

DEPARTMENT OF CIVIL ENGINEERING

PRESENTATION DISPLAYING THE
SUBJECT OF
CONCRETE TECHNOLOGY

INTRODUCTION TO CONCRETE

- CONCRETE MAY BE DEFINED AS A COMPOSITE BUILDING MATERIAL FORMED FROM COMBINING CEMENT WITH SAND, CRUSHED ROCK AGGREGATES , AND WATER. CONCRETE IS USED MORE THAN ANY OTHER MAN MADE PLANET ON THE EARTH.

INGREDIENTS	COMPOSITION (%)
CEMENT	7-15%
WATER	14-21%
AGGREGATES	60-80%



Basic Concrete Ingredients



CEMENT



Coarse Aggregate

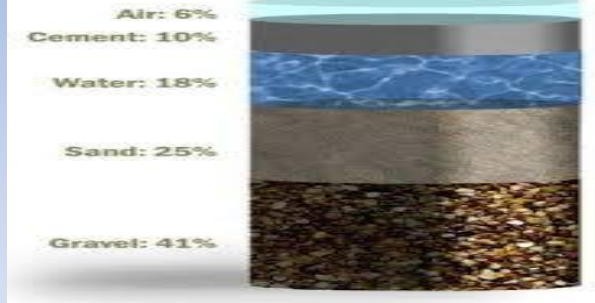


NATURAL SAND



WATER

TYPES OF CONCRETE



- **CEMENT CONCRETE** - IT IS THE BASIC TYPE OF CONCRETE PREPARED BY MIXING CEMENT , SAND , COARSE AGGREGATES AND WATER.
- **LIME CONCRETE** - IT IS THE CONCRETE PREPARED BY MIXING HYDRAULIC LIME , FINE AGGREGATES , COARSE AGGREGATES AND WATER . THIS TYPE OF CONCRETE IS USED FOR INFERIOR WORKS .
- **REINFORCED CEMENT CONCRETE** - IT IS THE TYPE OF CONCRETE IN WHICH STEEL BARS ARE PROVIDED WITHI THE CONCRETE MASS . THE STEEL BARS PROVIDED ARE CALLED REINFORCEMENTS AS THEY REINFORCE THE CONCRETE BY INCREASING ITS TENSILE STRENGTH .
- **PRESTRESSED CEMENT CONCRETE** - A CONCRETE IN WHICH AN ARTIFICIAL COMPRESSIVE STRESS IS INTRODUCED TO NEUTRALIZE THE STRESSES.

GRADES OF CONCRETE

<u>GROUP</u>	<u>GRADE DESIGNATION</u>	<u>SPECIFIC CHARACTERISTIC COMPRESSIVE STRENGTH OF 150mm CUBE AT 28 DAYS</u>
<u>ORDINARY CONCRETE</u>	M10	10
	M15	15
	M20	20
<u>STANDARD CONCRETE</u>	M25	25
	M30	30
	M35	35
	M40	40
	M45	45
	M50	50
	M55	55
<u>HIGH STRENGTH CONCRETE</u>	M60	60
	M65	65
	M70	70
	M75	75
	M80	80



CEMENT



A CEMENT IS A BINDER , A SUBSTANCE USED FOR CONSTRUCTION THAT SETS , HARDENS AND ADHERES TO OTHER MATERIALS THEREBY BINDING THEM TOGETHER . CEMENT IS SELDOM ON ITS OWN , BUT RATHER TO BIND SAND AND GRAVEL TOGETHER .

HYDRATION OF CEMENT – DRY CEMENT DOES NOT BIND FINE AND COARSE AGGREGATES . IT ACQUIRES ADHESIVE PROPERTIES ONLY WHEN MIXED WITH WATER . THE CHEMICAL REACTION THAT TAKES PLACE BETWEEN CEMENT AND WATER IS KNOWN AS HYDRATION OF CEMENT .

