American Concrete Institute

# Preconstruction Evaluation and Placement of PLC Concrete – Challenges and Opportunities

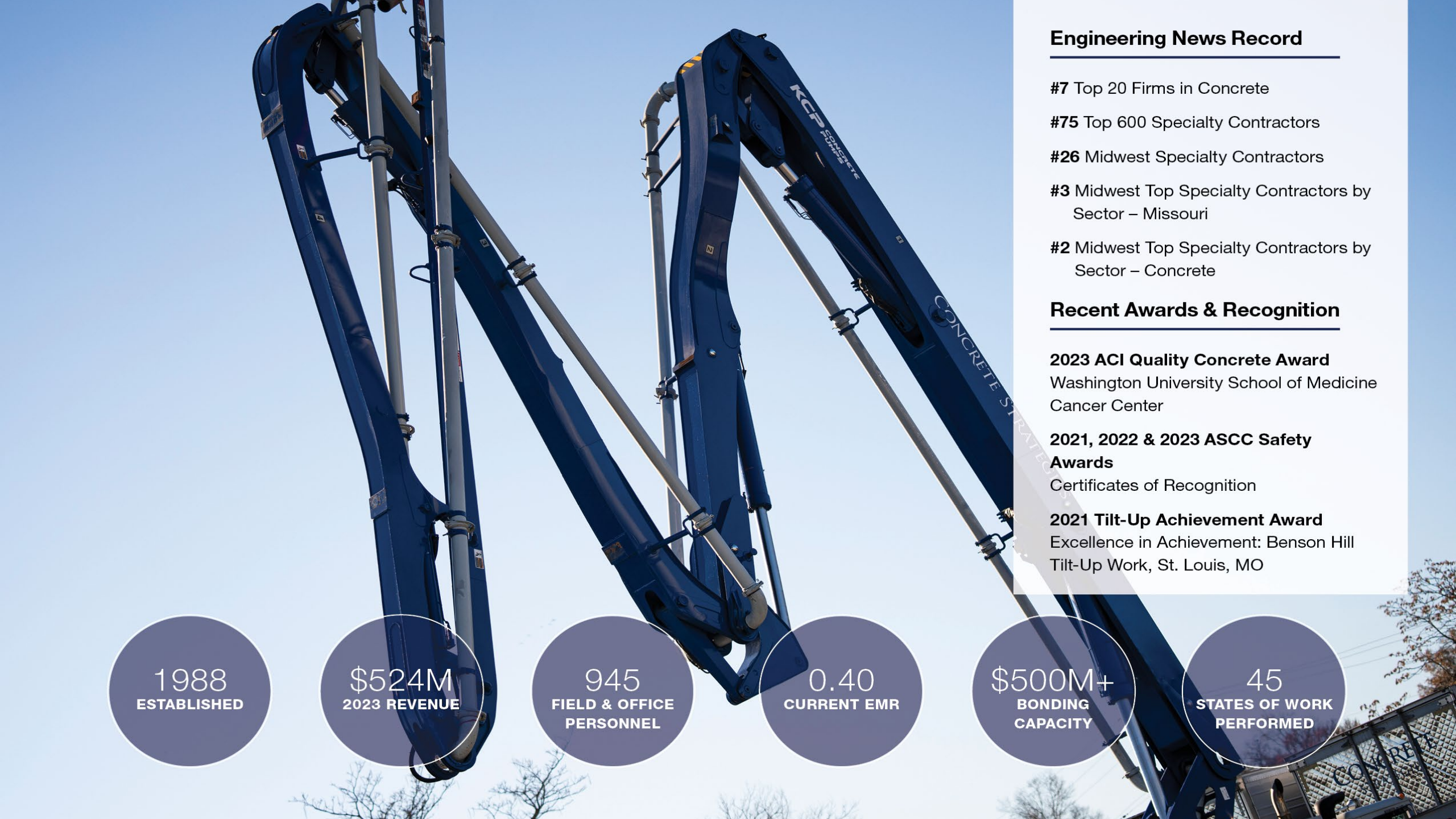
Kyle Kammer, PE – Concrete Strategies

(With Input from Mike Baldoni – IMI Ready Mix)

And Sustainable Concrete Too!

# Contents

- Company Overview
- PLC
  - Transition
  - Testing
- Issues
- Preconstruction focus
  - Specifications
  - Mix design evaluation
- Placement
  - Test Slabs
  - Feedback
- Recommendations and conclusions




## Engineering News Record

**#7** Top 20 Firms in Concrete

**#75** Top 600 Specialty Contractors

**#26** Midwest Specialty Contractors

**#3** Midwest Top Specialty Contractors by Sector – Missouri

**#2** Midwest Top Specialty Contractors by Sector – Concrete

## Recent Awards & Recognition

**2023 ACI Quality Concrete Award**
Washington University School of Medicine Cancer Center

**2021, 2022 & 2023 ASCC Safety Awards**
Certificates of Recognition

**2021 Tilt-Up Achievement Award**
Excellence in Achievement: Benson Hill Tilt-Up Work, St. Louis, MO

1988
**ESTABLISHED**

$524M
**2023 REVENUE**

945
**FIELD & OFFICE PERSONNEL**

0.40
**CURRENT EMR**

$500M+
**BONDING CAPACITY**

45
**STATES OF WORK PERFORMED**

**Concrete Strategies Inc. (CSI)** is a full-service national concrete contractor with the in-house resources and expertise to safely self-perform a wide variety of commercial construction including all aspects of cast in place concrete, precast erections and concrete restoration. CSI began as Clayco Tilt-Up in 1988. In 2005, our services expanded and we re-branded the company to showcase the additional offerings. Our 30 years in the business has enabled us to learn and refine our craft to meet the current market needs.

We provide the integrated services our clients expect, achieving Construction Success through:

- Economical Pricing
- Safe Jobsites
- Efficient, On-time Delivery
- High-quality, Innovative Results


## National Presence

# Transition from ASTM C150 to ASTM C595

- Producers began sending 1:1 letters to customers explaining the switch to 1L cement. ’21-’22
- Cement shortage of 2022 gave urgency to customer adoption of product
- Occasionally projects midstream wanted new testing to confirm that C595 blended cement would meet the specifications that were written for C150
- Some ready mix producers and contractors got the chance to work with the vendors ahead of the full switch to Type 1L cement and were well prepared for the transition.

To Whom It May Concern,

The following letter is regarding the cement switch that took place in our Tennessee market. Starting in late July, every cement manufacturer in this area switched to only supplying ready mix producers a Type 1L cement in lieu of the Type I/II cement. The manufacturing process is very similar, but they are adding an extra five to ten percent of ground limestone. The extra limestone added during the manufacturing process reduces the carbon footprint of the cement which is why there is a big push for Type 1L from cement companies. Due to this transition, Type 1L cement is our only option.

