

Steel Fibers for Concrete

INSDAG'S PERSPECTIVE

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Introduction:

Steel fiber reinforced concrete (SFRC) is a composite material that combines traditional concrete with steel fibers, without usage of conventional steel reinforcement. Adding steel fibers enhances the concrete's properties, making it more robust, durable, and resistant to cracking.



Fig 1: Site Steel Fiber Photos

Fiber Reinforced Concrete has been particularly put to use in Tunnel linings.

Sustainability aspects:

Steel Fiber has reduced carbon footprint in the tunnel construction works due to reduction in use of steel and concrete.

Use of Steel fiber:

Steel Fiber can be useful in the following areas:

1. Shotcrete Works
 - a. With Steel Fiber, shotcrete thickness reduced by 40% - 50% compared to conventional shotcrete with wiremesh.
2. Concrete Works
 - a. With Steel Fiber, thickness reduced by 30% - 50% compared to conventional RCC lining.



Fig 2: Shotcreting



Fig 3, 4: Finished Linings

Tunnels have seen a very interesting trend in the steel usage. INSDAG tried to get a first-hand experience by interacting with industry expert who has field experience. In this regard, INSDAG has noted the following points:

Steel usage is primary in the following two areas:

1. Shotcreting

Earlier	New Trends
<ul style="list-style-type: none"> • Shotcreting was done with the help of 4mm, 6mm and 8 mm dia wire mesh with 6mm dia mostly being used • The consumption of steel in the case was close to 6 Kg/ m² • Conventional steel fixing was time consuming • The major risk was of loose falls during steel fixing. 	<ul style="list-style-type: none"> • Steel Fiber is mixed in the batching plant • The consumption of the same is around 4.5 Kg/m² • SFRS has reduced construction time. • Has reduced the percentage of rebound. • Risk factor almost eliminated

2. Tunnel Lining

Earlier	New Trends
<ul style="list-style-type: none"> • Double Layered reinforcement was used • Component Thickness of 300 to 500 mm • The consumption of steel in the case was close to 70-100 Kg/ m³ • Time consuming process. • Risk of puncturing of PVC Waterproofing membrane. 	<ul style="list-style-type: none"> • Steel Fiber is mixed in the batching plant • The consumption of the same is around 40 Kg/m³ • The need for reinforcement bars is eliminated • Component Thickness reduced to 150 to 300mm.

Advantages of Steel Fiber:

- Enhanced durability
- Increased tensile strength for better resistance to breaking under pressure
- Improved crack resistance
- Greater flexural strength to withstand deformation under load
- Strong impact resistance
- Strengthened fatigue resistance to endure higher stress levels
- Superior resistance to spalling, preventing surface chipping under stress

Major Suppliers of Steel Fibers:

1. Normet India Pvt Ltd
2. Precision Drawell Pvt Ltd
3. Bekaert Industries Steel
4. Marchem Specialities Pvt. Ltd.

Typical Features:

Shape	Type	Length	Thickness
3D (Double End Hooked)	Glued	35 mm for shotcrete 60 mm for lining concrete	< 1.0 mm

A few consultants in the field of Tunnel Engineering:

1. Amberg Engineering
2. Lombardi Engineering India Pvt. Ltd.
3. ICT
4. Tumas
5. Geodata Engineering

Codal References:

EN 14889, ASTM A 820, ISO 15862, ISO 13270 (No specific Indian Standards for FRC // SFRC)

Note:

- In India, SFRC is a recent phenomenon and it was used in some tunnels of USBRL project.
- RVNL has started using Steel fiber in its projects like in Bhanupali-Bilaspur-Beri Railway Line Project.
- NHAI has started using Steel Fiber in its projects like in 8-Lane Delhi-Vadodara Greenfield Expressway Project.
- In Tunnel No. 13, 14 & 15 of the USBRL, no steel reinforcement bars have been used in 90% of the tunnel lining works. It has been replaced with Steel Fibers.
- Efforts are on to explore use of SFRC in other infrastructure activities as well
- Steel Fiber is mixed in the batching plant to the concrete
- There are some hiccups during concrete pouring, due to Fiber Clustering effect.

Other Important areas:

Steel majors can explore the possibility of the following areas:

- Hydraulic Gentries for the Tunnels: A very important aspect in the tunnel lining execution works.
- Rock Bolts: A significant share of the project in terms of cost is attributed to rock bolts
- Primary support system like Steel Lattice, Ribs, forepoles and piperoots etc.

Courtesy: M/s Dilip Buildcon, Bhopal

References:

1. B2B Purchase June 2024 Issue