TYPES OF CEMENTS

THE PORTLAND AND NON-PORTLAND CEMENTS GENERALLY USED ARE AS FOLLOWS :-

- ORDINARY PORTLAND CEMENT
- RAPID HARDENING PORTLAND CEMENT
- LOW HEAT PORTLAND CEMENT
- SULPHATE RESISTING CEMENT
- BLAST FURNACE SLAG CEMENT
- MASONRY CEMENT
- WHITE AND COLOURED PORTLAND CEMENT
- AIR ENTRAINING CEMENT
- PORTLAND POZZOLANA CEMENT
- HIGH ALUMINA CEMENT
- OIL WELL CEMENT
- QUICK SETTING CEMENT
- HYDROPHOBIC CEMENT
- EXPANSIVE CEMENT

SETTING TIME OF CEMENT

IN ORDER THAT THE CONCRETE MAY BE PLACED IN POSITION EASILY , IT IS NECESSARY THAT THE INITIAL SETTING TIME OF CEMENT IS NOT TOO LESS AFTER IT HAS BEEN LAID, HARDENING SHOULD BE RAPID SO THAT THE STRUCTURE CAN COME INTO USE AS SOON AS POSSIBLE .

➤ **INITIAL SETTING TIME-** TIME INTERVAL BETWEEN THE ADDITION OF WATER TO CEMENT AND THE TIME AT WHICH THE NEEDLE FAILS TO PENETRATE ABOUT

5mm OF TEST BLOCK IS CALLED INITIAL SETTING TIME

FINAL SETTING TIME- FINAL SETTING TIME IS THE INTERVAL BETWEEN THE ADDITION OF WATER TO CEMENT AND THE TIME AT WHICH THE NEEDLE MAKES

AN IMPRESSION ON CEMENT PASTE BUT COLLAR FAILS TO DO SO .

AGGREGATES

AGGREGATE IS THE BROAD CATEGORY OF BASIC MATERIAL USED IN CONSTRUCTION , INCLUDING SAND , GRAVEL , CRUSHED STONE AGGREGATES , SLAG SAW DUST , BROKEN BRICKS etc. IT CONSTITUTES ABOUT 85% OF THE VOLUME OF CONCRETE . THEY ARE CHEMICALLY INERT AND FORM MORTAR AND CONCRETE WHEN MIXED WITH CEMENT.

REQUIREMENTS OF A GOOD AGGREGATE

- IT SHOULD BE CHEMICALLY INACTIVE
- IT SHOULD BE SUFFICIENTLY STRONG
- IT SHOULD BE HARD ENOUGH
- IT SHOULD BE DURABLE
- THE PORES SHOULD BE LIMITED
- IT SHOULD HAVE A ROUGH SURFACE
- IT SHOULD BE WELL GRADED



CLASSIFICATION OF AGGREGATES

ON THE BASIS OF FORMATION

- NATURAL AGGREGATES
- ARTIFICIAL AGGREGATES

ON THE BASIS OF SIZE


- FINE AGGREGATES
- COARSE AGGREGATES
- ALL IN AGGREGATES
- SINGLE SIZE AGGREGATES

ON THE BASIS OF SHAPE

- ROUNDED AGGREGATES
- IRREGULAR OR PARTLY ROUNDED AGGREGATES
- ANGULAR AGGREGATES
- FLAKY AND ELONGATED AGGREGATES

CHARACTERISTICS OF AGGREGATES

- **STRENGTH OF AGGREGATES** – THE STRENGTH OF AGGREGATE AFFECTS THE STRENGTH OF CONCRETE AS A WHOLE . THIS STRENGTH CAN BE CALCULATED BY AGGREGATE CRUSHING VALUE AND AGGREGATE IMPACT VALUE . THE CRUSHING VALUE LIMIT IS GENERALLY 45 PER CENT FOR AGGREGATES USED FOR WEARY SURFACES . THE CRUSHING VALUE IS OBTAINED BY PERFORMING CRUSHING TEST ON CONCRETE .
- **AGGREGATE SIZE** – THE REQUIREMENTS OF AGGREGATES OF VARIOUS SIZES DIFFER FROM ONE TYPE OF WORK TO ANOTHER , FROM ONE REQUIREMENT TO ANOTHER SO THE AGGREGATES ARE WISELY CHOSEN DEPENDING UPON THE TYPE OF WORK , AVAILABILITY OF MATERIAL (LIKE CEMENT) AND OTHER SIMILAR FACTORS.

