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

# Experimental Determinations
Gca = float(input("Enter the value of specific gravity of CA: "))
Gfa = float(input("Enter the value of specific gravity of FA: "))
Gc = float(input("Enter the value of specific gravity of Cement: "))
Water_Density = float(input("Enter the value of Water Density (kg/m^3): "))
AGG_Size = float(input("Enter the nominal size of Aggregate (mm): "))
Nature_of_AGG = input("Nature of Aggregates: ")
Slump = float(input("Enter the value of workability of concrete (mm): "))
Admixture = input("Type of Admixture: ")
Exposure_Condition = input("Exposure Condition: ")
Concreting = input("Type of Concreting: ")
Zone = int(input("Zone: "))

# 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 + sigma[fck] * 1.65
print("Target Mean Strength:", ft, "MPa")

# Maximum free Water Cement Ratio
WC_ratio = {
    "Mild": 0.55,
    "Moderate": 0.5,
    "Severe": 0.45,
    "Very Severe": 0.45,
    "Extreme": 0.4
}

print("W/C Ratio:", WC_ratio[Exposure_Condition])

# Minimum Cement Content
Min_Cement_Content = {
    "Plain": None,
    "Mild": 300,
    "Moderate": 300,
    "Severe": 320,
    "Very Severe": 340,
    "Extreme": 360
}
```

```
if Concreting == "Plain":
    Min_Cement_Content_value = None
else:
    Min_Cement_Content_value = Min_Cement_Content[Exposure_Condition]

print("Minimum Cement Content:", Min_Cement_Content_value, "kg/m^3")

# Water Content
Water_Content = {
    10: 208,
    15: 198,
    20: 186,
    25: 175,
    30: 165,
    40: 150
}

Water_Content_value = Water_Content[AGG_Size]

# Adjust Water Content based on Slump
if Slump == 75:
    Water_Content_value += Water_Content_value * 0.03
elif Slump == 100:
    Water_Content_value += Water_Content_value * 0.06
elif Slump == 125:
    Water_Content_value += Water_Content_value * 0.09
elif Slump == 150:
    Water_Content_value += Water_Content_value * 0.12
elif Slump == 175:
    Water_Content_value += Water_Content_value * 0.15
elif Slump == 200:
    Water_Content_value += Water_Content_value * 0.18

# Adjust Water Content based on Nature of Aggregate
if Nature_of_AGG == "Sub-Angular":
    pass  # No change
elif Nature_of_AGG == "Gravel":
    Water_Content_value -= 20
elif Nature_of_AGG == "Round":
    Water_Content_value -= 10

# Adjust Water Content based on Admixture
if Admixture == "Plasticizer":
    Water_Content_value -= 0.1 * Water_Content_value
elif Admixture == "Super-plasticizer":
    Water_Content_value -= 0.2 * Water_Content_value

print("Water Content:", Water_Content_value, "kg/m^3")

# Cement Content
WC_ratio_value = WC_ratio[Exposure_Condition]
Cement_Content = Water_Content_value / WC_ratio_value
print("Cement Content:", Cement_Content, "kg/m^3")

print("As Per IS 456:2000, Maximum allowed Cement Content is 450 kg/m^3")
```

```
# Check Cement Content against maximum allowed
if Cement_Content > 450:
    Cement_Content = 450
    print("Cement Content adjusted to maximum allowed:", Cement_Content, "kg/m^3")

# Volume Calculations
Vol_Cement = Cement_Content / (Gc * Water_Density)
print("Volume of Cement:", Vol_Cement, "m^3")

Vol_Water = Water_Content_value / Water_Density
print("Volume of Water:", Vol_Water, "m^3")

Vol_AGG = 1 - Vol_Water - Vol_Cement
print("Volume of Course Aggregates and Fine Aggregates:", Vol_AGG, "m^3")

# Zone ID calculations
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: 0.5, 20: 0.66, 40: 0.75}
}

Fraction = Zone_ID[Zone][AGG_Size]

if WC_ratio_value == 0.5:
    Fraction = Fraction
elif WC_ratio_value == 0.45:
    Fraction += (0.01 * Fraction)
elif WC_ratio_value == 0.4:
    Fraction += (0.02 * Fraction)
elif WC_ratio_value == 0.55:
    Fraction -= (0.01 * Fraction)
elif WC_ratio_value == 0.6:
    Fraction -= (0.02 * Fraction)

print("Course Aggregate fraction:", Fraction)

Vol_CA = Vol_AGG * Fraction
print("Volume of Course Aggregate:", Vol_CA, "m^3")

Vol_FA = Vol_AGG - Vol_CA
print("Volume of Fine Aggregate:", Vol_FA, "m^3")

Mass_CA = Vol_CA * Gca * Water_Density
print("Mass of Course Aggregates:", Mass_CA, "kg")

Mass_FA = Vol_FA * Gfa * Water_Density
print("Mass of Fine Aggregates:", Mass_FA, "kg")
# Ratios
print("Weight Batching:")
print(f"{Cement_Content/Cement_Content}: {Mass_FA/Cement_Content}: {Mass_CA/Cement_
print("Volume Batching:")
print(f"{Vol_Cement/Vol_Cement}: {Vol_FA/Vol_Cement}: {Vol_CA/Vol_Cement}: {Vol_Wat
```

```
Enter the value of characteristic compressive strength (MPa): 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 (kg/m^3): 1000
Enter the nominal size of Aggregate (mm): 20
Nature of Aggregates: Sub-Angular
Enter the value of workability of concrete (mm): 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
Minimum Cement Content: 320 kg/m^3
Water Content: 197.16 kg/m^3
Cement Content: 438.1333333333333 kg/m^3
As Per IS 456:2000, Maximum allowed Cement Content is 450 kg/m^3
Volume of Cement: 0.1390899470899471 m^3
Volume of Water: 0.19716 m^3
Volume of Course Aggregates and Fine Aggregates: 0.6637500529100528 m^3
Course Aggregate fraction: 0.606
Volume of Course Aggregate: 0.402232532063492 m^3
Volume of Fine Aggregate: 0.2615175208465608 m^3
Mass of Course Aggregates: 1102.1171378539682 kg
Mass of Fine Aggregates: 716.5580071195767 kg
Weight Batching:
1.0: 1.6354793223970863: 2.51548342480364: 0.45
Volume Batching:
1.0: 1.8802043304930003: 2.891887878880097: 1.4175
```