Thomas® CONCRETE

2500 Cumberland Parkway Tel 770-431-3300
Suite 200 Atlanta, GA. 30339 Fax 770-431-3305
www.thomasconcrete.com

Greater Georgia Concrete LLC
REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. ANY ACTION SHOWN IS SUBJECT TO THE REQUIREMENTS OF THE DRAWINGS AND SPECIFICATIONS.
Signed: Richard A Kimsey

FOR APPROVAL
04/30/2018 11:45:55 AM

Letter of Transmittal

To: **GREATER GEORGIA CONCRETE**

Date: **04/27/2018**
Project: **Georgia Tech Living Building Challenge 3.1**
Location: **955 Fowler Street NW**

Item	Description
1	Concrete Mix Design(s)
2	Aggregate Gradations
3	Admixture Certifications
4	Cement Mill Test Data
5	Flyash / Slag Data
6	Field Test Data

If we can be of further technical assistance, please feel free to call on us at any time.

Justin Lazenby
Manager of Technical Services

Cc: , Sales

Thomas CONCRETE

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Suite 200 Atlanta, GA 30339

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To: GREATER GEORGIA CONCRETE

Date: 4/27/2018
Project: Georgia Tech Living Building Challenge 3.1
Location: 955 Fowler St NW

Mix Code Number	Description	Usage
302-2FS	3000 COM THOMAGREEN AIR .50	Retaining Walls
302-3FS	3000 COM THOMAGREEN NON AIR .50	Foundations.
352-2FS	3500 COM THOMAGREEN AIR .50	Exterior S.O.G.
352-3FS	3500 COM THOMAGREEN NON AIR .50	Interior S.O.G.
457FS	4500 COM THOMAGREEN AIR	Wall.
507-1FS	5000 COM THOMAGREEN NON AIR	Columns **& Piers**
~~504HE~~	~~5000 HIGH EARLY NON-AIR~~	~~PT Slabs~~

Not in project

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Project: Georgia Tech Living Building Challenge 3.1
955 Fowler St NW

Customer: GREATER GEORGIA CONCRETE
Plant: 10 - Atlanta

Date: 4/27/2018

Concrete Mix Design
Please use mix code numbers for ordering

Mix Code:			302-2FS	302-3FS	352-2FS	352-3FS	457FS
STRENGTH (psi)			3000	3000	3500	3500	4500
AIR	LOWER %		3.0	0.0	3.0	0.0	3.0
	UPPER %		6.0	3.0	6.0	3.0	6.0
SLUMP (in.)			3.00 To 5.00	3.00 To 5.00	3.00 To 5.00	3.00 To 5.00	3.00 To 5.00
Cement	LBS	Holcim Type I-II	275	285	280	285	340
Cement	LBS	Type 3					
Slag	LBS	SLAG	140	140	160	160	200
Fly Ash	LBS	Fly Ash	135	140	120	120	140
Sand	LBS	Foley Natural	250	263			221
Sand	LBS	Vulcan Norcross MNF	998	1074	1248	1361	903
Stone	LBS	Vulcan Norcross #57	1799	1806	1799	1799	1806
Admix	OZ	AEA 14	AS REQ		AS REQ		AS REQ
Admix	OZ	C02					6.8
Admix	OZ	Plastiment XR					
Admix	OZ	2100	10.4	10.0	11.0	11.0	14.0
Water	GAL	Potable	33.0	34.0	33.0	34.0	33.0
W/C+P			0.50	0.50	0.49	0.50	0.40
LOCATION			Retaining Walls	Foundations.	Exterior S.O.G.	Interior S.O.G.	Wall.

We guarantee that the above design(s) will meet the specified ultimate strength requirement when placing, sampling, testing and curing are performed and test results are evaluated in accordance with applicable ASTM C-94 and/or ACI standards and specifications and when such is executed by personnel certified by ACI. Yield will be evaluated in accordance w/ ACI & ASTM standards. ASTM C-94 and the ACI require that the ready-mix producer be provided with copies of test reports in when compressive strength is a basis for acceptance. We hereby request copies of these reports in order that we can properly monitor the performance of concrete on this project.

Sincerely,

Justin Lazenby
Manager of Technical Services

Thomas CONCRETE

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Suite 200 Atlanta, GA 30339 Fax 770-431-3305
www.thomasconcrete.com

Project: Georgia Tech Living Building Challenge 3.1
955 Fowler St NW

Customer: GREATER GEORGIA CONCRETE
Plant: 10 - Atlanta

Date: 4/27/2018

Concrete Mix Design
Please use mix code numbers for ordering

Mix Code:			507-1FS	504HE
STRENGTH (psi)			5000	5000
AIR	LOWER %		0.0	0.0
	UPPER %		3.0	3.0
SLUMP (in.)			3.00 To 5.00	3.00 To 8.00
Cement	LBS	Holcim Type I-II	355	
Cement	LBS	Type 3		658
Slag	LBS	SLAG	205	
Fly Ash	LBS	Fly Ash	150	
Sand	LBS	Foley Natural	235	257
Sand	LBS	Vulcan Norcross MNF	956	1044
Stone	LBS	Vulcan Norcross #57	1823	1823
Admix	OZ	AEA 14		
Admix	OZ	C02	7.1	
Admix	OZ	Plastiment XR		13.2
Admix	OZ	2100	14.0	20.0
Water	GAL	Potable	34.0	34.0
W/C+P			0.40	0.43
LOCATION			Columns & Piers	PT Slabs

Not in project

We guarantee that the above design(s) will meet the specified ultimate strength requirement when placing, sampling, testing and curing are performed and test results are evaluated in accordance with applicable ASTM C-94 and/or ACI standards and specifications and when such is executed by personnel certified by ACI. Yield will be evaluated in accordance w/ ACI & ASTM standards. ASTM C-94 and the ACI require that the ready-mix producer be provided with copies of test reports in when compressive strength is a basis for acceptance. We hereby request copies of these reports in order that we can properly monitor the performance of concrete on this project.

Sincerely,

Justin Lazenby
Manager of Technical Services

BUILDING TRUST

CONTACT

Paul Ramsburg
Technical Sales Specialist
Mobile: 864-344-4109
ramsburg.paul@us.sika.com

PROJECT CONSIDERATION May 10, 2018

GEORGIA TECH LIVING BLDG. / SIKA ADMIXTURES

Dear Sirs;

Upon review of the Red List materials and chemicals not to be used on the Georgia Tech Living Bldg project we at Sika Corporation have determined that no materials and chemicals listed there-in are contained in the chemical admixture for use in ready-mix concrete purchased and used by Thomas Concrete. Specifically, the following admixtures:
ViscoCrete 2100 (High-range Water Reducer)
Plastocrete 161 (Type A Water Reducer)
Plastiment XR (Retarder)
SikaTard 440 (Hydration Stabilizer)
SikaSet NC (Non-Chloride Accelerator)
SikaSet HE (Accelerator)
AEA-14 (Air Entraining Admixture)

Should you have any further questions, please do not hesitate to contact me.

Sincerely,

Paul Ramsburg
Technical Sales Specialist
Sika Corporation

CarbonCure™ Statement on Red List Compliance for Living Building Challenge with Ready Mixed Concrete

To Whom It May Concern,

This is to advise that the CarbonCure™ Ready Mixed Technology complies with the Living Building Challenge Red List and does not include any of the following materials:

- Asbestos
- Cadmium
- Chlorinated Polyethylene and Chlorosulfonated Polyethlene
- Chlorofluorocarbons (CFCs)
- Chloroprene (Neoprene)
- Formaldehyde (added)
- Halogenated Flame Retardants
- Hydrochlorofluorocarbons (HCFCs)
- Lead (added)
- Mercury
- Petrochemical Fertilizers and Pesticides
- Phthalates
- Polyvinyl Chloride (PVC)
- Wood treatments containing Creosote, Arsenic or Pentachlorophenol

CarbonCure™ injects recycled and purified carbon dioxide (CAS # 124-38-9) from local industrial facilities into ready mixed concrete. The carbon dioxide is 100% pure and contains no other contaminants.

Sincerely,

Kevin Cail
Chief Technology Officer
CarbonCure Technologies

Vulcan Materials Company

Basic Quality Statistical Summary Report

Plant 024 (1713)-Norcross
Product 570-0057 Washed (25290)
Specification GADOT 57
Period 01/30/2018 - 03/01/2018

Sieve/Test	Tests	Average	Target	Specification
1 1/2" (37.5mm)	96	100.0	100-100	100-100
1" (25mm)	96	97.8	97-100	95-100
3/4" (19mm)	96	79.9		
1/2" (12.5mm)	96	38.4	32-48	25-60
3/8" (9.5mm)	96	17.7		
#4 (4.75mm)	96	1.7	0-5	0-10
#8 (2.36mm)	96	0.5	0-1.5	0-5
#200 (75µm)	3	0.48		0-1.5
Pan	96	0.00		