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- **AGGREGATE SHAPE**- THE SHAPE OF AGGREGATES AFFECTS THE CONCRETE PROPERTIES LIKE WORKABILITY OF CONCRETE , STRENGTH OF CONCRETE , AND ALSO AFFECTS THE AMOUNT OF MATERIAL REQUIRED FOR THE PRODUCTION OF A GOOD QUALITY CONCRETE . THE VARIOUS SHAPES ARE IRREGULAR , ELONGATED , FLAKY ETC.
 - **AGGREGATE SURFACE TEXTURE** – THE SURFACE TEXTURE OF THE AGGREGATES AFFECTS THE BOND B/W THE AGGREGATES AND THE CEMENT PASTE . THE SURFACE TEXTURE GENERALLY DENOTES THE NATURE OF SURFACE ie.,SMOOTH OR ROUGH .
 - **BULK DENSITY** – THE MASS OF THE MATERIAL IN A GIVEN VOLUME IS DEFINED AS THE BULK DENSITY OF AN AGGREGATE AND IS MEASURED IN kg/litre .

WORKABILITY OF CONCRETE

THE WORKABILITY OF PLASTIC CONCRETE MAY BE DEFINED AS THE AMOUNT OF USEFUL ENERGY NECESSARY TO OVERCOME INTERNAL FRICTION BETWEEN INDIVIDUAL PARTICLES IN THE CONCRETE AND CAUSE 100% COMPACTION.

CONSISTENCY- IT IS THE ABILITY OF CONCRETE TO FLOW OR IS THE DEGREE OF WETNESS AND IS MEASURED BY SLUMP TEST , FLOW TEST .

HOMOGENEITY – IT MEANS THE UNIFORM DISTRIBUTION OF THE CEMENT IN THE CONCRETE MIX AND IT CANNOT BE MEASURED BY ANY STANDARDIZED TESTS .

