Field Pilot of Low Carbon Concrete

Final Report

FINAL REPORT

December 4, 2024

WJE No. 2024.1541

PREPARED FOR:

Open Compute Project Foundation

PREPARED BY:

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062
847.272.7400 tel

Field Pilot of Low Carbon Concrete

Final Report

Thomas Van Dam, Ph.D., PE (IL, MI, NV)
Principal

Todd Nelson, PE
Principal

Karthik Pattaje, Ph.D.
Associate II

FINAL REPORT
December 4, 2024
WJE No. 2024.1541

PREPARED FOR:
Open Compute Project Foundation

PREPARED BY:
Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062
847.272.7400 tel

CONTENTS

APPENDIX G. Field Abrasion Testing

EXECUTIVE SUMMARY

Open Compute Project (OCP) Foundation supported a collaborative effort between Amazon Web Services, Google, META, and Microsoft, known collectively as the Hyperscalers Green DC Futures group, for adoption of low embodied GHG emissions concrete (referred to hereafter as low embodied carbon concrete) for high-risk data center applications. In this project, four concrete mixess with varying degrees of embodied carbon were used in a Field Pilot of concrete slab-on-ground construction to assess performance for this application. Full-scale slabs, utilizing these four concrete mixes, were constructed on Wiss, Janney, Elstner Associates, Inc.'s (WJE's) campus in Northbrook, IL. In addition to (WJE), technical support for this collaborative effort was provided by Concrete Strategies Inc. (CSI - contractor), Ozinga Bros., Inc. (ready-mix concrete supplier), and Sutter Engineering LLC (consultant). The four concrete mixes, included as part of this field pilot, are described as follows:

Mix 1 – Control. A straight ASTM C595 Type IL blended cement mix with proportions commonly used in slab construction for data centers. This mix had a cement content of 517 pounds per cubic yard (lb/yd^3) and a water-to-cementitious material ratio (*w/cm*) of 0.50.

Mix 2 – 40% SC. Mix 2 used the same *w/cm* (0.50) as Mix 1, but with a lower total cementitious material content of 491 lb/yd^3. Further, 40% of the ASTM C595 Type IL cement was replaced with ASTM C989 slag cement. The estimated embodied carbon was 30% lower than Mix 1.

Mix 3 – C1157 & Type IL. A mix with a total cementitious material content of 605 lb/yd^3 consisting of approximately 80% of the cementitious material content being an Ozinga ASTM C1157 performance hydraulic cement and approximately 20% being ASTM C595 Type IL cement. This mix had a design *w/cm* of 0.35. The estimated embodied carbon was 43% lower than Mix 1.

Mix 4 – C1157. A mix with an Ozinga ASTM C1157 performance cement with a cementitious material content of 750 lb/yd^3 and a design *w/cm* of 0.34. The estimated embodied carbon was 57% lower than Mix 1.

These mixes were thoroughly tested in the laboratory to assess comparative performance, compliance with the collective Hyperscalers' specifications, and identify potential challenges during the construction of the slabs. During the field placement, the mixes were evaluated during construction for constructability, pumpabaility, and finishability and field quality control testing.

Preconstruction, laboratory testing was conducted to assess the plastic properties (slump, air content, unit weight, bleed, heat of hydration and setting characteristics) and hardened properties (compressive strength, flexural strength, drying shrinkage, cracking resistance, coefficient of thermal expansion (CTE), and bulk resistivity) of each mix. It was found that all mixes met the typical Hyperscalers' specified plastic and hardened concrete properties measured during construction, including plastic air content (maximum of 3.0%), slump (5 to 9 inches), and compressive strength (minimum of 4,000 psi at 28 days).

Mix 1 and 2 had fresh concrete properties similar to typical concrete used in slab construction and would be familiar to a crew experienced in this type of construction. But there were observations made on the fresh properties of Mix 3 and Mix 4 during the preconstruction laboratory testing that would be expected to impact construction including the following:

- The setting characteristics of Mix 3 were very fast setting, and it was agreed that the quantity of accelerator should be reduced for the slab construction. On the other hand, Mix 4 showed a delayed final set and it was anticipated that the final finishing procedures during construction would be delayed.
- With regards to bleeding, Mixes 3 and 4 exhibited little to no bleed water. Bleed water helps protect concrete at the earliest stages of strength gain, and a lack of it would make these mixes more susceptible to early-age plastic shrinkage cracking. The appearance and subsequent disappearance of bleed water is also an indication to a crew that a slab is ready to be finished and its absence would pose a difficulty to finishers as they contemplate the timing of finishing operations.
- Mix 3 and Mix 4 had lower heat of hydration than Mix 1 and Mix 2. The exothermic (heat generating) reaction between water and cement can be a problem for construction during hot weather or for massive placements (i.e. mass concrete) as the increased heat can accelerate setting, result in high thermal stress, and in extreme cases result in damaging chemical alterations. Whereas low heat of hydration would be viewed as a benefit for mass concrete placements such as foundations, it can compromise the rate of strength gain during cooler temperatures. For indoor construction such as this project, the differences in heat of hydration would be expected to have little impact.
- Mix 3 and Mix 4 for were much more difficult to work with in the laboratory. The observed behavior is referred to as being thixotropic meaning that the mixtures easily flow when energy is applied (during mixing or consolidation using vibrators) but stiffen at rest, requiring more energy to initiate and maintain movement. Even though most all concrete demonstrates some thixotropic behavior that observed in Mix 3 and Mix 4 was considered extreme. Unfortunately, there is no concrete test commonly used to measure thixotropy. In addition, these mixes quickly lost workability after batching. These observations indicated additional efforts would likely be needed during slab construction to place, consolidate, and finish Mix 3 and Mix 4 compared to Mix 1 and Mix 2.

In addition to the plastic properties of concrete that have a direct impact on constructability, there were a few notable differences in the hardened properties of the preconstruction laboratory concrete that are worth noting including the following:

- Mix 3 significantly exceeded the 28-day design strength of 4,000 psi, achieving 8,460 psi compressive strength at 28 days. The "over design" of Mix 3 could be addressed to reduce the long-term strength gain, potentially by reducing the total cementitious content, thereby increasing economy while further reducing the embodied carbon. Mix 4 barely achieved the 28-day design of 4,000 psi, reaching 4,140 psi in 28 days. It was thought that some modification of Mix 4 may be needed to achieve a higher 28-day strength to account for expected variability in concrete strength during construction.
- The drying shrinkage of all mixes met the collective requirements of the Hyperscalers but Mix 3 and Mix 4 showed a significant reduction in drying shrinkage compared to Mix 1 and Mix 2. The results of the restrained shrinkage data suggest that the cracking potential is moderate to high for Mixes 1, 2, and 3, but low for Mix 4. Having a lower measured drying shrinkage and a lower

restrained shrinkage cracking potential in concrete used for slab-on-ground applications has benefits for the reduction in out-of-joint cracking and potentially for an increase in joint spacing.

The results of the preconstruction laboratory testing were used to inform the construction of the test site. Typical practices were employed to construct the slab-on-ground project on WJE's campus on July 31 and August 1, 2024. Construction included pumping of the concrete approximately 100 feet; consolidation with use of internal vibrators; leveling using a vibratory screed; bull floating; and final floating and troweling using walk-behind and ride-on equipment. Each of the four slabs was densified to level of a slight shine to the surface and then stopped, with a burnished finish not being the goal of the final finish. All four mixes were successfully pumped, placed and finished, and all achieved design strength. Some notable observations from construction include:

- Mix 2 was qualifiedly judged to be the best performing mix and Mix 2 the second best for pumpability, placeability, and finishability based on feedback from the contractor and observations performed by WJE.
- As expected, based on the preconstruction laboratory testing, difficulties were encountered with the placement, screeding, and finishing of Mix 3 and Mix 4. It was noted that Mix 3 and Mix 4 lost workability within 15 to 20 minutes after concrete placement, thus creating difficulties in closing the surface, screeding to a level surface, and in performing final floating and troweling finishing processes. As anticipated, the final finish of Mix 4 took longer than the other mixes.
- The floor flatness testing showed that Mix 1 and Mix 2 met all Hyperscalers' requirements for floor flatness, whereas the results for Mix 3 and Mix 4 were slightly less than most of their requirements. The lower flatness measurements for Mix 3 and Mix 4 were likely associated with the difficulties encountered during placing and finishing these mixes.
- The abrasion resistance testing performed on the surface of all four slabs showed good performance, with Mix 2, Mix 3, and Mix 4 showing very little depth of abrasion during the testing. This implies that the lower embodied carbon concrete mixes can achieve a densified surface and provide abrasion resistance in data center slab applications.

This test site demonstrated the value of conducting a rigorous laboratory testing program prior to construction that assesses properties of fresh and hardened concrete beyond what are normally measured. These results informed the construction phase, anticipating difficulties in advance. All mixes tested could be constructed and largely met project requirements. The two mixes with the lowest embodied carbon, Mix 3 and Mix 4, were the most difficult to construct. Although they would be suitable for multiple concrete applications, they would not be able to be effectively used for traditional slab-on-ground construction without modifications that improve workability. Alternatively, modifications to traditional construction practices could be implemented that would facilitate the use of these materials.

PROJECT BACKGROUND

The Hyperscalers Green DC Futures group, which represents Amazon Web Services, Google, Meta, and Microsoft, supported this project to de-risk the adoption of reduced carbon concrete, i.e., concrete with reduced greenhouse gas emissions associated with its production compared to a standard benchmark, in future data center construction. The project focused on the application of reduced carbon concrete in data center slabs, which is a relatively high-risk application. The engineering consultants Wiss, Janney, Elstner Associates, Inc. (WJE) and Sutter Engineering, LLC; contractor Concrete Strategies; and concrete supplier Ozinga collaborated on a small-scale slab-on-ground construction using a typical data center slab mix (i.e., a control) and three reduced carbon concrete mixes. The goal was to compare the constructability and performance of these mixes generally and whether they met the requirements of a collective Hyperscalers specification. The reduction in estimated embodied carbon of each reduced carbon concrete mix compared to the control mix is presented in **Mix 2 – 40% SC.** Mix 2 used the same *w/cm* (0.50) as Mix 1, but with a lower total cementitious material content of 491 lb/yd^3. Further, 40% of the ASTM C595 Type IL cement was replaced with ASTM C989 slag cement. The estimated embodied carbon was 30% lower than Mix 1.

Mix 3 – C1157 & Type IL. A mix with a total cementitious material content of 605 lb/yd^3 consisting of approximately 80% of the cementitious material content being an Ozinga ASTM C1157 performance hydraulic cement and approximately 20% being ASTM C595 Type IL cement. This mix had a design *w/cm* of 0.35. The estimated embodied carbon was 43% lower than Mix 1.

Mix 4 – C1157. A mix with an Ozinga ASTM C1157 performance cement with a cementitious material content of 750 lb/yd^3 and a design *w/cm* of 0.34. The estimated embodied carbon was 57% lower than Mix 1.

Table 1. The detailed mix designs are presented in **Table 2**. The draft environmental product declarations (EPD) for these mixes are provided in **APPENDIX A**. The four concrete mixes included in this project are identified and summarily described as follows:

Mix 1 – Control. A straight ASTM C595 Type IL blended cement mix with proportions commonly used in slab construction for data centers. This mix had a cement content of 517 pounds per cubic yard (lb/yd^3) and a water-to-cementitious material ratio (w/cm) of 0.50.

Mix 2 – 40% SC. Mix 2 used the same *w/cm* (0.50) as Mix 1, but with a lower total cementitious material content of 491 lb/yd^3. Further, 40% of the ASTM C595 Type IL cement was replaced with ASTM C989 slag cement. The estimated embodied carbon was 30% lower than Mix 1.

Mix 3 – C1157 & Type IL. A mix with a total cementitious material content of 605 lb/yd^3 consisting of approximately 80% of the cementitious material content being an Ozinga ASTM C1157 performance hydraulic cement and approximately 20% being ASTM C595 Type IL cement. This mix had a design *w/cm* of 0.35. The estimated embodied carbon was 43% lower than Mix 1.

Mix 4 – C1157. A mix with an Ozinga ASTM C1157 performance cement with a cementitious material content of 750 lb/yd^3 and a design *w/cm* of 0.34. The estimated embodied carbon was 57% lower than Mix 1.

Table 1. Embodied Carbon

Parameter	Mix 1 - Control	Mix 2 – 40% SC	Mix 3 – C1157 & Type IL	Mix 4 – C1157
Embodied Carbon (kg CO_2 e/yd^3)	214	149	121	92
% Reduction from Control	--	30%	43%	57%
% Reduction from National Benchmark[1]	9%	37%	49%	61%
% Reduction from Regional Benchmark[2]	7%	35%	48%	60%

[1] *National benchmark for a 4,000 psi mix at 28 days is 236 kg CO_2 e/yd^3 based on NRMCA Member National and Regional LCA Benchmark (Industry Average) Report – V3.2, dated December 2021.*

[2] *Regional benchmark for a 4,000 psi mix at 28 days for the Great Lakes Midwest region is 231 kg CO_2 e/yd^3 based on NRMCA Member National and Regional LCA Benchmark (Industry Average) Report – V3.2, dated December 2021.*

Table 2. Concrete Mix Designs[1]

Constituent	Description or Source	Units	Mix 1 - Control	Mix 2 - 40% SC	Mix 3 - C1157 & Type IL	Mix 4 - C1157
Type IL cement	St. Gen, MO	lbs/yd^3	517	295	130	--
Slag cement	Holcim, Chicago, IL	lbs/yd^3	--	196	--	--
C1157 cement	Ozinga, Chicago, IL	lbs/yd^3	--	--	475	750
Coarse aggregate (#67)	Vulcan Materials Company, McCook, IL	lbs/yd^3	1401	1443	1435	1324
Coarse aggregate (#4)	LaFarge/Conco Western Stone Co, North Aurora, IL	lbs/yd^3	469	483	480	443
Fine aggregate	Meyer Material Co, McHenry, IL	lbs/yd^3	1445	1440	1430	1320
Water	n/a	lbs/yd^3	259	246	212	255
Mid-range water reducer	MIRA® 110	fl. oz.	28	28	--	--
High-range water reducer	ADVA® Cast 575	fl. oz.	--	--	25	8
Workability enhancing admixture	ADVA® XT2	fl. oz.	--	--	--	20
Rheology-modifying admixture	V-MAR® F100	fl. oz.	--	--	--	45
Accelerating admixture	OZ Set	fl. oz.	--	--	166	262
W/CM (not incl. admixtures)	--	--	0.50	0.50	0.35	0.34
W/CM (incl. admixtures)	--	--	0.50	0.50	0.37	0.37
Target Air Content	--	%	1.5	1.5	1.5	1.5

[1]*Aggregate quantities presented in SSD condition, A "--" indicates that the material was not used in the mix.*

All the mixes were non-air entrained and contained aggregates local to Chicago area where the slabs were constructed. The mixes did not contain fiber reinforcement and were designed to be 4,000 psi at 28 days. The Hyperscalers collective have similar requirements for slab-on-ground concrete.

The goal of this field pilot was to understand the performance of these mixes and potential challenges encountered when using concrete mixtures with reduced embodied carbon. The field pilot included a rigorous laboratory evaluation program of the mixes, field observations of the construction of the panels, and field quality control testing. The following report summarizes these activities.

LABORATORY EVALUATIONS

The raw materials for each mix were shipped by the concrete supplier, Ozinga, to WJE's laboratories in Northbrook, Illinois. Each mix was tested in the laboratory for plastic and hardened properties to assess performance and to make comparisons between the mixes. The following describes the raw material characterization and laboratory testing performed on each mix.

Raw Materials Characterization

- **Absorption and Density.** The relative density and absorption of each coarse aggregate was measured in accordance with ASTM C127, *Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate*, and the relative density and absorption of the fine aggregate was measured in accordance with ASTM C128, *Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate*. This testing was performed to allow for appropriate moisture content adjustments during laboratory batching and for the mixture proportions to yield appropriately.
- **Aggregate Gradation.** The gradations of each coarse aggregate and the fine aggregate were determined in general accordance with ASTM C136, *Standard Test Method for sieve Analysis of Fine and Coarse Aggregates*.

Concrete Physical Testing

Each mix was then batched and tested to characterize plastic properties, workability, setting characteristics, bleeding potential, strength, drying shrinkage, susceptibility to cracking, coefficient of thermal expansion, and resistivity. The goal of the testing was to determine if the proposed concrete mixes were practical for field use prior to placement of the field pilot slabs and to test the physical properties for comparison of the mixes and comparison to specification limits. WJE batched each of the four concrete mixes and evaluated the following concrete properties (some testing is on-going):

- **Plastic Properties.**
  - Concrete slump, per ASTM C143, *Standard Test Method for Slump of Hydraulic-Cement Concrete*. The Hyperscalers' specifications for slump varies between 5 to 10 inches.
  - Air content, per ASTM C231, *Standard Test Method for air Content of Freshly Mixed Concrete by the Pressure Method*. The Hyperscalers' specifications limit the maximum air content to 3%.
  - Unit weight, per ASTM C138, *Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.*

    - Temperature, per ASTM C1064, *Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete*.

- **Setting Time.** Setting time was assessed according to ASTM C403, *Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance*. Measurement of the setting characteristics of the mixes were used to assess the impact on timing of construction schedule and finishing processes. Extended setting times would delay construction schedule and the finishing processes.
- **Heat of Hydration.** The total heat of hydration was measured in general according to ASTM C1702 *Standard Test Method for Measurement of Heat of Hydration of Hydraulic Cementitious Materials Using Isothermal Conduction Calorimetry*. The cementitious material was obtained from each mix by sifting the concrete through a No. 4 sieve. The mortar passing the sieve was collected and placed in an isothermal calorimeter to measure the total heat generated by the cementitious material during the first 7-days. The hydration reaction between cement and water is exothermic, meaning heat is released as the reaction occurs. Measuring this heat of hydration is important as it provides an indication on the rate and progression of the reaction, but also because different combinations of cementitious materials release different amounts of heat. A combination that releases less heat at a slower rate is ideal for some applications, like mass concrete where heat must be controlled, but may be disadvantageous for use during cooler weather as insufficient heat may be generated to drive the reaction forward resulting in slow strength gain.
- **Bleed Potential.** The bleed rate and total concrete bleed water was measured according to ASTM C232, *Standard Test Method for Bleeding of Concrete*. Understanding the bleed rate and total bleed potential with the changes in materials between mixes is important from an early age curing and power finishing standpoint. With less bleed water and lower bleeding rates, early age curing (preventing moisture loss) becomes more important to prevent plastic cracking. In addition, judgement of initiation of the finishing process are affected with less bleed water.
- **Compressive Strength.** Compressive strength testing was performed at 1, 2, 3, 7, 28, and 56 days of age per ASTM C39, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*. Compressive strength testing will also be performed at 90 days.

  Specifications for slab construction require a minimum of 4,000 psi at 28 days.
- **Flexural Strength.** Flexural strength testing was performed at 3, 7, and 28 days of age per ASTM C78, *Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)*.

  Flexural strength testing in accordance with ASTM C78 was performed to make comparisons between the mixes and assess if the mix changes followed typical trends for compressive strength to flexural strength ratios.
- **Drying Shrinkage.** Drying shrinkage was tested per ASTM C157, *Standard Test Method for Length Change of Hardened Concrete*, modified by specifications for a 7-day moist cure in lieu of 28 days. The initial comparator reading was made at 24 hours after fabrication consistent with ASTM C157.

  Most of the Hyperscalers' specifications for slabs limit the maximum drying shrinkage to 0.040% at 28 days and 0.032% at 21 days of drying, respectively. One has the requirement at 0.040% at 28 days of drying after moist curing for 28 days, which is less stringent compared to the shorter moist curing period employed in this testing program.

The drying shrinkage potential of the mixes were compared to understand the mix changes effect on the drying shrinkage and ultimately cracking potential.

- **Restrained Shrinkage.** Restrained ring shrinkage testing was performed according to ASTM C1581, *Standard Test Method for Determining Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage*. The testing was performed to compare the cracking potential of the mix changes. Limiting the quantity and width of cracks is important in slabs, and this method was used in assessing these characteristics.
- **Coefficient of Thermal Expansion.** The coefficient of thermal expansion (CTE) was measured at nominal age of 28 and 56 days per AASHTO T 336, *Standard Method of Test for Coefficient of Thermal Expansion of Hydraulic Cement Concrete*. The CTE is a measure of the change in concrete dimension due to changes in temperature. This can affect the jointing of slabs, and the effect of alternate cementitious materials used in this test program on the thermal movement of concrete was evaluated with this test.
- **Bulk Resistivity.** The bulk resistivity of the mixes at 28, 56, and 90 days (saturated in simulated pore solution (SPS)) was measured per AASHTO T 402, *Standard Method of Test for Electrical Resistivity of a Concrete Cylinder Tested in a Uniaxial Resistance Test*. This test method can provide an indication of the concrete's resistance to penetration of chloride ions and other fluids.
- **Maturity.** Maturity curves and equations were developed for each mix for compressive strength in general accordance with ASTM C1074, *Standard Practice for Estimating Concrete Strength by the Maturity Method*. Maturity curves were developed through laboratory testing to help estimate the in-situ physical properties of the field slabs based on actual concrete temperatures of the in-place concrete.

Raw Material Characterization Results

The following paragraphs summarize the results of the material characterization portion with the details of the testing and aggregate gradations presented in **APPENDIX B**. The relative density and absorption values of the aggregates are provided in **Table 3**. Concrete batches were appropriately adjusted based on these absorption and specific gravity measurements.

Table 3. Aggregate Characterization Results

Aggregate	Source	Relative Density (SSD)	Absorption (%)
Fine aggregate	Meyer Material Co, McHenry, IL	2.68	0.7
Coarse aggregate (#67)	Vulcan Materials Company, McCook, IL	2.74	1.6
Coarse aggregate (#4)	LaFarge/Conco Western Stone Co, North Aurora, IL	2.70	1.8

Concrete Physical Testing Results

Plastic Concrete Testing Results

The results from testing of the concrete in its plastic state for the four mixes are summarized in this section and the associated test reports are in **APPENDIX C**.

Plastic Properties

For each of the mixes, the laboratory measured plastic properties (concrete slump, air content, unit weight and temperature) are shown in **Table 4**. Multiple batches were made for each mix to fabricate samples for subsequent physical testing. These batches are denoted by a hyphenated number to indicate the batch number of a given mix. For example, Mix 1-1 and Mix 1-2, represent two batches of concrete from the same mix – Mix 1.

Table 4. Plastic properties

Batch ID	Slump (in.) ASTM C143	Air Content (%) ASTM C231	Density (lb/ft^3) ASTM C138	Temperature (°F) ASTM C1064
Mix 1-1	7.50	1.6	149.6	77.3
Mix 1-2	8.00	1.9	149.1	76.9
Mix 2-1	8.00	1.7	150.3	75.2
Mix 2-2	6.50	1.9	150.3	75.9
Mix 3-1	8.25	2.3	151.5	78.6
Mix 3-2	6.50	2.5	151.2	78.6
Mix 3-3	8.25	2.1	151.6	76.1
Mix 4-1	8.25	2.0	149.6	75.3
Mix 4-2	6.25	2.2	150.0	77.3
Mix 4-3	8.25	2.0	150.7	75.2

Consistent with typical pumpable concrete supplied for slab-on-ground construction, the target was to have a slump from 5 to 9 inches and a maximum air content of 3%. These metrics were achieved in the laboratory. Another goal of the laboratory batching was to achieve a cohesive and finishable mix; this was accomplished in all mixes, assessed subjectively during the batching, and placement and finishing of subsequent test samples. Mix 2 screeded, finished, and the surface closed better than the control and was also judged to be more cohesive. Screeding and closing of the surface of Mixes 3 and 4 were judged to be difficult. It was also noted that Mix 4 is sensitive to the high-range water-reducer dosage with a noticeable difference in the rheology of the concrete, which was highly thixotropic.

The thixotropic nature of the concrete mixes with the ASTM C1157 cement (Mixes 3 and 4) requires external energy to move the concrete once static. Placement and finishing of these concrete mixes were considerably harder in the lab compared to Mixes 1 and 2, making it difficult to prepare samples . This behavior is expected to impact placement in the field.

Setting Time

The setting characteristics of each mix were measured in accordance with ASTM C403, with the results presented in **Table 5**. The setting characteristics were found to be similar between Mixes 1 and 2. Mix 3 had a faster setting time which was too fast from a constructability standpoint. Therefore, the quantity of accelerator used in this mix was reduced by 50% for the field placement. The final setting time of Mix 4 was considerably longer than the other mixes. This longer setting time will delay the power floating and power troweling operations and affect the finishing schedule during.

Table 5. Setting times

Mix ID	Initial Setting Time (h:mm)	Final Setting Time (h:mm)
Mix 1 - Control	3:25	4:30
Mix 2 – 40% SC	3:15	4:55
Mix 3 – C1157 & Type IL	1:50	3:20
Mix 4 – C1157	3:40	9:40

Heat of Hydration

The total heat of hydration for the four mixes was calculated and presented in **Table 6**. Heat of hydration is the heat generated during the chemical reaction between the cementitious materials and water. Having a lower heat of hydration means less potential to retain heat and can result in slower strength gain during cooler temperatures.

As anticipated, with the increase in replacement rates of the Type IL cement in Mixes 2, 3, and 4, the total heat of hydration compared to control was lower at early and late ages. Mix 2 generated 14% less heat than the control while Mix 3 and Mix 4 generated 38% and 56% less heat than control during the first 7 days. Proper early age curing and protection of Mixes 2, 3, and 4 becomes more important with lower heat of hydration, especially during cold weather construction.

Table 6. Total Heat Generated (J/g)

Sample ID	24 Hours	48 Hours	72 Hours	168 Hours
Mix 1 - Control	170.4	213.4	239.6	282.2
Mix 2 – 40% SC	124.5	163.7	189.2	242.3
Mix 3 – C1157 & Type IL	89.4	127.1	146.7	176.1
Mix 4 – C1157	77.5	101.0	109.0	123.0

Bleed Water

The bleeding rate and total bleed of each mix was performed in accordance with ASTM C232, with the results from these tests tabulated in **Table 7** and shown in **Figure 1**.

The bleed characteristics were found to be similar between Mixes 1 and 2. Mix 4 had limited and delayed bleeding compared to control. No bleeding was observed with Mix 3. Because of this, early age curing of Mix 3 and Mix 4 becomes more important to prevent moisture loss from the surface and associated plastic shrinkage cracking.

Table 7. Bleed Test Results

Mix ID	Total accumulated Bleed water (%)	Time req. for cessation of bleeding (min.)
Mix 1 - Control	2.2	130
Mix 2 – 40% SC	2.7	130
Mix 3 – C1157 & Type IL	0.0	NA
Mix 4 – C1157	0.8	160

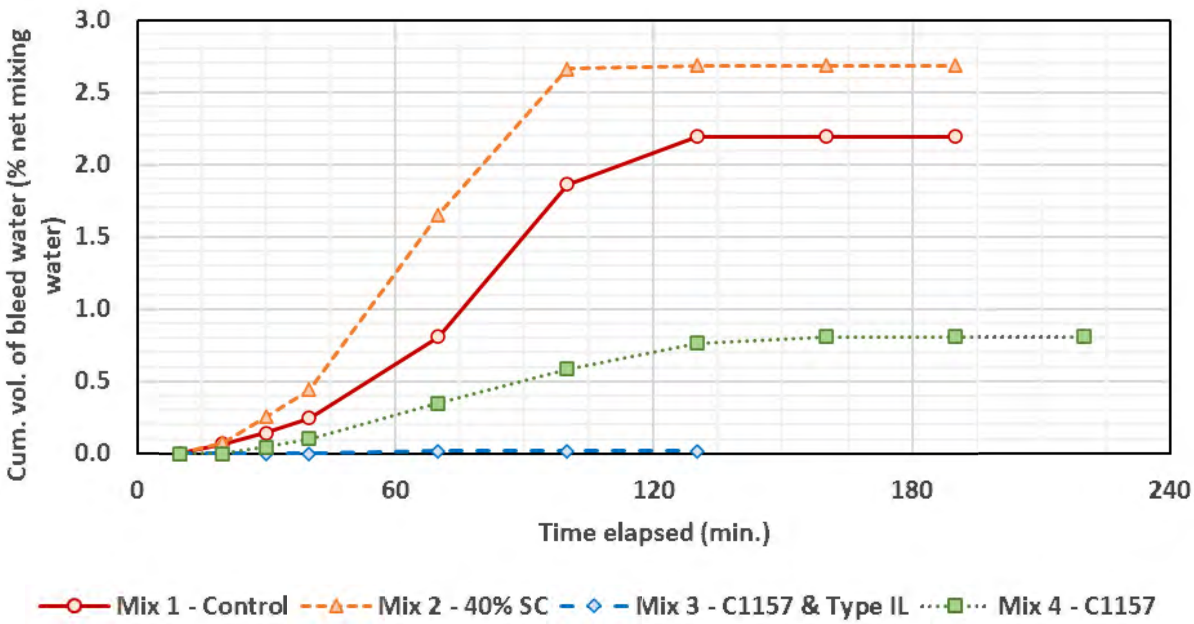


Figure 1. Bleed Test Results.

Hardened Concrete Testing Results

The hardened concrete testing results of the three mixes are summarized in the following paragraphs and detailed in **APPENDIX D**.

Compressive Strength

The compressive strength of each mix was tested on three 4x8 inch cylinders at 1, 2, 3, 7, 28, 56, and 90 days, with results presented in **Table 8** and plotted in **Figure 2**.

All mixes achieved the 28-day design strength of 4,000 psi, with Mixes 1 through 3 exceeding the required 4,000 psi at 7 days. Mix 4 achieved the 4,000 psi at 28 days. The lower 1-day strengths of Mixes 2 through 4 are expected (a close-up of the strength at early ages is shown in **Figure 3**). Based on the 28-day strength of Mix 3, the concrete proportions are overdesigned, and modifications of this mix would be recommended to lower the 28-day strength. It is noted that Mix 4 only slightly achieved the 28-day design strength of 4,000 psi with a measured strength of 4,140 psi and modifications may be needed to increase the 28-day strength for anticipated variability of concrete strength.

Table 8. Compressive Strength Testing Results (psi)

Age (days)	Mix 1 - Control	Mix 2 – 40% SC	Mix 3 – C1157 & Type IL	Mix 4 – C1157
1	2,230	1,370	1,270	1,310
2	3,250	2,380	3,240	2,540
3	3,950	3,010	4,800	3,070
7	4,540	4,510	6,600	3,410
28	5,870	5,750	8,100	4,140
56	5,920	6,300	8,600	4,470
90	6,130	6,760	8,460	4,690

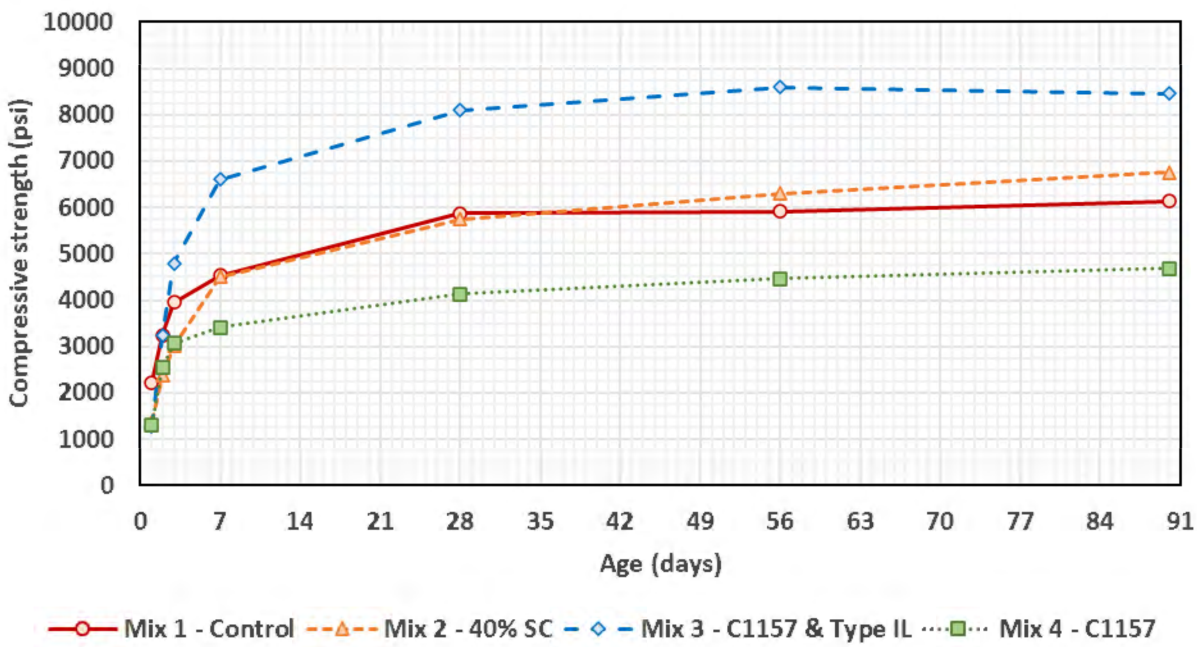


Figure 2. Compressive Strength Results.

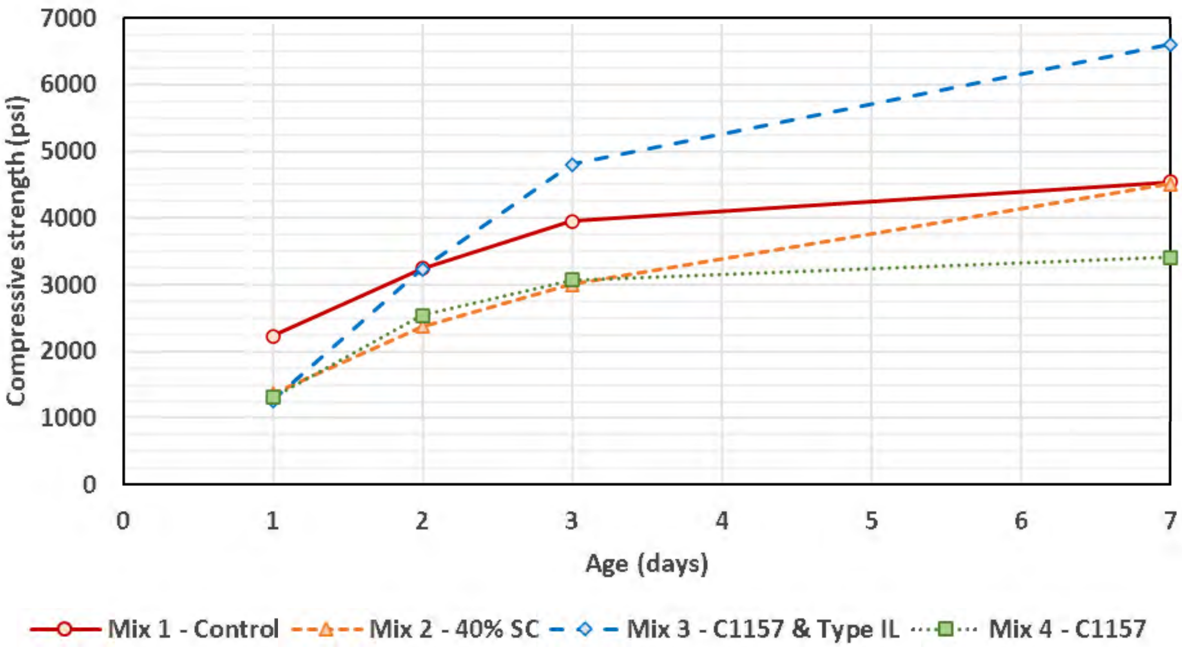


Figure 3. Compressive Strength at Early Ages.

Flexural Strength

The flexural strength of each mix was tested on two 4x4x14 inch prisms per ASTM C78 at 3, 7, and 28 days of age. The results are presented in **Table 9** and plotted in **Figure 4**.

The flexural strengths measured on all mixes follows similar trends as the compressive strength, except for Mix 4, which appears to develop flexural strength faster than the compressive strength.

Table 9. Flexural Strength Testing Results (psi)

Age (days)	Mix 1 - Control	Mix 2 – 40% SC	Mix 3 – C1157 & Type IL	Mix 4 – C1157
3	575	520	670	615
7	710	700	880	660
28	840	870	1,075	780

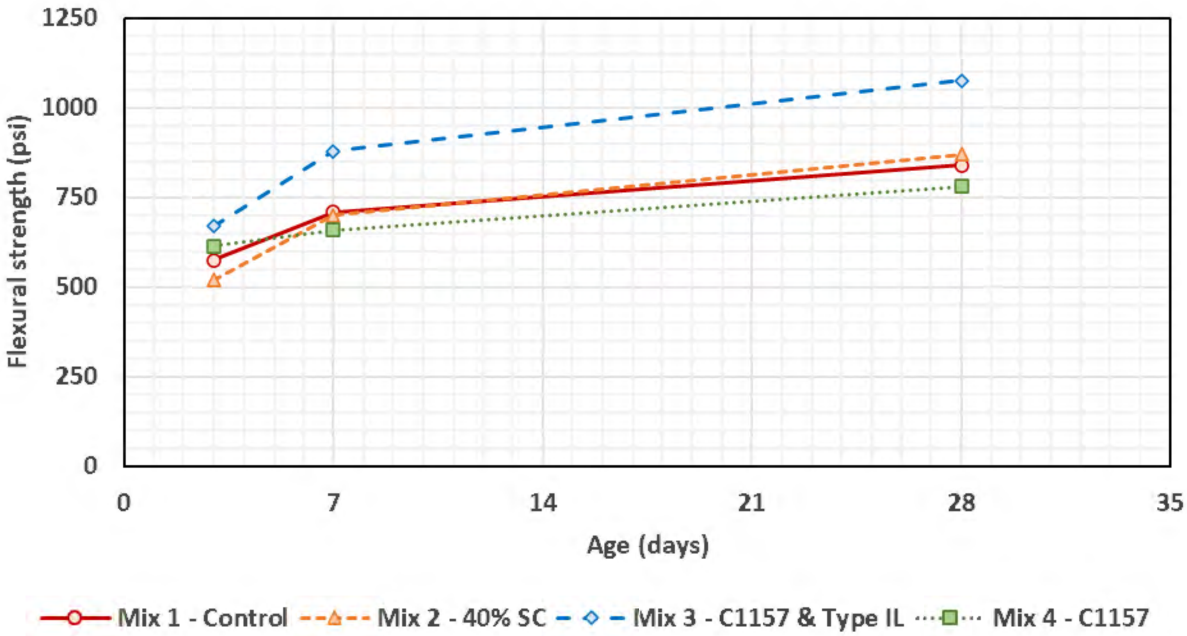


Figure 4. Flexural Strength Results.

Drying Shrinkage

The drying shrinkage test was performed on three prisms, measuring 4 x 4 x 11.25 inches, on all four mixes according to ASTM C157 (modified to a 7-day moist cure) with results presented in **Table 10** and plotted in **Figure 5**. The moist cure was modified to include 7 days of moisture curing while still using the 24-hour reading as the initial comparator reading for which all subsequent readings were compared, consistent with ASTM C157. Shrinkage is important within restrained structures as it contributes to the development of stress as the concrete dries, with lower shrinkage potential being desirable.

Table 10. Length Change Measurements (%)

Age (days)	Drying Age (days)	Mix 1 - Control	Mix 2 – 40% SC	Mix 3 – C1157 & Type IL	Mix 4 – C1157
1	-	0.000	0.000	0.000	0.000
7	-	0.003	0.003	0.004	0.002
8	1	-0.007	-0.005	-0.001	0.000
10	3	-0.013	-0.010	-0.002	-0.001
14	7	-0.019	-0.014	-0.004	-0.005
21	14	-0.028	-0.021	-0.008	-0.007
28	21	-0.033	-0.026	-0.012	-0.009
35	28	-0.036	-0.027	-0.013	-0.008
63	56	-0.046	-0.035	-0.022	-0.017
97	90	-0.050	-0.040	-0.029	-0.025

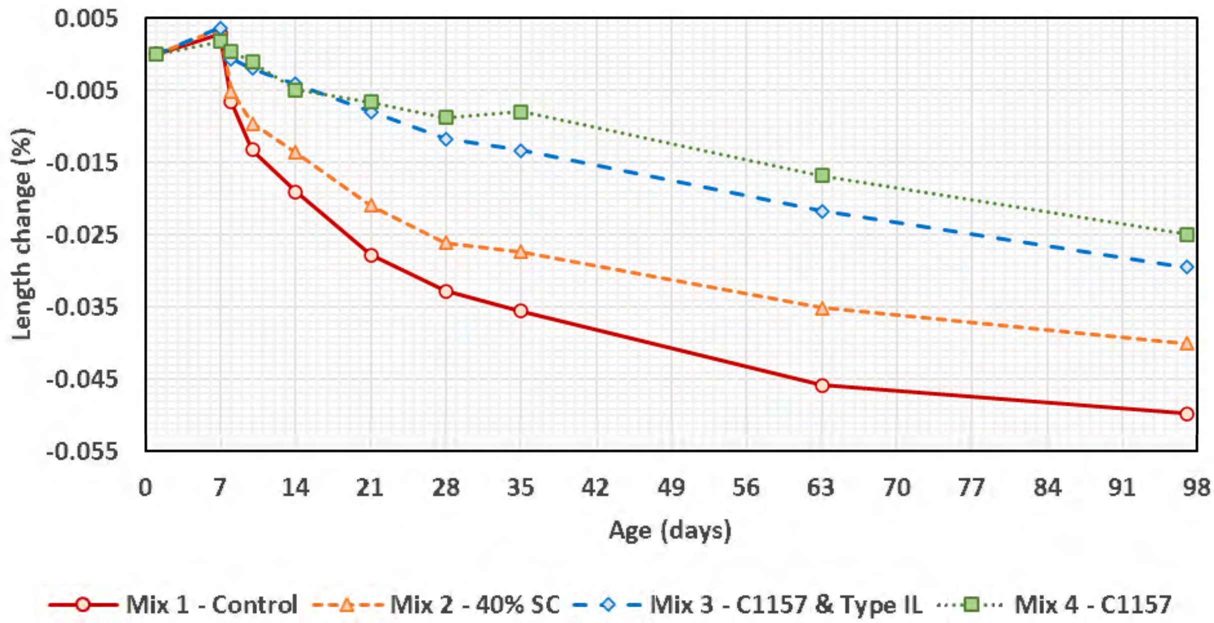


Figure 5. Drying Shrinkage Results (Modified C157: 7-day moist cure).

All mixes met the Hyperscalers' requirements of a maximum drying shrinkage of 0.040% at 28 days of drying and requirements of a maximum of 0.032% at 21 days. Mixes 3 and 4 showed a significant reduction in measured shrinkage compared to Mix 1, control.

Restrained Shrinkage

Restrained shrinkage ring testing was performed on all mixes per ASTM C1581, and the results are presented in **Table 11**.

This data suggests that the cracking potential is moderate to high for Mixes 1, 2, and 3 and low for Mix 4. Mix 3 behaved similarly to the control with a slightly higher maximum strain and rate of stress development. Mix 2 had a greater maximum strain and stress rate compared to control. Mix 4, however, had lower maximum strain and a considerably lower stress rate.

Table 11. Restrained Shrinkage Results

Mix ID	Maximum strain (in/in x 10^{-6})	Average Stress Rate (psi/day)	Age at Cracking (day)	Potential for Cracking[1]
Mix 1 - Control	-47	30	10	Moderate - High
Mix 2 - 40% SC	-60	50	9	Moderate - High
Mix 3 - C1157 & Type IL	-56	33	10	Moderate - High
Mix 4 - C1157	-27	8	23	Low

Note: [1]Potential for cracking per Table X1.1 of ASTM C1581

Coefficient of Thermal Expansion

The coefficient of thermal expansion (CTE) test was performed at the nominal age of 28 and 56 days on two 4×8 inch cylinders from each mix in accordance with AASHTO T336, and the average of the results is presented in **Table 12**.

All mixes had typical measured CTE values for the aggregates used. The addition of ASTM C1157 cement and the higher cementitious materials contents in Mixes 3 and 4 appears to have increased the CTE of the concrete compared to Mixes 1 and 2.

Table 12. Concrete Coefficient of Thermal Expansion Results (10^{-6}/°F)

Mix ID	28 days	56 days
Mix 1 - Control	5.6	5.4
Mix 2 - 40% SC	5.5	5.7
Mix 3 - C1157 & Type IL	6.0	6.1
Mix 4 - C1157	6.3	6.3

Bulk Resistivity

The bulk resistivity test was performed at 28, 56, and 90 days of age in general accordance with AASHTO T 402. The results are presented in **Table 13**. Two 4×8 cylinders were tested for each mix. After demolding at 24 hours, the cylinders were submerged in simulated pore solution (SPS). Electrical resistivity of concrete is a method to assess the resistance to flow of electrical current which indirectly is a measure of the concrete's ability to resist the flow of chloride ions. Applied current flows through the pore network of the concrete. A higher resistance indicates a disconnected and/or lower porosity. This in turn can mean lower permeability of the concrete. In order, Mixes 2, 3, and 4 had higher measured resistivity. This is due to the use of slag cement in Mix 2 and the ASTM C1157 cement and lower *w/cm* in Mixes 3 and 4.

Table 13. Bulk Resistivity (in Ohm-m)

Age (days)	Mix 1 - Control	Mix 2 – 40% SC	Mix 3 – C1157 & Type IL	Mix 4 – C1157
28	39.5	89.0	197.9	366.6
56	47.8	109.7	247.3	364.5
90	49.8	128.4	263.8	379.1

Maturity

The maturity curves were developed in general accordance with ASTM C1074 for all mixes with respect to compressive strength. Two 4x8 inch cylinders were instrumented with maturity meters to measure the time and temperature history prior to testing compressive strength at 1, 2, 3, and 7 days of age. Maturity equations and curves for compressive strength are shown in **Figure 6**. The gain in physical properties (maturity) of concrete is related to its hydration temperature history (product of the concrete temperature and age).

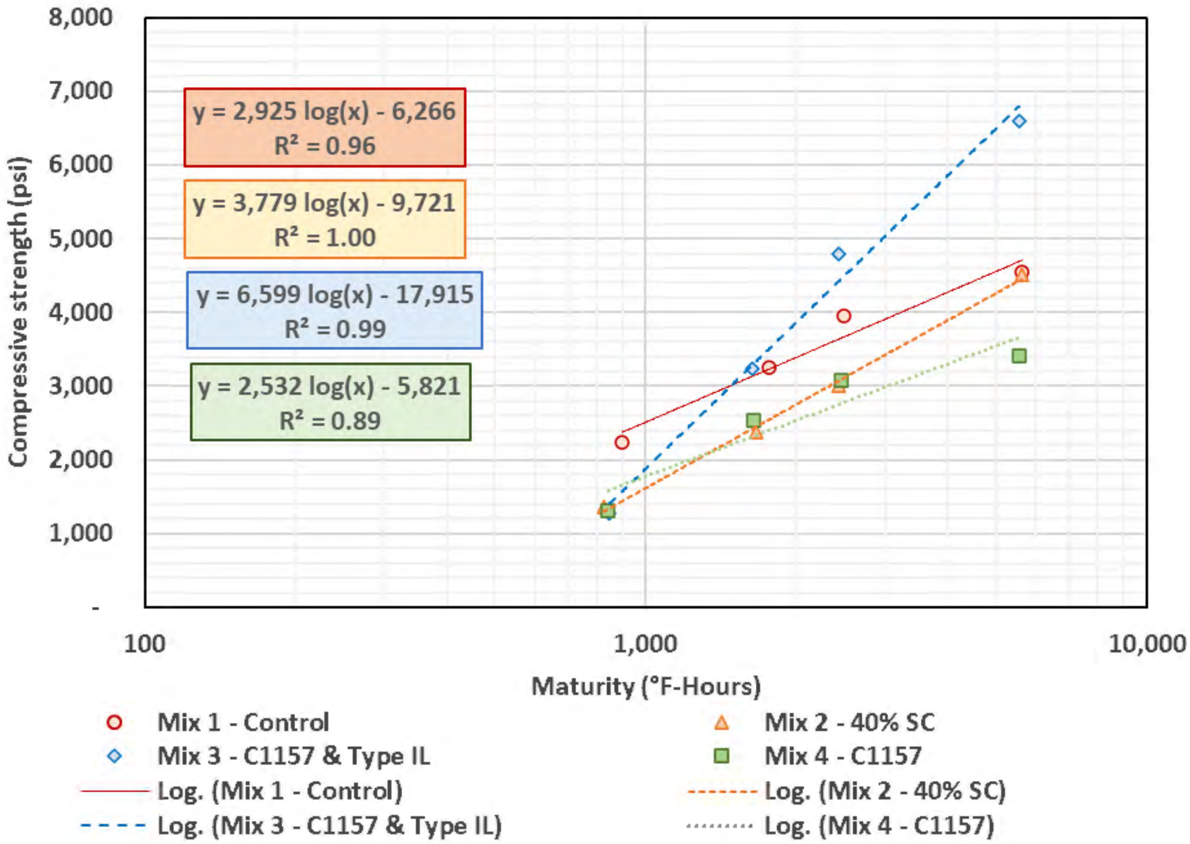


Figure 6. Maturity Plot for Compressive Strength.

FIELD PLACEMENT

Slabs were constructed at WJE's Northbrook, IL, laboratory using Mixes 1, 2, 3, and 4 to assess the constructability and finishability of these mixes during field placement in the context of slab-on-ground applications. The slabs were additionally instrumented with various temperature and maturity sensors to evaluate the usefulness of the different types of instruments for assessing in situ strength. The work performed and WJE's observations and findings from the field placement are summarized in this section.

Introduction

Concrete was placed for Mix 3 and 4 on July 31, 2024, and Mix 1 and 2 on August 1, 2024, at the WJE Northbrook Annex II. Two ready-mix concrete trucks were provided by Ozinga for each of the four mixes for a total of 12 cubic yards of concrete per mix. Concrete Strategies removed the existing concrete slab on ground, prepared the subgrade, installed formwork and reinforcement, and pumped, placed and finished the concrete. WJE documented the construction of the interior slab-on-ground for all four mixes as described herein.

Site Description

The site consists of the WJE Northbrook Annex II, a one-story building located adjacent to the WJE Headquarters Main Building in Northbrook, Illinois. The previously existing slab-on-ground located at the interior of Annex II was sawcut and demolished to expose the subgrade in preparation for placement of the four new mixes. The demolished area was approximately 45 ft 8 in. in the east-west direction and 37 ft 8 in. in the north-south direction resulting in quadrants for each slab of approximately 22 ft 10 in. in the east-west direction and 18 ft 10 in. in the north-south direction.

The site location is shown in detail in **APPENDIX E**, and a plan view of the area within Annex II where the existing slab was to be removed and the new slabs constructed is shown in **Figure 7**. The removal area was divided into four, 18-foot-10-inch by 22-foot-10-inch quadrants centered around a support column. Mixes 1, 2, 3, and 4 were each assigned for placement in a quadrant as shown in **Figure 8**. Half of the area of each mix was reinforced, as indicated in **Figure 9**.

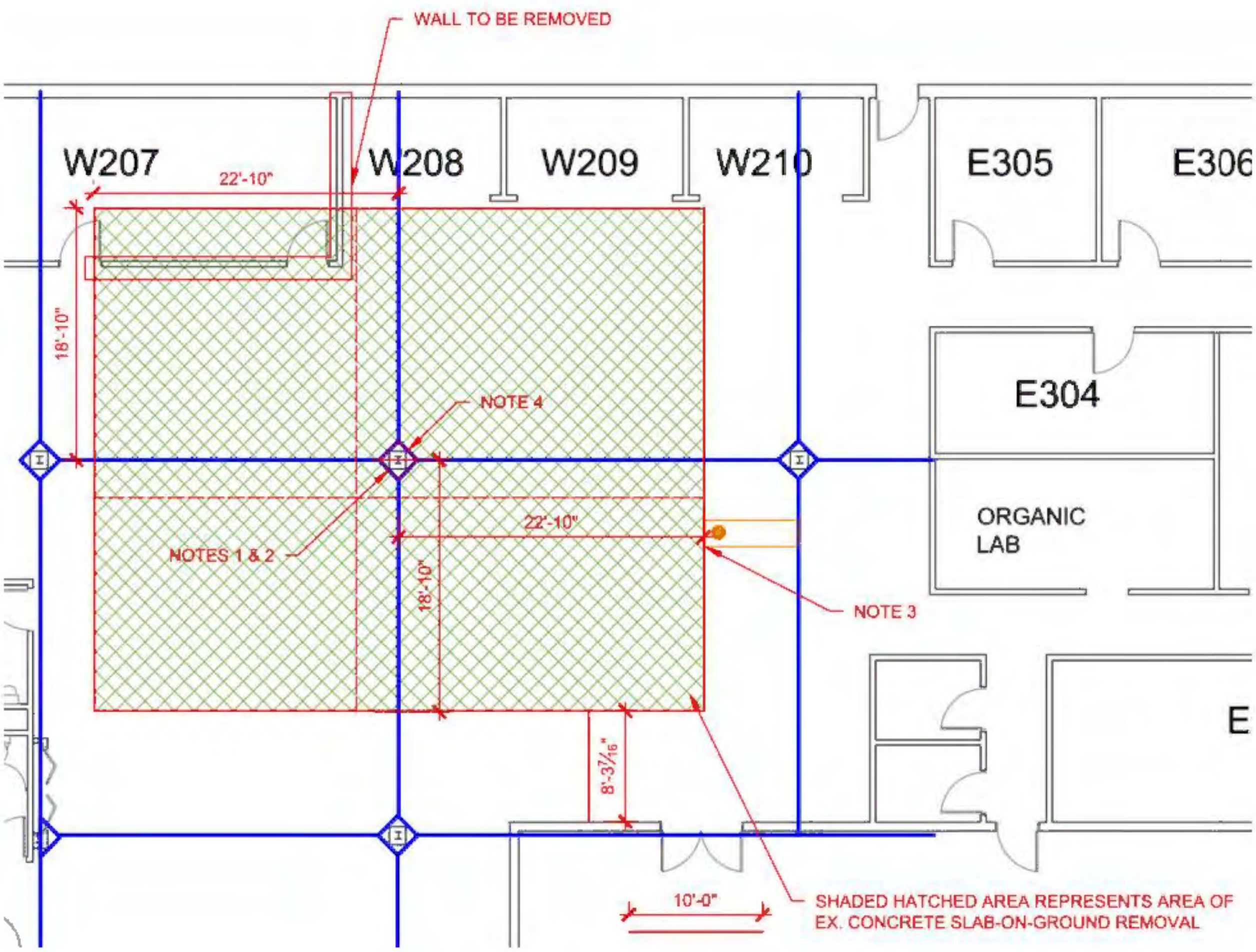


Figure 7. Plan view of the extent of removal of existing slab. The solid blue lines indicate existing slab joints, while the hatched area, not including the central column isolation base, indicates the slab removal area. Note 4 indicates to leave the existing central column isolation slab in place. Refer to Appendix E for other notes.

