Boksburg Tel (010) 447 7100
Midrand Tel (010) 446 6745

TIP NO. 3

Quantum Readymix Concrete

COLD WEATHER CONCRETING

Since it is now well on its way to winter and no doubt the adverse effects of cold weather will affect construction projects please find our TIP No.3 dealing with **cold weather concreting** and its effects on concrete.

In doing this work we have tried to bring to the reader's attention the effects of concrete incorporating fly ash as an extender, at both normal and cold temperatures. Previous work done on this topic as well as research concludes that fly ash mixes are no more adversely affected by cold weather than pure cement mixes. The same study also concluded that this however is not the case should concrete contain milled granulated blast furnace slag (MGBS) as an extender.

The graphs and tables contained herein refer to a **"Standard Cure"** as well as **"Cold Cure".**

Standard Cure:
Refers to cubes stripped and cured for 28 days at between 22°C and 25°C as per SABS.

Standard Cure:
Refers to cubes cured for 1 day at 5°C and then 27 days at +10°C at a RH of 90%.

Whilst it may be debated that this is highly unlikely under normal highveld conditions one must take into account the other many factors need to be considered (see below). Cold shutters for instance can reduce concrete temperatures quite significantly particularly in say shutter boxes of narrow cross section (200mm x 200mm).

Attached please find some typical results with regard to compressive strength development of comparative 30 MPa Concrete mixes using either, CEM I 42,5 or a blend of CEM I 42,5 and 30% Fly ash.

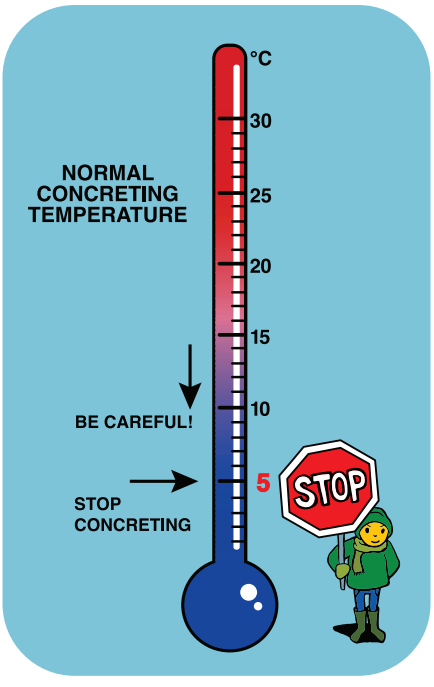
As can be seen, the strength development of both CEM I 42,5 concrete and the 30% Fly Ash concrete is seriously affected by low temperatures. Under the extreme conditions mentioned above, 24 hour strength for both types of concrete could not be measured, since the concrete was only just in the process of achieving initial set as per ASTM – Spec.

- **Placing Temperature of Concrete**
- **Form work (Steel of Timber)**
- **Exposure of cast element to wind / sunshine etc.**
- **Total binder content**
- **W/C – ratio**
- **Workability of mix (a high slump mix will be more prone to cold curing than a low slump mix)**
- **Ambient temperature**
- **Thickness / Volume of structure**
- **Is temperature rising or falling (am or pm)**

STANDARD CURE (AS PER SABS)

Mix design (Kg/m^3) and concrete results:

DESCRIPTION OF MATERIAL		CEMENT MIX	FLY ASH MIX
CEM I 42,5	Kg	335	250
Fly Ash	Kg		105
River Sand	Kg	795	795
19,0mm Dolerite Stone	Kg	1140	1160
Water	Liters	200	185
Slump	mm	65	60
1 Day	MPa	7.5	6.0
2 Days	MPa	10.0	9.0
3 Days	MPa	15.0	13.5
7 Days	MPa	25.0	22.0
28 Days	MPa	42.0	40.0



Materials Used

CEM I 42,5 - Lafarge - Fly Ash: Lethabo Fly Ash - Ash Resources - Fine Aggregates: Concrete Decomposed Sand (Granite) Coarse Aggregate: 19,0mm Stone (Dolerite)

COLD CURE (simulated Highveld conditions)

