Not Your Grandfather's Concrete

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Tech Center

The Perfect Pavement

- Long lasting
- Cost effective
- Safe
- Smooth and creamy

The Perfect Material for Pavements

- Cost effective
- Easy to build with
- Get traffic on it fast
- Unbreakable
- Weather-proof
- Sustainable
- Resilient

The Perfect Specification

- You get paid after […] years
- Strength and only strength(?)
- Or we do something that predicts life
  - Environment
  - Loads
  - Constructibility

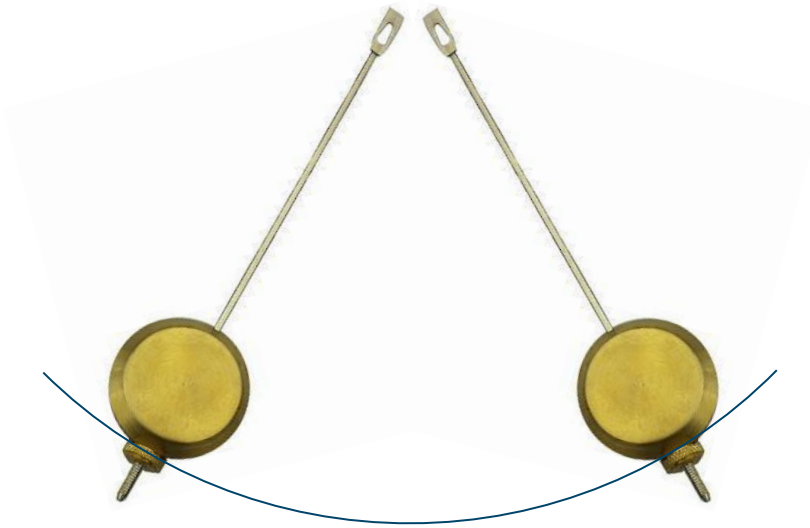
The Perfect Test

- ✓ Fast
- ✓ Reliable
- ✓ Cost effective

- ✓ Meaningful

Challenges to writing specifications

- “Get out of the way,” Celik Ozyildirim, VA
- “Protect the contractors from themselves,” Maria Masten, MN
- “Trust but verify,” Proverb
- “Keep it simple,” Everybody



Complications

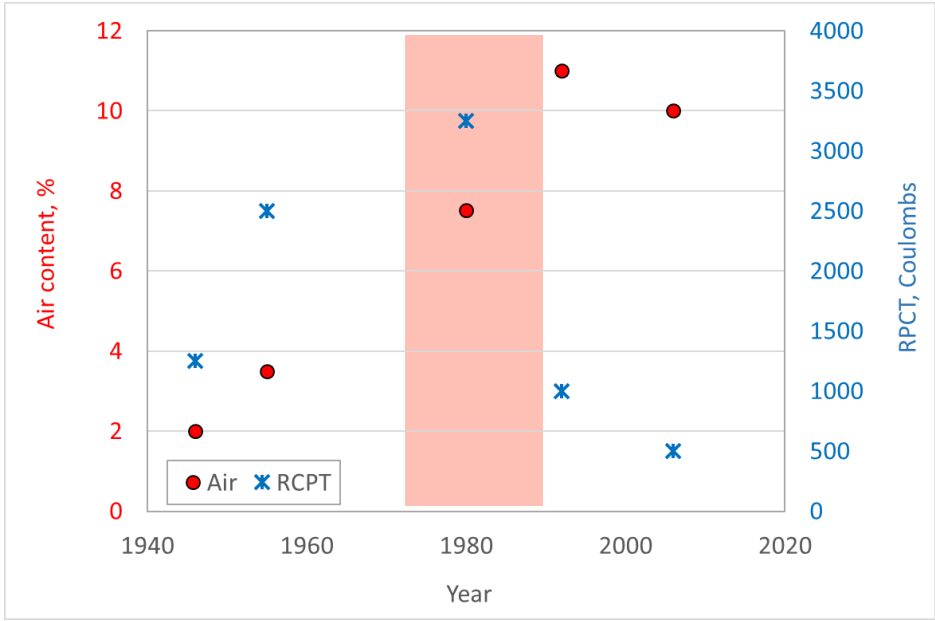
- Concrete changes over time
  - Hydration may continue
  - Cracking
  - Moisture / temperature state
- The environment is not constant
  - Yearly / daily changes
  - Local effects

Why bother changing?

