Fibermesh : Polypropylene fibres for concrete and mortar

Nina Industries, Mumbai, are the sole distributors of *Fibermesh* in India. Some of the features of *Fibermesh*, as per the manufacturers, are:

- it is made of 100 percent virgin polypropylene fibre which is manufactured to assured quality standard and designed to achieve maximum distribution and freedom from clustering in the mix.
- it is non-absorbent, alkali-tolerant and durable in concrete.
- it is available in a variety of lengths — in fibrillated or monofilament format to suit application
- it can be added at the batching plant or on site at the recommended rate of 0.9 kg/m^3 of concrete,
- it is compatible with all cements and admixtures and placeability of concrete is unaffected despite possible lower slump.

Why fibres?

Synthetic fibres have two effects on fresh concrete; they should that should help reduce subsidence and cracking. They reduce bleeding so solids in the concrete don't settle as much, and they increase the tensile strength. To test this theory, a study was conducted*, *Table* 1.

Fig 1 Within 4 hours, subsidence cracks had formed in some of the concrete specimens that didn't contain synthetic fibres

Concretes with 4 percent and 5 percent inch slumps; cover depths of 12.7, 19, and 25.4 mm and #6 and #8 bars was chosen. Each combination of these variables was tested three times with half of the specimens containing no fibres and other half containing 0.55 kg pounds of *Fibermesh MD* fibrillated polypropylene fibres per cubic yard. The low-slump concrete, 12.7 mm, and 25.4 mm covers and #6 rebar matched specimens were used.

The specimens were inspected for subsidence cracking 4 hours and 18 hours after casting Most of the cracks were visible while the concrete was still plastic, *Fig* 1.

Fibres stop the cracking

As *Fig* 2 shows, the difference in test results was dramatic. Subsidence cracks — some as wide as 18 mm occurred in all 36 of the fibre free concrete test specimens. But none in the 36 fibrous concrete specimens made with a 12.7 mm of cover, a #8 bar and a 127 mm slump concrete.

Adding synthetic fibres at the dosage rates used typically increased the costs of the delivered concrete by 10 percent or more. But specifying the typical 609 mm cover depth for bridge decks can also increase the cost for continuous spans because more tension steel or a greater slab thickness over supports may be required. However, an increased cover depth reduces the rate at which chloride ions can penetrate uncracked concrete and reach the reinforcement. This delays initiation of corrosion by increasing the time until the chloride-concentration threshold is reached.

Thinner cover depths allow rebar to more effectively reduce the width of cracks from all sources - and the consequences of these wider cracks. So adding fibres and reducing cover depths may improve the durability of bridge decks and similar reinforced slabs adversely affected by cracking. And since as-built concrete cover is

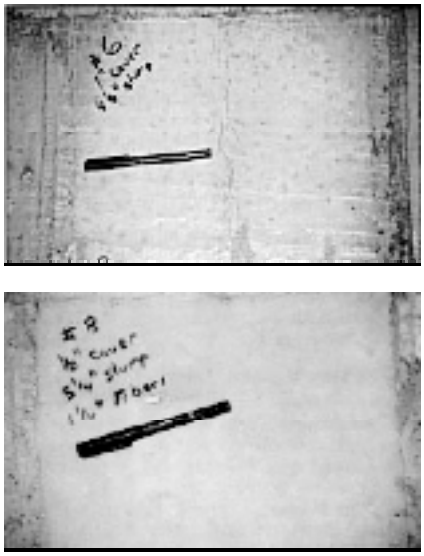

Fig 2 The image (on top) shows a typical subsidence crack in fibre-free concrete. All 36 specimens that didn't contain synthetic fibres cracked in this manner. But there were no subsidence cracks in the fibres concrete speciments, even in the worst-case specimens made with 12.7 mm of cover, a #8 bar and a 133 mm-slump concrete (bottom)

Table 1 (a): Concrete proportion and properties

Materials	*Batch weight, kg/m^3 (lb/yd^3)*
Type I/II portland cement	332.2 (560)
Class F fly ash	74.7 (126)
Water	163.1 (275)
Coarse aggregate	1020.4 (1720)
Fine aggregate	717.9 (1210)
Air entraining agent	7 x 10^{-4} l/kg (1.1 oz/100 lb)
Water reducer	26 x 10^{-4} l/kg (4 oz/100 lb)
Water/cementitious materials ratio	0.39

Physical properties	*Set 1*	*Set 2*	*Set 3*	*Set 4*
Slump, cm (in)	11.4 (4½)	13.9 (5½)	11.4 (4½)	13.3 (5¼)
Air content, percent	5.0	6.0	5.0	62
Unit weight, pcf	141.8	140.6	140.6	138.0
Temperature, °C (°F)	23 (73)	22 (72)	24 (75)	24 (75)
Fibres, kg/m^3 (lb/yd^3)	0	0	0.74 (1¼)	0.74 (1¼)
Water added l/m^3 (gal/yd^3)	10 (2)	15 (3)	0	10 (2)
Compressive strength, kg/cm^2 (psi)				
7 days	266 (3780)	264 (3760)	250 (3560)	225 (3200)
28 days	356 (5060)	363 (5165)	357 (5080)	327 (4660)

*Suprenant, Bruce A. and Malisch, Ward R. The fiber factor, *Concrete Construction*, October 1999

sometimes less than the specified value, fibrous concrete may provide added insurance against subsidence cracking when cover depth is less than desired. However, before one can evaluate the benefits of fibre, actual bridge-deck field trails using fibrous concrete and thinner specified cover depths are needed.

Advantages

- Polypropylene fibres inhibits micro-cracking, bleeding and increase cement hydration in fresh concrete, thereby reducing surface permeability, dusting and wear
- They distribute localised stresses, thereby reducing damage from impact, flexural fatigue, shatter, spalling and cracking in hardened concrete
- They help in reducing maintenance and repair costs
- They provide a tough and durable surface
- They help in saving time due to speed and convenience of concrete placing and flexibility
- they can help in achieving a cost saving of over 50 percent in screeds and overlays in comparison to crack-control steel wire fabric.

According to the British Board of Agreement (BBA) test results, following properties of *Fibermesh* are observed in fresh and hardened concrete.

- reduction in plastic cracking by 83-95 percent in fresh concrete
- reduction in bleeding by 35-55 percent in fresh concrete
- reduction in plastic settlement by 27-42 percent in fresh concrete
- increase in freeze/thaw resistance by 82 percent in hardened concrete
- increase in abrasion resistance by over 50 percent in hardened concrete
- reduction in surface permeability by 79 percent in hardened concrete.

Applications

Some of the applications of *Fibermesh* include: long strip, wide bay and large area fast-track pours, composite slabs, screeds; toppings and overlays; mortars and renders; stamped, pumped, extruded and sprayed concrete; water-retaining structures; plaster and cement-based waterproofing treatments.

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