5.3 HIGH STRENGTH CONCRETE

Concrete is classified, based on the compressive strength

- ✓ Normal strength concrete
- ✓ High strength concrete (HSC)- more than 35MPa
- ✓ Ultra strength concrete (USC)- more than 100MPa

Methods of manufacture of HSC

- ➢ Re-vibration
- ➢ Uses of admixtures
- ➢ High-speed slurry mixing
- ➢ Sulphur impregnation
- ➢ Prevention of cracks
- ➢ Uses of cementitious aggregates
- ➢ Re-seeding

1. **Re-vibration**

- ❑ The controlled vibration increases the strength of concrete, up to strength of HSC.

2. **Uses of admixtures**

- ❑ By using the water reducing agents the strength of concrete will be increased.

3. **High speed slurry mixing**

- ❑ In this method cement and water mixture is prepared first and then the aggregate is blended of cement paste.
- ❑ Water saved in the vigorous blending of cement paste

4. **Prevention of cracks**

- If 2% to 3% of fine aggregate is replaced by polythene or polystyrene lenticular pieces 0.025 mm thick and 3 mm to 4mm in diameter, will result in the increase of concrete strength
- By this method, the high strength up to 100 Mpa can be achieved.

5. **Sulphur-filling or impregnation**

- By impregnating low strength porous concrete by sulphur, sufficient high strength concrete has been produced.

6. **Use of cementitious aggregate**

- A kind of aggregate known as ALAG.
- Using ALAG as aggregate, concrete gives strength up to 125 Mpa with w/c ratio 0.32.

7. **Seeding**

- In this method, a small quantity of finely powdered- fully hydrated Portland cement is added to the fresh concrete mix.

5.3.1 FIBRE REINFORCED CONCRETE

Fibre reinforced concrete (FRC) is the concrete containing fibrous material which increases its structural integrity. It contains short discrete fibres that are uniformly distributed and randomly oriented.

Advantages of FRC

- Increased durability.
- High bond strength.
- Reduction in shrinkage and shrinkage cracks.
- Improved fatigue strength.
- Better toughness.

- Low permeability.
- Increased tensile strength.
- Reduced air voids and water voids.
- High resistance to creep
- Reinforced concrete itself is a composite material, where the reinforcement acts as the strengthening fibre and the concrete as the matrix. It is therefore imperative that the behavior under thermal stresses for the two materials be similar so that the differential deformation of concrete and the reinforcement are minimized.
- Act as crack arrester.

Effect of fibres in concrete

- To control plastic shrinkage cracking and drying shrinkage cracking.
- Lower the permeability.
- Decreases the flexural strength of concrete.
- Increases the tensile strength of concrete.
- Decreases the workability.
- Increases the impact strength.

Different types of fibres in concrete

- ➢ Steel fibres (steel fibre reinforced concrete)
- ➢ Polypropylene fibres (Polypropylene fibres reinforced concrete, PFRC)
- ➢ Glass fibres(Glass fibres reinforced concrete, GFRC)
- ➢ Asbestos fibres
- ➢ Carbon fibres
- ➢ Organic fibres

Steel fibres

- ✓ Most common type of fibres used in FRC.
- ✓ Size varies from 0.25 mm to 0.75 mm.

- ✓ Used to improve the flexural, impact and fatigue strength.
- ✓ Used in Road Pavement constructions, Air fields, Bridge decks, thin shells and flooring.
- ✓ Reduces little workability of the concrete.

Plastic fibres

- ✓ Having high tensile strength and low Young's Modulus.
- ✓ Examples: Poly – propylene, Nylon, Acrylic, Aramid and Polyethylene.

Glass fibres

- ✓ Available in three forms, i.e., Rovings, Strands and Woven (or chopped strand) mats.
- ✓ Adding 2% of fibres in concrete increase the flexural strength double

Asbestos fibres

- ✓ Mineral fibre
- ✓ Maximum length of fibre in limited to 10mmm.
- ✓ Tensile strength of concrete varies from 560 k/m to 980 N/mm^2

Carbon fibres

- ✓ Possess high tensile strength and Young's Modulus.
- ✓ Increases the compressive strength.
- ✓ High cost material.

Organic fibres

Organic fibre such as polypropylene or natural fibre may be chemically more inert than either steel or glass fibres. Organic fibres are also cheaper, especially if natural. A large volume of vegetable fibre may be used to obtain a multiple cracking composite. The problem of mixing and uniform dispersion may be solved by adding a super plasticizer.

Applications of FRC

- ✓ Pavements and floors
- ✓ Water retaining structures.
- ✓ Blast resisting structures
- ✓ Pre cast products (Pre cast pipes, boats, wall panels etc.)
- ✓ Wearing surface to existing bridges / culverts.
- ✓ Repairs and rehabilitation works.

5.3.3 SLURRY INFILTRATED FIBRE CONCRETE (SIFCON)

- ✓ This is the type of fibre concrete in which steel fibre bed is prepared and cement slurry is infiltrated.
- ✓ In normal fibre reinforced concrete , fibres are mixed with wet concrete and placed
- ✓ As against this, cement slurry is in filtrated into the fibre –packed bed in caser of SIFCON
- ✓ SIFCON has higher ductility and impact resistance when compared with normal FRC.
- ✓ With this technique, macro-fibre contents up to 20% by volume can be achieved
- ✓ With a consequent enormous increase in both flexural load carrying capacity and toughness.
- ✓ With such high fibre volume, a very high compressive strength is also achieved.
- ✓ SIFCON can be used for blast resistance structures and burglar proof safe vaults in banks and residential buildings.