

Silica Fume – Shotcrete

For Building, Construction, Mining and Tunneling

Fig 1a - President Hotel in Melbourne used silica fume spraycrete as the contractor found it the cheapest means of constructing curved architectural walls



Fig 1b - Water tanks 20m diameter and 5m tall have been constructed in one day with silica fume shotcrete. An internal shutter about 3m long and full height is moved like a horizontal jump form.



INTRODUCTION

Shotcrete relies on three key components which ensure the ideal performance for commercial construction, mining and tunnelling applications.

Silica fume imparts the following properties:

- High cohesion and adhesion (fig 2) makes Silica fume shotcrete a viable low cost construction method, particularly where formwork costs are high, eg basements, curved walls, water tanks. In underground construction Silica fume shotcrete linings can be shot in one pass without using toxic accelerators (fig 8).
- High durability (fig 3) and strength makes silica fume the ideal choice in severe exposure environments.

Shotcrete should incorporate fibre specifically selected for each application:-

- Synthetic fibres (fig 4) provide excellent control of early age cracking, a particular consideration in high cement contents shotcrete which is highly restrained.

CONCRETE BENEFITS

WITH SILICA FUME

Formwork Elimination

- shortens construction period
- reduced labour

Low Rebound

- reduced waste
- low clean up

High Build

- no cold joints
- rapid construction

Waterproof

- no membrane required

Durable

- suitable for severe exposure

High Quality Finish

- suitable for coating

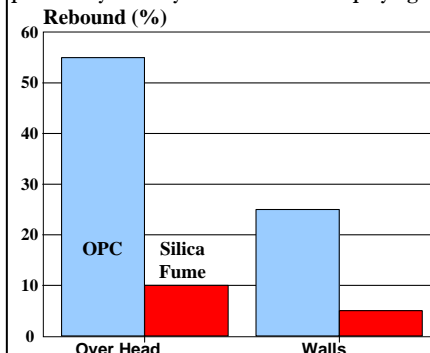
WITH SYNTHETIC FIBRES

- low early age cracking
- high build

WITH SCANFIBRE STEEL FIBRES

- eliminates mesh
- low overspray
- low preparation
- high toughness and impact

Fig 2 – Silica fume shotcrete’s cohesion and adhesion reduces the amount of rebound, particularly with dry mix and overhead spraying.



- Scanfibre steel fibres impart high toughness (fig 5) enabling mesh to be excluded (fig 6).
- The high toughness of steel fibres imparts high impact resistance (fig 7).

Fig 3 – Silica fume shotcrete provides resistance to corrosion. The very low chloride permeability is indicated here (ref Morgan 1992)

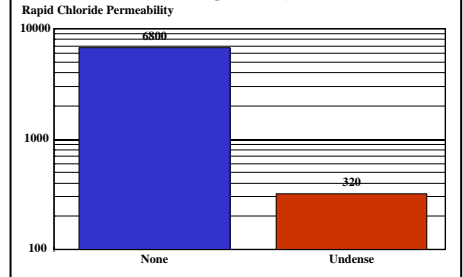


Fig 4 - The low early age cracking with Nycon synthetic fibres results from their high bond performance due to their hydrophilic nature

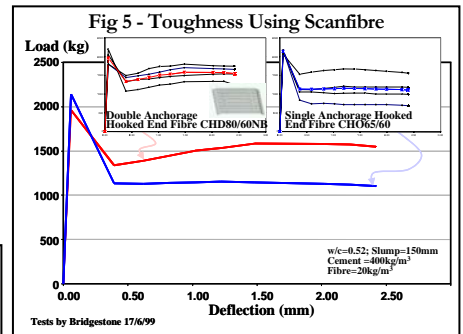
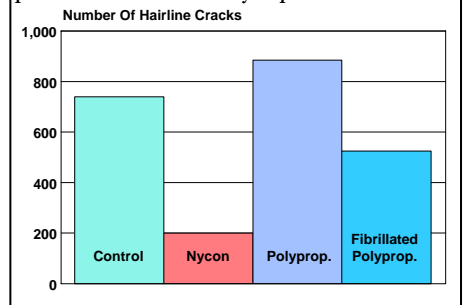
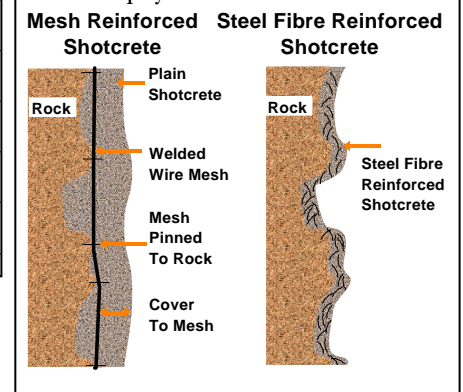


Fig 6 – Use of Scanfibre can eliminate mesh and reduce overspray.