Basic Quality Statistical Summary Report

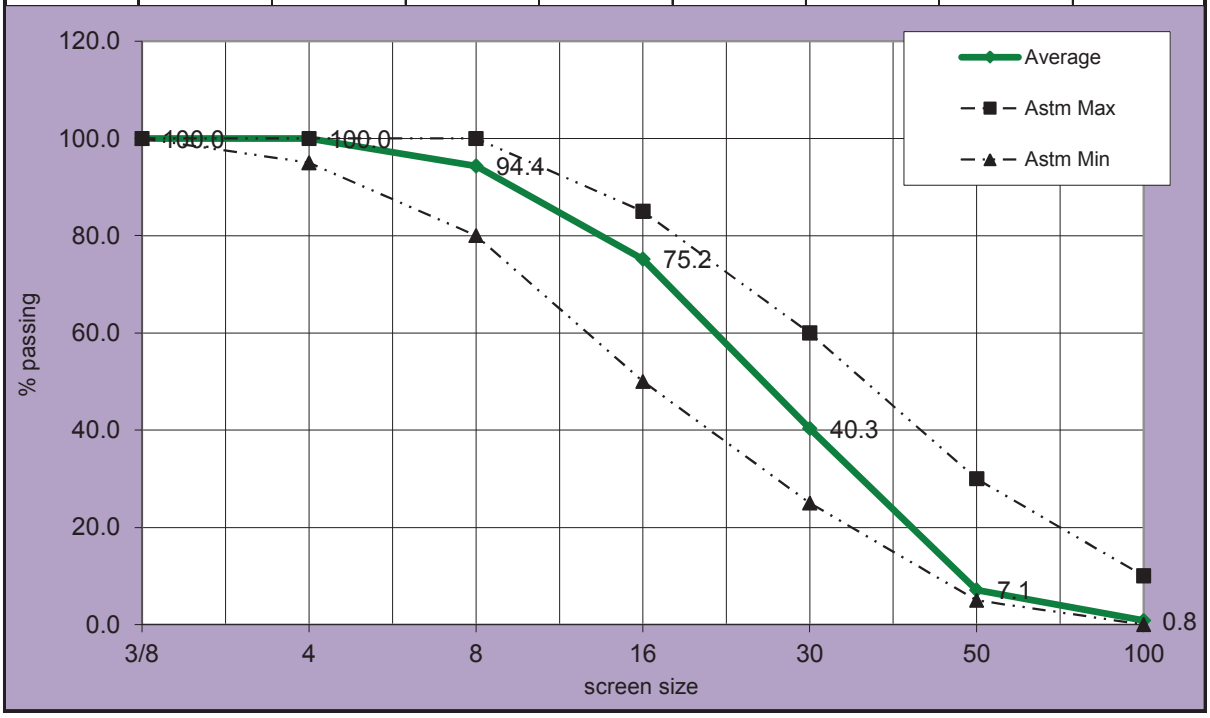
Plant 024 (1713)-Norcross
Product 010-10SM Mfg Sand (30960)
Specification GADOT 10SM
Period 01/30/2018 - 03/01/2018

Sieve/Test	Tests	Average	Target	Specification
3/8" (9.5mm)	68	100.0	100-100	100-100
#4 (4.75mm)	68	99.4	97-100	95-100
#8 (2.36mm)	68	80.6		
#16 (1.18mm)	68	60.2	51-90	45-95
#30 (0.6mm)	68	41.6		
#50 (0.3mm)	68	19.8	12-24	8-30
#100 (0.15mm)	68	7.4	2-9	1-10
#200 (75µm)	68	2.80	0-3	0-4
Pan	68	0.00		

MONTHLY GRADATION SUMMARY

FOLEY MATERIALS - City Pit — Concrete Sand

			percent passing individual screen sizes					
Date	3/8	4	8	16	30	50	100	FM
1/2/18	100	100	93	72	37	7.3	1.0	2.90
1/3/18	100	100	92	72	37	7.4	1.0	2.90
1/4/18	100	100	93	73	37	7.4	1.0	2.88
1/5/18	100	100	93	72	37	7.4	0.9	2.90
1/8/18	100	100	93	72	35	5.4	0.4	2.95
1/9/18	100	100	93	72	41	8.5	0.7	2.85
1/10/18	100	100	93	70	32	7.6	1.3	2.96
1/11/18	100	100	92	71	35	8.2	1.4	2.92
1/12/18	100	100	91	73	47	7.8	0.8	2.81
1/15/18	100	100	92	68	41	7.6	1.4	2.90
1/15/18	100	100	93	72	37	7.3	1.0	2.90
1/16/18	100	100	94	76	42	6.6	0.7	2.82
1/19/18	100	100	95	74	37	7.0	1.2	2.87
1/19/18	100	100	94	76	43	8.8	1.6	2.77
1/22/18	100	100	95	77	42	6.7	0.6	2.79
1/22/18	100	100	94	76	42	6.8	0.8	2.81
1/22/18	100	100	95	84	54	6.5	0.4	2.60
1/22/18	100	100	95	75	37	7.0	1.0	2.85
1/23/18	100	100	96	79	44	6.0	0.7	2.75
1/24/18	100	100	96	79	43	6.1	0.6	2.75
1/25/18	100	100	99	72	37	6.8	0.3	2.85
1/26/18	100	100	95	72	37	6.8	0.4	2.90
1/29/18	100	100	97	79	43	7.7	0.7	2.73
1/29/18	100	100	96	83	50	6.1	0.3	2.65
1/29/18	100	100	100	91	49	10.2	1.5	2.48
1/30/18	100	100	95	76	37	5.9	0.3	2.86
1/31/18	100	100	96	75	37	5.1	0.7	2.89
Average	**100.0**	**100.0**	**94.4**	**75.2**	**40.3**	**7.1**	**0.8**	**2.82**
high	100.0	100.0	99.6	91.2	54.4	10.2	1.6	2.96
low	100.0	99.8	91.0	68.3	32.1	5.1	0.3	2.48
Std. Dev.	0.0	0.0	2.1	4.9	5.3	1.1	0.4	0.11
ASTM	100	100	100	85	60	30	10	
ASTM	100	95	80	50	25	5	0	



BUILDING TRUST

Sika Corporation · 201 Polito Avenue · Lyndhurst, NJ 07071 · USA

Ms. Joanna Moak
Thomas Concrete
2825 Humphries Way
Doraville, GA 30360

CONTACT

Nathaniel Artman
Concrete Specialist
Phone: +1.330.495.0109
Mobile: +1.330.495.0109
artman.nathaniel@us.sika.com

RE: CERTIFICATE OF COMPLIANCE - SIKA AEA-14

April 13, 2018

This is to confirm that Sika AEA-14, air entraining admixture, conforms to the requirements of ASTM C 260/AASHTO M 154.

Sika AEA-14 is manufactured under quality control conditions by Sika Corporation. Sika AEA-14 exhibits the typical physical properties as stated in the current data sheet for the product found at Sika's website www.usa.sika.com when used as directed within the product's shelf life for one year from the date of installation. **Always read the current applicable product data sheet, safety data sheet and label prior to use.**

Results may differ based upon statistical variations depending upon mix design, mixing methods and equipment, temperature, application methods, test methods, actual site conditions and curing conditions.

NO OTHER WARRANTIES, EXPRESS OR IMPLIED, SHALL APPLY INCLUDING ANY WARRANTY OF MERCHANTIBILITY OR FITNESS FOR A PARTICULAR PURPOSE. SIKA SHALL NOT BE LIABLE UNDER ANY LEGAL THEORY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND. SIKA SHALL NOT BE RESPONSIBLE FOR THE USE OF THIS PRODUCT IN A MANNER TO INFRINGE ON ANY PATENT OR ANY OTHER INTELLECTUAL PROPERTY RIGHTS HELD BY OTHERS.

Sincerely,

Nathaniel Artman, EI
Concrete Specialist

BUILDING TRUST

Sika Corporation · 201 Polito Avenue · Lyndhurst, NJ 07071 · USA

Ms. Joanna Moak
Thomas Concrete
2825 Humphries Way
Doraville, GA 30360

CONTACT

Nathaniel Artman
Concrete Specialist
Phone: +1.330.495.0109
Mobile: +1.330.495.0109
artman.nathaniel@us.sika.com

RE: CERTIFICATE OF COMPLIANCE - PLASTIMENT XR May 24, 2016

This is to confirm that Plastiment XR, water reducing and set retarding admixture, conforms to the requirements of ASTM C 494/AASHTO M 194, Type B & D.

Plastiment XR is manufactured under quality control conditions by Sika Corporation. Plastiment XR exhibits the typical physical properties as stated in the current data sheet for the product found at Sika's website www.usa.sika.com when used as directed within the product's shelf life for one year from the date of installation. **Always read the current applicable product data sheet, material safety data sheet and label prior to use.**

Results may differ based upon statistical variations depending upon mix design, mixing methods and equipment, temperature, application methods, test methods, actual site conditions and curing conditions.

NO OTHER WARRANTIES, EXPRESS OR IMPLIED, SHALL APPLY INCLUDING ANY WARRANTY OF MERCHANTIBILITY OR FITNESS FOR A PARTICULAR PURPOSE. SIKA SHALL NOT BE LIABLE UNDER ANY LEGAL THEORY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND. SIKA SHALL NOT BE RESPONSIBLE FOR THE USE OF THIS PRODUCT IN A MANNER TO INFRINGE ON ANY PATENT OR ANY OTHER INTELLECTUAL PROPERTY RIGHTS HELD BY OTHERS.

Sincerely,

Nathaniel Artman, EI
Concrete Specialist

BUILDING TRUST

Sika Corporation · 201 Polito Avenue · Lyndhurst, NJ 07071 · USA

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Thomas Concrete
2825 Humphries Way
Doraville, GA 30360

CONTACT

Nathaniel Artman
Concrete Specialist
Phone: +1.330.495.0109
Mobile: +1.330.495.0109
artman.nathaniel@us.sika.com

RE: CERTIFICATE OF COMPLIANCE - SIKA VISCOCRETE-2100 April 13, 2018

This is to confirm that Sika ViscoCrete-2100, high range water reducing admixture, conforms to the requirements of ASTM C 494/AASHTO M 194, Type A & F.

Sika ViscoCrete-2100 is manufactured under quality control conditions by Sika Corporation. Sika ViscoCrete-2100 exhibits the typical physical properties as stated in the current data sheet for the product found at Sika's website www.usa.sika.com when used as directed within the product's shelf life for one year from the date of installation. **Always read the current applicable product data sheet, safety data sheet and label prior to use.**

Results may differ based upon statistical variations depending upon mix design, mixing methods and equipment, temperature, application methods, test methods, actual site conditions and curing conditions.

NO OTHER WARRANTIES, EXPRESS OR IMPLIED, SHALL APPLY INCLUDING ANY WARRANTY OF MERCHANTIBILITY OR FITNESS FOR A PARTICULAR PURPOSE. SIKA SHALL NOT BE LIABLE UNDER ANY LEGAL THEORY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND. SIKA SHALL NOT BE RESPONSIBLE FOR THE USE OF THIS PRODUCT IN A MANNER TO INFRINGE ON ANY PATENT OR ANY OTHER INTELLECTUAL PROPERTY RIGHTS HELD BY OTHERS.