- Life is more complicated…
  - Admixtures
  - Changing cements
  - Higher demands
  - Reducing clinker

What was good concrete?

- Plain cement
- Volumetric batching
- Add water to taste
- Quality defined by strength and slump



What is good concrete?

- Constructible (Workable)
- Dimensionally stable
  - Aggregates
  - Shrinkage
- Impermeable (Transport properties)
- Cold weather resistant
  - Freeze thaw
  - Salt attack
- Strong (enough)

Workability

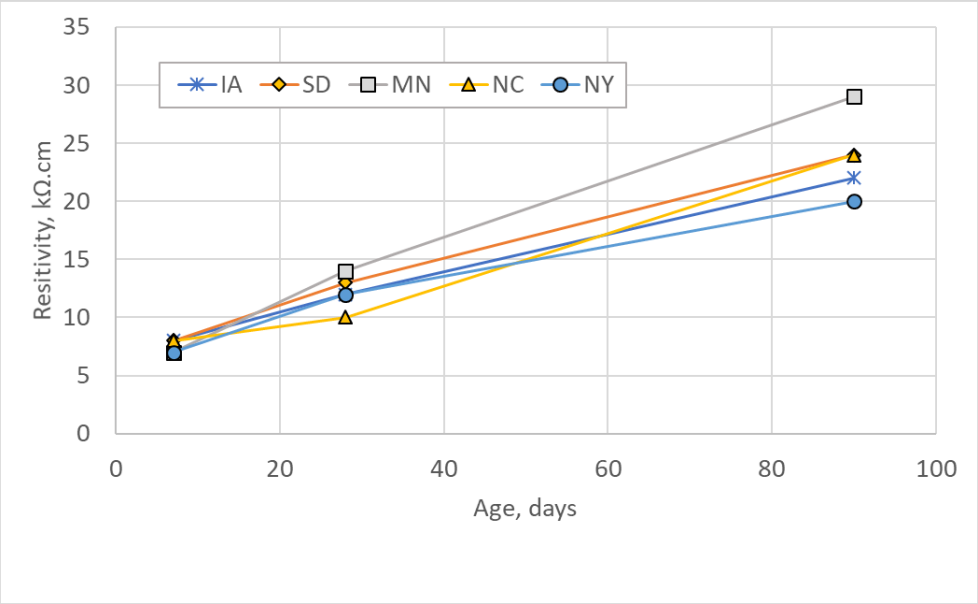
- Not too wet / Not too dry
- Right for the equipment you are using
- Response to vibration
- Thixotropy