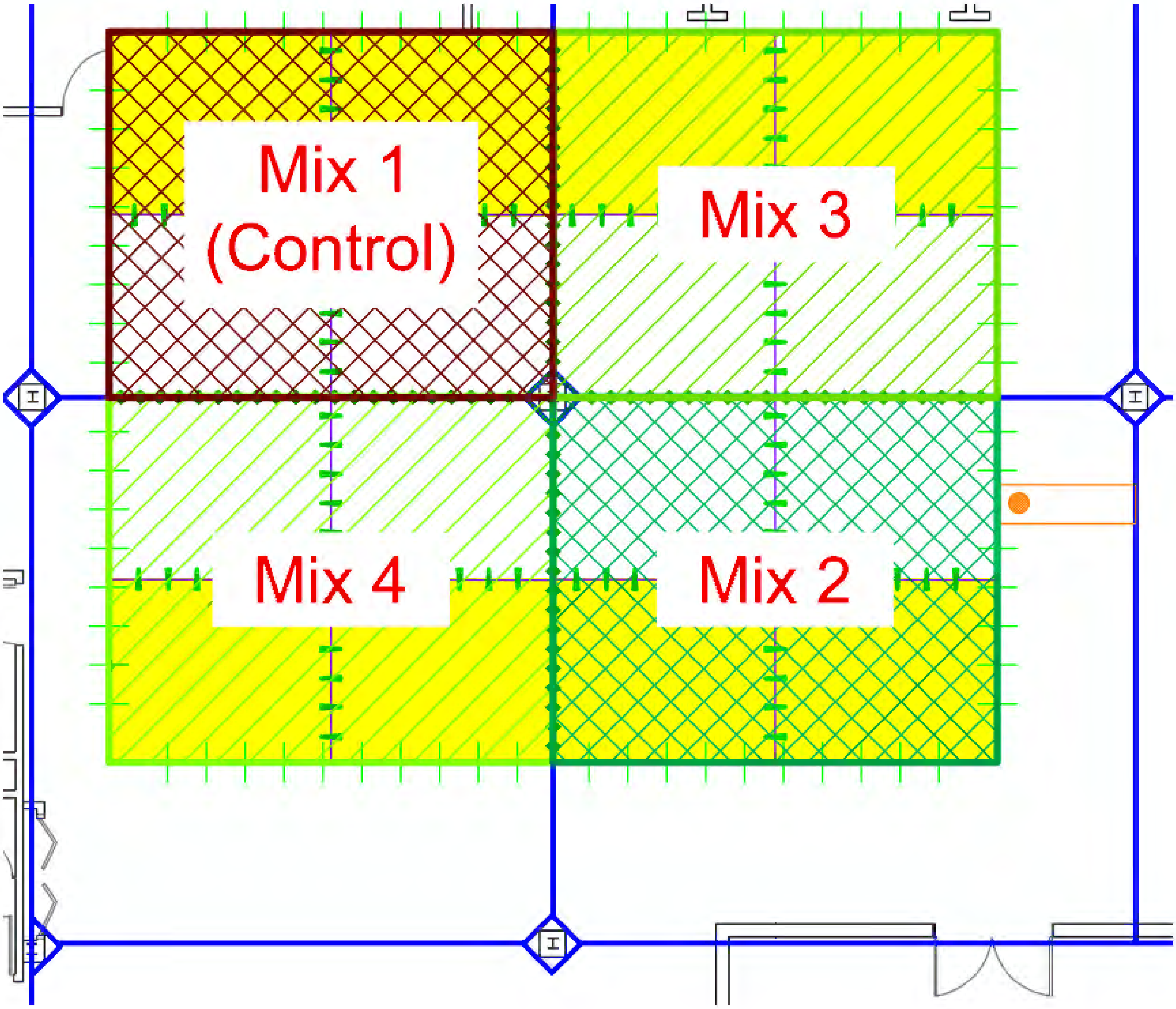


Figure 8. Plan view identifying the location where each mix was placed.

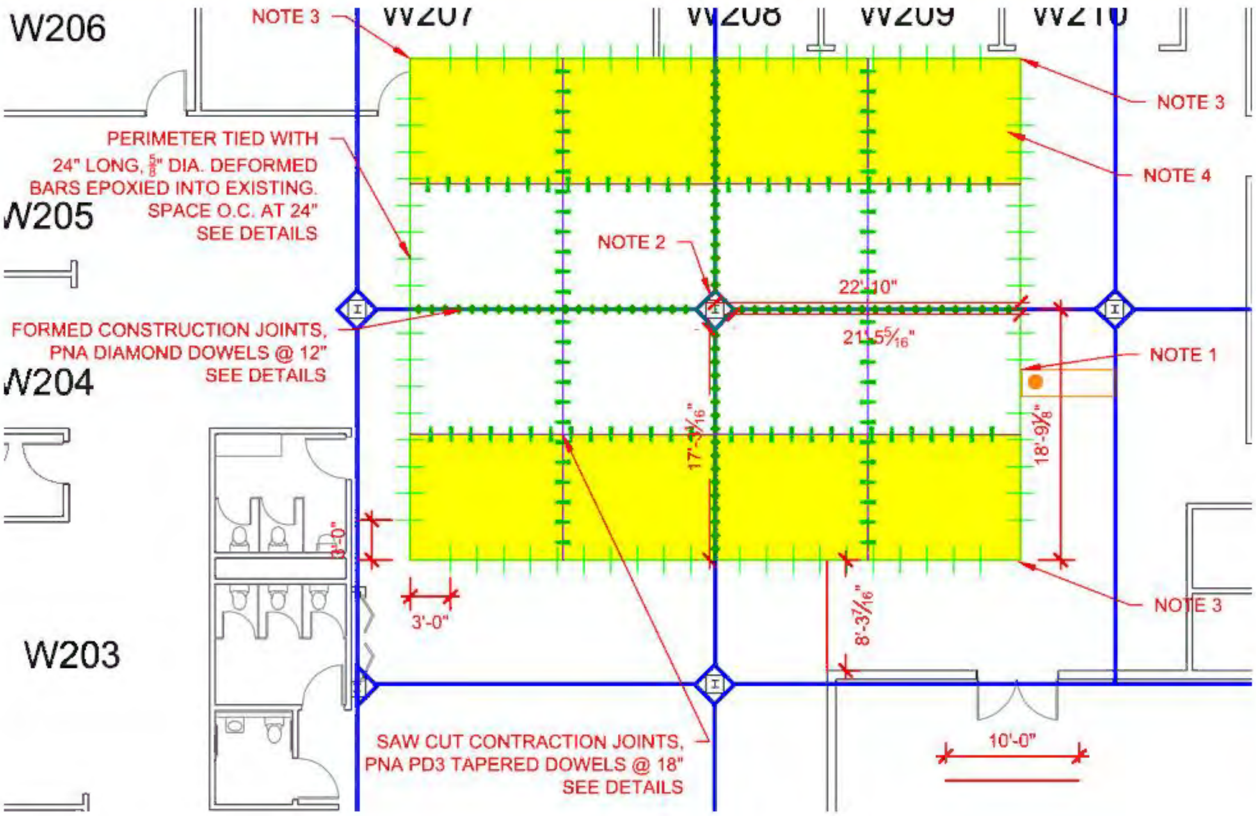


Figure 9. Plan view of replacement slabs identifying areas with reinforcement (yellow-shaded areas) and use of dowels or deformed bars across joints.

Formwork, Reinforcement and Dowels

The formwork, reinforcement and dowels were in general conformance with the *WJE JTC Annex II Partial Floor Slab Replacement* drawing set developed by WJE shown in **APPENDIX E**. The sawcut perimeter at the previously existing slab served as the formwork for the slab exterior edges and 2x4 wood planks served as interior forms between slabs. The form depth varied from 6 in. to 8 in. on average. A moisture retarder was placed atop the subgrade. Along the perimeter joint at the existing slab, 24 in. long No. 5 reinforcing bars were epoxied in place with 12 in. of embedment at 24 in. on-center. At the formed interior construction joints between slabs, ¼ in. dowel plates were installed with 3 in. of embedment at slab mid-depth at 12 in. on-center. Half of each of the four slabs was reinforced with No. 4 reinforcing bars at approximately 16 in. on-center on average in each direction. The control joints of each slab (dividing each slab panel into four) were reinforced with preassembled dowel baskets.

Instrumentation

Each slab was instrumented with identical instrumentation consisting of two maturity probes, an EXACT sensor probe, and two REBEL sensors. These sensors were used to predict the in-place concrete strength using various methods described later.

Sensors were installed prior to placement of concrete on each slab. Temperature probes (for match curing and maturity) were fastened to a reinforcing chair such that the nominal height of all probes was approximately 3 inches, measured from the bottom of each slab. The reinforcing chairs were fastened to the ground to prevent movement of the chairs during concrete placement. The REBEL sensors were installed at the base of the slab in accordance with the manufacturer's instructions. The typical instrumentation setup for each slab is shown in **Figure 10**. All sensors were installed near the slab corners closest to the central column. Datalogging equipment was stationed at the central column. The concrete placement plan was such that the sensors would be covered with concrete from the second truck of concrete for mix.

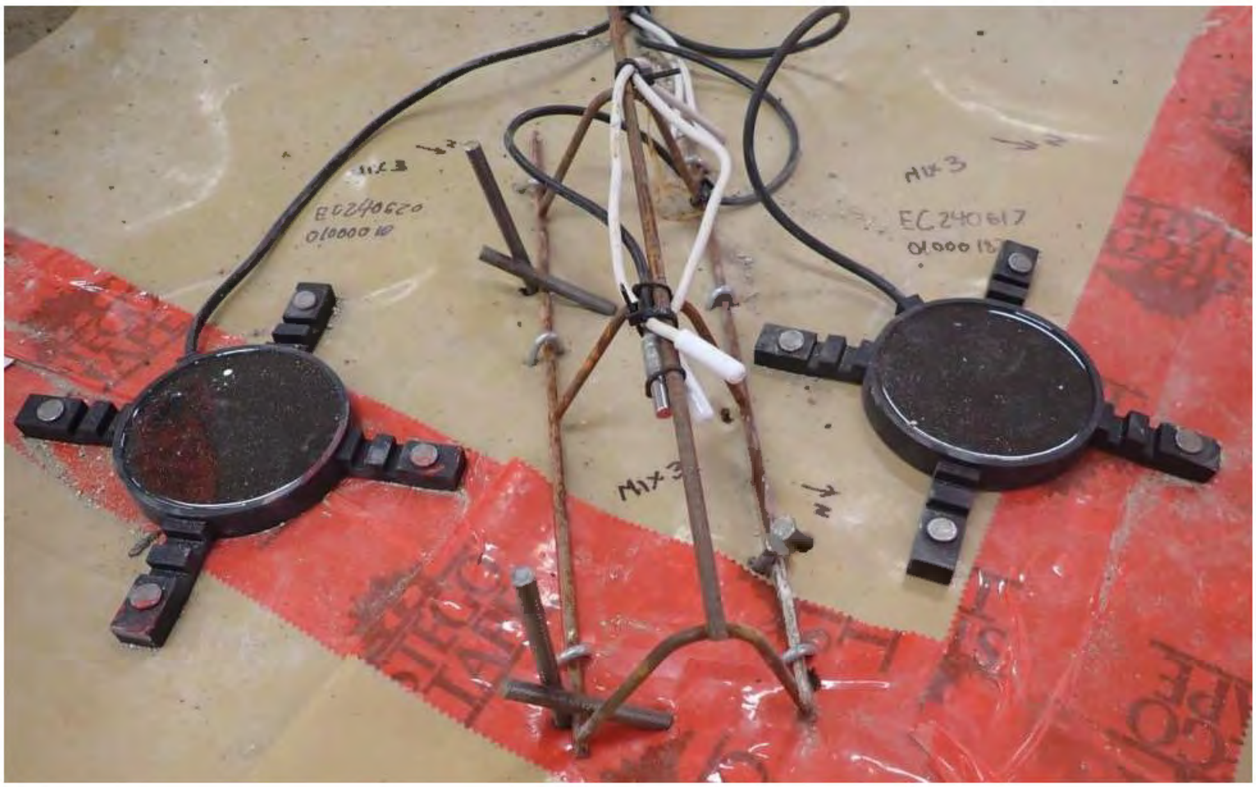


Figure 10. Typical instrumentation setup, including two maturity probes (white), one exact chamber control probe, and two rebel sensors on either side of the temperature probes.

Concrete Placement

On July 31, 2024, Slab 3 and Slab 4, made with Mix 3 and Mix 4, were constructed at the northeast and southwest quadrants of the formwork, respectively. On August 1, 2024, Slab 1 and Slab 2, made with Mix 1 and Mix 2, were constructed at the northwest and southeast quadrants of the formwork, respectively. Two concrete trucks carrying approximately 6 cubic yards each were provided by Ozinga. The general placement process for each slab consisted of pumping from the concrete truck to the slab-on-ground formwork followed by raking and use of internal stingers (vibrators). The surface was leveled with a rectangular 2-by-4 metal float followed by vibratory screeding. The finishing process consisted of application of an evaporation retarder (Evapre, by W. R. Meadows, or SpecFilm, by SpecChem) to the concrete surface followed by bull floating. Each slab underwent a waiting period to facilitate stiffening and cessation of bleed water. After sufficient stiffening and cessation of bleeding, each slab underwent multiple rounds of pan finishing with a ride on power I machine. After completion of pan finishing, the pans were removed, and each slab underwent multiple rounds of trowel blade finishing. Following finishing, a densifier was applied to the concrete surface via spray canister. After a waiting period to facilitate drying of the densifier, a curing compound was applied to the concrete surface via spray canister. Control joints were sawcut to divide each slab into quadrants within 24 hours of construction.

Table 14 presents the timing of the finishing procedures relative to Mix 1 (control), Truck 1 batching. For example, "+55" means 55 more minutes elapsed between batching of the concrete and the activity noted than the elapsed time for the corresponding activity for the control mix, Mix 1. The following subsections summarize deviations from the general placement procedure, overall contractor experience, and our observations of each mix.

Table 14. Finishing Sequence for Mixes

Slab Placement Event	Time Elapsed from Batching[1]	Time Elapsed from Batching Relative to Mix 1 Batching[1]		
	Mix 1 - Control	Mix 2 - 40% SC	Mix 3 - C1157 & Type IL	Mix 4 - C1157
Truck #1 Batched	Start	n/a	n/a	n/a
Truck #1 Arrived	45 min	+24 min	+38 min	+11 min
Truck #2 Batched	40 min	+4 min	-5 min	+7 min
Truck #2 Arrived	1 hr, 38 min	-3 min	+7 min	+13 min
Concrete Placement Started	54 min	+32 min	+23 min	+25 min
Concrete Placement Finished	2 hr, 22 min	-33 min	-5 min	-6 min
Pan Finishing Started	2 hr, 41 min	+1 hr, 25 min	-9 min	+18 min
Pan Finishing Complete	3 hr, 48 min	+57 min	-23 min	+14 min
Trowel Blade Finishing Started	4 hr, 56 min	+1 hr, 13 min	0 min	+58 min
Trowel Blade Finishing Complete	5 hr, 8 min	+1 hr, 45 min	+1 hr, 35 min	+3 hr, 20 min
Densifier Application	6 hr, 5 min	+1 hr, 37 min	+1 hr, 27 min	+3 hr, 13 min
Curing Compound Application	7 hr, 32 min	+1 hr, 51 min	+1 hr, 16 min	+3 hr, 11 min

Note: [1]All activities are relative to Truck #1 batching

Slab 1

Slab 1 was placed with Mix 1 - Control. Based on the as-batched quantities, Mix 1, Truck 1 (#1706) and Mix 1, Truck 2 (#1715) had a *w/cm* of 0.458 and 0.450, respectively. Upon arrival of Truck 1, Ozinga added 40 oz of HR-A575 superplasticizer and 5 gal of water to the truck. Upon initial placement of Truck 1, the contractor requested "more water" be added. Ozinga added an additional 25 oz of HR-A575 superplasticizer and 4 gal of water to Truck 1. During placement, WJE observed that the mix was very fluid, and there was some segregation of aggregate (Figure 13). Upon arrival of Truck 2, Ozinga added 55 oz of HR-A575 superplasticizer and 8 gal of water to the truck. Approximately 1 hour 20 min into the placement of concrete from Truck 2 (approximately 2 hour 20 min after batching of Truck 2), it was observed that the mix was beginning to get stiff. The contractor noted that the concrete from Truck 2 was more difficult to place than Truck 1. Mix 1 responded well and quickly to internal vibration and the vibratory screed (Figure 12). After vibratory screeding, WJE observed popping bubbles at the concrete surface (Figure 13). The surface of Mix 1 closed moderately well. Mix 1 exhibited a minor amount of bleed water (Figure 14). Upon completion of power trowel finishing, the majority of the slab surface excluding edges developed a shine (Figure 15). The contractor did not note any major challenges during the finishing efforts. Mix 1 was noted to be pumpable, moderately placeable, and finishable. The contractor ranked this mix as second best of the four mixes in regard to overall constructability.

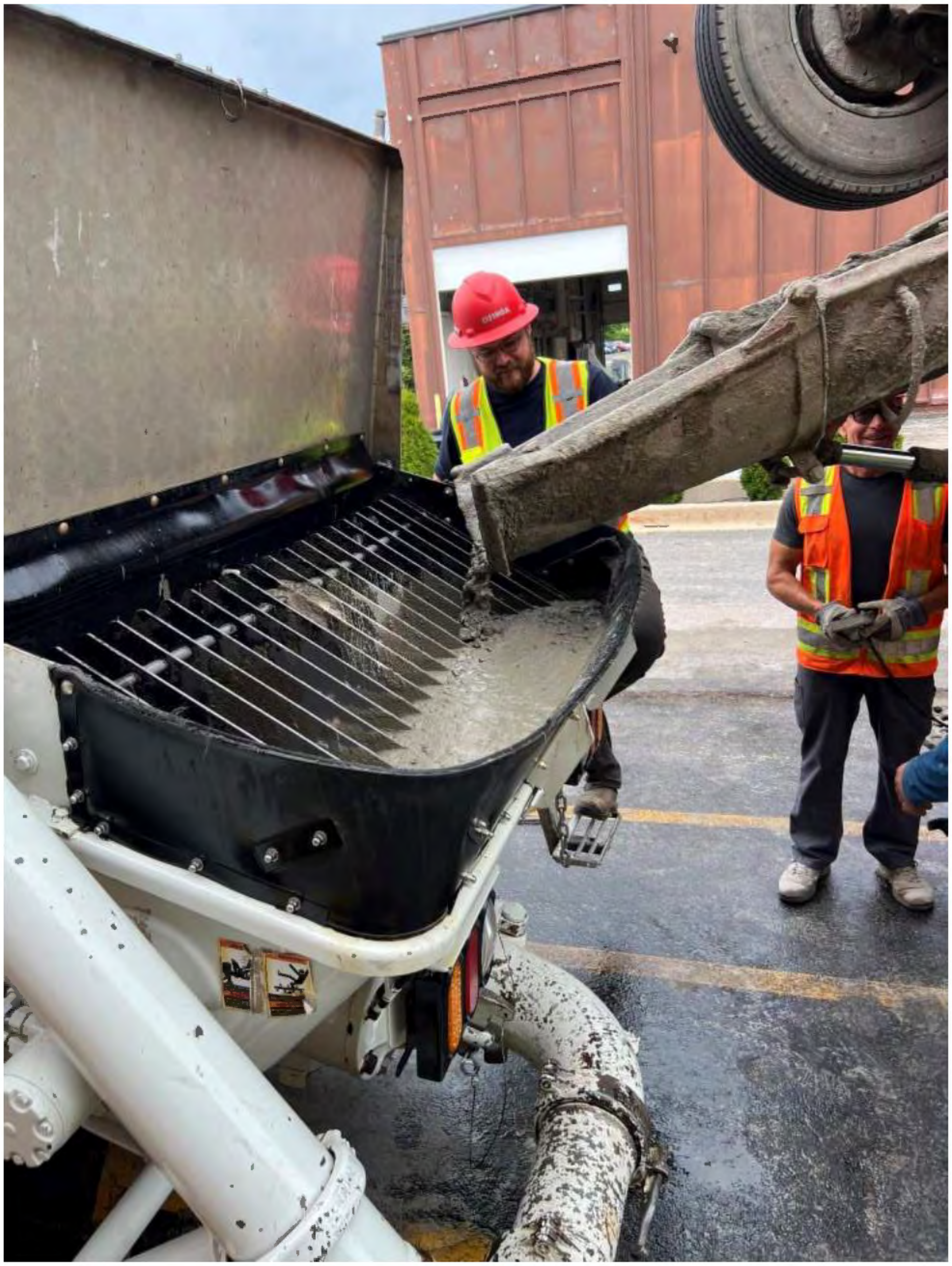


Figure 11. Mix 1, Truck #1 poured into hopper after Ozinga additions.

Figure 12. Representative photo of Slab 1 placement with Mix 1.

Figure 13. Slab 1, Mix 1 close-up photograph of concrete surface following vibratory screeding.

Figure 14. Slab 1, Mix 1 close-up photograph of concrete surface following bull floating and hand troweling at edges. Note small amount of bleed water.

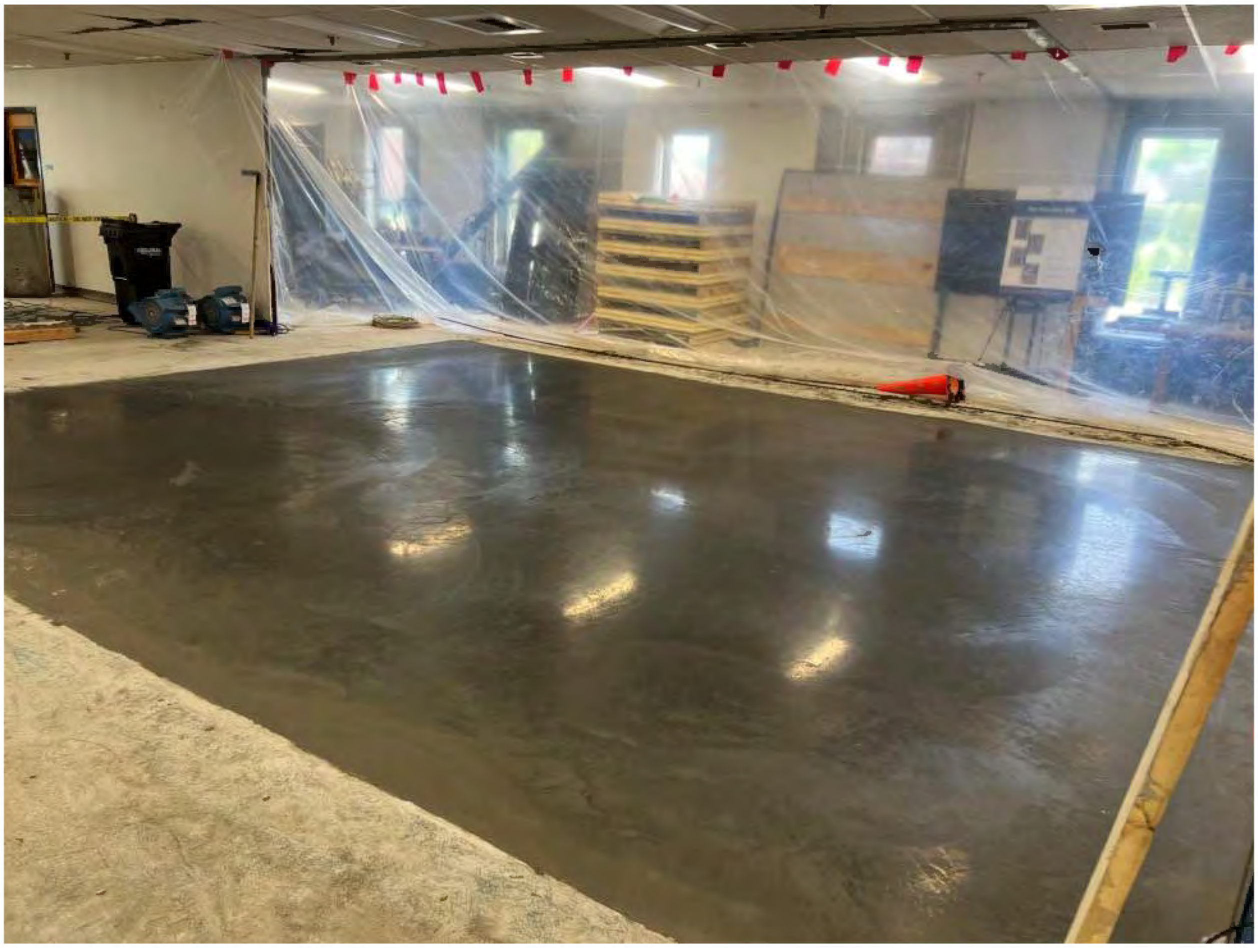


Figure 15. Slab 1, Mix 1 after completion of placement and power troweling.

Slab 2

Slab 2 was placed with Mix 2 - 40% SC. Based on the as-batched quantities, Mix 2, Truck 1 (#1226) and Mix 2, Truck 2 (#1207) had a *w/cm* of 0.446 and 0.448, respectively. Upon arrival of Truck 1, Ozinga added two 27 oz (total of 54 oz) additions of HR-A575 superplasticizer and 5 gal of water to the truck. Upon placement of the concrete from Truck 1, it was observed that the mix was easily placeable and movable with rakes, there was no segregation in the mix, and the mix had a good consistency (Figure 16). Upon vibratory screeding (Figure 17) and bull bloating (Figure 18), the surface of the mix closed well. Mix 2 exhibited a minor amount of bleed water (Figure 18). It appeared that pan finishing efforts started slightly late at the south portion of the slab and slightly early at the north portion of the slab based on the amount of material moving at the concrete surface. Upon completion of power trowel finishing, the majority of the slab surface excluding edges developed a shine (Figure 19). Relative to the control mix, Mix 2 took the contractor slightly longer to power finish (pans and trowel) and the densifier and curing compound were applied later; all other placement operations were within approximately +/-30 minutes. The contractor did not note any challenges during the finishing efforts. Mix 2 was noted to be pumpable, easily placeable, and finishable. The contractor ranked this mix as the best of the four mixes in regard to overall constructability.

Figure 16. Representative photo of Slab 2 placement with Mix 2.

Figure 17. Slab 2 Mix 2 close-up photograph of concrete surface following vibratory screeding.

Figure 18. Slab 2, Mix 2 close-up photograph of concrete surface following bull floating. Note small amount of bleed water.

Figure 19. Slab 2, Mix 2 after completion of placement and power finishing.

Slab 3

Slab 3 was placed with Mix 3 - C1157 & Type IL. Based on the as-batched quantities, Mix 3, Truck 1 (#1226) and Mix 3, Truck 2 (#1317) had a *w/cm* of 0.311 and 0.310, respectively. Upon arrival of Truck 1, Ozinga added one 20 oz addition followed by one 40 oz addition (total of 60 oz) of HR-A575 superplasticizer to the truck. Within the first 15 minutes of placement of concrete from Truck 1, the mix was a fair consistency with some aggregate segregation, pumpable and placeable (Figure 20). However, after 5 to 10 minutes of not moving the mix, it was observed that it was difficult to move and screed. Without application of energy to mix to keep is in motion, the mix became stiff and lost workability. Upon arrival of Truck 2, Ozinga added 10 oz of HR-A575 superplasticizer to the truck. The concrete from Truck 2 had poor consistency with segregation of aggregate and paste (Figure 21). The concrete from Truck 2 exhibited the same behavior as the concrete from Truck 1 in which a high amount of force was required to keep the mix movable if it was left untouched for more than 5 to 10 minutes and was resistant to internal vibration and vibratory screeding.

The mix exhibited little to no bleed water (Figure 22). WJE observed the contractor pour approximately ¾ of a bucket of evaporation retarder directly to the mix and impart a high amount of force by impact with shovels, vibration, and vibratory screed to facilitate placement (Figure 23). To impart additional energy on the mix to create a level surface, the contractor began pan finishing with a walkable pan finishing unit (Figure 24). A level surface was ultimately achieved by the contractor with difficulty. Pan finishing with the drivable unit was performed 15 minutes upon completion of placement.

Upon completion of power trowel finishing, most of the slab surface excluding edges developed a shine (Figure 25). WJE observed plastic shrinkage cracking in the slab surface after completion of power troweling (Figure 26). Relative to the control mix, the densifier and curing compound were applied later at Mix 3; all other placement operations were within approximately +/-30 minutes. The contractor did not note major challenges with the finishability or pumpability of the mix. However, the contractor noted major challenges with placement and leveling of this mix stating that vibratory screeding should be performed within 10 minutes of placement. Mix 3 behaves in a thixotropic manner with its viscosity being dependent on the amount of energy applied to it. The contractor ranked this mix the worst of the four mixes in regard to overall constructability.

Figure 20. Representative photo of Slab 3 placement with Mix 3 upon initial pumping and placement of Truck 1. Note some aggregate segregation.

Figure 21. Representative photo of Slab 3 placement with Mix 3 upon initial pumping and placement of Truck 2. Note aggregate and paste segregation.

Figure 22. Slab 3 placement after Mix 3 became stiff and difficult to move.

Figure 23. Evaporation retarder application to Mix 3 to facilitate vibratory screeding at Slab 3.

Figure 24. Slab 3 during placement showing use of pushable pan finisher.

Figure 25. Slab 3, Mix 3 after completion of placement and power finishing.

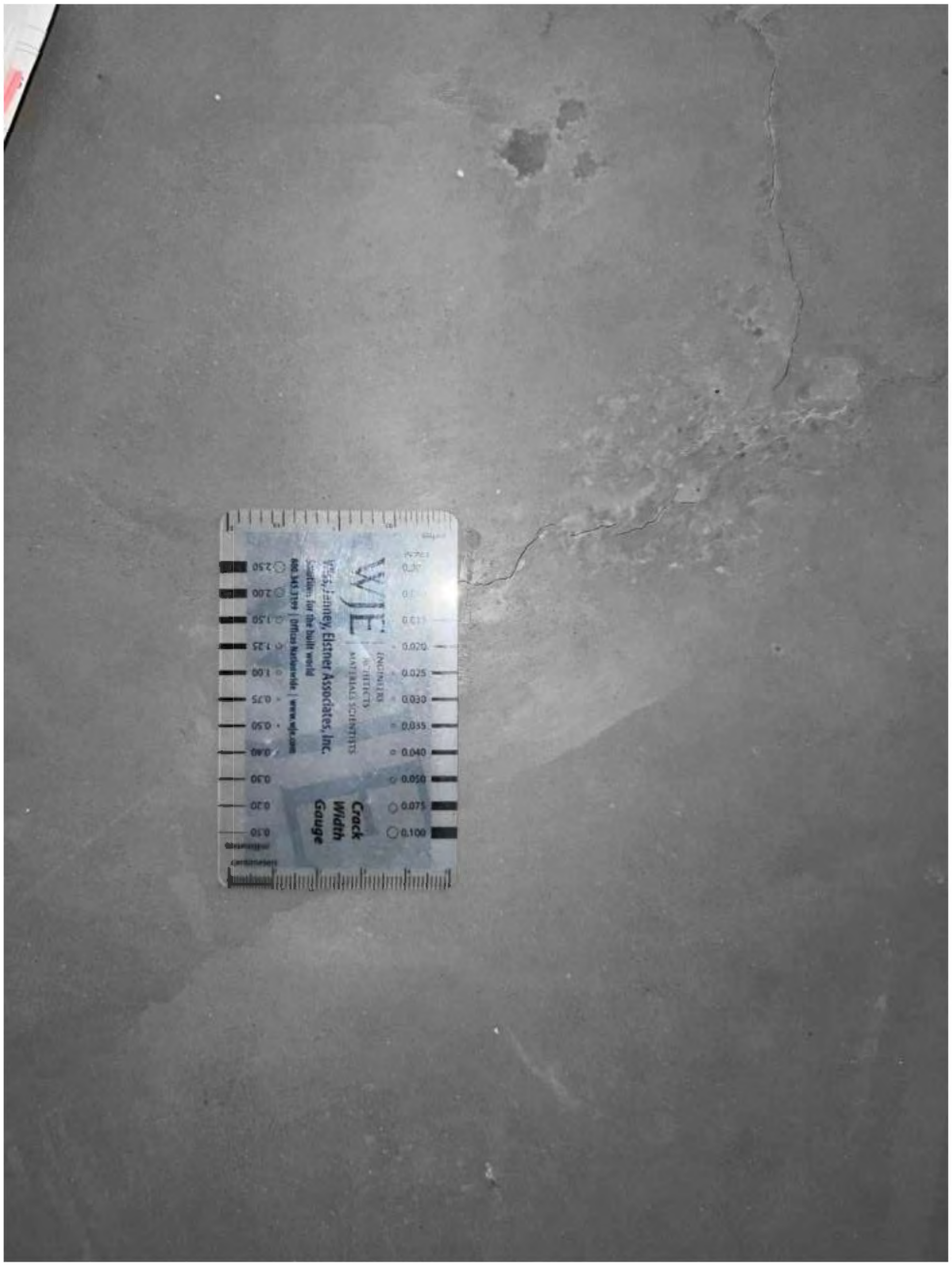


Figure 26. Plastic shrinkage cracking in Slab 3 following completion of power troweling.

Slab 4

Slab 4 was placed with Mix 4 - C1157. Based on the as-batched quantities, Mix 4, Truck 1 (#2203) and Mix 4, Truck 2 (#1706) had a *w/cm* of 0.309 and 0.328, respectively. Upon arrival of Truck 1, Ozinga added 20 oz of HR-A575 superplasticizer to the truck. Upon placement of the concrete from Truck 1, some segregation of the mix was noted (Figure 27) with the contractor stating that the aggregate appeared to settle to the bottom. The mix was initially fluid and flowing. However, after about 15 minutes into placement, without movement to the mix, the mix became stiff and difficult to move and screed (Figure 28 and Figure 29). It was observed that the mix became increasingly difficult to work as time passed. No additions were made by Ozinga to concrete in Truck 2. The consistency of the concrete in Truck 2 was more uniform and better than that observed for Truck 1. The concrete from Truck 2 exhibited the same behavior as the concrete from Truck 1 where the mix became difficult to move without application of energy. Mix 4 exhibited thixotropic behavior in which its viscosity was dependent on the amount of energy applied. The mix was also noted to be sticky and contractor equipment (e.g., boots) were getting stuck in the mix.

A level surface was ultimately achieved by the contractor with difficulty. Mix 4 did not exhibit any bleed water, however the surface was shiny and did not easily imprint (Figure 30). Prior to pan finishing with a ride-on machine, a walk-behind pan finishing unit was utilized (Figure 31). It appeared that power troweling with trowel blades was performed too early as multiple passes were not resulting in the development of shine at the slab surface. During hand troweling at the edges, the contractor noted that the surface was “creaming up” and was able to be troweled to a satisfactory finish. Upon completion of power trowel finishing, the most of the slab surface excluding edges developed a shine (Figure 32). Relative to the control mix, Mix 4 took the contractor longer to trowel finish and therefore the densifier and curing compound were applied later; all other placement operations were within approximately +/-30 minutes. The contractor ranked this mix second to worst of the four mixes in regard to overall constructability.

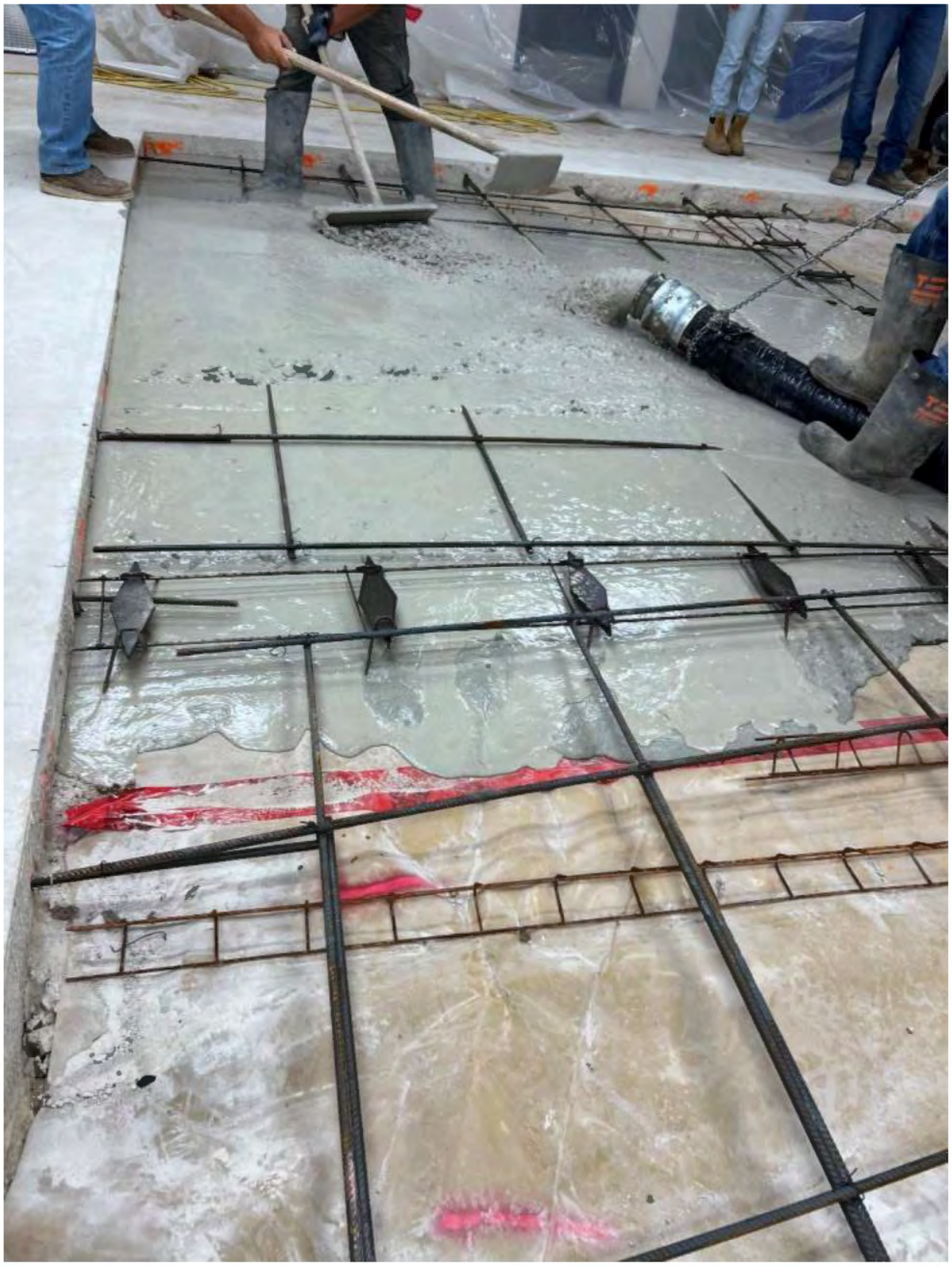


Figure 27. Representative photo of Slab 4, Mix 4 placement of Truck 1. Note aggregate and paste segregation.

Figure 28. Representative photo of Slab 4, Mix 4 after mix became stiff and more difficult to move.

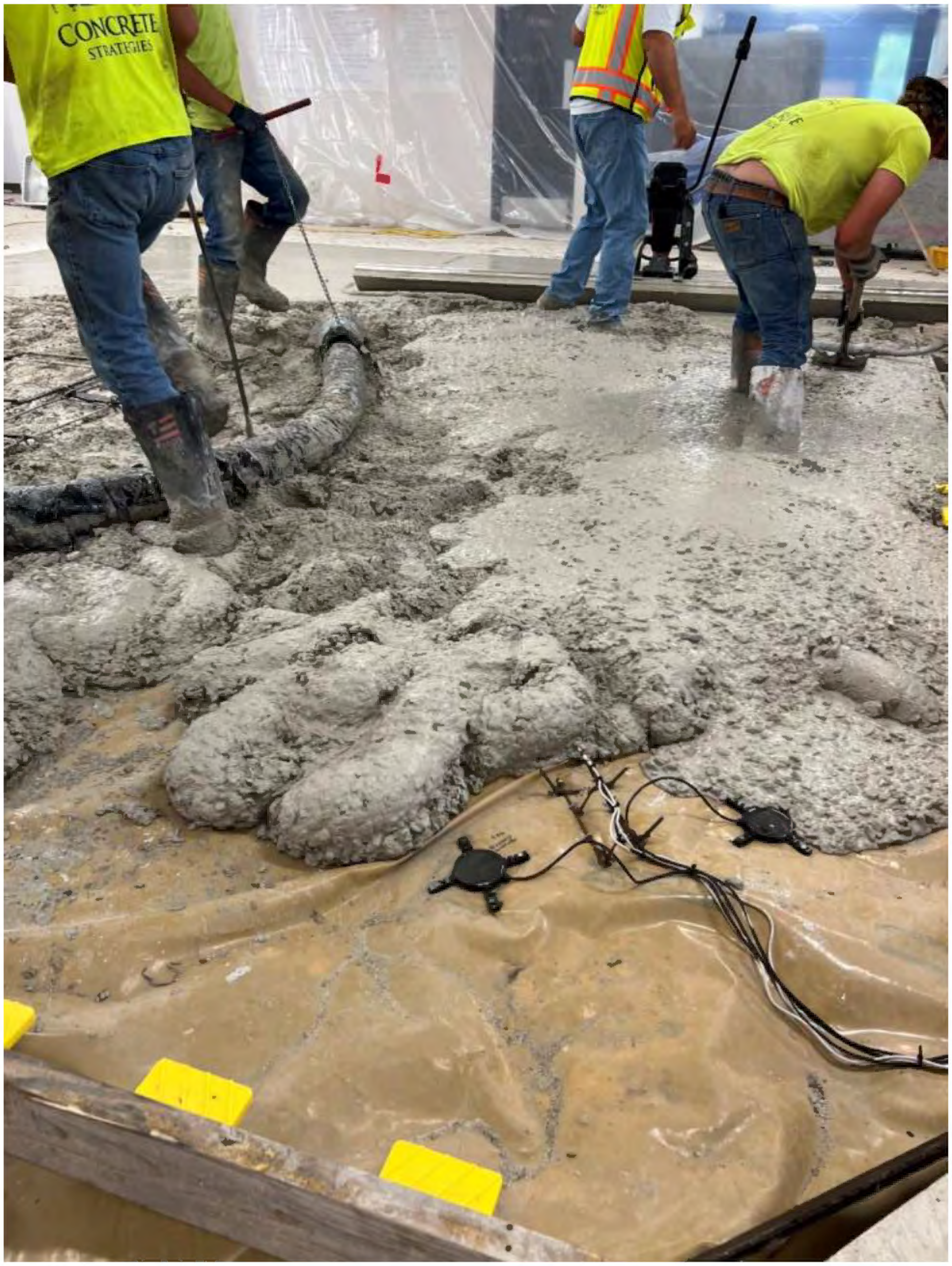


Figure 29. Slab 4, Mix 4 exhibiting thixotropic behavior in which the concrete sitting inside the pump hose from Truck 1 before arrival of Truck 2 became stiff.

Figure 30. Slab 4, Mix 4 close-up photograph of concrete surface following placement, vibratory screeding, and bull bloating.

Figure 31. Slab 4, Mix 4 walkable pan finishing at edges.

Figure 32. Slab 4, Mix 4 after completion of placement and power finishing. Application of densifier via spray canister commencing in photograph.

Field Quality Control Testing

Plastic Properties

Quality control testing was performed on all concrete truck loads. The concrete after being pumped was sampled with a wheelbarrow. Plastic properties tested for each concrete truck included slump (ASTM C143), temperature (ASTM C1064), unit weight (ASTM C138), and air content (ASTM C231).

The plastic property test results are summarized in **Table 15**. All the mixes and trucks met the target air content but some of the slump measurements were higher than targeted, especially Mix 4 which exhibited segregation during placement.

Table 15. Concrete Plastic Properties

Property	Mix 1 - Control		Mix 2 - 40% SC		Mix 3 - C1157 & Type IL		Mix 4 - C1157	
	Truck 1*	Truck 2	Truck 1	Truck 2	Truck 1	Truck 2	Truck 1	Truck 2
Temperature (°F)	85.1	86.7	86.0	82.9	87.0	88.3	83.1	82.4
Slump (in.)	6.00	8.50	7.50	9.00	8.50	9.75	10.00	11.00
Air Content (%)	2.2	2.6	1.8	1.8	1.5	0.5	1.0	1.2
Unit Weight (lb/ft^3)	152.2	150.7	151.8	151.6	154.7	155.7	152.1	153.2

*Note: *Concrete was sitting for 20 minutes before testing.*

Floor Flatness (Ff) and Floor Levelness (Fl)

Floor flatness and floor levelness values were measured for all four slabs in general accordance with ASTM E1155, *Standard Test Method for Determining F_f Floor Flatness and F_L Floor Levelness Numbers*. Each test section consisted of two runs, running diagonally along the respective test section. The test results are summarized in **Table 16**. Levelness measurements are not included as the existing slab elevations (which were used as formwork for the slab construction) were not level, so any levelness measurements of the constructed slab are not appropriate to assess the constructability of these mixes.

Table 16. Floor Flatness and Floor Levelness Statistics

Slab	Total Length (feet)	F_F
Mix 1	38	44.60
Mix 2	38	44.90
Mix 3	37	33.50
Mix 4	39	34.10

Most Hyperscalers require an overall floor flatness of 35 whereas one requires an overall floor flatness of 25. Mixes 1 and 2 meet three of their requirements for floor flatness but Mixes 3 and 4 were slightly less than their requirements. All mixes met the remaining Hyperscalers' requirement for minimum floor flatness. The lower flatness for Mixes 3 and 4 was likely associated with the difficulties placing and in finishing of these mixes.

Compressive Strength Testing

The conditioning of the cylinders used for compressive strength testing has a significant impact on the strength results. To investigate the differences in compressive strength of the concrete when subject to different curing conditions, cylinders were stored in three distinct conditions prior to testing:

- Standard curing per ASTM C31 including moist curing: 100% relative humidity and 73.5 ± 3.5 °F.
- Field curing: cylinders stored in ambient relative humidity and temperature as the slabs.
- Match curing: cylinders cured in an environmental chamber at the same temperature as the interior of the slab from the same mix (temperature monitored with an embedded temperature probe).

All cylinders were prepared at the time of concrete placement, from the second truck of each mix, in accordance with ASTM C31, *Practice for making and Curing Concrete Test Specimens in the Field*, and tested according to ASTM C39, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*. Further details for each storage condition and summaries of the compressive strength results are included in the following subsections. All the test reports are given in **APPENDIX F**.

Standard Cured

Standard cured cylinders were stored next to the slab for the first 24±0.5 hours, until demolding, after which they were moved to a moist room, controlled at a minimum of 95% relative humidity and a temperature of 73.5 ± 3.5 °F, compliant with ASTM C511, *Standard Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes*. Standard cured compressive strength results are presented in **Table 17** and plotted in **Figure 33**.

Table 17. Standard Cured Cylinder Compressive Strength Testing Results (psi)

Age (days)	Mix 1 - Control	Mix 2 - 40% SC	Mix 3 - C1157 & Type IL	Mix 4 - C1157
1*	3,570	1,750	2,240	2,030
2	4,310	2,830	4,890	3,550
3	4,770	3,520	6,130	4,240
7	5,080	4,930	8,240	5,380
28	6,250	6,570	10,680	7,190
56	6,700	6,890	11,100	8,190

*Note: *At 1 day, the cylinders were tested after demolding at 24 hours and the results are the same as the field cured.*

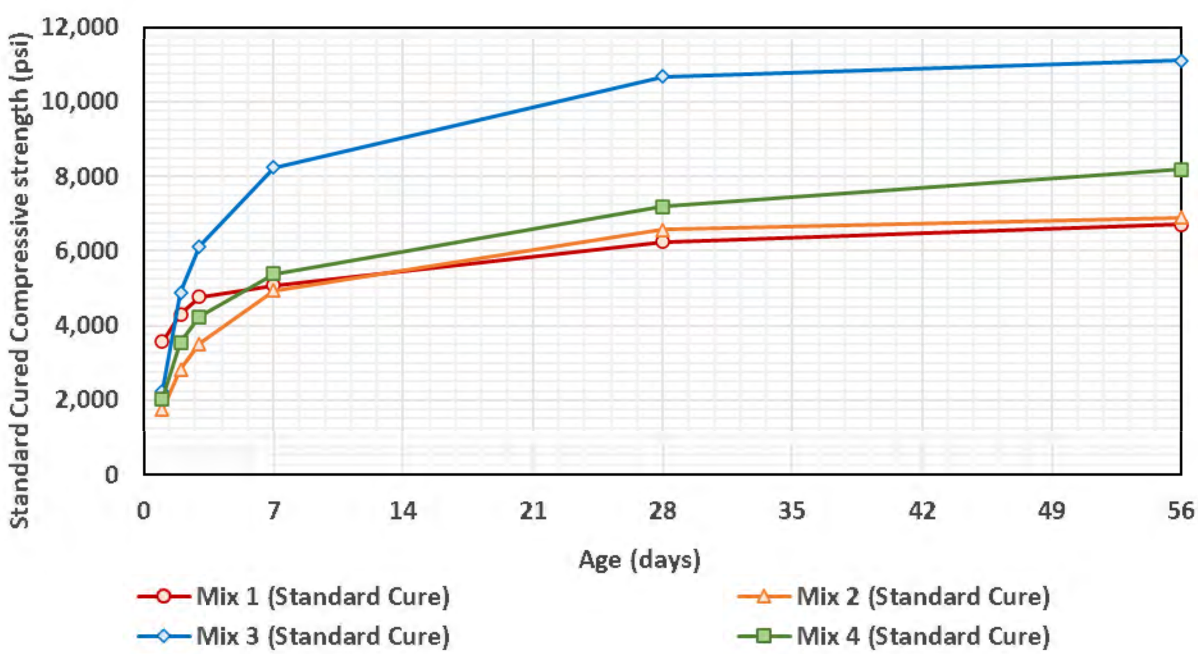


Figure 33. Standard Cured Cylinder Compressive Strength Results.

Field Cured

Field cured cylinders were stored next to the slab and demolded after 24±0.5 hours, after which they were continued to be stored in the same location until the time of compressive testing. It is noted that the standard cured, and field cured conditions were identical up until an age of 24 hours, i.e. the time of demolding. Field cured compressive strength results are presented in **Table 18** and plotted in **Figure 34**.

Table 18. Field Cured Cylinder Compressive Strength Testing Results (psi)

Age (days)	Mix 1 - Control	Mix 2 - 40% SC	Mix 3 - C1157 & Type IL	Mix 4 - C1157
1	3,570	1,750	2,240	2,030
2	4,510	2,880	4,640	3,590
3	5,090	3,550	5,850	4,170
7	5,720	4,850	7,540	4,980
28	6,520	5,880	9,410	6,550
56	6,920	6,310	9,350	7,030

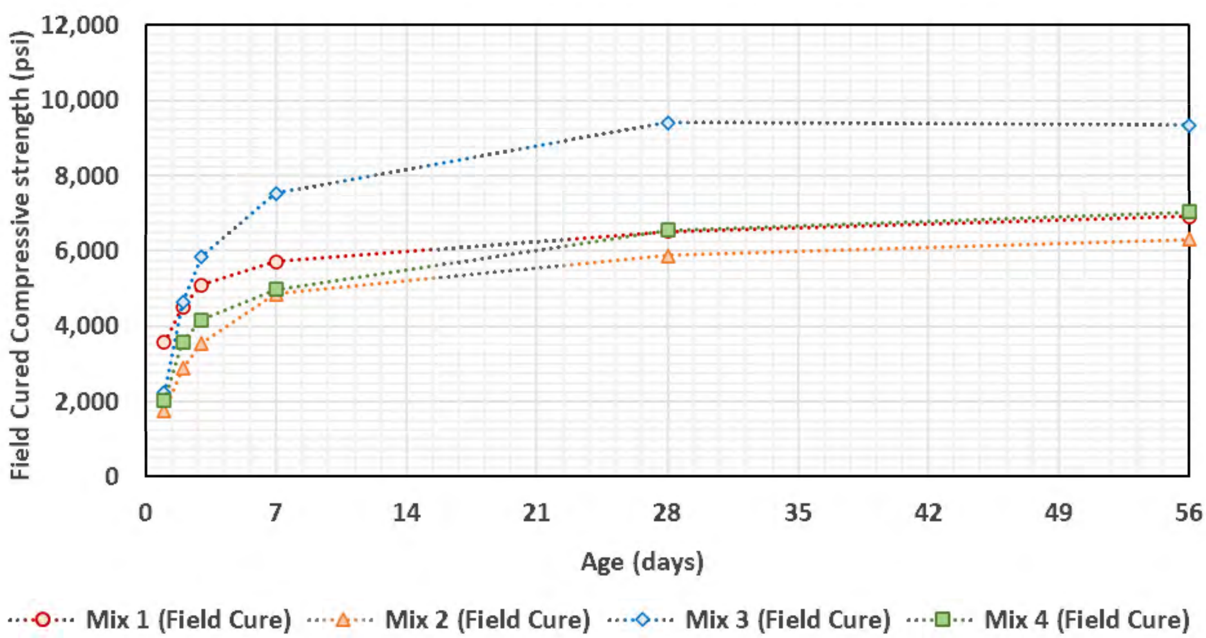


Figure 34. Field Cured Cylinder Compressive Strength Results.

