: Sub-Angular Enter the value of workability of concrete: 100 Type of Admixture: Super-Plastisizer

Exposure\_ Condition: Severe Type of Concreting: Reinforced Zone: 1

Target Mean Strength: 48.25 MPa W/C Ratio: 0.45

Minmum Cement Content: 320 kg/m^3

Water Content: 187.16 kg/m^3

Cement Content: 415.9111111111111 kg/m^3

As Per IS 456:2000, Maximum allowed Cement Content is 450 kg/m^3 Safe

Volume of Cemnet: 0.1320352733686067 m^3 Volume of Water: 0.18716 m^3

**Volume of Course Aggregates and Fine Aggregates: 0.68080472663 13932 m^3 Course Aggregate fraction: 0.606**

**Volume of Course Aggregate: 0.4125676643386243 m^3 Volume of Fine Aggregate: 0.26823706229276895 m^3 Mass of Course Aggregates: 1130.4354002878308 kg/m^3 Mass of Fine Aggregates: 734.969550682 187 kg/m^3 Weight Batching**

**1.0: 1.7671313197637537 : 2.7179735527330835 : 0.45**

**Volume Batching:**

**1.0: 2.0315560792904463: 3.1246776244924126 :1.4174999999999998**