Sincerely,

Nathaniel Artman, EI
Concrete Specialist

Holcim

NSF Certified to NSF/ANSI 61 & 372

Material Certification Report

Material: Portland Cement
Type: I-II (MH)

Test Period: 01-Nov-2017 to 30-Nov-2017
Date Issued: 14-Dec-2017

Certification

This cement meets the specifications of ASTM C150 and AASHTO M85 for Type I-II (MH) cement.

General Information

Supplier:	Holcim-Holly Hill	Source Location:	Holcim-Holly Hill
Address:	2173 Gardner Blvd Holly Hill, SC 29059		2173 Gardner Blvd Holly Hill, SC 29059
Contact:	Scott Poaps / (803) 496-2995	Contact:	

The following is based on average test data during the test period. The data is typical of cement shipped by Holcim; individual shipments may vary.

Test Data on ASTM Standard Requirements

Chemical			Physical		
Item	**Limit [1]**	**Result**	**Item**	**Limit [1]**	**Result**
SiO_2 (%)	-	20.2	Air Content (%)	12 max	6
Al_2O_3 (%)	6.0 max	4.8	Blaine Fineness (m^2/kg)	260-430	390
Fe_2O_3 (%)	6.0 max	3.5			
CaO (%)	-	63.4	Autoclave Expansion (%) (C151)	0.80 max	0.00
MgO (%)	6.0 max	1.4	Compressive Strength MPa (psi)		
SO_3 (%) [2]	3.0 max	3.2	3 day	10.0 (1450) min	28.0 (4060)
Loss on Ignition (%) [5]	3.5 max	1.6	7 day	17.0 (2470) min	34.8 (5050)
Insoluble Residue (%)	1.50 max	0.43			
CO_2 (%)	-	0.5	Initial Vicat (minutes)	45-375	91
$CaCO_3$ in Limestone (%)	70 min	90			
Potential Phase Compositions [3]:					
C_3S (%)	-	57			
C_2S (%)	-	15			
C_3A (%)	8 max	7			
C_4AF (%)	-	11			
$C_3S + 4.75C_3A$ (%)	100 max	89			

Test Data on ASTM Optional Requirements

Chemical			Physical		
Item	**Limit [1]**	**Result**	**Item**	**Limit [1]**	**Result**
Equivalent Alkalies (%)	0.60 max	0.47	Heat of Hydration kJ/kg (cal/g) (ASTM C1702) 3 Days [4]	-	320 (76)
			Mortar Bar Expansion (%) (C1038)	-	0.004

Notes (*1-9)

1 - Dashes in the Limit / Result columns mean Not Applicable.
2 - It is permissible to exceed the specification limit provided that ASTM C1038 Mortar Bar Expansion does not exceed 0.020% at 14 days.
3 - Adjusted per Annex A1.6 of ASTM C150 and AASHTO M85.
4 - Test results represent the most recent value and is provided for information only.
5 - Limit = 3.0 when limestone is not an ingredient in the final cement product

Additional Data

Item	Limestone	Inorganic Processing Addition	Base Cement Phase Composition	Result
Amount (%)	1.2	0.4	C_3S (%)	58
SiO_2 (%)	2.2	35.7	C_2S (%)	15
Al_2O_3 (%)	0.7	7.1	C_3A (%)	7
Fe_2O_3 (%)	0.6	0.7	C_4AF (%)	11
CaO (%)	52.4	42.1		
SO_3 (%)	0.5	2.2		

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Version: 160815

Scott Poaps,
Quality Manager

Holcim

NSF Certified to NSF/ANSI 61 & 372

Material Certification Report

Material: Portland Cement
Type: III

Test Period: 01-Nov-2017 to 30-Nov-2017
Date Issued: 14-Dec-2017

Certification

This cement meets the specifications of ASTM C150 and AASHTO M85 for Type III cement.

General Information

Supplier:	Holcim-Holly Hill	Source Location:	Holcim-Holly Hill
Address:	2173 Gardner Blvd Holly Hill, SC 29059		2173 Gardner Blvd Holly Hill, SC 29059
Contact:	Scott Poaps / (803) 496-2995	Contact:	

The following is based on average test data during the test period. The data is typical of cement shipped by Holcim; individual shipments may vary.

Test Data on ASTM Standard Requirements

Chemical			Physical		
Item	**Limit [1]**	**Result**	**Item**	**Limit [1]**	**Result**
SiO_2 (%)	-	19.9	Air Content (%)	12 max	5
Al_2O_3 (%)	-	4.8	Blaine Fineness (m^2/kg)	-	488
Fe_2O_3 (%)	-	3.4			
CaO (%)	-	63.4	Autoclave Expansion (%) (C151)	0.80 max	-0.02
MgO (%)	6.0 max	1.3	Compressive Strength MPa (psi)		
SO_3 (%) [2]	3.5 max	3.6	1 day	12.0 (1740) min	22.4 (3250)
Loss on Ignition (%) [5]	3.5 max	1.7	3 day	24.0 (3480) min	35.3 (5120)
Insoluble Residue (%)	1.50 max	0.49			
CO_2 (%)	-	0.7	Initial Vicat (minutes)	45-375	70
$CaCO_3$ in Limestone (%)	70 min	90			
Potential Phase Compositions [3]:					
C_3S (%)	-	57			
C_2S (%)	-	14			
C_3A (%)	15 max	7			
C_4AF (%)	-	10			

Test Data on ASTM Optional Requirements

Chemical			Physical		
Item	**Limit [1]**	**Result**	**Item**	**Limit [1]**	**Result**
Equivalent Alkalies (%)	0.60 max	0.49	Mortar Bar Expansion (%) (C1038)	-	0.001

Notes (*1-9)

1 - Dashes in the Limit / Result columns mean Not Applicable.
2 - It is permissible to exceed the specification limit provided that ASTM C1038 Mortar Bar Expansion does not exceed 0.020% at 14 days.
3 - Adjusted per Annex A1.6 of ASTM C150 and AASHTO M85.
5 - Limit = 3.0 when limestone is not an ingredient in the final cement product

Additional Data

Item	Limestone	Inorganic Processing Addition	Base Cement Phase Composition	Result
Amount (%)	1.7	-	C_3S (%)	58
SiO_2 (%)	2.3	-	C_2S (%)	14
Al_2O_3 (%)	0.7	-	C_3A (%)	7
Fe_2O_3 (%)	0.6	-	C_4AF (%)	10
CaO (%)	52.2	-		
SO_3 (%)	0.5	-		

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Version: 160815

Scott Poaps,
Quality Manager

Build something great™ BORAL

REPORT OF FLY ASH ANALYSIS

Project Name: Bowen
Sample ID #: 170328003 **Tested By:** QC
Sample Date: March 2017 **Report Date:** 16-May-17
Silos 2,3,4 & 5

CHEMICAL TESTS	RESULTS	ASTM C 618 CLASS F/C	AASHTO M 295 CLASS F/C
Silicon Dioxide (SiO_2), %	47.83		
Aluminum Oxide (Al_2O_3), %	20.48		
Iron Oxide (Fe_2O_3), %	15.61		
Sum of SiO_2, Al_2O_3, Fe_2O_3, %	83.92	70.0/50.0 min.	70.0/50.0 min.
Calcium Oxide (CaO), %	5.35		
Magnesium Oxide (MgO), %	0.89		
Sulfur Trioxide (SO_3), %	2.99	5.0 max.	5.0 max.
Sodium Oxide (Na_2O), %	1.15		
Potassium Oxide (K_2O), %	2.39		
Total Alkalies (as Na_2O), %	2.72		
Available Alkalies (as Na_2O), %	0.98		

PHYSICAL TESTS	RESULTS	ASTM C 618 CLASS F/C	AASHTO M 295 CLASS F/C
Moisture Content, %	0.05	3.0 max.	3.0 max.
Loss on Ignition, %	1.91	6.0 max.	5.0 max.
Amount Retained on No. 325 Sieve, %	13.45	34 max.	34 max.
Specific Gravity	2.45		
Autoclave Soundness, %	0.03	0.8 max.	0.8 max.
Strength Activity Index with Portland Cement at 7 days, % of Control	82.8	75 min.*	75 min.*
Strength Activity Index with Portland Cement at 28 days, % of Control	96.4	75 min.*	75 min.*
Water Required, % of Control	97.5	105 max.	105 max.
Loose Bulk Density, lbs/ft^3	68.9		

Meets ASTM C 618 and AASHTO M 295, FDOT Section 929, TxDOT DMS 4610, SCDOT 701, and MDOT 714 for class F Fly Ash

*Meeting the 7 day or 28 day strength activity index will indicate specification compliance.

Melissa Garcia
Melissa Garcia
Quality Assurance / Laboratory Manager

Material Certification Report

LEHIGH™ HEIDELBERGCEMENT Group

Brand Name: Lehigh Slag Cement
Material: GGBFS
Type: ASTM C989 Grade 120

DATE: 01-Mar-2018
Silo # 611/612

General Information

Supplier:	Lehigh Cement Company	Source Location:	Lehigh Cement Company
Address:	575 Cargo Road		575 Cargo Road
	Cape Canaveral, Florida 32920		Cape Canaveral, Florida 32920

The following information is based on monthly average test data. The data is typical of GGBFS shipped by Lehigh Cement Company. Cape Canaveral, FL Plant. Individual shipments may vary.