We have this material approved for several WWTP with Metro Nashville. I have included shrinkage results on a mix that is similar to the mix design that is used on your project. As you can see the shrinkage results are similar, in fact better, with the Type 1L versus Type I/II. If you would like to further discuss, please let me know.

Respectfully submitted,

*Mike Baldoni*

Mike Baldoni
imi Quality Control
615-483-0117

# GOOD TO GO!!!

CUBE STRENGTHS ARE GOOD!

# Internal Lab Testing

- Results from the same cement source yet different local materials.
- All using a different type of natural sand
- One region using a gravel source versus limestone.
- Showed a 200-600 psi drop in strengths with the same proportions

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type I/II | | | | |
| | | | | | Type 1L | | | | |
| | | 4111CC | 4111CC | 4111CC | 4111CC | 7641CC | 7641CC | 7641CC | 7641CC |
| | Cement | 438 | 438 | 438 | 438 | 540 | 540 | 540 | 540 |
| | Ash | 108 | 108 | 108 | 108 | 0 | 0 | 0 | 0 |
| | Stone | 1833 | 1823 | 1833 | 1823 | 1847 | 1839 | 1847 | 1839 |
| | Sand | 1357 | 1349 | 1357 | 1349 | 1340 | 1334 | 1340 | 1334 |
| | Water | 275 | 275 | 275 | 275 | 285 | 285 | 285 | 285 |
| Type A WR (Lignin Base) | | Yes | Yes | 0 | 0 | Yes | Yes | 0 | 0 |
| MRWR (Polycarboxylate) | | 0 | 0 | Yes | Yes | 0 | 0 | Yes | Yes |
| **Central KY 28 Day Average** | | **6555** | **6925** | **6530** | **6185** | **7405** | **6705** | **7140** | **6585** |
| **Eastern KY 28 Day Average** | | ***6437*** | ***5866*** | ***6230*** | ***5681*** | ***6656*** | ***6440*** | ***7394*** | ***6559*** |
| **Western KY 28 Day Average** | | **6717** | **6515** | **6695** | **6558** | **6844** | **6759** | **7112** | **6998** |

# Low Breaks

- Missouri Project
  - High Rise PT Project
  - 6K psi Column mix
  - 2000 psi drop in running avg in 1.5 month period
- Virginia Project
  - Industrial Mfg project
  - 4500 psi paving mix
  - Struggling to hit 4000psi @ 28 days (840 lbs of cementitious/CY)
- Illinois Project
  - LMC Overlay
  - 4000 psi @ 14 days
  - 3200 psi @ 14 days
  - 7D Wet Cure
- Texas Project
  - High Rise CIP Structure
  - 7500 psi drilled pier mix passed less than 20% of tested loads
  - 10K Vertical Mix had signs of early strength issues – HRWR Dosage on site

# Performance Concerns / Observations

- Higher water demand resulting in less overdesign
- Loss of early strength gain (1-4 day)
- Behaved more sensitive in extreme weather
- Less bleed water causing finishing timing issues
- Concrete cylinder curing / handling more critical
- Using a low dose of HRWR in lieu of a lignin type A has increased our strengths
- The lower specific gravity needs to be accounted for as well. These together will reduce over yielding.  As we know, over yielding mixes lose strength quickly.

# Issues We've Seen (more of since the 1L Transition)

- Cracking
- Differential Set
- Crusting
- Difficulty Finishing
- Low Breaks
- Unpredictable set times
- New Chemical Interactions/Incompatibilities
- Bleed Water
- Delamination

