Florida Department of Transportation Research

Effects of Coarse Aggregate on the Physical Properties of Florida Concrete Mixes

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Current Situation

The concrete used on highway projects is mostly Portland cement concrete, a mixture of Portland cement, a coarse granular material called aggregate, and fine granular material, often sand. While chiefly a filler, aggregate's properties strongly affect the properties of concrete made with it. Most aggregate produced in Florida, called limerock, is a type of local limestone which tends to be more porous, softer, and less dense than limestone from other U.S. regions. It is generally assumed that this difference produces a less strong concrete, so, additional Portland cement is used to compensate, leading to increased cost for concrete including limerock.

This concrete sample shows how aggregate is distributed in concrete. The whitish areas are Brooksville limestone.

Research Objectives

In this project, University of Florida researchers studied the effects of aggregate on the physical properties of Portland cement concrete, using limerock from Florida and Alabama. Their goal was to provide better correction factors for aggregate types used in concrete formulations specified in Florida Department of Transportation (FDOT) guidelines.

Project Activities

The researchers began by reviewing factors that contribute to the concrete's strength, especially modulus of elasticity (MOE) and the equations used to calculate it. The factor used in MOE calculations to correct for the effects of aggregate type was of particular interest.

Researchers then selected aggregates to be tested, guided by FDOT specifications. Their goal was to obtain a selection representative of coarse aggregates used in Florida structural concrete. The chosen aggregates were Miami oolite and limestones from Brooksville and Perry, Florida, and Calera, Alabama. Georgia granite served as the reference point.

From the structural concrete classes covered by FDOT specifications, the lowest and highest strength classes were chosen for this project: Class II Deck and Class VI. Mix components were subjected to a number of tests, including isothermal calorimetry, particle size distribution, Blaine fineness, and quantitative X-ray diffraction.

Each sample mix was cast in the form of cylinders, flexural beams, and slabs for destructive and non-destructive testing. Destructive tests included compressive strength, modulus of elasticity, splitting tensile strength, and flexural strength. Non-destructive testing included rebound hammer, pulse velocity, and coefficient of thermal expansion. Researchers then examined the implications of experimental findings for MOE calculation, generally finding correction factors for Florida aggregates too conservative.

Project Benefits

This project can lead to improved concrete mix specifications that conserve strength requirements while being more economical.

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