Silica Fume – Floors & Pavements

For Building, Construction, Mining & Tunnelling

MICROSILICA FLOOR AND PAVEMENT CONCRETE

Microsilica FPC can include a range of specialist materials for industrial floors, housing slabs, pavements and agricultural hard stands:

- Scancem steel fibres to replace and improve on conventional reinforcing
- Synthetic fibres to provide early age crack control (up to 1 day)
- Microsilica to give high abrasion resistance, strength and chemical resistance
- Pigments for a brighter finish or an environmentally sensitive appearance

ABRASION RESISTANCE

The abrasion resistance of concrete is closely linked to the strength of the cement paste. This can be improved by using a lower water:cement ratio, reducing bleed (reduces the water:cement ratio at the surface), and by adding Microsilica. Bleed can have a major affect on abrasion resistance. Microsilica virtually eliminates bleed, synthetic fibres reduce it significantly.

IMPACT RESISTANCE

Impact Resistance is a measure of the ability of the concrete to absorb the energy imparted to it by a sharp, short duration load or blow. Fibres enable concrete to absorb the energy by turning it from a brittle material to a tougher more ductile one. The level of improvement is determined by the fibre type, geometry and dosage.

Synthetic fibres give the highest level of impact resistance to concrete and are therefore of value:-

- In heavy equipment workshops
- In addition to Microsilica where abrasion and impact are present
- Where tracked vehicles are used
- Where rocks, rubble or rubbish are loaded
- Where vibration is a problem
- Where steel wheeled trolleys, rubbish dumpsters etc are use

PLASTIC CRACKING

When the concrete is fresh and still plastic i.e. in the first few hours after placing, various factors can cause early age tensile strains which exceed the tensile capacity of the young concrete. Low dosages of synthetic fibres will increase the resistance of concrete to this type of cracking. Performance is related to the fibre characteristics but, in general, synthetic fibres are superior to steel fibres in controlling plastic cracking because the comparatively low steel fibre count per kilo of fibres added results in a much lower fibre/paste bond area that cannot effectively mobilise the load carrying capacity of steel fibres at early age.

Early age strains that are of significance are plastic shrinkage, early thermal and plastic settlement. Drying shrinkage cracking, the majority of which occurs from 1 day to 90 days can not be controlled by synthetic fibre because the concrete strength and modules are far higher than the fibres. Long term strains are best controlled by steel fibre.

TOUGHNESS

Toughness is the principal criteria for designing industrial floor slabs. The design is based on the fact that the concrete will behave in a ductile fashion with the steel fibres spreading the load into the surrounding concrete, and hence over a larger spread of ground. Toughness is a standard measure for steel fibre concrete and is the subject of ASTM, JIS and many European standards. The Concrete Society (UK) has maintained the JIS defined Re_3 designation of toughness as being suitable for floor slab design in its Technical Report 34.

The performance of fires varies enormously depending on the steel properties, anchorage design and aspect ratio. Scancem is the leading fibre in terms of toughness performance.

TENSILE STRENGTH

Fibres do not increase tensile strength significantly. Conventionally 30Mpa concrete is taken to have a flexural

strength of 4Mpa. In some steel fibre slab design methods a flexural strength of 6Mpa as the principal criteria used in the elastic design. This can simply be achieved by increasing the compressive strength of the concrete to 40Mpa by lowering the w/c ratio or by using Microsilica. In other words the steel fibre is redundant. This shows the method is invalid and a toughness basis should be used.

SHEAR STRENGTH

Steel fibres provide shear capacity because many of the fibres are under a steep angle and act like stirrups I direct tension. Hence, if the slab cracks, the steel fibres will provide a locking action that prevents differential vertical movement.

Scancem steel fibres provide excellent shear capacity and hence 30kg/m^3 of 60/1.00mm fibre were specified. The Microsilica FPC with Scancem steel fibres was pumped to the job site with ease.

CONSTRUCTABILITY

Use of steel fibres and silica fume can make construction considerably easier and cheaper. Where steel fibres are used to replace mesh the cost and time saving associated with not placing mesh are considerable. Another benefit is that without

mesh its often possible to truck the concrete up to the work face, no pumping or wheelbarrowing involved. A big decision, what joint spacing? In Europe jointless floors (40 metre plus joint centres) are not uncommon. This requires a high degree of expertise and specialist design. More generally steel fibre floor slabs enable joint spacing to be increased. It is recommended that the slabs are allowed to move and thickened sections should be isolated from large pours.

Microsilica Concrete requires close attention to ensure plastic cracking, due to the low bleed does not occur. This low bleed can be an advantage, in that finishing can be undertaken immediately with the one pass finish method.

SUGGESTED READING

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3. Gjorv, O.E., Baerland, T., and Heinrich, R.R., "Abrasion Resistance of High Strength Concrete Pavements. Concrete International Vol 12 No 1, January 1990.
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7. "High Performance Concretes, A State of the Art Report", Strategic Highway Research Program, National Research Council, SHRP-C/FR-91-103, 1991.
8. Baluguru. P., and Shah S.P., "Fibre Reinforced Composites" Me Graw Hill 1992.

SCANCEM MATERIALS

Products For Engineered Concrete

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