

# Evaluation of Ground Iron Blast-Furnace Slag: Grade 100

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Principal Investigator:  
John Eggers, P.E.  
Louisiana Transportation  
Research Center

LTRC Contacts:  
Administrative:  
Harold "Skip" Paul  
Assoc. Director, Research  
(225)767-9102

Technical:  
Curtis Fletcher, P.E.  
Research Manager  
(225)767-9109

## Problem

Recently DOTD approved the use of ground granulated blast furnace slag (GGBFS) grade 120 for use in its pavements and structures. At this time, there have been two pavement projects (LA 14 & North Line Road-ALF) and one structural project (Charenton Bridge) that have utilized GGBFS Grade 120. Currently, there is only one source provider for GGBFS Grade 120.

If it produces concrete that is strong, durable, workable, economical, and found to be comparable to GGBFS Grade 120, GGBFS Grade 100 will be competitive with all the Portland cement concrete the department uses. The department then may see fit to use it in certain applications, as compared to GGBFS Grade 120 which is already an enhancement and cost saving measure. Successful implementation will also alleviate the current sole providership that is in the Qualified Products List.



A modulus testing frame with a 6 x 12 cylinder.



LTRC

Louisiana Transportation  
Research Center

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4101 Gourrier Avenue  
Baton Rouge, LA 70808-4443

## Objectives

The significance of this research is to compare GGBFS Grade 100 with the results of the GGBFS Grade 120 research (96-3C). Variations in set times and physical properties will be focus of this project in order to determine its applicability.

Through a series of standard ASTM tests, researchers will attempt to determine the effects of GGBFS Grade 100 on concrete, at various substitution rates and temperatures. The tests will determine the strength, durability, and workability of GGBFS Grade 100 concrete so that a comparison to GGBFS Grade 120 can be made.

In this respect, most of the test procedure from the GGBFS Grade 120 study (96-3C) will be repeated for the GGBFS Grade 100 study. From this comparison, specifications and applications for GGBFS Grade 100 can be developed.

## Description

Tests will be conducted to address all of the preceding. They will include the following ASTM tests:

**ASTM C 143:**

*Slump of Fresh Concrete*

**ASTM C 148:**

*Air Content and Unit Weight*

**ASTM C 403:**

*Set Time of Fresh Concrete*

**ASTM C 39:**

*Compressive Strength*

**ASTM C 78:**

*Flexural Strength*

**ASTM C 469:**

*Static Modulus of Elasticity and*

*Poisson's Ratio*

**ASTM C 666:**

*Resistance to Rapid Freezing and Thawing*

**ASTM C 157:**

*Length Change*

**ASTM C 512-87:**

*Creep Test of Concrete in Compression*

**ASTM C 672-92:**

*Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to De-icing Chemicals*

**ASTM C 944-90a:**

*Standard Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating Cutter Method*

**AASHTO C 1202:**

*Rapid Chloride Permeability Test*

In addition to these tests, temperatures during the set time testing will be monitored using thermocouples or a maturity meter. The maturity meter will be used as a means of predicting very early strength. Because of the very low early (less than 12 hours) strength of concrete, conventional destructive test methods often do not yield useful results and data.

All mixes will be tested with their components at 50° F, 70° F, and 90° F to address the set time and strength gain delay. The 90° F temperature testing is in addition

to the previous GGBFS Grade 120 testing. It is included here for information's sake since this is a realistic temperature common to job site conditions in Louisiana. Concrete mixes will conform to DOTD Standard Specifications for Roads and Bridges. They will be representative of concrete used in pavement and structures in Louisiana.

## Implementation Potential

The results of this study will assist the department in determining whether or not to allow the use of GGBFS Grade 100 in concrete pavement and structures. It is envisioned that incorporation of GGBFS Grade 100 will benefit DOTD and the state economically and ecologically. In addition to the economical cost savings already experienced through the use of GGBFS Grade 120, GGBFS Grade 100 could result in a further cost savings for concrete specified by DOTD.

Furthermore, by using this otherwise waste material as a partial replacement for cement in concrete, DOTD plays a part in the ecological recycling of these waste materials.