Synthetic Fibre Reinforced Concrete (SNFRC)

Makmal Penyelidikan Struktur, Konkrit dan Alam Sekitar
Bahagian Inovasi, Penyelidikan dan Pembangunan Kejuruteraan
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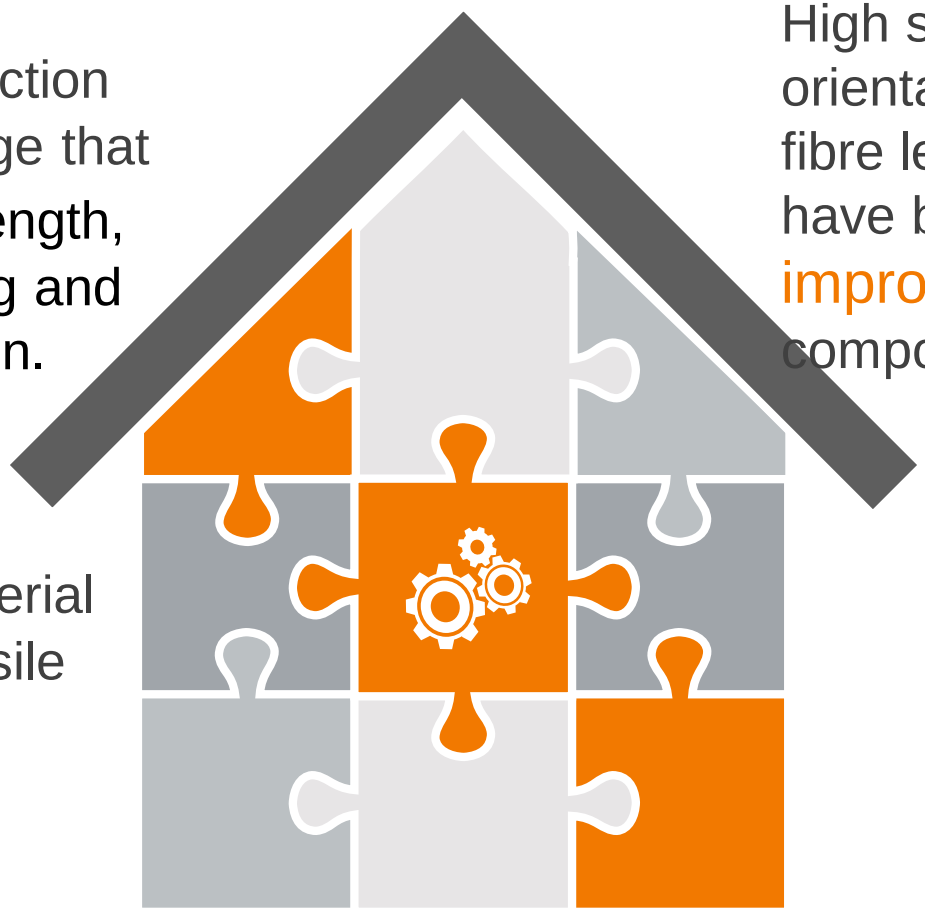
Fibre

Fibre is a small piece of reinforcing material possessing certain characteristics properties. It can be circular or flat.

The fibre is often described by a parameter called ‘aspect ratio’. The aspect ratio of the fibre is the ratio of its length to its diameter. Typical aspect ratio ranges from 30 to 150.

Fibres in Concrete

Concrete is used as a construction material but it has a disadvantage that is brittleness – low tensile strength, poor resistance to crack opening and propagation, and weak in tension.



High strength fibres, favourable orientation, the volume of fibres, fibre length and diameter of fibre have been found independently to improve the strength of composites.

Fibre is such a reinforcing material to enhance the flexural and tensile strength and act as binder that combine Portland cement with cement matrices.

Types of Fibres

Steel Fibres

Synthetic Fibres

Glass Fibres

Natural Fibres

Synthetic Fibres

Synthetic fibres are fibres manufactured from organic polymers such as acrylic, aramid, carbon, polyester, polyethylene and the most common nylon and polypropylene.

Synthetic fibres are engineered to withstand the long-term alkaline environment of concrete.

Synthetic fibres were divided into two categories – micro synthetic fibres and macro synthetic fibres.

Micro synthetic fibres

- Micro synthetic fibres have a diameter that is less than 0.3 mm in diameter.
- Micro synthetic fibres are fine hair like fibres typically between 6 mm and 12 mm in length, either monofilament or fibrillated.
- Most fiber types are manufactured from polypropylene, polyethylene, polyester, nylon and other synthetic materials, such as carbon, aramid and acrylics.
- Micro synthetic fibres are not a structural reinforcing fibre and cannot be used to replace any structural steel elements. It were used for plastic shrinkage control, impact protection and fire anti-spalling.

Macro synthetic fibres

- Macro synthetic fibres have a diameter greater than 0.3 mm.
- Macro synthetic fibres are short discreet elements and typically between 30 mm and 65 mm long.
- Typical materials include polypropylene and other polymer blends with the same physical characteristics (e.g., length, shape) as steel fibers.
- Macro fibres can be used as a replacement for crack control mesh or as structural reinforcement in concrete or shotcrete. It is used where an increase in residual flexural strength is required.

Synthetic Fibres

STRENGTHS

Unaffected by the alkalis in the cement paste, resistant to moisture and to the substances present in air-entraining and chemical admixtures. The fibres also resistant to chlorides when used in marine structures or those subjected to de-icing salts.

