Concrete Pipe Association of Australasia Technical Paper

Curing of concrete pipe – a brief abstract

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INTRODUCTION

The most comprehensive investigations of concrete curing, including aspects of both strength and durability, were carried out by CSIRO through the 1980s & 90s, with results published in 1992 and 1997. While differences in binder composition have been found to influence the durability of concretes of the same strength grade, it remains generally (though not universally) true and accepted that strength and durability achieved by different curing treatments are co-related.

CURING OF CONCRETE PIPES

Concrete pipes, cured in the mould, are generally given a brief thermal cycle to achieve "stripping strength" and then stored on the factory site until the concrete is strong enough for the pipes to pass the prescribed load test and to be transported and installed. Manufacturers have carried out extensive investigations to determine the most economical curing parameters which will enable the required strength to be achieved, most recently with the advent of admixtures to assess where a worthwhile gain can be made through the use of these relatively new materials. Most pipe in Australia is manufactured to processes retaining the essentials of an invention dating from 1910 and the track record shows that all aspects including curing result in an extremely durable product.

With the advent of pre-stressing in the 1950s, early strength gain became a critical aspect to the manufacture of pre-stressed, precast concrete products. In the late 1960s, working with the industry group, CSIRO of that time systematically investigated the effects of different parameters, in particular the stand-down time, rate of temperature rise, and time at maximum temperature on the strength which could be achieved in a short enough time to allow one cast per day per mould. This cycle has become standardised throughout the industry in Australia for pre-stressed work and applied elsewhere. However the sole aim of the investigation was to achieve the highest strength in the available time. There was no separate investigation of effects on durability, nor any implication that the cycle was ideal if shorter periods of time were available, for example if a mould was to be used twice in the same day. A later investigation has shown no effect on durability properties from much shorter periods of "stand down" before the temperature is increased.

While concrete as made will in nearly all instances contain enough water to fully hydrate the cement, not all of this is actually available for the curing process. Most practical curing methods do not involve making extra water available and optimum curing techniques depend on retaining water already present. The CSIRO work, reported in 1992, found that:

- surface quality achieved with 7 days of "sealed" curing was generally equivalent to about 3 days of standard curing;
- little or no benefit arose for using water-retaining techniques beyond 7 days;
- steam curing (one day cycle) gave an ex-steam quality equivalent to 3 days of standard curing, similar to that achieved with water-retaining techniques;
- moist curing following the steam cycle, for 6 days or 27 days, gave virtually no change in sorptivity values.

It was also found, in another investigation that typical outdoor exposure of high strength concrete would result within a year in surface quality equivalent to 7 days of standard curing, independent of the initial curing treatment.

CONCLUSION

There is no justification for mandatory stand-down times before steaming, rates of temperature rise or concrete maturity. Where the product has a specified minimum strength grade of at least 50 MPa the durability design can be based on the quality which concrete of that grade will achieve with 7 days of standard curing. Actual curing of the product will take place in the factory and during the early period of service, and the specification will be tailored so the 7 days equivalent is achieved by contributions from both phases.