

CONCRETE IN COLD WEATHER GUIDELINES

Over the last number of years Ireland has experienced a sustained period of wet weather followed by a prolonged and severe cold spell with temperatures falling to extremely low levels.

This type of weather can result in serious damage to concrete, primarily in exterior paving such as slabs, footpaths, driveways and yards.

Frost damage to these types of areas usually presents as surface scaling/de-lamination and or surface pop outs.

While fresh concrete is particularly vulnerable to frost attack mature concrete up to ten years old can also be similarly affected.

Certain precautions can be taken to minimize and possibly prevent frost damage to concrete and the following advice whilst not exhaustive will help protect concrete against frost damage.

Further guidance can also be got from the Irish Concrete Federations publication "Guidelines for Concreting in Cold Weather" available on www.irishconcrete.ie

Effects of cold weather on unprotected concrete

During extremely cold weather concrete (particularly fresh and early age concrete) can be severely damaged by frost and ice. When fresh concrete cools below 0°C the water in the mix freezes and expands which causes cracking internally and blistering of the surface. Mature concrete that is saturated can also be seriously affected by low temperatures.

- If there is a risk of frost at night it is essential to protect fresh concrete from freezing.
- Fresh concrete strength must reach 2N/mm² to avoid the effects of frost damage.
- Concrete temperature must be kept at or above 5°C for the first 48 hours to achieve this.
- Low temperatures will slow down concrete strength development for several weeks.
- Strength development is further reduced during cold weather if GGBS or PFA is used.
- Striking times of formwork must be extended during periods of cold weather.
- External slabs, yards and driveways are particularly vulnerable because they have a large surface area and thin section which allows heat to escape rapidly. Particular precautions must be taken to prevent frost damage to these areas.
- While it is common practice to apply de-icing agents such as salt on concrete surfaces to clear ice and snow during winter, these in themselves can damage the concrete surface that they are applied to. Ammonia based de-icing agents are particularly aggressive and should not be used as they can severely damage concrete surfaces.

Precautions to be taken when concreting in cold weather

- Specifications recommend that concreting should not start when the air temperature is 5°C and falling and should only begin when the temperature is at 3°C and rising.
- Fresh concrete should never be placed on or against frozen ground.
- Reinforcing bars and shuttering must be free of ice and snow. Cover and insulate the concrete where possible.
- If concrete has to be placed it should be organized so that it is done as quickly as possible.
- Frost blankets should be used to provide insulation and protection for exposed concrete surfaces.
- Wind breaks will reduce wind chill and evaporation and help lower heat loss especially from slabs.
- Heaters may be necessary to provide continuous heating to the concrete to maintain heat.
- Increasing the cement content or grade of concrete will generate more heat in the concrete; consider the use of air entrainment, polypropylene fibres or accelerator.
- The Irish Standard for Concrete : IS EN 206, recommends using C30/37 (37N) air entrained or C40/50 (50N) concrete where wet horizontal surfaces are exposed to significant freeze/thaw cycles.



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