UNIT III

PROPORTIONING OF CONCRETE MIX

SYLLABUS

Principles of Mix Proportioning - Properties of concrete related to Mix Design - Physical properties of materials required for Mix Design - Design Mix and Nominal Mix - BIS Method of Mix Design - Mix Design Examples

3.1 PRINCIPLES OF MIX PROPORTIONING

1 The environmental exposure condition for the structure
2 The grade of concrete, their characteristic strength's and standard deviations
3 The type of cement
4 The types and sizes of aggregates and their sources of supply
5 The nominal maximum sizes of aggregates
6 Maximum and minimum cement content in kg/m^3
7 Water cement ratio
8 The degree of workability of concrete based on placing conditions
9 Air content inclusive of entrained air
10 The maximum/minimum density of concrete
11 The maximum/minimum temperature of fresh concrete
12 Type of water available for mixing and curing
13 The source of water and the impurities present in it.

THE ENVIRONMENTAL EXPOSURE CONDITION FOR THE STRUCTURE

(as per IS456:2000)

Environmental Exposure Conditions

(*Clauses* 8.2.2.1 *and* 35.3.2)

Sl No.	Environment	Exposure Conditions
(1)	(2)	(3)
i)	Mild	Concrete surfaces protected against weather or aggressive conditions, except those situated in coastal area.
ii)	Moderate	Concrete surfaces sheltered from severe rain or freezing whilst wet
		Concrete exposed to condensation and rain
		Concrete continuously under water
		Concrete in contact or buried under non-aggressive soil/ground water
		Concrete surfaces sheltered from saturated salt air in coastal area
iii)	Severe	Concrete surfaces exposed to severe rain, alternate wetting and drying or occasional freezing whilst wet or severe condensation.
		Concrete completely immersed in sea water
		Concrete exposed to coastal environment
iv)	Very severe	Concrete surfaces exposed to sea water spray, corrosive fumes or severe freezing conditions whilst wet
		Concrete in contact with or buried under aggressive sub-soil/ground water
v)	Extreme	Surface of members in tidal zone
		Members in direct contact with liquid/ solid aggressive chemicals

THE GRADE OF CONCRETE, THEIR CHARACTERISTIC STRENGTH AND STANDARD DEVIATIONS (as per IS456:2000)

Grades of Concrete

(Clause 6.1, 9.2.2, 15.1.1 *and* 36.1 *)*

Group	Grade Designation	Specified Characteristic Compressive Strength of 150 mm Cube at 28 Days in N/mm²
(1)	(2)	(3)
Ordinary Concrete	M 10	10
	M 15	15
	M 20	20
Standard Concrete	M 25	25
	M 30	30
	M 35	35
	M 40	40
	M 45	45
	M 50	50
	M 55	55
High Strength Concrete	M 60	60
	M 65	65
	M 70	70
	M 75	75
	M 80	80

NOTES

1 In the designation of concrete mix M refers to the mix and the number to the specified compressive strength of 150 mm size cube at 28 days, expressed in N/mm².

2 For concrete of compressive strength greater than M 55, design parameters given in the standard may not be applicable and the values may be obtained from specialized literatures and experimental results.

Assumed Standard Deviation

(Clause 9.2.4.2 and *Table* 11*)*

Grade of Concrete	Assumed Standard Deviation N/mm²
M 10 M 15	3.5
M 20 M 25	4.0
M 30 M 35 M 40 M 45 M 50	5.0

NOTE—The above values correspond to the site control having proper storage of cement; weigh batching of all materials; controlled addition of water; regular checking of all materials, aggregate gradings and moisture content; and periodical checking of workability and strength. Where there is deviation from the above the values given in the above table shall be increased by 1N/mm².

3.1.1 Objectives of Mix Design

- The purpose of concrete mix design is to ensure the most optimum proportions of the constituent materials to fulfil the requirement of the structure being built. Mix design should ensure following objectives.
- Toachieve the designed/ desired workability in the plastic stage
- Toachieve the desired minimum strength in the hardened stage
- Toachieve the desired durability in the given environment conditions
- Toproduce concrete as economically as possible.