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COIMBATORE

DEPARTMENT OF CIVIL ENGINEERING

19CET302-DESIGN OF RC STRUCTURAL ELEMENTS

III YEAR / V SEMESTER

Unit 1 : INTRODUCTION

Properties of concrete

Introduction

Reinforced concrete, as a composite material, has occupied a special place in the modern construction of different types of structures due to its several advantages

Concrete

- Concrete is a product obtained artificially by hardening of the mixture of cement, sand, gravel and water in predetermined proportions.
- Depending on the quality and proportions of the ingredients used in the mix the properties of concrete vary almost as widely as different kinds of stones.
- Concrete has enough strength in compression, but has little strength in tension.
- Due to this, concrete is weak in bending, shear and torsion. Hence the use of plain concrete is limited applications where great compressive strength and weight are the principal requirements and where tensile stresses are either totally absent or are extremely low.

Properties of Concrete

The important properties of concrete, which govern the design of concrete mix are as follows

(i) Weight

The unit weights of plain concrete and reinforced concrete made with sand, gravel of crushed natural stone aggregate may be taken as 24 KN/m^3 and 25 KN/m^3 respectively.

(ii) Compressive Strength

With given properties of aggregate the compressive strength of concrete depends primarily on age, cement content and the water cement ratio are given Table 2 of IS 456:2000. Characteristic strength are based on the strength at 28 days. The strength at 7 days is about two-thirds of that at 28 days with ordinary portland cement and generally good indicator of strength likely to be obtained.

Table 2 Grades of Concrete

(Clause 6.1, 9.2.2, 15.1.1 and 36.1)

Group	Grade Designation	Specified Characteris Compressive Strength 150 mm Cube at 28 Da 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

(iii) Increase in strength with age

There is normally gain of strength beyond 28 days. The quantum of increase depends upon the grade and type of cement curing and environmental conditions etc.

(iv) Tensile strength of concrete

The flexure and split tensile strengths of various concrete are given in IS 516:1959 and IS 5816:1970 respectively when the designer wishes to use an estimate of the tensile strength from compressive strength, the following formula can be used

Flexural strength, $f_{cr}=0.7\sqrt{f_{ck}}$ N/mm^2

(v) Elastic Deformation

The modulus of elasticity is primarily influenced by the elastic properties of the aggregate and to lesser extent on the conditions of curing and age of the concrete, the mix proportions and the type of cement. The modulus of elasticity is normally related to the compressive characteristic strength of concrete

$E_c=5000\sqrt{f_{ck}}$ N/mm^2

Where Ec= the short-term static modulus of elasticity in N/mm^2

fck=characteristic cube strength of concrete in N/mm^2

(vi) Shrinkage of concrete

Shrinkage is the time dependent deformation, generally compressive in nature. The constituents of concrete, size of the member and environmental conditions are the factors on which the total shrinkage of concrete depends. However, the total shrinkage of concrete is most influenced by the total amount of water present in the concrete at the time of mixing for a given humidity and temperature. The cement content, however, influences the total shrinkage of concrete to a lesser extent. The approximate value of the total shrinkage strain for design is taken as 0.0003 in the absence of test data (cl. 6.2.4.1).

(vii) Creep of concrete

Creep is another time dependent deformation of concrete by which it continues to deform, usually under compressive stress. The creep strains recover partly when the stresses are released.

(f) Thermal expansion of concrete

The knowledge of thermal expansion of concrete is very important as it is prepared and remains in service at a wide range of temperature in different countries having very hot or cold climates. Moreover, concrete will be having its effect of high temperature during fire.

The coefficient of thermal expansion depends on the nature of cement, aggregate, cement content, relative humidity and size of the section. IS 456 stipulates (cl. 6.2.6) the values of coefficient of thermal expansion for concrete / °C for different types of aggregate.

Workability and Durability of Concrete

Workability and durability of concrete are important properties to be considered. The relevant issues are discussed in the following:

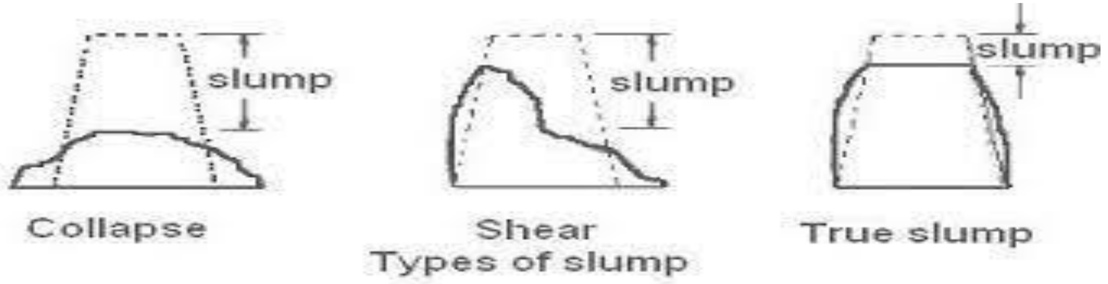
- The workability of a concrete mix gives a measure of the ease with which fresh concrete can be placed and compacted.
- The concrete should flow readily into the form and go around and cover the reinforcement, the mix should retain its consistency and the aggregates should not segregate.
- A mix with high workability is needed where sections are thin and/or reinforcement is complicated and congested.
- The main factor affecting workability is the water content of the mix. Admixtures will increase workability but may reduce strength.
- The size of aggregate, its grading and shape, the ratio of coarse to fine aggregate and the aggregate-to-cement ratio also affect workability to some degree.