WEAKNESS

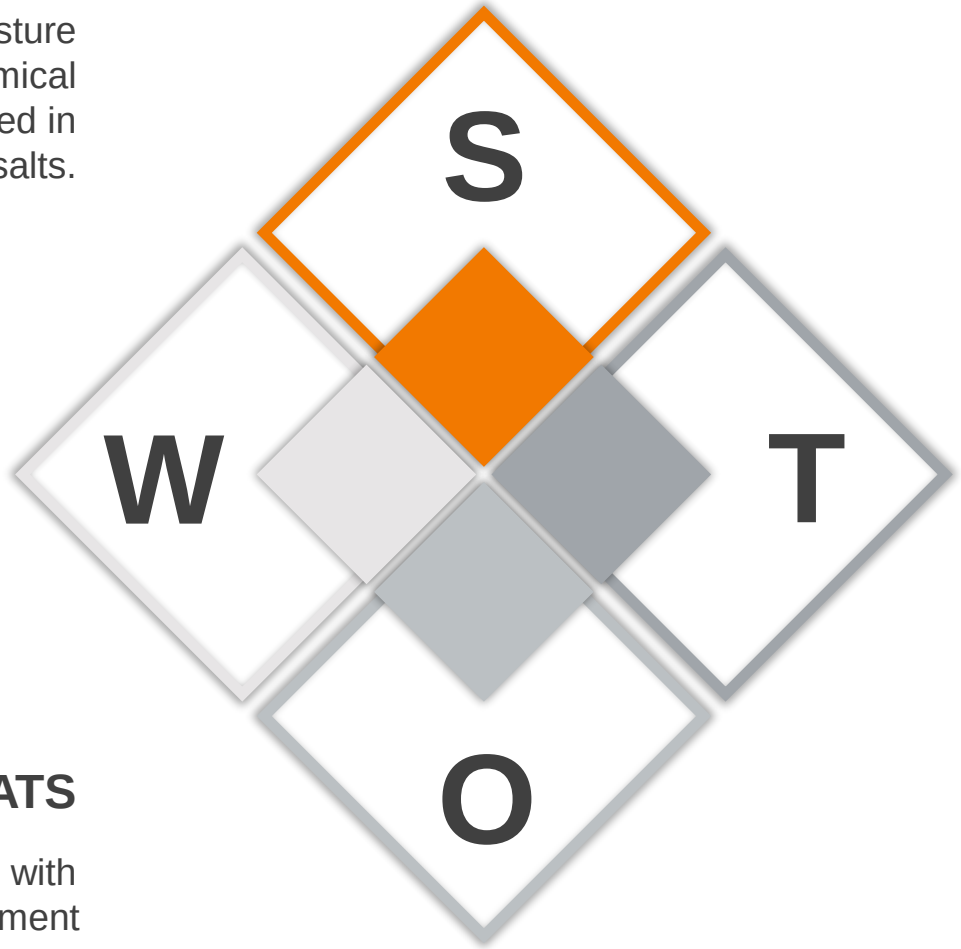
Substantially increase the production cost due to the more expensive material.

OPPORTUNITIES

Suitable for providing nominal reinforcement in aggressive environments such as marine and coastal structures, as they do not suffer the problems of staining and spalling that can result from corrosion of steel.

THREATS

Synthetic fibres can be likened to the use of steel fibres, but with different physical characteristics. It cannot replace moment resisting or structural steel reinforcement.



Synthetic Fibre Reinforced Concrete (SNFRC)

SNFRC is relatively a new composite material made of hydraulic cement, aggregates and discrete fibres.

History of SNFRC

1963
Research on using synthetic fibres in concrete began

1978
Commercial applications as reinforcement in concrete began

1994
More than one billion square feet of synthetic fibre reinforced concrete has been successfully placed

2000
More research have been developed to optimize the benefits of synthetic fibres

Advantages of SNFRC

- Improve load capacity and ductility
- Improve impact and abrasion resistance of concrete
- Improve surface durability
- Improve cohesion of the fresh mixture
- Greater flexural and shear strength
- Increase fire resistance

- Reduce plastic shrinkage cracking
- Reduce permeability of concrete
- Reduce settlement and bleed in deeper sections

Application of SNFRC

Mining and Tunnelling

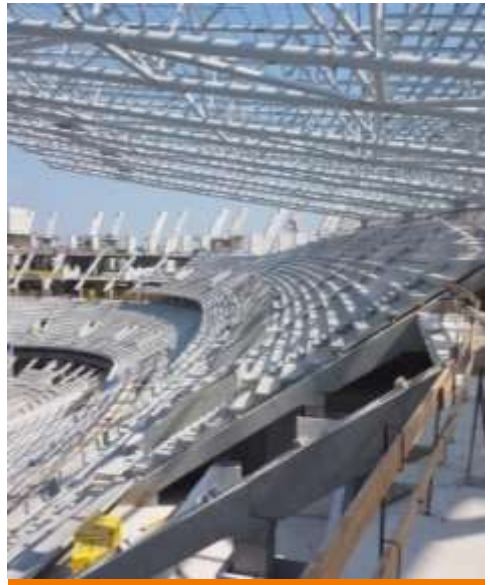
Precast segments and shotcrete

Commercial Flooring

Exterior and interior floors, polished concrete and slabs

Highways, Roadways & Bridges

Conventional concrete paving, barrier rails, curb and gutter work



Precast Concrete & Products

Architectural panels, walls, fencing, septic tanks and sculptures

Conclusion

- The efficient utilization of SNFRC improved static and dynamic properties like tensile strength, energy absorbing characteristics, impact strength and fatigue strength.
- The enormous increase in impact resistance and fatigue resistance allow the new material to be used in some specified applications where conventional concrete is at a disadvantage.

Thank You