Test Data on ASTM "Standard" Requirements

Chemical (C989, Table 2)			Physical (C989, Table1)		
Item	**Limit**	**Result**	**Item**	**Limit**	**Result**
			+45 µm (No. 325) Sieve (%)	20 max	0.61
			Blaine Fineness (m2/kg)	-	492
Sulfide S (%)	2.5 max	1.0	Air Content (%)	12 max	2.6
			Expansion in Water (C-1038) (%)	0.020 max	0.016
Sulfate Ion - SO_3 (%)	NA	3.1	Slag Activity Index (SAI %)		
			Average of Last 5 Samples:		
			Avg 7 Day Index		96
			Avg 28 Day Index	115 min	135
			Current Samples:		
			7 Day Index		100
			28 Day Index	110 min	133

Test Data on CCRL Reference Cement

Chemical			Physical		
Item	**Limit**	**Result**	**Item**	**Limit**	**Result**
Total Alkalies as Na_2O (%)	0.60 - 0.90	0.78	Blaine Fineness (m2/kg)	-	382
C_3S	-	57	Compressive Strength MPa (psi):		
C_2S	-	15	7 Day	-	4437
C_3A	-	7	28 Day	34.5 (5000) min	37.7 (5468)
C_4AF	-	8			

Optional Test Data

Chemical			Physical		
Item	**Limit**	**Result**	**Item**	**Limit**	**Result**
% Total Alkalies	-	0.42	Specific Gravity (Latest Result)	-	2.86
%Cl (Chloride)	-	<0.01	1 Day Accelerated (C-1073) psi	-	2600

Certification Statement

Lehigh Slag Cement meets Section 929-1 and 929-5 of FDOT Specifications

Lehigh Cement Office Cape Canaveral, FL - (321) 323-5032

THOMAS CONCRETE

ENVIRONMENTAL PRODUCT DECLARATION

Mix 302-2FS • Atlanta Plant

This Environmental Product Declaration (EPD) reports the impacts for 1 m^3 of ready mixed concrete mix, meeting the following specifications:

- ASTM C94: Ready-Mixed Concrete
- UNSPSC Code 30111505: Ready Mix Concrete
- CSI Section 03 30 00: Cast-in-Place Concrete

COMPANY

Thomas Concrete
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PLANT

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EPD PROGRAM OPERATOR

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428

DATE OF ISSUE

04/20/2018 **(valid for 5 years until 04/20/2023)**

ENVIRONMENTAL IMPACTS

Declared Product:

Mix 302-2FS • Atlanta Plant
3000 Air En-trained
Compressive strength: 3000 psi at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	**228**
Ozone Depletion Potential (kg CFC-11-eq)	**7.5E-6**
Acidification Potential (kg SO_2-eq)	**0.87**
Eutrophication Potential (kg N-eq)	**0.36**
Photochemical Smog Creation Potential (kg O_3-eq)	**15.7**
Total Primary Energy Consumption (MJ)	**1,794**
Nonrenewable (MJ)	**1,728**
Renewable (MJ)	**66.3**
Total Concrete Water Consumption (m^3)	**3.17**
Batching Water (m^3)	**0.14**
Washing Water (m^3)	**0.02**
Nonrenewable Material Resource Consumption (kg)	**2,190**
Renewable Material Resource Consumption (kg)	**1.62**
Hazardous Waste Production (kg)	**0.01**
Nonhazardous Waste Production (kg)	**8.13**

Product Components: crushed aggregate (ASTM C33), Portland cement (ASTM C150), natural aggregate (ASTM C33), slag cement (ASTM C989), fly ash (ASTM C618), batch water (ASTM C1602), admixture (ASTM C494)

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LIFE CYCLE ASSESSMENT

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- Water use in mixing and distributing concrete.

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THOMAS CONCRETE

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DATE OF ISSUE

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ENVIRONMENTAL IMPACTS

Declared Product:

Mix 302-3FS • Atlanta Plant
3000 Non Air
Compressive strength: 3000 psi at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	**236**
Ozone Depletion Potential (kg CFC-11-eq)	**7.7E-6**
Acidification Potential (kg SO_2-eq)	**0.89**
Eutrophication Potential (kg N-eq)	**0.37**
Photochemical Smog Creation Potential (kg O_3-eq)	**16.1**
Total Primary Energy Consumption (MJ)	**1,844**
Nonrenewable (MJ)	**1,775**
Renewable (MJ)	**68.4**
Total Concrete Water Consumption (m^3)	**3.26**
Batching Water (m^3)	**0.14**
Washing Water (m^3)	**0.02**
Nonrenewable Material Resource Consumption (kg)	**2,260**
Renewable Material Resource Consumption (kg)	**1.67**
Hazardous Waste Production (kg)	**0.01**
Nonhazardous Waste Production (kg)	**8.20**

Product Components: crushed aggregate (ASTM C33), Portland cement (ASTM C150), natural aggregate (ASTM C33), slag cement (ASTM C989), fly ash (ASTM C618), batch water (ASTM C1602), admixture (ASTM C494)

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THOMAS CONCRETE

ENVIRONMENTAL PRODUCT DECLARATION

Mix 352-2FS • Atlanta Plant

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DATE OF ISSUE

04/20/2018 **(valid for 5 years until 04/20/2023)**

ENVIRONMENTAL IMPACTS

Declared Product:

Mix 352-2FS • Atlanta Plant
3500 Air En-trained
Compressive strength: 3500 psi at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	**235**
Ozone Depletion Potential (kg CFC-11-eq)	**7.9E-6**
Acidification Potential (kg SO_2-eq)	**0.91**
Eutrophication Potential (kg N-eq)	**0.37**
Photochemical Smog Creation Potential (kg O_3-eq)	**16.4**
Total Primary Energy Consumption (MJ)	**1,870**
Nonrenewable (MJ)	**1,802**
Renewable (MJ)	**68.7**
Total Concrete Water Consumption (m^3)	**3.18**
Batching Water (m^3)	**0.14**
Washing Water (m^3)	**0.02**
Nonrenewable Material Resource Consumption (kg)	**2,194**
Renewable Material Resource Consumption (kg)	**1.68**
Hazardous Waste Production (kg)	**0.01**
Nonhazardous Waste Production (kg)	**8.19**

Product Components: crushed aggregate (ASTM C33), Portland cement (ASTM C150), slag cement (ASTM C989), fly ash (ASTM C618), batch water (ASTM C1602), admixture (ASTM C494)

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ENVIRONMENTAL IMPACTS

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Mix 352-3FS • Atlanta Plant
3500 Non Air
Compressive strength: 3500 psi at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	**240**
Ozone Depletion Potential (kg CFC-11-eq)	**8.0E-6**
Acidification Potential (kg SO_2-eq)	**0.93**
Eutrophication Potential (kg N-eq)	**0.38**
Photochemical Smog Creation Potential (kg O_3-eq)	**16.7**
Total Primary Energy Consumption (MJ)	**1,905**
Nonrenewable (MJ)	**1,835**
Renewable (MJ)	**69.9**
Total Concrete Water Consumption (m^3)	**3.30**
Batching Water (m^3)	**0.14**
Washing Water (m^3)	**0.02**
Nonrenewable Material Resource Consumption (kg)	**2,271**
Renewable Material Resource Consumption (kg)	**1.71**
Hazardous Waste Production (kg)	**0.01**
Nonhazardous Waste Production (kg)	**8.24**

Product Components: crushed aggregate (ASTM C33), Portland cement (ASTM C150), slag cement (ASTM C989), fly ash (ASTM C618), batch water (ASTM C1602), admixture (ASTM C494)

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- **Aggregate (crushed):** US-EI (2016): "Gravel, crushed, at mine/US", 2001
- **Admixture (air-entraining):** EFCA EPD, Europe 2015
- **Admixture (retarding):** EFCA EPD, 2015
- **Admixture (other):** Highest impact in each impact category of the six EFCA admixture EPD, 2015
- **Microfibers:** ELCD: "Polypropylene fibres (PP), crude oil based, production mix, at plant, PP granulate without additives EU-27 S", 2005
- **Municipal Water:** US-EI (2016): "Tap water, at user/US", 2000
- **Truck transport:** US-EI (2016): "Transport, single unit truck, diesel powered/NREL/US", 2007 and US EPA emission factors, 2014
- **Rail transport:** US-EI (2016): "Transport, train, diesel powered NREL/US", 2007
- **Ship transport:** US-EI (2016): "Transport, ocean freighter, average fuel mix NREL/US", 2007
- **Diesel:** US-EI (2016): "Diesel, combusted in industrial equipment/NREL/US", 2007
- **Natural gas:** US-EI (2016): "Natural gas, combusted in industrial boiler/NREL/US", 2007
- **Carbon Cure:** Primary data, 2017

THOMAS CONCRETE

ENVIRONMENTAL PRODUCT DECLARATION

Mix 457FS • Atlanta Plant

This Environmental Product Declaration (EPD) reports the impacts for 1 m^3 of ready mixed concrete mix, meeting the following specifications:

- ASTM C94: Ready-Mixed Concrete
- UNSPSC Code 30111505: Ready Mix Concrete
- CSI Section 03 30 00: Cast-in-Place Concrete

COMPANY

Thomas Concrete
2500 Cumberland Pwky, Suite 200
Atlanta, GA 30339

PLANT

Atlanta Plant
1430 Marietta Blvd
Atlanta, GA 30318

EPD PROGRAM OPERATOR

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428

DATE OF ISSUE

04/20/2018 **(valid for 5 years until 04/20/2023)**

ENVIRONMENTAL IMPACTS

Declared Product:

Mix 457FS • Atlanta Plant
4500 Air En-Trained Carbon Cure
Compressive strength: 4500 psi at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	**275**
Ozone Depletion Potential (kg CFC-11-eq)	**9.2E-6**
Acidification Potential (kg SO_2-eq)	**1.05**
Eutrophication Potential (kg N-eq)	**0.42**
Photochemical Smog Creation Potential (kg O_3-eq)	**18.6**
Total Primary Energy Consumption (MJ)	**2,117**
Nonrenewable (MJ)	**2,036**
Renewable (MJ)	**80.5**
Total Concrete Water Consumption (m^3)	**3.06**
Batching Water (m^3)	**0.14**
Washing Water (m^3)	**0.02**
Nonrenewable Material Resource Consumption (kg)	**2,172**
Renewable Material Resource Consumption (kg)	**2.01**
Hazardous Waste Production (kg)	**0.01**
Nonhazardous Waste Production (kg)	**8.49**

Product Components: crushed aggregate (ASTM C33), Portland cement (ASTM C150), natural aggregate (ASTM C33), slag cement (ASTM C989), fly ash (ASTM C618), batch water (ASTM C1602), admixture (ASTM C494),

The Carbon Leadership Forum PCR: Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) for Concrete, Version 1.1 dated 12/4/2013, serves as the PCR for this EPD. http://www.carbonleadershipforum.org

PCR review was conducted by: Nicholas Santero • thinkstep (formerly PE International).