Match Cured

Match cured cylinders were cast at the time of casting, like the standard cured and field cured cylinders, but were immediately placed into the match cure chambers (EXACT Match). The match cure chambers maintained an internal cylinder temperature equivalent to the in-place temperature of the slab, as measured by the temperature probes located within a sample cylinder in the chamber and a temperature probe in the slab, respectively. The temperature of each slab as well as each internal cylinder is plotted in

Figure 35. Specimens were stored in the match cure chamber and not demolded till the time of testing. Match cured compressive strength results are presented in **Table 19** and plotted in **Figure 36**.

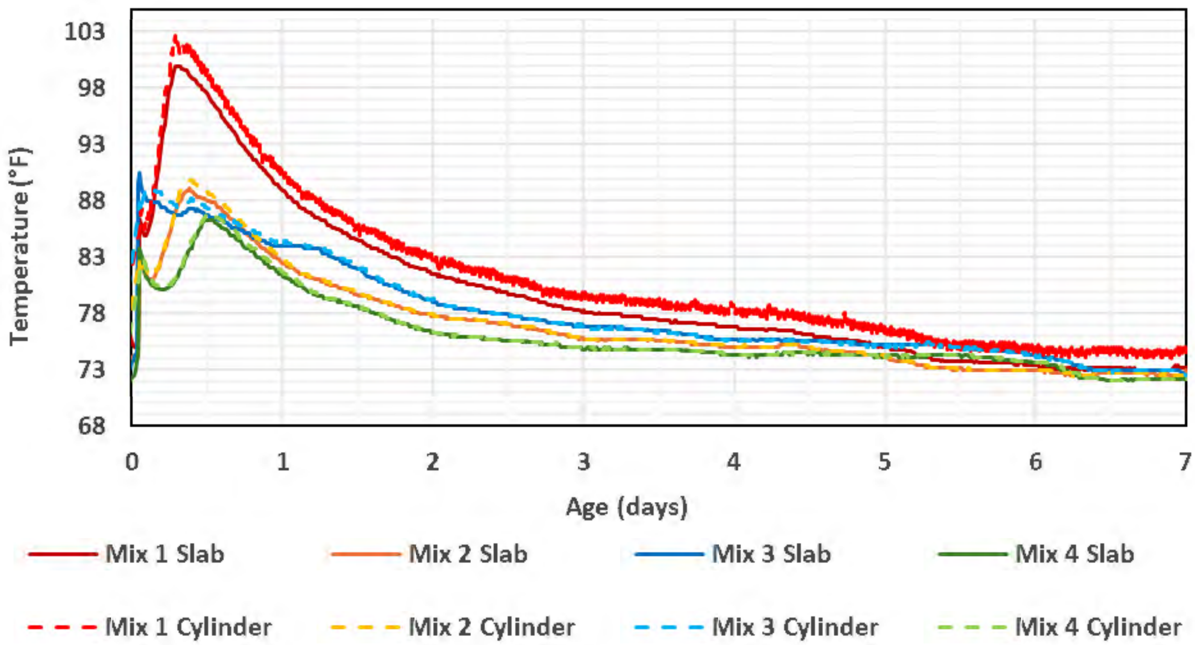


Figure 35. EXACT match curing internal cylinder temperatures versus slab temperatures for each concrete mix.

Table 19. Match Cured Cylinder Compressive Strength Testing Results (psi)

Age (days)	Mix 1 - Control	Mix 2 - 40% SC	Mix 3 - C1157 & Type IL	Mix 4 - C1157
1	3,940	2,160	3,480	2,810
2	4,560	3,210	5,870	4,140
3	4,850	3,740	6,940	4,730
7	5,420	4,990	8,370	5,750

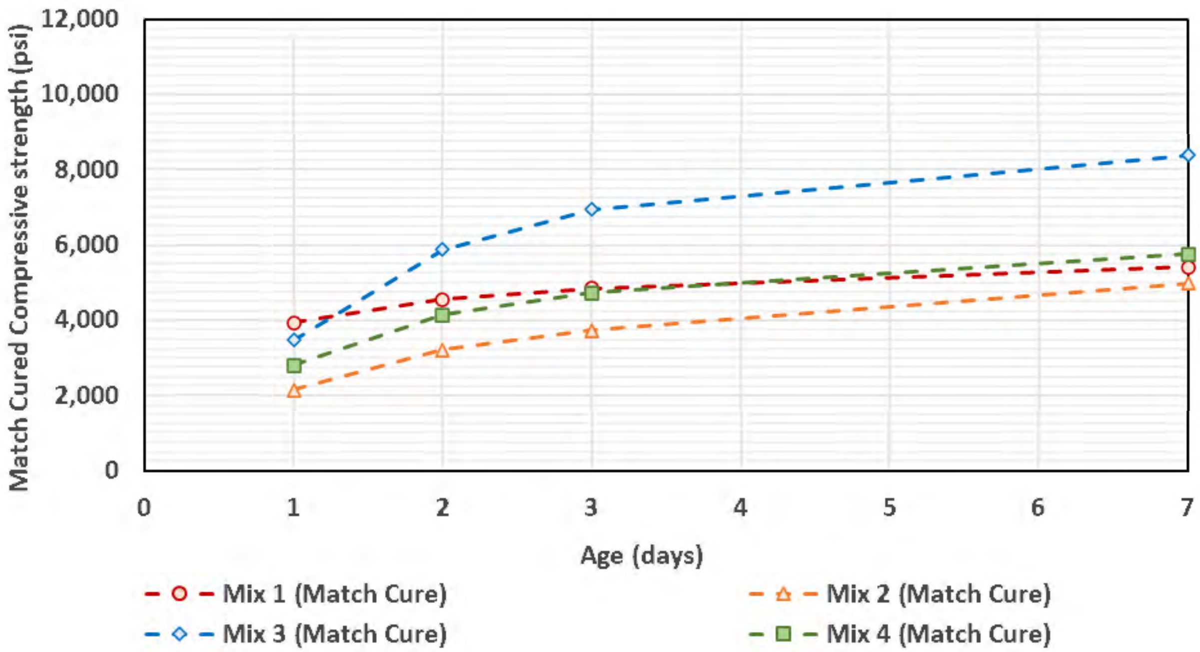


Figure 36. Match Cured Cylinder Compressive Strength Results.

Methods for Estimation of Concrete Compressive Strength

REBEL

REBEL™ Concrete Strength Sensing System (REBEL) is a sensor from the company Wavelogix, Inc., reportedly capable of providing real-time, in-place strength data for concrete without the need to develop maturity curves or test any concrete cylinders. This proprietary technology was incorporated in this study to evaluate its use in alternative cementitious materials such as ASTM C1157 cement and to gain confidence in this recent technology.

For each slab, two REBEL sensors were installed per manufacturer recommendations as described in the instrumentation section above to estimate the in-situ concrete compressive strength. The results from each sensor were averaged to provide the values presented in **Table 20**.

Table 20. REBEL Sensor Compressive Strength Estimation (psi)

Age (days)	Mix 1 - Control	Mix 2 - 40% SC	Mix 3 - C1157 & Type IL	Mix 4 - C1157
1	2,920	3,640	3,500	3,440
2	3,330	3,850	4,070	4,020
3	4,160	4,870	4,700	4,630
7	5,500	6,370	6,150	5,950

Maturity

The temperature time history from the maturity probes installed in the slabs was used along with the maturity equations developed in the lab to estimate the in-place compressive strengths of the slab. It is noted that the maturity equation was developed for the mix designs used in the lab testing and some difference is to be expected due to changes to the concrete mixes placed in the field. The estimated in-place strengths are conservative.

Table 21. Estimated Compressive Strength from Maturity (psi)

Age (days)	Mix 1 - Control	Mix 2 - 40% SC	Mix 3 - C1157 & Type IL	Mix 4 - C1157
1	2,850	1,800	2,200	1,840
2	3,590	2,800	3,990	2,510
3	4,010	3,380	4,990	2,900
7	4,890	4,590	7,110	3,730

Comparison of Compressive Strength Test Results

For each concrete mix, the strength data for all three curing conditions are plotted in **Figure 37**, **Figure 38**, **Figure 39**, and **Figure 40**.

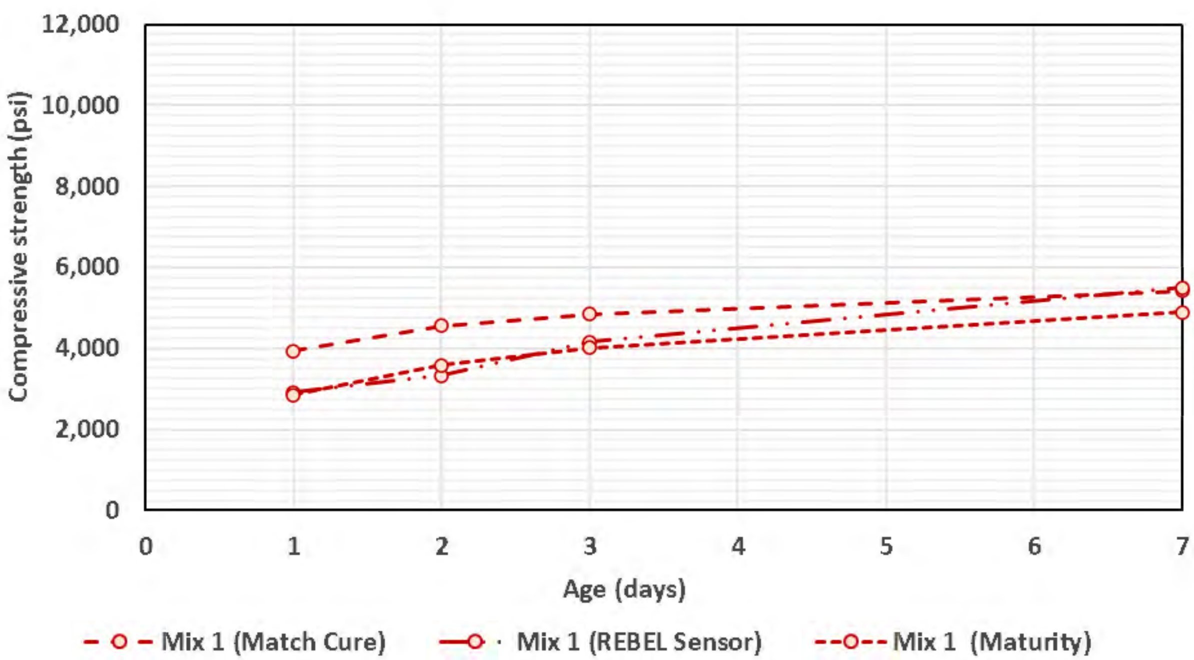


Figure 37. Compressive Strength Results from Different Curing Conditions for Mix 1.

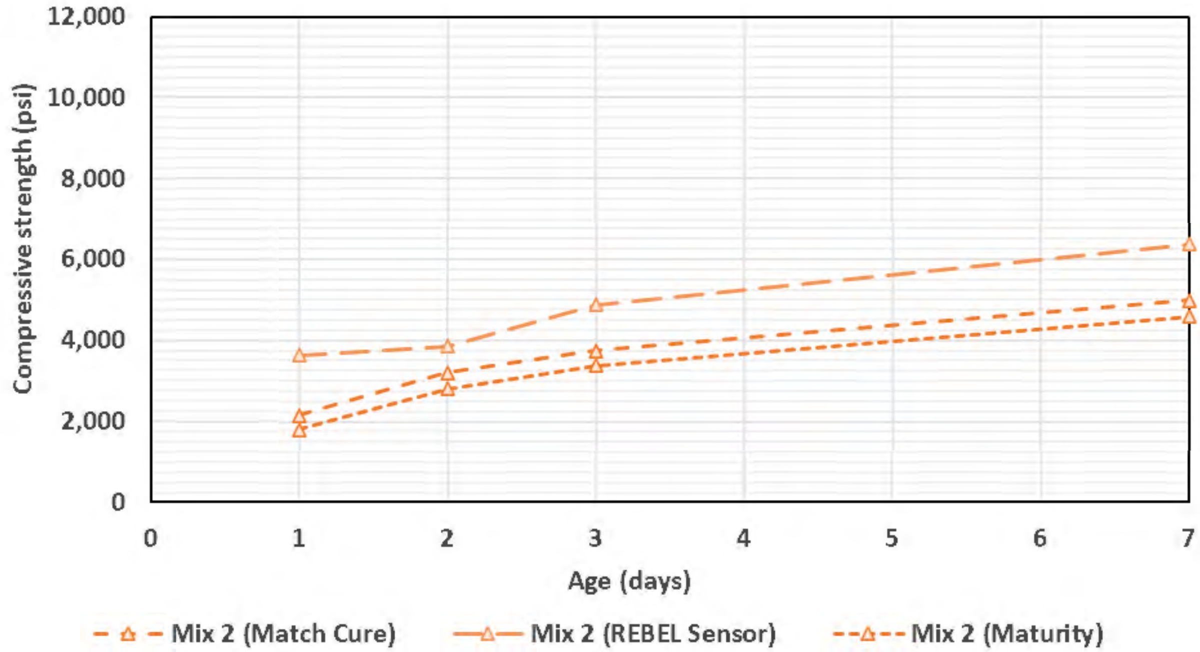


Figure 38. Compressive Strength Results from Different Curing Conditions for Mix 2.

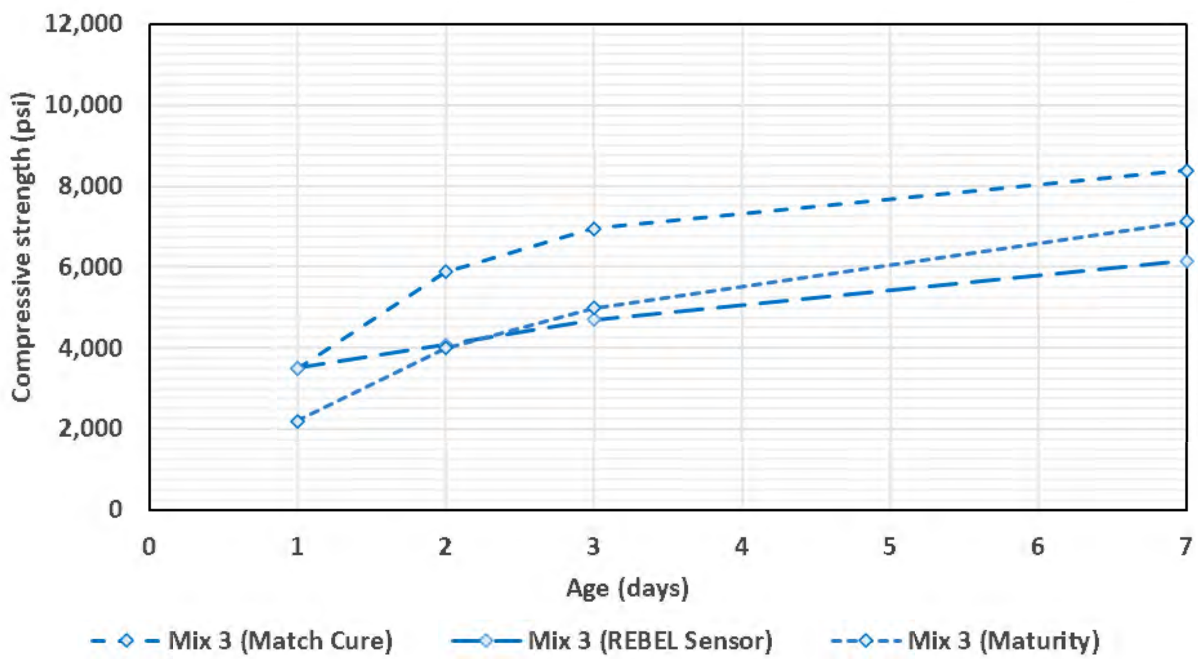


Figure 39. Compressive Strength Results from Different Curing Conditions for Mix 3.

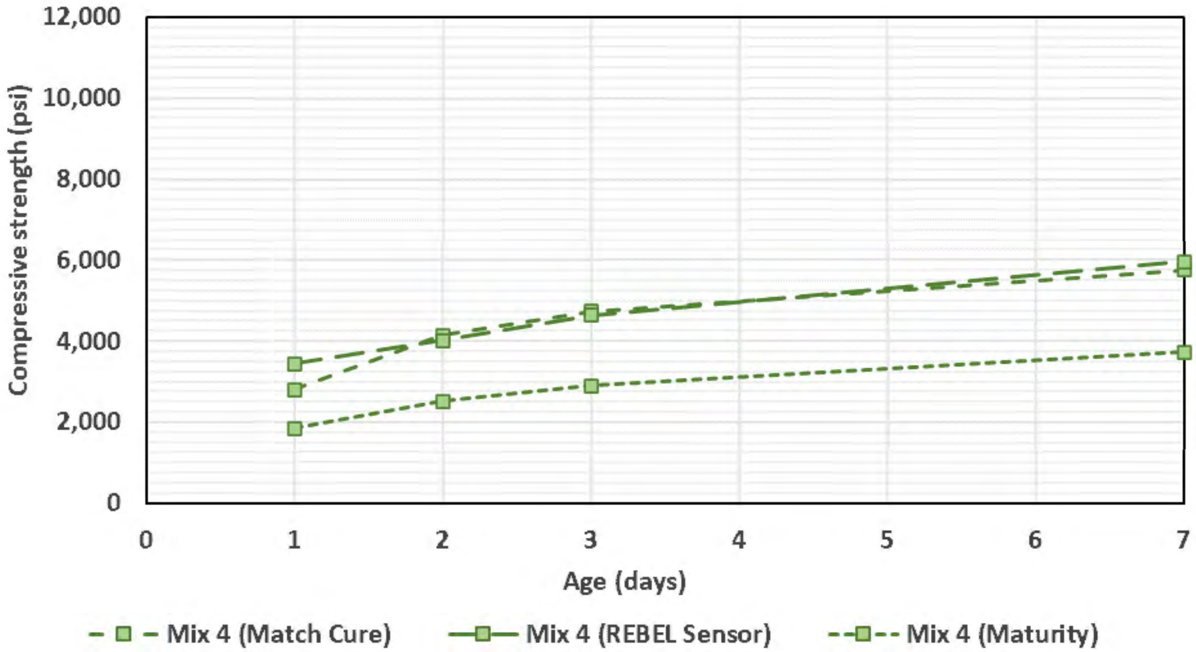


Figure 40. Compressive Strength Results from Different Curing Conditions for Mix 4.

The ambient conditions inside Annex II during the first week after the slabs were placed ranged at about 70 to 80°F and 50 to 80% relative humidity as shown in **Figure 41**. The warmer ambient temperature meant the field cured samples were expected to be similar or greater in strength to the standard cured cylinders. It is likely that if ambient conditions were colder, the field cured cylinders could have strengths lower than standard cured cylinders.

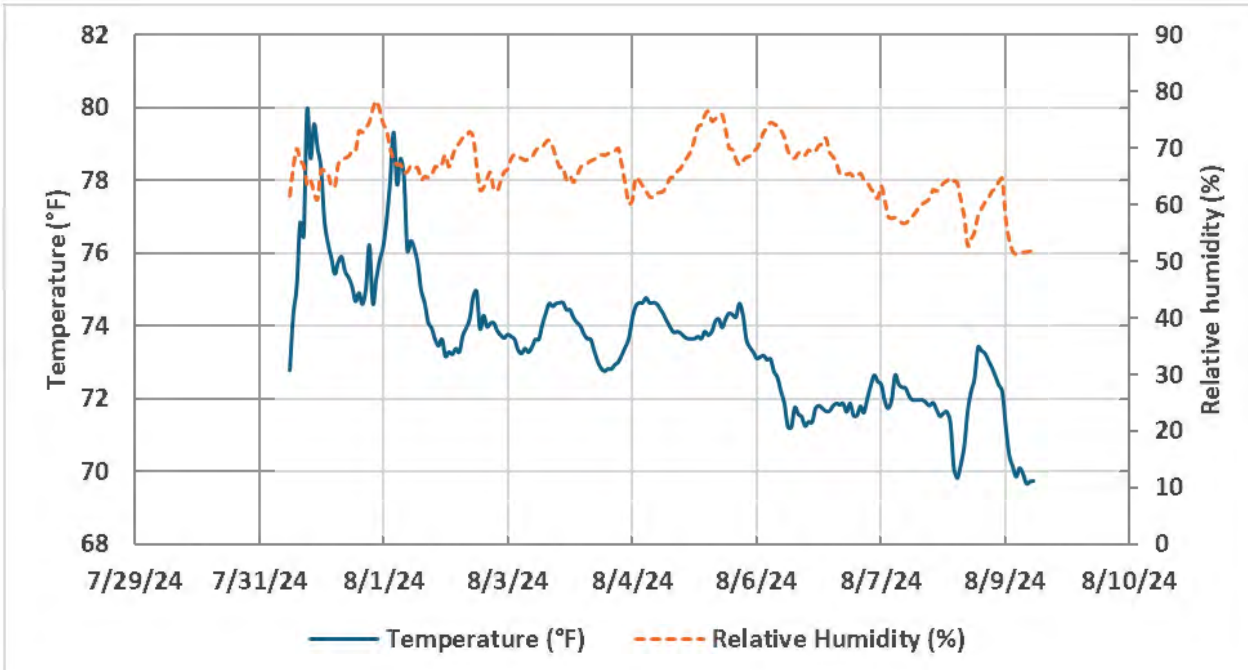


Figure 41. Ambient Conditions During and After Concrete Placement.

Match cured cylinders typically had greater strengths than standard and field cured cylinders. This is expected since large concrete sections retain the heat from their hydration reaction and typically cure at temperatures higher than the standard cured cylinders when the ambient conditions are high. Match cured strengths are greater than the standard and field cured strengths except for Mix 1.

In projects where concrete is placed in cold weather, match cured strengths can be valuable as it tracks the in-place strength of the concrete as opposed to standard cured (which will be cured at a higher temperatures) and field cured cylinders (which due to the smaller concrete volume will not have a similar strength profile as the larger concrete section).

The strength of concrete is severely impacted by the temperature at which it is cured. The use of match curing allows for accurate estimation of the in-place strength of the concrete. The estimation of the strengths from the maturity equations typically underestimated the strengths while the REBEL sensors varied in their ability to estimate the strengths as seen in **Figure 42**, **Figure 43**, **Figure 44**, and **Figure 45**. Compared to match cured strengths, for Mixes 1 and 3, the REBEL sensors underestimated the strengths. For Mix 2, it overestimated the strengths, while accurately estimating the strength of Mix 4.

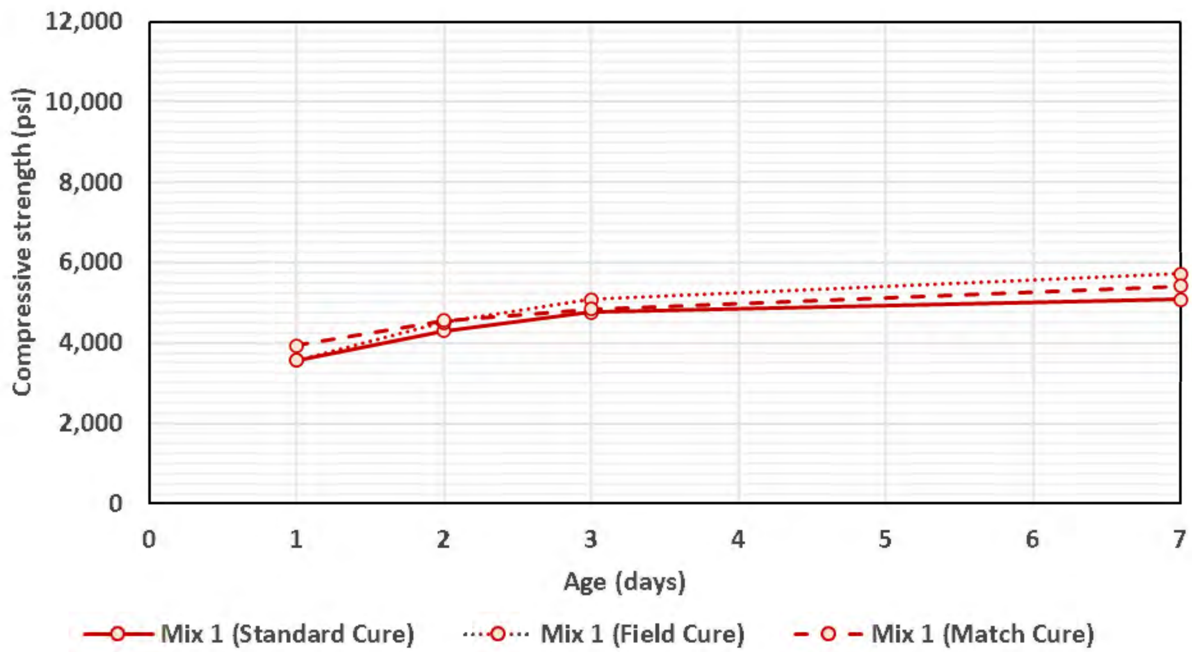


Figure 42. Estimated Compressive Strength Results Compared with Match Cured Strength for Mix 1.

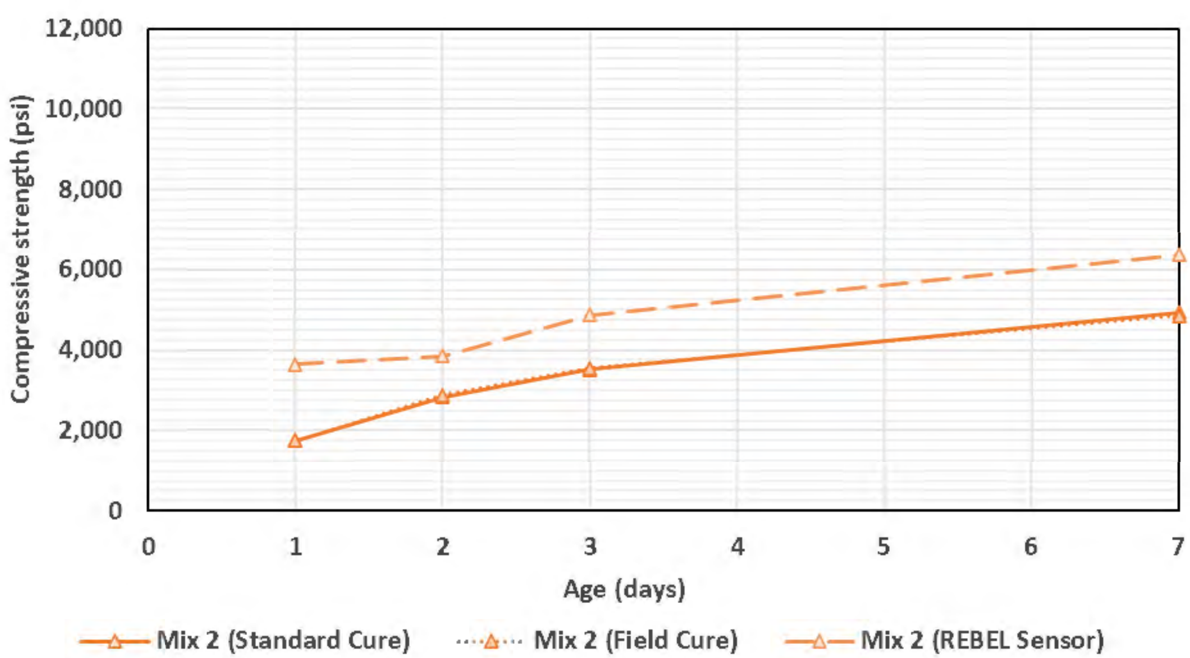


Figure 43. Estimated Compressive Strength Results Compared with Match Cured Strength for Mix 2.

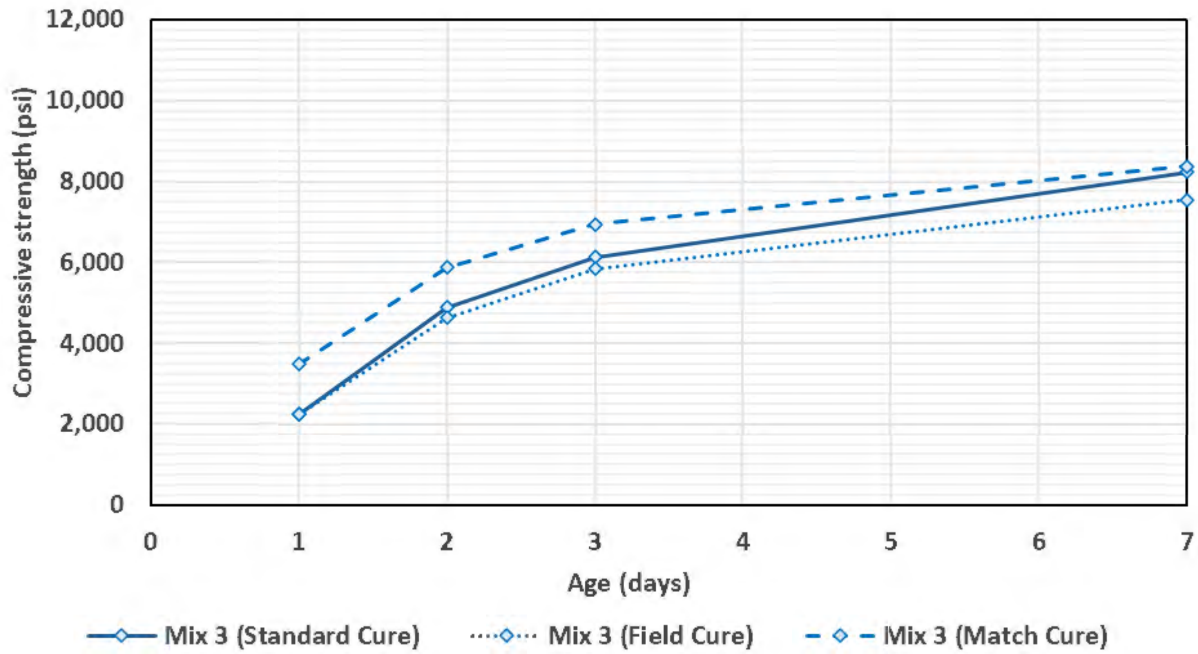


Figure 44. Estimated Compressive Strength Results Compared with Match Cured Strength for Mix 3.

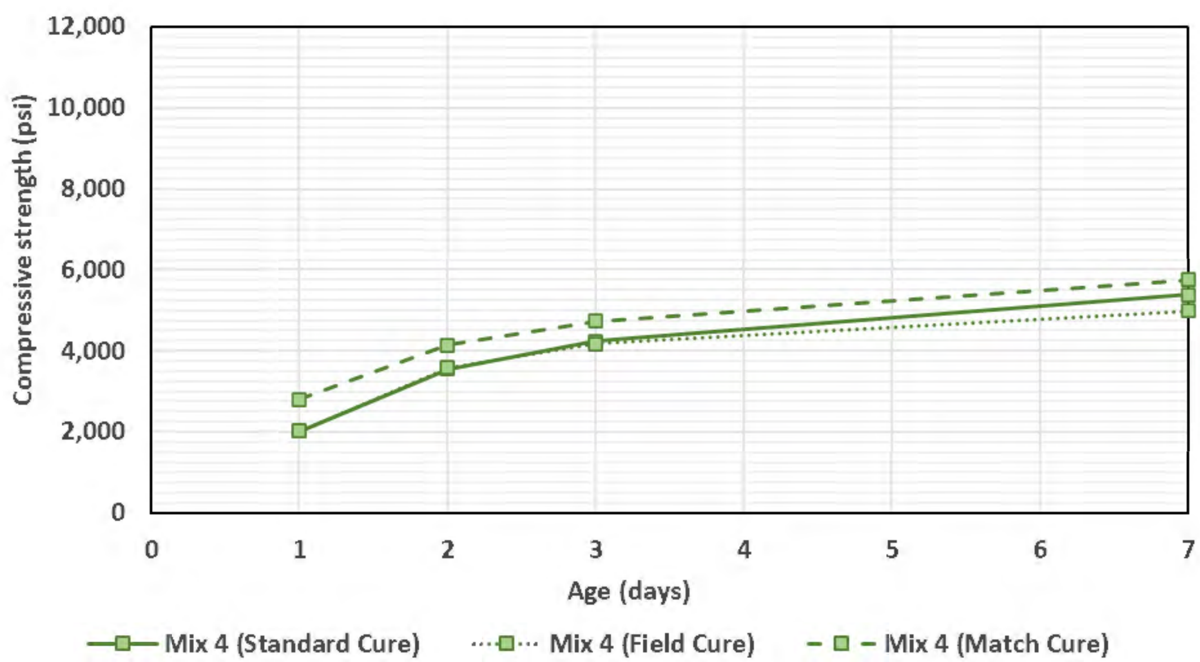


Figure 45. Estimated Compressive Strength Results Compared with Match Cured Strength for Mix 4.

It is noted that the standard cured strengths for Mixes 1 and 2 were generally similar between the lab study and the field placement. However, for Mixes 3 and 4, there was a significant difference in the standard cured strengths. At 28 days, Mix 3 was 2,600 psi and Mix 4 was 3,000 psi higher in the field mix compared to the lab mix.

Field Abrasion Testing

The abrasion resistance of the finished surfaces of the slabs was tested according to BS EN 13892-4:2002 – *Methods of test for screed materials – Part 4: Determination of wear resistance-BCA* when the slabs were 57 days of age. Three tests were performed on each slab, and locations with a relatively uniform and clean densified layer were targeted for testing. The testing dates and results are summarized in **Table 22** and detailed in **APPENDIX G**.

Mix 4 exhibited the best abrasion resistance, with no wear observed at any of the three test locations. This was unexpected because the finish on Mix 4 was inconsistent to the extent that not all the test locations had a clean, densified surface. Mixes 2 and 3 both exhibited good abrasion resistance, with slight wear between 0.01 and 0.02 mm on average. Mix 1, the control, exhibited the poorest abrasion resistance of the four slabs and the greatest range of test results, from 0.00 to 0.19 mm of wear. However, Mix 1 still falls under the wear resistance class AR1 per EN 13813:2002 (E), which is the second best wear resistance class identified by the standard.

Table 22. Summary of Abrasion Resistance Testing per BS EN 13892-4

	Mix 1 - Control	**Mix 2 – 40% SC**	**Mix 3 – C1157 & Type IL**	**Mix 4 – C1157**
Date cast	Aug. 1, 2024	Aug. 1, 2024	Jul. 31, 2024	Jul. 31, 2024
Date of BS EN 13892-4 testing	Sep. 27, 2024	Sep. 27, 2024	Sep. 26, 2024	Sep. 26, 2024
Age at testing	57 days	57 days	57 days	57 days
Mean Depth of Wear (mm):				
Test 1	0.00	0.01	0.02	0.00
Test 2	0.03	0.00	0.02	0.00
Test 3	0.19	0.03	0.01	0.00
Test Area Average (mm)	**0.073**	**0.013**	**0.017**	**0.000**

APPENDIX A. ENVIRONMENTAL PRODUCT DECLARATIONS

READY MIX CONCRETE PRODUCED BY:OZINGA

FACILITY:	Jarvis
STRENGTH:	4000 psi @ 28 days
MIX NAME:	2686M

IMPACT INDICATOR		PER YD3	PER M3
Global Warming Potential	kg CO_2e	214.08	280.01
Ozone Depletion	kg CFC11e	7.27E-06	9.51E-06
Acidification	kg SO2e	0.62	0.82
Eutrophication	kg NE	0.33	0.44
SFP (Smog)	kg O3e	12.83	16.78
Non-renew. energy	MJ, NCV	2001.88	2618.36

GENERAL INFORMATION		
Declared Product	Ready-mixed concrete produced by Ozinga	
Date of Issue	March 20, 2024	
Period of Validity	August 13th, 2025	
EPD Holder	Ozinga Bros., Inc. 19001 Old LaGrange Road Mokena, IL 60448 www.ozinga.com	OZINGA®
Program Operator	ASTM International 100 Bar Harbor Drive West Conshohocken, PA 19428-2959, USA	ASTM INTERNATIONAL Helping our world work better
LCA and EPD Developer	WAP Sustainability Consulting 1701 Market Street Chattanooga, TN 37408 www.wapsustainability.com	Athena Sustainable Materials Institute
Core PCR	ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products	
Sub-category PCR	NSF International Product Category Rule (PCR) for Concrete Version 2.2 (December 2022), Verified by Thomas P. Gloria, Ph.D., Industrial Ecology Consultants	
Independent LCA Reviewer and EPD Verifier	Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006 ☐ Internal ☒ External Thomas P. Gloria, Ph.D., Industrial Ecology Consultants	
For Additional Explanatory Material	Manufacture Representative: Ryan Cialdella (ryancialdella@ozinga.com) Software Tool: Theta by WAP Sustainability Consulting V.1.0.	

The declared product meets the following product specifications:

- ACI 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- ACI 318: Building Code Requirements for Structural Concrete.
- ASTM C94 Standard Specification for Ready-Mixed Concrete.
- CSI Masterformat Division 03-30-00: Cast-in-Place Concrete.
- UNSPSC Code 30111500: Ready Mix

Disclaimer:
EPDS are comparable only if they comply with this document, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

This EPD was calculated using manufacturer specific cement data that represents 100% of the total cement used in this mix.

METHODOLOGICAL FRAMEWORK

DECLARED UNIT

The declared unit is 1 cubic meter (1 cubic yard) of ready mixed concrete product. The defined concrete mix is intended for commercial applications developed and produced by Ozinga. Key product variables include:

- Compressive strength - Compressive strengths are represented in the mix design and includes the number of days after pouring as apart of the reference value: e.g. 3,000 psi @ 28 days; 4,000 psi @ 56 days; 6,000 psi @ 90 days; etc.
- Water to cementitious materials ratio (w/cm) – Varies but generally lower for a higher strength non-air entrained mix design (above 5,000 psi (34.5 MPa)) in accordance with ACI 211.1 recommendations
- SCM use – various mix designs call for Portland cement displacement by incorporating fly ash (FA) and/or slag cement (SL)
- Admixtures use – Admixtures use was specified for the mix design that was modeled. Admixtures include air-entraining admixture, water reducing and accelerating admixtures, high range water reducer admixtures, and carbon dioxide.
- No hazardous substances are present in the declared product.
- The ready mixed concrete products represented in this EPD are comprised of :

  BatchWater (ASTM C1602), Natural Fine Aggregate (ASTM C33), Crushed Coarse Aggregate (ASTM C33), Water Reducer (ASTM C494), Portland Limestone Cement (ASTM C595)

SCOPE OF LCA

A summary of life cycle stages included in the EPD is identified in Figure 1 as follows:

- A1: Raw Material Supply (upstream processes): Extraction, handling, and processing of the raw materials used in the production of concrete, cement, supplementary cementitious materials, aggregate (coarse and fine), water, admixtures, and other materials or chemicals used in concrete mixtures.
- A2: Transportation: Transportation of these materials from the supplier to the 'gate' of the concrete producer.
- A3: Manufacturing (core processes): The energy used to store, batch, mix and distribute the concrete and operate the facility (concrete plant).

A summary of activities excluded from the EPD is as follows:

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

CONTINUED ON NEXT PAGE

METHODOLOGICAL FRAMEWORK CONTINUED

CUT-OFF RULES

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty (e.g., portland cement and admixtures) are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.
- Proxy data was used for admixtures used by Ozinga that did not align with any of the admixture categories published in the European Federation of Concrete Admixtures Associations (EFCA) EPDs. In those cases, the Water Reducing Admixture data was selected as a conservative assumption as per the NCF PCR Appendix A.

ALLOCATION

The allocation of co-products or secondary flows cross the system boundary conforms with the ISO 21930: 2017 Section 7.2.4. allocation criteria were applied as follows:

- Allocation was not applied to any of the gate-to-gate production facilities.
- For Secondary Data sources, the NSF PCR default allocation selection (i.e. "Cut-off" or "Alloc Rec") was applied.
- The product category rules for this EPD recognize fly ash, silica fume and slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input.
- A portion (30%) of the reported fleet energy use for truck mixing plants was allocated to the mixing facility.

BUILDING LIFE CYCLE INFORMATION MODULES (X: Included in LCA; MND: Module Not Declared)

Production State			Construction Stage		Use Stage							End-Of-Life Stage			
Extraction Upstream Production	Transport to Facility	Manufacturing	Transport to Site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Sqe	De-Construction /Demolition	Transport to Waste Process, or Disposal	Waste Processing	Disposal of Waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

DATA SOURCES

This EPD is based on foreground LCI data collected from the participating company's production facilities for the calendar year 2020. All upstream material, resource and energy carrier inputs have been sourced from various industry-average datasets and literature. Many of these data sets are defaulted to those specified for use in the NSF PCR 2021. The following Table describes each LCI data source and includes the data quality assessment.

MATERIALS	LCI DATA SOURCE	YEAR	GEOGRAPHY	DATA QUALITY
Portland Cement and Limestone Cement, ASTM C595, AASHTO M 240, or CSA A3001	Holcim - Ste. Genevieve Blended Type IL	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Slag Cement, ASTM C989	Slag Cement Association EPD of North America Slag Cement (2021)	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Fly Ash, ASTM C618	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Silica Fume, ASTM C1240	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Crushed Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, crushed {RoW}| production | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Natural Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, round {RoW}| gravel and sand quarry operation | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Manufactured Lightweight Aggregates, ASTM C330	ecoinvent 3.4: Expanded clay {RoW}| production | Cut-off, U (2018), modified with US average electricity	2000	World/US	Technology: good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Gypsum	ecoinvent 3.5: Gypsum, mineral {RoW}| gypsum quarry operation | Alloc Rec, U	2021	World/US	Technology: good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Admixtures and Carbon Dioxide, ASTM C494	GCP Applied Technologies LCA for Concrete Admixtures ecoinvent 3.5: Carbon dioxide liquid {RoW}| production | Cut-off U	2021	North America	Technology: very good, Time: very good, Geography: fair, Completeness: very good, Reliability: very good
Batch and Wash Water, ASTM C1602	ecoinvent 3.4: Tap water {RoW}| market for | Cut-off, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Road Transport	USLCI 2014: Transport, combination truck, short-haul, diesel powered/tkm/RNA (2014)	2010	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Rail Transport	USLCI 2014: Transport, train, diesel powered / US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Ocean Transport	USLCI 2014: Transport, ocean freighter, average fuel mix/US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Electricity	ecoinvent 3.4: Electricity, low voltage {XX}| market for | Cut-off, U (2018)	2015	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Diesel	USLCI 2014: Diesel, combusted in industrial boiler / US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Gasoline	USLCI 2014: Gasoline, combusted in equipment /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Liquefied Propane Gas	USLCI 2014: Liquefied petroleum gas, combusted in industrial boiler /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Hazardous Solid Waste	ecoinvent 3.4: Hazardous waste, for incineration {RoW}| treatment of hazardous waste, hazardous waste incineration | Alloc, Rec, U (2018), modified with US electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Non-Hazardous Solid Waste	ecoinvent 3.4: Inert waste {RoW}| treatment of, sanitary landfill | Alloc Rec, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good

*The product category rules for this EPD recognize fly ash, silica fume and slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input

CALCULATED RESULTS A1-A3

FACILITY: Jarvis

MIX NAME: 2686M

STRENGTH: 4000 psi @ 28 days

DECLARED UNIT: 1 cubic meter (1 cubic yard) ready mix concrete produced at Ozinga Ready Mix Concrete

CORE MANDATORY IMPACT INDICATOR			PER YD3	PER M3
Global warming potential	GWP	kg C02e	214.08	280.01
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	7.27E-06	9.51E-06
Acidification potential of soil and water sources	AP	kg SO2e	0.62	0.82
Eutrophication potential	EP	kg Ne	0.33	0.44
Formation potential of tropospheric ozone	SFP	kg 03e	12.83	16.78
Abiotic depletion potential for fossil resources	ADPf	MJ, NCV	1376.64	1800.57
Abiotic depletion potential for non-fossil mineral resources	ADPe	kg Sbe	8.88E-05	1.16E-04
Fossil fuel depletion	FFD	MJ Surplus	76.04	99.45
USE OF PRIMARY RESOURCES				
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	21.76	28.47
Renewable primary energy carrier used as material	RPRM	MJ, NCV	0.00	0.00
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	2001.88	2618.36
Non-renewable primary energy carrier used as material	NRPRM	MJ, NCV	0.00	0.00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY				
Secondary material	SM	kg	0.00	0.00
Renewable secondary fuel	RSF	MJ, NCV	0.00	0.00
Non-renewable secondary fuel	NRSF	MJ, NCV	12.19	15.95
Recovered energy	RE	MJ, NCV	0.00	0.00
MANDATORY INVENTORY PARAMETERS				
Consumption of freshwater resources	FW	m3	1.37	1.80
Calcination and carbonation emissions	CCE	kg CO2e	107.17	140.17
INDICATORS DESCRIBING WASTE				
Hazardous waste disposed	HWD	kg	1.26E-05	1.64E-05
Non-hazardous waste disposed	NHWD	kg	0.26	0.33
High-level radioactive waste, conditioned, to final repository	HLRW	m3	9.35E-04	1.22E-03
Intermediate- and low-level radioactive waste, to final repository	ILLRW	m3	2.28E-06	2.99E-06
Components for re-use	CRU	kg	0.00	0.00
Materials for recycling	MR	kg	0.00	0.00
Materials for energy recovery	MER	kg	0.00	0.00
Recovered energy exported from the product system	EE	MJ, NCV	0.00	0.00

REFERENCES

- American Concrete Institute (2009) ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- American Concrete Institute (2008) ACI 318: Building Code Requirements for Structural Concrete.
- ASTM International General Program Instructions (2020) v8.0
- Bare, J. (2012) Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) v2.1.
- European Federation of Concrete Admixture Associations (2015). EFCA Environmental Declarations for Admixtures.
- International Organization for Standardization (2017) ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
- National Renewable Energy Laboratory (2019) U.S. Life Cycle Inventory Database http://www.nrel.gov/lci/
- NSF International (2021) Product Category Rule for Concrete, Version 2.1
- ASTM International (2018) ASTM C94: Standard Specification for Ready-Mixed Concrete.
- Construction Specifications Institute (CSI) MasterFormat Division 03-30-00 Cast-in- Place Concrete
- CSA Group (2014) CSA A23.1-09/A23.2-14 - Concrete materials and methods of concrete construction / Test methods and standard practices for concrete.
- EN 15804:2012 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
- ISO 14040:2006 Environmental Management - Life cycle assessment - Principles and framework
- ISO 14044:2006/AMD 1:2017/ AMD 2:2020 Environmental Management – Life cycle assessment – Requirements and guidelines
- Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., & Weidema, B. (2016) The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, 21, 1218–1230.

READY MIX CONCRETE PRODUCED BY:OZINGA

FACILITY:	Jarvis
STRENGTH:	4000 psi @ 28 days
MIX NAME:	2686M3

IMPACT INDICATOR		PER YD3	PER M3
Global Warming Potential	kg CO_2e	149.26	195.23
Ozone Depletion	kg CFC11e	5.83E-06	7.63E-06
Acidification	kg SO2e	0.53	0.70
Eutrophication	kg NE	0.29	0.37
SFP (Smog)	kg O3e	10.25	13.40
Non-renew. energy	MJ, NCV	1585.48	2073.73

GENERAL INFORMATION	
Declared Product	Ready-mixed concrete produced by Ozinga
Date of Issue	March 20, 2024
Period of Validity	August 13th, 2025
EPD Holder	Ozinga Bros., Inc. 19001 Old LaGrange Road Mokena, IL 60448 www.ozinga.com
Program Operator	ASTM International 100 Bar Harbor Drive West Conshohocken, PA 19428-2959, US/
LCA and EPD Developer	WAP Sustainability Consulting 1701 Market Street Chattanooga, TN 37408 www.wapsustainability.com
Core PCR	ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products
Sub-category PCR	NSF International Product Category Rule (PCR) for Concrete Version 2.2 (December 2022), Verified by Thomas P. Gloria, Ph.D., Industrial Ecology Consultants
Independent LCA Reviewer and EPD Verifier	Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006 ☐ Internal ☒ External Thomas P. Gloria, Ph.D., Industrial Ecology Consultants
For Additional Explanatory Material	Manufacture Representative: Ryan Cialdella (ryancialdella@ozinga.com) Software Tool: Theta by WAP Sustainability Consulting V.1.0.

The declared product meets the following product specifications:

- ACI 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- ACI 318: Building Code Requirements for Structural Concrete.
- ASTM C94 Standard Specification for Ready-Mixed Concrete.
- CSI Masterformat Division 03-30-00: Cast-in-Place Concrete.
- UNSPSC Code 30111500: Ready Mix

Disclaimer:
EPDS are comparable only if they comply with this document, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

This EPD was calculated using manufacturer specific cement data that represents 100% of the total cement used in this mix.

METHODOLOGICAL FRAMEWORK

DECLARED UNIT

The declared unit is 1 cubic meter (1 cubic yard) of ready mixed concrete product. The defined concrete mix is intended for commercial applications developed and produced by Ozinga. Key product variables include:

- Compressive strength - Compressive strengths are represented in the mix design and includes the number of days after pouring as apart of the reference value: e.g. 3,000 psi @ 28 days; 4,000 psi @ 56 days; 6,000 psi @ 90 days; etc.
- Water to cementitious materials ratio (w/cm) – Varies but generally lower for a higher strength non-air entrained mix design
(above 5,000 psi (34.5 MPa)) in accordance with ACI 211.1 recommendations
- SCM use – various mix designs call for Portland cement displacement by incorporating fly ash (FA) and/or slag cement (SL)
- Admixtures use – Admixtures use was specified for the mix design that was modeled. Admixtures include air-entraining admixture, water reducing and accelerating admixtures, high range water reducer admixtures, and carbon dioxide.
- No hazardous substances are present in the declared product.
- The ready mixed concrete products represented in this EPD are comprised of :
BatchWater (ASTM C1602), Crushed Coarse Aggregate (ASTM C33), Natural Fine Aggregate (ASTM C33), Carbon D ioxide (ASTM C494), Water Reducer (ASTM C494), Portland Limestone Cement (ASTM C595), Slag Cement (ASTM

SCOPE OF LCA

A summary of life cycle stages included in the EPD is identified in Figure 1 as follows:

- A1: Raw Material Supply (upstream processes): Extraction, handling, and processing of the raw materials used in the production of concrete, cement, supplementary cementitious materials, aggregate (coarse and fine), water, admixtures, and other materials or chemicals used in concrete mixtures.
- A2: Transportation: Transportation of these materials from the supplier to the 'gate' of the concrete producer.
- A3: Manufacturing (core processes): The energy used to store, batch, mix and distribute the concrete and operate the facility (concrete plant).

A summary of activities excluded from the EPD is as follows:

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

CONTINUED ON NEXT PAGE

METHODOLOGICAL FRAMEWORK CONTINUED

CUT-OFF RULES

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty (e.g., portland cement and admixtures) are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.
- Proxy data was used for admixtures used by Ozinga that did not align with any of the admixture categories published in the European Federation of Concrete Admixtures Associations (EFCA) EPDs. In those cases, the Water Reducing Admixture data was selected as a conservative assumption as per the NCF PCR Appendix A.

ALLOCATION

The allocation of co-products or secondary flows cross the system boundary conforms with the ISO 21930: 2017 Section 7.2.4. allocation criteria were applied as follows:

- Allocation was not applied to any of the gate-to-gate production facilities.
- For Secondary Data sources, the NSF PCR default allocation selection (i.e. "Cut-off" or "Alloc Rec") was applied.
- The product category rules for this EPD recognize fly ash, silica fume and slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input.
- A portion (30%) of the reported fleet energy use for truck mixing plants was allocated to the mixing facility.

BUILDING LIFE CYCLE INFORMATION MODULES (X: Included in LCA; MND: Module Not Declared)

Production State			Construction Stage		Use Stage							End-Of-Life Stage			
Extraction Upstream Production	Transport to Facility	Manufacturing	Transport to Site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Sqe	De-Construction /Demolition	Transport to Waste Process, or Disposal	Waste Processing	Disposal of Waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

DATA SOURCES

This EPD is based on foreground LCI data collected from the participating company's production facilities for the calendar year 2020. All upstream material, resource and energy carrier inputs have been sourced from various industry-average datasets and literature. Many of these data sets are defaulted to those specified for use in the NSF PCR 2021. The following Table describes each LCI data source and includes the data quality assessment.

