Technical Note TN125

Long Distance Transport and Extended Placement Times for Concrete

September 2014
1 Scope

This technical note provides guidelines for the long distance transport and extended placement times for concrete in the concrete state. It applies when concrete cannot reasonably be delivered to site, placed and compacted within the timeframe stipulated in MRTS70. Limits for placing and compacting concrete in MRTS70 are 60 minutes (for concrete at or below a temperature of 32 °C) and 45 minutes (for concrete above 32 °C but not exceeding 35 °C).

This procedure should only be undertaken in consultation with Bridge Construction, Maintenance and Asset Management (BCMAM) and with approval of the Contract Administrator.

2 Reference documents

Table 2 – References

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
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<tr>
<td>AS 1478.1 - 2000</td>
<td>Chemical admixtures for concrete, mortar and grout</td>
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<td></td>
<td>Part 1: Admixtures for concrete</td>
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<tr>
<td>AS 1379 - 2007</td>
<td>Specification and supply of concrete</td>
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<td>AS 1012</td>
<td>Methods of testing concrete</td>
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<td>MRTS70</td>
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3 Glossary of terms

Table 3 – Definitions

<table>
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<td>Workability</td>
<td>A measure of the ability to place, compact and finish plastic concrete. Commonly evaluated by means of slump or consistency test.</td>
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<tr>
<td>Set Retarding (Re) admixture</td>
<td>An admixture that decreases the initial rate of reaction between cementitious material and water.</td>
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<tr>
<td>High Range Water-reducing (HWR) admixture</td>
<td>An admixture that has a marked water-reducing function, sufficient to increase the slump of concrete significantly (i.e. to produce highly workable concrete) without changing the water/cement ratio. Also known as a superplasticizer.</td>
</tr>
<tr>
<td>Hydration Control admixture</td>
<td>An admixture used to maintain workability (reduce slump loss) and prevent the cement hydration process.</td>
</tr>
<tr>
<td>Trial mix</td>
<td>Evaluation of concrete mix, replicating process and materials of proposed usage. Refer MRTS70.</td>
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4 Context

When concrete is to be transported over a long distance or extended placement times are required the concrete must have a level of workability at the site that will allow the concrete to be discharged and placed into the works, respond effectively to compaction, and then receive the required finish.
Two distinct properties of the concrete must be separately considered when attempting extended transport of concrete. These are:

a) workability, and

b) setting time.

There are two ways in which these properties can be extended for a longer period of time:

a) lowering of concrete temperature to a state that reduces the cement hydration rate for an extended period of time, and/or

b) addition of admixture or combination of admixtures at the correct dosage.

Generally option (b) is the preferred and the most effective option.

4.1 Concrete hydration

Concrete goes through three stages after mixing: Loss of Workability, Initial Set and Final Set.

At the “Loss of Workability” stage the concrete will generally respond to a dose of superplasticiser and be able to be properly placed, compacted and finished.

However, if the concrete has commenced “Initial Set” it will not readily respond to compaction or the dosage of an admixture to restore workability.

If a set-retarding admixture has been used, the “Initial Set” stage will be extended. The length of retardation will depend on the dosage and type of the admixture.

5 Chemical admixtures

Chemical admixtures for concrete are described in AS 1478.1.

To manage setting times, a set-retarding admixture can be used. In circumstances where concrete is to be transported over a considerable distance and where slump loss needs to be managed another type of admixture, called a Hydration Control admixture, can also be used.

5.1 Set Retarding admixtures

A Set-Retarding admixture may not necessarily maintain the level of workability at which the concrete was initially batched at the plant. Some loss of workability during travel to the site is expected but should be small.

In concrete with a dosage of a set-retarding admixture the level of workability may well drop even though the cement hydration reaction has not yet started. In this case the concrete will readily respond to a site dosage of a superplasticiser, and a useful level of workability, suitable for placing and handling, will be re-established. This dose of superplasticiser only will not maintain the workability for an extended period of time.

5.2 Hydration control admixtures

The other type of admixture, known as a hydration control admixture, have the action of maintaining workability during travel; or at least minimising the degree of slump loss.

5.3 Superplasticisers

If the concrete is at the stage where “Initial Set” has started, it will never respond with an increase in workability to a dose of superplasticiser.
However if the concrete has only lost workability it will instantly and safely respond to a dosage of superplasticiser and regain a higher slump.

6 Acceptable approaches

The following approaches are acceptable to achieve extended times to placement or long distance transport of concrete.

6.1 Short distances (up to one hour)

Maintain concrete workability by use of set retarding admixtures, only added at the batch plant to standard concrete mixes.

6.2 Medium distances (one to two hours)

Add a set retarding admixture at the batch plant to a typical 80 to 90 mm slump concrete. Add a high range water reducing admixture at site before use to bring the concrete up to the nominated slump. To be effective, the concrete should arrive at site at the 80 to 90 mm slump on site before the addition of the high range water reducing admixture.

6.3 Long distances (over two hours)

Add a high range water reducing admixture and a hydration stabiliser at the batch plant. Typically an activating admixture is added before concrete placement commences to cancel the effect of the hydration stabiliser.

7 Unacceptable approaches

The addition of water after the maximum standard placement times specified in MRTS70 is not permitted. Addition of water for dry materials on site is also not permitted as it is generally not possible to dry the materials to the required level.

8 Evaluation

The mix should be evaluated at the planning stage and during transport and delivery for mixes is in excess of one hour to placement and compaction.

8.1 Proposed mix and process

A trial mix should be prepared and tested to evaluate and predict the expected performance of the concrete mix and the method to deliver it successfully to site, including addition of admixtures. The following properties should be measured:

a) strength development (e.g. AS 1012.9 @ 1, 3, 7, 14, 28 days from sampling at time of placement)

b) workability retention (e.g. AS 1012.3 @ 0, 15, 30, 60, 120 minutes or as required), and

c) extent of reaction (e.g. temperature @ 0, 15, 30, 60, 120 minutes or as required).

The trial mix should simulate the expected travel time and timing of addition of admixtures.

The concrete and admixture suppliers should be able to advise on suitable mixes and dosages of admixtures.
8.2 Performance

The extent of setting and loss of workability can be estimated at any point in time by comparison with these baselines.

Testing of concrete should be conducted in accordance with the relevant specification (i.e. MRTS70). Additional testing may be required.

It should also be noted that some technical supervision from the concrete supplier will generally be required to develop and implement these processes.