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Mix Design of Cement Concrete as per IS 10262

This document provides a detailed mix design procedure for M25 grade cement concrete as per the guidelines of IS 10262:2019. The mix design is based on standard assumptions and includes step-by-step calculations to proportion the different ingredients: cement, water, fine aggregate, and coarse aggregate.

1. Given Data

- Grade of Concrete: M25
- Characteristic Compressive Strength: 25 MPa
- Maximum Size of Aggregate: 20 mm
- Exposure Condition: Moderate
- Workability: 100 mm slump
- Water-Cement Ratio: 0.45
- Type of Cement: OPC 43 Grade
- Specific Gravity of Cement: 3.15
- Specific Gravity of Coarse Aggregate: 2.74
- Specific Gravity of Fine Aggregate: 2.65
- Water Absorption of Coarse Aggregate: 0.5%
- Water Absorption of Fine Aggregate: 1.0%
- Free Surface Moisture of Coarse Aggregate: Nil
- Free Surface Moisture of Fine Aggregate: Nil
- Dry Rodded Bulk Density of Coarse Aggregate: 1600 kg/m³
- Grading Zone of Fine Aggregate: Zone II

2. Target Mean Strength Calculation

The target mean strength of the concrete mix is calculated using the formula:

A	B	C
Input Parameters	Values	Unit
Grade of Concrete (f _{ck})	25	MPa
Target Mean Strength (f _{target})	31.6	MPa
Water-Cement Ratio	0.45	
Water Content	186	liters
Cement Content	413.33	kg/m ³
Specific Gravity of Cement	3.15	
Specific Gravity of Coarse Aggregate	2.74	
Specific Gravity of Fine Aggregate	2.65	
Fine Aggregate (% volume)	35	%
Coarse Aggregate Bulk Density	1600	kg/m ³
Workability (slump)	100	mm

$$f_{\text{target}} = f_{\text{ck}} + 1.65 \times S$$

where,

f_{ck} = Characteristic compressive strength (25 MPa),

S = Standard deviation (Assumed as 4 MPa for M25 grade).

Thus, target mean strength = $25 + 1.65 \times 4 = 31.6$ MPa.

Exposure Condition: Moderate exposure, as per IS 456:2000. Moderate exposure refers to concrete structures exposed to atmospheric conditions that are not extremely aggressive, such as weathering, corrosion, or carbonation.

Workability: The workability (measured by slump) is assumed to be 100 mm, suitable for general reinforced concrete work.

3. Water-Cement Ratio

From the assumed data, the water-cement ratio is taken as 0.45 based on the exposure condition. As per IS 456, the maximum water-cement ratio for moderate exposure should not exceed 0.50. Therefore, 0.45 is safe for this mix design.

4. Water Content

For a 20 mm maximum size of aggregate, the estimated water content for a slump of 100 mm is 186 liters (from IS 10262). Adjustments for workability and moisture content are not needed as the values are within acceptable ranges.

5. Cement Content

The cement content can be calculated using the formula:

$$\begin{aligned}\text{Cement Content} &= \text{Water Content} / \text{Water-Cement Ratio} \\ &= 186 / 0.45 \\ &= 413 \text{ kg/m}^3.\end{aligned}$$

As per IS 456, the minimum cement content for moderate exposure is 300 kg/m³. Thus, 413 kg/m³ satisfies the criteria.

6. Proportioning of Coarse and Fine Aggregates

Based on the mix design procedures, the ratio of fine aggregate to total aggregate by absolute volume is 35% for Zone II fine aggregate.

Hence, the proportions of coarse and fine aggregates are determined from the absolute volume method.

7. Mix Proportion Calculation

- Water = 186 liters
- Cement = 413 kg
- Fine Aggregate = 628 kg
- Coarse Aggregate = 1255 kg
- Water-Cement Ratio = 0.45

Final mix proportion by weight:

Cement: Fine Aggregate: Coarse Aggregate = 1: 1.52: 3.04.

E	F	G
Output Parameters	Values	Unit
Cement Content (kg/m ³)	413.33	kg/m ³
Fine Aggregate (kg/m ³)	628	kg/m ³
Coarse Aggregate (kg/m ³)	34.0725	kg/m ³
Water Content	186	liters
Mix Proportion (C:F:CA)	1: 1.52: 3.04	

8. Conclusion

The mix design provided above is for M25 grade concrete, and it is assumed based on standard values. All proportions are in line with the IS code 10262:2019 requirements. The mix ensures adequate strength, durability, and workability for moderate exposure conditions.