MATERIALS	LCI DATA SOURCE	YEAR	GEOGRAPHY	DATA QUALITY
Portland Cement and Limestone Cement, ASTM C595, AASHTO M 240, or CSA A3001	Holcim - Ste. Genevieve Blended Type IL	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Slag Cement, ASTM C989	Skyway Cement Company - Slag Cement	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Fly Ash, ASTM C618	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Silica Fume, ASTM C1240	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Crushed Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, crushed {RoW}| production | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Natural Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, round {RoW}| gravel and sand quarry operation | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Manufactured Lightweight Aggregates, ASTM C330	ecoinvent 3.4: Expanded clay {RoW}| production | Cut-off, U (2018), modified with US average electricity	2000	World/US	Technology: good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Gypsum	ecoinvent 3.5: Gypsum, mineral {RoW}| gypsum quarry operation | Alloc Rec, U	2021	World/US	Technology: good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Admixtures and Carbon Dioxide, ASTM C494	GCP Applied Technologies LCA for Concrete Admixtures ecoinvent 3.5: Carbon dioxide liquid {RoW}| production | Cut-off U	2021	North America	Technology: very good, Time: very good, Geography: fair, Completeness: very good, Reliability: very good
Batch and Wash Water, ASTM C1602	ecoinvent 3.4: Tap water {RoW}| market for | Cut-off, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Road Transport	USLCI 2014: Transport, combination truck, short-haul, diesel powered/tkm/RNA (2014)	2010	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Rail Transport	USLCI 2014: Transport, train, diesel powered / US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Ocean Transport	USLCI 2014: Transport, ocean freighter, average fuel mix/US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Electricity	ecoinvent 3.4: Electricity, low voltage {XX}| market for | Cut-off, U (2018)	2015	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Diesel	USLCI 2014: Diesel, combusted in industrial boiler / US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Gasoline	USLCI 2014: Gasoline, combusted in equipment /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Liquefied Propane Gas	USLCI 2014: Liquefied petroleum gas, combusted in industrial boiler /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Hazardous Solid Waste	ecoinvent 3.4: Hazardous waste, for incineration {RoW}| treatment of hazardous waste, hazardous waste incineration | Alloc, Rec, U (2018), modified with US electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Non-Hazardous Solid Waste	ecoinvent 3.4: Inert waste {RoW}| treatment of, sanitary landfill | Alloc Rec, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good

** The product category rules for this EPD recognize fly ash, silica fume and slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input*

CALCULATED RESULTS A1-A3

FACILITY: Jarvis

MIX NAME: 2686M3

STRENGTH: 4000 psi @ 28 days

DECLARED UNIT: 1 cubic meter (1 cubic yard) ready mix concrete produced at Ozinga Ready Mix Concrete

CORE MANDATORY IMPACT INDICATOR			PER YD3	PER M3
Global warming potential	GWP	kg C02e	149.26	195.23
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	5.83E-06	7.63E-06
Acidification potential of soil and water sources	AP	kg SO2e	0.53	0.70
Eutrophication potential	EP	kg Ne	0.29	0.37
Formation potential of tropospheric ozone	SFP	kg 03e	10.25	13.40
Abiotic depletion potential for fossil resources	ADPf	MJ, NCV	1058.38	1384.31
Abiotic depletion potential for non-fossil mineral resources	ADPe	kg Sbe	9.30E-05	1.22E-04
Fossil fuel depletion	FFD	MJ Surplus	75.32	98.52
USE OF PRIMARY RESOURCES				
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	20.67	27.03
Renewable primary energy carrier used as material	RPRM	MJ, NCV	0.00	0.00
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	1585.48	2073.73
Non-renewable primary energy carrier used as material	NRPRM	MJ, NCV	0.00	0.00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY				
Secondary material	SM	kg	0.00	0.00
Renewable secondary fuel	RSF	MJ, NCV	0.00	0.00
Non-renewable secondary fuel	NRSF	MJ, NCV	6.96	9.10
Recovered energy	RE	MJ, NCV	0.00	0.00
MANDATORY INVENTORY PARAMETERS				
Consumption of freshwater resources	FW	m3	1.39	1.82
Calcination and carbonation emissions	CCE	kg CO2e	61.15	79.98
INDICATORS DESCRIBING WASTE				
Hazardous waste disposed	HWD	kg	7.23E-06	9.45E-06
Non-hazardous waste disposed	NHWD	kg	0.26	0.35
High-level radioactive waste, conditioned, to final repository	HLRW	m3	8.88E-04	1.16E-03
Intermediate- and low-level radioactive waste, to final repository	ILLRW	m3	1.46E-06	1.90E-06
Components for re-use	CRU	kg	0.00	0.00
Materials for recycling	MR	kg	0.00	0.00
Materials for energy recovery	MER	kg	0.00	0.00
Recovered energy exported from the product system	EE	MJ, NCV	0.00	0.00

REFERENCES

- American Concrete Institute (2009) ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- American Concrete Institute (2008) ACI 318: Building Code Requirements for Structural Concrete.
- ASTM International General Program Instructions (2020) v8.0
- Bare, J. (2012) Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) v2.1.
- European Federation of Concrete Admixture Associations (2015). EFCA Environmental Declarations for Admixtures.
- International Organization for Standardization (2017) ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
- National Renewable Energy Laboratory (2019) U.S. Life Cycle Inventory Database http://www.nrel.gov/lci/
- NSF International (2021) Product Category Rule for Concrete, Version 2.1
- ASTM International (2018) ASTM C94: Standard Specification for Ready-Mixed Concrete.
- Construction Specifications Institute (CSI) MasterFormat Division 03-30-00 Cast-in- Place Concrete
- CSA Group (2014) CSA A23.1-09/A23.2-14 - Concrete materials and methods of concrete construction / Test methods and standard practices for concrete.
- EN 15804:2012 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
- ISO 14040:2006 Environmental Management - Life cycle assessment - Principles and framework
- ISO 14044:2006/AMD 1:2017/ AMD 2:2020 Environmental Management – Life cycle assessment – Requirements and guidelines
- Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., & Weidema, B. (2016) The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, 21, 1218–1230.

READY MIX CONCRETE PRODUCED BY:OZINGA

FACILITY:	Jarvis
STRENGTH:	4000 psi @ 28 days
MIX NAME:	2686HS4

IMPACT INDICATOR		PER YD3	PER M3
Global Warming Potential	kg CO_2e	120.39	157.47
Ozone Depletion	kg CFC11e	5.29E-06	6.92E-06
Acidification	kg SO2e	0.56	0.73
Eutrophication	kg NE	0.27	0.35
SFP (Smog)	kg O3e	9.91	12.96
Non-renew. energy	MJ, NCV	1451.68	1898.72

GENERAL INFORMATION	
Declared Product	Ready-mixed concrete produced by Ozinga
Date of Issue	March 20, 2024
Period of Validity	August 13th, 2025
EPD Holder	Ozinga Bros., Inc. 19001 Old LaGrange Road Mokena, IL 60448 www.ozinga.com
Program Operator	ASTM International 100 Bar Harbor Drive West Conshohocken, PA 19428-2959, US/
LCA and EPD Developer	WAP Sustainability Consulting 1701 Market Street Chattanooga, TN 37408 www.wapsustainability.com
Core PCR	ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products
Sub-category PCR	NSF International Product Category Rule (PCR) for Concrete Version 2.2 (December 2022), Verified by Thomas P. Gloria, Ph.D., Industrial Ecology Consultants
Independent LCA Reviewer and EPD Verifier	Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006 ☐ Internal ☒ External Thomas P. Gloria, Ph.D., Industrial Ecology Consultants
For Additional Explanatory Material	Manufacture Representative: Ryan Cialdella (ryancialdella@ozinga.com) Software Tool: Theta by WAP Sustainability Consulting V.1.0.

The declared product meets the following product specifications:

- ACI 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- ACI 318: Building Code Requirements for Structural Concrete.
- ASTM C94 Standard Specification for Ready-Mixed Concrete.
- CSI Masterformat Division 03-30-00: Cast-in-Place Concrete.
- UNSPSC Code 30111500: Ready Mix

Disclaimer:
EPDS are comparable only if they comply with this document, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

This EPD was calculated using manufacturer specific cement data that represents 100% of the total cement used in this mix.

METHODOLOGICAL FRAMEWORK

DECLARED UNIT

The declared unit is 1 cubic meter (1 cubic yard) of ready mixed concrete product. The defined concrete mix is intended for commercial applications developed and produced by Ozinga. Key product variables include:

- Compressive strength - Compressive strengths are represented in the mix design and includes the number of days after pouring as apart of the reference value: e.g. 3,000 psi @ 28 days; 4,000 psi @ 56 days; 6,000 psi @ 90 days; etc.
- Water to cementitious materials ratio (w/cm) – Varies but generally lower for a higher strength non-air entrained mix design
(above 5,000 psi (34.5 MPa)) in accordance with ACI 211.1 recommendations
- SCM use – various mix designs call for Portland cement displacement by incorporating fly ash (FA) and/or slag cement (SL)
- Admixtures use – Admixtures use was specified for the mix design that was modeled. Admixtures include air-entraining admixture, water reducing and accelerating admixtures, high range water reducer admixtures, and carbon dioxide.
- No hazardous substances are present in the declared product.
- The ready mixed concrete products represented in this EPD are comprised of :
BatchWater (ASTM C1602), Crushed Coarse Aggregate (ASTM C33), Natural Fine Aggregate (ASTM C33), Accelerati
ng Admixture - Non Chlorides (ASTM C494), Carbon Dioxide (ASTM C494), Water Reducer (ASTM C494), Blended C

SCOPE OF LCA

A summary of life cycle stages included in the EPD is identified in Figure 1 as follows:

- A1: Raw Material Supply (upstream processes): Extraction, handling, and processing of the raw materials used in the production of concrete, cement, supplementary cementitious materials, aggregate (coarse and fine), water, admixtures, and other materials or chemicals used in concrete mixtures.
- A2: Transportation: Transportation of these materials from the supplier to the 'gate' of the concrete producer.
- A3: Manufacturing (core processes): The energy used to store, batch, mix and distribute the concrete and operate the facility (concrete plant).

A summary of activities excluded from the EPD is as follows:

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

CONTINUED ON NEXT PAGE

METHODOLOGICAL FRAMEWORK CONTINUED

CUT-OFF RULES

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty (e.g., portland cement and admixtures) are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.
- Proxy data was used for admixtures used by Ozinga that did not align with any of the admixture categories published in the European Federation of Concrete Admixtures Associations (EFCA) EPDs. In those cases, the Water Reducing Admixture data was selected as a conservative assumption as per the NCF PCR Appendix A.

ALLOCATION

The allocation of co-products or secondary flows cross the system boundary conforms with the ISO 21930: 2017 Section 7.2.4. allocation criteria were applied as follows:

- Allocation was not applied to any of the gate-to-gate production facilities.
- For Secondary Data sources, the NSF PCR default allocation selection (i.e. "Cut-off" or "Alloc Rec") was applied.
- The product category rules for this EPD recognize fly ash, silica fume and slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input.
- A portion (30%) of the reported fleet energy use for truck mixing plants was allocated to the mixing facility.

BUILDING LIFE CYCLE INFORMATION MODULES (X: Included in LCA; MND: Module Not Declared)

Production State			Construction Stage		Use Stage							End-Of-Life Stage			
Extraction Upstream Production	Transport to Facility	Manufacturing	Transport to Site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Sqe	De-Construction /Demolition	Transport to Waste Process, or Disposal	Waste Processing	Disposal of Waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

DATA SOURCES

This EPD is based on foreground LCI data collected from the participating company's production facilities for the calendar year 2020. All upstream material, resource and energy carrier inputs have been sourced from various industry-average datasets and literature. Many of these data sets are defaulted to those specified for use in the NSF PCR 2021. The following Table describes each LCI data source and includes the data quality assessment.

MATERIALS	LCI DATA SOURCE	YEAR	GEOGRAPHY	DATA QUALITY
Portland Cement and Limestone Cement, ASTM C595, AASHTO M 240, or CSA A3001	Holcim - Ste. Genevieve Blended Type IL	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Slag Cement, ASTM C989	Slag Cement Association EPD of North America Slag Cement (2021)	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Fly Ash, ASTM C618	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Silica Fume, ASTM C1240	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Crushed Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, crushed {RoW}| production | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Natural Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, round {RoW}| gravel and sand quarry operation | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Manufactured Lightweight Aggregates, ASTM C330	ecoinvent 3.4: Expanded clay {RoW}| production | Cut-off, U (2018), modified with US average electricity	2000	World/US	Technology: good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Gypsum	ecoinvent 3.5: Gypsum, mineral {RoW}| gypsum quarry operation | Alloc Rec, U	2021	World/US	Technology: good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Admixtures and Carbon Dioxide, ASTM C494	GCP Applied Technologies LCA for Concrete Admixtures ecoinvent 3.5: Carbon dioxide liquid {RoW}| production | Cut-off U	2021	North America	Technology: very good, Time: very good, Geography: fair, Completeness: very good, Reliability: very good
Batch and Wash Water, ASTM C1602	ecoinvent 3.4: Tap water {RoW}| market for | Cut-off, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Road Transport	USLCI 2014: Transport, combination truck, short-haul, diesel powered/tkm/RNA (2014)	2010	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Rail Transport	USLCI 2014: Transport, train, diesel powered / US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Ocean Transport	USLCI 2014: Transport, ocean freighter, average fuel mix/US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Electricity	ecoinvent 3.4: Electricity, low voltage {XX}| market for | Cut-off, U (2018)	2015	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Diesel	USLCI 2014: Diesel, combusted in industrial boiler / US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Gasoline	USLCI 2014: Gasoline, combusted in equipment /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Liquefied Propane Gas	USLCI 2014: Liquefied petroleum gas, combusted in industrial boiler /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Hazardous Solid Waste	ecoinvent 3.4: Hazardous waste, for incineration {RoW}| treatment of hazardous waste, hazardous waste incineration | Alloc, Rec, U (2018), modified with US electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Non-Hazardous Solid Waste	ecoinvent 3.4: Inert waste {RoW}| treatment of, sanitary landfill | Alloc Rec, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good

** The product category rules for this EPD recognize fly ash, silica fume and slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input*

CALCULATED RESULTS A1-A3

FACILITY: Jarvis

MIX NAME: 2686HS4

STRENGTH: 4000 psi @ 28 days

DECLARED UNIT: 1 cubic meter (1 cubic yard) ready mix concrete produced at Ozinga Ready Mix Concrete

CORE MANDATORY IMPACT INDICATOR			PER YD3	PER M3
Global warming potential	GWP	kg C02e	120.39	157.47
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	5.29E-06	6.92E-06
Acidification potential of soil and water sources	AP	kg SO2e	0.56	0.73
Eutrophication potential	EP	kg Ne	0.27	0.35
Formation potential of tropospheric ozone	SFP	kg 03e	9.91	12.96
Abiotic depletion potential for fossil resources	ADPf	MJ, NCV	949.02	1241.27
Abiotic depletion potential for non-fossil mineral resources	ADPe	kg Sbe	1.45E-04	1.90E-04
Fossil fuel depletion	FFD	MJ Surplus	75.17	98.32
USE OF PRIMARY RESOURCES				
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	45.82	59.93
Renewable primary energy carrier used as material	RPRM	MJ, NCV	0.00	0.00
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	1451.68	1898.72
Non-renewable primary energy carrier used as material	NRPRM	MJ, NCV	0.00	0.00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY				
Secondary material	SM	kg	0.00	0.00
Renewable secondary fuel	RSF	MJ, NCV	0.00	0.00
Non-renewable secondary fuel	NRSF	MJ, NCV	5.65	7.39
Recovered energy	RE	MJ, NCV	0.00	0.00
MANDATORY INVENTORY PARAMETERS				
Consumption of freshwater resources	FW	m3	1.37	1.79
Calcination and carbonation emissions	CCE	kg CO2e	31.43	41.11
INDICATORS DESCRIBING WASTE				
Hazardous waste disposed	HWD	kg	1.39E-03	1.82E-03
Non-hazardous waste disposed	NHWD	kg	0.81	1.06
High-level radioactive waste, conditioned, to final repository	HLRW	m3	2.87E-03	3.75E-03
Intermediate- and low-level radioactive waste, to final repository	ILLRW	m3	1.49E-06	1.95E-06
Components for re-use	CRU	kg	0.00	0.00
Materials for recycling	MR	kg	0.00	0.00
Materials for energy recovery	MER	kg	0.00	0.00
Recovered energy exported from the product system	EE	MJ, NCV	0.00	0.00

REFERENCES

- American Concrete Institute (2009) ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- American Concrete Institute (2008) ACI 318: Building Code Requirements for Structural Concrete.
- ASTM International General Program Instructions (2020) v8.0
- Bare, J. (2012) Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) v2.1.
- European Federation of Concrete Admixture Associations (2015). EFCA Environmental Declarations for Admixtures.
- International Organization for Standardization (2017) ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
- National Renewable Energy Laboratory (2019) U.S. Life Cycle Inventory Database http://www.nrel.gov/lci/
- NSF International (2021) Product Category Rule for Concrete, Version 2.1
- ASTM International (2018) ASTM C94: Standard Specification for Ready-Mixed Concrete.
- Construction Specifications Institute (CSI) MasterFormat Division 03-30-00 Cast-in- Place Concrete
- CSA Group (2014) CSA A23.1-09/A23.2-14 - Concrete materials and methods of concrete construction / Test methods and standard practices for concrete.
- EN 15804:2012 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
- ISO 14040:2006 Environmental Management - Life cycle assessment - Principles and framework
- ISO 14044:2006/AMD 1:2017/ AMD 2:2020 Environmental Management – Life cycle assessment – Requirements and guidelines
- Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., & Weidema, B. (2016) The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, 21, 1218–1230.

READY MIX CONCRETE PRODUCED BY:OZINGA

FACILITY:	Jarvis
STRENGTH:	4000 psi @ 28 days
MIX NAME:	5099M

IMPACT INDICATOR		PER YD3	PER M3
Global Warming Potential	kg CO_2e	92.41	120.86
Ozone Depletion	kg CFC11e	5.27E-06	6.89E-06
Acidification	kg SO2e	0.56	0.73
Eutrophication	kg NE	0.24	0.31
SFP (Smog)	kg O3e	9.27	12.12
Non-renew. energy	MJ, NCV	1308.55	1711.52

GENERAL INFORMATION

Declared Product	Ready-mixed concrete produced by Ozinga
Date of Issue	March 21, 2024
Period of Validity	August 13th, 2025
EPD Holder	Ozinga Bros., Inc. 19001 Old LaGrange Road Mokena, IL 60448 www.ozinga.com
Program Operator	ASTM International 100 Bar Harbor Drive West Conshohocken, PA 19428-2959, US/
LCA and EPD Developer	WAP Sustainability Consulting 1701 Market Street Chattanooga, TN 37408 www.wapsustainability.com
Core PCR	ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products
Sub-category PCR	NSF International Product Category Rule (PCR) for Concrete Version 2.2 (December 2022), Verified by Thomas P. Gloria, Ph.D., Industrial Ecology Consultants
Independent LCA Reviewer and EPD Verifier	Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006 ☐ Internal ☒ External Thomas P. Gloria, Ph.D., Industrial Ecology Consultants
For Additional Explanatory Material	Manufacture Representative: Ryan Cialdella (ryancialdella@ozinga.com) Software Tool: Theta by WAP Sustainability Consulting V.1.0.

The declared product meets the following product specifications:

- ACI 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- ACI 318: Building Code Requirements for Structural Concrete.
- ASTM C94 Standard Specification for Ready-Mixed Concrete.
- CSI Masterformat Division 03-30-00: Cast-in-Place Concrete.
- UNSPSC Code 30111500: Ready Mix

Disclaimer:
EPDS are comparable only if they comply with this document, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

This EPD was calculated using industry average cement data. Cement LCA impacts can vary depending upon manufacturing process, efficiency and fuel source by as much as 50% for some environmental impact categories. Cement accounts for as much as 90% of the impacts of the concrete mixes included in this EPD and thus manufacturer specific cement impacts could result in variation of as much as 45%.

METHODOLOGICAL FRAMEWORK

DECLARED UNIT

The declared unit is 1 cubic meter (1 cubic yard) of ready mixed concrete product. The defined concrete mix is intended for commercial applications developed and produced by Ozinga. Key product variables include:

- Compressive strength - Compressive strengths are represented in the mix design and includes the number of days after pouring as apart of the reference value: e.g. 3,000 psi @ 28 days; 4,000 psi @ 56 days; 6,000 psi @ 90 days; etc.
- Water to cementitious materials ratio (w/cm) – Varies but generally lower for a higher strength non-air entrained mix design
(above 5,000 psi (34.5 MPa)) in accordance with ACI 211.1 recommendations
- SCM use – various mix designs call for Portland cement displacement by incorporating fly ash (FA) and/or slag cement (SL)
- Admixtures use – Admixtures use was specified for the mix design that was modeled. Admixtures include air-entraining admixture, water reducing and accelerating admixtures, high range water reducer admixtures, and carbon dioxide.
- No hazardous substances are present in the declared product.
- The ready mixed concrete products represented in this EPD are comprised of :

  BatchWater (ASTM C1602), Crushed Coarse Aggregate (ASTM C33), Natural Fine Aggregate (ASTM C33), Water Re ducer - High Range (ASTM C494), Carbon Dioxide (ASTM C494), Accelerating Admixture - Non Chlorides (ASTM C4

SCOPE OF LCA

A summary of life cycle stages included in the EPD is identified in Figure 1 as follows:

- A1: Raw Material Supply (upstream processes): Extraction, handling, and processing of the raw materials used in the production of concrete, cement, supplementary cementitious materials, aggregate (coarse and fine), water, admixtures, and other materials or chemicals used in concrete mixtures.
- A2: Transportation: Transportation of these materials from the supplier to the 'gate' of the concrete producer.
- A3: Manufacturing (core processes): The energy used to store, batch, mix and distribute the concrete and operate the facility (concrete plant).

A summary of activities excluded from the EPD is as follows:

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

CONTINUED ON NEXT PAGE

METHODOLOGICAL FRAMEWORK CONTINUED

CUT-OFF RULES

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty (e.g., portland cement and admixtures) are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.
- Proxy data was used for admixtures used by Ozinga that did not align with any of the admixture categories published in the European Federation of Concrete Admixtures Associations (EFCA) EPDs. In those cases, the Water Reducing Admixture data was selected as a conservative assumption as per the NCF PCR Appendix A.

ALLOCATION

The allocation of co-products or secondary flows cross the system boundary conforms with the ISO 21930: 2017 Section 7.2.4. allocation criteria were applied as follows:

- Allocation was not applied to any of the gate-to-gate production facilities.
- For Secondary Data sources, the NSF PCR default allocation selection (i.e. "Cut-off" or "Alloc Rec") was applied.
- The product category rules for this EPD recognize fly ash, silica fume and slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input.
- A portion (30%) of the reported fleet energy use for truck mixing plants was allocated to the mixing facility.

BUILDING LIFE CYCLE INFORMATION MODULES (X: Included in LCA; MND: Module Not Declared)

Production State			Construction Stage		Use Stage							End-Of-Life Stage			
Extraction Upstream Production	Transport to Facility	Manufacturing	Transport to Site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Sqc	De-Construction /Demolition	Transport to Waste Process, or Disposal	Waste Processing	Disposal of Waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

DATA SOURCES

This EPD is based on foreground LCI data collected from the participating company's production facilities for the calendar year 2020. All upstream material, resource and energy carrier inputs have been sourced from various industry-average datasets and literature. Many of these data sets are defaulted to those specified for use in the NSF PCR 2021. The following Table describes each LCI data source and includes the data quality assessment.

MATERIALS	LCI DATA SOURCE	YEAR	GEOGRAPHY	DATA QUALITY
Portland Cement and Limestone Cement, ASTM C595, AASHTO M 240, or CSA A3001	Portland Cement Association EPD of Portland C ement and Portland Limestone Cement (2021)	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Slag Cement, ASTM C989	Slag Cement Association EPD of North America Slag Cement (2021)	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Fly Ash, ASTM C618	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Silica Fume, ASTM C1240	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Crushed Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, crushed {RoW}| production | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Natural Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, round {RoW}| gravel and sand quarry operation | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Manufactured Lightweight Aggregates, ASTM C330	ecoinvent 3.4: Expanded clay {RoW}| production | Cut-off, U (2018), modified with US average electricity	2000	World/US	Technology: good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Gypsum	ecoinvent 3.5: Gypsum, mineral {RoW}| gypsum quarry operation | Alloc Rec, U	2021	World/US	Technology: good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Admixtures and Carbon Dioxide, ASTM C494	GCP Applied Technologies LCA for Concrete Admixtures ecoinvent 3.5: Carbon dioxide liquid {RoW}| production | Cut-off U	2021	North America	Technology: very good, Time: very good, Geography: fair, Completeness: very good, Reliability: very good
Batch and Wash Water, ASTM C1602	ecoinvent 3.4: Tap water {RoW}| market for | Cut-off, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Road Transport	USLCI 2014: Transport, combination truck, short-haul, diesel powered/tkm/RNA (2014)	2010	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Rail Transport	USLCI 2014: Transport, train, diesel powered / US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Ocean Transport	USLCI 2014: Transport, ocean freighter, average fuel mix/US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Electricity	ecoinvent 3.4: Electricity, low voltage {XX}| market for | Cut-off, U (2018)	2015	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Diesel	USLCI 2014: Diesel, combusted in industrial boiler / US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Gasoline	USLCI 2014: Gasoline, combusted in equipment /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Liquefied Propane Gas	USLCI 2014: Liquefied petroleum gas, combusted in industrial boiler /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Hazardous Solid Waste	ecoinvent 3.4: Hazardous waste, for incineration {RoW}| treatment of hazardous waste, hazardous waste incineration | Alloc, Rec, U (2018), modified with US electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Non-Hazardous Solid Waste	ecoinvent 3.4: Inert waste {RoW}| treatment of, sanitary landfill | Alloc Rec, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good

*The product category rules for this EPD recognize fly ash, silica fume and slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input.

CALCULATED RESULTS A1-A3

FACILITY: Jarvis

MIX NAME: 5099M

STRENGTH: 4000 psi @ 28 days

DECLARED UNIT: 1 cubic meter (1 cubic yard) ready mix concrete produced at Ozinga Ready Mix Concrete

CORE MANDATORY IMPACT INDICATOR			PER YD3	PER M3
Global warming potential	GWP	kg C02e	92.41	120.86
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	5.27E-06	6.89E-06
Acidification potential of soil and water sources	AP	kg SO2e	0.56	0.73
Eutrophication potential	EP	kg Ne	0.24	0.31
Formation potential of tropospheric ozone	SFP	kg 03e	9.27	12.12
Abiotic depletion potential for fossil resources	ADPf	MJ, NCV	742.03	970.54
Abiotic depletion potential for non-fossil mineral resources	ADPe	kg Sbe	2.98	3.89
Fossil fuel depletion	FFD	MJ Surplus	73.60	96.27
USE OF PRIMARY RESOURCES				
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	43.72	57.19
Renewable primary energy carrier used as material	RPRM	MJ, NCV	0.00	0.00
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	1308.55	1711.52
Non-renewable primary energy carrier used as material	NRPRM	MJ, NCV	0.00	0.00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY				
Secondary material	SM	kg	0.00	0.00
Renewable secondary fuel	RSF	MJ, NCV	0.00	0.00
Non-renewable secondary fuel	NRSF	MJ, NCV	4.08	5.34
Recovered energy	RE	MJ, NCV	0.00	0.00
MANDATORY INVENTORY PARAMETERS				
Consumption of freshwater resources	FW	m3	1.31	1.71
Calcination and carbonation emissions	CCE	kg CO2e	7.08	9.26
INDICATORS DESCRIBING WASTE				
Hazardous waste disposed	HWD	kg	6.69E-03	8.75E-03
Non-hazardous waste disposed	NHWD	kg	0.52	0.68
High-level radioactive waste, conditioned, to final repository	HLRW	m3	1.73E-03	2.27E-03
Intermediate- and low-level radioactive waste, to final repository	ILLRW	m3	1.38E-06	1.80E-06
Components for re-use	CRU	kg	0.00	0.00
Materials for recycling	MR	kg	0.00	0.00
Materials for energy recovery	MER	kg	0.00	0.00
Recovered energy exported from the product system	EE	MJ, NCV	0.00	0.00

REFERENCES

- American Concrete Institute (2009) ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- American Concrete Institute (2008) ACI 318: Building Code Requirements for Structural Concrete.
- ASTM International General Program Instructions (2020) v8.0
- Bare, J. (2012) Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) v2.1.
- European Federation of Concrete Admixture Associations (2015). EFCA Environmental Declarations for Admixtures.
- International Organization for Standardization (2017) ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
- National Renewable Energy Laboratory (2019) U.S. Life Cycle Inventory Database http://www.nrel.gov/lci/
- NSF International (2021) Product Category Rule for Concrete, Version 2.1
- ASTM International (2018) ASTM C94: Standard Specification for Ready-Mixed Concrete.
- Construction Specifications Institute (CSI) MasterFormat Division 03-30-00 Cast-in- Place Concrete
- CSA Group (2014) CSA A23.1-09/A23.2-14 - Concrete materials and methods of concrete construction / Test methods and standard practices for concrete.
- EN 15804:2012 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
- ISO 14040:2006 Environmental Management - Life cycle assessment - Principles and framework
- ISO 14044:2006/AMD 1:2017/ AMD 2:2020 Environmental Management – Life cycle assessment – Requirements and guidelines
- Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., & Weidema, B. (2016) The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, 21, 1218–1230.

APPENDIX B. RAW MATERIAL CHARACTERIZATION

Density, Relative Density, and Absorption Worksheet

ASTM C128 Density, Relative Density, and Absorption of Fine Aggregate

Project Number: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 6/23/2024

Checked by: K. Pattaje **Date:** 10/2/2024

Oven:
- ☐ SN# 004N0079
- ☐ SN# 804N0020
- ☐ East Thermotron 7466C
- ☑ Hot Plate

Balance:
- ☐ B543618517
- ☐ 1121330641
- ☐ AE826228
- ☑ #2214

Pycnometer:
- ☐ Pyrex 500ML A
- ☑ Pyrex 500ML B
- ☐ ______

Mold:
- ☑ WJE 1301 A
- ☐ ______

Tamper:
- ☑ WJE 1301 B
- ☐ ______

Aggregate starting condtion:
- ☑ Oven dried
- ☐ Not oven dried

Sample ID	Oven Dry Weight (g)	Pycnometer Weight and Water (g)	Pycnometer, Sample, and Water (g)	Weight of SSD Sample (g)	Relative Density, Oven Dry	Relative Density, SSD	Relative Density, Apparent	Absorption (%)
Meyer McHenry Sand	496.4	685.6	998.9	500	2.66	2.68	2.71	0.7

Calculations Based on the Gravimetric Procedure

Density, Relative Density, and Absorption Worksheet

ASTM C127 Density, Relative Density, and Absorption of Coarse Aggregate

Project Number: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 6/23/2024
Checked by: K. Pattaje **Date:** 10/2/2024

Balance:
- ☐ SN# B543618517
- ☒ SN# 1121330641
- ☐ SN# AE826228
- ☐ ____________

Oven:
- ☐ SN# 004N0079
- ☐ SN# 804N0020
- ☐ East Thermotron 7466C
- ☒ Hot Plate

Sieve:
- ☐ #4 10408819
- ☐ #8 10418854
- ☐ #16 11467169
- ☐ ____________

Aggregate starting condtion:
- ☒ Oven dried
- ☐ Not oven dried

Sample ID	Oven Dry Weight (g)	SSD Weight (g)	Submerged Weight (g)	Relative Density, Oven Dry	Relative Density, SSD	Relative Density, Apparent	Absorption, %
#67 Vulcan McCook	7624.3	7743.5	4914.8	2.70	2.74	2.81	1.6
#4 LaFarge Conco	14257.7	14508.4	9131.6	2.65	2.70	2.78	1.8

ASTM C117 Test Methods for Materials Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing and ASTM C136 Sieve Analysis of Fine and Coarse Aggregates

WJE Project No.: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 6/23/2024

Checked by: K. Pattaje **Date:** 10/2/2024

Balance:
- ☐ B543618517
- ☐ 1121330641
- ☒ #2214

Oven:
- ☐ 004N0079
- ☐ 804N0020
- ☒ Hot Plate

Condition:
- ☐ Wet
- ☒ Dry
- ☐ As Received

Shaker:
- ☒ #8852
- ☐ By Hand

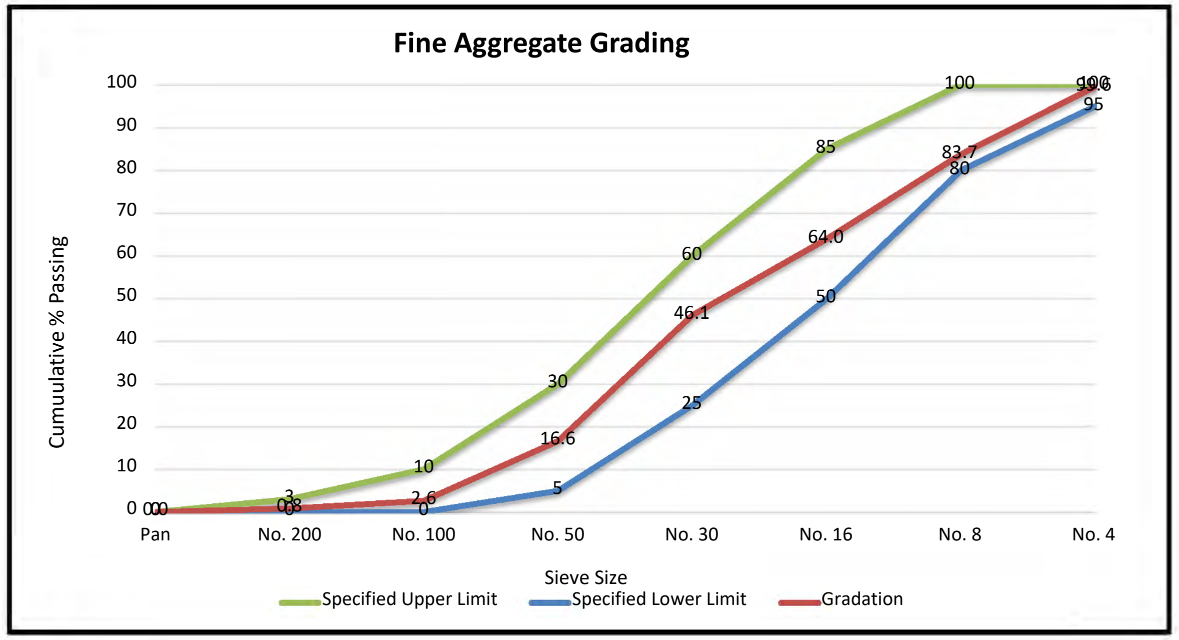
ASTM C117 Procedure:
- ☒ A - Plain Water
- ☐ B - Wetting Agent
- ☐ N/A - Not performed

Original Weight (g):	877.6	**% Lost by Sieving:**	0.0	**Sample ID:**	Meyer McHenry Sand
Dry Weight After Washing (g):	872.1	**% Finer than No. 200 by Washing:**	0.6	**Specification:**	ASTM C33 Fine Aggregate

Sieve Size	Sieve Serial Number	Individual Weight Retained (g)	Individual Percent Retained	Cumulative Percent Retained	Cumulative Percent Passing
No. 4	8730	3.6	0	0	99.6
No. 8	8731	139.3	16	16	83.7
No. 16	8732	173.2	20	36	64.0
No. 30	8733	157.0	18	54	46.1
No. 50	8734	258.5	29	83	16.6
No. 100	8735	122.8	14	97	2.6
No. 200	8736	15.8	1.8	99	0.8
Pan	-	1.9	0.2	100*	#NUM!
Wash	-	5.5	0.6		
TOTAL		877.6	99		

* Includes material removed by washing.

Fineness Modulus: **2.87**



Comments:

ASTM C136 Sieve Analysis of Fine and Coarse Aggregates

WJE Project No:	2024.1541	**Project Coordinator:**	T. Nelson
Operator:	M. Haddad	**Date:**	6/23/2024
Checked by:	K. Pattaje	**Date:**	10/2/2024

Balance:
- ☐ B543618517
- ☐ 1121330641
- ☒ #2214

Oven:
- ☐ 004N0079
- ☐ 804N0020
- ☒ Hot Plate

Condition:
- ☐ Wet
- ☒ Dry
- ☐ As Received

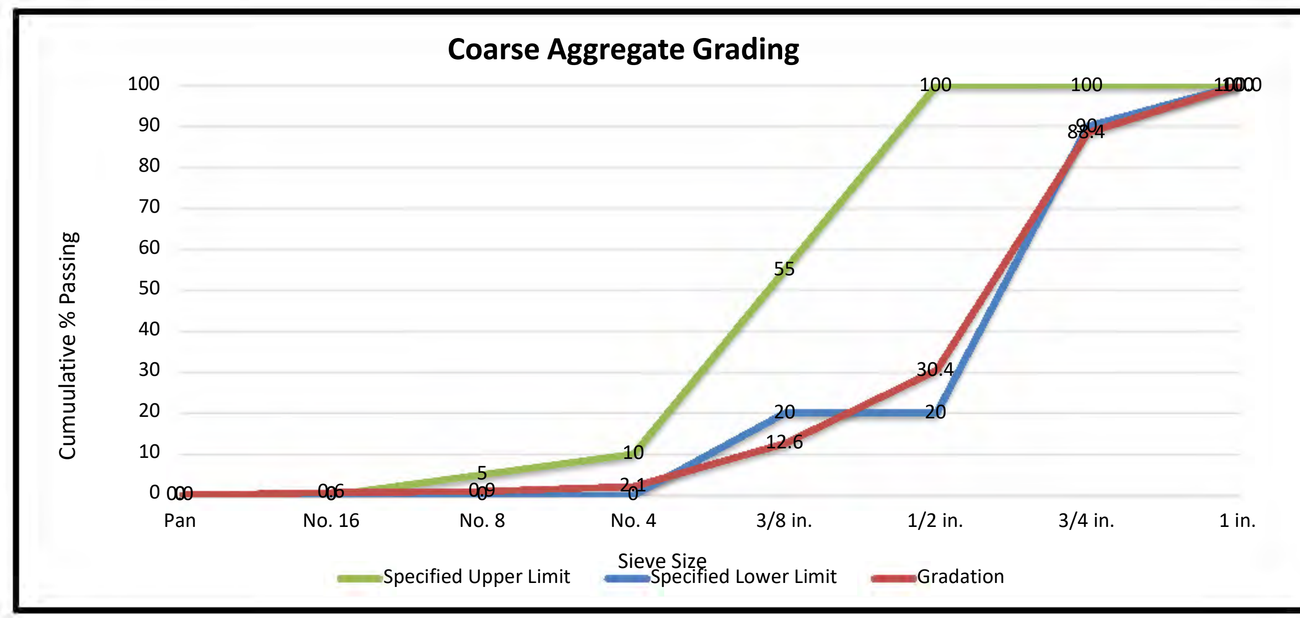
Shaker:
- ☐ #8852
- ☐ By Hand

Original Weight (g): 6636.2 **% Lost:** 0.0%

Sample ID: #67 Vulcan McCook

Specification: ASTM C33 Coarse Aggregate 67

Sieve Size	Sieve Serial Number	Individual Weight Retained (g)	Individual Percent Retained	Cumulative Percent Retained	Cumulative Percent Passing
1 in.	8726	0.0	0	0	100
3/4 in.	8727	767.2	12	12	88
1/2 in.	8728	3850.3	58	70	30
3/8 in.	8729	1183.6	18	87	13
No. 4	8730	696.4	10	98	2
No. 8	8731	80.0	1	99	1
No. 16	8732	21.0	0	99	1
Pan and Wash	-	37.4	0.6	100	0.0
TOTAL		6635.9	100.00		



Comments:

ASTM C136 Sieve Analysis of Fine and Coarse Aggregates

WJE Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 6/23/2024

Checked by: K. Pattaje **Date:** 10/2/2024

Balance:
- ☐ B543618517
- ☐ 1121330641
- ☒ #2214

Oven:
- ☐ 004N0079
- ☐ 804N0020
- ☒ Hot Plate

Condition:
- ☐ Wet
- ☒ Dry
- ☐ As Received

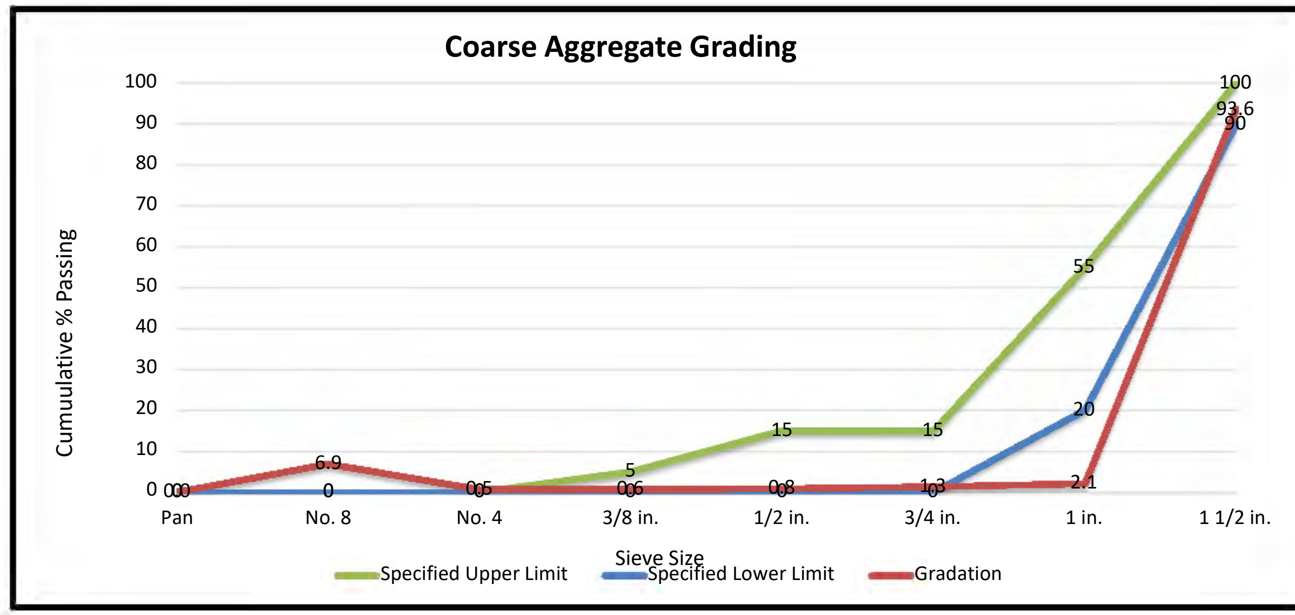
Shaker:
- ☒ #8852
- ☐ By Hand

Original Weight (g): 14135 **% Lost:** 0.0%

Sample ID: #4 LaFarge Conco

Specification: ASTM C33 Coarse Aggregate 4

Sieve Size	Sieve Serial Number	Individual Weight Retained (g)	Individual Percent Retained	Cumulative Percent Retained	Cumulative Percent Passing
1 1/2 in.	N/A	904.7	6	6	94
1 in.	8726	12935.0	92	98	2
3/4 in.	8727	116.7	1	99	1
1/2 in.	8728	62.8	0	99	1
3/8 in.	8729	24.4	0	99	1
No. 4	8730	13.8	0	99	1
No. 8	8731	12.0	0	93	7
Pan and Wash	-	65.6	0.5	100	0.0
TOTAL		14135.0	100.00		



Comments:

APPENDIX C. LAB TESTING - PLASTIC CONCRETE PROPERTIES

ASTM C403-23 - Setting Time of Concrete by Penetration Resistance

Project Number: 2024.1541 **Lab Coordinator:** T. Nelson **Project Manager:** T. Van Dam

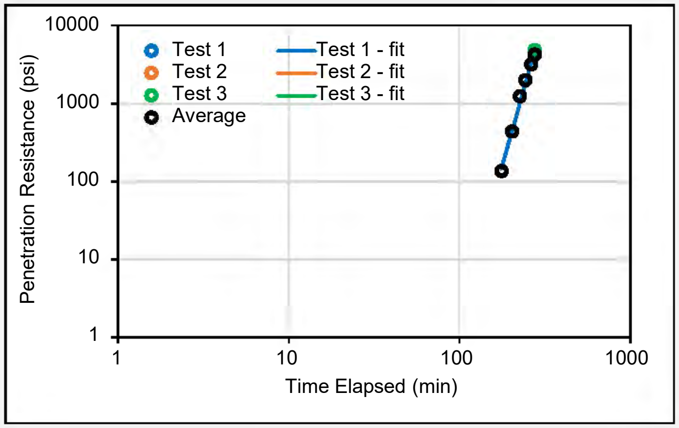
Operator: M. Haddad **Initials:** MH **Date:** 6/25/2024
Checked by: T.Neslon **Initials:** TDN **Date:** 6/25/2024

Mix ID: 1-2

Time Batched: 6/25/2024 16:03

	Test 1	Test 2	Test 3
Mortar Temp. after Sieving (°F):	75.2		
Ambient Temp. at Start of Test (°F):	73.6		
Ambient Temp. at End of Test (°F):			

Time of Reading	Time Elapsed (min)	Penetration Resistance (psi)			
		Test 1	Test 2	Test 3	Average
6/25/24 16:03	0				
6/25/24 19:00	177	136			136
6/25/24 19:28	205	440			440
6/25/24 19:50	227	1240			1240
6/25/24 20:07	244	2000			2000
6/25/24 20:27	264	3200			3200
6/25/24 20:40	277	4240			4240
Time of Initial Set (h:mm):		3:27			**3:25**
Time of Final Set (h:mm):		4:30			**4:30**



Comments:

ASTM C403-23 - Setting Time of Concrete by Penetration Resistance

Project Number: 2024.1541 **Lab Coordinator:** T. Nelson **Project Manager:** T. Van Dam

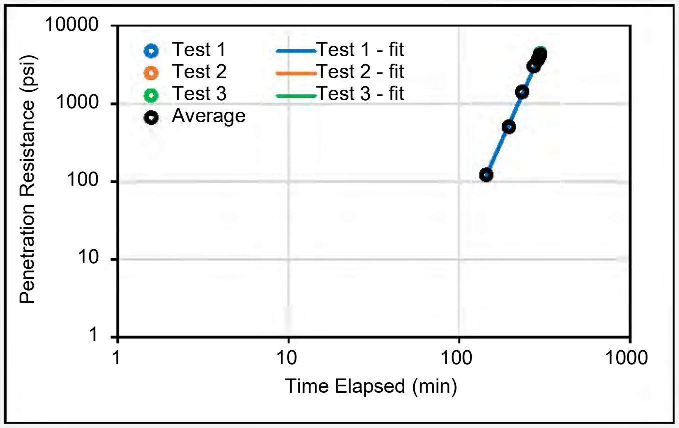
Operator: M. Haddad **Initials:** MH **Date:** 6/26/2024
Checked by: T.Nelson **Initials:** TDN **Date:** 6/27/2024

Mix ID: 2-2

Time Batched: 6/26/2024 9:45

	Test 1	Test 2	Test 3
Mortar Temp. after Sieving (°F):	74.8		
Ambient Temp. at Start of Test (°F):	72.3		
Ambient Temp. at End of Test (°F):	72.6		

Time of Reading	Time Elapsed (min)	Penetration Resistance (psi)			
		Test 1	Test 2	Test 3	Average
6/26/24 9:45	0				
6/26/24 12:10	145	122			122
6/26/24 13:02	197	504			504
6/26/24 13:40	235	1400			1400
6/26/24 14:20	275	3000			3000
6/26/24 14:35	290	3680			3680
6/26/24 14:45	300	4240			4240
Time of Initial Set (h:mm):		3:13			**3:15**
Time of Final Set (h:mm):		4:54			**4:55**



Comments:

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C403-23 - Setting Time of Concrete by Penetration Resistance

Project Number: 2024.1541 **Lab Coordinator:** T. Nelson **Project Manager:** T. Van Dam

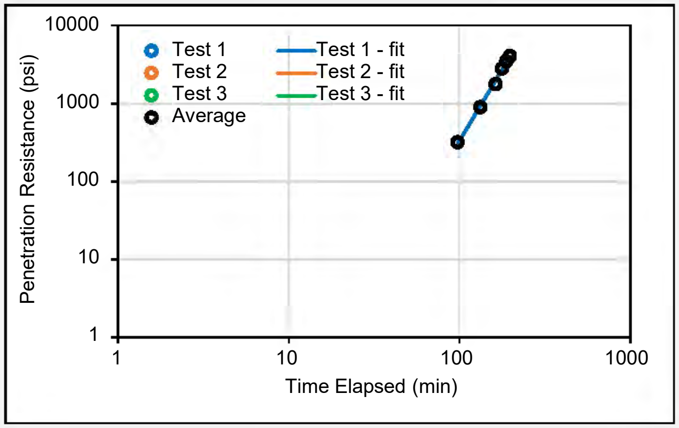
Operator: M. Haddad **Initials:** MH **Date:** 6/27/2024
Checked by: T.Nelson **Initials:** TDN **Date:** 6/27/2024

Mix ID: 3-2

Time Batched: 6/27/2024 10:02

	Test 1	Test 2	Test 3
Mortar Temp. after Sieving (°F):	74.8		
Ambient Temp. at Start of Test (°F):	73.4		
Ambient Temp. at End of Test (°F):	72.9		

Time of Reading	Time Elapsed (min)	Penetration Resistance (psi)			
		Test 1	Test 2	Test 3	Average
6/27/24 10:02	0				
6/27/24 11:40	98	320			320
6/27/24 12:15	133	900			900
6/27/24 12:45	163	1760			1760
6/27/24 13:00	178	2800			2800
6/27/24 13:10	188	3440			3440
6/27/24 13:20	198	4080			4080
Time of Initial Set (h:mm):		1:52			**1:50**
Time of Final Set (h:mm):		3:18			**3:20**



Comments:

ASTM C403-23 - Setting Time of Concrete by Penetration Resistance

Project Number: 2024.1541 **Lab Coordinator:** T. Nelson **Project Manager:** T. Van Dam

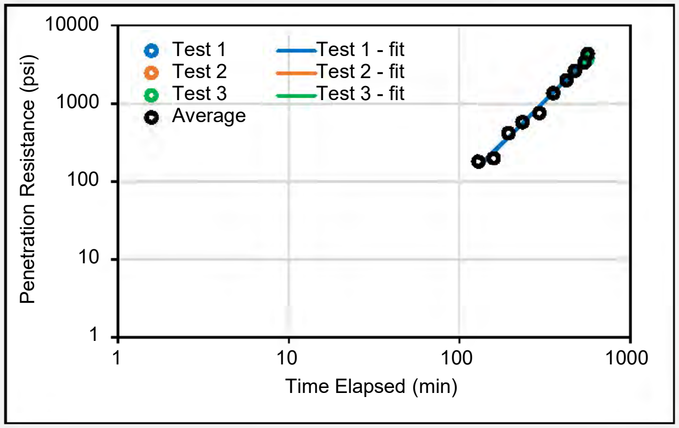
Operator: M. Haddad **Initials:** MH **Date:** 6/28/2024
Checked by: T.Nelson **Initials:** TDN **Date:** 6/29/2024

Mix ID: 4-2

Time Batched: 6/28/2024 10:36

	Test 1	Test 2	Test 3
Mortar Temp. after Sieving (°F):	76.1		
Ambient Temp. at Start of Test (°F):	73.7		
Ambient Temp. at End of Test (°F):	73.2		

Time of Reading	Time Elapsed (min)	Penetration Resistance (psi)			
		Test 1	Test 2	Test 3	Average
6/28/24 10:36	0				
6/28/24 12:45	129	180			180
6/28/24 13:15	159	200			200
6/28/24 13:50	194	420			420
6/28/24 14:30	234	580			580
6/28/24 15:30	294	760			760
6/28/24 16:30	354	1360			1360
6/28/24 17:40	424	2000			2000
6/28/24 18:30	474	2640			2640
6/28/24 19:35	539	3360			3360
6/28/24 20:00	564	4320			4320
Time of Initial Set (h:mm):		3:42			**3:40**
Time of Final Set (h:mm):		9:38			**9:40**



Comments:

ASTM C232-21 Bleeding of Concrete

Project Number: 2024.1541 **Lab Coordinator:** Todd Nelson **Project Manager:** Todd Nelson

Operator:	Rob Bee	**Initials:**	RFB	**Date:**	6/25/2024
Checked by:	Todd Nelson	**Initials:**	TDN	**Date:**	6/26/2024

Mix ID & Batch No.: Mix 1

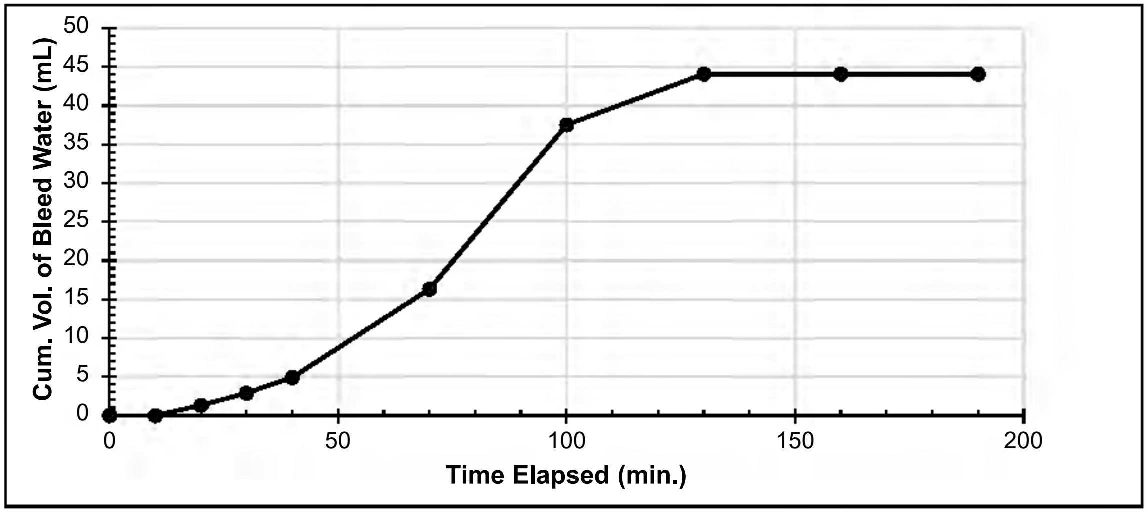
☐ Wet-sieved

Date Batched: 6/25/2024

Time Batched: 3:45 PM

Scales Used:
- ☒ Asset No. 2214
- ☐ Asset No. 2215
- ☐ Asset No. 2866
- ☐ Asset No. 5089
- ☐ Other:

Sample	Total Accumulated Bleed Water (%)	Time Req. for Cessation of Bleeding (min.)
Mix 1	2.2	130



Comments:

ASTM C232-21 Bleeding of Concrete

Project Number: 2024.1541.0 **Lab Coordinator:** Todd Nelson **Project Manager:** Tom Van Dam

Operator: Andrew Witte **Initials:** ACW **Date:** 6/26/2024
Checked by: T.Nelson **Initials:** TDN **Date:** 6/27/2024

