

Usage of Concrete in Cold Weather Conditions

Laying concrete in cold weather requires careful preparation and implementation to ensure durability and structural integrity. Key considerations include the temperature of the concrete, the ambient air temperature, and the methods of protection. Here's a summary of the main points and recommendations for successful concreting in cold weather:

Key Issues with Cold Weather Concreting

RISK OF FREEZING:

If fresh concrete cools below 0°C, water in the mix freezes and expands, causing irreparable damage.

Concrete achieves resistance to freezing once it reaches a strength of ~2 N/mm², typically within 48 hours if maintained above 5°C.

SLOWER STRENGTH DEVELOPMENT:

Even when temperatures remain above freezing, colder conditions slow down strength gain significantly.

SET TIME DELAYS:

At 21°C, concrete sets in about 6 hours. At 4.4°C, set time extends to over 14 hours, with further delays at lower temperatures.

TEMPERATURE CATEGORIES AND PRECAUTIONS

1. Ambient Temperature Below 5°C but No Frost

Impact:

No permanent damage, but prolonged strength development.

Recommendations:

Leave formwork in place longer to prevent damage to edges and ensure structural integrity.

Increase cement content and reduce or eliminate GGBS/pfa for faster strength gain.

Protect exposed surfaces with insulating material to maintain concrete temperature.

2. Ambient Temperature Below 5°C but No Frost

Impact:

Risk of freezing necessitates immediate protection of freshly placed concrete.

Recommendations:

Ensure concrete is delivered at or above 5°C.

Use frost blankets, insulated formwork, or temporary covers with heating.

Ensure all equipment and surfaces (sub-bases, formwork, reinforcement) are free from ice and snow.

3. Severe Frost Day and Night

Impact:

Extreme conditions require enhanced precautions; failure to do so could compromise the concrete.

Recommendations:

Use heated water for mixing to ensure concrete temperature exceeds 5°C.

Delay work if heated water isn't available or if adequate protection cannot be ensured.

Employ insulating materials and additional heating methods for formwork and exposed areas.

General Best Practices

TEMPERATURE MONITORING:

Track both ambient air and concrete temperatures to ensure compliance with the recommended thresholds.

EARLY STRENGTH DEVELOPMENT:

Keep concrete warm for the critical first 48 hours using blankets, heaters, or insulated formwork coverings.

FORMWORK TIMING:

Allow extra time before removing formwork to prevent premature exposure of concrete to cold air.

SURFACE PREPARATION:

Clear all surfaces of ice, snow, and frost before placing concrete to prevent contamination and ensure proper bonding.

COMMUNICATION WITH SUPPLIERS:

Coordinate with ready-mix supplier to confirm the delivery temperature of the concrete and adjust plans as necessary.

By following these guidelines and adapting to the severity of the cold weather, you can mitigate the risks associated with cold-weather concreting and ensure a successful project.

