CVL3211 : Civil Engineering Materials
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Concrete

This chapter will cover under given topics.

- ▶ Properties of concrete
- ▶ Proportioning of concrete
- ▶ Testing of concrete

Properties and application of concrete

- ▶ Concrete is mixture of cement, sand and aggregates.
- ▶ Properties of concrete are governed by properties of its constituents, e.g. Cement grade, aggregate strength, water-cement ratio, size and shape of aggregates, proportion of concrete etc.
- ▶ After applying concrete, it needs approximately 28 day curing to counter heat of hydration.
- ▶ Hydration of concrete is an exothermic reaction which exerts a large amount of heat and to absorb the heat and supply more water for hydration several methods are used collectively called curing.

Physical behavior of concrete

- ▶ Concrete shows strain-softening stress-strain behavior.
- ▶ Water-cement ratio and Size of aggregates in concrete is directly proportional to air content (void ratio), workability and inversely proportional to strength.
- ▶ Increase in water-cement (w/c) ratio causes increase in strength if it is below standard consistency.
- ▶ Shape of aggregate from uniform (sphere) to angular (elongated) cause increase in surface area and strength and decrease in workability and air content.

Batching of concrete

Assume an example;

$0.25 m^3$ of M20 concrete with water cement ratio of 0.5 and air content 3% is to be formed, given specific gravities of cement sand and aggregates are 3, 2.6, 2.7. Calculate the weight of all the ingredients.

Solution

Volume of concrete$= 0.25 m^3$.

Air content of concrete mix $= (3 \times 0.25)/100 = 0.0075 m^3$

Volume of concrete minus air $= 0.25 - 0.0075 = 0.2425 m^3$

Let us assume weight of cement be x, for M20 (1:1.5:3)

	Cement	**Sand**	**Coarse aggregates**
Weight (Kg)	x	$1.5x$	$3x$
Density (gm/cc)	3	2.6	2.7
Volume ($m^3 \times 10^{-3}$)	$x/3$	$1.5x/2.6$	$3x/2.7$

Batching of concrete

Volume or Weight of water $= 0.5x$
Volume balance equation,
$V_c + V_w + V_s + V_a = 0.2425 m^3$
$(x/3 + 0.5x + 1.5x/2.6 + 3x/2.7) \times 1/1000 m^3 = 0.2425 m^3$
From above equation;
$x =$ weight of cement $= 96.178 Kg$
Weight of sand $= 144.267 Kg$
weight of coarse aggregates $= 288.534 Kg$
weight of water $= 48.089 Kg$

Laboratory testing of concrete

- ▶ Concrete is tested for its compressive strength in laboratory by using $15 \times 15 \times 15$ cm^3 cube.
- ▶ A population of cube is tested for breaking load and Characteristic compressive strength (f_{ck}) is calculated as $\mu - k\sigma$, where μ is average and σ is standard deviation of all compressive stress. k is a statistical factor to be used for requirement of quality control.
- ▶ Flexural test is performed on a cuboid specimen of $15 \times 15 \times 30$ cm^3 size. It gives modulus of rupture.
- ▶ Splitting tensile testing is performed on a cylinder 15 cm diameter and 30 cm height to determine indirect tensile strength of concrete.