Mix ID & Batch No.: Mix 2

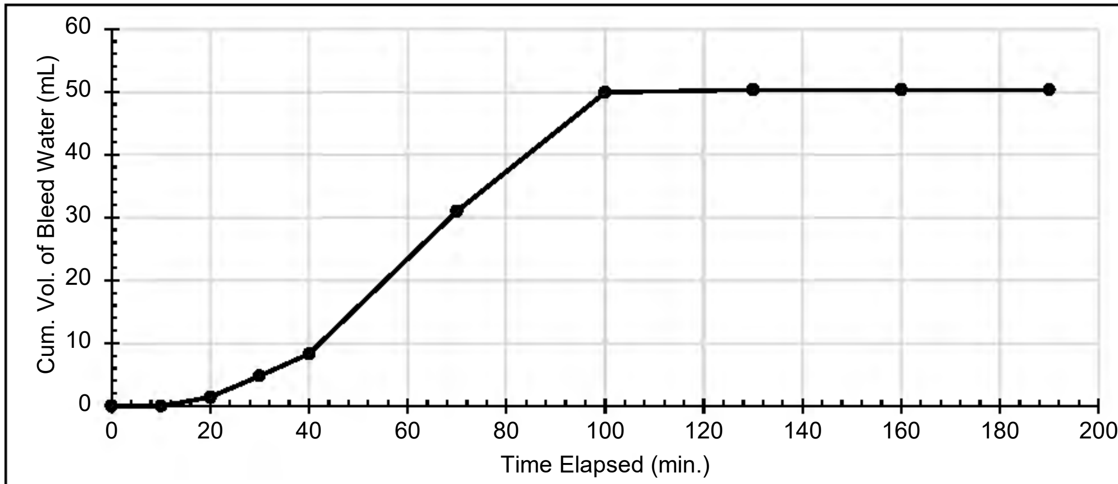
Date Batched: 6/26/2024

Time Batched: 9:30 AM

☐ Wet-sieved

Scales Used:
☑ Asset No. 2214
☐ Asset No. 2215
☑ Asset No. 2866
☐ Asset No. 5089
☐ Other: ______

Sample	Total Accumulated Bleed Water (%)	Time Req. for Cessation of Bleeding (min.)
Mix 2	2.7	130



Comments: ______

ASTM C232-21 Bleeding of Concrete

Project Number: 2024.1541 **Lab Coordinator:** Todd Nelson **Project Manager:** Todd Nelson

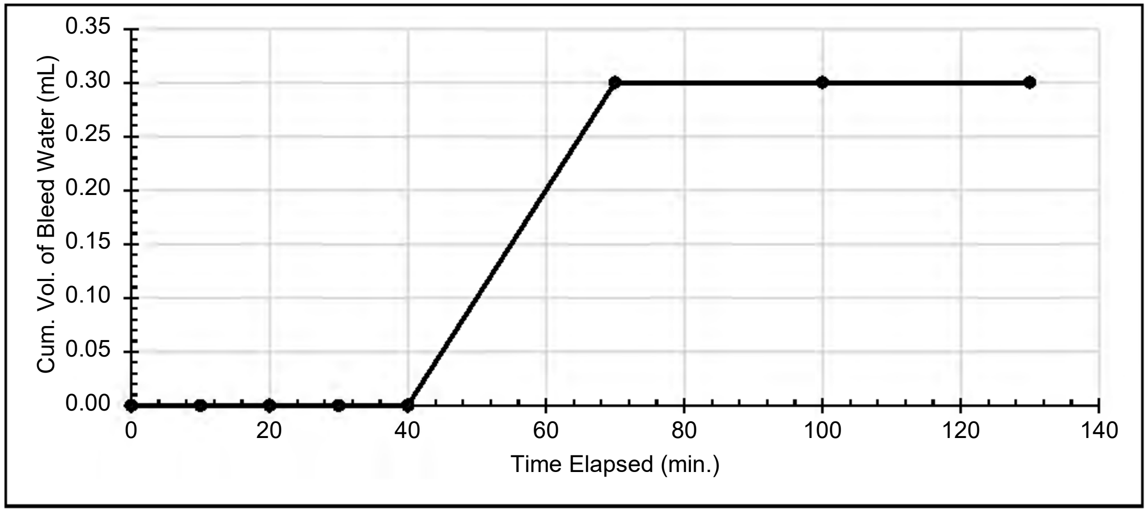
Operator: Andrew Witte **Initials:** ACW **Date:** 6/27/2024
Checked by: Karthik Pattaje **Initials:** KP **Date:** 10/3/2024

Mix ID & Batch No.: Mix 3
Date Batched: 6/27/2024
Time Batched: 11:00 AM

☐ Wet-sieved

Scales Used:
☐ Asset No. 2214
☐ Asset No. 2215
☐ Asset No. 2866
☐ Asset No. 5089
☐ Other: ______

Sample	Total Accumulated Bleed Water (%)	Time Req. for Cessation of Bleeding (min.)
Mix 3	0.0	130



Comments: ______

ASTM C232-21 Bleeding of Concrete

Project Number: 2024.1541 **Lab Coordinator:** Todd Nelson **Project Manager:** Todd Nelson

Operator: Andrew Witte **Initials:** ACW **Date:** 6/28/2024
Checked by: Todd Nelson **Initials:** TDN **Date:** 6/28/2024

Mix ID & Batch No.: Mix 4

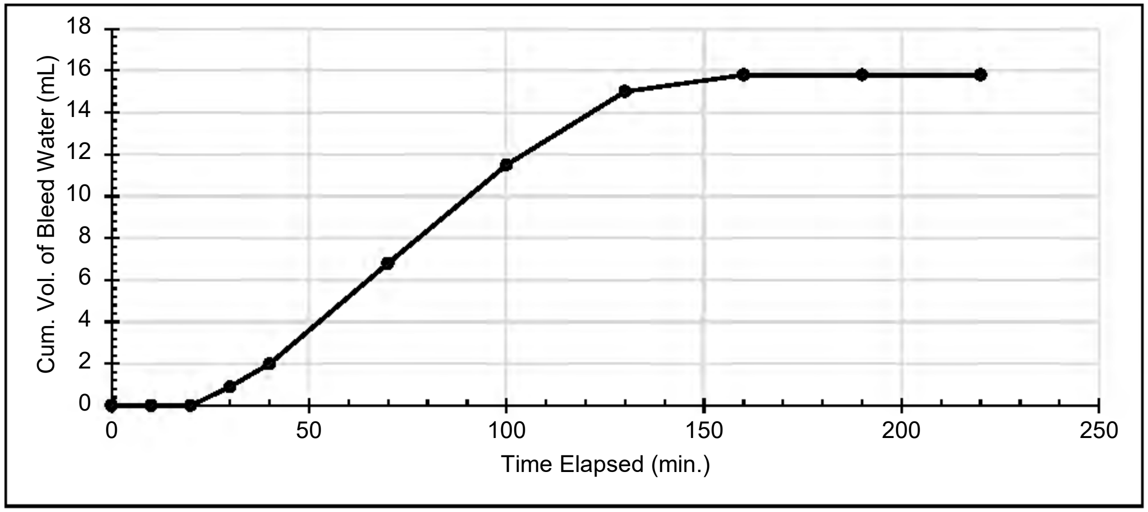
Date Batched: 6/28/2024

Time Batched: 11:20 AM

☐ Wet-sieved

Scales Used:
☒ Asset No. 2214
☐ Asset No. 2215
☒ Asset No. 2866
☐ Asset No. 5089
☐ Other: ________

Sample	Total Accumulated Bleed Water (%)	Time Req. for Cessation of Bleeding (min.)
Mix 4	0.8	160



Comments: ________

APPENDIX D. LAB TESTING - PHYSICAL TESTING RESULTS

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/12/2024

Checked by: T.Nelson **Date:** 7/12/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 - A	7.70	145.4	4.01	12.65	28,260	2,235	1.92	1	None	1
Mix 1 - B	7.74	144.2	4.02	12.67	27,600	2,179	1.93	1	None	1
Mix 1 - C	7.73	146.2	4.01	12.60	28,370	2,252	1.93	1	None	1
Average	--	**145**	--	--	--	**2,220**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 1, tested 10:00 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/13/2024

Checked by: T.Nelson **Date:** 7/13/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 - A	7.65	145.1	4.02	12.70	38,170	3,007	1.90	1	None	2
Mix 1 - B	7.70	144.9	4.01	12.64	41,430	3,277	1.92	1	None	2
Mix 1 - C	7.70	145.1	4.01	12.63	41,220	3,264	1.92	1	None	2
Average	--	**145**	--	--	--	**3,180**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 1, Tested at 9:30 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/14/2024

Checked by: T.Nelson **Date:** 7/14/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 - A	7.76	144.8	4.02	12.68	49,250	3,885	1.93	1	None	3
Mix 1 - B	7.70	144.4	4.01	12.63	50,860	4,028	1.92	1	None	3
Mix 1 - C	7.76	142.4	4.03	12.75	48,600	3,813	1.93	1	None	3
Average	--	**144**	--	--	--	**3,910**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Mix 1, Tested at 9:15 am**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/18/2024

Checked by: D. Witte **Date:** 7/19/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 - A	7.71	147.1	4.00	12.59	58,220	4,623	1.93	2	None	7
Mix 1 - B	7.71	146.0	4.02	12.67	57,310	4,523	1.92	1	None	7
Mix 1 - C	7.72	145.4	4.01	12.63	58,190	4,608	1.93	1	None	7
Average	--	**146**	--	--	--	**4,580**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 1, Tested at 11:00 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/8/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 - A	7.73	146.6	4.01	12.64	68,000	5,382	1.93	1	None	28
Mix 1 - B	7.81	146.0	4.01	12.65	65,960	5,216	1.95	2	None	28
Mix 1 - C	7.67	144.4	4.02	12.71	67,310	5,297	1.91	1	None	28
Average	--	**146**	--	--	--	**5,300**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 1, Tested at 9:15 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 56-day A	7.70	146.7	4.00	12.58	71,290	5,670	1.92	2	None	56
Mix 1 56-day B	7.69	145.8	4.02	12.70	69,500	5,470	1.91	1	None	56
Mix 1 56-day C	7.69	147.1	4.01	12.62	70,660	5,600	1.92	1	None	56

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:10, 9:35, and 9:43 respectively

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/12/2024

Checked by: T.Nelson **Date:** 7/12/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 2 - A	7.71	143.6	4.03	12.74	18,850	1,479	1.91	1	None	1
Mix 2 - B	7.61	145.0	4.01	12.63	18,870	1,495	1.90	1	None	1
Mix 2 - C	7.74	142.9	4.03	12.73	19,510	1,532	1.92	1	None	1
Average	--	**144**	--	--	--	**1,500**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:45 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/13/2024

Checked by: T.Nelson **Date:** 7/13/2024

Capping Method
- ◻ Sulfur
- ◻ Lapped
- ◼ End Ground
- ◻ Unbonded

Conditioning
- ◻ As Received
- ◼ Wet
- ◻ Dry

Capping
- ◼ Plane
- ◻ Sound
- ◻ Other

Calipers
- ◻ 12/060107
- ◻ B657697
- ◼ Asset# 995

Test Machine
- ◼ Test Mark SN# 11005
- ◻ Satec ID: 120HLVC1240
- ◻ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 2 - A	7.74	143.8	4.02	12.68	31,870	2,514	1.93	2	None	2
Mix 2 - B	7.74	144.4	4.00	12.57	32,190	2,562	1.94	1	None	2
Mix 2 - C	7.74	141.8	4.03	12.77	32,070	2,512	1.92	2	None	2
Average	--	**143**	--	--	--	**2,530**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Mix 2, Tested at 10:20 am**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/14/2024

Checked by: T.Nelson **Date:** 7/14/2024

Capping Method
- [ ] Sulfur
- [ ] Lapped
- [x] End Ground
- [ ] Unbonded

Conditioning
- [ ] As Received
- [x] Wet
- [ ] Dry

Capping
- [x] Plane
- [ ] Sound
- [ ] Other

Calipers
- [ ] 12/060107
- [ ] B657697
- [x] Asset# 995

Test Machine
- [x] Test Mark SN# 11005
- [ ] Satec ID: 120HLVC1240
- [ ] Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 2 - A	7.68	144.4	4.02	12.67	39,620	3,128	1.91	1	None	3
Mix 2 - B	7.66	143.9	4.02	12.68	39,520	3,117	1.91	1	None	3
Mix 2 - C	7.71	145.2	4.01	12.64	38,830	3,073	1.92	1	None	3
Average	--	**144**	--	--	--	**3,110**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Mix 2, Tested at 10:15 am**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 7/18/2024

Checked by: D. Witte **Date:** 7/29/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 2 - A	7.71	142.8	4.02	12.68	53,690	4,234	1.92	1	None	7
Mix 2 - B	7.72	143.5	4.03	12.73	52,720	4,141	1.92	1	None	7
Mix 2 - C	7.73	143.3	4.02	12.68	54,230	4,276	1.92	1	None	7
Average	--	**143**	--	--	--	**4,220**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 2, Tested at 12:10 pm

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/8/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 2 - A	7.71	144.8	4.02	12.70	65,980	5,197	1.92	1	None	28
Mix 2 - B	7.70	143.2	4.02	12.70	65,400	5,151	1.92	1	None	28
Mix 2 - C	7.71	144.8	4.01	12.65	63,980	5,057	1.92	1	None	28
Average	--	**144**	--	--	--	**5,140**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 2, Tested at 10:10 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 2 56-day A	7.75	145.6	4.01	12.61	70,610	5,598	1.93	1	None	56
Mix 2 56-day B	7.68	145.3	4.01	12.65	69,830	5,520	1.91	1	None	56
Mix 2 56-day C	7.72	145.2	4.02	12.67	67,390	5,320	1.92	1	None	56
Average	--	**145**	--	--	--	**5,480**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:10, 9:52, 10:10 am respectively

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/12/2024

Checked by: T.Nelson **Date:** 7/12/2024

Capping Method
- ▫ Sulfur
- ▫ Lapped
- ▪ End Ground
- ▫ Unbonded

Conditioning
- ▫ As Received
- ▪ Wet
- ▫ Dry

Capping
- ▪ Plane
- ▫ Sound
- ▫ Other

Calipers
- ▫ 12/060107
- ▫ B657697
- ▪ Asset# 995

Test Machine
- ▪ Test Mark SN# 11005
- ▫ Satec ID: 120HLVC1240
- ▫ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 3 - A	7.80	142.9	4.02	12.67	10,270	810	1.94	1	None	1
Mix 3 - B	7.71	141.7	4.02	12.70	10,570	832	1.92	1	None	1
Mix 3 - C	7.73	141.3	4.03	12.78	10,400	814	1.92	1	None	1
Average	--	**142**	--	--	--	**820**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested 11:30 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/13/2024

Checked by: T.Nelson **Date:** 7/13/2024

Capping Method
- [ ] Sulfur
- [ ] Lapped
- [x] End Ground
- [ ] Unbonded

Conditioning
- [ ] As Received
- [x] Wet
- [ ] Dry

Capping
- [x] Plane
- [ ] Sound
- [ ] Other

Calipers
- [ ] 12/060107
- [ ] B657697
- [x] Asset# 995

Test Machine
- [x] Test Mark SN# 11005
- [ ] Satec ID: 120HLVC1240
- [ ] Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 3 - A	7.71	143.2	4.01	12.64	19,530	1,545	1.92	1	None	2
Mix 3 - B	7.78	142.4	4.01	12.60	19,010	1,509	1.94	1	None	2
Mix 3 - C	7.76	143.4	4.02	12.66	19,110	1,509	1.93	1	None	2
Average	--	**143**	--	--	--	**1,520**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Mix 3 Tested at 11:20 am**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/14/2024

Checked by: T.Nelson **Date:** 7/14/2024

Capping Method
- ▫ Sulfur
- ▫ Lapped
- ▪ End Ground
- ▫ Unbonded

Conditioning
- ▫ As Received
- ▪ Wet
- ▫ Dry

Capping
- ▪ Plane
- ▫ Sound
- ▫ Other

Calipers
- ▫ 12/060107
- ▫ B657697
- ▪ Asset# 995

Test Machine
- ▪ Test Mark SN# 11005
- ▫ Satec ID: 120HLVC1240
- ▫ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 3 - A	7.71	143.2	4.02	12.71	24,470	1,925	1.92	1	None	3
Mix 3 - B	7.67	143.7	4.02	12.67	27,190	2,147	1.91	1	None	3
Mix 3 - C	7.66	142.9	4.02	12.71	26,160	2,058	1.90	1	None	3
Average	--	**143**	--	--	--	**2,040**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 3 Tested at 11:15 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/18/2024

Checked by: D. Witte **Date:** 7/19/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 3 - A	7.71	144.2	4.01	12.63	41,110	3,255	1.92	1	None	7
Mix 3 - B	7.74	142.9	4.02	12.69	39,680	3,128	1.92	1	None	7
Mix 3 - C	7.72	144.0	4.01	12.65	38,930	3,079	1.92	1	None	7
Average	--	**144**	--	--	--	**3,150**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 3 Tested at 11:15 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/8/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☐ As Received ☑ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 3 - A	7.75	142.6	4.01	12.65	52,310	4,136	1.93	1	None	28
Mix 3 - B	7.74	146.6	3.99	12.52	55,470	4,431	1.94	2	None	28
Mix 3 - C	7.73	141.8	4.02	12.71	51,990	4,090	1.92	1	None	28
Average	--	**144**	--	--	--	**4,220**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 3 Tested at 11:20 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 3 56-day A	7.68	142.4	4.02	12.71	60,680	4,775	1.91	1	None	56
Mix 3 56-day B	7.68	144.3	4.01	12.61	58,780	4,661	1.92	1	None	56
Mix 3 56-day C	7.66	144.3	4.01	12.65	61,120	4,831	1.91	2	None	56
Average	--	**144**	--	--	--	**4,760**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Tested at 9:10, 10:20, and 10:35 respectively**

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/13/2024

Checked by: T.Nelson **Date:** 7/13/2024

Capping Method
- ▫ Sulfur
- ▫ Lapped
- ▪ End Ground
- ▫ Unbonded

Conditioning
- ▫ As Received
- ▪ Wet
- ▫ Dry

Capping
- ▪ Plane
- ▫ Sound
- ▫ Other

Calipers
- ▫ 12/060107
- ▫ B657697
- ▪ Asset# 995

Test Machine
- ▪ Test Mark SN# 11005
- ▫ Satec ID: 120HLVC1240
- ▫ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 4 - A	7.69	145.6	4.01	12.65	35,020	2,768	1.92	1	None	1
Mix 4 - B	7.69	145.4	4.02	12.69	34,710	2,735	1.91	1	None	1
Mix 4 - C	7.77	145.9	4.03	12.73	35,370	2,778	1.93	1	None	1
Average	--	**146**	--	--	--	**2,760**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 4, Tested at 9:45 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/14/2024

Checked by: T.Nelson **Date:** 7/14/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 4 - A	7.72	146.4	4.00	12.53	50,030	3,991	1.93	1	None	2
Mix 4 - B	7.72	146.8	4.01	12.63	55,420	4,387	1.92	1	None	2
Mix 4 - C	7.67	145.8	4.01	12.63	51,960	4,115	1.91	1	None	2
Average	--	**146**	--	--	--	**4,160**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Mix 4, Tested at 9:40 am**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/15/2024

Checked by: T.Nelson **Date:** 7/15/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 4 - A	7.69	146.7	4.01	12.63	61,560	4,876	1.92	1	None	3
Mix 4 - B	7.67	145.5	4.01	12.62	59,270	4,698	1.91	1	None	3
Mix 4 - C	7.69	145.7	4.03	12.73	63,430	4,983	1.91	1	None	3
Average	--	**146**	--	--	--	**4,850**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 4, Tested at 9:45 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: R. Bee **Date:** 7/19/2024

Checked by: K. Pattaje **Date:** 7/19/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☒ 12/060107
- ☐ B657697
- ☐ Asset#

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 4 - A	2.65	421.9	4.01	12.63	72,430	5,733	0.66	Type 4		7
Mix 4 - B	2.73	415.4	4.01	12.60	68,770	5,458	0.68	Type 4		7
Mix 4 - C	2.71	429.3	3.97	12.35	75,030	6,074	0.68	Type 1		7
Average	--	**422**	--	--	--	**5,760**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 4, Three cylinders tested at 8:55 AM, 9:07 AM, and 9:12 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/9/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 4 - A	7.87	148.2	4.00	12.56	75,960	6,046	1.97	1		28
Mix 4 - B	7.72	146.6	4.03	12.74	72,710	5,707	1.92	1		28
Mix 4 - C	7.73	146.1	4.02	12.70	78,940	6,218	1.92	1		28
Average	--	**147**	--	--	--	**5,990**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 4, Three cylinders tested at 10:30 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 4 56-day A	7.68	147.9	4.00	12.58	86,100	6,845	1.92	2	None	56
Mix 4 56-day B	7.67	147.8	4.01	12.65	85,610	6,770	1.91	2	None	56
Mix 4 56-day C	7.74	147.4	4.01	12.65	85,380	6,752	1.93	1	None	56
Average	--	**148**	--	--	--	**6,790**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Tested at 9:20, 9:45, and 10:00 am**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/13/2024

Checked by: T.Nelson **Date:** 7/13/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 5 - A	7.75	144.5	4.02	12.70	19,690	1,551	1.93	2	None	1
Mix 5 - B	7.82	144.3	4.02	12.68	19,690	1,553	1.95	1	None	1
Mix 5 - C	7.85	144.6	4.01	12.63	18,760	1,485	1.96	1	None	1
Average	--	**144**	--	--	--	**1,530**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 5, Tested at 10:30 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/14/2024

Checked by: T.Nelson **Date:** 7/14/2024

Capping Method
- [ ] Sulfur
- [ ] Lapped
- [x] End Ground
- [ ] Unbonded

Conditioning
- [ ] As Received
- [x] Wet
- [ ] Dry

Capping
- [x] Plane
- [ ] Sound
- [ ] Other

Calipers
- [ ] 12/060107
- [ ] B657697
- [x] Asset# 995

Test Machine
- [x] Test Mark SN# 11005
- [ ] Satec ID: 120HLVC1240
- [ ] Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 5 - A	7.78	144.1	4.02	12.69	33,400	2,632	1.93	2	None	2
Mix 5 - B	7.66	145.1	4.00	12.56	33,330	2,653	1.92	1	None	2
Mix 5 - C	7.84	147.1	3.99	12.50	33,140	2,652	1.97	1	None	2
Average	--	**145**	--	--	--	**2,650**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Mix 5, Tested at 10:40 am**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/15/2024

Checked by: K. Pattaje **Date:** 7/16/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 5 - A	7.73	145.8	4.01	12.61	38,350	3,041	1.93	1	None	3
Mix 5 - B	7.73	143.8	4.03	12.77	39,660	3,106	1.92	1	None	3
Mix 5 - C	7.68	145.1	4.00	12.58	39,630	3,151	1.92	1	None	3
Average	--	**145**	--	--	--	**3,100**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 5, Tested at 10:45 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: R. Bee **Date:** 7/19/2024

Checked by: K. Pattaje **Date:** 7/19/2024

Capping Method
- [ ] Sulfur
- [ ] Lapped
- [x] End Ground
- [ ] Unbonded

Conditioning
- [ ] As Received
- [x] Wet
- [ ] Dry

Capping
- [x] Plane
- [ ] Sound
- [ ] Other

Calipers
- [x] 12/060107
- [ ] B657697
- [ ] Asset#

Test Machine
- [x] Test Mark SN# 11005
- [ ] Satec ID: 120HLVC1240
- [ ] Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 5 7-day 1	7.23	144.7	4.01	12.62	49,410	3,916	1.80	Type 1		7
Mix 5 7-day 2	7.73	145.6	4.02	12.67	50,010	3,946	1.92	Type 1		7
Mix 5 7-day 3	7.75	144.6	4.02	12.68	49,920	3,937	1.93	Type 1		7
Average	--	**145**	--	--	--	**3,930**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 5, Three cylinders tested at 9:20 AM, 9:25 AM, and 9:30 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/9/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 5 - A	7.71	145.4	4.03	12.75	59,920	4,700	1.91	1		28
Mix 5 - B	7.73	145.5	4.02	12.67	56,120	4,429	1.92	1		28
Mix 5 - C	7.74	144.7	4.02	12.68	58,710	4,630	1.93	1		28
Average	--	**145**	--	--	--	**4,590**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 5, Three cylinders tested at 10:30 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/16/2024

Checked by: K. Pattaje **Date:** 8/16/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 5 35-day A	7.71	146.2	4.00	12.59	57,800	4,589	1.92	1	None	35
Mix 5 35-day B	7.73	147.5	4.01	12.61	57,940	4,595	1.93	1	None	35
Average	--	**147**	--	--	--	**4,590**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 5, Two cylinders tested at 12:40 pm

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 5 56-day A	7.73	146.1	4.01	12.62	57,680	4,572	1.93	1	None	56
Mix 5 56-day B	7.74	144.4	4.03	12.76	61,680	4,834	1.92	2	None	56
Mix 5 56-day C	7.78	145.1	4.01	12.65	60,010	4,743	1.94	1	None	56
Average	--	**145**	--	--	--	**4,720**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Tested at 9:20, 10:10, and 10:25 am**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/13/2024

Checked by: T.Nelson **Date:** 7/13/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 6 - A	7.71	144.3	4.03	12.74	13,820	1,085	1.91	1	None	1
Mix 6 - B	7.77	145.8	3.99	12.53	13,330	1,064	1.95	1	None	1
Mix 6 - C	7.76	143.2	4.01	12.65	13,040	1,031	1.93	1	None	1
Average	--	**144**	--	--	--	**1,060**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 6, Tested at 11:40 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/14/2024

Checked by: T.Nelson **Date:** 7/14/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 6 - A	7.64	142.9	4.02	12.67	25,840	2,039	1.90	1	None	2
Mix 6 - B	7.66	145.0	4.02	12.67	26,350	2,080	1.91	1	None	2
Mix 6 - C	7.64	144.7	3.99	12.50	26,610	2,129	1.92	1	None	2
Average	--	**144**	--	--	--	**2,080**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 6, Tested at 11:30 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/15/2024

Checked by: K. Pattaje **Date:** 7/16/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 6 - A	7.70	144.9	4.02	12.68	31,410	2,477	1.91	1	None	3
Mix 6 - B	7.70	145.2	4.00	12.59	32,270	2,563	1.92	1	None	3
Mix 6 - C	7.67	143.0	4.01	12.65	31,480	2,488	1.91	1	None	3
Average	--	**144**	--	--	--	**2,510**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Mix 6, Tested at 11:30 am**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: D. Witte **Date:** 7/19/2024

Checked by: K. Pattaje **Date:** 7/19/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☒ 12/060107
- ☐ B657697
- ☐ Asset#

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 6 7-day 1	7.72	144.5	3.99	12.53	38,750	3,093	1.93	Type 1		7
Mix 6 7-day 2	7.70	146.2	4.01	12.60	46,610	3,698	1.92	Type 1		7
Mix 6 7-day 3	7.72	145.7	4.01	12.62	47,590	3,770	1.93	Type 1		7
Average	--	**145**	--	--	--	**3,520**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Mix 6, Three cylinders tested at 9:35 AM, 9:40 AM, and 9:45 AM**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/9/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Capping Method
☐ Sulfur
☐ Lapped
☑ End Ground
☐ Unbonded

Conditioning
☐ As Received
☑ Wet
☐ Dry

Capping
☑ Plane
☐ Sound
☐ Other

Calipers
☐ 12/060107
☐ B657697
☑ Asset# 995

Test Machine
☑ Test Mark SN# 11005
☐ Satec ID: 120HLVC1240
☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 6 - A	7.71	144.2	4.01	12.62	59,140	4,687	1.92	1		28
Mix 6 - B	7.67	142.8	4.03	12.73	60,760	4,773	1.90	2		28
Mix 6 - C	7.66	145.0	4.00	12.57	65,360	5,201	1.92	1		28
Average	--	**144**	--	--	--	**4,890**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 6, Three cylinders tested at 10:40 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 6 56-day A	7.70	143.1	4.03	12.76	72,430	5,678	1.91	1	None	56
Mix 6 56-day B	7.68	144.6	4.02	12.68	67,380	5,315	1.91	1	None	56
Mix 6 56-day C	7.73	145.6	4.02	12.66	70,580	5,573	1.92	1	None	56
Average	--	**144**	--	--	--	**5,520**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:20, 10:35, and 10:45 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/29/2024

Checked by: K. Pattaje **Date:** 7/29/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/26/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 6 REDO-A	7.80	144.5	4.00	12.59	41,330	3,282	1.95	2	NONE	3
MIX 6 REDO-B	7.81	143.7	4.01	12.62	42,670	3,382	1.95	1	NONE	3
MIX 6 REDO-C	7.78	143.2	4.03	12.77	42,380	3,319	1.93	1	NONE	3
Average	--	**144**	--	--	--	**3,330**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments:

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 7/14/2024

Checked by: T.Nelson **Date:** 7/14/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☒ Asset 995

Test Machine:
- ☒ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐

Curing:
- ☒ Standard (Saturated)
- ☐

Condition:
- ☒ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☒ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 1	4.05	4.00	12	3,078	565	Yes	3
Mix 1	4.05	4.10	12	3,223	570	Yes	3
					570		

Comments: Tested at 9:50 am

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/18/2024

Checked by: D. Witte **Date:** 7/19/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ Asset 995

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ______

Curing:
- ☑ Standard (Saturated)
- ☐ ______

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 1	4.05	4.10	12	3,116	555	Yes	7
Mix 1	4.05	4.10	12	3,319	595	Yes	7
					575		

Comments: Tested at 1:10 pm

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 8/8/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ 7112

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ____

Curing:
- ☑ Standard (Saturated)
- ☐ ____

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☑ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 1	4.00	4.15	12	3,662	655	Yes	28
Mix 1	4.05	4.05	12	3,238	580	Yes	28
					620		

Comments: Tested at 1:00 pm

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ 995

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐

Curing:
- ☑ Standard (Saturated)
- ☐

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 1-2 a	4.05	4.10	12	3,925	695	Yes	56
Mix 1-2 b	4.10	4.10	12	4,005	700	Yes	56
					700		

Comments:

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/14/2024

Checked by: T.Nelson **Date:** 7/14/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ Asset 995

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ____

Curing:
- ☑ Standard (Saturated)
- ☐ ____

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 2	4.00	4.10	12	2,332	425	Yes	3
Mix 2	4.05	4.10	12	2,396	425	Yes	3
					425		

Comments: Tested at 10:30 am

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/18/2024

Checked by: D. Witte **Date:** 7/19/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☒ Asset 995

Test Machine:
- ☒ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ______

Curing:
- ☒ Standard (Saturated)
- ☐ ______

Condition:
- ☒ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☒ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 2	4.10	4.10	12	2,984	515	Yes	7
Mix 2	4.10	4.10	12	2,894	510	Yes	7
					515		

Comments: Tested at 1:25 pm

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/8/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ Asset 7112

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ________

Curing:
- ☑ Standard (Saturated)
- ☐ ________

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 2	4.05	4.05	12	2,702	485	Yes	28
Mix 2	4.05	4.05	12	3,120	565	Yes	28
					525		

Comments: Tested at 1:00 pm

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ 995

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ____________

Curing:
- ☑ Standard (Saturated)
- ☐ ____________

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 2-2 a	4.05	4.15	12	3,391	595	Yes	56
Mix 2-2 b	4.05	4.00	12	3,414	630	Yes	56
					615		

Comments: ____________

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/14/2024

Checked by: T.Nelson **Date:** 7/14/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☒ Asset 995

Test Machine:
- ☒ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐

Curing:
- ☒ Standard (Saturated)
- ☐

Condition:
- ☒ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☒ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 3	4.05	4.10	12	2,416	435	Yes	3
Mix 3	4.05	4.20	12	2,287	400	Yes	3
					420		

Comments: Tested at 11:30 am

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/18/2024

Checked by: D. Witte **Date:** 7/19/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☒ Asset 995

Test Machine:
- ☒ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐

Curing:
- ☒ Standard (Saturated)
- ☐

Condition:
- ☒ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☒ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 3	4.00	4.15	12	3,005	540	Yes	7
Mix 3	4.05	4.10	12	3,003	540	Yes	7
					540		

Comments: Tested at 1:40 am

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/8/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ Asset 7112

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ____________

Curing:
- ☑ Standard (Saturated)
- ☐ ____________

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 3	4.05	4.10	12	3,998	705	Yes	28
Mix 3	4.05	4.05	12	3,678	665	Yes	28
					685		

Comments: Tested at 1:00 pm

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ 995

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ______

Curing:
- ☑ Standard (Saturated)
- ☐ ______

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 3-2 a	4.05	4.05	12	4,371	785	Yes	56
Mix 3-2 b	4.05	4.05	12	4,349	795	Yes	56
					790		

Comments:

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/15/2024
Checked by: K. Pattaje **Date:** 7/16/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☒ Asset 995

Test Machine:
- ☒ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ______

Curing:
- ☒ Standard (Saturated)
- ☐ ______

Condition:
- ☒ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☒ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 4-2	4.05	4.05	12	2,983	545	Yes	3
Mix 4-2	4.00	4.10	12	3,357	610	Yes	3
					580		

Comments: Tested at 10:20 am

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669

Project Coordinator: T. Nelson

Operator: K. Pattaje **Date:** 7/19/2024

Checked by: D. Witte **Date:** 7/19/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☒ Asset 995

Test Machine:
- ☒ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐

Curing:
- ☒ Standard (Saturated)
- ☐

Condition:
- ☒ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☒ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 4-2	4.05	4.10	12	3,955	710	Yes	7
Mix 4-2	4.05	4.10	12	3,726	670	Yes	7
					690		

Comments: Tested at 9:55 am

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/9/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ Asset 7112

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ________

Curing:
- ☑ Standard (Saturated)
- ☐ ________

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 4-2	4.05	4.05	12	3,883	695	Yes	28
Mix 4-2	4.05	4.05	12	3,633	655	Yes	28
					675		

Comments: ________

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/8/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ 995

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ____________

Curing:
- ☑ Standard (Saturated)
- ☐ ____________

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 4-2 a	4.05	4.10	12	4,055	720	Yes	56
Mix 4-2 b	4.05	4.10	12	4,059	720	Yes	56
					720		

Comments: ____________

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/15/2024

Checked by: K. Pattaje **Date:** 7/16/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☒ Asset 995

Test Machine:
- ☒ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ________

Curing:
- ☒ Standard (Saturated)
- ☐ ________

Condition:
- ☒ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☒ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 5-2	4.05	4.10	12	3,122	560	Yes	3
Mix 5-2	4.05	4.05	12	2,961	530	Yes	3
					545		

Comments: Tested at 10:55 am

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: K. Pattaje **Date:** 7/19/2024

Checked by: D. Witte **Date:** 7/19/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ Asset 995

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ______

Curing:
- ☑ Standard (Saturated)
- ☐ ______

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 5-2	4.05	4.10	12	3,457	610	Yes	7
Mix 5-2	4.05	4.00	12	3,270	600	Yes	7
					605		

Comments: Tested at 10:15 am

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/9/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ Asset 7112

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ____________

Curing:
- ☑ Standard (Saturated)
- ☐ ____________

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 5-2	4.15	4.05	12	3,662	630	Yes	28
Mix 5-2	4.00	4.10	12	3,512	640	Yes	28
					635		

Comments:

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ 995

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐

Curing:
- ☑ Standard (Saturated)
- ☐

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 5-2 a	4.05	4.10	12	4,044	730	Yes	56
Mix 5-2 b	4.10	4.10	12	4,262	745	Yes	56
					740		

Comments:

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 7/15/2024

Checked by: K. Pattaje **Date:** 7/16/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☒ Asset 995

Test Machine:
- ☒ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ________

Curing:
- ☒ Standard (Saturated)
- ☐ ________

Condition:
- ☒ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☒ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 6-2	4.05	4.10	12	2,473	445	Yes	3
Mix 6-2	4.05	4.10	12	2,390	425	Yes	3
					435		

Comments: Tested at 11:50 am

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: K. Pattaje **Date:** 7/19/2024

Checked by: D. Witte **Date:** 7/19/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☒ Asset 995

Test Machine:
- ☒ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ______

Curing:
- ☒ Standard (Saturated)
- ☐ ______

Condition:
- ☒ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☒ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 6-2	4.15	4.10	12	3,209	550	Yes	7
Mix 6-2	4.00	4.05	12	2,919	535	Yes	7
					545		

Comments: Tested at 10:30 am

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/9/2024
Checked by: K. Pattaje **Date:** 8/9/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ Asset 7112

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ______

Curing:
- ☑ Standard (Saturated)
- ☐ ______

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 6-1	4.05	4.10	12	4,010	710	Yes	28
Mix 6-1	4.05	4.15	12	3,988	710	Yes	28
					710		

Comments: ______

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

Job Number: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Calipers:
- ☐ Serial No: 12/060107
- ☐ Serial No. B65703
- ☐ Serial No. B65697
- ☑ 995

Test Machine:
- ☑ Satec ID: 120HLVC1240
- ☐ Test Mark SN#. 11005
- ☐ ____________

Curing:
- ☑ Standard (Saturated)
- ☐ ____________

Condition:
- ☑ Moist
- ☐ Dry
- ☐ As Received

Sample Preparation:
- ☐ Capped
- ☐ Ground
- ☐ Shims Used
- ☐ Sawed
- ☑ Molded

Sample ID	Average Depth (in.)	Average Width (in.)	Span Length (in.)	Max. Load (lbs.)	Modulus of Rupture (psi)	Broken In Middle Third?	Age of sample (Days)
Mix 6-2 a	4.05	4.10	12	4,348	780	Yes	56
Mix 6-2 b	4.05	4.10	12	4,281	755	Yes	56
					770		

Comments:

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.²)	Density (lb/ft³)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 1 sample 1	56	7.69	4.02	12.70	145.8	69,500	5,470	1.91	1	None

Modulus of Elasticity (psi)	3,475,000
Poisson's Ratio	

Comments:

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.^{2})	Density (lb/ft^3)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 1 sample 2	56	7.69	4.01	12.62	147.1	70,660	5,600	1.92	1	None

Modulus of Elasticity (psi)	3,225,000
Poisson's Ratio	

Comments:

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.^{2})	Density (lb/ft^3)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 2 Sample 1	56	7.68	4.01	12.65	145.3	69,830	5,520	1.91	1	None

Modulus of Elasticity (psi)	3,250,000
Poisson's Ratio	

Comments:

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.²)	Density (lb/ft³)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 2 Sample 2	56	7.72	4.02	12.67	145.2	67,390	5,320	1.92	1	None

Modulus of Elasticity (psi)	3,125,000
Poisson's Ratio	

Comments:

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.^{2})	Density (lb/ft^3)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 3 Sample 1	56	7.68	4.01	12.61	144.3	58,780	4,660	1.92	1	None

Modulus of Elasticity (psi)	3,200,000
Poisson's Ratio	

Comments:

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/5/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.^{2})	Density (lb/ft^3)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 3 Sample 2	56	7.66	4.01	12.65	144.3	61,120	4,830	1.91	2	None

Modulus of Elasticity (psi)	2,900,000
Poisson's Ratio	

Comments:

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.²)	Density (lb/ft³)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 4 Sample 1	56	7.67	4.01	12.65	147.8	85,610	6,770	1.91	2	None

Modulus of Elasticity (psi)	3,425,000
Poisson's Ratio	

Comments:

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.²)	Density (lb/ft³)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 4 Sample 2	56	7.74	4.01	12.65	147.4	85,380	6,750	1.93	1	None

Modulus of Elasticity (psi)	3,550,000
Poisson's Ratio	

Comments:

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.^{2})	Density (lb/ft^3)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 5 Sample 1	56	7.74	4.03	12.76	144.4	61,680	4,830	1.92	2	None

Modulus of Elasticity (psi)	3,125,000
Poisson's Ratio	

Comments:

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.^{2})	Density (lb/ft^3)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 5 Sample 2	56	7.78	4.01	12.65	145.1	60,010	4,740	1.94	1	None

Modulus of Elasticity (psi)	2,975,000
Poisson's Ratio	

Comments:

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.²)	Density (lb/ft³)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 6 Sample 1	56	7.68	4.02	12.68	144.6	67,380	5,320	1.91	1	None

Modulus of Elasticity (psi)	3,400,000
Poisson's Ratio	

Comments:

ASTM C469 Modulus of Elasticity

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/6/2024

Checked by: K. Pattaje **Date:** 9/9/2024

Capping Method
- ☐ Sulfur
- ☒ Lapped
- ☐ Unbonded
- ☑ End gound

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Other

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Age (days)	Capped Length (in.)	Avg. Dia. (in.)	Area (in.^{2})	Density (lb/ft^3)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects
Mix 6 Sample 2	56	7.73	4.02	12.66	145.6	70,580	5,570	1.92	1	None

Modulus of Elasticity (psi)	3,350,000
Poisson's Ratio	

Comments:

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C157-17 - Length Change of Hardened Hydraulic-Cement Mortar and Concrete

Project Number: 2024.2669 **Lab Coordinator:** K. Pattaje **Project Manager:** T. Nelson

Operator: L. ZEGLER **Date:** 7/12/2024

Checked by: K. Pattaje **Date:** 8/15/2024

Mix ID: MIX 1-2

Date Cast: 7/11/2024

Type of Material: Concrete / Mortar

Specimen Size: 3 x 3 x 11.25 in / 4 x 4 x 11.25 in

Mix Temp. (°F):

Consolidation: Rodding / Vibration

Max. Size of Aggregate: 3/4" / 1/2"

Number of Specimens: 3

Slump (in.):

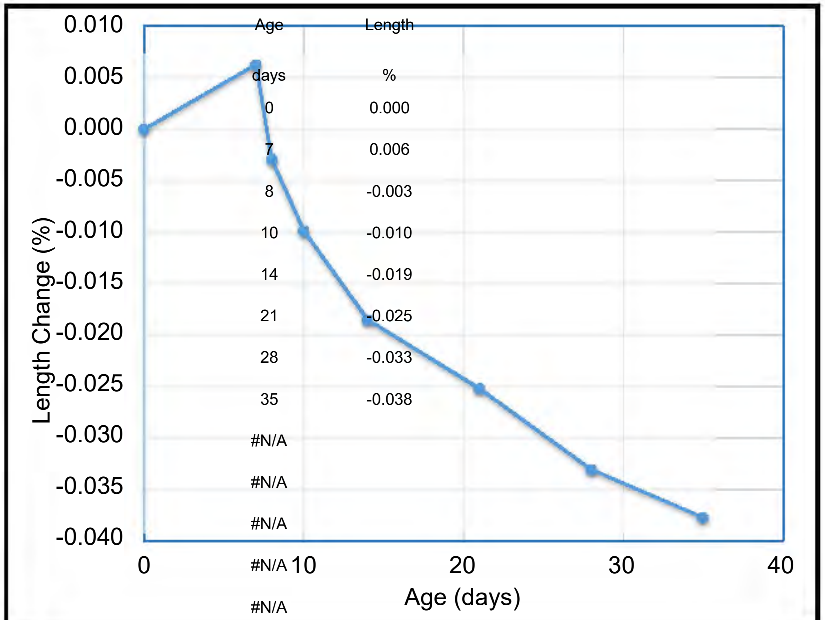
Curing Duration (days): 7

Storage Condition: Water / Air

Length Comparator: SN: 11200975 / SN: 12210636

Dial Gage: SN: 204402

Reading #	Age (days)	Time of Storage (days)	Average Length Change (%)
0	0	Before cure	0.000
1	7	0	0.006
2	8	1	-0.003
3	10	3	-0.010
4	14	7	-0.019
5	21	14	-0.025
6	28	21	-0.033
7	35	28	-0.038
8			
9			
10			
11			
12			



ASTM C157-17 - Length Change of Hardened Hydraulic-Cement Mortar and Concrete

Project Number: 2024.2669 **Lab Coordinator:** K. Pattaje **Project Manager:** T. Nelson

Operator: L. ZEGLER **Date:** 7/12/2024

Checked by: K. Pattaje **Date:** 8/15/2024

Mix ID: MIX 2-2

Date Cast: 7/11/2024

Type of Material: Concrete / Mortar / ______

Specimen Size: 3 x 3 x 11.25 in / 4 x 4 x 11.25 in / ______

Mix Temp. (°F): ______

Slump (in.): ______

Consolidation: Rodding / Vibration / ______

Max. Size of Aggregate: 3/4" / 1/2" / ______

Number of Specimens: 3

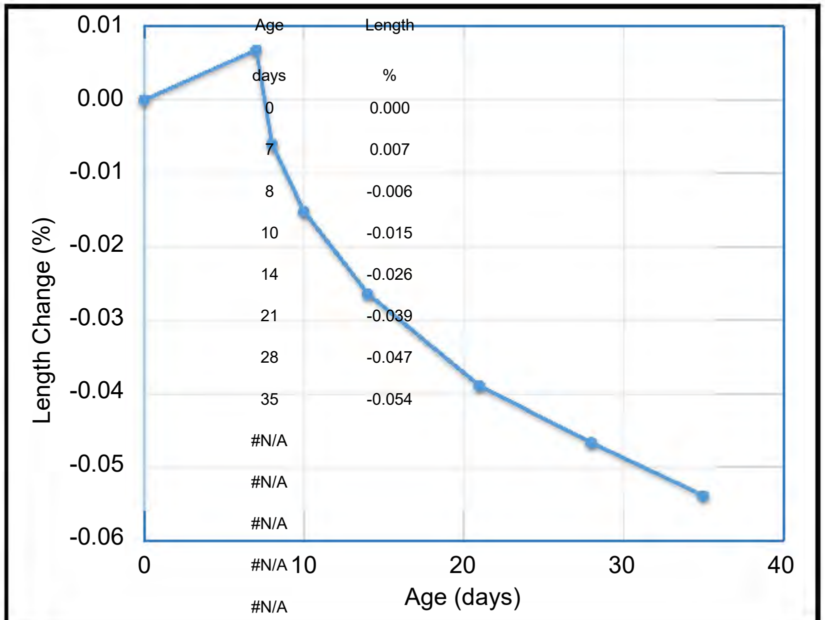
Curing Duration (days): 7

Storage Condition: Water / Air / ______

Length Comparator: SN: 11200975 / SN: 12210636 / ______

Dial Gage: SN: 204402 / ______

Reading #	Age (days)	Time of Storage (days)	Average Length Change (%)
0	0	Before cure	0.000
1	7	0	0.007
2	8	1	-0.006
3	10	3	-0.015
4	14	7	-0.026
5	21	14	-0.039
6	28	21	-0.047
7	35	28	-0.054
8			
9			
10			
11			
12			



ASTM C157-17 - Length Change of Hardened Hydraulic-Cement Mortar and Concrete

Project Number: 2024.2669 **Lab Coordinator:** K. Pattaje **Project Manager:** T. Nelson

Operator: L. ZEGLER **Date:** 7/12/2024

Checked by: K. Pattaje **Date:** 8/15/2024

Mix ID: MIX 3-2

Date Cast: 7/11/2024

Type of Material: ■ Concrete ☐ Mortar ☐ ____

Specimen Size: ☐ 3 x 3 x 11.25 in ■ 4 x 4 x 11.25 in ☐ ____

Mix Temp. (°F): ____

Slump (in.): ____

Consolidation: ☐ Rodding ■ Vibration ☐ ____

Max. Size of Aggregate: ■ 3/4" ☐ 1/2" ☐ ____

Number of Specimens: 3

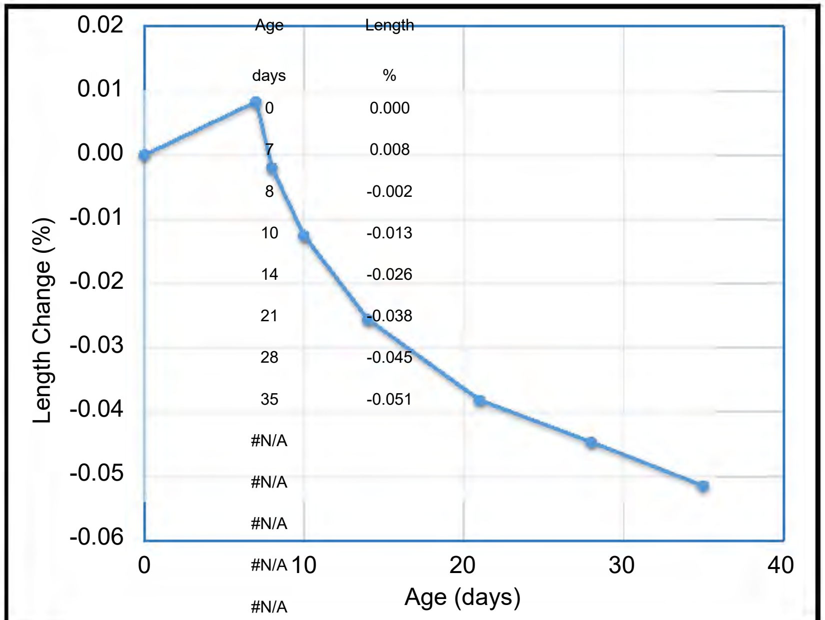
Curing Duration (days): 7

Storage Condition: ☐ Water ■ Air ☐ ____

Length Comparator: ■ SN: 11200975 ☐ SN: 12210636 ☐ ____

Dial Gage: ☐ SN: 204402 ☐ ____

Reading #	Age (days)	Time of Storage (days)	Average Length Change (%)
0	0	Before cure	0.000
1	7	0	0.008
2	8	1	-0.002
3	10	3	-0.013
4	14	7	-0.026
5	21	14	-0.038
6	28	21	-0.045
7	35	28	-0.051
8			
9			
10			
11			
12			



ASTM C157-17 - Length Change of Hardened Hydraulic-Cement Mortar and Concrete

Project Number: 2024.2669 **Lab Coordinator:** K. Pattaje **Project Manager:** T. Nelson

Operator: L. ZEGLER **Date:** 7/13/2024

Checked by: K. Pattaje **Date:** 8/16/2024

Mix ID: MIX 4-2 **Date Cast:** 7/12/2024

Type of Material: Concrete / Mortar

Specimen Size: 3 x 3 x 11.25 in / 4 x 4 x 11.25 in

Mix Temp. (°F):

Slump (in.):

Consolidation: Rodding / Vibration

Max. Size of Aggregate: 3/4" / 1/2"

Number of Specimens: 3

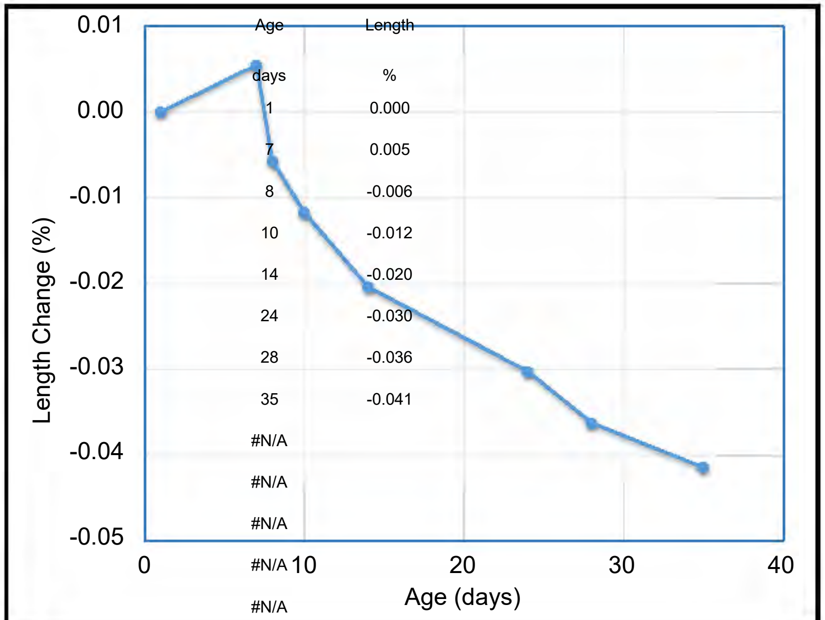
Curing Duration (days): 7

Storage Condition: Water / Air

Length Comparator: SN: 11200975 / SN: 12210636

Dial Gage: SN: 204402

Reading #	Age (days)	Time of Storage (days)	Average Length Change (%)
0	1	Before cure	0.000
1	7	0	0.005
2	8	1	-0.006
3	10	3	-0.012
4	14	7	-0.020
5	24	17	-0.030
6	28	21	-0.036
7	35	28	-0.041
8			
9			
10			
11			
12			



WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C157-17 - Length Change of Hardened Hydraulic-Cement Mortar and Concrete

Project Number: 2024.2669 **Lab Coordinator:** K. Pattaje **Project Manager:** T. Nelson

Operator: L. ZEGLER **Date:** 7/13/2024

Checked by: K. Pattaje **Date:** 8/16/2024

Mix ID: MIX 5-2

Date Cast: 7/12/2024

Type of Material: ■ Concrete □ Mortar □ ____

Specimen Size: □ 3 x 3 x 11.25 in ■ 4 x 4 x 11.25 in □ ____

Mix Temp. (°F): ____

Slump (in.): ____

Consolidation: □ Rodding ■ Vibration □ ____

Max. Size of Aggregate: ■ 3/4" □ 1/2" □ ____

Number of Specimens: 3

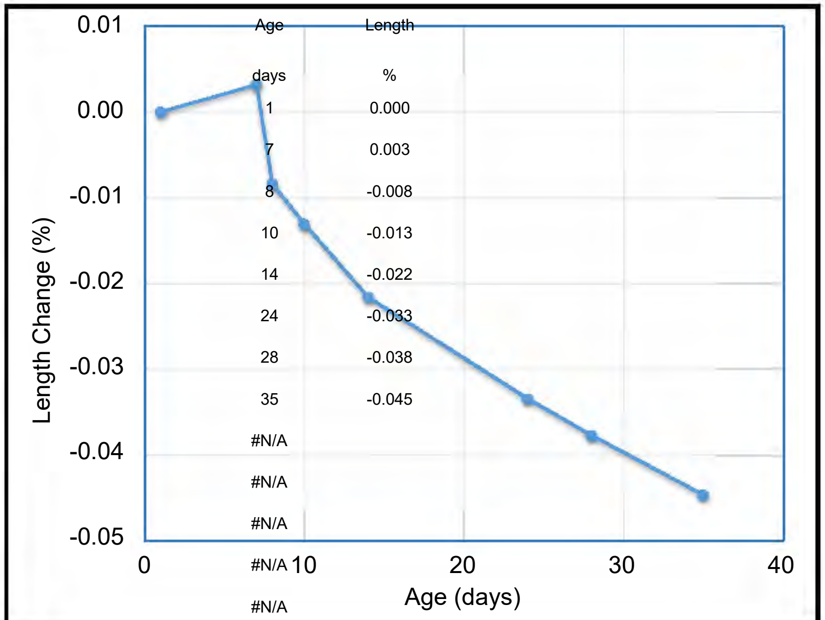
Curing Duration (days): 7

Storage Condition: □ Water ■ Air □ ____

Length Comparator: ■ SN: 11200975 □ SN: 12210636 □ ____

Dial Gage: □ SN: 204402 □ ____

Reading #	Age (days)	Time of Storage (days)	Average Length Change (%)
0	1	Before cure	0.000
1	7	0	0.003
2	8	1	-0.008
3	10	3	-0.013
4	14	7	-0.022
5	24	17	-0.033
6	28	21	-0.038
7	35	28	-0.045
8			
9			
10			
11			
12			