Independent verification of the declaration, according to ISO 14025:2006: ☐ internal ☑ external

Third party verifier: Thomas P. Gloria (t.gloria@industrial-ecology.com) • Industrial Ecology Consultants

LCA and EPD developer: Laurel McEwen (laurel.mcewen@climateearth.com) • Climate Earth

LIFE CYCLE ASSESSMENT

This EPD is based on a 'cradle-to-gate' life cycle assessment (LCA) of ready mixed concrete mixes. A summary of life cycle processes included in the EPD is as follows:

- Raw material supply (upstream processes): Extraction, handling, and processing of the raw materials used in production of concrete: cement, supplementary cementitious materials, aggregate (coarse and fine), water, admixtures, and other materials or chemicals used in concrete mixtures.
- Transportation: Transportation of these materials from supplier to the gate of the concrete producer.
- Manufacturing (core processes): Energy used to store, batch, mix, and distribute the concrete and operate the facility (concrete plant).
- Water use in mixing and distributing concrete.

A summary of cradle-to-gate life cycle processes excluded from the EPD is as follows:

- Production, manufacture, and construction of buildings, capital goods, and infrastructure.
- Production and manufacture of concrete production equipment, concrete delivery vehicles, earthmoving equipment, and laboratory equipment.
- Personnel-related activities (travel, furniture, office supplies).
- Energy and water use related to company management and sales activities.

A summary of the limitations of this EPD include the following:

- This EPD does not report all of the environmental impacts due to manufacturing of the product, but rather environmental impacts for categories with established LCA-based methods to track and report. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change, water use in the upstream manufacturing process, and habitat destruction.
- This EPD reports the results of an LCA for 'cradle-to-gate' analysis. Thus, declarations themselves are not comparative assertions, defined as an environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function. An EPD does not make any statements that the product covered by the EPD is better or worse than any other product.
- In order to assess the local impacts of product manufacturing, additional analysis is required.
- Life cycle impact assessment results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins, or risks.

Note: The product manufacturer has the option of declaring additional information about their product including conformance with any other sustainability certification programs that often have performance and prescriptive requirements that aim to illustrate environmental best practices that cannot be captured by LCA.

DATA QUALITY, VARIABILITY, AND COMPARABILITY

This EPD was created using plant-specific data for upstream materials. Potential variations due to supplier locations, manufacturing processes, and efficiencies and fuel use are thus accounted for in this EPD. EPDs of concrete mixtures may not be comparable if they do not comply with this standard and data from this EPD. While EPDs can be used to compare concrete mixes, the data cannot be used to compare between construction products or concrete mixes used in different concrete products unless the data is integrated into a comprehensive LCA. For example, precast concrete, concrete masonry units, and site-cast concrete all have different manufacturing processes whose impacts are attributed to different LCA stages. This precludes direct comparison between mixes used in these different products until all life cycle phases are included.

DATA SOURCES

Information on the LCI data source, process name, geography, and year for each unit process are given below.

- **Portland cement:** Portland Concrete Association, Industry Average EPD, 2016
- **Slag cement:** Slag Cement Association, industry average EPD, 2014
- **Fly ash:** byproduct of coal combustion; no upstream manufacturing impacts
- **Silica fume:** byproduct of silicon and ferrosilicon alloy production; no upstream manufacturing impacts
- **Aggregate (natural):** US-EI (2016): "Gravel, round, at mine/US", 2001
- **Aggregate (crushed):** US-EI (2016): "Gravel, crushed, at mine/US", 2001
- **Admixture (air-entraining):** EFCA EPD, Europe 2015
- **Admixture (retarding):** EFCA EPD, 2015
- **Admixture (other):** Highest impact in each impact category of the six EFCA admixture EPD, 2015
- **Microfibers:** ELCD: "Polypropylene fibres (PP), crude oil based, production mix, at plant, PP granulate without additives EU-27 S", 2005
- **Municipal Water:** US-EI (2016): "Tap water, at user/US", 2000
- **Truck transport:** US-EI (2016): "Transport, single unit truck, diesel powered/NREL/US", 2007 and US EPA emission factors, 2014
- **Rail transport:** US-EI (2016): "Transport, train, diesel powered NREL/US", 2007
- **Ship transport:** US-EI (2016): "Transport, ocean freighter, average fuel mix NREL/US", 2007
- **Diesel:** US-EI (2016): "Diesel, combusted in industrial equipment/NREL/US", 2007
- **Natural gas:** US-EI (2016): "Natural gas, combusted in industrial boiler/NREL/US", 2007
- **Carbon Cure:** Primary data, 2017

THOMAS CONCRETE

ENVIRONMENTAL PRODUCT DECLARATION

Mix 507-1FS • Atlanta Plant

This Environmental Product Declaration (EPD) reports the impacts for 1 m^3 of ready mixed concrete mix, meeting the following specifications:

- ASTM C94: Ready-Mixed Concrete
- UNSPSC Code 30111505: Ready Mix Concrete
- CSI Section 03 30 00: Cast-in-Place Concrete

COMPANY

Thomas Concrete
2500 Cumberland Pwky, Suite 200
Atlanta, GA 30339

PLANT

Atlanta Plant
1430 Marietta Blvd
Atlanta, GA 30318

EPD PROGRAM OPERATOR

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428

DATE OF ISSUE

10/03/2017 **(valid for 5 years until 10/03/2022)**

ENVIRONMENTAL IMPACTS

Declared Product:

Mix 507-1FS • Atlanta Plant
5000 CARBON CURE
Compressive strength: 5000 psi at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	**287**
Ozone Depletion Potential (kg CFC-11-eq)	**9.5E-6**
Acidification Potential (kg SO_2-eq)	**1.08**
Eutrophication Potential (kg N-eq)	**0.43**
Photochemical Smog Creation Potential (kg O_3-eq)	**19.3**
Total Primary Energy Consumption (MJ)	**2,201**
Nonrenewable (MJ)	**2,118**
Renewable (MJ)	**83.6**
Total Concrete Water Consumption (m^3)	**3.14**
Batching Water (m^3)	**0.14**
Washing Water (m^3)	**0.02**
Nonrenewable Material Resource Consumption (kg)	**2,239**
Renewable Material Resource Consumption (kg)	**2.10**
Hazardous Waste Production (kg)	**0.02**
Nonhazardous Waste Production (kg)	**8.65**

Product Components: crushed aggregate (ASTM C33), Portland cement (ASTM C150), natural aggregate (ASTM C33), slag cement (ASTM C989), fly ash (ASTM C618), batch water (ASTM C1602), admixture (ASTM C494),

The Carbon Leadership Forum PCR: Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) for Concrete, Version 1.1 dated 12/4/2013, serves as the PCR for this EPD. http://www.carbonleadershipforum.org

PCR review was conducted by: Nicholas Santero • thinkstep (formerly PE International).

Independent verification of the declaration, according to ISO 14025:2006: ☐ internal ☑ external

Third party verifier: Thomas P. Gloria (t.gloria@industrial-ecology.com) • Industrial Ecology Consultants

LCA and EPD developer: Laurel McEwen (laurel.mcewen@climateearth.com) • Climate Earth

LIFE CYCLE ASSESSMENT

This EPD is based on a 'cradle-to-gate' life cycle assessment (LCA) of ready mixed concrete mixes. A summary of life cycle processes included in the EPD is as follows:

- Raw material supply (upstream processes): Extraction, handling, and processing of the raw materials used in production of concrete: cement, supplementary cementitious materials, aggregate (coarse and fine), water, admixtures, and other materials or chemicals used in concrete mixtures.
- Transportation: Transportation of these materials from supplier to the gate of the concrete producer.
- Manufacturing (core processes): Energy used to store, batch, mix, and distribute the concrete and operate the facility (concrete plant).
- Water use in mixing and distributing concrete.

A summary of cradle-to-gate life cycle processes excluded from the EPD is as follows:

- Production, manufacture, and construction of buildings, capital goods, and infrastructure.
- Production and manufacture of concrete production equipment, concrete delivery vehicles, earthmoving equipment, and laboratory equipment.
- Personnel-related activities (travel, furniture, office supplies).
- Energy and water use related to company management and sales activities.

A summary of the limitations of this EPD include the following:

- This EPD does not report all of the environmental impacts due to manufacturing of the product, but rather environmental impacts for categories with established LCA-based methods to track and report. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change, water use in the upstream manufacturing process, and habitat destruction.
- This EPD reports the results of an LCA for 'cradle-to-gate' analysis. Thus, declarations themselves are not comparative assertions, defined as an environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function. An EPD does not make any statements that the product covered by the EPD is better or worse than any other product.
- In order to assess the local impacts of product manufacturing, additional analysis is required.
- Life cycle impact assessment results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins, or risks.

Note: The product manufacturer has the option of declaring additional information about their product including conformance with any other sustainability certification programs that often have performance and prescriptive requirements that aim to illustrate environmental best practices that cannot be captured by LCA.

DATA QUALITY, VARIABILITY, AND COMPARABILITY

This EPD was created using plant-specific data for upstream materials. Potential variations due to supplier locations, manufacturing processes, and efficiencies and fuel use are thus accounted for in this EPD. EPDs of concrete mixtures may not be comparable if they do not comply with this standard and data from this EPD. While EPDs can be used to compare concrete mixes, the data cannot be used to compare between construction products or concrete mixes used in different concrete products unless the data is integrated into a comprehensive LCA. For example, precast concrete, concrete masonry units, and site-cast concrete all have different manufacturing processes whose impacts are attributed to different LCA stages. This precludes direct comparison between mixes used in these different products until all life cycle phases are included.

DATA SOURCES

Information on the LCI data source, process name, geography, and year for each unit process are given below.

