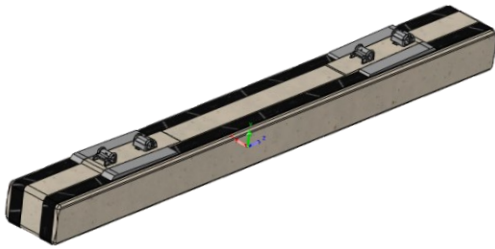


FSC Concrete Railway Ties *No Steel Reinforcing*



What the FSC Tech brings to Railway Ties is:

- **LONGER LIFE CYCLE** Traditional steel reinforcement is replaced by pretensioned FRP. This method eliminates the corrosion issues, and any cracking is no longer a concern. The FRP has a tensile unit strength 4 to 6 times that of steel.

- **HIGH PRODUCTIVITY / LOWER COST** The FSC tie can be produced in a high volume / low cost dry cast production environment.
- **RESISTANCE TO FREEZE-THAW CYCLES** Dry cast concrete provides inherent freeze thaw resistance.
- **ELECTRICAL CONDUCTIVITY FREE** The FRP is completely non conductive – no phantom currents.
- **GREATER VIBRATION DAMPENING** Due to the FRP being applied at the surface at a lower prestressing percentage than embedded steel.
- **REDUCED BALLAST CONSUMPTION** For the high stiffness of the FSC ties.
- **INCREASED FLEXURAL STRENGTH** The FRP wound under tension provides the necessary tensile reinforcement but also imparts flexural capacity that is not possible with any other reinforcement scheme. No long term creep, and no overstressing and resulting gauge changes.

FSC Ties - Structural Behavior

The FSC Tie shows a great displacement capability / flexural strength not reachable by the current Concrete Ties.

The example is for a rectangular FSC Tie with:

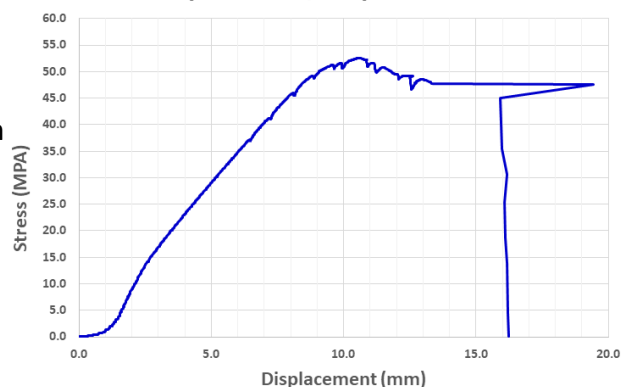
- Base 230 mm (9"), Height 180 mm (7"), Length 2500 mm (8' 2.5")
- 28 Day Concrete Strength = 50 MPa
- Post Compression by Wrapping = 4.5 MPa

RESULT

Flexural Strength (MOR) = **52.4 MPa** (7,600 psi)

Young's Modulus (MOE) = **51.1 GPa** (7.4 M psi)

Graph Stress/Displacement



The FSC Innovative Reinforcing



Wrapping Machine

FSC Reinforcing consists of **wrapping an impregnated fiber roving around the product to be reinforced**. This technique imparts flexural strength and specific resistance to tensile stresses in the concrete element.

The fiber roving is wrapped in tension along with a fast set thermo setting resin and this generate a post compression in the concrete, and is the primary reinforcement *but not an embedded reinforcement*.

This post compression utilizing FRP generates flexural strength.

- **This tensioned wrapping is applied in multiple layers** (laps) taking advantage of a very uniform stress distribution and a very low resin requirement that is resulting in a composite with a very high unitary strength.
- **The number of layers (laps) determines the amount of post compression given to the concrete.**
- The composite has a much lower elastic modulus vs. steel (70 Vs 200 GPA) which determines a lower loss of compression for the same concrete creep, and also increases the tie fatigue limit.

When a rectangular or square product like Ties is wrapped, the generated compression is bi-axial.

While this is a quite revolutionary method, there are ASTM, ACI and ISO specs for appropriate calculations. These basically follow the FRP prestressing and post tensioned reinforcement method.

A Tie Reinforced with FSC Technology is COMPLETELY INSENSITIVE to Concrete Cracks

As we do not utilize steel that needs corrosion protection, even in the case of cracked concrete the flexural capacity of the concrete products reinforced with this technology maintains flexural strength even after the concrete is cracked.

FSC TECHNOLOGIES

FSC is a US company with R&D in Italy. Its core business is to help Customers develop solutions based on its Innovation in Structural Engineering by replacing embedded steel reinforcement with a system of wrapping concrete elements with pretensioned FRP and a small amount of resin.

**The Wrapping has
Abrasion Resistance vs
Ballast superior to the
Concrete itself**