ASTM C157-17 - Length Change of Hardened Hydraulic-Cement Mortar and Concrete

Project Number: 2024.2669 **Lab Coordinator:** K. Pattaje **Project Manager:** T. nelson

Operator: L. ZEGLER **Date:** 7/13/2024

Checked by: K. Pattaje **Date:** 8/16/2024

Mix ID: MIX 6-2

Date Cast: 7/12/2024

Type of Material: [x] Concrete [ ] Mortar [ ] ______

Specimen Size: [ ] 3 x 3 x 11.25 in [x] 4 x 4 x 11.25 in [ ] ______

Mix Temp. (°F): ______

Slump (in.): ______

Consolidation: [ ] Rodding [x] Vibration [ ] ______

Max. Size of Aggregate: [x] 3/4" [ ] 1/2" [ ] ______

Number of Specimens: 3

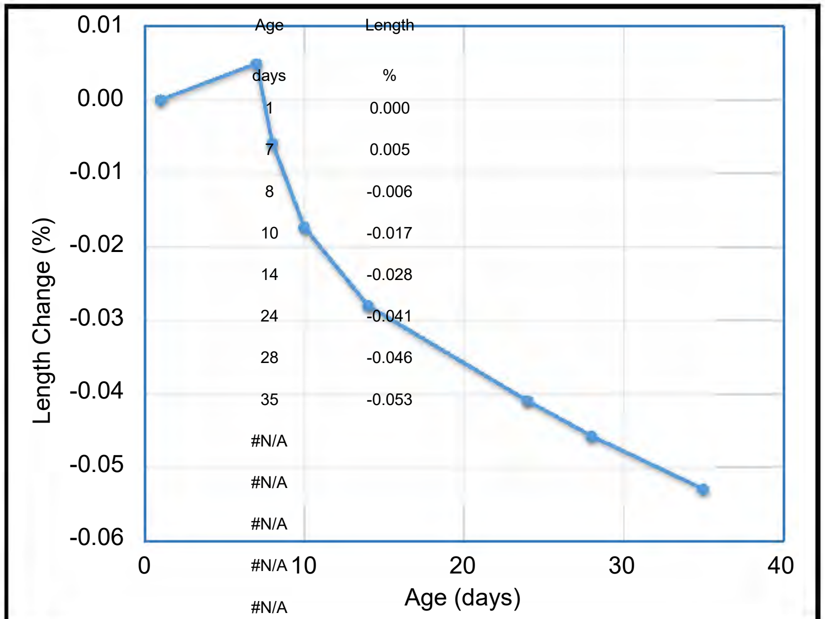
Curing Duration (days): 7

Storage Condition: [ ] Water [x] Air [ ] ______

Length Comparator: [x] SN: 11200975 [ ] SN: 12210636 [ ] ______

Dial Gage: [ ] SN: 204402 [ ] ______

Reading #	Age (days)	Time of Storage (days)	Average Length Change (%)
0	1	Before cure	0.000
1	7	0	0.005
2	8	1	-0.006
3	10	3	-0.017
4	14	7	-0.028
5	24	17	-0.041
6	28	21	-0.046
7	35	28	-0.053
8			
9			
10			
11			
12			



WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: R. Bee, D. Witte **Date:** 7/17/2024

Checked by: Karthik Pattaje **Date:** 9/10/2024

Mix ID: Mix 1_3 **Curing Type:** ☐ Moist curing w/ wet burlap ☒ Other

Date and Time of Batching: 7/17/24 9:40 AM **Curing Duration (hr):** 24

Sample ID	Gauge #	Initial Strain (in/in x 10^{-6})	Maximum Strain (in/in x 10^{-6})	Stress Rate (psi/day)	Age at Cracking* (day)	Notes
A	1	4	-45	16	19.25	
	2	5	-71	23		
	3	4	-53	19		
	4	2	-70	21		
	Average	*4*	*-60*	*20*		
B	1	4	-81	21	23.75	
	2					
	3	5	-67	16		
	4	3	-75	19		
	Average	*4*	*-74*	*19*		
C	1	6	-66	17	23.25	
	2					
	3	1	-59	14		
	4	3	-62	16		
	Average	*3*	*-63*	*16*		
Average		**4**	**-66**	**18**	**22**	--

* Or termination of test (if noted in comments below)

Comments: Strain gauge #2 in rings B and C not considered

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

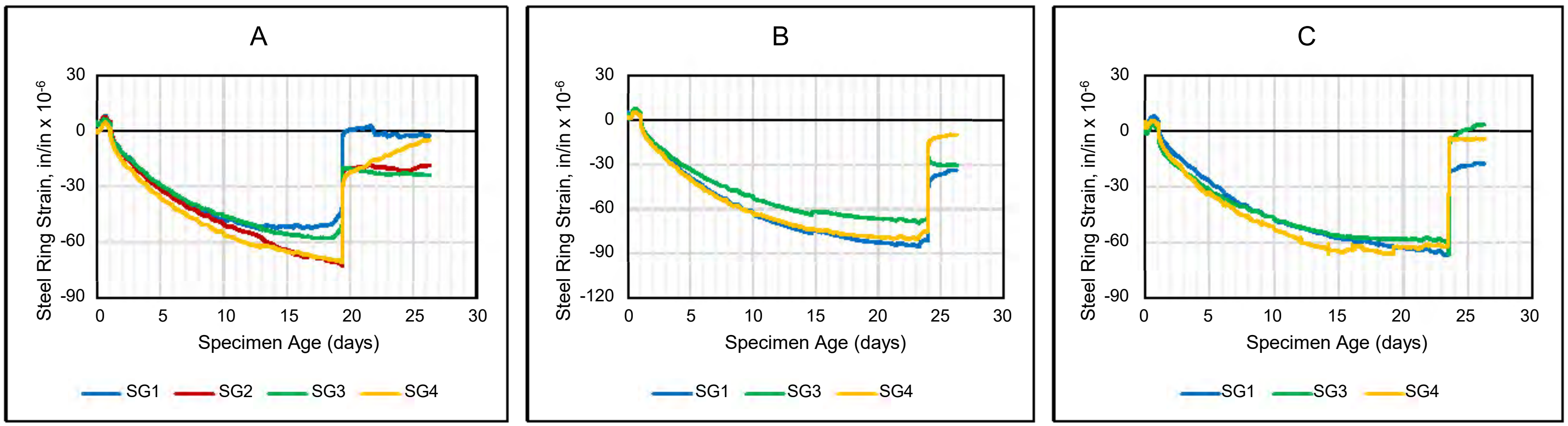
Operator: R. Bee, D. Witte **Date:** 7/17/2024

Checked by: Karthik Pattaje **Date:** 9/10/2024

Mix ID: Mix 1_3 **Curing Type:** ▫ Moist curing w/ wet burlap ▪ Other

Date and Time of Batching: 7/17/24 9:40 AM **Curing Duration (hr):** 24

Steel Ring Strain vs. Specimen Age



Comments: Strain gauge #2 in rings B and C not considered

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: R. Bee, D. Witte **Date:** 7/17/2024

Checked by: Karthik Pattaje **Date:** 9/10/2024

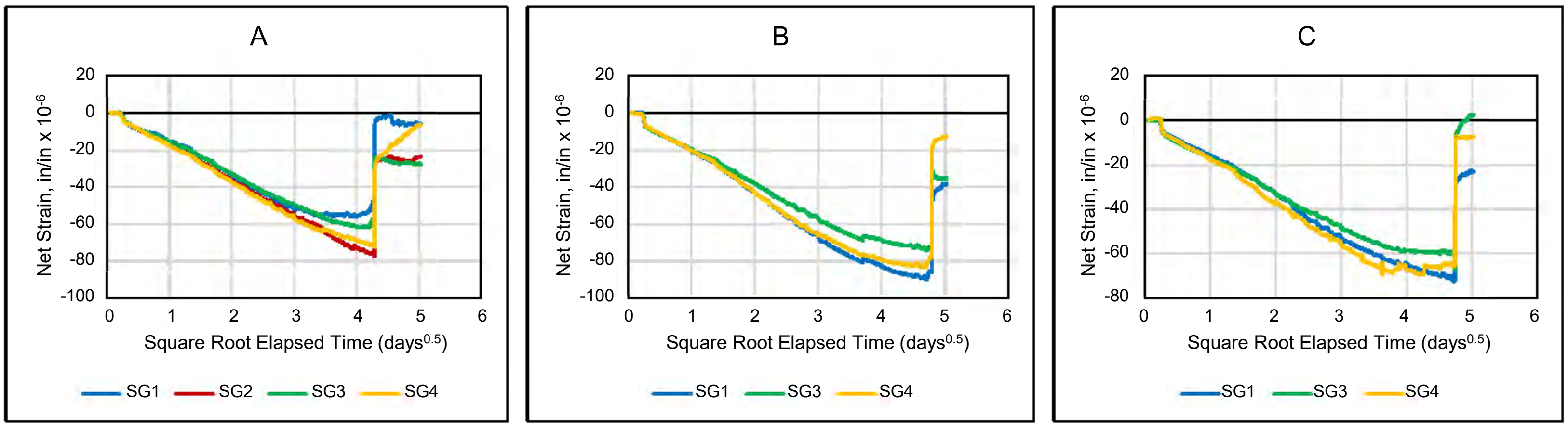
Mix ID: Mix 1_3

Curing Type:
- ☐ Moist curing w/ wet burlap
- ☒ Other

Date and Time of Batching: 7/17/24 9:40 AM

Curing Duration (hr): 24

Net Strain vs. Square Root Elapsed Time



Comments: Strain gauge #2 in rings B and C not considered

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: R. Bee, D. Witte **Date:** 7/17/2024

Checked by: K. Pattaje **Date:** 9/11/2024

Mix ID: Mix 2_3 **Curing Type:** ▫ Moist curing w/ wet burlap ▫ Other

Date and Time of Batching: 7/17/24 10:34 AM **Curing Duration (hr):** 24

Sample ID	Gauge #	Initial Strain (in/in x 10^{-6})	Maximum Strain (in/in x 10^{-6})	Stress Rate (psi/day)	Age at Cracking* (day)	Notes
A	1					Data from this ring was not considered for analysis.
	2					
	3					
	4					
	Average					
B	1	5	-45	12	23.25	
	2	2	-54	14		
	3	0	-65	15		
	4					
	Average	*2*	*-55*	*14*		
C	1	2	-58	18	20.00	
	2	2	-51	16		
	3	1	-49	15		
	4	0	-54	15		
	Average	*1*	*-53*	*16*		
Average		**2**	**-54**	**15**	**22**	**--**

* Or termination of test (if noted in comments below)

Comments: Strain gauge #2 in ring A and #4 in C not considered

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

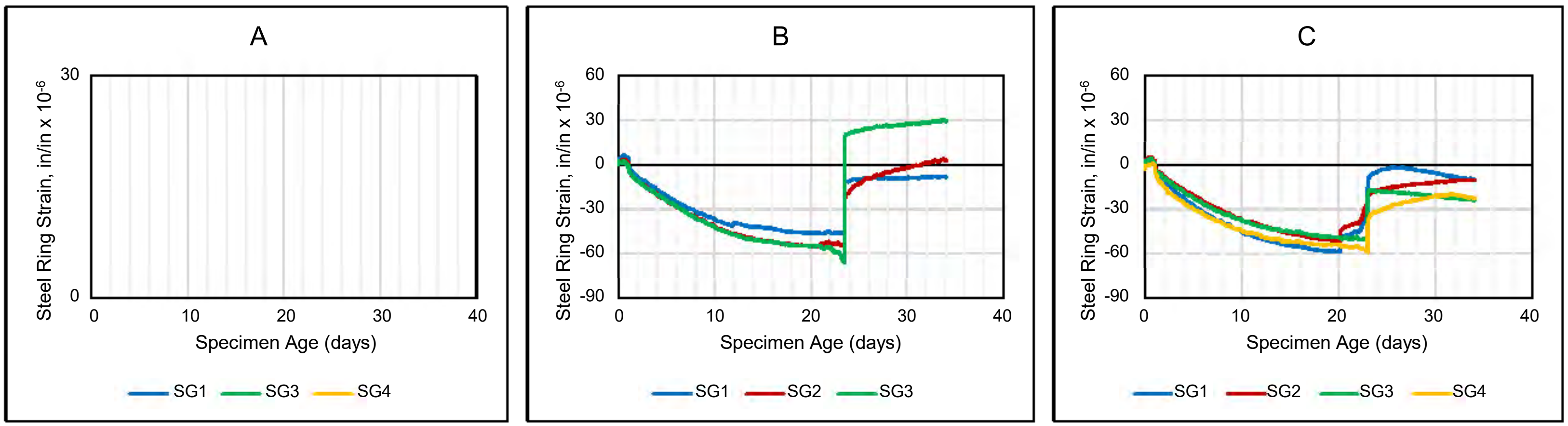
Operator: R. Bee, D. Witte **Date:** 7/17/2024

Checked by: K. Pattaje **Date:** 9/11/2024

Mix ID: Mix 2_3 **Curing Type:** ◘ Moist curing w/ wet burlap ◘ Other

Date and Time of Batching: 7/17/24 10:34 AM **Curing Duration (hr):** 24

Steel Ring Strain vs. Specimen Age



Comments: Strain gauge #2 in ring A and #4 in C not considered

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

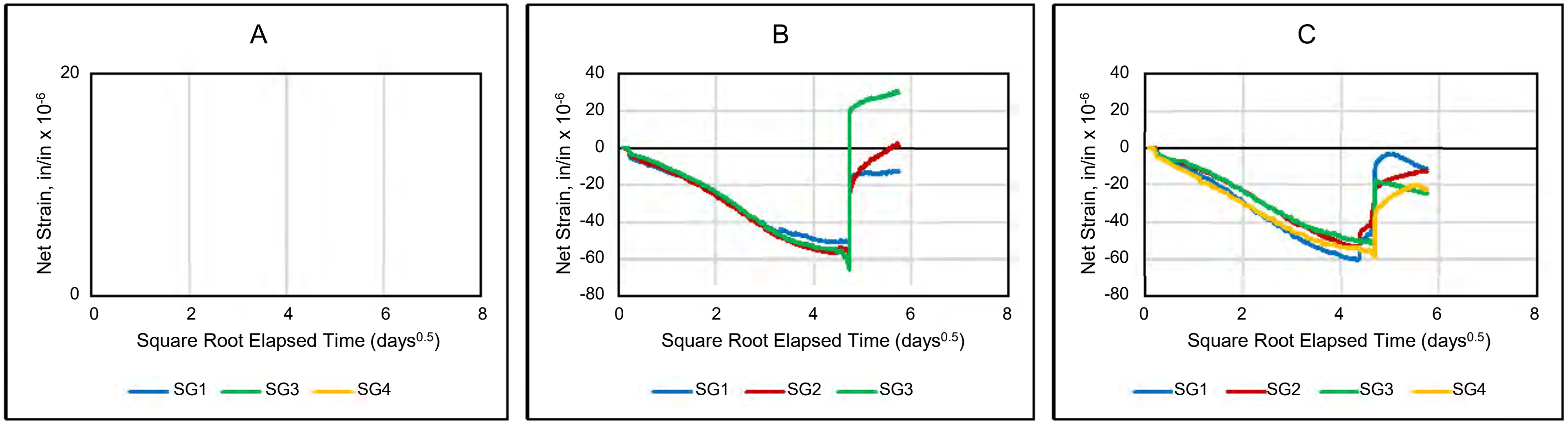
Operator: R. Bee, D. Witte **Date:** 7/17/2024

Checked by: K. Pattaje **Date:** 9/11/2024

Mix ID: Mix 2_3 **Curing Type:** ◽ Moist curing w/ wet burlap ◽ Other

Date and Time of Batching: 7/17/24 10:34 AM **Curing Duration (hr):** 24

Net Strain vs. Square Root Elapsed Time



Comments: Strain gauge #2 in ring A and #4 in C not considered

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: R. Bee, D. Witte **Date:** 7/18/2024

Checked by: K. Pattaje **Date:** 9/11/2024

Mix ID: Mix 3_3 **Curing Type:** ▫ Moist curing w/ wet burlap ▫ Other

Date and Time of Batching: 7/18/24 3:00 PM **Curing Duration (hr):** 24

Sample ID	Gauge #	Initial Strain (in/in x 10^{-6})	Maximum Strain (in/in x 10^{-6})	Stress Rate (psi/day)	Age at Cracking* (day)	Notes
A	1	1	-68	34	14.00	
	2	0	-71	34		
	3	1	-54	29		
	4					
	Average	*0*	*-64*	*32*		
B	1	2	-48	32	10.75	
	2	-1	-61	37		
	3	-4	-42	24		
	4	-1	-47	30		
	Average	*-1*	*-50*	*31*		
C	1	2	-45	23	15.75	
	2	-1	-57	24		
	3	2	-49	22		
	4	1	-47	23		
	Average	*1*	*-49*	*23*		
Average		**0**	**-54**	**29**	**14**	**--**

* Or termination of test (if noted in comments below)

Comments: Ring A SG#4 omitted

ENGINEERS
ARCHITECTS
MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: R. Bee, D. Witte **Date:** 7/18/2024

Checked by: K. Pattaje **Date:** 9/11/2024

Mix ID: Mix 3_3 **Curing Type:** ▫ Moist curing w/ wet burlap ▫ Other

Date and Time of Batching: 7/18/24 3:00 PM **Curing Duration (hr):** 24

Steel Ring Strain vs. Specimen Age

Comments:

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

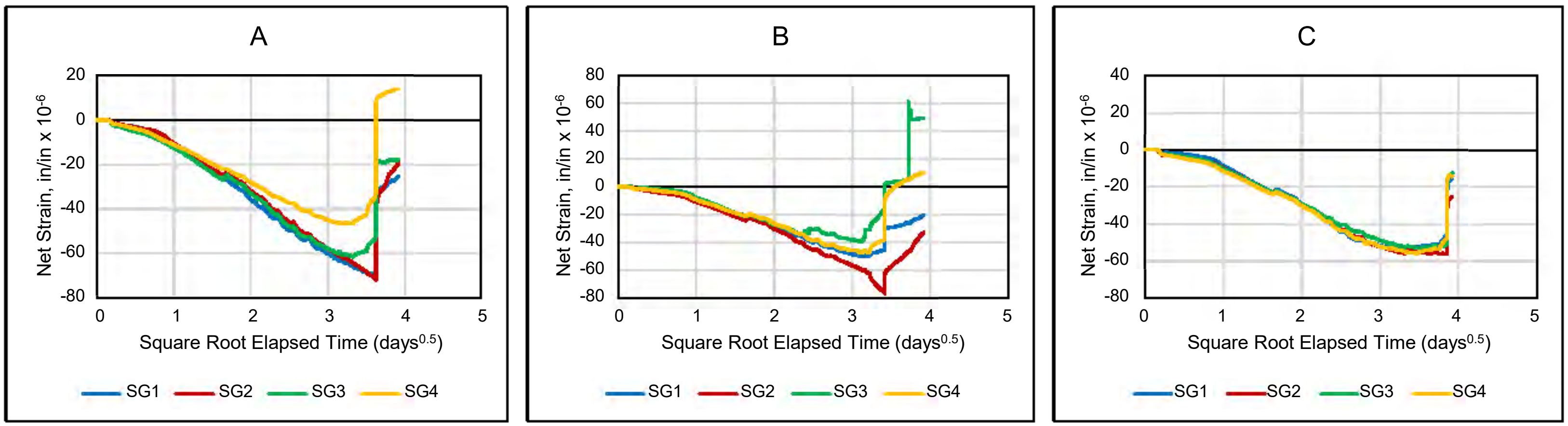
Operator: R. Bee, D. Witte **Date:** 7/18/2024

Checked by: K. Pattaje **Date:** 9/11/2024

Mix ID: Mix 3_3 **Curing Type:** ◘ Moist curing w/ wet burlap ◘ Other

Date and Time of Batching: 7/18/24 3:00 PM **Curing Duration (hr):** 24

Net Strain vs. Square Root Elapsed Time



Comments: Ring A SG#4 omitted

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: R. Bee, D. Witte **Date:** 8/22/2024

Checked by: K. Pattaje **Date:** 9/25/2024

Mix ID: Mix 4_4 **Curing Type:** ▫ Moist curing w/ wet burlap ▫ Other

Date and Time of Batching: 8/22/24 9:04 AM **Curing Duration (hr):** 26

Sample ID	Gauge #	Initial Strain (in/in x 10^{-6})	Maximum Strain (in/in x 10^{-6})	Stress Rate (psi/day)	Age at Cracking* (day)	Notes
A	1	-3	-71	20	19.25	
	2	-4	-70	20		
	3	-4	-96	28		
	4	-1	-63	18		
	Average	*-3*	*-75*	*21*		
B	1	-3	-84	17	24.75	
	2					
	3	1	-77	17		
	4	1	-74	16		
	Average	*0*	*-78*	*17*		
C	1	-2	-77	23	18.00	
	2					
	3	3	-70	20		
	4	-2	-68	19		
	Average	*0*	*-72*	*21*		
Average		**-1**	**-75**	**20**	**21**	**--**

* Or termination of test (if noted in comments below)

Comments: SG 2 of Ring B and Ring C omitted

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

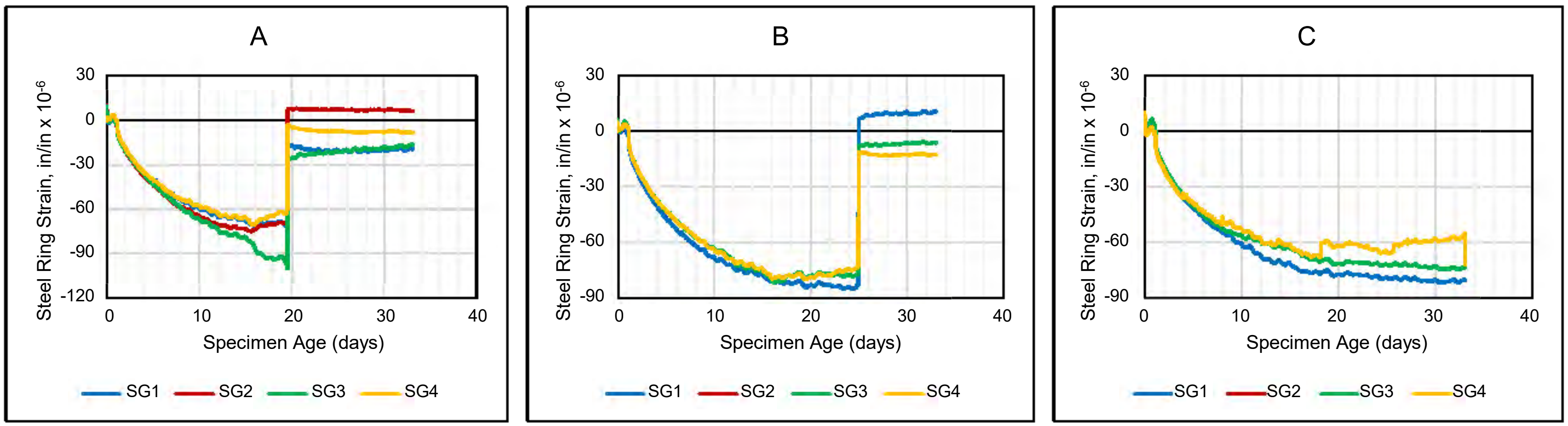
Operator: R. Bee, D. Witte **Date:** 8/22/2024

Checked by: K. Pattaje **Date:** 9/25/2024

Mix ID: Mix 4_4 **Curing Type:** ◘ Moist curing w/ wet burlap ◘ Other

Date and Time of Batching: 8/22/24 9:04 AM **Curing Duration (hr):** 26

Steel Ring Strain vs. Specimen Age



Comments: SG 2 of Ring B and Ring C omitted

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

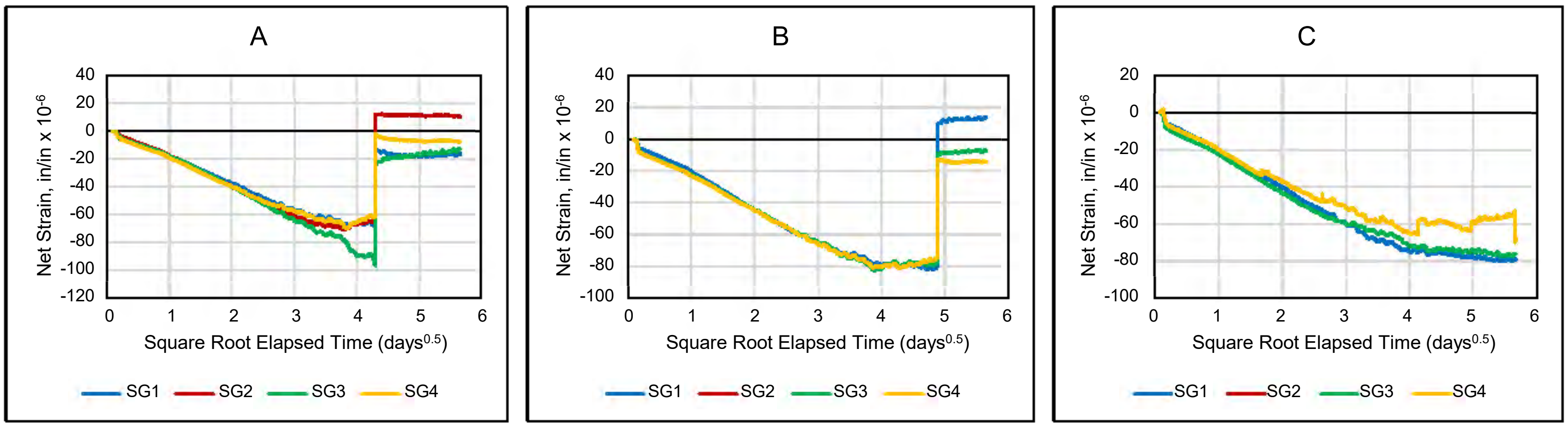
Operator: R. Bee, D. Witte **Date:** 8/22/2024

Checked by: K. Pattaje **Date:** 9/25/2024

Mix ID: Mix 4_4 **Curing Type:** ▫ Moist curing w/ wet burlap ▫ Other

Date and Time of Batching: 8/22/24 9:04 AM **Curing Duration (hr):** 26

Net Strain vs. Square Root Elapsed Time



Comments: SG 2 of Ring B and Ring C omitted

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: R. Bee, D. Witte **Date:** 8/22/2024

Checked by: K. Pattaje **Date:** 9/25/2024

Mix ID: Mix 5_4

Date and Time of Batching: 8/22/24 9:38 AM

Curing Type: ▫ Moist curing w/ wet burlap ▫ Other

Curing Duration (hr): 26

Sample ID	Gauge #	Initial Strain (in/in x 10^{-6})	Maximum Strain (in/in x 10^{-6})	Stress Rate (psi/day)	Age at Cracking* (day)	Notes
A	1	-4	-64	23	16.00	
	2					
	3	-1	-52	20		
	4	-4	-51	19		
	Average	*-3*	*-56*	*21*		
B	1	-3	-53	17	19.00	
	2	-2	-58	19		
	3	-3	-28	10		
	4					
	Average	*-3*	*-46*	*15*		
C	1	-1	-60	18	20.25	
	2	-2	-50	15		
	3	-2	-53	17		
	4	-2	-45	14		
	Average	*-2*	*-52*	*16*		
Average		**-3**	**-51**	**17**	**18**	**--**

* Or termination of test (if noted in comments below)

Comments: Ring A SG2 and Ring B SG4 omitted

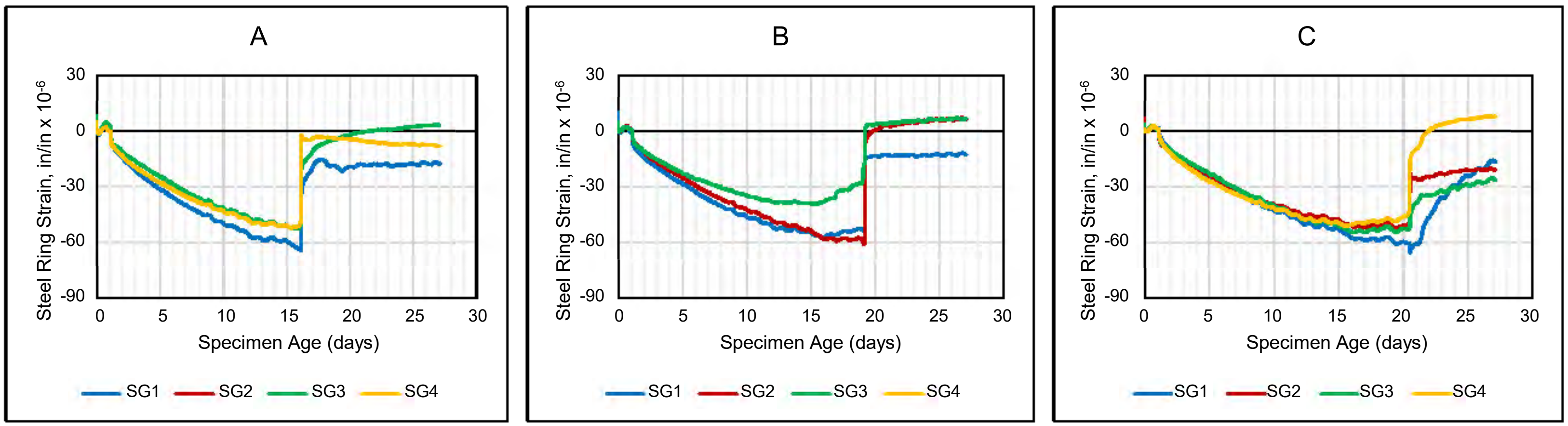
ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator:	R. Bee, D. Witte	**Date:**	8/22/2024
Checked by:	K. Pattaje	**Date:**	9/25/2024

Mix ID:	Mix 5_4	**Curing Type:**	▫ Moist curing w/ wet burlap ▫ Other
Date and Time of Batching:	8/22/24 9:38 AM	**Curing Duration (hr):**	26

Steel Ring Strain vs. Specimen Age



Comments: Ring A SG2 and Ring B SG4 omitted

Wiss, Janney, Elstner Associates, Inc.
ISO 17025 Quality Assurance Program
TL 165

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

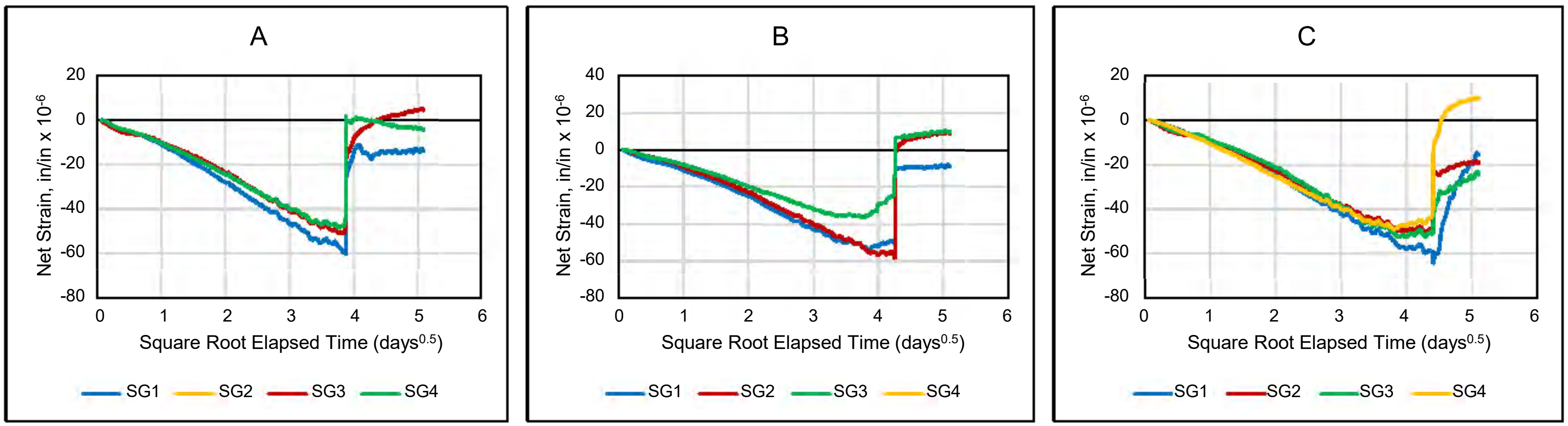
Operator: R. Bee, D. Witte **Date:** 8/22/2024

Checked by: K. Pattaje **Date:** 9/25/2024

Mix ID: Mix 5_4 **Curing Type:** ◘ Moist curing w/ wet burlap ◘ Other

Date and Time of Batching: 8/22/24 9:38 AM **Curing Duration (hr):** 26

Net Strain vs. Square Root Elapsed Time



Comments: Ring A SG2 and Ring B SG4 omitted

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: R. Bee, D. Witte **Date:** 8/26/2024

Checked by: K. Pattaje **Date:** 9/25/2024

Mix ID: Mix 6_4 **Curing Type:** ▫ Moist curing w/ wet burlap ▫ Other

Date and Time of Batching: 8/26/24 2:10 PM **Curing Duration (hr):** 24

Sample ID	Gauge #	Initial Strain (in/in x 10^{-6})	Maximum Strain (in/in x 10^{-6})	Stress Rate (psi/day)	Age at Cracking* (day)	Notes
A	1	1	-55	37	10.75	
	2	1	-59	39		
	3	1	-54	34		
	4					
	Average	*1*	*-56*	*37*		
B	1	1	-43	22	15.00	
	2					
	3	2	-54	26		
	4	0	-42	22		
	Average	*1*	*-46*	*24*		
C	1	0	-57	26	15.25	
	2	1	-52	26		
	3	1	-31	18		
	4	0	-44	24		
	Average	*1*	*-46*	*24*		
Average		**1**	**-49**	**28**	**14**	**--**

* Or termination of test (if noted in comments below)

Comments: SG 4 of Ring A and SG 2 of Ring B omitted

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

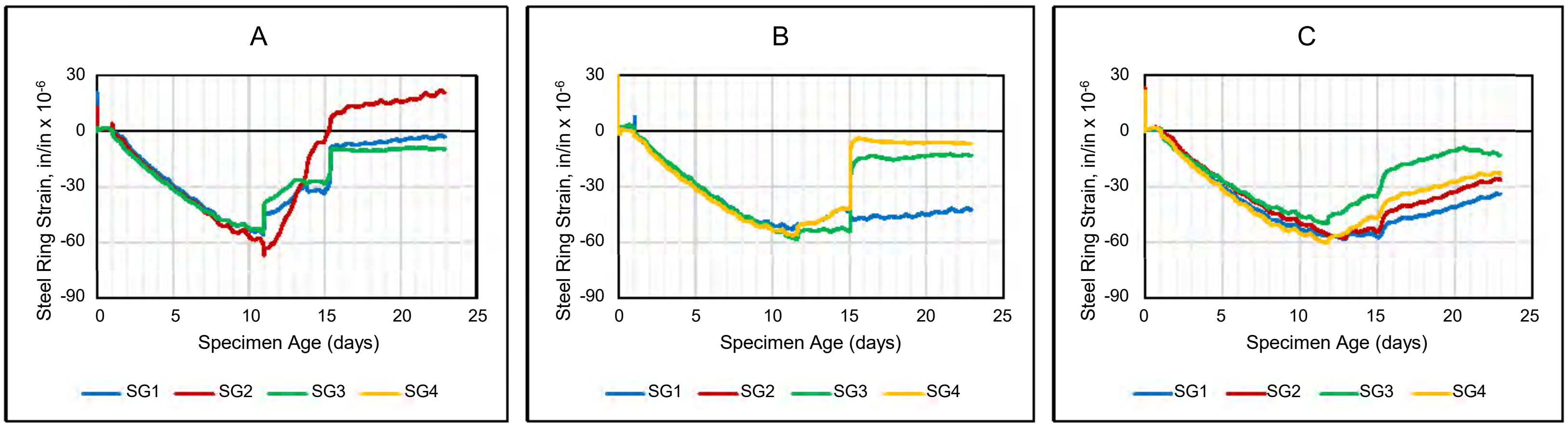
Operator: R. Bee, D. Witte **Date:** 8/26/2024

Checked by: K. Pattaje **Date:** 9/25/2024

Mix ID: Mix 6_4 **Curing Type:** ▫ Moist curing w/ wet burlap ▫ Other

Date and Time of Batching: 8/26/24 2:10 PM **Curing Duration (hr):** 24

Steel Ring Strain vs. Specimen Age



Comments: SG 4 of Ring A and SG 2 of Ring B omitted

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C1581 - Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

WJE Project No: 2024.2669 **Project Coordinator:** T. Nelson

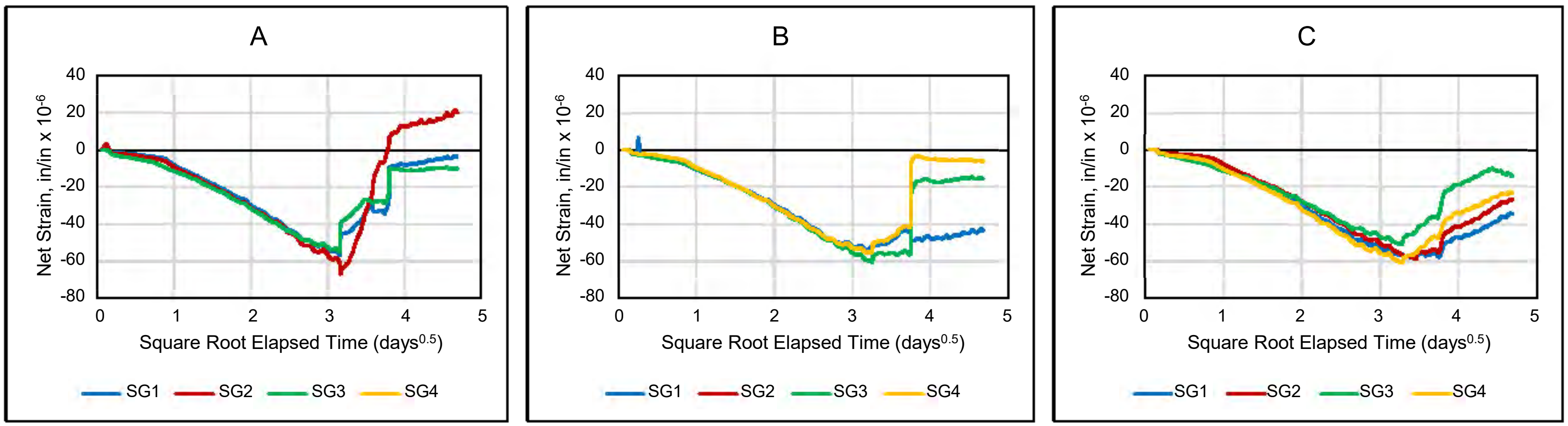
Operator: R. Bee, D. Witte **Date:** 8/26/2024

Checked by: K. Pattaje **Date:** 9/25/2024

Mix ID: Mix 6_4 **Curing Type:** ◘ Moist curing w/ wet burlap ◘ Other

Date and Time of Batching: 8/26/24 2:10 PM **Curing Duration (hr):** 24

Net Strain vs. Square Root Elapsed Time



Comments: SG 4 of Ring A and SG 2 of Ring B omitted

AASHTO T336 - Coefficient of Thermal Expansion of Hyrdraulic Cement Concrete

Project Number: 2024.2669.0 **Project Coordinator:** T. Nelson

Operator: D. Witte **Test Date:** 12/8/2023

Checked by: L. Pham **Review Date:** 8/23/2024

Mix ID: Mix 1_1

Specimen Type: ☑ Cast ☐ Cored ☐

Date Cast: 7/11/2024

Curing Duration (days): 28

Specimen Age (days): 28

Calibration Sample Material: SS 304

Calibration Sample CTE (10^{-6}/°C): 16.20

Curing Condition ☑ Saturated ☐

Specimen Dia. (in): 4

Verification Sample Material: SS 440C

Verification Sample CTE (10^{-6}/°C): 10.40

Specimen ID	Length (in)	Correction Factor (10-6/°C)	Segment	Start Temperature (°C)	Start LVDT Reading (in.)	End Temperature (°C)	End LVDT Reading (in.)	Measured Length Change, ΔLm (in.)	Length Change of Frame, ΔLf (in.)	Actual Length Change, ΔLa (in.)	Concrete CTE (10-6/°C)	Concrete CTE (10-6/°F)
Mix 1 Cylinder A	7.006	3.19	Heating	10.0	0.000201	50.0	0.002142	0.001941	8.95E-04	2.84E-03	10.11	5.62
			Cooling	50.0	0.002142	10.0	0.000213	-0.001929	-8.96E-04	-2.82E-03	10.06	5.59
			Sample 1 CTE (Avergage of two segments)								10.09	5.60
Mix 1 Cylinder B	7.022	-0.21	Heating	10.1	0.000001	50.0	0.002878	0.002877	-5.89E-05	2.82E-03	10.05	5.58
			Cooling	50.0	0.002878	10.1	0.000012	-0.002866	5.89E-05	-2.81E-03	10.00	5.56
			Sample 2 CTE (Avergage of two segments)								10.03	5.57

Concrete Mixture CTE (10-6/°C and 10-6/°F, respectively)	10.1	5.6

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

AASHTO T336 - Coefficient of Thermal Expansion of Hyrdraulic Cement Concrete

Project Number: 2024.2669.0 **Project Coordinator:** T. Nelson

Operator: D. Witte **Test Date:** 12/8/2023

Checked by: L. Pham **Review Date:** 8/23/2024

Mix ID: Mix 2_1

Date Cast: 7/11/2024

Curing Duration (days): 30

Curing Condition ☑ Saturated ☐

Specimen Type: ☑ Cast ☐ Cored ☐

Specimen Age (days): 30

Specimen Dia. (in): 4

Calibration Sample Material: SS 304
Calibration Sample CTE (10^{-6}/°C): 16.20

Verification Sample Material: SS 440C
Verification Sample CTE (10^{-6}/°C): 10.40

Specimen ID	Length (in)	Correction Factor (10-6/°C)	Segment	Start Temperature (°C)	Start LVDT Reading (in.)	End Temperature (°C)	End LVDT Reading (in.)	Measured Length Change, ΔLm (in.)	Length Change of Frame, ΔLf (in.)	Actual Length Change, ΔLa (in.)	Concrete CTE (10-6/°C)	Concrete CTE (10-6/°F)
Mix 2 Cylinder A	6.959	3.19	Heating	9.9								
			Cooling	50.0								
			Sample 1 CTE (Avergage of two segments) *Invalid test data due to instrumentation error									
Mix 2 Cylinder B	6.954	-0.21	Heating	10.0	0.001568	50.1	0.004331	0.002763	-5.85E-05	2.70E-03	**9.71**	**5.39**
			Cooling	50.1	0.004331	10.0	0.001586	-0.002745	5.85E-05	-2.69E-03	**9.64**	**5.36**
			Sample 2 CTE (Avergage of two segments)								**9.68**	**5.38**

Concrete Mixture CTE (10-6/°C and 10-6/°F, respectively)	9.7	5.4

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

AASHTO T336 - Coefficient of Thermal Expansion of Hyrdraulic Cement Concrete

Project Number: 2024.2669.0 **Project Coordinator:** T. Nelson

Operator: D. Witte **Test Date:** 12/8/2023

Checked by: L. Pham **Review Date:** 8/23/2023

Mix ID: Mix 3_1

Specimen Type: ☑ Cast ☐ Cored ☐

Date Cast: 7/11/2024

Curing Duration (days): 32

Specimen Age (days): 32

Calibration Sample Material: SS 304

Calibration Sample CTE (10^{-6}/°C): 16.20

Curing Condition ☑ Saturated ☐

Specimen Dia. (in): 4

Verification Sample Material: SS 440C

Verification Sample CTE (10^{-6}/°C): 10.40

Specimen ID	Length (in)	Correction Factor (10-6/°C)	Segment	Start Temperature (°C)	Start LVDT Reading (in.)	End Temperature (°C)	End LVDT Reading (in.)	Measured Length Change, ΔLm (in.)	Length Change of Frame, ΔLf (in.)	Actual Length Change, ΔLa (in.)	Concrete CTE (10-6/°C)	Concrete CTE (10-6/°F)
Mix 3 Cylinder A	6.960	3.19	Heating	9.8	-0.000477	50.1	0.001646	0.002123	8.94E-04	3.02E-03	**10.76**	**5.98**
			Cooling	50.1	0.001646	9.8	-0.000437	-0.002083	-8.94E-04	-2.98E-03	**10.62**	**5.90**
			Sample 1 CTE (Avergage of two segments)								**10.69**	**5.94**
Mix 3 Cylinder B	7.055	-0.21	Cooling	50.0	0.001854	9.8	-0.001045	-0.002899	5.96E-05	-2.84E-03	**10.00**	**5.56**
			Heating	9.8	-0.001045	50.0	0.001818	0.002863	-5.96E-05	2.80E-03	**9.88**	**5.49**
			Sample 2 CTE (Avergage of two segments)								**9.94**	**5.52**

Concrete Mixture CTE (10-6/°C and 10-6/°F, respectively)	10.3	5.7

AASHTO T336 - Coefficient of Thermal Expansion of Hyrdraulic Cement Concrete

Project Number: 2024.2669.0 **Project Coordinator:** T. Nelson

Operator: D. Witte **Test Date:** 12/8/2023

Checked by: L. Pham **Review Date:** 8/23/2024

Mix ID: Mix 4_1

Date Cast: 7/12/2024

Specimen Type: ☑ Cast ☐ Cored ☐

Curing Duration (days): 34

Specimen Age (days): 34

Calibration Sample Material: SS 304

Calibration Sample CTE (10^{-6}/°C): 16.20

Curing Condition ☑ Saturated ☐

Specimen Dia. (in): 4

Verification Sample Material: SS 440C

Verification Sample CTE (10^{-6}/°C): 10.40

Specimen ID	Length (in)	Correction Factor (10-6/°C)	Segment	Start Temperature (°C)	Start LVDT Reading (in.)	End Temperature (°C)	End LVDT Reading (in.)	Measured Length Change, ΔLm (in.)	Length Change of Frame, ΔLf (in.)	Actual Length Change, ΔLa (in.)	Concrete CTE (10-6/°C)	Concrete CTE (10-6/°F)
Mix 4 Cylinder A	7.039	3.19	Cooling	50.1	-0.000459	9.8	-0.002283	-0.001824	-9.05E-04	-2.73E-03	**9.62**	**5.35**
			Heating	9.8	-0.002283	50.1	-0.000441	0.001842	9.05E-04	2.75E-03	**9.69**	**5.38**
			Sample 1 CTE (Avergage of two segments)								**9.65**	**5.36**
Mix 4 Cylinder B	7.015	-0.21	Heating	9.9	-0.002757	50.1	-0.000031	0.002726	-5.92E-05	2.67E-03	**9.47**	**5.26**
			Cooling	50.1	-0.000031	9.9	-0.002746	-0.002715	5.91E-05	-2.66E-03	**9.43**	**5.24**
			Sample 2 CTE (Avergage of two segments)								**9.45**	**5.25**

Concrete Mixture CTE (10-6/°C and 10-6/°F, respectively)	**9.6**	**5.3**

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

AASHTO T336 - Coefficient of Thermal Expansion of Hyrdraulic Cement Concrete

Project Number: 2024.2669.0 **Project Coordinator:** T. Nelson

Operator: D. Witte **Test Date:** 12/8/2023

Checked by: L. Pham **Review Date:** 8/23/2024

Mix ID: Mix 5_1

Date Cast: 7/12/2024

Specimen Type: ☑ Cast ☐ Cored ☐

Curing Duration (days): 36

Specimen Age (days): 36

Calibration Sample Material: SS 304

Calibration Sample CTE (10^{-6}/°C): 16.20

Curing Condition ☑ Saturated ☐

Specimen Dia. (in): 4

Verification Sample Material: SS 440C

Verification Sample CTE (10^{-6}/°C): 10.40

Specimen ID	Length (in)	Correction Factor (10-6/°C)	Segment	Start Temperature (°C)	Start LVDT Reading (in.)	End Temperature (°C)	End LVDT Reading (in.)	Measured Length Change, ΔLm (in.)	Length Change of Frame, ΔLf (in.)	Actual Length Change, ΔLa (in.)	Concrete CTE (10-6/°C)	Concrete CTE (10-6/°F)
Mix 5 Cylinder A	7.056	3.19	Heating	9.9	-0.001405	50.1	0.000437	0.001842	9.03E-04	2.75E-03	**9.70**	**5.39**
			Cooling	50.1	0.000437	9.9	-0.001384	-0.001821	-9.04E-04	-2.73E-03	**9.61**	**5.34**
			Sample 1 CTE (Avergage of two segments)								**9.65**	**5.36**
Mix 5 Cylinder B	7.047	-0.21	Heating	9.9	-0.001264	50.1	0.001554	0.002818	-5.95E-05	2.76E-03	**9.74**	**5.41**
			Cooling	50.1	0.001554	9.9	-0.001267	-0.002821	5.95E-05	-2.76E-03	**9.75**	**5.42**
			Sample 2 CTE (Avergage of two segments)								**9.75**	**5.41**

Concrete Mixture CTE (10-6/°C and 10-6/°F, respectively)	9.7	5.4

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

AASHTO T336 - Coefficient of Thermal Expansion of Hyrdraulic Cement Concrete

Project Number: 2024.2669.0 **Project Coordinator:** T. Nelson

Operator: D. Witte **Test Date:** 12/8/2023

Checked by: L. Pham **Review Date:** 8/23/2024

Mix ID: Mix 6_1 **Specimen Type:** ☑ Cast ☐ Cored ☐

Date Cast: 7/12/2024

Curing Duration (days): 38 **Specimen Age (days):** 38

Calibration Sample Material: SS 304
Calibration Sample CTE (10^{-6}/°C): 16.20

Curing Condition ☑ Saturated ☐ **Specimen Dia. (in):** 4

Verification Sample Material: SS 440C
Verification Sample CTE (10^{-6}/°C): 10.40

Specimen ID	Length (in)	Correction Factor (10-6/°C)	Segment	Start Temperature (°C)	Start LVDT Reading (in.)	End Temperature (°C)	End LVDT Reading (in.)	Measured Length Change, ΔLm (in.)	Length Change of Frame, ΔLf (in.)	Actual Length Change, ΔLa (in.)	Concrete CTE (10-6/°C)	Concrete CTE (10-6/°F)
Mix 6 Cylinder A	7.020	3.19	Cooling	50.1	0.001120	9.8	-0.000795	-0.001915	-9.02E-04	-2.82E-03	**9.97**	**5.54**
			Heating	9.8	-0.000795	50.1	0.001124	0.001919	9.02E-04	2.82E-03	**9.98**	**5.54**
			Sample 1 CTE (Avergage of two segments)								**9.97**	**5.54**
Mix 6 Cylinder B	7.014	-0.21	Cooling	50.1	0.002166	9.8	-0.000622	-0.002788	5.93E-05	-2.73E-03	**9.67**	**5.37**
			Heating	9.8	-0.000622	50.1	0.002179	0.002801	-5.93E-05	2.74E-03	**9.71**	**5.40**
			Sample 2 CTE (Avergage of two segments)								**9.69**	**5.38**

Concrete Mixture CTE (10-6/°C and 10-6/°F, respectively)	9.8	5.5

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 10/9/2024

Checked by: K. Pattaje **Date:** 10/14/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 - A	7.66	144.4	4.03	12.77	73,710	5,771	1.90	1	None	90
Mix 1 - B	7.69	144.5	4.03	12.75	71,020	5,572	1.91	1	None	90
Mix 1 - C	7.67	146.2	4.01	12.65	69,000	5,455	1.91	1	None	90
Average	--	**145**	--	--	--	**5,600**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 1, Tested at 11:55 am

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 10/9/2024

Checked by: K. Pattaje **Date:** 10/14/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft^3)	Avg. Dia. (in.)	Area (in.^{2})	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 2 - A	7.71	145.0	4.02	12.67	72,670	5,735	1.92	1	None	90
Mix 2 - B	7.69	145.2	4.03	12.74	71,150	5,585	1.91	1	None	90
Mix 2 - C	7.70	145.3	4.02	12.67	74,970	5,918	1.92	2	None	90
Average	--	**145**	--	--	--	**5,750**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 2, Tested at 12:00 pm

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 10/9/2024

Checked by: K. Pattaje **Date:** 10/14/2024

Capping Method
- Sulfur
- Lapped
- ■ End Ground
- Unbonded

Conditioning
- As Received
- ■ Wet
- Dry

Capping
- ■ Plane
- Sound
- Other

Calipers
- 12/060107
- B657697
- ■ Asset# 995

Test Machine
- ■ Test Mark SN# 11005
- Satec ID: 120HLVC1240
- Other

Cast Date: 7/11/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 3 - A	7.77	143.2	4.01	12.65	61,780	4,883	1.94	1	None	90
Mix 3 - B	7.72	145.1	4.01	12.60	62,020	4,921	1.93	1	None	90
Mix 3 - C	7.69	145.0	4.01	12.62	62,650	4,966	1.92	2	None	90
Average	--	**144**	--	--	--	**4,920**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 3 Tested at 12:10 pm