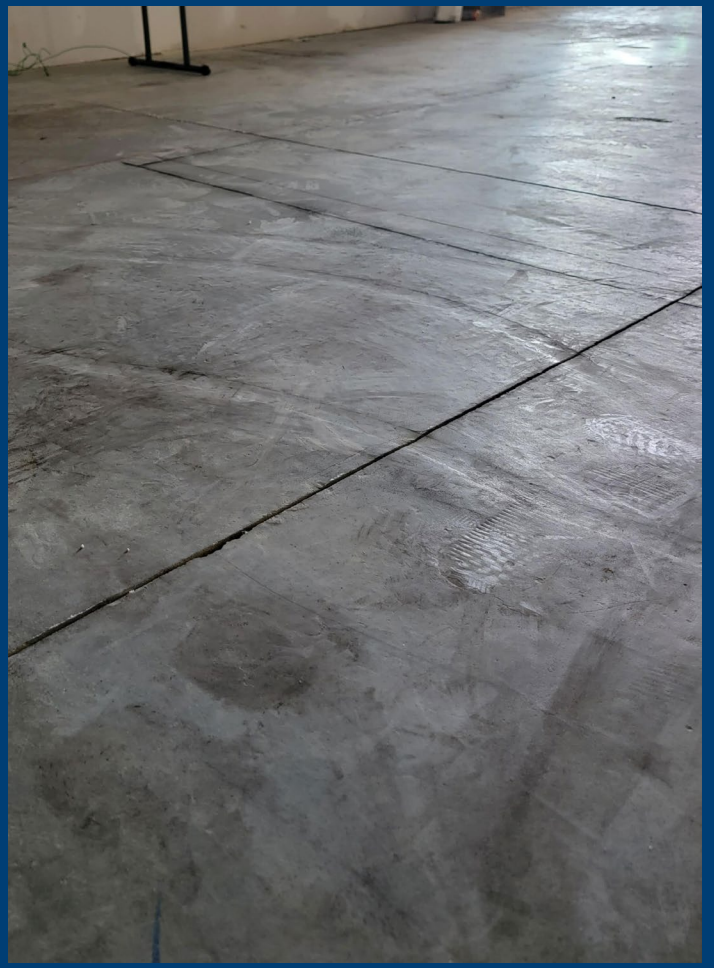
Picture from Con Expo Con/Agg

# Good to go…???

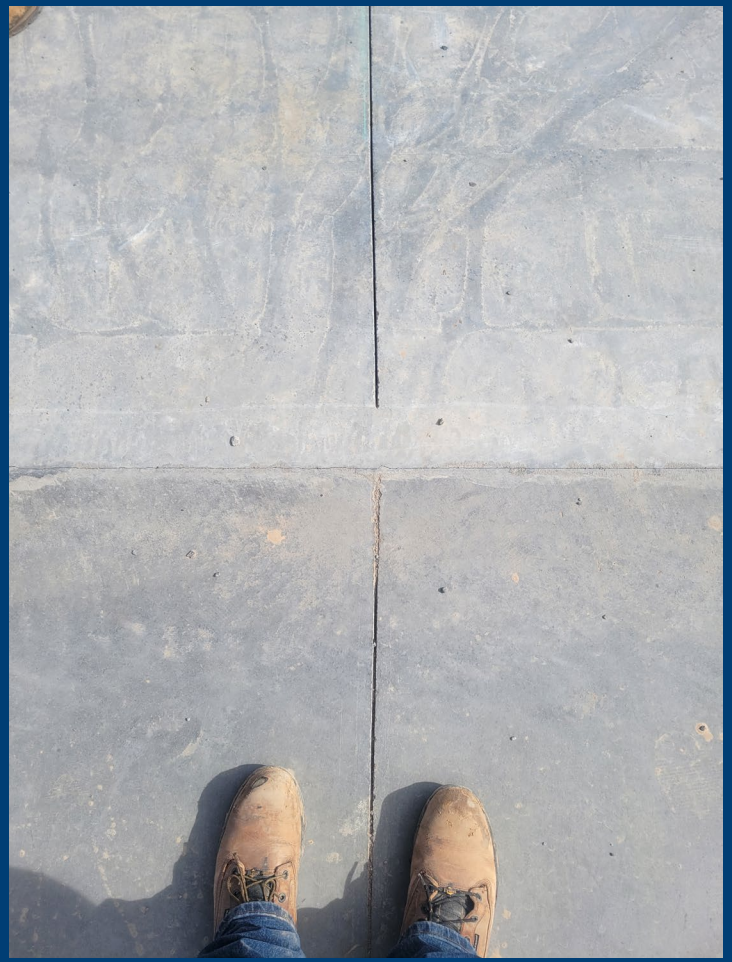
CUBE STRENGTHS ARE GOOD…The Dumb Contractor must have over-finished it!