- **Portland cement:** Portland Concrete Association, Industry Average EPD, 2016
- **Slag cement:** Slag Cement Association, industry average EPD, 2014
- **Fly ash:** byproduct of coal combustion; no upstream manufacturing impacts
- **Silica fume:** byproduct of silicon and ferrosilicon alloy production; no upstream manufacturing impacts
- **Aggregate (natural):** US-EI: "Gravel, round, at mine/US", 2001
- **Aggregate (crushed):** US-EI process: "Gravel, crushed, at mine/US", 2001
- **Admixture (accelerating):** EFCA EPD, "300 ETG AcceleratorEPD", Europe, 2006
- **Admixture (air-entraining):** EFCA EPD, "301 ETG Air Entrainer EPD", Europe 2006
- **Admixture (retarding):** EFCA EPD, "302 ETG Retarding EPD", Europe, 2006
- **Admixture (waterproofing):** EFCA EPD, "303 ETG Waterproofing EPD", Europe, 2006
- **Admixture (plasticizing):** EFCA EPD, "324 ETG Plasticiser EPD", Europe, 2006
- **Admixture (superplasticizing):** EFCA EPD, "325 ETG Superplasticiser EPD", Europe, 2006
- **Admixture (other):** Highest impact in each impact category of the six EFCA admixture EPDs, 2006
- **Microfibers:** ELCD: "Polypropylene fibres (PP), crude oil based, production mix, at plant, PP granulate without additives EU-27 S", 2005
- **Municipal Water:** US-EI process: "Tap water, at user/US", 2000
- **Truck transport:** US-EI: "Transport, single unit truck, diesel powered/NREL/US", 2007 and US EPA emission factors, 2014
- **Rail transport:** US-EI: "Transport, train, diesel powered NREL/US", 2007
- **Ship transport:** US-EI: "Transport, ocean freighter, average fuel mix NREL/US", 2007
- **Diesel:** US-EI: "Diesel, combusted in industrial equipment/NREL/US", 2007
- **Natural gas:** US-EI: "Natural gas, combusted in industrial boiler/NREL/US", 2007
- **Propane:** US-EI: "Liquefied petroleum gas, at refinery/NREL/US", 2007, and US EPA emission factors, 2008
- **Electricity (SERC):** Ecoinvent 3.2: "Electricity, medium voltage, market for, Alloc Rec", 2012
- **Carbon Cure:** Primary data, 2017

THOMAS CONCRETE

ENVIRONMENTAL PRODUCT DECLARATION

Mix 504HE • Atlanta Plant

This Environmental Product Declaration (EPD) reports the impacts for 1 m^3 of ready mixed concrete mix, meeting the following specifications:

- ASTM C94: Ready-Mixed Concrete
- UNSPSC Code 30111505: Ready Mix Concrete
- CSI Section 03 30 00: Cast-in-Place Concrete

COMPANY

Thomas Concrete
2500 Cumberland Pwky, Suite 200
Atlanta, GA 30339

PLANT

Atlanta Plant
1430 Marietta Blvd
Atlanta, GA 30318

EPD PROGRAM OPERATOR

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428

DATE OF ISSUE

04/23/2018 **(valid for 5 years until 04/23/2023)**

ENVIRONMENTAL IMPACTS

Declared Product:

Mix 504HE • Atlanta Plant
5000 High Early
Compressive strength: 5000 psi at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	**462**
Ozone Depletion Potential (kg CFC-11-eq)	**1.2E-5**
Acidification Potential (kg SO_2-eq)	**1.29**
Eutrophication Potential (kg N-eq)	**0.63**
Photochemical Smog Creation Potential (kg O_3-eq)	**25.0**
Total Primary Energy Consumption (MJ)	**2,984**
Nonrenewable (MJ)	**2,855**
Renewable (MJ)	**129**
Total Concrete Water Consumption (m^3)	**3.24**
Batching Water (m^3)	**0.14**
Washing Water (m^3)	**0.02**
Nonrenewable Material Resource Consumption (kg)	**2,572**
Renewable Material Resource Consumption (kg)	**3.21**
Hazardous Waste Production (kg)	**0.02**
Nonhazardous Waste Production (kg)	**10.3**

Product Components: crushed aggregate (ASTM C33), Portland cement (ASTM C150), natural aggregate (ASTM C33), batch water (ASTM C1602), admixture (ASTM C494)

The Carbon Leadership Forum PCR: Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) for Concrete, Version 1.1 dated 12/4/2013, serves as the PCR for this EPD. http://www.carbonleadershipforum.org

PCR review was conducted by: Nicholas Santero • thinkstep (formerly PE International).

Independent verification of the declaration, according to ISO 14025:2006: ☐ internal ☑ external

Third party verifier: Thomas P. Gloria (t.gloria@industrial-ecology.com) • Industrial Ecology Consultants

LCA and EPD developer: Laurel McEwen (laurel.mcewen@climateearth.com) • Climate Earth

LIFE CYCLE ASSESSMENT

This EPD is based on a 'cradle-to-gate' life cycle assessment (LCA) of ready mixed concrete mixes. A summary of life cycle processes included in the EPD is as follows:

- Raw material supply (upstream processes): Extraction, handling, and processing of the raw materials used in production of concrete: cement, supplementary cementitious materials, aggregate (coarse and fine), water, admixtures, and other materials or chemicals used in concrete mixtures.
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- Manufacturing (core processes): Energy used to store, batch, mix, and distribute the concrete and operate the facility (concrete plant).
- Water use in mixing and distributing concrete.

A summary of cradle-to-gate life cycle processes excluded from the EPD is as follows:

- Production, manufacture, and construction of buildings, capital goods, and infrastructure.
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DATA QUALITY, VARIABILITY, AND COMPARABILITY

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DATA SOURCES

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- **Portland cement:** Portland Concrete Association, Industry Average EPD, 2016
- **Slag cement:** Slag Cement Association, industry average EPD, 2014
- **Fly ash:** byproduct of coal combustion; no upstream manufacturing impacts
- **Silica fume:** byproduct of silicon and ferrosilicon alloy production; no upstream manufacturing impacts
- **Aggregate (natural):** US-EI (2016): "Gravel, round, at mine/US", 2001
- **Aggregate (crushed):** US-EI (2016): "Gravel, crushed, at mine/US", 2001
- **Admixture (air-entraining):** EFCA EPD, Europe 2015
- **Admixture (retarding):** EFCA EPD, 2015
- **Admixture (other):** Highest impact in each impact category of the six EFCA admixture EPD, 2015
- **Microfibers:** ELCD: "Polypropylene fibres (PP), crude oil based, production mix, at plant, PP granulate without additives EU-27 S", 2005
- **Municipal Water:** US-EI (2016): "Tap water, at user/US", 2000
- **Truck transport:** US-EI (2016): "Transport, single unit truck, diesel powered/NREL/US", 2007 and US EPA emission factors, 2014
- **Rail transport:** US-EI (2016): "Transport, train, diesel powered NREL/US", 2007
- **Ship transport:** US-EI (2016): "Transport, ocean freighter, average fuel mix NREL/US", 2007
- **Diesel:** US-EI (2016): "Diesel, combusted in industrial equipment/NREL/US", 2007
- **Natural gas:** US-EI (2016): "Natural gas, combusted in industrial boiler/NREL/US", 2007
- **Carbon Cure:** Primary data, 2017

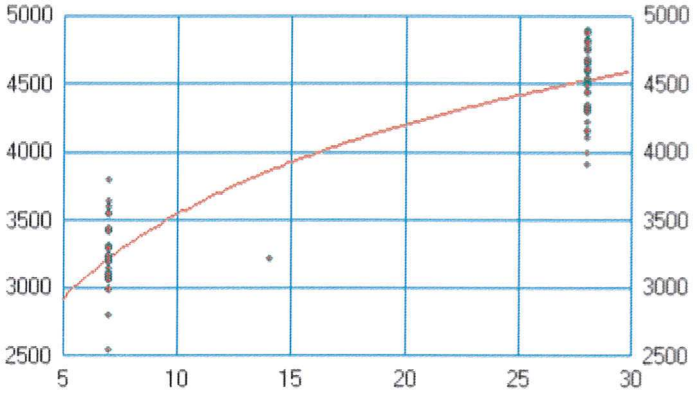
MIX 302-2FS ALSO SUBMITTED AS SUBSTANTIATION FOR MIX 352-2FS

Date: 4/27/2018

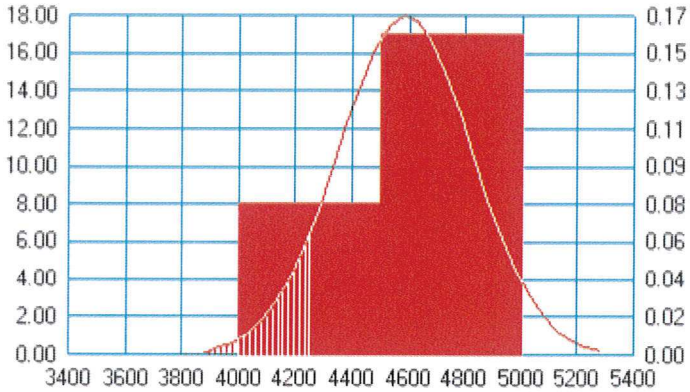
Mix Name: 302-2FS

Units : US

PSI **Strength and Strength Fit vs Maturity** **PSI** **# of Occ.** **Histogram for 28 Day Strength** **%/PSI**



Maturity Days



PSI

95% of tests lie above cross-hatched area

STRENGTH SUMMARY, Compression Either 4" x 8" Or 6" x 12"

No. Of Tests	Avg Slump	Avg Air	Avg 3 Day Strengths	Avg 7 Day	Avg 28 Day	Avg 56 Day	Std Dev	ACI318 Req'd
25	5.40	4.24		3220	4590		210	3290

DETAILED STRENGTH, Compression Either 4" x 8" Or 6" x 12"

Batch Number	Date	Slump	Air	3 Day Strengths	7 Day	28 Day	56 Day
712250	6/6/2017	4.50	3.20		3110	4490	
712253	6/7/2017	5.00	4.00		3320	4810	
712255	6/8/2017	5.50	3.10		2990	4650	
712256	6/13/2017	5.00	4.50		3050	4830	
7155161	6/22/2017	4.00	3.10		2540	4580	
7170409	6/25/2017	5.00	3.80		3300	4010	
7171262	6/28/2017	5.50	4.10		3050	4270	
C56202	7/12/2017	6.00	5.20		3300	4660	
C56210	7/17/2017	5.50	4.40		2980	4350	
C56214	7/20/2017	5.00	4.00		3150	4220	
C56218	7/21/2017	5.00	4.25		3300	4290	
51991002	8/8/2017	5.25	4.20		3220	4440	
51991009	8/11/2017	5.50	4.70		3440	4680	
51991017	8/17/2017	4.50	3.20		3640	4900	
51991015	8/17/2017	5.50	3.90		3800	4550	
51992000	9/1/2017	6.00	4.40		3300	4660	
51992012	9/6/2017	5.50	5.10		3600	4770	
51992009	9/6/2017	6.25	4.80		3420	4880	
BR1055	10/3/2017	6.50	5.00		3240	4610	
BR1062	10/6/2017	5.50	3.90		3550	4600	

