

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 ($<0^{\circ}\text{C}$) 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 \rightarrow %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 $>2\text{N/mm}^2$.
- 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 $\leq 0^{\circ}\text{C}$ or covered in ice or snow (e.g. sub-base formwork, steel rebar, site equipment and plant).

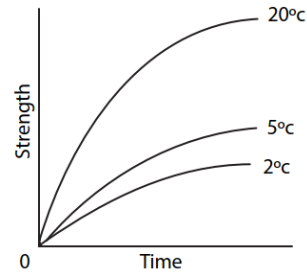


Fig.1 Effect of concrete temperature on strength.

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 (wheelbarrows 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.

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 °C. 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.

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, expanding and causing damage to the asset.

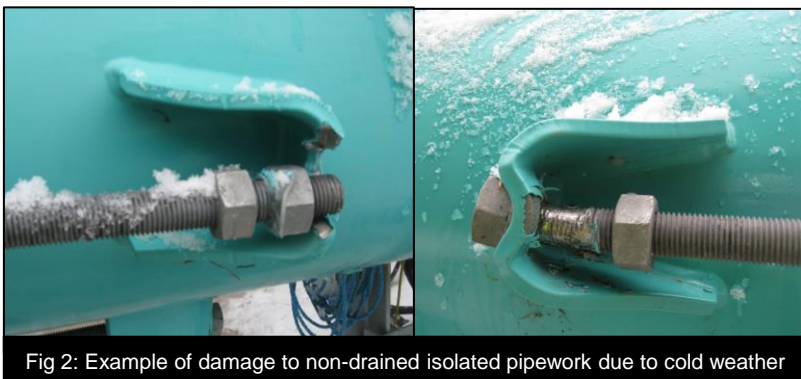


Fig 2: Example of damage to non-drained isolated pipework due to cold weather



Fig 3: Hose Reel Gun attachment with crack