# Cracking

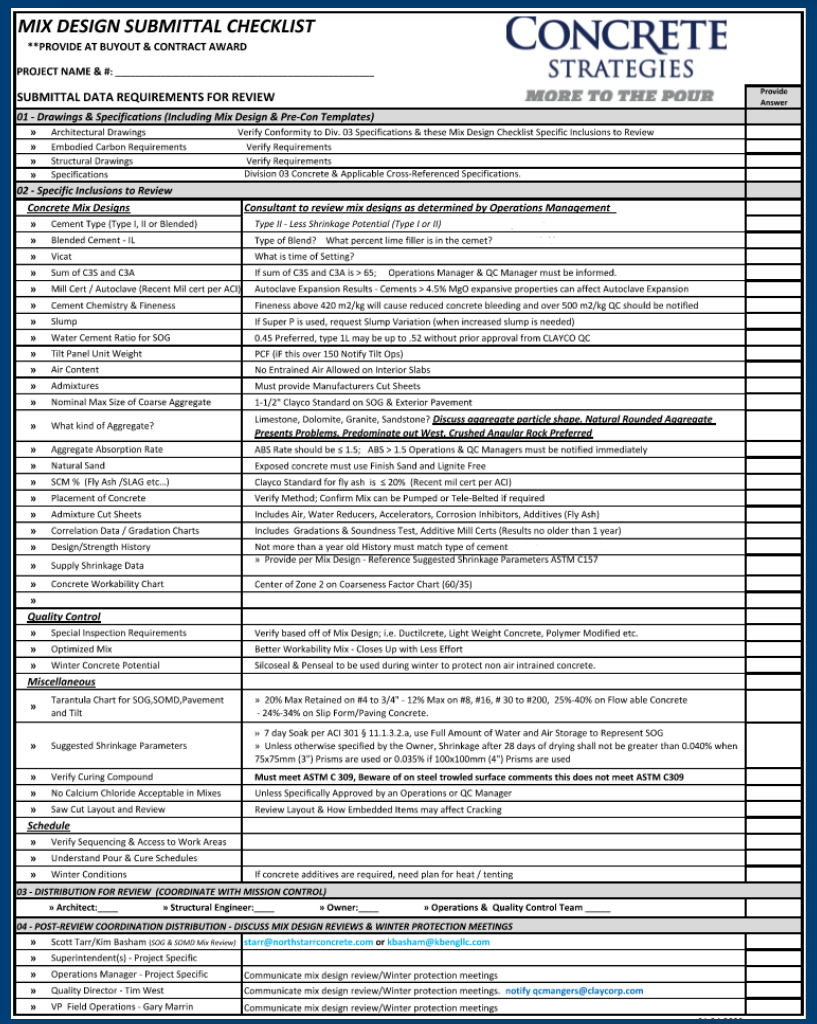
# Differential Set/Crusting



# And all the other 1L Issues!



# Preconstruction Opportunities



**MIX DESIGN SUBMITTAL CHECKLIST**

**PROVIDE AT BUYOUT & CONTRACT AWARD

PROJECT NAME & #: _____

CONCRETE STRATEGIES
MORE TO THE POUR

| SUBMITTAL DATA REQUIREMENTS FOR REVIEW | | Provide Answer |
|---|---|---|
| ***01 - Drawings & Specifications (Including Mix Design & Pre-Con Templates)*** | | |
| » Architectural Drawings | Verify Conformity to Div. 03 Specifications & these Mix Design Checklist Specific Inclusions to Review | |
| » Embodied Carbon Requirements | Verify Requirements | |
| » Structural Drawings | Verify Requirements | |
| » Specifications | Division 03 Concrete & Applicable Cross-Referenced Specifications. | |
| ***02 - Specific Inclusions to Review*** | | |
| ***Concrete Mix Designs*** | ***Consultant to review mix designs as determined by Operations Management*** | |
| » Cement Type (Type I, II or Blended) | *Type II - Less Shrinkage Potential (Type I or II)* | |
| » Blended Cement - IL | Type of Blend? What percent lime filler is in the cemet? | |
| » Vicat | What is time of Setting? | |
| » Sum of C3S and C3A | If sum of C3S and C3A is > 65; Operations Manager & QC Manager must be informed. | |
| » Mill Cert / Autoclave (Recent Mil cert per ACI) | Autoclave Expansion Results - Cements > 4.5% MgO expansive properties can affect Autoclave Expansion | |
| » Cement Chemistry & Fineness | Fineness above 420 m2/kg will cause reduced concrete bleeding and over 500 m2/kg QC should be notified | |
| » Slump | If Super P is used, request Slump Variation (when increased slump is needed) | |
| » Water Cement Ratio for SOG | 0.45 Preferred, type 1L may be up to .52 without prior approval from CLAYCO QC | |
| » Tilt Panel Unit Weight | PCF (iF this over 150 Notify Tilt Ops) | |
| » Air Content | No Entrained Air Allowed on Interior Slabs | |
| » Admixtures | Must provide Manufacturers Cut Sheets | |
| » Nominal Max Size of Coarse Aggregate | 1-1/2" Clayco Standard on SOG & Exterior Pavement | |
| » What kind of Aggregate? | Limestone, Dolomite, Granite, Sandstone? ***Discuss aggregate particle shape. Natural Rounded Aggregate Presents Problems. Predominate out West. Crushed Angular Rock Preferred*** | |
| » Aggregate Absorption Rate | ABS Rate should be ≤ 1.5; ABS > 1.5 Operations & QC Managers must be notified immediately | |
| » Natural Sand | Exposed concrete must use Finish Sand and Lignite Free | |
| » SCM % (Fly Ash /SLAG etc...) | Clayco Standard for fly ash is ≤ 20% (Recent mil cert per ACI) | |
| » Placement of Concrete | Verify Method; Confirm Mix can be Pumped or Tele-Belted if required | |
| » Admixture Cut Sheets | Includes Air, Water Reducers, Accelerators, Corrosion Inhibitors, Additives (Fly Ash) | |
| » Correlation Data / Gradation Charts | Includes Gradations & Soundness Test, Additive Mill Certs (Results no older than 1 year) | |
| » Design/Strength History | Not more than a year old History must match type of cement | |
| » Supply Shrinkage Data | » Provide per Mix Design - Reference Suggested Shrinkage Parameters ASTM C157 | |
| » Concrete Workability Chart | Center of Zone 2 on Coarseness Factor Chart (60/35) | |
| » | | |
| ***Quality Control*** | | |
| » Special Inspection Requirements | Verify based off of Mix Design; i.e. Ductilcrete, Light Weight Concrete, Polymer Modified etc. | |
| » Optimized Mix | Better Workability Mix - Closes Up with Less Effort | |
| » Winter Concrete Potential | Silcoseal & Penseal to be used during winter to protect non air intrained concrete. | |
| ***Miscellaneous*** | | |
| » Tarantula Chart for SOG,SOMD,Pavement and Tilt | » 20% Max Retained on #4 to 3/4" - 12% Max on #8, #16, # 30 to #200, 25%-40% on Flow able Concrete - 24%-34% on Slip Form/Paving Concrete. | |
| » Suggested Shrinkage Parameters | » 7 day Soak per ACI 301 § 11.1.3.2.a, use Full Amount of Water and Air Storage to Represent SOG<br>» Unless otherwise specified by the Owner, Shrinkage after 28 days of drying shall not be greater than 0.040% when 75x75mm (3") Prisms are used or 0.035% if 100x100mm (4") Prisms are used | |
| » Verify Curing Compound | **Must meet ASTM C 309, Beware of on steel trowled surface comments this does not meet ASTM C309** | |
| » No Calcium Chloride Acceptable in Mixes | Unless Specifically Approved by an Operations or QC Manager | |
| » Saw Cut Layout and Review | Review Layout & How Embedded Items may affect Cracking | |
| ***Schedule*** | | |
| » Verify Sequencing & Access to Work Areas | | |
| » Understand Pour & Cure Schedules | | |
| » Winter Conditions | If concrete additives are required, need plan for heat / tenting | |
| ***03 - DISTRIBUTION FOR REVIEW (COORDINATE WITH MISSION CONTROL)*** | | |
| **» Architect:___ » Structural Engineer:___ » Owner:___ » Operations & Quality Control Team ____** | | |
| ***04 - POST-REVIEW COORDINATION DISTRIBUTION - DISCUSS MIX DESIGN REVIEWS & WINTER PROTECTION MEETINGS*** | | |
| » Scott Tarr/Kim Basham *(SOG & SOMD Mix Review)* | starr@northstarrconcrete.com **or** kbasham@kbenglic.com | |
| » Superintendent(s) - Project Specific | | |
| » Operations Manager - Project Specific | Communicate mix design review/Winter protection meetings | |
| » Quality Director - Tim West | Communicate mix design review/Winter protection meetings. notify qcmangers@claycorp.com | |
| » VP Field Operations - Gary Marrin | Communicate mix design review/Winter protection meetings | |

- "By failing to prepare, you are preparing to fail.

  --Benjamin Franklin

- Put yourself in the best position to succeed when the grey stuff hits the forms!

