Quality Impacts of Cold Weather (Pt.1 Concrete)

Ready Mix Concrete operations require extra care during cold weather. Failure to control temperatures during a pour can cause the water in the concrete to freeze (<0°c) and expand (micro-cracking), which weakens the concrete's durability and strength.

Planning For Low Temperatures:

- Always check the forecast prior to concreting activities and consider rescheduling where beneficial.
- Low temperatures slow down the concrete's development on strength (see fig.1). Mixtures containing combination cements (GGBS / FA) are most susceptible (e.g. CIIIA (36-65%) and CIIIB (60-80%)) and harden slower during cold weather, requiring increased strike time. Review the concrete mixture, can it be adjusted to increase its hardening rate ->%cement/admixtures?
- Specify that ready-mix concrete be delivered at a temperature of 10°C (or higher) to allow for some heat loss during handling.
- Concrete can largely resist freezing when >2N/mm2.
- Plan and record all temperature controls within the activities' ITP Control Sheets.
- Lower concrete temperatures affect the rate of rise. Ensure a concrete thermometer is purchased to determine the temperature and confirm the rate of rise before issuing a Temporary Works Permit to Load.

Ready-Mix Concrete Deliveries:

- Review the temperature - Never accept Ready-Mix Concrete below 5 °C. Mix constituent materials shall be free from snow, ice and frost.
- Concrete typically loses approx. 5°C during transportation and placing.
- Where possible, select Supplier's that can provide heated read-mix concrete.
- Place concrete as soon as reasonably practicable and consider additional labour and standby plant to increase handling times and provision of protection.
- Concrete should not be placed against any formwork or reinforcement with a temperature of ≤0°C or covered in ice or snow (e.g. sub-base formwork, steel rebar, site equipment and plant).

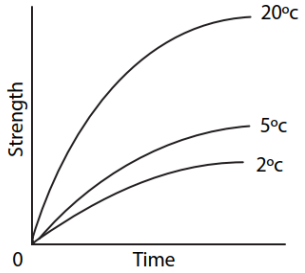

Fig.1 Effect of concrete temperature on strength.

Protecting Concrete Post-Pour:

- Exposed concrete surfaces should be protected as soon as possible with insulating covers such as: Mineral Wool, Foam or Polythene sheet with an air gap (note: do not use wet hessian).
- All plant should be protected against frost, with smaller items being kept under cover (wheel-barrows and skips).
- Where overnight frost is expected, the concrete must be protected with insulated covers / frost blanket and insulated formwork to ensure concrete remains above 5°C for the first 48 hours and reaches a strength of 5N/mm^2.
- Frequently monitor & record temperatures, ensure records are maintained demonstrating controls (BIM 360 Field).
- Temperatures at the surface of the concrete shall be measured where the lowest temperature is expected.
- Note: When the insulation cover (frost blanket) is removed, care should be taken to avoid a sudden change in temperature at the concrete's surface and the development of steep temperature gradient within the concrete. This is especially important with thicker sections where thermal cracking may occur.
- In cold weather, when the temperature of freshly-placed concrete may approach 0 °C, cold water curing must not be employed.

Note: CESWI Clauses 4.6 & 4.8 must be adhered to alongside (BS EN 2006-1 & BS EN 13670).

Quality Impacts of Cold Weather (Pt.2 Site Activities)

Earthworks:

When planning earthworks in winter, consider that:

- The moisture content of the ground can vary changing its composition and stability.
- Compaction requirements may change due to frozen ground or excessively wet ground.
- Testing of ground compaction will depend on the weather conditions (e.g. frozen / wet). For example, If there is potential for frost heave, the ground conditions will change as the temperatures rise, increasing pore water pressure within the soils.

Electrical Cable Installation in Cold Weather:

When installing and handling electrical cable it is important to work within the temperature limits stated by the manufacturer. Considerations should include:

- **Minimum Cold Bend Temperature**: The lowest temperature at which the cable will not break or crack when manually bent.
- **Minimum Installation Temperature**: This is a recommended true minimum operating temperature.
- **Minimum Continuous Flexing Temperature**: For applications that continually stretch and flex cables.

Installation of Pipelines:

Welding / tenting structures (e.g. Zapp shelters) should be sought during the colder and wet months to ensure the correct ambient temperature and dry conditions. There may also be a need to have forced heating during extended cold periods.

Drain-off of Pipe Isolations & Hose Reels:

Consider draining down or lagging any isolated pipework and hose-reels exposed to cold weather (where safe & applicable), to prevent the water freezing, expending and causing damage to the asset.

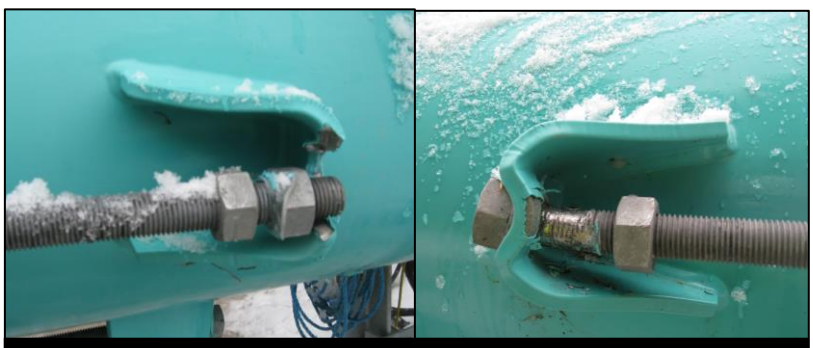

Fig 2: Example of damage to non-drained isolated pipework due to cold weather

Fig 3: Hose Reel Gun attachment with crack

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Installation of Materials:

Materials need to be installed to the manufacturer's specifications for installation, e.g. sealants such as Sikaflex generally cannot be applied in temperatures below 5 ºC. The preparation of a joint to ensure dry and frost free can cause damage to the concrete around the joint by shocking the concrete in the use of a propane gas torch, which can lead to cracking.

Testing of Structures:

Materials and structures often contract during the colder months. This should be considered when devising testing regimes such as drop tests on concrete / steel / plastic tanks. As a result, there will be more leakage in the winter months if a structure was built in the summer or if cracks have been filled with hydrophilic resin, as they may start to open up in the winter.

Gritting:

On concrete assets (walkways, slabs, structures) consider alternatives to Rock Salt Grit (e.g. UREA - Ice Melt XM De-Ice) to reduce damage and deterioration. (see Safety Alert 22-85 Winter Preparedness for further information). Temporary GRP mesh walkways may also mitigate hazards due to their elevated, anti-slip properties.

Example of concrete cracking

Example damage on concrete from Rock Salt