ASSSIGNMENT 4

Q1

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# Concrete Mix Design as per IS 10262

# Inputs

fck = float(input("Enter the value of characteristic compressive strength (fck in MPa): "))

Gca = float(input("Enter the specific gravity of Coarse Aggregate (Gca): "))

Gfa = float(input("Enter the specific gravity of Fine Aggregate (Gfa): "))

Gc = float(input("Enter the specific gravity of Cement (Gc): "))

Water_Density = float(input("Enter the value of Water Density (usually 1000 kg/m^3): "))

AGG_Size = int(input("Enter the nominal size of aggregate (10/20/40 mm): "))

Nature_of_AGG = input("Enter Nature of Aggregates (Sub-Angular/Gravel/Round): ").title()

Slump = float(input("Enter the value of slump/workability in mm: "))

Admixture = input("Type of Admixture (None/Plastisizer/Super-Plastisizer): ")

Exposure_Condition = input("Exposure Condition (Mild/Moderate/Severe/Very Severe/Extreme): ").title()

Concreting = input("Type of Concreting (Plain/Reinforced): ")

Zone = int(input("Zone of Fine Aggregate (1 to 4): "))

# Target Mean Strength

sigma = {10: 3.5, 15: 3.5, 20: 4, 25: 4, 30: 5, 35: 5, 40: 5, 45: 5, 50: 5, 55: 5}

ft = fck + 1.65 * sigma[fck]

print("Target Mean Strength:", ft, "MPa")

# Water-Cement Ratio based on Exposure

WC_ratio = {

    "Mild": 0.55,

    "Moderate": 0.5,

    "Severe": 0.45,

    "Very Severe": 0.45,
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    "Extreme": 0.4
}
wc = WC_ratio[Exposure_Condition]
print("W/C Ratio:", wc)
# Minimum Cement Content
Min_Cement_Content = {
    "Mild": 300,
    "Moderate": 300,
    "Severe": 320,
    "Very Severe": 340,
    "Extreme": 360
}
print("Minimum Cement Content:", Min_Cement_Content[Exposure_Condition], "kg/m³")
# Water Content from IS Table (Base values)
Water_Content_Table = {10: 208, 20: 186, 40: 165}
Water_Content = Water_Content_Table[AGG_Size]
# Adjust for Slump
if Slump == 75:
    Water_Content += Water_Content * 0.03
elif Slump == 100:
    Water_Content += Water_Content * 0.06
elif Slump == 125:
    Water_Content += Water_Content * 0.09
elif Slump == 150:
    Water_Content += Water_Content * 0.12
elif Slump == 175:
    Water_Content += Water_Content * 0.15
elif Slump == 200:
    Water_Content += Water_Content * 0.18
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# Adjust for Aggregate Shape
if Nature_of_AGG == 'Sub-Angular':
  Water_Content -= 10
elif Nature_of_AGG == "Gravel":
  Water_Content -= 20
elif Nature_of_AGG == "Round":
  Water_Content -= 25
# Adjust for Admixture
if Admixture == "Plastisizer":
  Water_Content -= 0.1 * Water_Content
elif Admixture == "Super-Plastisizer":
  Water_Content -= 0.2 * Water_Content
print("Final Water Content:", Water_Content, "kg/m^3")
# Cement Content
Cement_Content = Water_Content / wc
print("Cement Content:", Cement_Content, "kg/m^3")
print("Note: Max Cement Content as per IS 456: 450 kg/m^3")
if Cement_Content > 450:
  Cement_Content = 450
  print("Cement content limited to 450 kg/m^3")
else:
  print("Cement content is safe")
# Volume of components
Vol_Cement = Cement_Content / (Gc * Water_Density)
Vol_Water = Water_Content / Water_Density
print("Volume of Cement:", Vol_Cement, "m^3")
print("Volume of Water:", Vol_Water, "m^3")
# Remaining volume for aggregates
Vol_AGG = 1 - (Vol_Cement + Vol_Water)
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print("Volume available for Aggregates:", Vol_AGG, "m³")
# Coarse aggregate fraction from IS table
Zone_ID = {
   1: {10: 0.44, 20: 0.60, 40: 0.69},
   2: {10: 0.46, 20: 0.62, 40: 0.71},
   3: {10: 0.48, 20: 0.64, 40: 0.73},
   4: {10: 0.50, 20: 0.66, 40: 0.75}
}
Fraction = Zone_ID[Zone][AGG_Size]
# Adjust for W/C ratio
if wc == 0.45:
   Fraction += 0.01 * Fraction
elif wc == 0.4:
   Fraction += 0.02 * Fraction
elif wc == 0.55:
   Fraction -= 0.01 * Fraction
elif wc == 0.60:
   Fraction -= 0.02 * Fraction
print("Coarse Aggregate Fraction:", Fraction)
Vol_CA = Vol_AGG * Fraction
Vol_FA = Vol_AGG - Vol_CA
print("Volume of Coarse Aggregate:", Vol_CA, "m³")
print("Volume of Fine Aggregate:", Vol_FA, "m³")
Mass_CA = Vol_CA * Gca * Water_Density
Mass_FA = Vol_FA * Gfa * Water_Density
print("Mass of Coarse Aggregate:", Mass_CA, "kg/m³")
print("Mass of Fine Aggregate:", Mass_FA, "kg/m³")
# Weight Batching Ratio
print("\nWeight Batching Ratio (Cement : FA : CA : Water)")
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print(f"1 : {Mass_FA / Cement_Content:.2f} : {Mass_CA / Cement_Content:.2f} : {Water_Content / Cement_Content:.2f}")