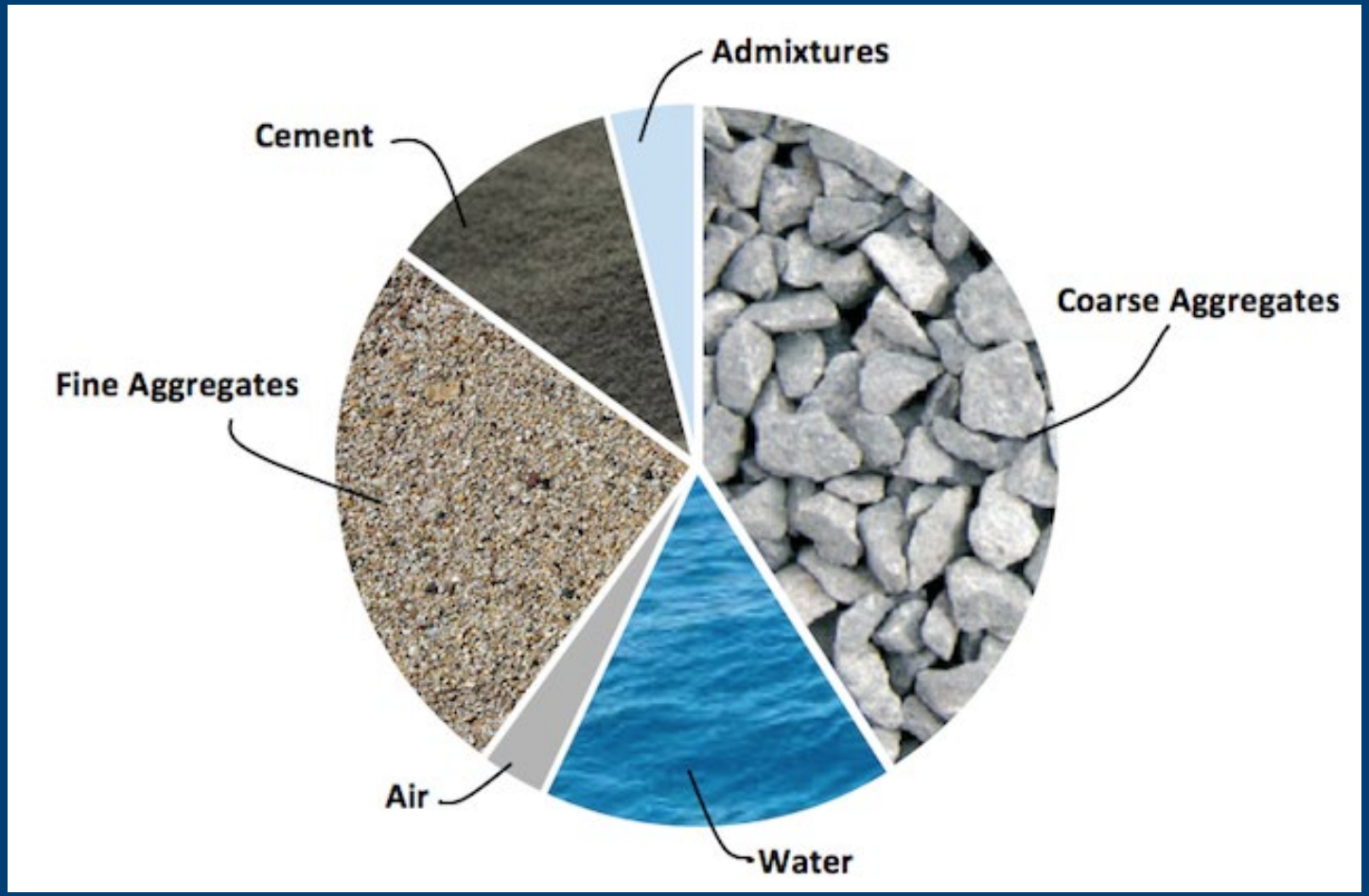
# Specifications


- Start with reading them…
- …no seriously…read the specs
- Look out for the old copy/paste trick.
- Watch for prescriptive specs.

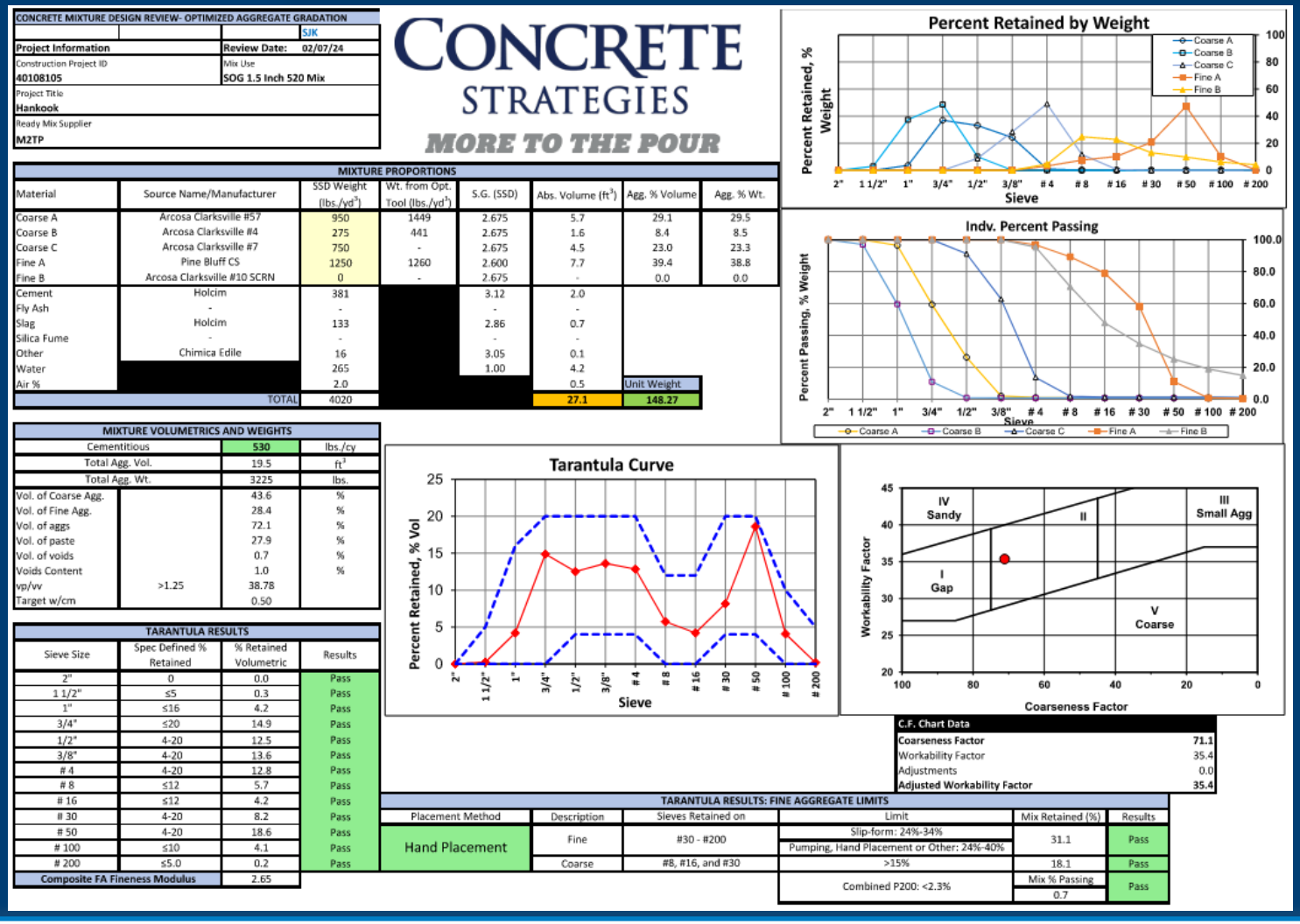
# Mix Design Evaluation

- Look at the parts and pieces of the mix.
- Don’t assume everything will go well.
- ESPECIALLY when switching materials (ANY materials) or using a new supplier/working in a new area
- How much past data does the supplier have?

Picture from Giatec Scientific Inc.