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 10/10/2024

Checked by: K. Pattaje **Date:** 10/14/2024

Capping Method
- [ ] Sulfur
- [ ] Lapped
- [x] End Ground
- [ ] Unbonded

Conditioning
- [ ] As Received
- [x] Wet
- [ ] Dry

Capping
- [x] Plane
- [ ] Sound
- [ ] Other

Calipers
- [ ] 12/060107
- [ ] B657697
- [x] Asset# 995

Test Machine
- [x] Test Mark SN# 11005
- [ ] Satec ID: 120HLVC1240
- [ ] Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 4 - A	7.69	148.9	3.99	12.52	85,630	6,842	1.93	1	None	90
Mix 4 - B	7.72	149.1	3.98	12.46	89,470	7,181	1.94	1	None	90
Mix 4 - C	7.74	149.2	3.99	12.49	85,220	6,821	1.94	2	None	90
Average	--	**149**	--	--	--	**6,950**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Mix 4, Three cylinders tested at 5:15 PM**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 10/10/2024

Checked by: K. Pattaje **Date:** 10/14/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☒ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☒ Wet
- ☐ Dry

Capping
- ☒ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☒ Asset# 995

Test Machine
- ☒ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 5 - A	7.70	147.6	4.00	12.57	67,820	5,396	1.93	1	None	90
Mix 5 - B	7.69	147.3	4.01	12.65	63,060	4,987	1.92	2	None	90
Mix 5 - C	7.69	146.2	4.02	12.68	67,040	5,287	1.91	1	None	90
Average	--	**147**	--	--	--	**5,220**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 5, Three cylinders tested at 5:15 pm

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.2669 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 10/10/2024

Checked by: K. Pattaje **Date:** 10/14/2024

Capping Method
- [ ] Sulfur
- [ ] Lapped
- [x] End Ground
- [ ] Unbonded

Conditioning
- [ ] As Received
- [x] Wet
- [ ] Dry

Capping
- [x] Plane
- [ ] Sound
- [ ] Other

Calipers
- [ ] 12/060107
- [ ] B657697
- [x] Asset# 995

Test Machine
- [x] Test Mark SN# 11005
- [ ] Satec ID: 120HLVC1240
- [ ] Other

Cast Date: 7/12/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 6 - A	7.70	146.1	4.00	12.59	69,020	5,484	1.92	1	None	90
Mix 6 - B	7.71	144.5	4.00	12.55	69,490	5,535	1.93	1	None	90
Mix 6 - C	7.69	145.7	4.00	12.59	73,540	5,839	1.92	1	None	90
Average	--	**145**	--	--	--	**5,620**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 6, Three cylinders tested at 5:15 pm

APPENDIX E. SLAB DESIGN DRAWINGS AND LOCATIONS

DE-RISKING LOW EMBODIED CARBON CONCRETE

PROJECT:

WJE JTC Annex II Partial Floor Slab Replacement

255 Melvin Dr.
Northbrook, IL 60062

CLIENT:

Concrete Strategies

2127 Innerbelt Business Center
Overland, MO 63114

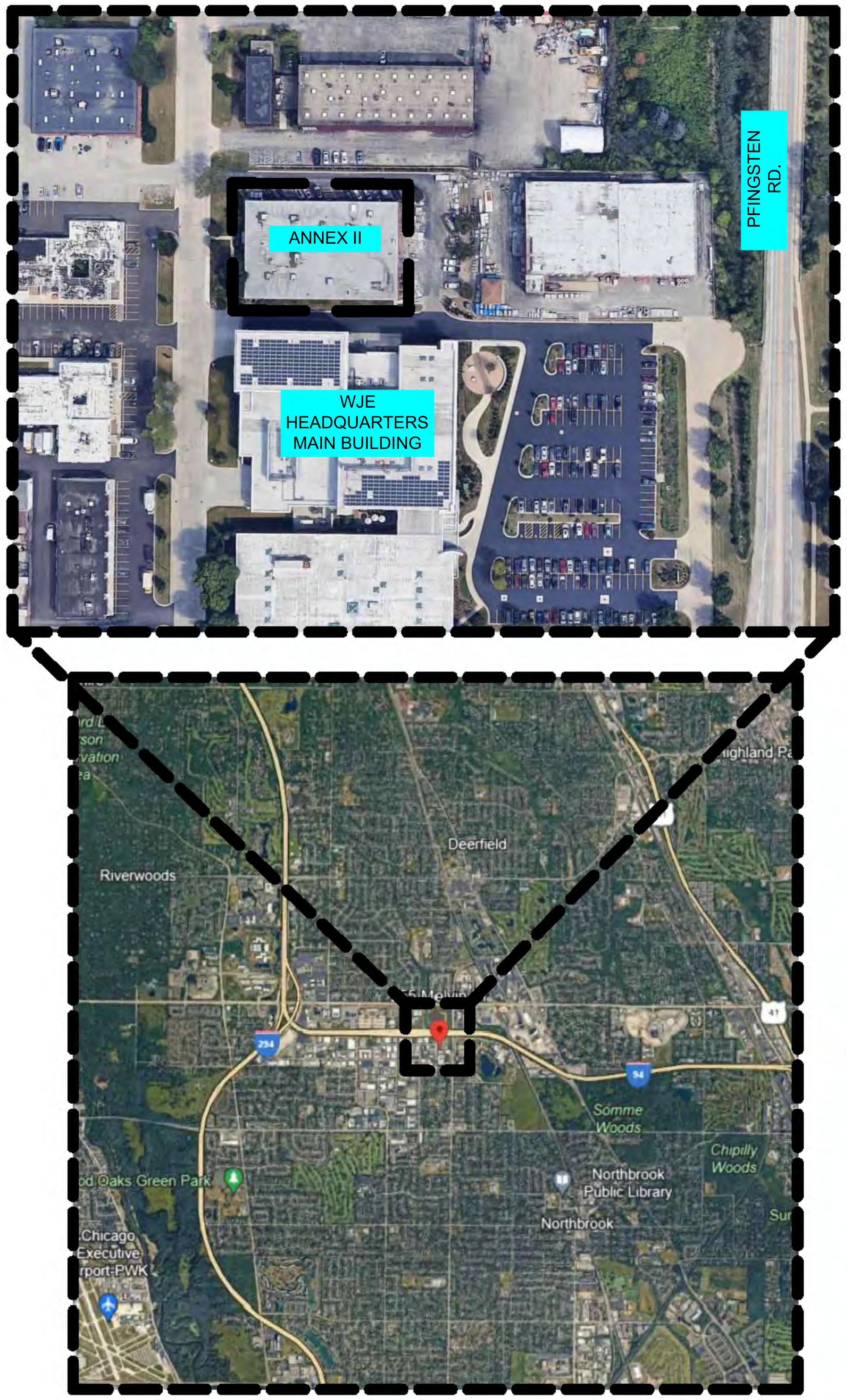
SHEET INDEX

STANDARD SYMBOLS

X / SX.X	ELEVATION CALLOUT
X / SX.X	SECTION CUT CALLOUT
X / SX.X	ENLARGED PLAN OR DETAIL CALLOUT
T/F.F.	ELEMENT ELEVATION MARKER
	CHANGE IN SURFACE ELEVATION
N	NORTH ARROW
	TOP OR BOTTOM BARS, ORIENTED PARALLEL TO MARK.
	TOP OR BOTTOM BARS, ORIENTED PARALLEL TO MARK AND PLACED BETWEEN ARROWS

STANDARD ABBREVIATIONS

ADD'L.	ADDITIONAL
B	BOTTOM BARS
B.O.	BOTTOM OF.....
℄	CENTERLINE
CL.	CLEAR COVER
CONC.	CONCRETE
CONT.	CONTINUOUS(LY)
CJ	CONSTRUCTION JOINT
db	BAR DIAMETER
DL	DEAD LOAD
DIA.	DIAMETER
DIM(S)	DIMENSION(S)
EA.	EACH
E.F.	EACH FACE
E.W.	EACH WAY
E.J.	EXPANSION JOINT
EL. or ELEV.	ELEVATION
EQ.	EQUAL(LY)
EMBED.	EMBEDMENT
EX.	EXISTING
EXT.	EXTERIOR
F.F.	FINISH FLOOR
FND.	FOUNDATION
HDG	HOT-DIP GALVANIZED
INT.	INTERIOR
K	KIPS (1000 lbs.)
LD	TENSION DEVELOPMENT LENGTH
LDH	HOOK BAR DEVELOPMENT LENGTH
LF	LINEAR FEET
LL	LIVE LOAD
MAX.	MAXIMUM
MIN.	MINIMUM
MISC.	MISCELLANEOUS
N.T.S.	NOT TO SCALE
NO. or #	NUMBER
O.C.	ON CENTER
O.H.	OPPOSITE HAND
PAR.	PARAGRAPH
PERP.	PERPENDICULAR
PLF	POUNDS PER LINEAR FOOT
PSF	POUNDS PER SQUARE FOOT
R	RADIUS
REINF.	REINFORCE(D) (MENT) (ING)
REQ'D.	REQUIRED
SIM.	SIMILAR
SF	SQUARE FEET
S.S.	STAINLESS STEEL
TEMP.	TEMPORARY(Y) (ILY)
T	TOP BARS
T/	TOP OF.....
TYP.	TYPICAL(LY)
U.N.O.	UNLESS NOTED OTHERWISE
V.I.F.	VERIFY IN FIELD
VERT.	VERTICAL(LY)
WWR	WELDED WIRE REINFORCEMENT
W/	WITH



N

1 Location Plan
SCALE: NTS

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062
847.272.7400 tel
www.wje.com

Atlanta | Austin | Boston | Chicago | Cleveland | Dallas | Denver | Detroit
Doylestown | Honolulu | Houston | Indianapolis | London | Los Angeles
Milwaukee | Minneapolis | New Haven | Northbrook (HQ) | New York
Pittsburgh | Philadelphia | Portland | Princeton | Raleigh | San Antonio
San Diego | San Francisco | Seattle | South Florida | Washington, DC

Consultants

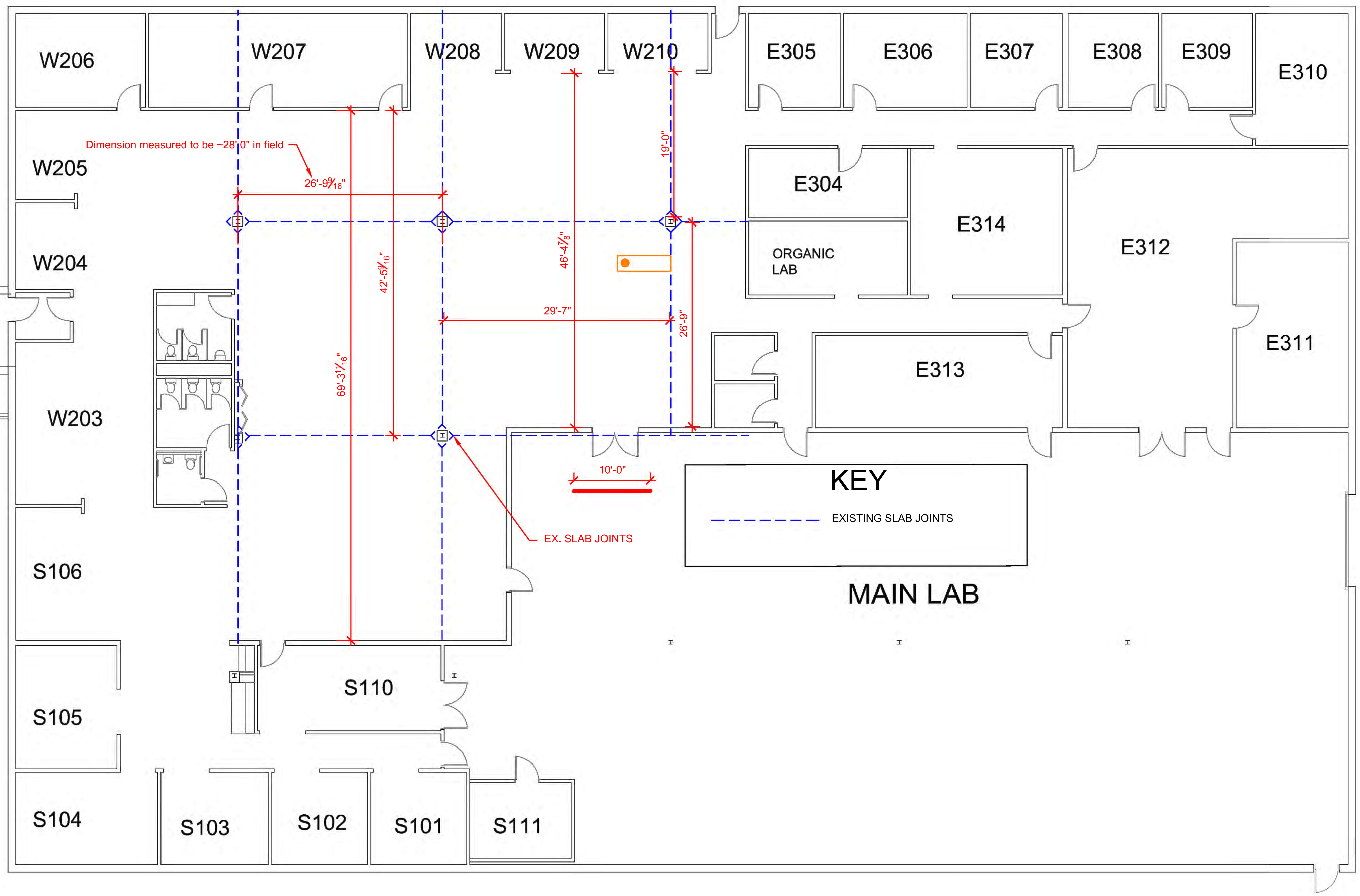
Project
DE-RISKING LOW EMBODIED CARBON CONCRETE
255 Melvin Dr.
Northbrook, IL 60062

Client
Concrete Strategies
2127 Innerbelt Business Center
Overland, MO 63114

Mark	Date	Description

THIS SHEET PLOTS FULL SIZE AT 18x24 (INCHES)

Project No.	2024.1541
Date	5-27-24
Drawn	ACW
Checked	---
Scale	As Noted
Sheet Title	Title
Sheet No.	1



ANNEX II - FLOOR PLAN

WJE

WJE, Inc. or PC
StreetAddress
City, State Zip
tel | fax
www.wje.com

Atlanta | Austin | Boston | Chicago | Cleveland | Dallas | Denver | Detroit
Doylestown | Honolulu | Houston | Indianapolis | London | Los Angeles
Milwaukee | Minneapolis | New Haven | Northbrook (HQ) | New York
Pittsburgh | Philadelphia | Portland | Princeton | Raleigh | San Antonio
San Diego | San Francisco | Seattle | South Florida | Washington, DC

Consultants

Project

DE-RISKING LOW EMBODIED CARBON CONCRETE
255 Melvin Dr.
Northbrook, IL 60062

Client

Concrete Strategies
2127 Innerbelt Business Center
Overland, MO 63114

Mark	Date	Description

Project No. 2024.1541

Date 5-27-24

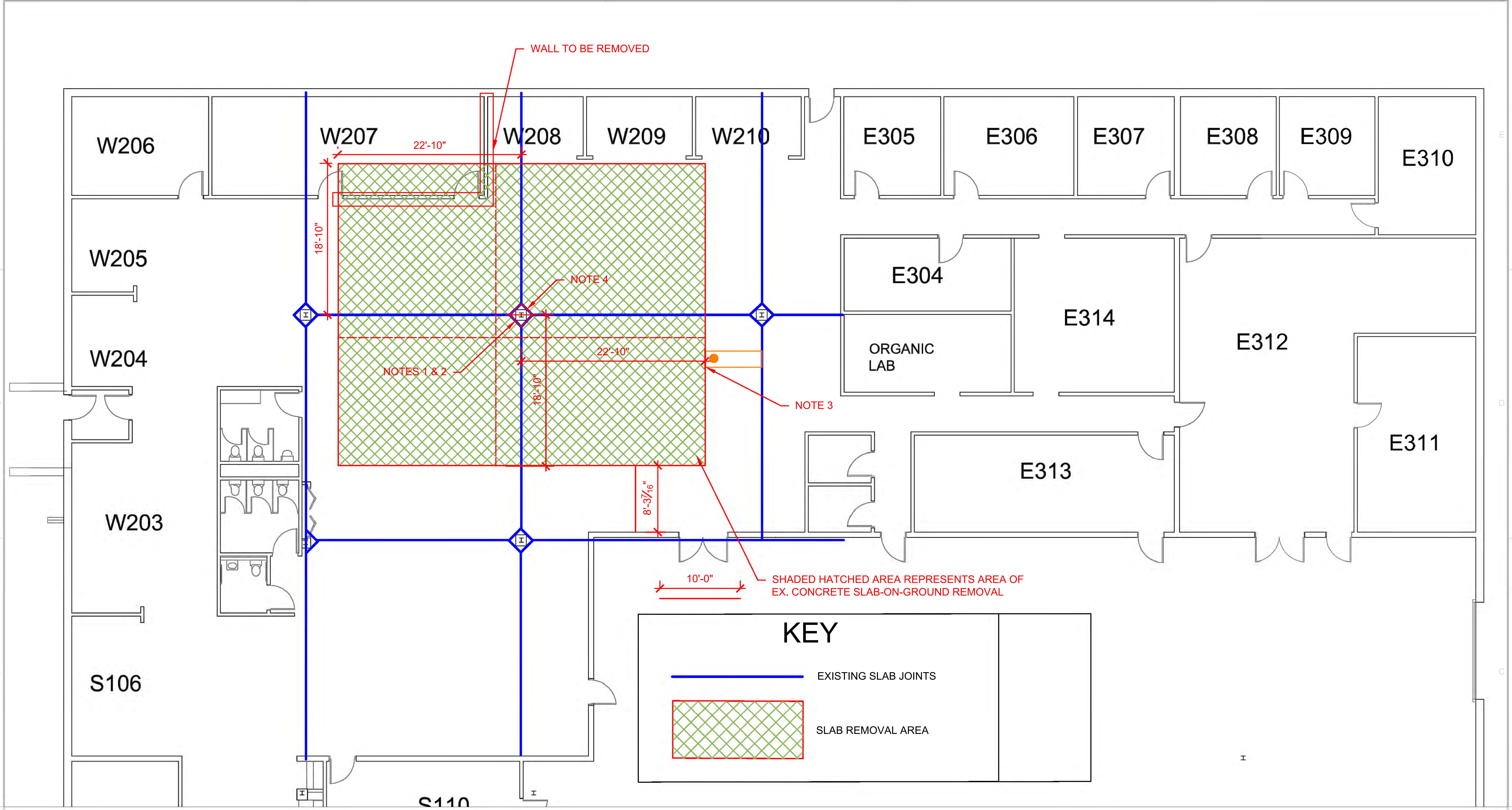
Drawn ACW

Checked ---

Scale As Noted

Sheet Title: Existing Plan

Sheet No. 2



ANNEX II - FLOOR PLAN

NOTES

1. WHEN REMOVING PORTIONS OF SLAB, REMOVE 22'-10" EAST TO WEST FROM CENTERLINE OF COLUMN AND COLUMN JOINTS IN BOTH DIRECTIONS
2. REMOVE 18'-10" NORTH TO SOUTH FROM CENTERLINE OF COLUMN AND COLUMN JOINTS IN BOTH DIRECTIONS
3. DO NOT REMOVE SLAB BEYOND THE EDGE OF THE DRAINAGE FIXTURE
4. LEAVE EXISTING COLUMN ISOLATION SLAB, SEE DETAILS. MEASURE SLAB REMOVAL AREA FROM CENTERLINE OF COLUMN AND EX.COLUMN LINE JOINTS

WJE

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062
847.272.7400 tel
www.wje.com

Atlanta | Austin | Boston | Chicago | Cleveland | Dallas | Denver | Detroit
Doylestown | Honolulu | Houston | Indianapolis | London | Los Angeles
Milwaukee | Minneapolis | New Haven | Northbrook (HQ) | New York
Pittsburgh | Philadelphia | Portland | Princeton | Raleigh | San Antonio
San Diego | San Francisco | Seattle | South Florida | Washington, DC

Consultants

Project

DE-RISKING LOW EMBODIED CARBON CONCRETE
255 Melvin Dr.
Northbrook, IL 60062

Client

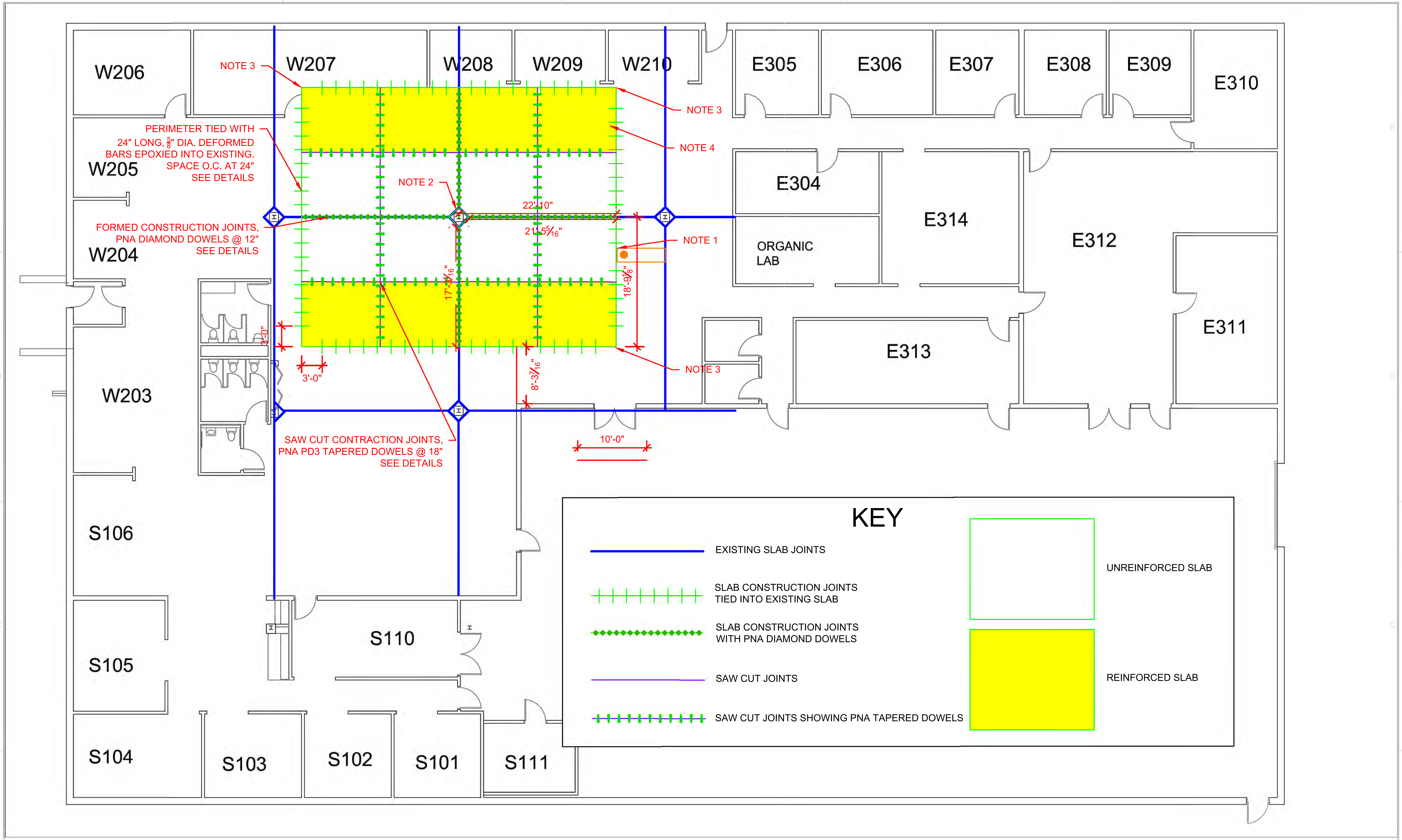
Concrete Strategies
2127 Innerbelt Business Center
Overland, MO 63114

Mark	Date	Description

Project No.	2024.1541
Date	5-27-24
Drawn	ACW
Checked	---
Scale	As Noted

Sheet Title: Slab Demolition Plan

Sheet No. 3



ANNEX II - FLOOR PLAN

N

NOTES

1. PERIMETER TIES ARE 24" LONG, 5/8" DIA. (#5) DEFORMED BARS EPOXIED INTO EXISTING SLAB, SPACED O.C. AT 24"
2. DO NOT INSTALL TIES INTO DRAINAGE STRUCTURE, PLACE TIE CENTERLINES APPROX. 3" FROM EDGE OF DRAINAGE SLAB AREA.
3. DO NOT INSTALL TIES OR DOWELS INTO EX. ISOLATION JOINT AROUND COLUMN, USE 3/8" COMPRESSIBLE FILLER (SEE ISOLATION JOINT DETAIL).
4. START TIES 3' 0" FROM ALL PERIMETER CORNERS, DO NOT INSTALL TIES WITHIN 3' OF PERIMETER CORNERS.
5. YELLOW SHADED REGIONS ARE REINFORCED SLABS, SEE SLAB SECTION DETAIL

WJE

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062
847.272.7400 tel
www.wje.com

Atlanta | Austin | Boston | Chicago | Cleveland | Dallas | Denver | Detroit
Doylestown | Honolulu | Houston | Indianapolis | London | Los Angeles
Milwaukee | Minneapolis | New Haven | Northbrook (HQ) | New York
Pittsburgh | Philadelphia | Portland | Princeton | Raleigh | San Antonio
San Diego | San Francisco | Seattle | South Florida | Washington, DC

Consultants

Project

DE-RISKING LOW EMBODIED CARBON CONCRETE
255 Melvin Dr.
Northbrook, IL 60062

Client

Concrete Strategies
2127 Innerbelt Business Center
Overland, MO 63114

Mark	Date	Description

THIS SHEET PLOTS FULL SIZE AT 18x24 (INCHES)

Project No. 2024.1541

Date 5-27-24

Drawn ACW

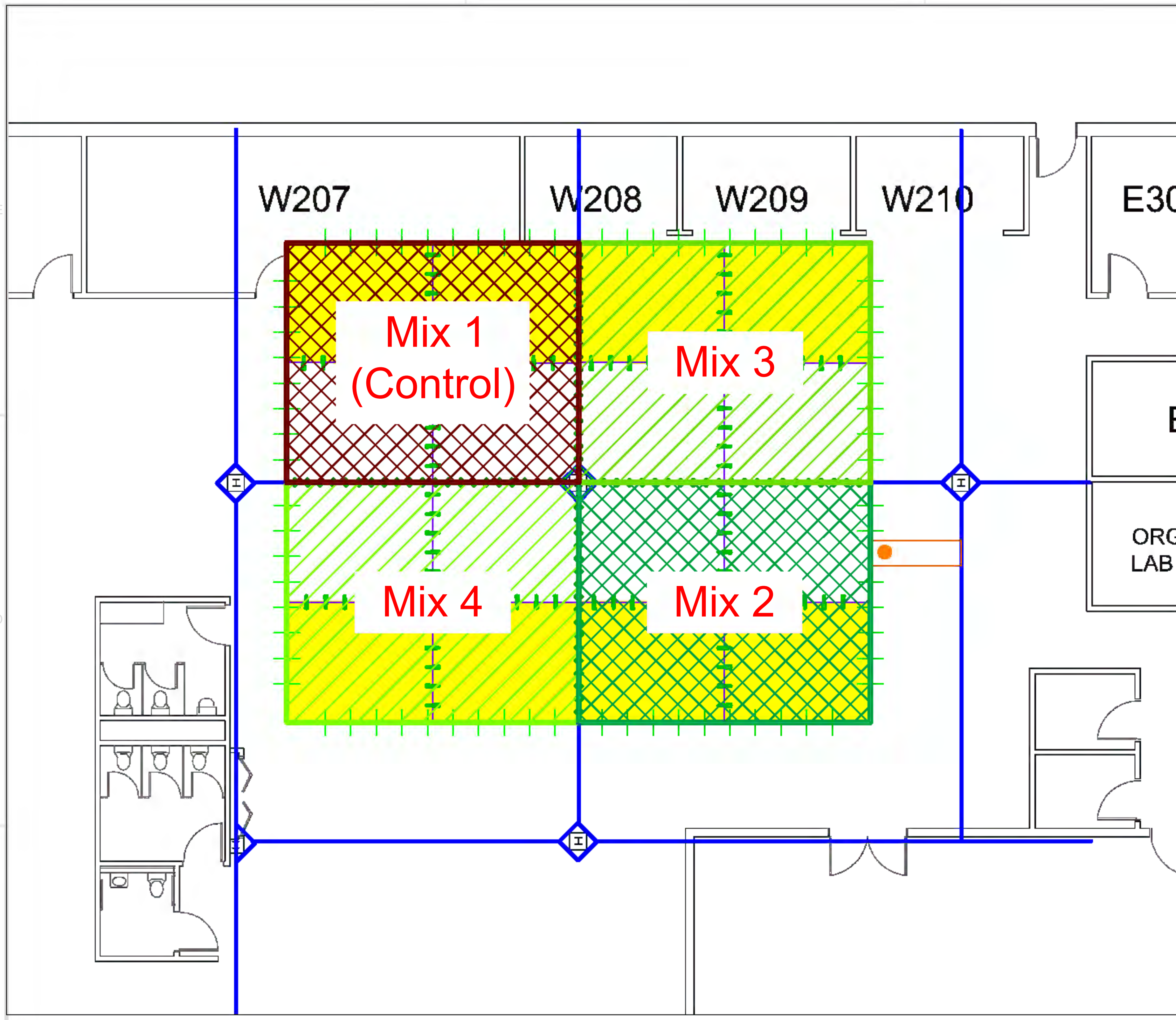
Checked ---

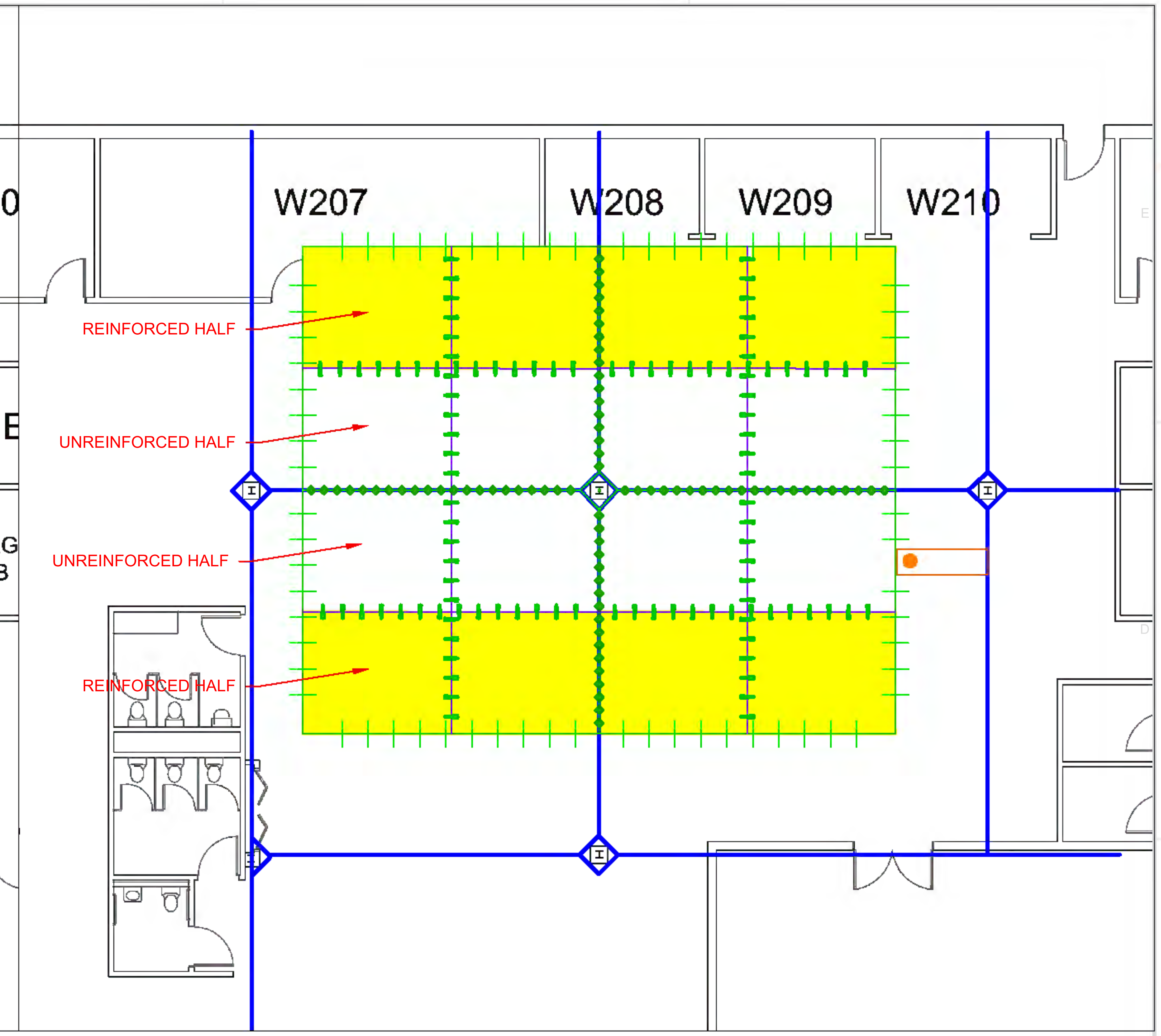
Scale As Noted

Slab Replacement Plan

Sheet Title

Sheet No. 4





	Mix 1 (Control)	Mix 2	Mix 3	Mix 4
Mix Design Number	**2686M**	**2686M3**	**2686HS4**	**5099M**
Specified Strength (psi)	4000 @ 28 days	4000 @ 28 days	4000 @ 28 days	4000 @ 28 days
Slump Range (in.)	4.0 +/- 1.0	4.0 +/- 1.0	4.0 +/- 1.0	4.0 +/- 1.0
Air %	0.00 To 3.00 %	0.00 To 3.00 %	0.00 To 3.00 %	0.00 To 3.00 %
Slump Range w/ HRWR (in.)				
Usage	HYPERSCALE CONTROL MIX	Mix 2	Mix 3	Mix 4
Material Specification & Description	**One Cubic Yard Weights (SSD)**			
C1157 - CEMENT			475 lb	750 lb
ASTM C-150 - CEMENT				
C595 TYPE 1L - CEMENT	517 lb	295 lb	130 lb	
GRADE 100 - SLAG		196 lb		
ASTM C94, POTABLE - POTABLE	31.0 gal	29.5 gal	25.4 gal	30.6 gal
ASTM C494 - CARBONCURE		(*)	(*)	(*)
ASTM C494 TYPE A/F - MULTI-RANGE WATER REDUCER	(*)	(*)	(*)	(*)
ASTM C33 #67 - COARSE AGGREGATE	1401 lb	1443 lb	1435 lb	1324 lb
ASTM C33 #4 Coarse Aggregate	469 lb	483 lb	480 lb	443 lb
ASTM C33 - FINE AGGREGATE	1445 lb	1440 lb	1430 lb	1320 lb
W / C M RATIO:	0.50	0.50	0.35	0.34

NOTES

1. ALL SLABS SHALL HAVE CONCRETE ACCORDING TO THE SPECIFIED MIX DESIGNS
2. CONCRETE MIXES SHALL BE CAST IN THE RESPECTIVE QUADRANTS AS SHOWN HEREIN
3. YELLOW SHADED SUBQUADRANT REGIONS SHALL BE REINFORCED, I.E. HALF OF EACH MIXES TOTAL SLAB AREA. THE OTHER HALVES SHALL NOT BE REINFORCED.

WJE

WJE, Inc. or PC
StreetAddress
City, State Zip
tel | fax
www.wje.com

Atlanta | Austin | Boston | Chicago | Cleveland | Dallas | Denver | Detroit
Doylestown | Honolulu | Houston | Indianapolis | London | Los Angeles
Milwaukee | Minneapolis | New Haven | Northbrook (HQ) | New York
Pittsburgh | Philadelphia | Portland | Princeton | Raleigh | San Antonio
San Diego | San Francisco | Seattle | South Florida | Washington, DC

Consultants

Project

DE-RISKING LOW EMBODIED CARBON CONCRETE
255 Melvin Dr.
Northbrook, IL 60062

Client

Concrete Strategies
2127 Innerbelt Business Center
Overland, MO 63114

Mark	Date	Description

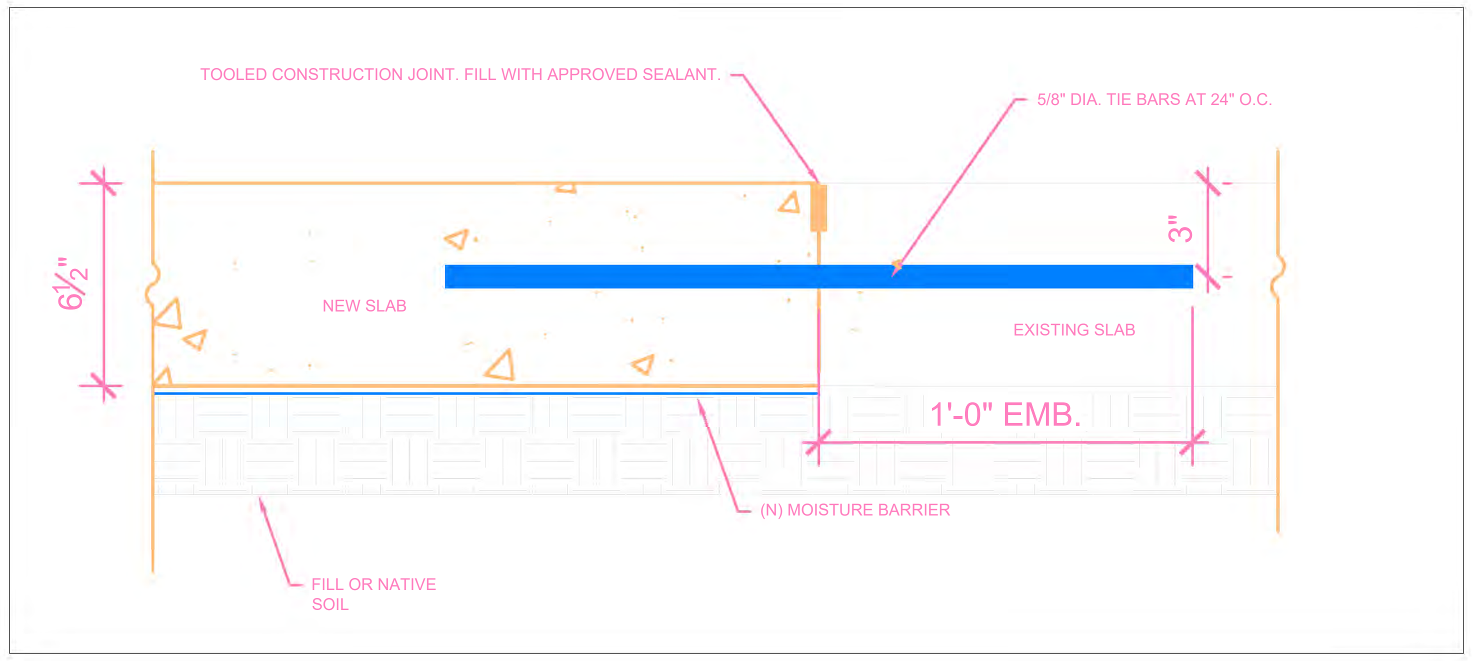
THIS SHEET PLOTS FULL SIZE AT 18x24 (INCHES)

Project No. 2024.1541
Date 5-27-24
Drawn Drawn By
Checked Checked By
Scale As Noted

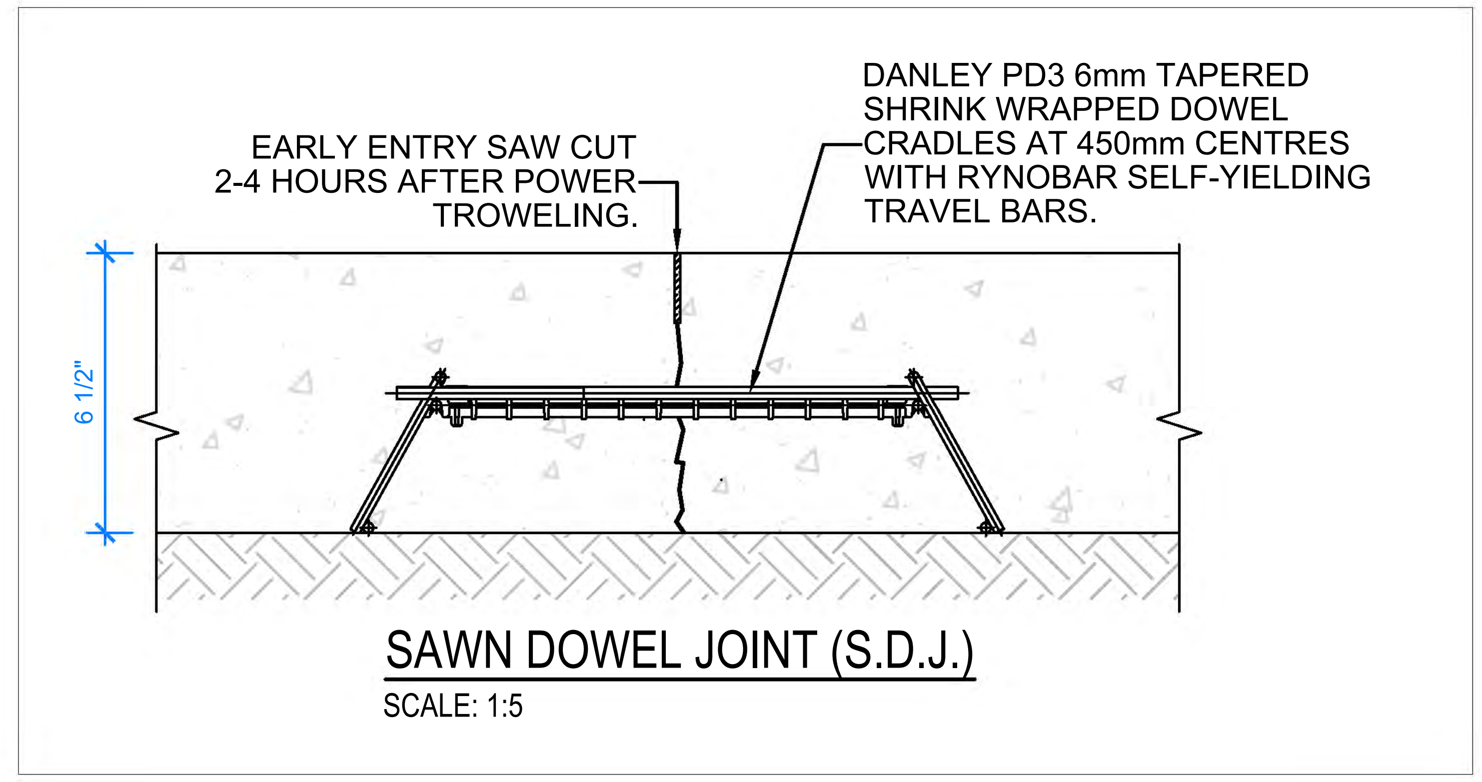
Slab Replacement Mix Designs

Sheet Title

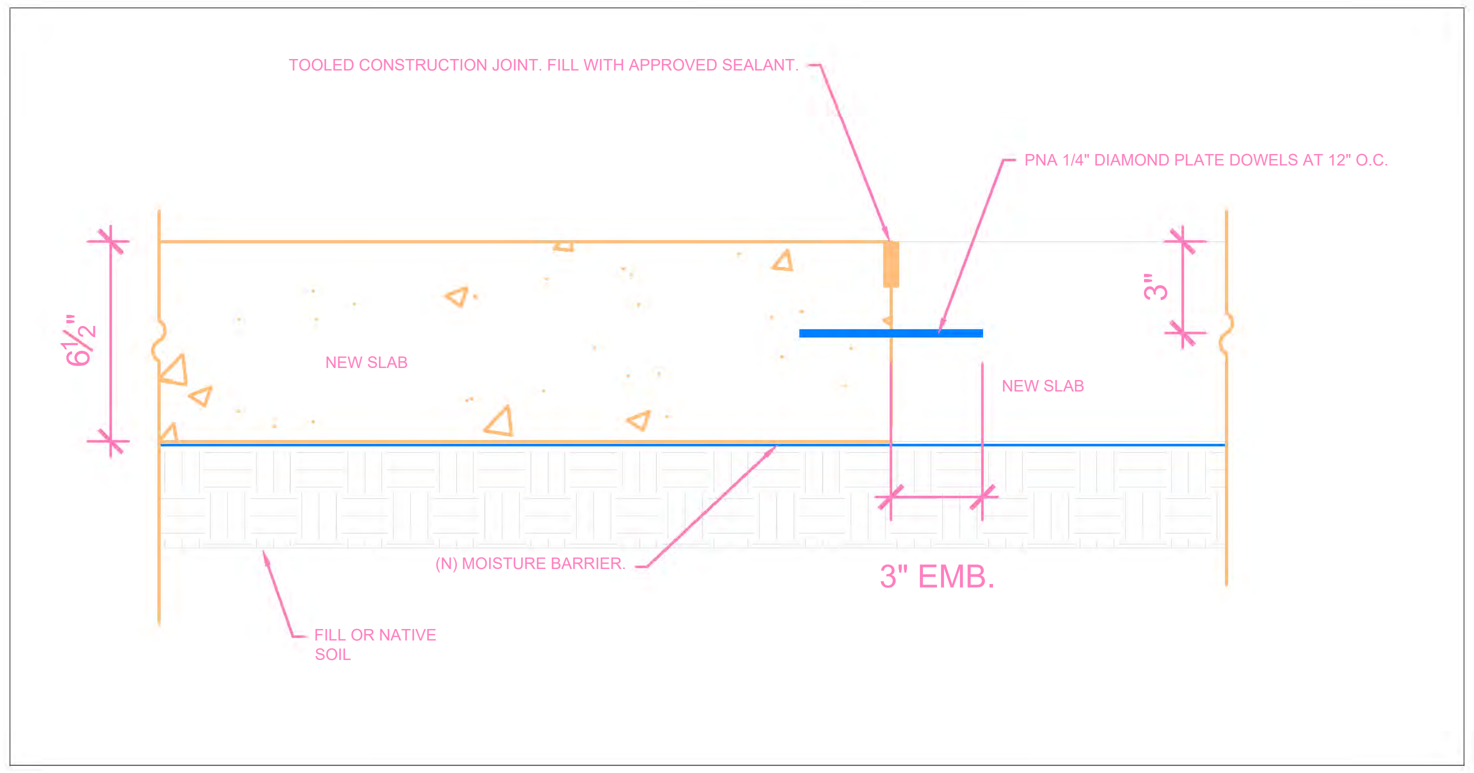
Sheet No. 5



SECTION 1
TYPICAL PERIMETER JOINT TIED INTO EXISTING SLAB



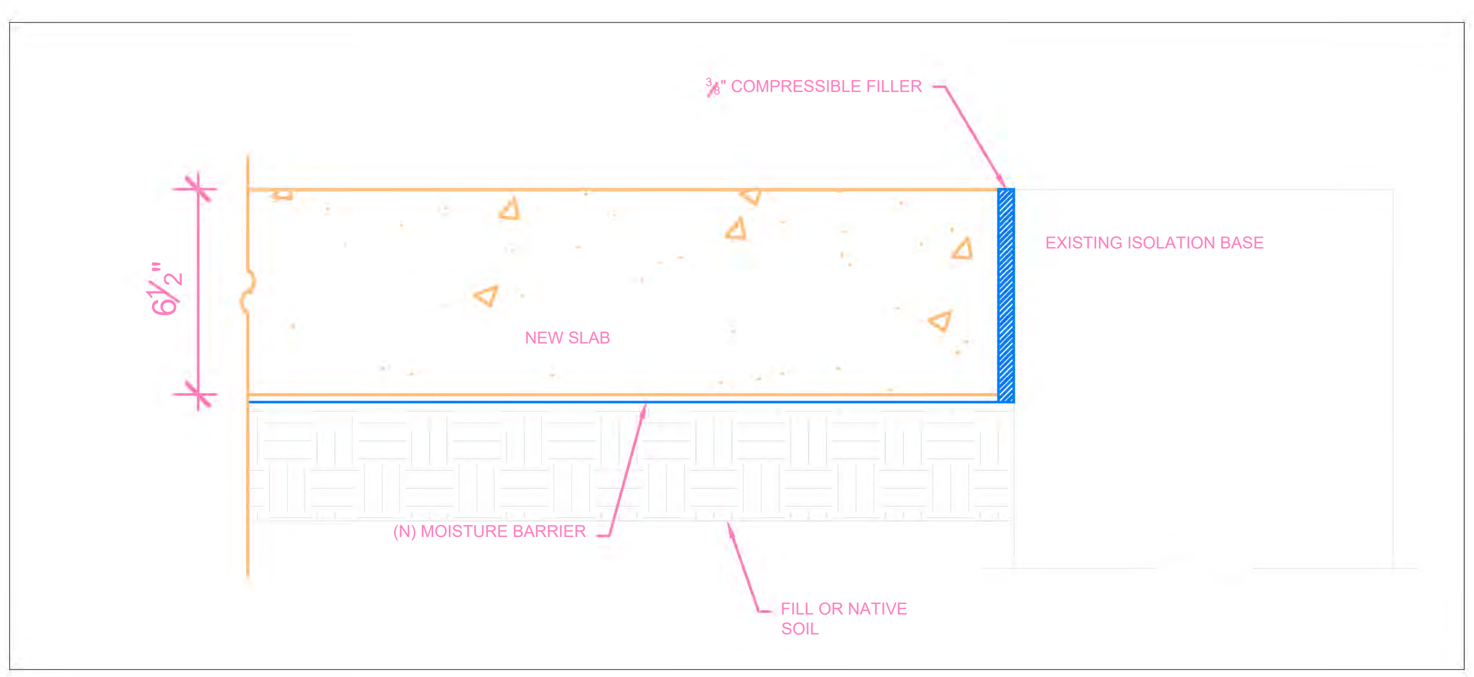
SECTION 4
TYPICAL SAW CUT CONTRACTION JOINTS WITH PNA PD3 TAPERED DOWELS



SECTION 2
TYPICAL CONSTRUCTION JOINTS BETWEEN NEWLY INSTALLED SLABS

NOTES

1. ALL SLABS SHALL HAVE CONCRETE ACCORDING TO THE SPECIFIED MIX DESIGNS
2. APPROVED SEALANTS USED AT DOWELED AND SAWCUT CONSTRUCTION JOINTS SHALL BE TO A DEPTH OF NO LESS THAN 1-1/2"



SECTION 3
JOINT AT EXISTING ISOLATION BASE

WJE

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062
847.272.7400 tel
www.wje.com

Atlanta | Austin | Boston | Chicago | Cleveland | Dallas | Denver | Detroit
Doylestown | Honolulu | Houston | Indianapolis | London | Los Angeles
Milwaukee | Minneapolis | New Haven | Northbrook (HQ) | New York
Pittsburgh | Philadelphia | Portland | Princeton | Raleigh | San Antonio
San Diego | San Francisco | Seattle | South Florida | Washington, DC

Consultants

Project

DE-RISKING LOW EMBODIED CARBON CONCRETE
255 Melvin Dr.
Northbrook, IL 60062

Client

Concrete Strategies
2127 Innerbelt Business Center
Overland, MO 63114

Mark	Date	Description

THIS SHEET PLOTS FULL SIZE AT 18x24 (INCHES)

Project No. 2024.1541
Date 5-27-24
Drawn ACW
Checked ---
Scale As Noted

Sheet Title: Detail Sections

Sheet No. 6

APPENDIX F. FIELD TESTING - PHYSICAL TESTING RESULTS

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☐ As Received ☑ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 Standard Cure	7.82	150.7	4.03	12.72	55,300	4,346	1.94	1	None	2
Mix 1 Standard Cure	7.73	152.1	4.02	12.69	54,930	4,328	1.92	1	None	2
Mix 1 Standard Cure	7.78	151.3	4.02	12.69	53,910	4,248	1.94	1	None	2
Average	--	**151**	--	--	--	**4,310**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:50, Standard Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/4/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☐ As Received ☑ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 Standard Cure	7.84	150.0	4.03	12.76	61,660	4,833	1.95	1	None	3
Mix 1 Standard Cure	7.78	151.5	4.03	12.75	60,140	4,717	1.93	1	None	3
Mix 1 Standard Cure	7.79	152.4	4.02	12.67	60,370	4,765	1.94	1	None	3
Average	--	**151**	--	--	--	**4,770**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:25, Standard Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/8/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 Standard Cure	7.86	152.4	4.02	12.69	65,020	5,125	1.95	1	None	7
Mix 1 Standard Cure	7.87	154.6	4.00	12.57	63,920	5,084	1.97	1	None	7
Mix 1 Standard Cure	7.80	153.7	3.99	12.50	62,950	5,037	1.95	1	None	7
Average	--	**154**	--	--	--	**5,080**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:40, Standard Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/29/2024

Checked by: K. Pattaje **Date:** 9/30/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 Standard Cure	7.80	151.8	4.02	12.72	76,800	6,039	1.94	1	None	28
Mix 1 Standard Cure	7.76	153.0	4.01	12.63	82,650	6,544	1.94	1	None	28
Mix 1 Standard Cure	7.81	153.8	4.00	12.54	77,480	6,180	1.95	1	None	28
Average	--	**153**	--	--	--	**6,250**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10, 10:15 and 10:25 am Standard Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/26/2024

Checked by: K. Pattaje **Date:** 9/30/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 1 Standard Cure	7.77	154.8	3.99	12.49	84,120	6,736	1.95	1	None	56
Mix 1 Standard Cure	7.76	153.6	4.00	12.59	83,270	6,613	1.94	1	None	56
Mix 1 Standard Cure	7.71	152.9	4.02	12.67	85,510	6,747	1.92	1	None	56
Average	--	**154**	--	--	--	**6,700**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 7:55, 8:05, and 8:15 am; Standard Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/2/2024