# Volume Batching Ratio

print("\nVolume Batching Ratio (Cement : FA : CA : Water)")

print(f"1 : {Vol_FA / Vol_Cement:.2f} : {Vol_CA / Vol_Cement:.2f} : {Vol_Water / Vol_Cement:.2f}")
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OUTPUT-

Enter the value of characteristic compressive strength (fck in MPa): 40

Enter the specific gravity of Coarse Aggregate (Gca): 2.74

Enter the specific gravity of Fine Aggregate (Gfa): 2.74

Enter the specific gravity of Cement (Gc): 3.15

Enter the value of Water Density (usually 1000 kg/m^3): 1000

Enter the nominal size of aggregate (10/20/40 mm): 20

Enter Nature of Aggregates (Sub-Angular/Gravel/Round): sub-angular

Enter the value of slump/workability in mm: 100

Type of Admixture (None/Plastisizer/Super-Plastisizer): super-plastisizer

Exposure Condition (Mild/Moderate/Severe/Very Severe/Extreme): severe

Type of Concreting (Plain/Reinforced): reinforced

Zone of Fine Aggregate (1 to 4): 1

Target Mean Strength: 48.25 MPa

W/C Ratio: 0.45

Minimum Cement Content: 320 kg/m^3

Final Water Content: 187.16 kg/m^3

Cement Content: 415.9111111111111 kg/m^3

Note: Max Cement Content as per IS 456: 450 kg/m^3

Cement content is safe

Volume of Cement: 0.1320352733686067 m^3

Volume of Water: 0.18716 m^3

Volume available for Aggregates: 0.6808047266313932 m^3

Coarse Aggregate Fraction: 0.606

Volume of Coarse Aggregate: 0.4125676643386243 m^3

Volume of Fine Aggregate: 0.26823706229276895 m^3

Mass of Coarse Aggregate: 1130.4354002878308 kg/m^3

Mass of Fine Aggregate: 734.969550682187 kg/m^3

Weight Batching Ratio (Cement : FA : CA : Water)

1 : 1.77 : 2.72 : 0.45

Volume Batching Ratio (Cement : FA : CA : Water)

1 : 2.03 : 3.12 : 1.42