Test Method RC 330.03

Density Decay Correction Factor for Materials Stabilised with Cementitious Binder

October 2019

1. Scope

This Method covers the laboratory procedure for the determination of the job specific density decay correction factor for granular pavement materials or earthworks material stabilised with cementitious binder.

2. Definitions

(a) Cementitious Binder

A cementitious material capable of being uniformly mixed into a (host) material to bind the particles together to increase its strength. Cementitious binders include Portland cement Type GP or blended cement Type GB, hydrated lime, quicklime, or a blend of ground granulated blast furnace slag (GGBFS), hydrated lime, fly ash, alkali activated slag or other pozzolanic material.

(b) Density Decay Correction Factor (DDCF)

A factor derived to calculate the field density ratio from a laboratory determined reference density where compaction of the test sample has occurred after the maximum allowable working time has expired.

(c) Maximum Allowable Working Time

The time available, to the nearest hour, for a crushed rock pavement material or an earthworks material, stabilised with a cementitious binder, to reach a value of 90% of the Unconfined Compressive Strength (UCS) determined for the stabilised material after storage for one hour at the specified temperature. This time is measured from the time cement is added to the material.

(d) Specified Temperature

The temperature at which mixed material and test specimens are moist cured for the required period.

3. Apparatus

(a) For maximum dry density and optimum moisture content of:

- Pavement material – as detailed in AS 1289.5.2.1, or
- Earthworks material – as detailed in AS 1289.5.1.1.

(b) For standing of mixed material or curing of specimens, apparatus to maintain the specified temperature.

4. Material Selection

(a) Obtain a representative sample of the granular pavement material, or the earthworks material, to be stabilised (including any additives, excluding binder).

(b) Obtain the appropriate cementitious binder that will be used in construction of the layer.

Note: The sample should contain sufficient material to determine the maximum dry density (MDD) and optimum moisture content (OMC), and for the preparation of at least 12 moulded test specimens.

5. Procedure

5.1 General

All mixed material and all test specimens shall be moist cured at the specified temperature for the construction period in Table 1, for the time interval required at step 5.3 (d).

Table 1 – Specified Temperature

Construction Period, months inclusive	Specified Temperature
October to April	20° to 25°C
May to September	10° to 15°C

5.2 Preparation

(a) Prepare and precondition the crushed rock, pavement or earthworks material in accordance with Clauses 5.1 and 5.4 of AS 1289.1.1, so that only material passing 19 mm sieve is included in the sample.

(b) Ensure that all asphalt and surfacing seal material, if present, is broken up. Take care not to crush individual particles.

(c) If appropriate, mix the required amount of any additive, (e.g. lime) into the sample, undertake mechanical treatment if appropriate, and condition and cure the material in a sealed container for at least 48 hours.

(d) Determine the Maximum Allowable Working Time in accordance with RC 330.02.

(e) Mix a sufficient quantity of either:

- the pavement material with 3% cementitious binder, or
- the earthworks material sample with the Design Distribution Rate of the cementitious binder,

by dry mass of sample, for the determination of MDD and OMC.

(f) Determine MDD and OMC for the stabilised sample before the maximum allowable working time expires, in accordance with AS 1289.5.2.1, or AS 1289.5.1.1, as appropriate.

(g) Mix the remainder of the sample with added water to achieve a laboratory moisture ratio within the range of 95% to 105% of OMC determined at step (f) above.

5.3 Density Decay Correction Factor Determination

(a) Split the sample into multiple sub-samples, each sufficient to compact two specimens at step (f) below.

(b) Cure the sub-samples for a minimum of 12 hours, or as appropriate to step (i), in sealed containers.

(c) Select a sub-sample. Add the required quantity of the cementitious binder, by dry mass of sample, and add water to obtain a laboratory moisture ratio of 95% to 105% of OMC. Thoroughly mix the stabilised sub-sample. Record the time of adding the cementitious binder to the sub-sample.

(d) Allow the stabilised sub-sample to stand and cure in sealed containers for the maximum allowable working time for the binder, as determined at step 5.2 (d), plus time *t* = either 2, 4, 8, 16, or 24 hours if working from step (i), at the specified temperature (refer to step 5.1 above).

(e) Prepare the cured stabilised sub-sample over a 10 mm screen and recombine material passing and retained on the screen to sealed containers.

(f) Compact two specimens in accordance with either:

- AS 1289.5.2.1, steps 5(h) to (o) for pavement material, or
- AS 1289.5.1.1, steps 5(h) to (o) for earthworks material, as appropriate.

Complete compaction within 30 minutes of the standing time beyond the maximum allowable working time, or within *t + 30* minutes if working from step (i).

(g) Determine the dry density (D_0 or D_t) of the moulded sample in accordance with either:

- AS 1289.5.2.1, step 6(b) or
- AS 1289.5.1.1, step 6(b), as appropriate.

(D_0 is for *t* = 0, and D_t is for other values of *t* when step (i) applies.)

(h) Calculate the mean value of the two dry density results obtained, as $\overline{D_0}$ or $\overline{D_t}$, as appropriate.

(i) Repeat steps (c) to (h) to determine values of $\overline{D_t}$ after storage of the sub-sample (stabilised, cured, broken-up, recombined and sealed) for *t* = 2, 4, 8, 16 and 24 hours beyond the maximum allowable working time under the specified temperature conditions detailed in Clause 5.1.

(j) Calculate the Density Decay Correction Factor (DDCF) for each standing time *t* from the following equation:

$$DDCF = \frac{\overline{D_t}}{\overline{D_0}}$$ where:

$\overline{D_0} =$	the mean dry density determined at the maximum allowable working time
$\overline{D_t} =$	the mean dry density determined at time *t* after maximum allowable working time

(k) Plot a graph of density decay correction factor versus standing time in excess of the maximum allowable working time. Draw a curve of best fit to fit the points (refer to Figure 1 for an example).