# Mix Design Evaluation



CONCRETE MIXTURE DESIGN REVIEW- OPTIMIZED AGGREGATE GRADATION

| | | |
|---|---|---|
| | | SJK |
| Project Information | Review Date: | 02/07/24 |
| Construction Project ID | Mix Use | |
| 40108105 | SOG 1.5 Inch 520 Mix | |
| Project Title | | |
| Hankook | | |
| Ready Mix Supplier | | |
| M2TP | | |

CONCRETE STRATEGIES
MORE TO THE POUR

MIXTURE PROPORTIONS

| Material | Source Name/Manufacturer | SSD Weight (lbs./yd³) | Wt. from Opt. Tool (lbs./yd³) | S.G. (SSD) | Abs. Volume (ft³) | Agg. % Volume | Agg. % Wt. |
|---|---|---|---|---|---|---|---|
| Coarse A | Arcosa Clarksville #57 | 950 | 1449 | 2.675 | 5.7 | 29.1 | 29.5 |
| Coarse B | Arcosa Clarksville #4 | 275 | 441 | 2.675 | 1.6 | 8.4 | 8.5 |
| Coarse C | Arcosa Clarksville #7 | 750 | - | 2.675 | 4.5 | 23.0 | 23.3 |
| Fine A | Pine Bluff CS | 1250 | 1260 | 2.600 | 7.7 | 39.4 | 38.8 |
| Fine B | Arcosa Clarksville #10 SCRN | 0 | - | 2.675 | - | 0.0 | 0.0 |
| Cement | Holcim | 381 | | 3.12 | 2.0 | | |
| Fly Ash | - | - | | - | - | | |
| Slag | Holcim | 133 | | 2.86 | 0.7 | | |
| Silica Fume | - | - | | - | - | | |
| Other | Chimica Edile | 16 | | 3.05 | 0.1 | | |
| Water | | 265 | | 1.00 | 4.2 | | |
| Air % | | 2.0 | | | 0.5 | Unit Weight | |
| | TOTAL | 4020 | | | 27.1 | 148.27 | |

MIXTURE VOLUMETRICS AND WEIGHTS

| | | | |
|---|---|---|---|
| Cementitious | | 530 | lbs./cy |
| Total Agg. Vol. | | 19.5 | ft³ |
| Total Agg. Wt. | | 3225 | lbs. |
| Vol. of Coarse Agg. | | 43.6 | % |
| Vol. of Fine Agg. | | 28.4 | % |
| Vol. of aggs | | 72.1 | % |
| Vol. of paste | | 27.9 | % |
| Vol. of voids | | 0.7 | % |
| Voids Content | | 1.0 | % |
| vp/vv | >1.25 | 38.78 | |
| Target w/cm | | 0.50 | |

TARANTULA RESULTS

| Sieve Size | Spec Defined % Retained | % Retained Volumetric | Results |
|---|---|---|---|
| 2" | 0 | 0.0 | Pass |
| 1 1/2" | ≤5 | 0.3 | Pass |
| 1" | ≤16 | 4.2 | Pass |
| 3/4" | ≤20 | 14.9 | Pass |
| 1/2" | 4-20 | 12.5 | Pass |
| 3/8" | 4-20 | 13.6 | Pass |
| # 4 | 4-20 | 12.8 | Pass |
| # 8 | ≤12 | 5.7 | Pass |
| # 16 | ≤12 | 4.2 | Pass |
| # 30 | 4-20 | 8.2 | Pass |
| # 50 | 4-20 | 18.6 | Pass |
| # 100 | ≤10 | 4.1 | Pass |
| # 200 | ≤5.0 | 0.2 | Pass |
| Composite FA Fineness Modulus | | 2.65 | |













C.F. Chart Data

| | |
|---|---|
| Coarseness Factor | 71.1 |
| Workability Factor | 35.4 |
| Adjustments | 0.0 |
| Adjusted Workability Factor | 35.4 |

TARANTULA RESULTS: FINE AGGREGATE LIMITS

| Placement Method | Description | Sieves Retained on | Limit | Mix Retained (%) | Results |
|---|---|---|---|---|---|
| Hand Placement | Fine | #30 - #200 | Slip-form: 24%-34%<br>Pumping, Hand Placement or Other: 24%-40% | 31.1 | Pass |
| | Coarse | #8, #16, and #30 | >15% | 18.1 | Pass |
| | | | Combined P200: <2.3% | Mix % Passing<br>0.7 | Pass |

- Mill Certs
- Strength History (Look at the dates!)
- Blaine Fineness
- w/c Ratio
- SCM's (Don't be afraid…a little slag never hurt anybody!)
- Paste Content
- Optimize Aggregate Gradations
- Aggregate Type/Shape
- Sand Fineness
- Set Times

# Placement – Test Pours

- Try it before you buy it!
- Plan for/budget for a test slab
- Don’t go for the smallest possible size
- Be willing to make an adjustment or two
- In-place mock ups can be risky!

# Placement – Test Pours

# Placement – Test Pours

- Test pours aren't only for slabs!
- Many Tilt-up jobs require a mockup.  Use it as an opportunity!

# Placement – Feedback

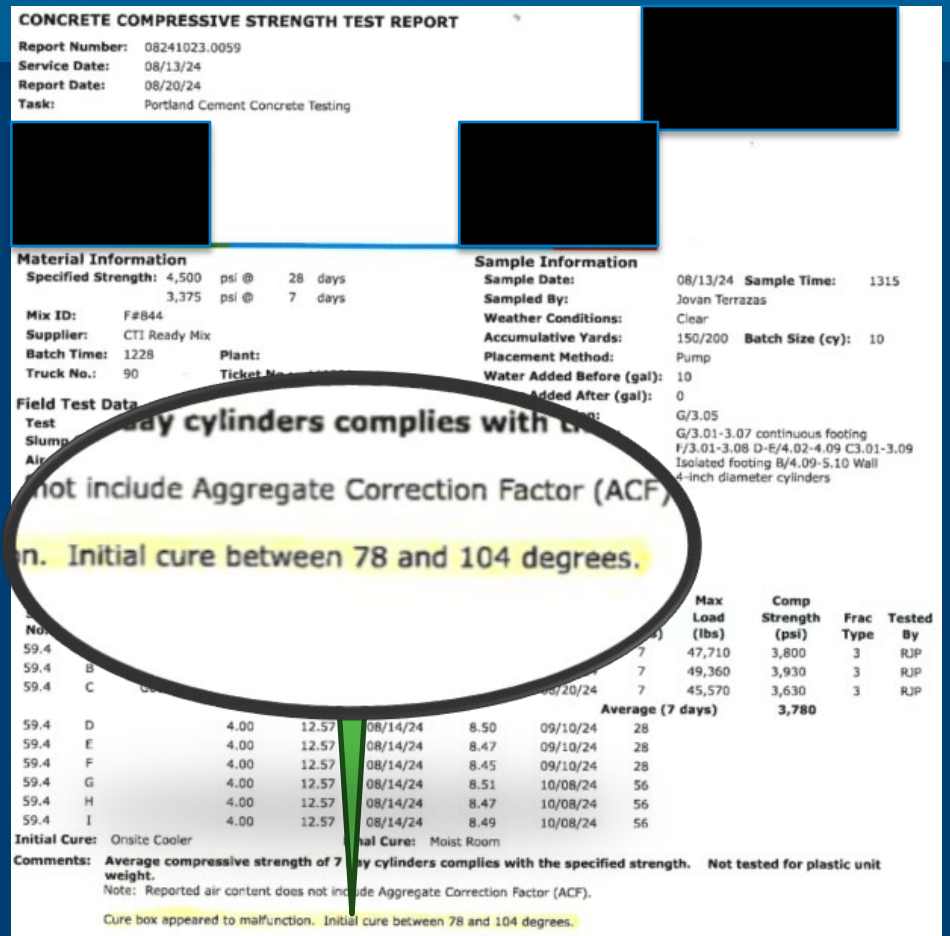
- Talk to the Finishers...
- Ask them questions
  - Set time
  - Workability
  - Finishability
  - Did you notice anything strange?
- Share the feedback with the ready mix supplier
- Pre Con Meetings are key

