Oriental Trexim Pvt.Ltd.

ORISIL

Building Future

Silica Fume / Microsilica for High Strength Concrete

SILICA FUME HIGH STRENGTH CONCRETE

Silica fume high strength concrete is now readily available from many concrete plants. Strengths of 100MPa are available in some locations.

Economics

The drive behind silica fume high strength concrete is economics.

- **Columns**. Figure 2 shows that the lowest column cost to carry a given load results by using silica fume high strength concrete and deleting expensive reinforcing steels.
- **Shaft Walls.** The great economic benefit is indirect. For example the value of extra floor space when 80MPa silica fume high strength concrete is used instead of 40 Mpa concrete could be as much as 50% of the core construction cost.
- **General.** Wherever concrete is in compression high strength concrete can be used to reduce material cost. Inevitably other cost savings are even greater. For example thinner tunnel segments leads too a great saving in excavation costs.

Physical Properties

Strength requirements are balanced between early age for stripping and long term structural performance. Silica fume is a key component of high strength concrete as it contributes to strength at early and later ages (fig 3).

CONCRETE BENEFITS

THINNER ELEMENTS

- Lower material cost
- Reduced self weight
- Reduced heat build up
- More space available
- More elegant design

REDUCED REINFORCEMENT

- Lower cost
- Faster construction
- Simpler placing
- Lower labour cost
- Improved compaction

HIGH STIFFNESS/LOW CREEP

- Less column shortening
- Smaller beam deflections
- Reduced sway

LOW SHRINKAGE

SHORTER CURING PERIOD

HIGH EARLY STRENGTH

LOW HEAT

Figure 1- Pumping 100MPa high flow silica fume concrete.

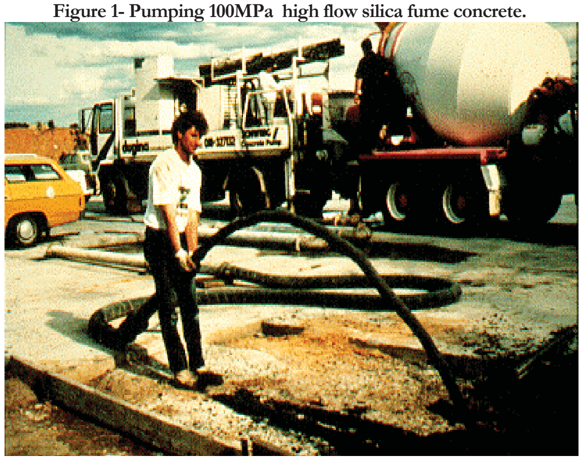


Figure 2 - Column Cost. - high strength concrete can lead to direct material cost savings. However, the major return can be future income from increased lettable area due to thinner elements.

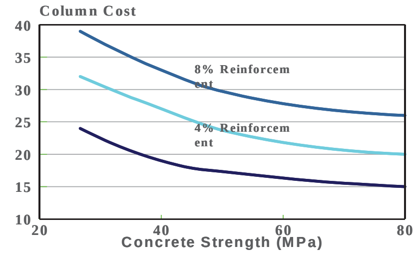


Figure 3 - Balance Between Early and Later Strength. Silica fume high strength concrete provides high early age strength as well as high long term strength.

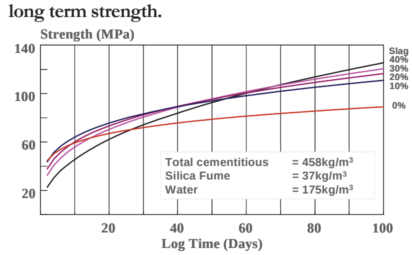
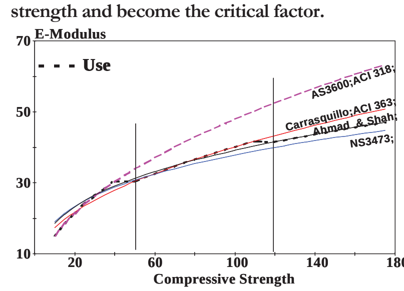


Figure 4 - E-modulus of Silica Fume high strength concrete. This does not rise as rapidly as strength and become the critical factor.



When designing with silica fume high

Figure 5 - Creep of Silica Fume Concrete. The creep of silica fume high strength concrete is significantly lower than normal concrete. This reduces deflections and prestress losses.