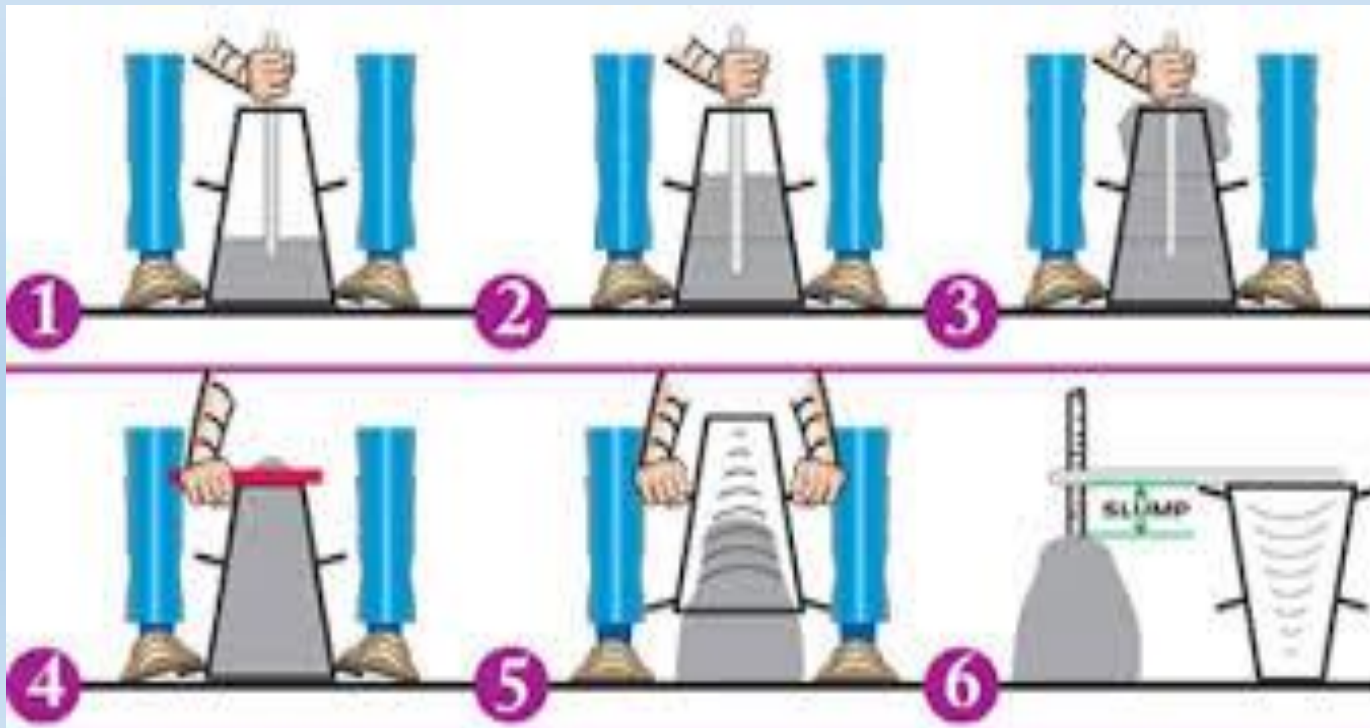
DEFECTS IN CONCRETE

➤ SEGREGATION – IT CAN BE DEFINED AS THE SEPARATION OF THE CONSTITUENT MATERIALS OF CONCRETE . IF A SAMPLE OF CONCRETE EXHIBITS A TENDENCY FOR SEPARATION OF ,SAY, COARSE AGGREGATES FROM THE REST OF THE INGREDIENTS THEN SAMPLE IS SAID TO BE EXHIBITING SEGREGATION .

➤ BLEEDING - BLEEDING IS A PARTICULAR FORM OF SEGREGATION , IN WHICH SOME OF THE WATER FROM THE CONCRETE COMES ON THE SURFACE OF CONCRETE , BEING OF THE LOWEST SPECIFIC GRAVITY AMONG ALL THE INGREDIENTS . IT IS USUALLY OBSERVED IN A HIGHLY WET , BADLY PROPORTIONED MIX AND INSUFFICIENTLY MIXED CONCRETE .

SLUMP TEST FOR WORKABILITY

- THE SLUMP TEST IS USED TO CALCULATE THE CONSISTENCY OR THE WETNESS OF CONCRETE . IT IS GENERALLY EMPLOYED AT SITES DUE TO ITS EASY APPARATUS AND PROCEDURE . THE FOLLOWING IMAGE DEFINES IT ENTIRE PROCEDURE :



COMPACTION FACTOR TEST

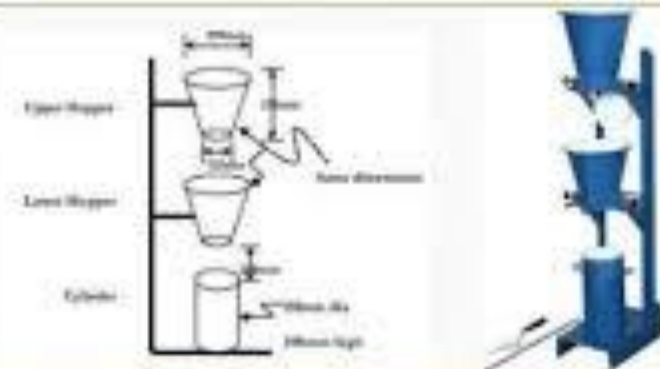
THE COMPACTIONFACTOR TEST WORKS ON THE PRINCIPLE OF DETERMINING THE AMOUNT OF WORK REQUIRED TO PRODUCE A 100% COMPACTION OF CONCRETE. IT IS MORE ACCURATE THAN SLUMP TEST FOR LOW AND MEDIUM WORKABILITY CONCRETE . THE PROCEDURE AND APPARATUS ARE AS FOLLOWS :


Compacting Factor Test

• Procedure

- 1) Ensure the apparatus and associated equipment are clean before test and free from hardened concrete and superfluous water .
- 2) Weigh the bottom cylinder to nearest 10gms , put it back on the stand and cover it up with a pair of floats .
- 3) Gently fill the upper hopper with the sampled concrete to the level of the rim with use of a scoop .
- 4) Immediately open the trap door of the upper hopper and allow the sampled concrete to fall into the middle hopper .
- 5) Remove the floats on top of the bottom cylinder and open the trap door of the middle hopper allowing the sampled concrete to fall into the bottom cylinder .
- 6) Remove the surplus concrete above the top of the bottom cylinder by holding a float in each hand and move towards each other to cut off the concrete across the top of cylinder .

Compaction Factor Apparatus





**THE BASICS OF CONCRETE TECHNOLOGY
HAVE BEEN
DISCUSSED DEEPLY IN THE PREVIOUS SLIDES . HOPE THAT
THEY WILL BE HELPFUL FOR
EXAM AS WELL AS KNOWLEDGE POINT OF VIEW**

**THANKS AND REGARDS,
CIVIL DEPARTMENT
G.P. MANESAR.**