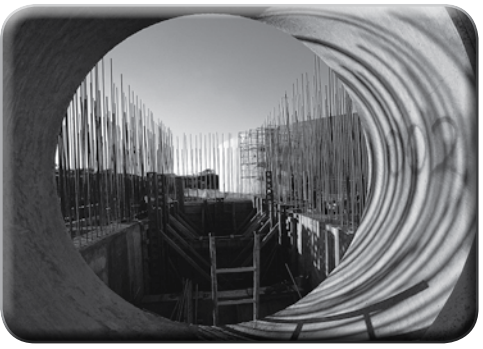

Microsilica
NEW ZEALAND

High Strength Concrete

A Natural Pozzolan for High Performance Concrete

Microsilica 600

MICROSILICA 600 — for High Strength Concrete

High strength concrete (HSC) provides economic benefits through thinner (lighter) construction elements and reduced construction times.

Strengths of 100MPa are being achieved by readymix concrete suppliers through the use of Microsilica 600.

New Zealand Concrete Design Standard – NZ 3101, limits the use of high strength concrete. As brittleness increases with strength, seismic design requirements limit compressive strength to 70MPa for ductile structures and structures of limited ductility. Other structures can be designed using concrete strengths of up to 100 MPa.

The use of high strength confinement steel, besides reducing the congesting of transverse reinformcement around columns and beam joints, greatly improves the ductile behaviour.

Benefits of Microsilica 600 Concrete

Thinner Elements

- Lower materials cost
- Reduced element weight
- Reduced heat build up
- Increased useable space
- Opportunities for more elegant designs

Improved Element Properties

- Less column shortening
- Reduced creep

Reduced Reinforcement

- Lower material cost
- Faster construction
- Simplified rebar placing
- Lower rebar fixing cost
- Less rebar congestion – improvement concrete compaction

Enhanced Concrete Properties

- Better pumpability
- Lower heat generation
- Better form finish

Economics

The use of Microsilica 600 in HSC leads to economical and faster construction.

General

Wherever concrete elements are in compression, higher strength concrete will result in reduced material cost.

In addition there are other indirect cost savings which can be significant. Thinner tunnel linings lead to savings in excavation. Lighter structures results in reduced foundation requirements.

Precast Concrete

For precise concrete elements, on site cartage demands are lessened. Transport costs are reduced.

Columns

Cost analysis carried out by the NZ Cement & Concrete Association (table 1) show that by increasing concrete strengths, financial savings can be achieved.

Item	Conventional 600mm x 500mm 40MPa Concrete	HSC Option 450mm x 450mm 70MPa Concrete	Savings
Concrete	$8400	$6660	$1740
Reinforcement			
Longitudinal	$7129	$3210	$3910
Transverse	$13360	$9340	$8004
Formwork	$23760	$19440	$4320
Total	$52640	$38650	$13990
Savings			26.6%

Table 1. *Comparative cost of columns using HSC and normal concrete*

Microsilica 600

Physical Properties

Compressive Strength

The pozzolanic reactivity, fine powder packing mechanism and the improvement of bond at the aggregate paste interface increases the strength of Microsilica 600 concrete.

Laboratory test series (Figure 1) carried out over a year using commercially available aggregates and sand, produced average results 10% higher than those achieved using just Portland Cement.

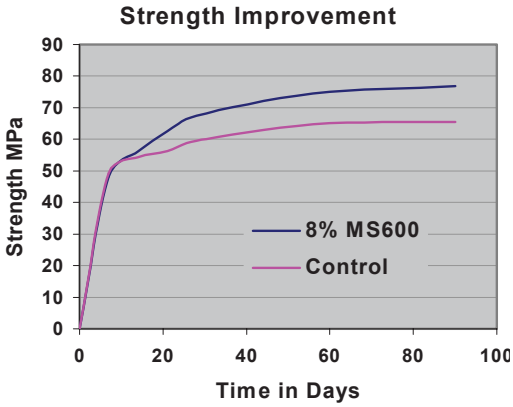

Figure 1. *Strength improvement. In this case 28 day strength increased by 10% but increases of up to 20% are possible.*

The efficiency of MS600 depends on many factors. Generally, however, Microsilica 600 does not decrease 7 day strengths and significant increases in compressive strength of concrete are obtained by 21 days.

The increase in strength is in line with the levels of efficiency as reported in the "General Microsilica 600" brochure.