(l) Determine from the curve the Density Decay Correction Factors at *t* = 3, 5, 7, 10, 15 and 21 hours standing time after the maximum allowable working time after addition of binder.

(m) Determine the Density Decay Correction Factor for each range of hours (2 to 4, 4 to 6, 6 to 8, 8 to 12,12 to 18 and 18 to 24) of standing time after mixing, using the DDCF values determined in step (l) for the mid points of the ranges. (refer to Figure 2 for an example).

6. Report

Report the following:

(a) The source and description of the material and any additives included.

(b) The type of the cementitious binder used.

(c) The percentage of cementitious binder added to the nearest 0.1%.

(d) The temperature at which the samples were conditioned.

(e) The Density Decay Correction Factor for each range of hours (2 to 4, 4 to 6, 6 to 8, 8 to 12,12 to 18 and 18 to 24) of standing time after mixing.

(f) Reference to this Test Method (RC 330.03).

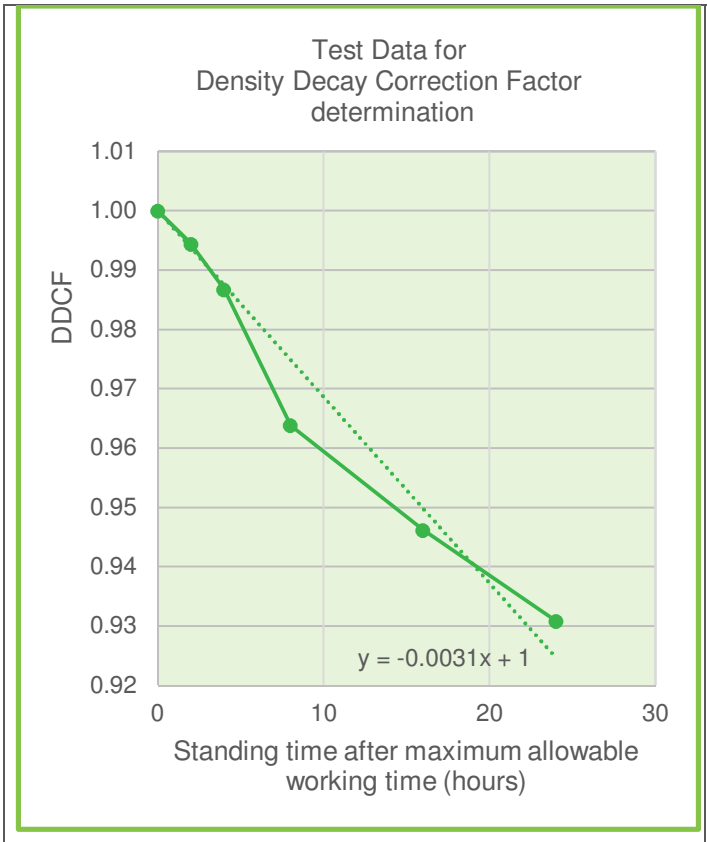

Figure 1 – DDCF for standing time after maximum allowable working time

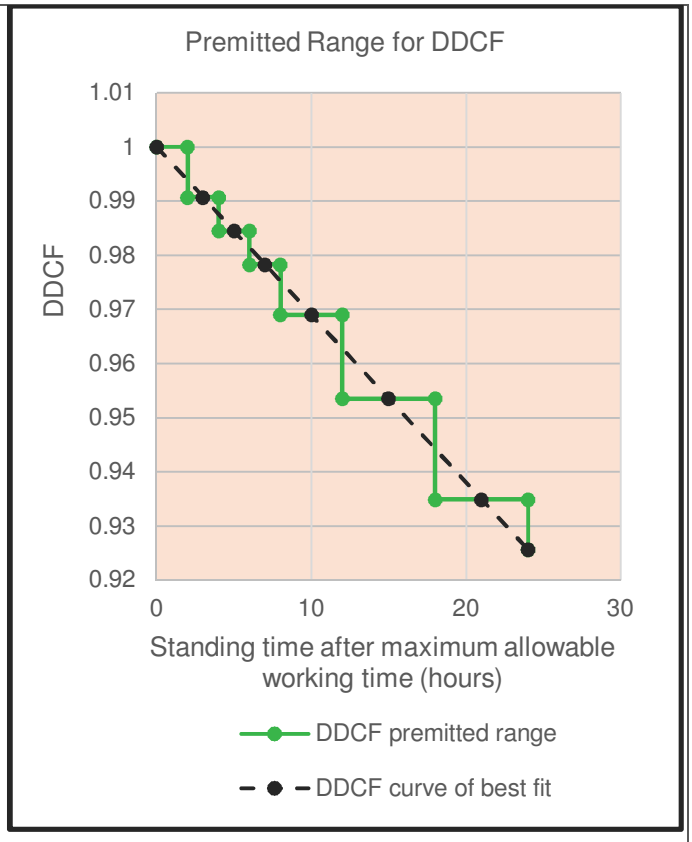

Figure 2 – Permitted range for DDCF for standing time after maximum allowable working time

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VicRoads Test Method - Revision Summary

RC 330.03 – Density Decay Correction Factor for Materials Stabilised with Cementitious Binder

Date	Clause	Description of Revision	Authorised by
October 2019	Various	Addition of text to incorporate the stabilisation of earthwork material Testing requirements clarified Provided examples of reporting.	Manager – Construction Materials
June 2012	Full document	Re-styled with minor corrections made	Principal Advisor – Pavements, Geotech. & Materials