

TB-0603 — Strength and Durability of Flowing Concrete using DARACEM® 19 Technical Bulletin

Introduction

A series of tests was conducted to evaluate the durability of flowing, superplasticized concrete. Three separate loads of concrete were produced with various addition rates of DARACEM® 19 to produce concrete with slumps ranging from 178 mm to 254 mm (7 in. to 10 in.). Standard tests were performed, including air content, slump and unit weight. Two beams were cast from each mix for freeze-thaw durability analysis (ASTM Method C666, Procedure B, Rapid Freezing in Air and Thawing in Water).

The test results show that DARACEM® 19 provided compressive strengths 2 to 5 MPa (250 to 700 psi) higher than the reference mix even at equal water-cement ratio. Thus, DARACEM® 19 provides a double benefit of increased workability (higher slumps), coupled with higher strengths, at the same cement content. This is due to the greatly improved dispersion of cement provided by the DARACEM® 19. The data also shows relative durability factors 95% and more of the reference mix after 300 freeze-thaw cycles.

Summary

To summarize, flowing concrete can be made which gives an increase in the degree of workability, coupled with higher compressive strengths, as well as proper freeze-thaw durability.

Flowing Concrete with Daracem 19, Summary of Test Data

Test Designation	A	B	C
Cement, kg/m ³ (lbs/yd ³)	335 (564)	335 (564)	335 (564)
Sand, kg/m ³ (lbs/yd ³)	783 (1320)	783 (1320)	783 (1320)
Coarse agg, kg/m ³ (lbs/yd ³)	1038 (1750)	1038 (1750)	1038 (1750)
Water, kg/m ³ (lbs/yd ³)	177 (298)	174 (293)	177 (299)
W/C ratio	0.53	0.52	0.53
Daravair®, mL/m ³ (oz/yd ³)	155 (4.0)	164 (4.25)	164 (4.25)
Before Daracem 19			
Air, %	6.0	6.5	7.0
Slump, mm (in.)	121 (4.75)	114 (4.50)	127 (5.00)
Unit weight, kg/m ³ (lbs/ft ³)	2307 (144.0)	2300 (143.6)	2281 (142.4)
Yield, m ³ (ft ³)	1.01 (27.31)	1.02 (27.35)	1.02 (27.62)
After Daracem 19			
Amount of Daracem 19 added, mL/100 kg (oz/100 lbs)	0.0 (0.0)	456 (7.0)	652 (10.0)
Air, %	N/T	6.2	6.2
Slump, mm (in.)	N/T	178 (7.00)	254 (10.00)
Temperature, °C (°F)	24 (76)	26 (79)	26 (78)
Unit weight, kg/m ³ (lbs/ft ³)	N/T	2320 (144.8)	2320 (144.8)
Yield, m ³ (ft ³)	N/T	1.00 (27.12)	1.01 (27.16)
Compressive Strength, MPa (psi)			
3 day	19.5 (2830)	23.2 (3370)	23.0 (3340)
% of reference	100	119	118
7 day	24.6 (3570)	27.4 (3970)	26.4 (3830)
% of reference	100	111	107
28 day	33.7 (4890)	37.2 (5390)	37.5 (5440)
% of reference	100	107	109
56 day	37.7 (5460)	40.2 (5830)	41.0 (5950)
% of reference	100	107	109
Freeze-Thaw Durability			
Durability factor	98.5	95.0	95.0
% of reference	100	96.0	96.0

Flowing Concrete with DARACEM® 19, Summary of Test Data

TEST DESIGNATION	A	B	C
Cement, kg/m ³ (lbs/yd ³)	335 (564)	335 (564)	335 (564)
Sand, kg/m ³ (lbs/yd ³)	783 (1320)	783 (1320)	783 (1320)
Coarse agg, kg/m ³ (lbs/yd ³)	1038 (1750)	1038 (1750)	1038 (1750)
Water, kg/m ³ (lbs/yd ³)	177 (298)	174 (293)	177 (299)
W/C ratio	0.53	0.52	0.53
Daravair®, mL/m ³ (oz/yd ³)	155 (4.0)	164 (4.25)	164 (4.25)

Before DARACEM® 19

Air, %	6.0	6.5	7.0
Slump, mm (in.)	121 (4.75)	114 (4.50)	127 (5.00)
Unit weight, kg/m ³ (lbs/ft ³)	2307 (144.0)	2300 (143.6)	2281 (142.4)
Yield, m ³ (ft ³)	1.01 (27.31)	1.02 (27.35)	1.02 (27.62)

After DARACEM® 19

Amount of DARACEM® 19 added, mL/100 kg (oz/100 lbs)	0.0 (0.0)	456 (7.0)	652 (10.0)
Air, %	N/T	6.2	6.2
Slump, mm (in.)	N/T	178 (7.00)	254 (10.00)
Temperature, °C (°F)	24 (76)	26 (79)	26 (78)
Unit weight, kg/m ³ (lbs/ft ³)	N/T	2320 (144.8)	2320 (144.8)
Yield, m ³ (ft ³)	N/T	1.00 (27.12)	1.01 (27.16)

Compressive Strength, MPa (psi)

3 day % of reference	19.5 (2830) 100	23.2 (3370) 119	23.0 (3340) 118
7 day % of reference	24.6 (3570) 100	27.4 (3970) 111	26.4 (3830) 107
28 day % of reference	33.7 (4890) 100	37.2 (5390) 107	37.5 (5440) 109

56 day % of reference	37.7 (5460) 100	40.2 (5830) 107	41.0 (5950) 109
Freeze-Thaw Durability			
Durability factor % of reference	98.5 100	95.0 96.0	95.0 96.0

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GCP Applied Technologies Inc., 62 Whittemore Avenue, Cambridge, MA 02140 USA.

In Canada, 294 Clements Road, West, Ajax, Ontario, Canada L1S 3C6.

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