Figure 3. *High strength concrete (105 MPa at 28 days) used for these bridge beams had a release strength after steam curing (heat maturity 620° CH) of 60 MPa.*

Drying Shrinkage

At the same water/binder ratio there is little difference in the long term shrinkage characteristics of Microsilica 600 concrete and standard concrete (Figure 3).
Although water content is recognized as being the major contributor to concrete drying shrinkage, aggregate and sand properties also influence the performance.

Extensive tests carried out using aggregates and sands sourced from major New Zealand quarries produced a wide range of shrinkage values (figure 3).

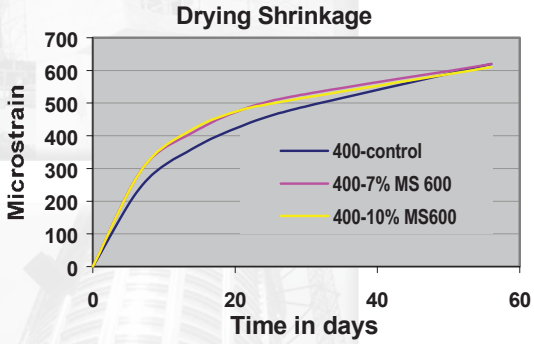

Figure 3. *Shrinkage of Microsilica 600 concrete is similar to conventional concrete.*

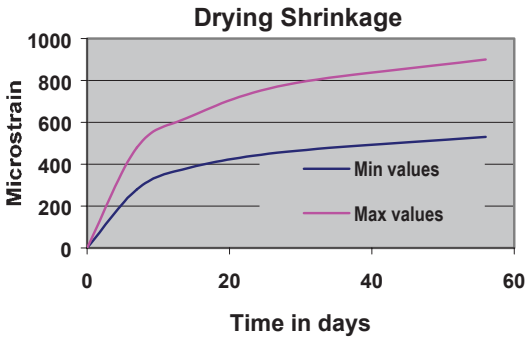

Figure 4. *Concrete shrinkage values over time. The influence of aggregate and sand on the shrinkage properties 10% MS600 dosage.*

Tensile Strength

Improved aggregate to paste bonding properties increase the concrete's inherent tensile strength. Relative to compression strength, the tensile strength of Microsilica 600 concrete is greater than conventional concrete.

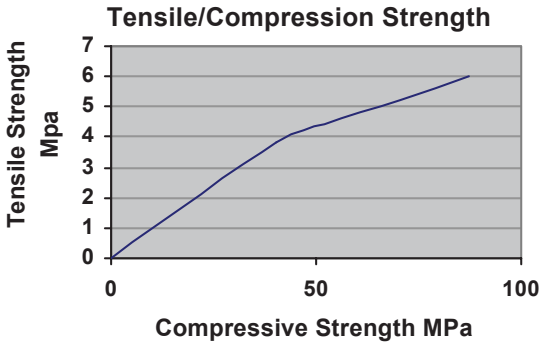

Figure 5. *Microsilica 600 increases the tensile to compressive strength ratio.*

Modulus of Elasticity

Extensive tests were carried out on aggregates obtained from five major New Zealand quarries.

As shown in table 2 within the range of strengths considered, Microsilica 600 impacts little on the Modulus of Elasticity. Geological properties of the coarse fraction of the concrete aggregates did influence performance.

	Strength	MOE
	MPa	GPa
Control	59	42.4
5% MS600	65	42.1
10% MS600	68	41.5

Table 2. *Relationship between strength and Modulus of Elasticity.*

Figure 6. *MS600 was used in concrete for high strength columns, reducing their size and giving increased usable area.*

MICROSILICA 600 APPLICATIONS & INFORMATION

Other Microsilica 600 applications for specialist concretes and high performance concrete are detailed in the following brochures:

- Industrial & Commercial Floors
- Chemical Resistant Concrete
- Waterproof Concrete
- Marine Concrete
- Shotcrete

Reference should also be made to the operational and safety requirements in the following documents:

- Health & Safety Data Sheet
- Concrete Mixing Instructions
- Concrete Placement & Finishing Procedures
- Plastic Properties of Microsilica 600 Concrete

MICROSILICA NZ

P O Box 1359, Shortland St, Auckland 1140,
New Zealand. Ph 64 7 345 4710.
Email microsilica@goldenbay.co.nz

Microsilica 600