Calculation of Density Ratio using Density Decay Correction Factor

Test Method
RC 330.04
February 2022

Abstract

The test calculates the Density Ratio, using a Density Decay Correction Factor, for a test site in a test lot of earthworks or pavement material stabilised in-situ with cementitious binders.

1. Scope

The test calculates the Density Ratio (DR or R_D), using a Density Decay Correction Factor (DDCF), for a test site in a test lot of in-situ stabilised earthworks or pavement material.

The calculation requires the use of a value for 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 (see Appendix A) has expired.

The calculation is applied to a test result from the field density test carried out on completion of compaction.

The calculation applies to testing of work, stabilised in-situ with cementitious binders, constructed to VicRoads Standard Specifications for:

(a) Section 290 – *Lime and/or Cementitious Stabilisation of Earthworks Materials, and*

(b) Section 307 – *In Situ Stabilisation of Pavements with Cementitious Binders.*

Note : a test lot normally consists of 3 or 6 test sites, and the calculation applies to each test site.

2. Procedure

For the test site:

(a) Record material source and placement location, date and time of addition of cementitious binder, and binder type, test lot bounds and test site to which the calculation refers.

(b) Obtain the field density at the completion of compaction, using AS 1289.5.8.1.

(c) Extract a sample and transport to a laboratory.

(d) Determine, using AS 1289.5.2.1, the reference density for the laboratory compacted sample as soon as practicable but not exceeding 24 hours after addition of the cementitious binder, and record the time and date of completion of laboratory compaction.

(e) Calculate the elapsed time (t) from addition of binder at step (a) to completion of laboratory compaction at step (d).

(f) Calculate a density ratio at time t (DR_t or R_{Dt}) based on the results of items (b) and (d) above.

(g) Determine DDCF corresponding to the elapsed time (t), by either:

i) for earthworks, selecting from Table A, corresponding to time (t), the binder type and the time of year construction is being undertaken; or

ii) for pavements, selecting from Table B, corresponding to time (t), the binder type and the time of year construction is being undertaken; or

iii) for individual earthworks sites using cementitious stabilisation of more than 20,000 m^2 where Type A material properties are required, or 50,000 m^2 where Type B material properties are required, the Contractor shall determine and apply a job specific DDCF determined in accordance with RC 330.03 - *Density Decay Correction Factor for Materials Stabilised with Cementitious Binder*; or

iv) for individual pavements sites using cementitious stabilisation of more than 10000 m^2, where the material to be stabilised is of a similar nature throughout, the Contractor shall determine and apply a job specific DDCF in accordance with RC 330.03 - *Density Decay Correction Factor for Materials Stabilised with Cementitious Binder*.

(h) Calculate the value of DR or R_D, using the formula:

DR	=	**DR_t** x **DDCF** , or
R_D	=	**R_{Dt}** x **DDCF** , where
DR, R_D	=	Density Ratio
DR_t, R_{Dt}	=	Density Ratio calculated using the reference density determined at time (t)
DDCF	=	Density Decay Correction Factor, determined at step (g).

(i) Apply the value of DR or R_D to further calculation as required in RC 316.00 – *Density Ratio and Moisture Ratio - Lot Characteristics*. If the value is used in further calculations, then rounding is applied at reporting.

3. Report

Report as required by AS 1289.5.8.1, AS 1289.5.2.1 and RC 316.00, and include:

(a) Binder type.

(b) Time (t) from addition of binder to completion of laboratory compaction.

(c) Value and source of DDCF used.

(d) Reference to this Test Method (RC 330.04).

Table A - Density Decay Correction Factors for Earthworks Material

Time (t) from Addition of Binder to Completion of Laboratory Compaction (hours)	Cementitious Binder (construction between October and April)		Cementitious Binder (construction between May and September)	
	Medium Setting	Rapid Setting	Medium Setting	Rapid Setting
1 to 2	1	1	1	1
2 to 4	1	0.994	1	1
4 to 6	0.982	0.987	1	0.988
6 to 10	0.954	0.964	0.969	0.967
10 to 18	0.932	0.946	0.963	0.952
18 to 24	0.910	0.931	0.957	0.938

Table B - Density Decay Correction Factors for Pavements Material

Time (t) from Addition of Binder to Completion of Laboratory Compaction (hours)	Cementitious Binder (construction between October and April)			Cementitious Binder (construction between May and September)		
	Slow Setting	Medium Setting	Rapid Setting	Slow Setting	Medium Setting	Rapid Setting
1 to 2	1	1	1	1	1	1
2 to 4	1	1	0.994	1	1	1
4 to 6	1	0.994	0.990	1	1	0.991
6 to 8	1	0.991	0.985	1	0.993	0.987
8 to 12	0.998	0.988	0.978	1	0.990	0.981
12 to 18	0.993	0.981	0.965	0.996	0.983	0.971
18 to 24	0.987	0.973	0.951	0.990	0.977	0.958

Appendix A - Maximum Allowable Working Times after Mixing for Various Cementitious Binders (from VicRoads Sections 290 and 307)		
Cementitious Binder Note: # not applicable to earthworks	Maximum Allowable Working Time (hours)	
	Construction between October and April	Construction between May and September
Slow Setting # Slag/Lime blends, Alkali Activated Slag and other Supplementary Cementitious Blends #	8	12
Medium Setting Type GB Cements Cement/Slag blend (50% to 60% cement content) # Cement/Fly Ash blend (70% to 80% cement content) # Cement/Slag/Fly Ash blend (55% to 65% cement content) #	3	5
Rapid Setting Type GP Cement	2	3
Lime		
Hydrated Lime and Quicklime	12	24

Department of Transport Test Method - Revision Summary

RC 330.04 – Calculation of Density Ratio using Density Decay Correction Factor

Version	Date	Clause	Description of Revision	Authorised by
1.0	February 2022	Full method	New Issue	Principal Engineer – Pavements, Geotech. & Materials

Contact Details

To receive the publication in an accessible format, please request on Department of Transport online message feedback form.

Engineering Group, Department of Transport, 60 Denmark St, Kew Vic 3101

Email: email@roads.vic.gov.au (quote document number and title)