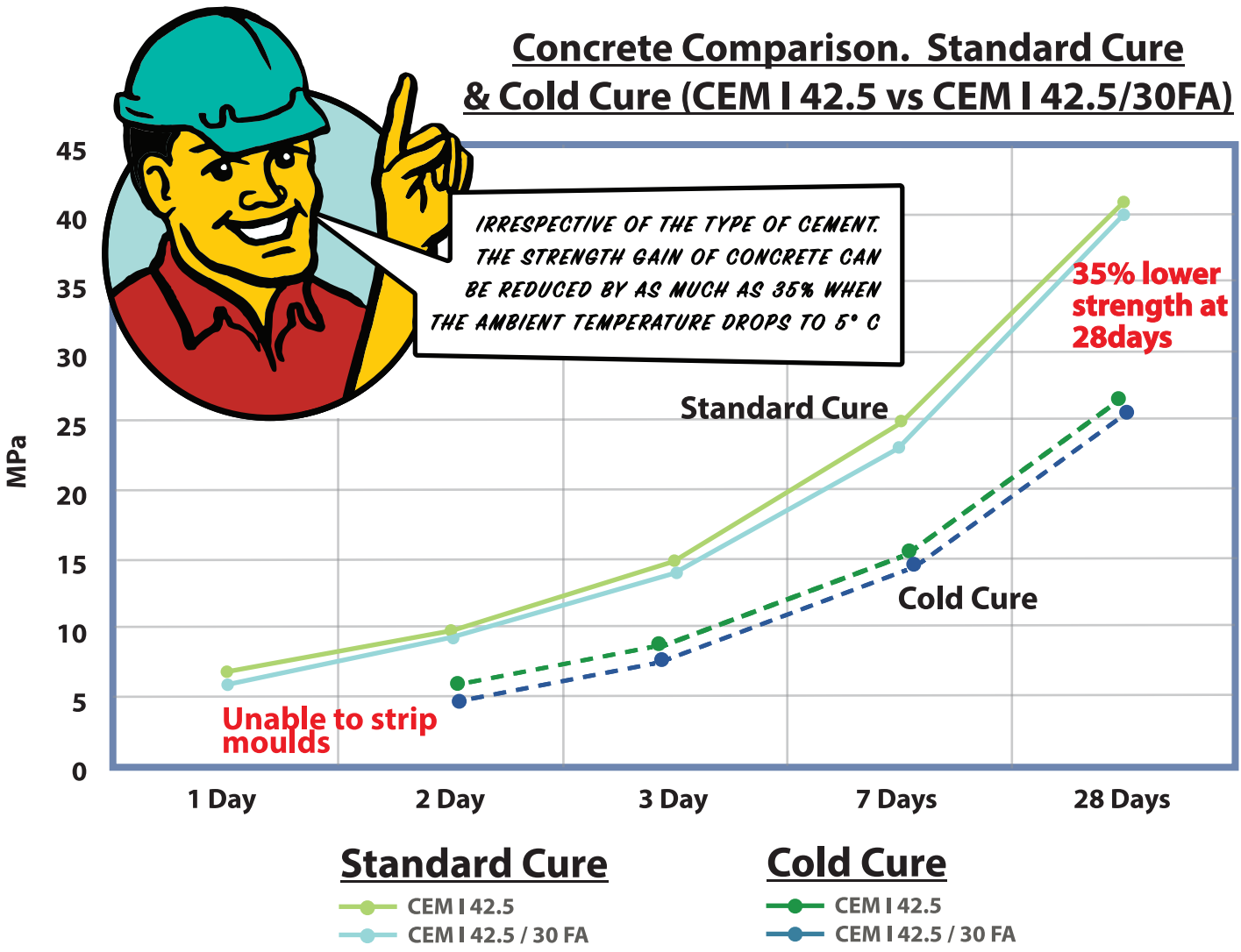
Mix design (kg/m³) and concrete results:

DESCRIPTION OF MATERIAL		CEMENT MIX	FLY ASH MIX
CEM I 42,5	Kg	335	250
Fly Ash	Kg		105
River Sand	Kg	795	795
19,0mm Dolerite Stone	Kg	1140	1160
Water	Liters	200	185
Slump	mm	65	60
1 Day	MPa	Could not measure	
2 Days	MPa	5.5	4.5
3 Days	MPa	9.0	8.0
7 Days	MPa	15.0	14.0
28 Days	MPa	27.0	26.5

** Insufficient 24 Hour Strength, Tested at 48 Hours**

Curing Conditions: 1 Day @ +5°C, 27 Days @ +10°C and 90% RH

Note : A climate room was used for the "Cold Cure"



In a comparative exercise, in midwinter, measuring the temperature on the shaded side of a building with no exposure to the sun versus the temperature on the sunny northern side of a building, the temperature was typically a critical 10°C - 15°C lower on the shaded side of the building