Performance Structural Concrete Optimized for Cost, Durability and Manufacturability

VERMONT
AGENCY OF TRANSPORTATION
RESEARCH PROGRAM

STUDY TIMELINE
1/2021 – 8/2025

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More information about the Agency of Transportation Research Program, including additional Fact Sheets, can be found at: http://vtrans.vermont.gov/planning/research

Introduction

Concrete mixes continue to improve and evolve with the use of low-carbon cements and aggregate mixes. This project aims to develop generic performance concrete mix designs that use the newer cement formulations and locally sourced aggregates.

Rank	Compress-ive strength (psi) Min: 4,000	Relative dynamic modulus (%) Min: 60	Durability factor Min: 60	Surface resistivity (KΩ.cm) Min: 22	Drying shrinkage (%) 28-day Max: 0.032
1	SM10 (5,845)	SM10 (95)	SM10 (95)	SM10 (149.95)	SM10 (0.027)
2	SM11 (5,838)	SM2 (95)	SM2 (95)	SM2 (125.06)	SM2 (0.029)
3	SM5 (4,995)	SM5 (89)	SM5 (89)	SM5 (114.43)	SM11 (0.030)
4	SM2 (4,354)	SM11 (87)	SM11 (87)	SM11 (80.48)	SM5 (0.034)

Final performance results of four best generic mixes: SM2 - PLC, GGP, Supplier 1; SM5: PLC, FFA, Supplier 2; SM10: PLC, SLAG, Supplier 3; SM11: PLC, SLAG, Supplier 3

Project Methodology

Twelve different generic mixes using various combinations of low-carbon Portland Limestone Cement (PLC), Ground Glass Pozzolan (GGP), Fine Fly Ash (FFA), and Slag; and aggregates from Vermont-based suppliers. Initial screening selected four candidate mixes for extensive testing, including strength, durability and shrinkage.

Conclusions/Next Steps

All four mixes met the 28-day specifications for strength (4,000 psi), freeze-thaw durability (300 cycles), surface resistivity (10 kΩ-cm) and structural concrete shrinkage 0.042%. 3 of 4 mixes met the 28-day shrinkage specification of 0.032% for bridge decks, with the last one at 0.034%.

Impacts and Benefits

These generic mixes will help suppliers deliver high quality concrete at lower cost and with shorter development times.