# Contractor Bad Habits?


# 3rd Party Testing

# 3rd Party Testing

# 3rd Party Testing



**CONCRETE COMPRESSIVE STRENGTH TEST REPORT**

**Report Number:** 08241023.0059
**Service Date:** 08/13/24
**Report Date:** 08/20/24
**Task:** Portland Cement Concrete Testing

[redacted]

**Material Information**
**Specified Strength:** 4,500 psi @ 28 days
3,375 psi @ 7 days
**Mix ID:** F#844
**Supplier:** CTI Ready Mix
**Batch Time:** 1228 **Plant:**
**Truck No.:** 90

**Sample Information**
**Sample Date:** 08/13/24 **Sample Time:** 1315
**Sampled By:** Jovan Terrazas
**Weather Conditions:** Clear
**Accumulative Yards:** 150/200 **Batch Size (cy):** 10
**Placement Method:** Pump
**Water Added Before (gal):** 10
**Added After (gal):** 0
G/3.05
G/3.01-3.07 continuous footing
F/3.01-3.08 D-E/4.02-4.09 C3.01-3.09
Isolated footing B/4.09-5.10 Wall
4-inch diameter cylinders

**Field Test Data**
Test
Slump
Air

**day cylinders complies with t**
**not include Aggregate Correction Factor (ACF)**
**n. Initial cure between 78 and 104 degrees.**

| | | | | | | | | Max Load (lbs) | Comp Strength (psi) | Frac Type | Tested By |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 59.4 | | | | | | | 7 | 47,710 | 3,800 | 3 | RJP |
| 59.4 | B | | | | | | 7 | 49,360 | 3,930 | 3 | RJP |
| 59.4 | C | | | | | 08/20/24 | 7 | 45,570 | 3,630 | 3 | RJP |
| | | | | | | | Average (7 days) | | 3,780 | | |
| 59.4 | D | 4.00 | 12.57 | 08/14/24 | 8.50 | 09/10/24 | 28 | | | | |
| 59.4 | E | 4.00 | 12.57 | 08/14/24 | 8.47 | 09/10/24 | 28 | | | | |
| 59.4 | F | 4.00 | 12.57 | 08/14/24 | 8.45 | 09/10/24 | 28 | | | | |
| 59.4 | G | 4.00 | 12.57 | 08/14/24 | 8.51 | 10/08/24 | 56 | | | | |
| 59.4 | H | 4.00 | 12.57 | 08/14/24 | 8.47 | 10/08/24 | 56 | | | | |
| 59.4 | I | 4.00 | 12.57 | 08/14/24 | 8.49 | 10/08/24 | 56 | | | | |

**Initial Cure:** Onsite Cooler **Final Cure:** Moist Room

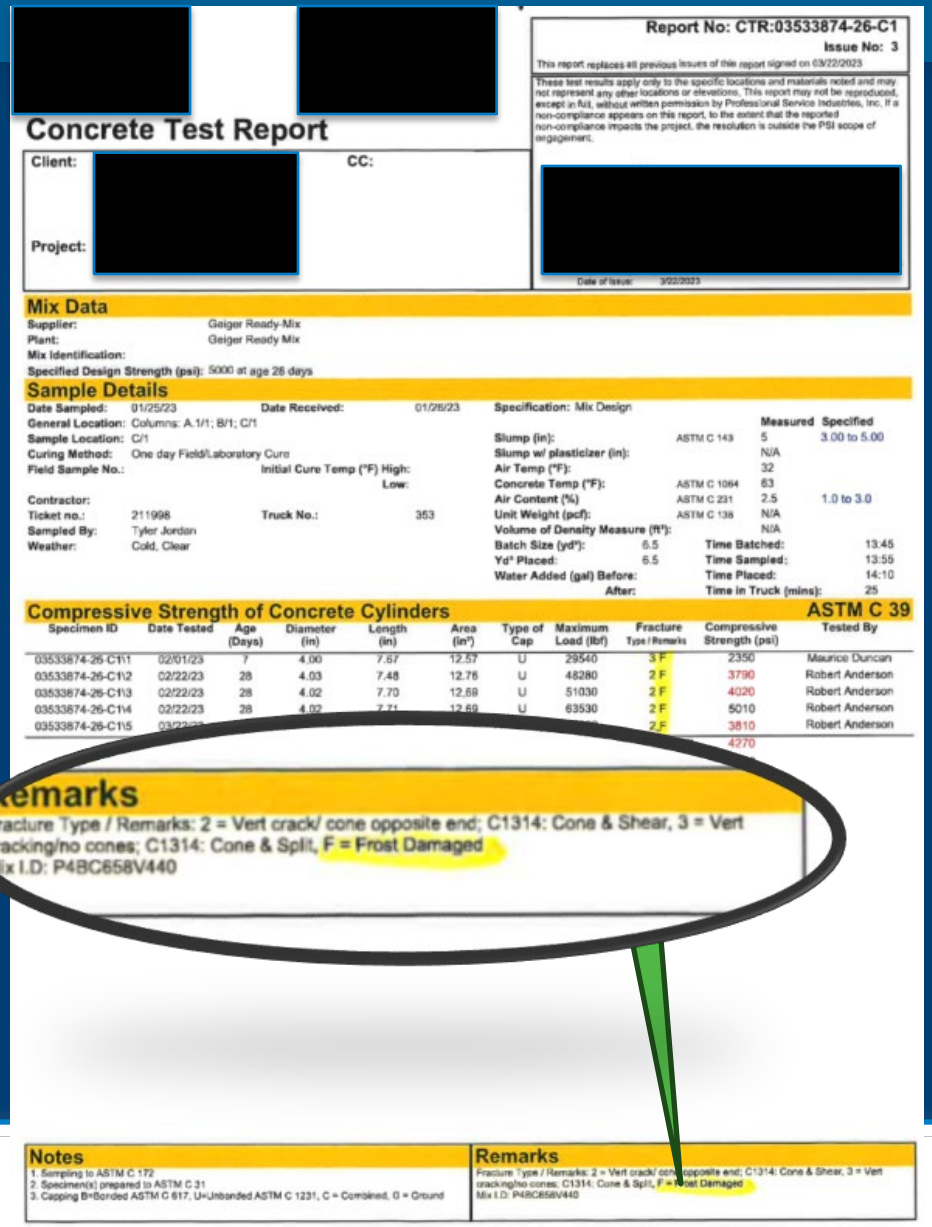
**Comments:** **Average compressive strength of 7 day cylinders complies with the specified strength.** **Not tested for plastic unit weight.**
Note: Reported air content does not include Aggregate Correction Factor (ACF).