DETAILED STRENGTH, Compression Either 4" x 8" Or 6" x 12"

Batch Number	Date	Slump	Air	Strengths 3 Day	7 Day	28 Day	56 Day
BR1060	10/6/2017	6.00	4.60		3070	4770	
6258596	10/16/2017	6.00	4.75		3120	4330	
6258600	10/16/2017	5.00	4.50		3200	4810	
6258608	10/23/2017	5.50	5.00		3100	4820	
6258610	10/24/2017	6.00	4.20		2800	4750	

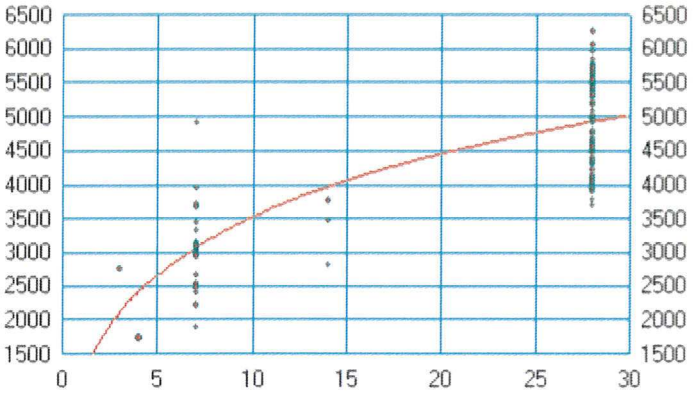
MIX 302-3FS ALSO SUBMITTED AS SUBSTANTIATION FOR MIX 352-3FS

Date: 4/27/2018

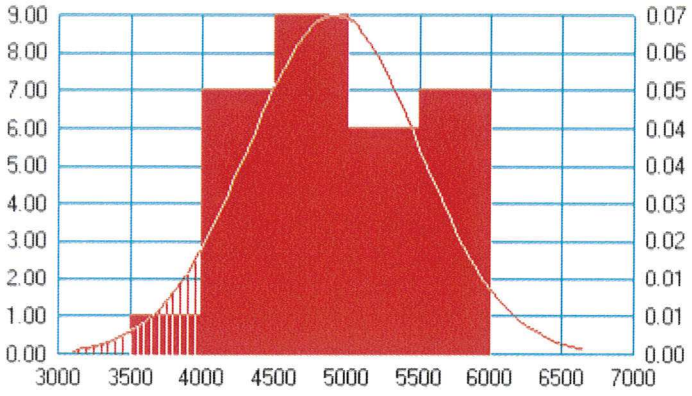
Mix Name: 302-3FS

Units : US

PSI **Strength and Strength Fit vs Maturity** **PSI** **# of Occ.** **Histogram for 28 Day Strength** **%/PSI**



Maturity Days



PSI

95% of tests lie above cross-hatched area

STRENGTH SUMMARY, Compression Either 4" x 8" Or 6" x 12"

No. Of Tests	Avg Slump	Avg Air	Strengths Avg 3 Day	Avg 7 Day	Avg 28 Day	Avg 56 Day	Std Dev	ACI318 Req'd
30	4.76	1.52	2770	3100	4910		610	3920

DETAILED STRENGTH, Compression Either 4" x 8" Or 6" x 12"

Batch Number	Date	Slump	Air	Strengths 3 Day	7 Day	28 Day	56 Day
7166956	3/16/2017	5.00	2.30		3010	5330	
355-2017	4/7/2017	5.00	2.50		3100	4630	
7186537	4/21/2017	7.00	1.00		3150	4070	
7186491	4/21/2017	4.75	1.10		3020	4080	
7251108	8/17/2017	5.00	1.50		4920	5340	
7256878	8/24/2017	4.00	2.00		3020	3900	
7267628	9/15/2017	3.25	1.50		3450	5580	
7272208	9/22/2017	4.00	1.80		3030	4820	
7277087	9/29/2017	3.75	1.30	2770	3140	4700	
7279340	10/3/2017	2.50	2.10		3680	5680	
1214	11/28/2017	4.50	1.50		3110	4540	
7316548	12/4/2017	4.25	1.50		2220	4530	
7322995	12/15/2017	5.50	0.70		2670	5010	
7323147	12/15/2017	5.50	0.80		3140	4150	
7322806	12/15/2017	5.00	0.80		3010	5470	
7324072	12/18/2017	5.75	1.60		2530	4380	
7232970A	12/18/2017	7.50	1.50		3080	4080	
7323994	12/18/2017	5.75	1.40		3330	4930	
7324733	12/19/2017	5.00	0.80		2400	4350	
7329736	1/8/2018	3.75	2.10		2960	5640	

DETAILED STRENGTH, Compression Either 4" x 8" Or 6" x 12"

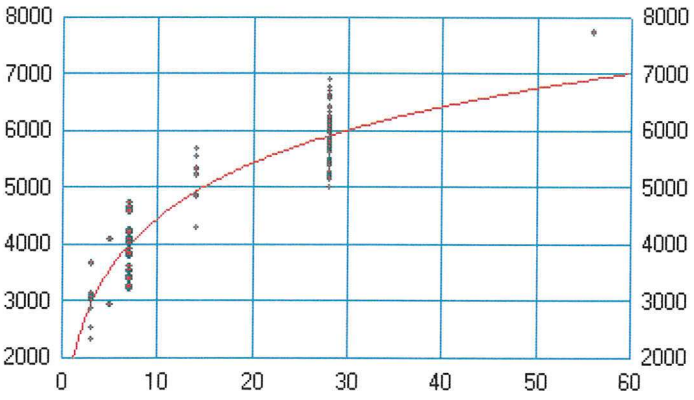
Batch Number	Date	Slump	Air	Strengths 3 Day	7 Day	28 Day	56 Day
7331425	1/10/2018	5.00	1.40		3140	4920	
7332119	1/11/2018	5.00	1.10		1900	4400	
7332316	1/12/2018	3.00	1.40		3040	5470	
7339983	1/26/2018	3.75	1.80		3010	5750	
7350063	2/15/2018	5.00	1.20		3680	5580	
7349912	2/15/2018	4.50	1.90		2990	4660	
7354160	2/19/2018	4.75	2.60		3720	5900	
7352834	2/21/2018	5.00	1.70		2970	5360	
7356024	2/27/2018	4.50	1.60		3960	5510	
370-2018	3/14/2018	5.50	1.20		2470	4510	

Date: 4/27/2018

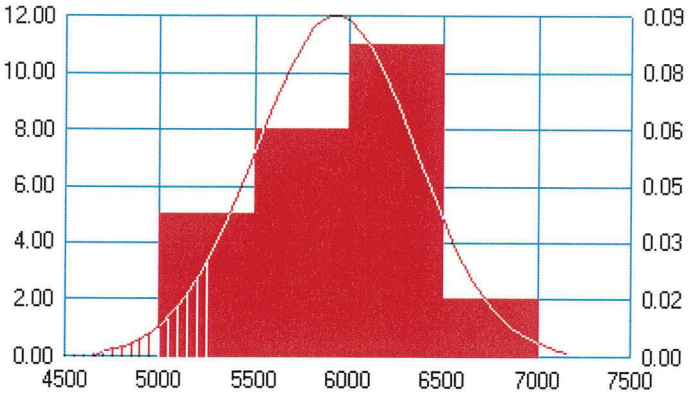
Mix Name: 457FS

Units : US

PSI **Strength and Strength Fit vs Maturity** **PSI** **# of Occ.** **Histogram for 28 Day Strength** **%/PSI**



Maturity Days



PSI

95% of tests lie above cross-hatched area

STRENGTH SUMMARY, Compression Either 4" x 8" Or 6" x 12" Strengths

No. Of Tests	Avg Slump	Avg Air	Avg 3 Day	Avg 7 Day	Avg 28 Day	Avg 56 Day	Std Dev	ACI318 Req'd
26	5.56	4.07	2950	4000	5930	7750	390	5540

DETAILED STRENGTH, Compression Either 4" x 8" Or 6" x 12"

Batch Number	Date	Slump	Air	Strengths 3 Day	7 Day	28 Day	56 Day
011-2017	2/3/2017	5.25	3.50		4630	6470	
211-2017	2/21/2017	4.00	2.20		4750	6850	7750
7016183	6/20/2017	5.00	4.00		3340	5490	
7021309	6/27/2017	5.00	4.20		4120	5780	
7023798	6/29/2017	6.00	3.20		3520	6170	
7026537	7/10/2017	7.50	3.00		4250	5810	
7033651	7/25/2017	5.00	3.20		4110	5860	
61598	8/22/2017	5.50	4.50		4220	6420	
61597	8/22/2017	5.25	5.00		4100	6260	
7254832	8/22/2017	4.25	1.00		4220	6020	
61599	8/23/2017	5.00	4.00		4240	6100	
7269873	9/20/2017	6.00	4.50	3680	4670	6600	
7269885	9/20/2017	4.00	5.00	3140	4050	5400	
7269897	9/20/2017	8.00	4.40	3070	3830	5480	
7269918	9/20/2017	6.25	4.60	2880	4100	6060	
1075-2017	9/20/2017	4.50	3.50		4600	6080	
7270242	9/20/2017	7.00	4.60	3010	3850	5140	
7269952	9/20/2017	7.25	4.70	2330	3620	5290	
1072-2017	9/20/2017	6.50	7.50		3270	5580	
7270038	9/20/2017	6.25	4.70	2540	3790	5500	

DETAILED STRENGTH, Compression Either 4" x 8" Or 6" x 12"