Checked by: T.Nelson **Date:** 8/2/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 1 - FIELD CURE	7.79	151.5	4.02	12.72	46,100	3,625	1.94	1	NONE	1
MIX 1 - FIELD CURE	7.84	152.1	4.01	12.61	44,330	3,515	1.96	1	NONE	1
MIX 1 - FIELD CURE	7.81	152.2	4.02	12.67	45,070	3,557	1.94	1	NONE	1
Average	--	**152**	--	--	--	**3,570**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:36, Field Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 1 - FIELD CURE	7.81	152.0	4.01	12.62	54,770	4,341	1.95	1	None	2
MIX 1 - FIELD CURE	7.77	153.1	4.01	12.61	56,770	4,502	1.94	1	None	2
MIX 1 - FIELD CURE	7.80	151.1	4.02	12.71	59,530	4,682	1.94	1	None	2
Average	--	**152**	--	--	--	**4,510**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Tested at 10:30, Field Cure**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 8/4/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 1 - FIELD CURE	7.84	152.2	4.02	12.72	64,620	5,081	1.95	2	None	3
MIX 1 - FIELD CURE	7.79	152.3	4.00	12.58	64,560	5,134	1.95	1	None	3
MIX 1 - FIELD CURE	7.76	150.6	4.02	12.71	64,200	5,051	1.93	1	None	3
Average	--	**152**	--	--	--	**5,090**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Tested at 10:20, Field Cure**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541　　**Project Coordinator:** T. Nelson

Operator: M. Haddad　　**Date:** 8/8/2024

Checked by: K. Pattaje　　**Date:** 8/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 1 - FIELD CURE	7.83	152.5	4.00	12.59	72,230	5,738	1.96	1	None	7
MIX 1 - FIELD CURE	7.83	151.4	4.02	12.70	73,920	5,820	1.95	2	None	7
MIX 1 - FIELD CURE	7.82	150.0	4.03	12.74	71,240	5,592	1.94	1	None	7
Average	--	**151**	--	--	--	**5,720**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:30, Field Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/29/2024

Checked by: K. Pattaje **Date:** 8/30/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 1 - FIELD CURE	7.79	151.6	4.00	12.58	78,600	6,249	1.95	1	None	28
MIX 1 - FIELD CURE	7.78	150.2	4.00	12.58	87,300	6,942	1.94	2	None	28
MIX 1 - FIELD CURE	7.83	148.1	4.03	12.76	81,140	6,361	1.94	1	None	28
Average	--	**150**	--	--	--	**6,520**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:40 Field Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/26/2024

Checked by: K. Pattaje **Date:** 9/30/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 1 - FIELD CURE	7.74	150.3	4.00	12.59	84,570	6,720	1.93	2	None	56
MIX 1 - FIELD CURE	7.76	150.2	3.99	12.51	91,670	7,330	1.95	1	None	56
MIX 1 - FIELD CURE	7.72	149.8	4.02	12.71	85,250	6,707	1.92	1	None	56
Average	--	**150**	--	--	--	**6,920**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:25 Field Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 8/2/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 1 - MATCH CURI	7.82	152.7	4.03	12.77	49,530	3,880	1.94	1	NONE	1
MIX 1 - MATCH CURI	7.79	151.5	4.02	12.67	50,610	3,993	1.94	1	NONE	1
Average	--	**152**	--	--	--	**3,940**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:50, Match Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 1 - MATCH CURI	7.74	153.4	4.01	12.64	56,110	4,440	1.93	1	None	2
MIX 1 - MATCH CURI	7.75	152.7	4.01	12.65	59,260	4,684	1.93	1	None	2
Average	--	**153**	--	--	--	**4,560**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:45, Match Cure

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/4/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 1 - MATCH CURI	7.73	151.3	4.02	12.66	61,670	4,871	1.93	1	None	3
MIX 1 - MATCH CURI	7.85	152.9	4.02	12.68	60,380	4,761	1.95	1	None	3
MIX 1 - MATCH CURI	7.79	152.0	4.01	12.64	62,010	4,908	1.94	1	None	3
Average	--	**152**	--	--	--	**4,850**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:30, Match Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/8/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 1 - MATCH CURI	7.79	154.4	4.00	12.57	69,220	5,507	1.95	1	None	7
MIX 1 - MATCH CURI	7.87	152.5	4.02	12.66	67,440	5,325	1.96	1	None	7
MIX 1 - MATCH CURI	7.77	150.4	4.03	12.77	69,200	5,417	1.93	1	None	7
Average	--	**152**	--	--	--	**5,420**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 11:00, Match Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☐ As Received ☑ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - Standard	7.78	154.3	4.01	12.65	34,870	2,758	1.94	1	None	2
MIX 2 - Standard	7.81	153.0	4.01	12.66	36,630	2,894	1.95	1	None	2
MIX 2 - Standard	7.78	154.3	4.00	12.59	35,770	2,840	1.94	1	None	2
Average	--	**154**	--	--	--	**2,830**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:15, Standard Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/4/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - Standard	7.70	154.1	4.00	12.58	43,750	3,479	1.92	1	None	3
MIX 2 - Standard	7.76	155.4	4.00	12.59	43,480	3,452	1.94	1	None	3
MIX 2 - Standard	7.73	153.0	4.03	12.73	46,000	3,614	1.92	1	None	3
Average	--	**154**	--	--	--	**3,520**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:45, Standard Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/8/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - Standard	7.75	154.6	4.00	12.58	62,800	4,994	1.94	1	None	7
MIX 2 - Standard	7.80	152.3	4.02	12.71	62,150	4,889	1.94	1	None	7
MIX 2 - Standard	7.81	152.8	4.02	12.70	62,190	4,896	1.94	1	None	7
Average	--	**153**	--	--	--	**4,930**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:50, Standard Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/29/2024

Checked by: K. Pattaje **Date:** 9/30/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - Standard	7.76	152.9	4.02	12.69	85,550	6,740	1.93	1	None	28
MIX 2 - Standard	7.80	153.9	4.01	12.65	86,270	6,817	1.94	1	None	28
MIX 2 - Standard	7.82	153.0	4.02	12.71	78,160	6,147	1.94	1	None	28
Average	--	**153**	--	--	--	**6,570**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:25, 9:35, and 9:45am, Standard Cure

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/26/2024

Checked by: K. Pattaje **Date:** 9/30/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - Standard	7.74	152.8	4.03	12.73	88,170	6,928	1.92	1	None	56
MIX 2 - Standard	7.79	153.0	4.01	12.65	86,310	6,826	1.94	1	None	56
MIX 2 - Standard	7.75	154.4	4.01	12.64	87,300	6,909	1.93	1	None	56
Average	--	**153**	--	--	--	**6,890**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 7:25, 7:35, and 7:45am, Standard Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/2/2024

Checked by: T.Nelson **Date:** 8/2/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - FIELD CURE	7.78	153.9	4.00	12.57	22,490	1,790	1.95	1	NONE	1
MIX 2 - FIELD CURE	7.85	153.7	4.00	12.57	22,050	1,754	1.96	1	NONE	1
MIX 2 - FIELD CURE	7.90	152.7	4.02	12.66	21,640	1,709	1.97	1	NONE	1
Average	--	**153**	--	--	--	**1,750**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:50

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☑ As Received ☐ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - FIELD CURE	7.73	153.1	4.01	12.62	36,290	2,875	1.93	1	None	2
MIX 2 - FIELD CURE	7.82	152.8	4.00	12.57	36,500	2,905	1.96	1	None	2
MIX 2 - FIELD CURE	7.75	152.8	4.01	12.63	36,060	2,856	1.93	1	None	2
Average	--	**153**	--	--	--	**2,880**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:10, Field Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/4/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☑ As Received ☐ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - FIELD CURE	7.82	152.0	4.01	12.62	45,100	3,575	1.95	1	None	3
MIX 2 - FIELD CURE	7.80	151.2	4.01	12.64	44,580	3,527	1.94	1	None	3
MIX 2 - FIELD CURE	7.75	150.3	4.03	12.77	45,470	3,561	1.92	1	None	3
Average	--	**151**	--	--	--	**3,550**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:55, Field Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/8/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - FIELD CURE	7.72	154.2	4.00	12.56	61,260	4,879	1.93	1	None	7
MIX 2 - FIELD CURE	7.78	151.4	4.02	12.70	59,100	4,655	1.93	1	None	7
MIX 2 - FIELD CURE	7.77	150.8	4.01	12.66	63,390	5,008	1.93	2	None	7
Average	--	**152**	--	--	--	**4,850**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:00, Field Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 8/29/2024

Checked by: K. Pattaje **Date:** 9/30/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - FIELD CURE	7.75	152.3	4.00	12.58	73,990	5,884	1.94	1	None	28
MIX 2 - FIELD CURE	7.77	149.7	4.01	12.61	72,950	5,783	1.94	1	None	28
MIX 2 - FIELD CURE	7.86	151.0	4.01	12.64	75,480	5,971	1.96	1	None	28
Average	--	**151**	--	--	--	**5,880**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:50, Field Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/26/2024

Checked by: K. Pattaje **Date:** 9/30/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - FIELD CURE	7.74	149.6	4.01	12.65	81,660	6,455	1.93	1	None	56
MIX 2 - FIELD CURE	7.78	148.5	4.03	12.76	77,500	6,076	1.93	1	None	56
MIX 2 - FIELD CURE	7.76	152.2	4.00	12.57	80,330	6,392	1.94	1	None	56
Average	--	**150**	--	--	--	**6,310**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:15, Field Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 8/2/2024

Checked by: T.Nelson **Date:** 8/2/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - MATCH CURI	7.79	153.7	4.01	12.62	27,450	2,175	1.94	1	NONE	1
MIX 2 - MATCH CURI	7.80	153.6	4.01	12.60	27,060	2,148	1.95	1	NONE	1
Average	--	**154**	--	--	--	**2,160**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:05

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - MATCH CURI	7.77	153.1	4.00	12.55	40,150	3,199	1.94	1	None	2
MIX 2 - MATCH CURI	7.77	153.0	4.00	12.58	40,380	3,211	1.94	2	None	2
Average	--	**153**	--	--	--	**3,210**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:05, Match Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 8/4/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - MATCH CURI	7.75	152.9	4.01	12.61	48,240	3,824	1.93	1	None	3
MIX 2 - MATCH CURI	7.79	153.4	4.00	12.56	45,010	3,584	1.95	1	None	3
MIX 2 - MATCH CURI	7.78	152.9	4.01	12.60	48,000	3,810	1.94	1	None	3
Average	--	**153**	--	--	--	**3,740**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:50, Match Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/8/2024

Checked by: K. Pattaje **Date:** 8/9/2024

Capping Method
☐ Sulfur
☐ Lapped
☑ End Ground
☐ Unbonded

Conditioning
☑ As Received
☐ Wet
☐ Dry

Capping
☑ Plane
☐ Sound
☐ Other

Calipers
☐ 12/060107
☐ B657697
☑ Asset# 995

Test Machine
☑ Test Mark SN# 11005
☐ Satec ID: 120HLVC1240
☐ Other

Cast Date: 8/1/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 2 - MATCH CURI	7.76	151.7	4.03	12.75	62,200	4,878	1.93	1	None	7
MIX 2 - MATCH CURI	7.80	155.0	3.99	12.52	64,370	5,142	1.95	1	None	7
MIX 2 - MATCH CURI	7.86	154.3	3.99	12.51	62,110	4,964	1.97	1	None	7
Average	--	**154**	--	--	--	**4,990**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:10, Match Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/2/2024

Checked by: T.Nelson **Date:** 8/2/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 3 Standard Cure	7.86	156.3	4.03	12.73	60,410	4,744	1.95	1	NONE	2
Mix 3 Standard Cure	7.77	155.7	4.01	12.63	63,840	5,056	1.94	1	NONE	2
Mix 3 Standard Cure	7.75	156.3	4.00	12.58	61,350	4,878	1.94	1	NONE	2
Average	--	**156**	--	--	--	**4,890**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:20, Standard Cure

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 3 Standard Cure	7.85	156.9	4.02	12.67	76,930	6,073	1.95	2	None	3
Mix 3 Standard Cure	7.83	156.5	4.01	12.63	76,550	6,063	1.95	1	None	3
Mix 3 Standard Cure	7.87	157.9	4.01	12.60	78,760	6,252	1.96	1	None	3
Average	--	**157**	--	--	--	**6,130**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:15, Standard Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: L. ZEGLER **Date:** 8/7/2024

Checked by: K.Pattaje **Date:** 8/7/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☐ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☑ B657697
- ☐ Asset#

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 3 Standard Cure	7.84	157.5	4.02	12.68	101,560	8,008	1.95	1	NONE	7
MIX 3 Standard Cure	7.85	157.8	4.03	12.73	107,440	8,438	1.95	1	NONE	7
MIX 3 Standard Cure	7.83	158.7	4.01	12.65	104,610	8,267	1.95	1	NONE	7
Average	--	**158**	--	--	--	**8,240**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 3 field, standard cure, Tested at 10:44 AM, 11:02 AM, and 11:18 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/28/2024

Checked by: K.Pattaje **Date:** 8/28/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☑ As Received ☐ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 3 Standard Cure	7.74	157.9	4.01	12.65	137,360	10,860	1.93	2	NONE	28
MIX 3 Standard Cure	7.72	159.2	4.00	12.56	130,570	10,393	1.93	2	NONE	28
MIX 3 Standard Cure	7.79	156.9	4.01	12.63	136,180	10,783	1.94	1	NONE	28
Average	--	**158**	--	--	--	**10,680**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 3 field, standard cure, Tested at 9:40 AM, 9:55 AM, and 10:10 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/25/2024

Checked by: K.Pattaje **Date:** 9/30/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 3 Standard Cure	7.73	155.2	4.03	12.75	142,190	11,153	1.92	2	NONE	56
MIX 3 Standard Cure	7.77	156.6	4.00	12.59	143,760	11,414	1.94	1	NONE	56
MIX 3 Standard Cure	7.75	156.5	4.02	12.67	135,810	10,721	1.93	1	NONE	56
Average	--	**156**	--	--	--	**11,100**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 3 field, standard cure, Tested at 8:00 AM, 8:10 AM, and 8:25 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: L. ZEGLER **Date:** 8/1/2024

Checked by: T.Nelson **Date:** 8/1/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☑ As Received ☐ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☑ B657697 ☐ Asset#

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 3 Field	7.89	155.2	4.02	12.69	29,140	2,297	1.96	1	NONE	1
MIX 3 Field	7.88	155.0	4.01	12.65	25,940	2,050	1.96	1	NONE	1
MIX 3 Field	7.88	155.7	4.02	12.70	29,960	2,359	1.96	1	NONE	1
Average	--	**155**	--	--	--	**2,240**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:26 AM, 10:34 AM, 10:43 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/2/2024

Checked by: T.Nelson **Date:** 8/2/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 3 Field Cure	7.83	155.8	4.02	12.68	56,730	4,474	1.95	1	NONE	2
Mix 3 Field Cure	7.78	155.0	4.01	12.63	58,420	4,626	1.94	1	NONE	2
Mix 3 Field Cure	7.77	155.4	4.02	12.69	61,200	4,823	1.93	1	NONE	2
Average	--	**155**	--	--	--	**4,640**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:10, Field Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 3 Field Cure	7.83	155.3	4.01	12.64	72,170	5,710	1.95	2	None	3
Mix 3 Field Cure	7.76	154.9	4.02	12.68	74,200	5,852	1.93	1	None	3
Mix 3 Field Cure	7.82	156.0	4.02	12.70	75,860	5,974	1.95	2	None	3
Average	--	**155**	--	--	--	**5,850**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Tested at 10:10, Field Cure**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: L. ZEGLER **Date:** 8/7/2024

Checked by: K. Pattaje **Date:** 8/7/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☐ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☑ B657697
- ☐ Asset#

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 3 Field	7.85	155.9	4.02	12.69	92,340	7,279	1.95	1	NONE	7
MIX 3 Field	7.73	155.5	4.01	12.62	101,790	8,064	1.93	1	NONE	7
MIX 3 Field	7.80	156.8	4.01	12.65	92,230	7,290	1.94	4	NONE	7
Average	--	**156**	--	--	--	**7,540**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:32 AM, 10:50 AM, 11:07 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/28/2024

Checked by: K. Pattaje **Date:** 8/28/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 3 Field	7.86	155.1	4.02	12.70	116,200	9,153	1.96	1	None	28
MIX 3 Field	7.82	155.5	4.02	12.66	124,570	9,839	1.95	2	None	28
MIX 3 Field	7.83	155.4	4.01	12.64	116,690	9,230	1.95	2	None	28
Average	--	**155**	--	--	--	**9,410**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:05 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/25/2024

Checked by: K. Pattaje **Date:** 9/30/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☑ As Received ☐ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 3 Field	7.76	154.9	4.00	12.59	120,480	9,566	1.94	1	None	56
MIX 3 Field	7.79	155.4	4.01	12.60	115,830	9,190	1.94	1	None	56
MIX 3 Field	7.70	154.6	4.01	12.65	117,600	9,298	1.92	1	None	56
Average	--	**155**	--	--	--	**9,350**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 7:00 am

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541

Project Coordinator: Todd Nelson

Operator: L. ZEGLER **Date:** 8/1/2024

Checked by: T.Nelson **Date:** 8/1/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☑ B657697
- ☐ Asset#

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 3 MATCH CURE	7.77	156.9	4.02	12.68	44,200	3,486	1.93	1	NONE	1
MIX 3 MATCH CURE	7.77	156.5	4.02	12.67	43,900	3,466	1.94	1	NONE	1
Average	--	**157**	--	--	--	**3,480**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:29 AM and 10:37 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/2/2024

Checked by: T.Nelson **Date:** 8/2/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 3 - MATCH CURI	7.74	155.4	4.01	12.65	76,250	6,026	1.93	1	NONE	2
MIX 3 - MATCH CURI	7.78	157.1	4.01	12.63	72,210	5,718	1.94	1	NONE	2
Average	--	**156**	--	--	--	**5,870**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:30, Match Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☑ As Received ☐ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 3 - MATCH CURI	7.82	158.6	4.01	12.61	86,040	6,825	1.95	1	None	3
MIX 3 - MATCH CURI	7.75	154.9	4.03	12.73	89,800	7,052	1.93	2	None	3
MIX 3 - MATCH CURI	7.75	156.1	4.02	12.69	88,110	6,945	1.93	2	None	3
Average	--	**157**	--	--	--	**6,940**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:35, Match Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541

Project Coordinator: T. Nelson

Operator: L. ZEGLER **Date:** 8/7/2024

Checked by: K.Pattaje **Date:** 8/7/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☑ As Received ☐ Wet ☐ Dry

Capping ☐ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☑ B657697 ☐ Asset#

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 3 MATCH	7.78	156.4	4.01	12.65	112,580	8,901	1.94	1	NONE	7
MIX 3 MATCH	7.75	157.1	4.01	12.64	105,880	8,380	1.93	1	NONE	7
MIX 3 MATCH	7.89	156.3	4.02	12.69	99,380	7,834	1.96	1	NONE	7
Average	--	**157**	--	--	--	**8,370**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 10:38 AM, 10:56 AM, 11:13 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541   **Project Coordinator:** T. Nelson

Operator: M. Haddad   **Date:** 8/2/2024

Checked by: T.Nelson   **Date:** 8/2/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☐ As Received ☑ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 - Standard	7.76	153.0	4.00	12.56	45,350	3,612	1.94	2	NONE	2
MIX 4 - Standard	7.78	152.1	4.01	12.61	43,540	3,452	1.94	1	NONE	2
MIX 4 - Standard	7.71	152.1	4.02	12.69	45,630	3,597	1.92	1	NONE	2
Average	--	**152**	--	--	--	**3,550**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:30

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 - Standard	7.81	153.2	4.01	12.62	50,880	4,032	1.95	1	None	3
MIX 4 - Standard	7.71	153.2	4.00	12.59	53,910	4,280	1.93	1	None	3
MIX 4 - Standard	7.76	154.6	4.01	12.65	55,920	4,419	1.93	2	None	3
Average	--	**154**	--	--	--	**4,240**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Tested at 8:50, Standard Cure**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: L. ZEGLER **Date:** 8/7/2024

Checked by: K. Pattaje **Date:** 8/7/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☐ As Received ☑ Wet ☐ Dry

Capping ☐ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☑ B657697 ☐ Asset#

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 Standard Cure	7.85	156.5	4.01	12.62	71,250	5,646	1.96	1	NONE	7
MIX 4 Standard Cure	7.83	154.2	4.01	12.60	66,020	5,239	1.95	1	NONE	7
MIX 4 Standard Cure	7.81	156.2	4.01	12.61	66,390	5,263	1.95	1	NONE	7
Average	--	**156**	--	--	--	**5,380**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 4 field standard cure, tested at 9:21 AM, 9:38 AM, and 9:52 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/28/2024

Checked by: K. Pattaje **Date:** 8/28/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☐ As Received ☑ Wet ☐ Dry

Capping ☐ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☑ B657697 ☐ Asset#

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 Standard Cure	7.80	154.2	3.99	12.50	87,720	7,019	1.96	1	NONE	28
MIX 4 Standard Cure	7.75	151.9	4.02	12.69	91,400	7,203	1.93	1	NONE	28
MIX 4 Standard Cure	7.75	152.9	4.02	12.70	93,370	7,351	1.93	1	NONE	28
Average	--	**153**	--	--	--	**7,190**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 4 field standard cure, tested at 8:25 AM, 8:35 AM, and 8:50 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 9/25/2024

Checked by: K. Pattaje **Date:** 9/30/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☑ B657697
- ☐ Asset#

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 Standard Cure	7.70	153.6	4.01	12.61	102,250	8,110	1.92	1	NONE	56
MIX 4 Standard Cure	7.74	155.9	4.00	12.58	105,950	8,421	1.93	1	NONE	56
MIX 4 Standard Cure	7.74	150.7	4.03	12.72	102,210	8,033	1.92	2	NONE	56
Average	--	**153**	--	--	--	**8,190**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Mix 4 field standard cure, tested at 7:25 AM, 7:35 AM, and 7:50 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** ____

Operator: L. ZEGLER **Date:** 8/1/2024

Checked by: T.Nelson **Date:** 8/1/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☑ B657697
- ☐ Asset#

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 Field Cure	7.84	151.2	4.02	12.67	26,840	2,119	1.95	1	NONE	1
MIX 4 Field Cure	7.85	154.5	4.01	12.65	26,690	2,110	1.96	1	NONE	1
MIX 4 Field Cure	7.85	150.8	4.02	12.70	23,640	1,862	1.95	1	NONE	1
Average	--	**152**	--	--	--	**2,030**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:53 AM, 9:01 AM, and 9:08 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/2/2024

Checked by: T.Nelson **Date:** 8/2/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☐ As Received
- ☑ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 4 Field cure 1	7.80	153.3	4.02	12.66	44,150	3,486	1.94	1	NONE	2
Mix 4 Field cure 2	7.82	154.9	4.02	12.68	46,220	3,644	1.95	1	NONE	2
Mix 4 Field cure 3	7.84	155.7	4.00	12.57	45,920	3,652	1.96	1	NONE	2
Average	--	**155**	--	--	--	**3,590**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Tested at 8:40, Field Cure**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☐ As Received ☑ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
Mix 4 Field Cure	7.75	154.9	4.01	12.61	53,120	4,211	1.93	2	None	3
Mix 4 Field Cure	7.75	150.7	4.02	12.70	51,200	4,033	1.93	2	None	3
Mix 4 Field Cure	7.75	153.0	4.01	12.60	53,790	4,268	1.93	2	None	3
Average	--	**153**	--	--	--	**4,170**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:45, Field Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: L. ZEGLER **Date:** 8/7/2024

Checked by: K. Pattaje **Date:** 8/7/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☑ As Received ☐ Wet ☐ Dry

Capping ☐ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☑ B657697 ☐ Asset#

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 Field Cure	7.82	153.6	4.02	12.71	61,730	4,855	1.94	1	NONE	7
MIX 4 Field Cure	7.81	152.7	4.01	12.61	66,010	5,233	1.95	1	NONE	7
MIX 4 Field Cure	7.85	152.3	4.01	12.64	61,420	4,858	1.96	1	NONE	7
Average	--	**153**	--	--	--	**4,980**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:06 AM, 9:28 AM, and 9:43 AM

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/28/2024

Checked by: K. Pattaje **Date:** 8/28/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 Field	7.75	152.9	4.01	12.61	80,980	6,422	1.93	1	NONE	28
MIX 4 Field	7.73	151.0	4.00	12.57	80,960	6,441	1.93	1	NONE	28
MIX 4 Field	7.82	154.2	4.01	12.64	85,700	6,781	1.95	1	NONE	28
Average	--	**153**	--	--	--	**6,550**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Tested at 8:00**

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541

Project Coordinator: T. Nelson

Operator: M. Haddad **Date:** 9/25/2024

Checked by: K. Pattaje **Date:** 9/30/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 Field	7.78	154.8	4.00	12.56	89,690	7,139	1.95	1	NONE	56
MIX 4 Field	7.85	154.4	3.99	12.52	89,400	7,141	1.97	1	NONE	56
MIX 4 Field	7.76	152.4	4.00	12.55	85,510	6,813	1.94	2	NONE	56
Average	--	**154**	--	--	--	**7,030**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 7:15

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:**

Operator: L. ZEGLER **Date:** 8/1/2024

Checked by: T.Nelson **Date:** 8/1/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☑ As Received ☐ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☑ B657697 ☐ Asset#

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 - MATCH CURI	7.84	154.8	4.02	12.68	36,300	2,863	1.95	1	NONE	1
MIX 4 - MATCH CURI	7.81	152.3	4.02	12.67	34,840	2,750	1.95	1	NONE	1
Average	--	**154**	--	--	--	**2,810**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 8:58 AM and 9:04 AM

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/2/2024

Checked by: T.Nelson **Date:** 8/2/2024

Capping Method
- ☐ Sulfur
- ☐ Lapped
- ☑ End Ground
- ☐ Unbonded

Conditioning
- ☑ As Received
- ☐ Wet
- ☐ Dry

Capping
- ☑ Plane
- ☐ Sound
- ☐ Other

Calipers
- ☐ 12/060107
- ☐ B657697
- ☑ Asset# 995

Test Machine
- ☑ Test Mark SN# 11005
- ☐ Satec ID: 120HLVC1240
- ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 - MATCH CURI	7.75	154.7	4.02	12.66	51,920	4,100	1.93	1	NONE	2
MIX 4 - MATCH CURI	7.72	153.9	4.01	12.60	52,730	4,185	1.93	1	NONE	2
Average	--	**154**	--	--	--	**4,140**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:10, Match Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: M. Haddad **Date:** 8/3/2024

Checked by: C Piehowski/ K. Pattaje **Date:** 8/5/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☑ As Received ☐ Wet ☐ Dry

Capping ☑ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☐ B657697 ☑ Asset# 995

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 - MATCH CURI	7.75	152.7	4.02	12.71	58,560	4,607	1.93	1	None	3
MIX 4 - MATCH CURI	7.76	156.6	3.99	12.52	62,160	4,964	1.94	2	None	3
MIX 4 - MATCH CURI	7.80	153.6	4.02	12.68	58,460	4,609	1.94	1	None	3
Average	--	**154**	--	--	--	**4,730**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: Tested at 9:00, Match Cure

ASTM C39 Compressive Strength of Concrete Cylinders

Project No: 2024.1541 **Project Coordinator:** T. Nelson

Operator: L. ZEGLER **Date:** 8/7/2024

Checked by: K. Pattaje **Date:** 8/7/2024

Capping Method ☐ Sulfur ☐ Lapped ☑ End Ground ☐ Unbonded

Conditioning ☑ As Received ☐ Wet ☐ Dry

Capping ☐ Plane ☐ Sound ☐ Other

Calipers ☐ 12/060107 ☑ B657697 ☐ Asset#

Test Machine ☑ Test Mark SN# 11005 ☐ Satec ID: 120HLVC1240 ☐ Other

Cast Date: 7/31/2024

Sample ID	Capped Length (in.)	Density (lbs/ft³)	Avg. Dia. (in.)	Area (in.²)	Max. Load (lbs.)	Compressive Strength (psi)	L/D	Fracture Type	Sample or Cap Defects	Age of sample (days)
MIX 4 MATCH CURE	7.93	155.3	4.01	12.63	68,880	5,453	1.98	1	NONE	7
MIX 4 MATCH CURE	7.84	154.8	4.01	12.61	74,630	5,918	1.96	1	NONE	7
MIX 4 MATCH CURE	7.85	153.8	4.01	12.65	74,490	5,891	1.96	1	NONE	7
Average	--	**155**	--	--	--	**5,750**	--	--	--	--

The results presented in this test report relate only to the items tested.

Comments: **Tested at 9:14 AM, 9:33 AM, and 9:48 AM**

APPENDIX G. FIELD ABRASION TESTING

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062
847.272.7400 tel
www.wje.com

SITE VISIT REPORT

Hyperscalers

Abrasion Resistance of Trial Slabs – Mixes 1 and 2

REPORT DATE	10/01/2024	**WJE PROJECT NO.**	2024.1541
REPORTED BY	Kathleen Hawkins	**WJE PROJECT MGR.**	Tom Van Dam
FACILITY NO.	WJE Northbrook Annex	**CLIENT**	Open Compute Foundation
ADDRESS	355 Melvin Dr Northbrook, IL 60062		

Test Information:

Method: BS EN 13892-4: 2002 – *Methods of test for screed materials – Part 4: Determination of wear resistance-BCA*

Test Date: 09/27/2024

Test Operator: Kathleen Hawkins (primary), Anuj Parashar, Drew Witte, and Le Pham

Equipment ID: AB517

Test Area Description: Slabs 1 and 2 in the Annex of WJE Northbrook.

Abrasion Test Results:

Slab 1: Mix 1 – Control

Slab 1 – Control	Test 1-1		Test 1-2		Test 1-3	
Abrasion Test Readings (mm)						
Reading #	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
1	0.00	0.00	-0.01	0.05	0.00	0.09
2	0.00	0.00	-0.01	0.02	0.01	0.13
3	-0.01	-0.02	-0.02	0.06	0.00	0.37
4	0.00	0.00	-0.01	0.08	0.00	0.18
5	0.00	0.00	0.01	0.03	0.00	0.28
6	0.01	0.00	0.01	0.02	0.00	0.22
7	0.00	-0.01	0.01	0.00	0.00	0.17
8	0.00	0.00	-0.01	-0.02	0.00	0.09
Average	0.00	0.00	0.00	0.03	0.00	0.19
Mean Depth of Wear (mm)	0.00		0.03		0.19	
Test Area Average (mm)	0.073					

Test Area Notes:

Test 1: Rocked more than other tests because of unlevelness of surface.

Test 2: Ring of wear visible at ~8 minutes. Rocking due to uneven floor observed. Relatively high amount of dust generated by test.

Test 3: Saw ring of wear immediately (~10 seconds). Floor appears more stable than for the Tests 1-1 and 1-2; no rocking of the unpinned feet observed. Relatively high amount of dust generated by the test. At ~14 minutes, started hearing a rattling rumble. A minor piece of the equipment came unscrewed from the fan casing; did not affect the test. Equipment appeared to be vibrating/hammering at a very low amplitude. Continued test to completion with close monitoring. Ended on time at 15 minutes 4 seconds.

Slab 2: Mix 2 – 40% SC

Slab 2 – 40% SC	Test 2-1		Test 2-2		Test 2-3	
Abrasion Test Readings (mm)						
Reading #	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
1	0.00	0.02	-0.02	-0.02	0.00	0.02
2	0.00	0.00	-0.02	-0.02	0.01	0.03
3	0.02	0.01	0.00	-0.01	0.00	0.01
4	0.00	-0.01	-0.01	-0.02	0.00	0.02
5	0.00	-0.01	-0.01	-0.01	0.00	0.03
6	0.01	0.02	-0.02	-0.02	0.00	0.03
7	0.00	0.01	0.01	0.01	0.00	0.03
8	-0.03	0.00	0.00	0.00	0.00	0.06
Average	0.00	0.01	-0.01	-0.01	0.00	0.03
Mean Depth of Wear (mm)	0.01		0.00		0.03	
Test Area Average (mm)	0.013					

Test Area Notes:

Test 1: No comment.

Test 2: No comment.

Test 3: Ring of wear visible at ~3 minutes. Test generated a relatively large amount of dust.

Summary of Abrasion Resistance Testing Results:

Test Area:	Average (mm)	Range (mm)
Slab 1 – Control	0.073	0.00 to 0.19
Slab 2 – 40% SC	0.013	0.00 to 0.03

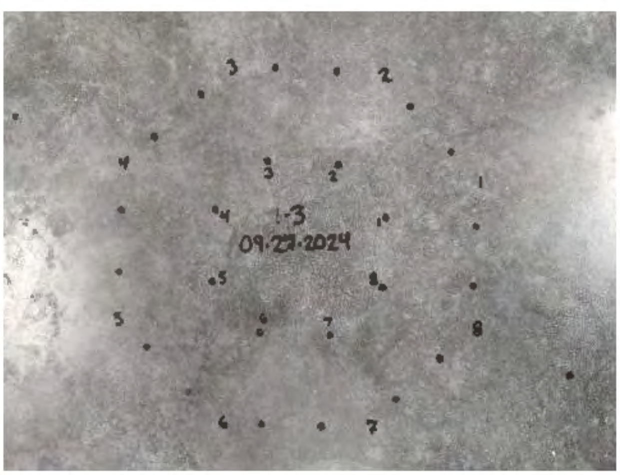
Photos – Slab 1 – Control

Test 1-1: Pre-testing

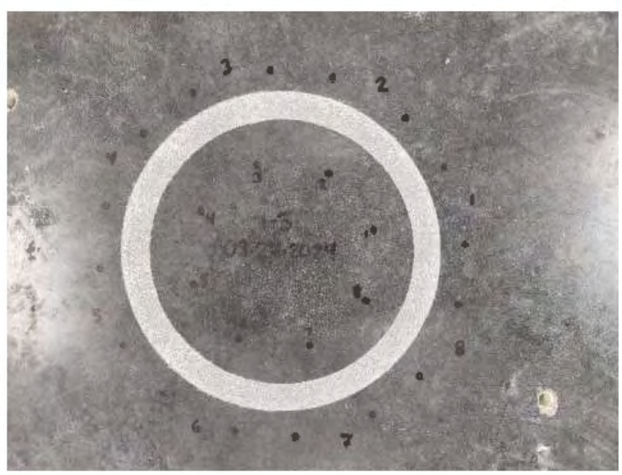
Test 1-1: Post-testing

Test 1-2: Pre-testing

Test 1-2: Post-testing

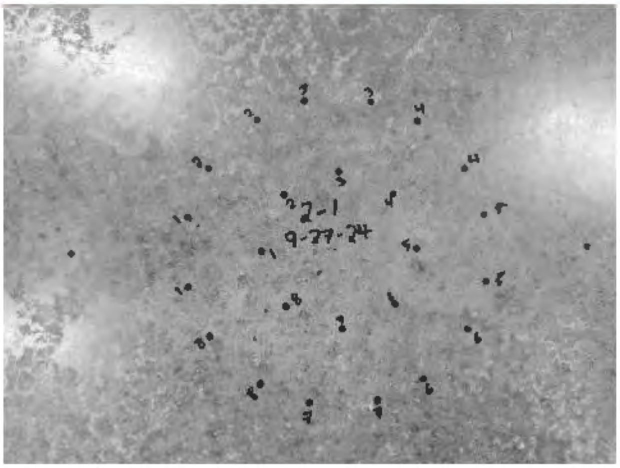


Test 1-3: Pre-testing

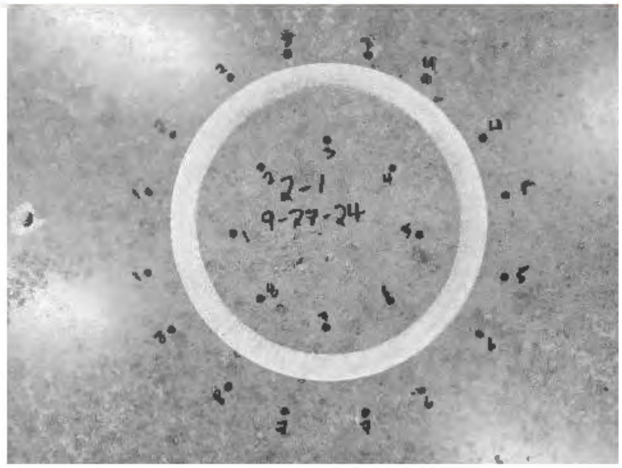


Test 1-3: Post-testing

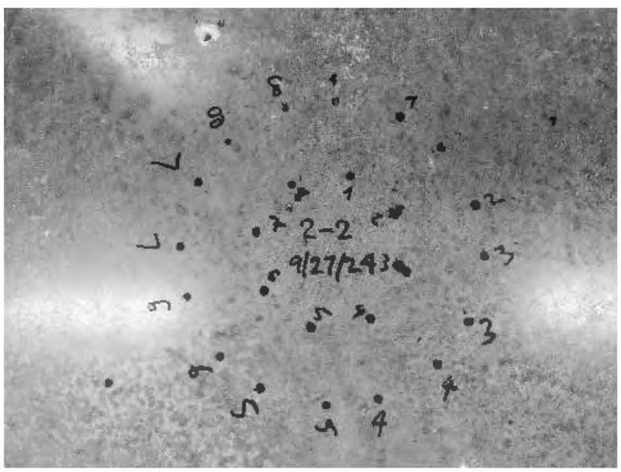
Photos – Slab 2 – 40% SC



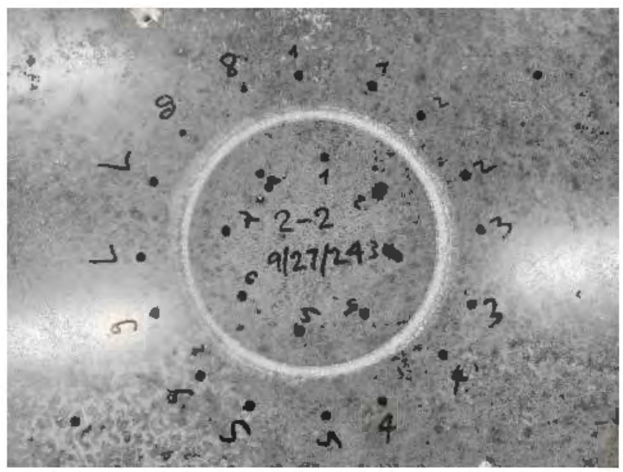
Test 2-1: Pre-testing



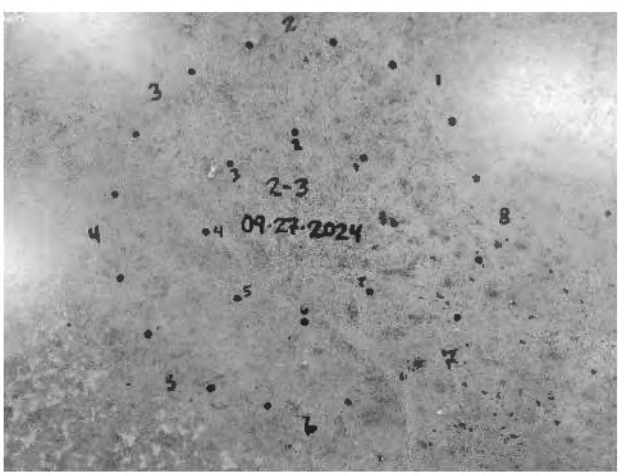
Test 2-1: Post-testing



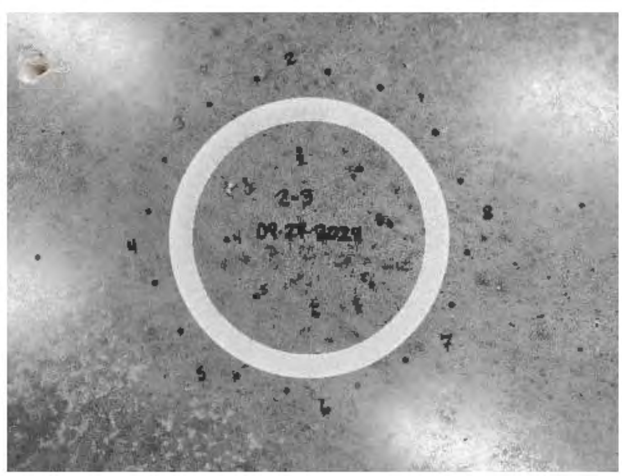
Test 2-2: Pre-testing



Test 2-2: Post-testing



Test 2-3: Pre-testing



Test 2-3: Post-testing

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062
847.272.7400 tel
www.wje.com

SITE VISIT REPORT

Hyperscalers

Abrasion Resistance of Trial Slabs – Mixes 3 and 4

REPORT DATE	10/01/2024	**WJE PROJECT NO.**	2024.1541
REPORTED BY	Kathleen Hawkins	**WJE PROJECT MGR.**	Tom Van Dam
FACILITY NO.	WJE Northbrook Annex	**CLIENT**	Open Compute Foundation
ADDRESS	355 Melvin Dr Northbrook, IL 60062		

Test Information:

Method: BS EN 13892-4: 2002 – *Methods of test for screed materials – Part 4: Determination of wear resistance-BCA*

Test Date: 09/26/2024

Test Operator: Kathleen Hawkins

Equipment ID: AB517

Test Area Description: Slabs 3 and 4 in the Annex of WJE Northbrook.

Abrasion Test Results:

Slab 3: Mix 3 – C1157 & Type IL

Slab 3 – C1157 & Type IL	Test 3-1		Test 3-2		Test 3-3	
Abrasion Test Readings (mm)						
Reading #	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
1	-0.03	-0.02	-0.01	0.01	0.01	0.03
2	0.00	0.03	-0.04	-0.04	0.01	0.02
3	0.03	0.07	-0.01	0.00	0.00	0.00
4	0.01	0.03	-0.01	0.00	0.01	0.03
5	0.02	0.05	0.01	0.04	0.02	0.03
6	0.02	0.04	-0.03	-0.02	-0.01	0.00
7	0.05	0.06	-0.02	-0.01	0.02	0.03
8	0.00	0.01	-0.01	0.01	0.00	0.00
Average	0.01	0.03	-0.02	0.00	0.01	0.02
Mean Depth of Wear (mm)	0.02		0.02		0.01	
Test Area Average (mm)	0.017					

Test Area Notes:

Test 1: No comments.

Test 2: Dust from drilling jumped like I was drilling on a delamination when drilling the northeast hole for this test.

Test 3: Saw ring of wear at ~2 minutes.

Slab 4: Mix 4 – C1157

Slab 4 – C1157	Test 4-1		Test 4-2		Test 4-3	
Abrasion Test Readings (mm)						
Reading #	**Pre-Test**	**Post-Test**	**Pre-Test**	**Post-Test**	**Pre-Test**	**Post-Test**
1	-0.02	-0.02	0.01	0.02	-0.01	-0.01
2	0.00	0.00	-0.02	-0.01	0.00	0.00
3	0.00	0.00	0.02	0.02	0.03	0.03
4	0.01	0.00	-0.03	-0.03	0.01	0.01
5	0.03	0.03	0.03	0.03	0.00	0.01
6	0.03	0.02	0.00	-0.01	0.00	0.00
7	0.02	0.02	0.01	0.01	-0.06	-0.06
8	-0.01	0.00	-0.02	-0.01	0.00	0.00
Average	0.01	0.01	0.00	0.00	0.00	0.00
Mean Depth of Wear (mm)	0.00		0.00		0.00	
Test Area Average (mm)	0.000					

Test Area Notes:

Test 1: No comment.

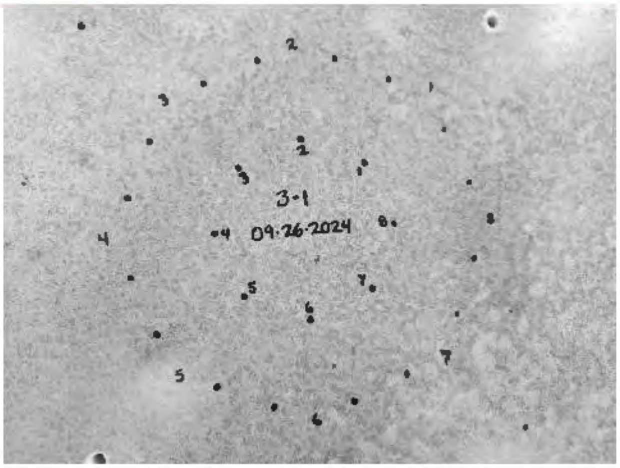
Test 2: Visible wear at outer edge of wheel path characterized by loss of any densified layer and exposure of the lighter colored, speckled mortar fraction of the concrete.

Test 3: Similar wear pattern as described for Test 4-2.

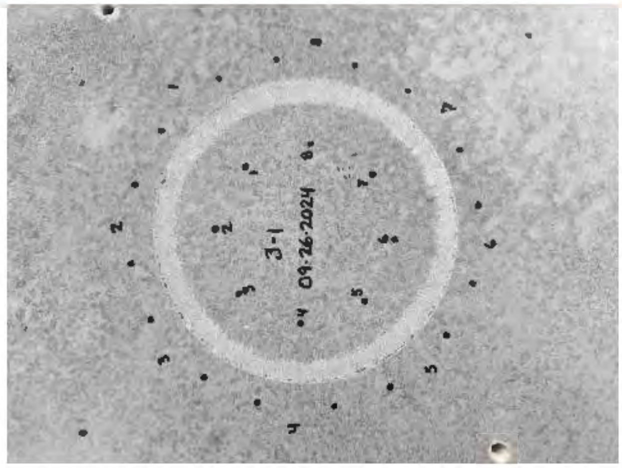
Summary of Abrasion Resistance Testing Results:

Test Area:	Average (mm)	Range (mm)
Slab 3 – C1157 & Type IL	0.017	0.01 to 0.02
Slab 4 – C1157	0.000	0.00 to 0.00

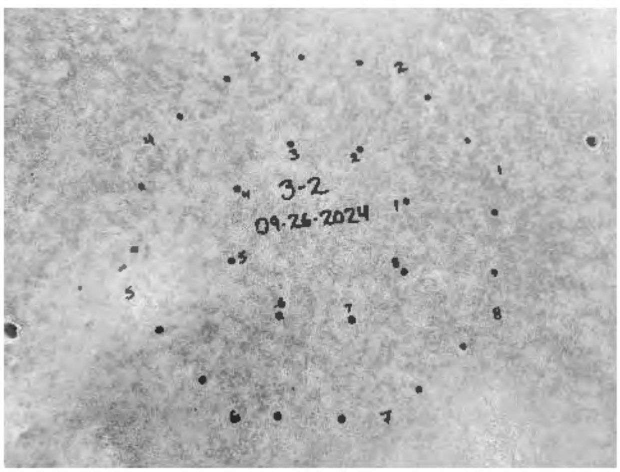
Photos – Slab 3 – C1157 & Type IL



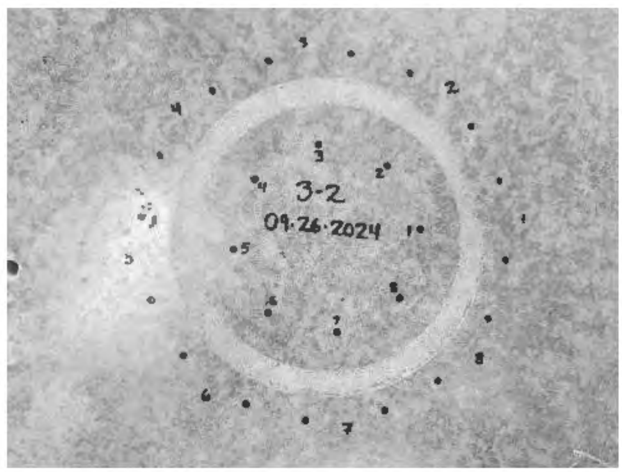
Test 3-1: Pre-testing



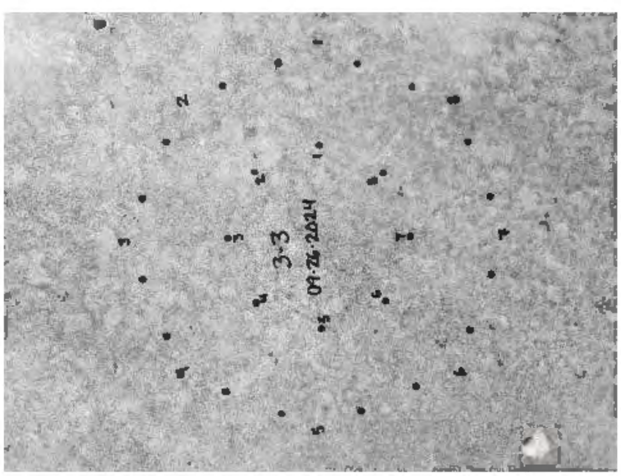
Test 3-1: Post-testing



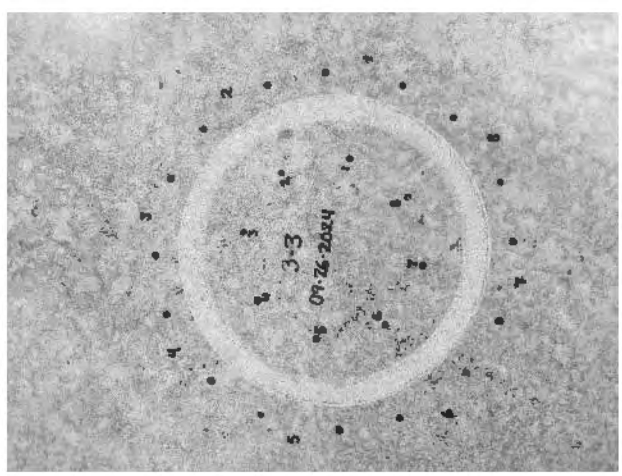
Test 3-2: Pre-testing



Test 3-2: Post-testing



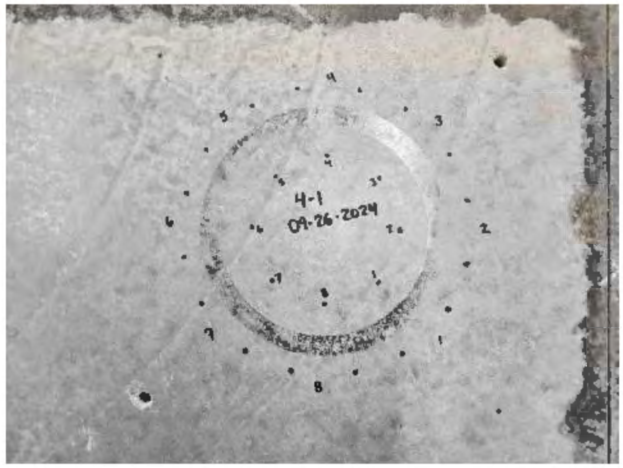
Test 3-3: Pre-testing



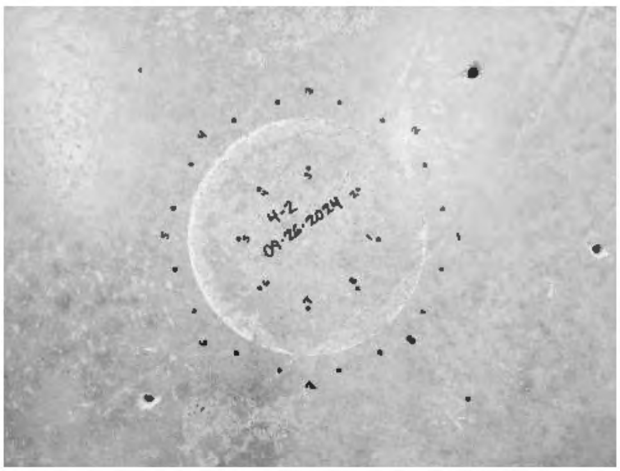
Test 3-3: Post-testing

Photos – Slab 4 – C1157

Test 4-1: Pre-testing

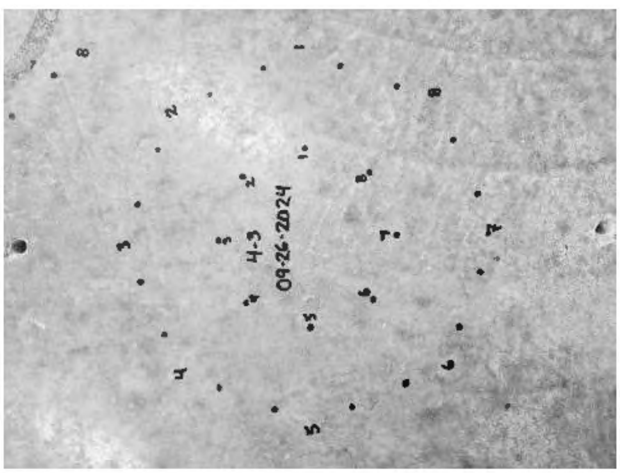


Test 4-1: Post-testing

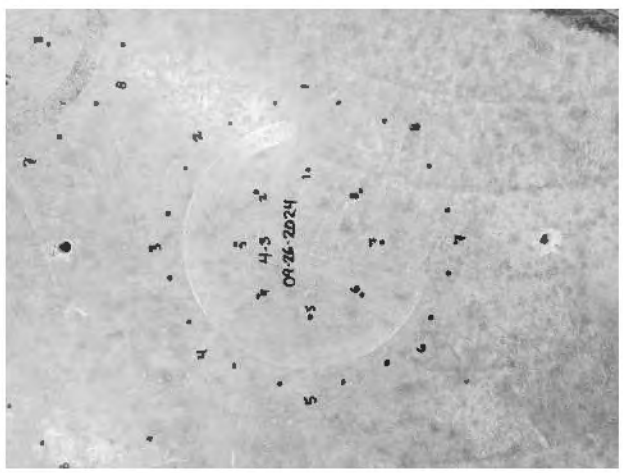


Test 4-2: Post-testing

Test 4-2: Post-testing close-up



Test 4-3: Pre-testing



Test 4-3: Post-testing