



November 6, 2013

Shotcrete Technologies Inc.
P. O. Box 3274
1431 Miner Street
Idaho Springs, CO 80452

Attention: Mr. Kristian Lovlie

Subject: High Strength Shotcrete Trial Mix
Project No. CT15647.000-425

Dear Mr. Lovlie:

This report presents preliminary results of a laboratory trial mix study to determine plastic properties and compressive strengths for a shotcrete (gunnite, no coarse aggregate) mix which generally meets the performance requirements of CDOT for a mixture used to line pipe. A total of seven mixes were prepared in conjunction with this project using various combinations of materials in an attempt to achieve the strengths outlined in the documentation for Colorado Project No. C131A-035. Compressive strength specimens were cast for testing at ages 1, 7 and 28 days. Flexural beams were cast for testing at ages 1 and 28 days. The fresh concrete was tested for slump, density, temperature and air content.

The latest of these trial mixes is presented in this report. This mix was prepared on October 9, 2013 using the following ingredients:

Material	Source
Cement	GCC Portland, Type II, Pueblo, CO
Silica Fume	Sikacrete 950DP (Bagged/Labeled. Delivered by client.)
Concrete Sand	ASTM C33, Frei Pit 4
Masonry Sand	L.G. Everist, Fort Lupton Pit
Admixture	Proprietary Admixtures
Water	Potable Tap Water – City of Denver

The target strengths for this CDOT Pipe Lining Mortar are presented below. There were no requirements for workability or air content. The mixture was adjusted to a consistency that the client, with his considerable experience in this type of construction, previously demonstrated to CTL as appropriate for use in centrifugal application of lining. The mix does not meet all the compositional requirements in the applicable CDOT specification. Moreover, the specifications required test methods not usually specified for concrete in CDOT specifications. Specifically the compressive strength is to be measured using cubes per ASTM C-109, and the flexural strength was to be measured using the center point loading method (ASTM C-293) rather than the third-point loading method. We cast cylinders for additional compressive strength testing and added conformation.


Target Properties	
Required Compressive Strength (1 day)	3000 psi
Required Compressive Strength (28 days)	8000 psi
Required Flexural Strength (1 day)	600 psi
Required Flexural Strength (28 days)	1080 psi

Data attached indicate this mix far exceeds all the required strengths at ages one and 28 days. This latest mix was the best in appearance of all that we prepared, and it appeared to be workable. Moreover, the mix appeared to have a consistency for sticking to an overhead surface. This last mix had a lower air content, as desired. (Earlier mixes had higher air contents.)

The gradation of the concrete sand used is also attached, Table No. 2.

If you have any questions or if we can be of further assistance, please call.

CTL | THOMPSON MATERIALS ENGINEERS, INC.


Orville R. Werner II, P.E.
Principal

11-6-13



ORW/hh
Enclosure

1 copy sent
email copy: kloevlie@gmail.com



Compressive Strengths, psi
ASTM C 39 (4-inch cylinders)

1-Day	7-Day	28-Day
4630	7780	10280
4630	7930	10110
Average		
4630	7860	10200

32mpa 81mpa 70mpa Approximate

Flexural Strengths, psi
ASTM C 293 (6x6x20 prisms, center point loading)

1-Day		28-Day
695		1460
715		1470
Average		
705		1465

5mpa 10mpa Approximate

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Compressive Strengths, psi
ASTM C 109 (2-inch cubes)

1-Day		28-Day
4450		11650
4500		12550
4250		11700
Average		
4400		11970