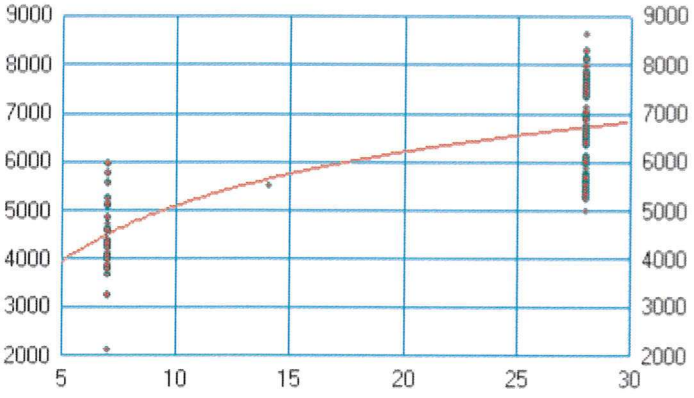
Batch Number	Date	Slump	Air	Strengths 3 Day	7 Day	28 Day	56 Day
82168B	11/2/2017	5.25	3.00		4100	6040	
82170B	11/3/2017	6.00	4.25		4100	5730	
82176B	11/15/2017	4.50	4.00		3550	6160	
1047A	12/12/2017	5.25	4.50		3330	5650	
762	12/17/2017	5.00	3.60		3860	6310	
183-2018	2/9/2018	5.00	5.20		3930	5890	

Date: 4/27/2018

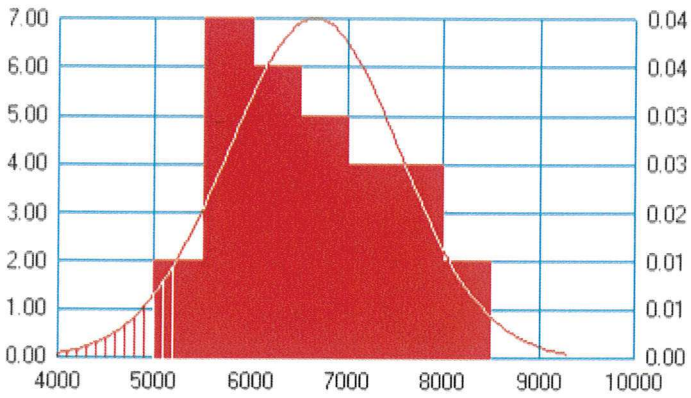
Mix Name: 507-1FS

Units : US

PSI **Strength and Strength Fit vs Maturity** **PSI** **# of Occ.** **Histogram for 28 Day Strength** **%/PSI**



Maturity Days



PSI

95% of tests lie above cross-hatched area

STRENGTH SUMMARY, Compression Either 4" x 8" Or 6" x 12"

No. Of Tests	Avg Slump	Avg Air	Strengths Avg 3 Day	Avg 7 Day	Avg 28 Day	Avg 56 Day	Std Dev	ACI318 Req'd
30	6.39	.98		4520	6650		900	6600

DETAILED STRENGTH, Compression Either 4" x 8" Or 6" x 12"

Batch Number	Date	Slump	Air	Strengths 3 Day	7 Day	28 Day	56 Day
7297353	11/1/2017	7.50	0.80		4100	5540	
1317-2017	11/1/2017	7.00	2.40		4320	6490	
7297250	11/1/2017	8.00	0.60		4240	5630	
7298365	11/2/2017	5.50	0.90		4660	5670	
7298837	11/3/2017	5.25	0.80		5100	6950	
7300880	11/6/2017	8.00	0.80		4070	5740	
7301608	11/7/2017	5.00	1.10		4400	6260	
7301953	11/8/2017	5.75	1.20		4740	6590	
7304425	11/13/2017	6.00	0.90		5270	6950	
7309637	11/20/2017	3.00	0.70		5150	7690	
7311343	11/22/2017	6.25	1.40		3990	6400	
7312215	11/27/2017	5.50	1.20		3690	5540	
7317170	12/4/2017	6.25	0.90		3800	6440	
7317811	12/5/2017	5.50	0.70		3250	5360	
7327011	12/27/2017	7.50	0.60		2110	5120	
7332217	1/11/2018	6.25	1.20		5610	7600	
733251	1/15/2018	8.50	1.10		3850	8250	
7336232	1/22/2018	6.50	1.30		4140	6210	
7387002	1/23/2018	6.50	1.10		5250	7830	
7342282	1/31/2018	8.00	1.10		4730	7470	

DETAILED STRENGTH, Compression Either 4" x 8" Or 6" x 12"

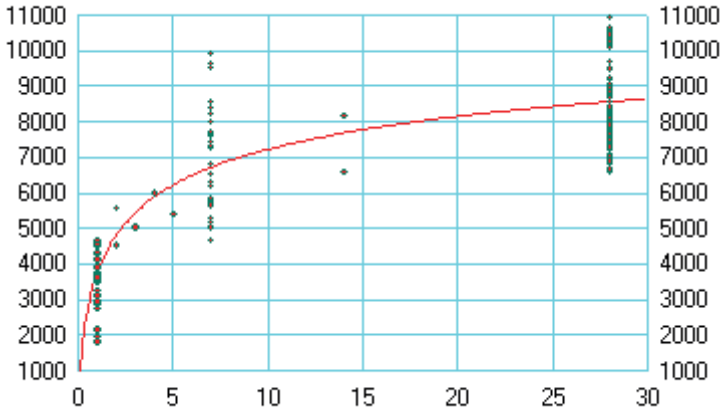
Batch Number	Date	Slump	Air	Strengths 3 Day	7 Day	28 Day	56 Day
7343154	2/1/2018	5.00	0.80		5970	8120	
7345813	2/6/2018	7.25	0.60		4870	7440	
7346661	2/8/2018	7.00	0.70		5770	7310	
7349128	2/14/2018	4.75	0.90		5580	6860	
7350905	2/16/2018	6.00	0.70		5150	7460	
7351493	2/19/2018	7.75	1.00		4590	6470	
7352094	2/20/2018	6.00	1.10		5550	7820	
7353693	2/22/2018	7.75	0.70		3880	5790	
7354461	2/23/2018	8.25	0.80		3660	5750	
7356235	2/27/2018	4.25	1.30		4060	6780	

Date: 4/23/2018

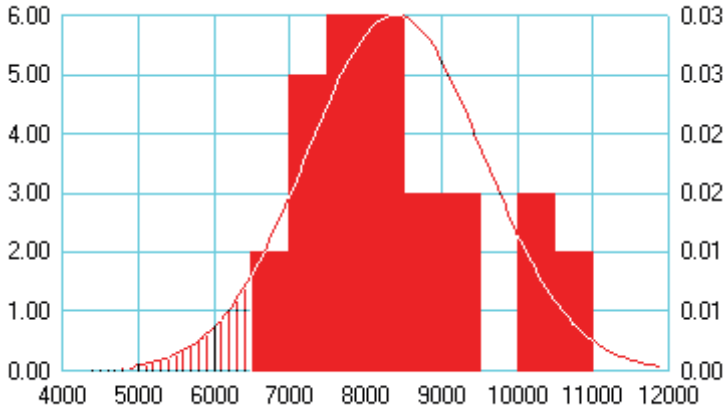
Mix Name: 504HE

Units : US

PSI **Strength and Strength Fit vs Maturity** **PSI** **# of Occ.** **Histogram for 28 Day Strength** **%/PSI**



Maturity Days



PSI

95% of tests lie above cross-hatched area

STRENGTH SUMMARY, Compression Either 4" x 8" Or 6" x 12"

No. Of Tests	Avg Slump	Avg Air	Strengths Avg 3 Day	Avg 7 Day	Avg 28 Day	Avg 56 Day	Std Dev	ACI318 Req'd
30	7.49	1.11	5040	6850	8390		1170	7220

DETAILED STRENGTH, Compression Either 4" x 8" Or 6" x 12"

Batch Number	Date	Slump	Air	Strengths 3 Day	7 Day	28 Day	56 Day
7305006	11/14/2017	8.00	0.90	5030	7300		
1370-2017	11/16/2017	5.00	2.10	6190	8100		
7309921	11/21/2017	8.00	1.20	6320	7610		
7310074	11/21/2017	7.75	0.80	5810	7180		
7310251	11/21/2017	7.75	1.00	5840	7650		
7309850	11/21/2017	7.00	1.10	7600	8480		
7316204	11/28/2017	7.75	1.40	5760	7420		
7312474	11/28/2017	8.00	0.90	7680	8550		
7313241	11/29/2017	7.00	1.40	5790	8050		
1411-2017	11/29/2017	7.50	1.60	7280	8460		
7313319A	11/29/2017	7.50	1.40	5280	7620		
7313459	11/29/2017	8.00	1.40	5850	7490		
7313207	11/29/2017	7.75	1.30	5870	8060		
7321870	12/14/2017	7.00	1.20	5870	7970		
7321768	12/14/2017	8.50	1.60	4680	6810		
7321469	12/14/2017	6.50	1.10	6530	8040		
7321563	12/14/2017	6.00	1.80	5670	7670		
7327270	12/28/2017	7.75	0.50	8560	9480		
7327183	12/28/2017	8.00	0.90	7710	9050		
7329646	1/8/2018	7.50	0.70	9540	10440		

DETAILED STRENGTH, Compression Either 4" x 8" Or 6" x 12"

Batch Number	Date	Slump	Air	Strengths 3 Day	7 Day	28 Day	56 Day
7329668	1/8/2018	8.00	1.10		9910	10730	
7329677	1/8/2018	7.50	0.60		9640	10840	
7329686	1/8/2018	8.00	1.00		7320	7820	
7331824	1/11/2018	8.00	0.60		8220	9090	
7333148	1/15/2018	6.75	1.00		5170	7180	
7339087	1/23/2018	6.50	1.50		6810	8720	
7340485	1/29/2018	7.75	0.80		8000	10220	
7340492	1/29/2018	8.00	0.70		7430	8930	
7340597	1/29/2018	8.00	0.50		8400	10240	
287-2018	3/2/2018	8.00	1.30	5040	5870	6660	