7 WORKABILITY OF CONCRETE

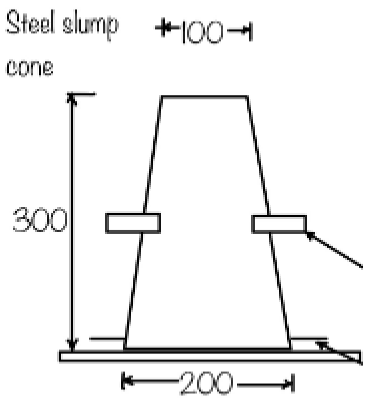
7.1 The concrete mix proportions chosen should be such that the concrete is of adequate workability for the placing conditions of the concrete and can properly be compacted with the means available. Suggested ranges of workability of concrete measured in accordance with IS 1199 are given below:

Placing Conditions	*Degree of Workability*	*Slump (mm)*
(1)	(2)	(3)
Blinding concrete; Shallow sections; Pavements using pavers	Very low	*See* **7.1.1**
Mass concrete; Lightly reinforced sections in slabs, beams, walls, columns; Floors; Hand placed pavements; Canal lining; Strip footings	Low	25-75
Heavily reinforced sections in slabs, beams, walls, columns;	Medium	50-100
Slipform work; Pumped concrete		75-100
Trench fill; *In-situ* piling	High	100-150
Tremie concrete	Very high	*See* **7.1.2**

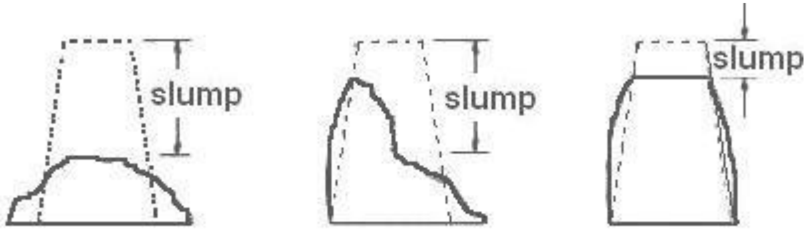
1. Name the slump?



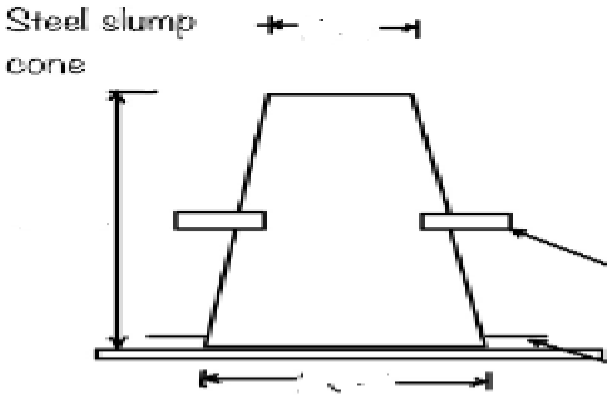
2. Mark the dimensions for the slump cone

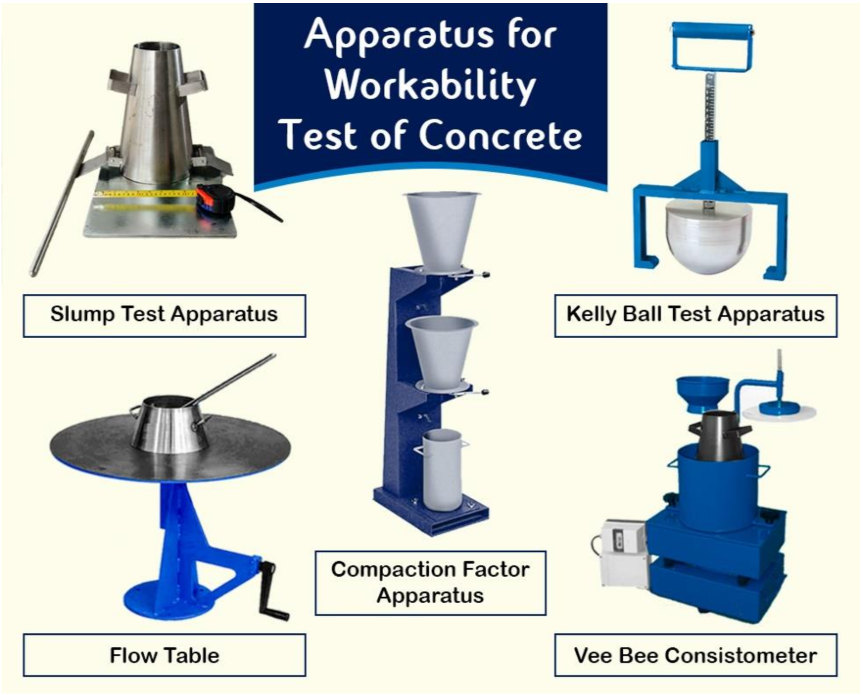


2. Name the given apparatus to find workability



Types of slump





THANK YOU

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