

Casting In Situ Concrete Piles and Diaphragm Wall Panels in Cold Weather in the UK

General

This note is intended to offer guidance on best practice in casting in situ concrete piles and diaphragm wall panels in the ground during cold weather in the UK.

Due to the water content of fresh concrete, during periods of cold weather, additional measures need to be implemented to ensure that the integrity of the finished foundation is not compromised.

The British Standard on the Structural Use of Concrete BS8110 states in cl 6.2.4:

“To provide confidence that the concrete can resist permanent damage from freezing the temperature of the concrete should, at no point, fall below 5 °C until the concrete in the structural element reaches a strength of 5 N/mm² nor should water curing be applied in conditions where freezing of the concrete is anticipated.”

Specification of Highway Works 1700 series makes similar recommendations.

The drawback in referring to BS8110 and the SHW1700 series is that they have been written to apply to concrete cast within traditional formwork above ground.

Piles are cast into an environment that provides a good degree of insulation, and below a metre or so depth will be warmer than the ambient above ground temperature. Once placed the heat of hydration will ensure that the concrete does not cool, and only the top of the pile will be at risk.

This difference is acknowledged in documents more directly aimed at the construction of foundations:

The ICE Specification for Piling and Embedded Retaining Walls (2nd Edition) clause B19.7 states:

“The temperature of fresh concrete shall not be allowed to fall below 5°C. In cold weather where the ambient air temperature is less than 5°C, the heads of newly cast piles are to be covered to protect them against freezing unless the final cut-off level is at least 0.25m below the final head level as cast.”

In BS EN 1536:2010 Execution of Special Geotechnical Works - Bored Piles the temperature of the concrete is not addressed but instead cl 8.4.1.20 states:

“At an ambient air temperature less than 3 °C and falling, the heads of newly cast bored piles shall be protected against freezing.” BS EN 12699:2000 makes a similar statement with regard to the protection of newly cast in place displacement piles.

This recognises the insulating effect of the ground over the majority of the pile/panel and draws attention to the fact that only the head of the pile/panel should then need protection.

It is worth noting that the equivalent document for the execution of minipiles (BSEN14199) does not mention a specific temperature only that:

“The temperature of the reinforcement or bearing element shall be high enough to avoid formation of ice on the surface when installed.” cl 8.7.4.5

The execution code for diaphragm walls (BSEN1538) makes no reference to the temperature of the concrete or the ambient conditions during the concreting process.

Guidance

Subject to any express requirements contained within the contract or specification for the works and based on the above it is suggested that concrete should be above 5°C at the point of placement.

When concrete is being provided by an external supplier, caution should be exercised if the supplier advises in advance that he cannot guarantee the temperature of the concrete at the point of delivery. Regardless of whether the temperature can be guaranteed or not, all fresh mixed concrete should be free of both frozen aggregate and ice particles. If necessary, technical advice should be sought from the proposed concrete supplier.

In order to ensure that the concrete is placed at the correct temperature a suitable thermometer will be required. This should be used to check the temperature of the concrete on arrival, and before placement if it has been kept waiting before use.

If the ambient temperature is likely to fall to below 3°C after placement of the concrete, and before the concrete has achieved a compressive strength of 5 N/mm² then the top of the pile/panel should be protected. If this is not done the top of the pile/panel will need to be broken down to remove any frost damaged concrete. The normal requirement to break down to sound concrete may mean that this material would be removed in the normal course of events anyway.

The curing time of concrete will increase in low temperatures, especially if materials such as GGBS are used. This should be taken into account when considering when piles/panels can be broken down as it may have programme implications.

In cold weather the correct production and handling of concrete test cubes is even more critical. Poor quality control at this stage may lead to low test results that do not accurately represent the in situ concrete strength of the piles. It is therefore extremely important to ensure that suitable equipment is utilised and that adequate procedures are followed.

Disclaimer

Although every effort has been made to check the accuracy of the information and validity of the guidance given in this document, neither the FPS or its members accept any responsibility for mis-statements contained herein or misunderstanding arising herefrom.

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