Cure box appeared to malfunction. Initial cure between 78 and 104 degrees.

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

CR0001, 3-31-22, Rev.7

Page 7 of 8



[redacted]

**Report No: CTR:03533874-26-C1**
**Issue No: 3**
This report replaces all previous issues of this report signed on 03/22/2023

These test results apply only to the specific locations and materials noted and may not represent any other locations or elevations. This report may not be reproduced, except in full, without written permission by Professional Service Industries, Inc. If a non-compliance appears on this report, to the extent that the reported non-compliance impacts the project, the resolution is outside the PSI scope of engagement.

[redacted]

Date of Issue: 3/22/2023

## Concrete Test Report

**Client:** [redacted] **CC:**
**Project:**

### Mix Data
**Supplier:** Geiger Ready-Mix
**Plant:** Geiger Ready Mix
**Mix Identification:**
**Specified Design Strength (psi):** 5000 at age 28 days

### Sample Details
**Date Sampled:** 01/25/23 **Date Received:** 01/26/23 **Specification:** Mix Design
**General Location:** Columns: A.1/1; B/1; C/1
**Sample Location:** C/1
**Curing Method:** One day Field/Laboratory Cure
**Field Sample No.:** **Initial Cure Temp (°F) High:** **Low:**
**Contractor:**
**Ticket no.:** 211998 **Truck No.:** 353
**Sampled By:** Tyler Jordan
**Weather:** Cold, Clear

| | | Measured | Specified |
|---|---|---|---|
| Slump (in): | ASTM C 143 | 5 | 3.00 to 5.00 |
| Slump w/ plasticizer (in): | | N/A | |
| Air Temp (°F): | | 32 | |
| Concrete Temp (°F): | ASTM C 1064 | 63 | |
| Air Content (%) | ASTM C 231 | 2.5 | 1.0 to 3.0 |
| Unit Weight (pcf): | ASTM C 138 | N/A | |
| Volume of Density Measure (ft³): | | N/A | |

**Batch Size (yd³):** 6.5 **Time Batched:** 13:45
**Yd³ Placed:** 6.5 **Time Sampled:** 13:55
**Water Added (gal) Before:** **Time Placed:** 14:10
**After:** **Time in Truck (mins):** 25

### Compressive Strength of Concrete Cylinders — ASTM C 39

| Specimen ID | Date Tested | Age (Days) | Diameter (in) | Length (in) | Area (in²) | Type of Cap | Maximum Load (lbf) | Fracture Type / Remarks | Compressive Strength (psi) | Tested By |
|---|---|---|---|---|---|---|---|---|---|---|
| 03533874-26-C1\1 | 02/01/23 | 7 | 4.00 | 7.67 | 12.57 | U | 29540 | 3 F | 2350 | Maurice Duncan |
| 03533874-26-C1\2 | 02/22/23 | 28 | 4.03 | 7.48 | 12.76 | U | 48280 | 2 F | 3790 | Robert Anderson |
| 03533874-26-C1\3 | 02/22/23 | 28 | 4.02 | 7.70 | 12.69 | U | 51030 | 2 F | 4020 | Robert Anderson |
| 03533874-26-C1\4 | 02/22/23 | 28 | 4.02 | 7.71 | 12.69 | U | 63530 | 2 F | 5010 | Robert Anderson |
| 03533874-26-C1\5 | 03/22/23 | | | | | | | 2 F | 3810 | Robert Anderson |
| | | | | | | | | | 4270 | |

**Remarks**
Fracture Type / Remarks: 2 = Vert crack/ cone opposite end; C1314: Cone & Shear, 3 = Vert cracking/no cones; C1314: Cone & Split, F = Frost Damaged
Mix I.D: P4BC658V440

**Notes**
1. Sampling to ASTM C 172
2. Specimen(s) prepared to ASTM C 31
3. Capping B=Bonded ASTM C 617, U=Unbonded ASTM C 1231, C = Combined, G = Ground

**Remarks**
Fracture Type / Remarks: 2 = Vert crack/ cone opposite end; C1314: Cone & Shear, 3 = Vert cracking/no cones; C1314: Cone & Split, F = Frost Damaged
Mix I.D: P4BC658V440

# 3rd Party Testing

- TALK WITH THE TESTERS!
  - Precon meetings
  - On the Jobsite
- They usually don't work for you, but will usually work with you.
- If you notice something's not right, bring it up.
- Initial curing and storage is CRITICAL.

# Continuous Improvement

- Ready Mix Suppliers
  - Work closely with your cement vendors
  - Attempting to connecting the dots between your results and theirs.
  - DO NOT SLEEP ON YOUR COMPANION CYLINDERS!!!
  - Keep a close eye on your material sources
- Cement/Admixture Suppliers
  - Admixture compatibility & set time testing (especially around material transitions)
  - Communication!
  - Develop relationships and work with ready-mix and contractors in your area. They can help you as much as you help them!

# Continuous Improvement

- Contractors
  - Cut back on the bad habits!
  - Proper Curing is key
  - Working with Testers to facilitate proper cylinder handling/storage procedures
  - Try it before you buy it

- Engineers & 3rd Party Labs
  - Keep informing that this is in fact our only option in some markets and specs need to allow us the use for Type 1L cement
  - Concrete curing and handling is more critical than ever, and we are continually to further assist and educate local inspectors on Type 1L concrete.
  - Follow the procedures
  - Work with the Materials Engineering, not against it.  Performance vs Prescriptive

# Continuous Improvement

- Owners
  - Educate yourselves
  - Engage with the industry
  - Understand what your asking for and what the downstream effects are
  - Develop good relationships with reputable Engineers/Architects, contractors and suppliers

# Conclusions

- A≠B (necessarily)
- Plan for the best and prepare for the worst!
- Understand the project requirements.  Work with RM suppliers!
- Treat every new mix as exactly that!  A new mix.
- Check through the material information in your mix design packages.
- Test pours are crucial.
- Involve the guys actually putting the concrete on the ground.
- Communicate - Suppliers->RM Producer->Contractors->Owners

# We have to work together!

# Presenter Info for Further Questions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# *Thank you*

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