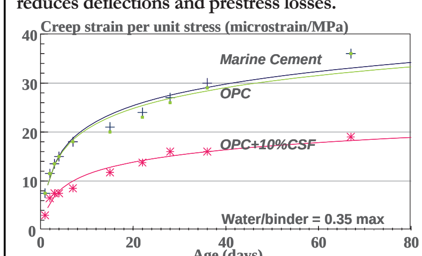


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Figure 6 - Shrinkage of silica fume high strength concrete. Provided silica fume high strength concrete is cured for 24hrs shrinkage is likely to be similar or less than normal concrete. (ref I.Burnett CSR)

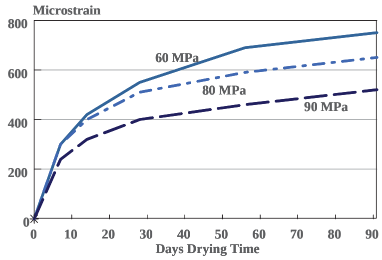
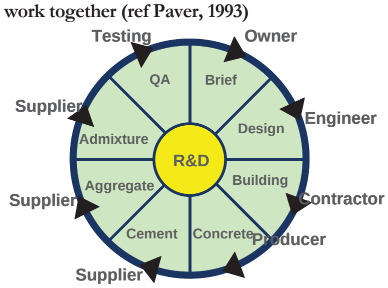


Figure 7 -Teamwork for Silica Fume high strength concrete. To successfully design, manufacture, transport, place and finish silica fume high strength concrete all parties must work together (ref Paver, 1993)



strength concrete it is necessary to use appropriate physical properties some of these are provided in the book "Silica Fume Concrete" available on request.

Key parameters are:

E Modulus – critical for elastic shortening in silica fume high strength concrete, (fig 4)

Creep – greatly reduced in silica fume high strength concrete (fig 5)

Shrinkage – reduced in silica fume high strength concrete (fig 6).

SPECIFICATION

Where silica fume concrete is to be used the general specification clauses outlined on the "Silica Fume " brochure shall be included in the concrete specification. Additionally, silica fume high strength concrete shall be specified by including the following clauses in the standard concrete specification:

Concrete shall be supplied with the following physical properties:

Min. Characteristic Strength:
7 day ____Mpa
28 day ____Mpa
90 day ____MPa

Maximum Shrinkage at 50 days ____ustrain.

Test reports showing that the proposed mix will meet these requirements shall be provided before placing any silica fume high strength concrete.

Creep, E-modules and tensile strength shall be calculated using design formula developed for use with silica fume at the designated strength.. Before silica fume high strength concrete shall be placed these calculations shall be approved by the Engineer.

TECHNICAL SUPPORT

High strength concrete

High strength concrete is far more difficult to achieve at the job site than in the laboratory. Factors like pumpability (fig 1) and setting time for slip forming makes it is essential that the project team (fig 7) work together for success. Our group can assist in establishing a functional project team.

GENERAL

Orisil Materials are able to provide technical support related to most aspects of the use of concrete in construction. This support takes the form of:

- Meeting with the Owner, Architect, Engineer and/or Contractor to develop a cost effective and technically appropriate silica fume concrete option that invariably offers advantages to all parties, "the win, win, win approach".
- Presentation to interested parties on the mechanisms by which silica fume concrete provides solutions to construction problems.
- Report preparation that details the design methods and assumptions used for any analysis undertaken and includes published papers supporting the use these design methods.
- Use of computer models to calculate the dosage of special additives.

SUGGESTED READING

1. Helland, S., "Slipforming of Concrete with Low Water Content", Vol 18, No 12, December 1984, pp 19-21.
2. Sellevold, E.J., "The Function of Condensed Silica Fume in High strength concrete", Utilisation of High strength concrete, Proceedings of the Symposium in Stavanger, Norway, June 1987, Trondheim, Tapir Publishers, 1987, pp 39-49.
3. Paver, I., "Construction Aspects" High Strength, High Performance Concrete Seminar, C&CA. Sydney, 1993.
4. Baweja, D., et al "High Performance Australian Concretes for Marine Applications" American Concrete Institute, Singapore 1994.
5. Luther, M. and Hansen, W., "Comparison of Creep and Shrinkage of High Strength Silica Fume Concretes with Fly Ash Concrete of Similar Strengths", Proceedings, CANMET/ACI Third International Conference on the Use of Fly Ash, Silica Fyme, Slab and Natural Pozzolans in Concrete, Trondheim, SP-114, Vol 1 ACI, Detroit, 1989.
6. Sellevold, E.J., "The Function of Condensed Silica Fume in High strength concrete", Proceedings Symposium on Utilisation of High strength concrete, Strevenger, Norway, 1987, pp 39-49.
7. Hansen, W., "Creep and Drying Shrinkage of Very High strength concrete", Department of Civil Engineering, The University of Michigan, Ann Arbor, Michigan, 1987, p23.

Figure 8 - Melbourne Central. Silica fume was used to provide high strength pumpable concrete.

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