Silica Fume Concrete – The Next Generation Construction Material

Fig 7 – Scanfibre steel fibres imparts high impact resistance not obtainable with other fibre types. Synthetic fibres only give low impact resistance.

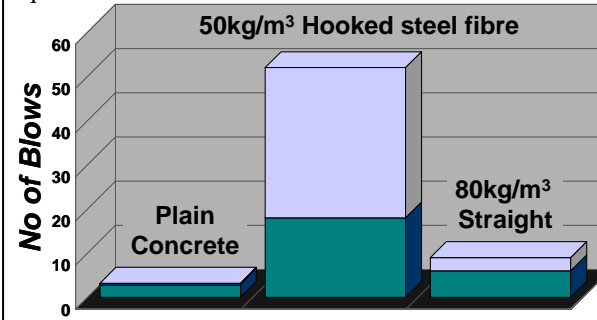
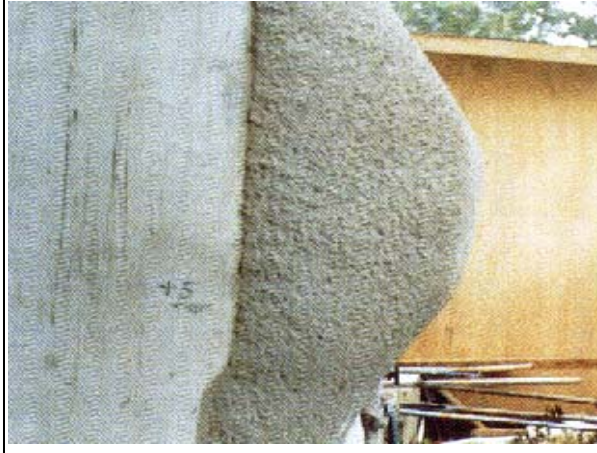


Fig 8 – Silica fume shotcrete can be built up to 10x that of normal shotcrete



SPECIFICATION

Where silica fume is to be used the general specification clauses outlined on the “Silica Fume” data sheet shall be included in the concrete specification.

Additionally shotcrete can be specified by including the following clauses in the standard concrete specification:-

- All shotcrete shall contain a minimum of 8% silica fume.
- Steel fibre shotcrete shall have the following properties*
 - R_{e3} 60%
 - 28Day f_c 40 MPa
- All shotcrete shall be placed in one pass to the full thickness such that there are no cold joints.
- All rebound shall be collected and removed from the job site.

*Consult Scancem Materials to give specific recommendations for your project.

GENERAL

Scancem Materials and its associates 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,

Fig 9 – Silica fume Shotcrete, the rapid simple way of applying concrete



Engineer and/or Contractor to develop a cost effective and technically

appropriate concrete option that invariably offers advantages to all parties; “the win, win, win approach”.

- Presentation to interested parties on the mechanisms by which advanced materials in concrete provide 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 of these design methods.

Use of computer models to calculate dosages of special materials.

TECHNICAL SUPPORT

We can provide shotcrete matched to design requirements for durability and toughness based on exposure conditions, or select suitable combinations of silica fume and Scanfibre to give the ideal impact and abrasion resistance.

SUGGESTED READING

- 1) Morgan, D.R., 'Use of Supplementary Cementing Materials in Shotcrete', Proceedings International Workshop on the Use of Fly Ash, Slag, Silica Fume, and Other Siliceous Materials in Concrete, Sydney, CIA, 1988 pp 403-432.
- 2) Morgan, D.R., "Advances in Shotcrete Technology for Support of

Underground Openings in Canada", Engineering Foundation Conference, Shotcrete for Underground Support V, Uppsala, Sweden, 1990.

3) Burge, TA., 'Fiber Reinforced High Strength Shotcrete with Condensed Silica Fume', SP91-57. American Concrete Institute 1991.

4) Wolsiefer, J., and Clear, K., 'Long Term Durability of Silica Fume Structural Concrete, Shotcrete, Grout, Slab Overlays and Patches', Fourth Canmet/ACI International Conference on Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete, Istanbul, Turkey, 1992.

5) Morgan, D.R., Neill, J., McAskill, N., and Duke, N., "Evaluation of Silica Fume Shotcrete", CANMET/CSCE International Workshop on Silica Fume in Concrete, Montreal, Quebec, 1987.

6) "Structural Shotcrete Walls", International Patent Pending No. PC-F/A492/0041 1.

7) Morgan, D.R., 'Wet-Mix Silica Fume Shotcrete: "Effect of Silica Fume Form"', Fourth CANMET/ACI International Conference on Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete, Volume 2, Istanbul, Turkey, 1992.

8) Vandewalle, M., "Tunnelling the -World" N.V. Bekaert, Belgium 1996.

The information given is based on knowledge and performance of the material Every precaution is taken in the manufacture of the product and the responsibility is limited to the quality of supplies, with no guaranty of results in the field as Scancem Materials has no control over site conditions or execution of works

SCANCEM MATERIALS

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