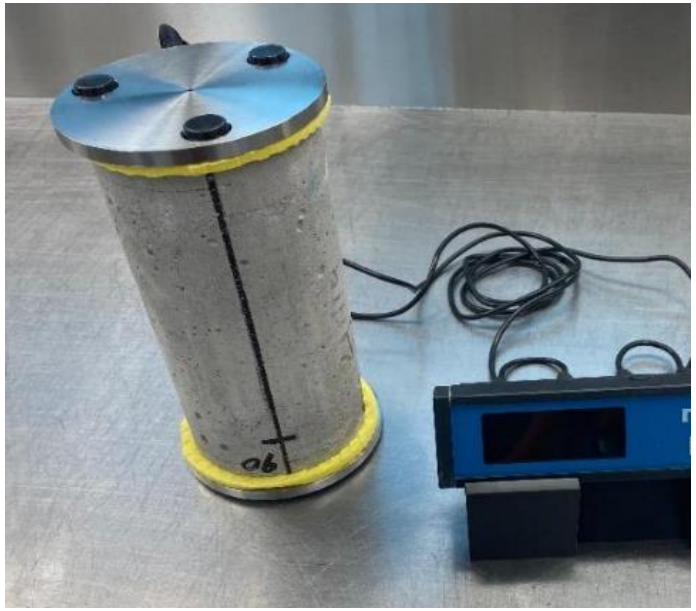
- Prequalification

Transport properties (permeability)

- All deterioration mechanisms involve fluid movement
- Keep water out = longer life
- Controlled by w/cm and binder type

- Prequalification
- QC
- Acceptance





Cold Weather

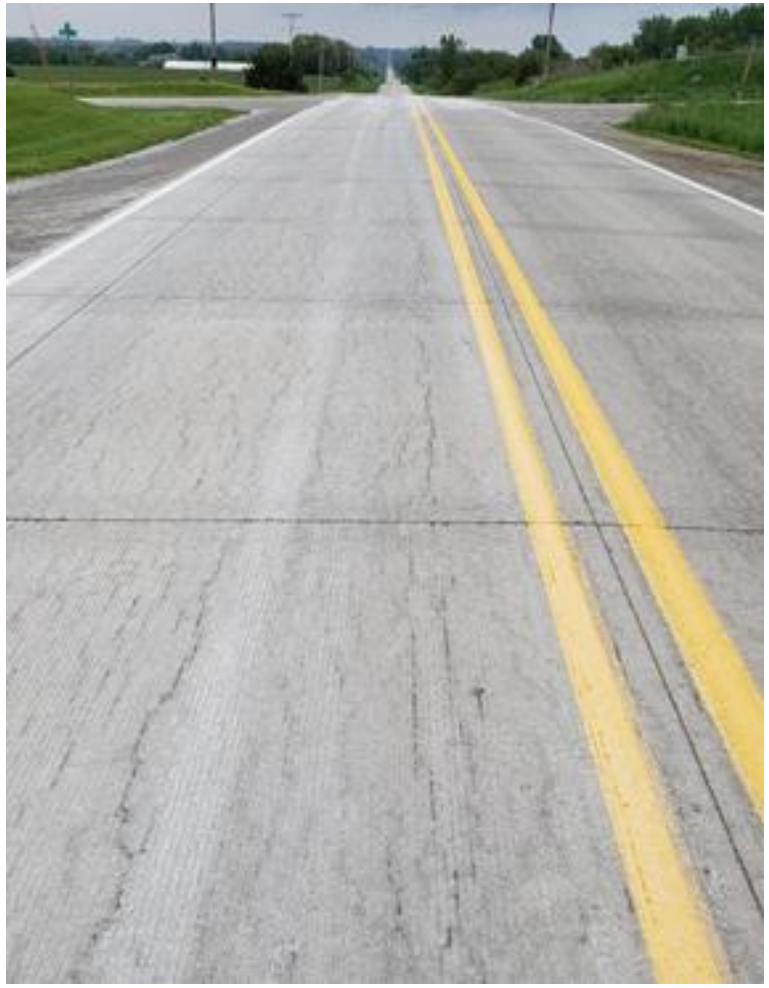
- Saturated Freeze-thaw
- De-icing salts
- Scaling

- Prequalification
- QC
- Acceptance

Aggregate Stability

- Aggregate growing due to
  - Alkali silica reaction
  - (Alkali carbonate reaction)
  - D-Cracking

- Prequalification



Shrinkage

- Influences cracking risk
- Controls warping
- Takes time

- Controlled by paste content

- Prequalification

Strength

- Strong enough to carry loads
  - (and not much more)
- Controlled by w/cm and binder type
- Prequalification
- QC
- Acceptance

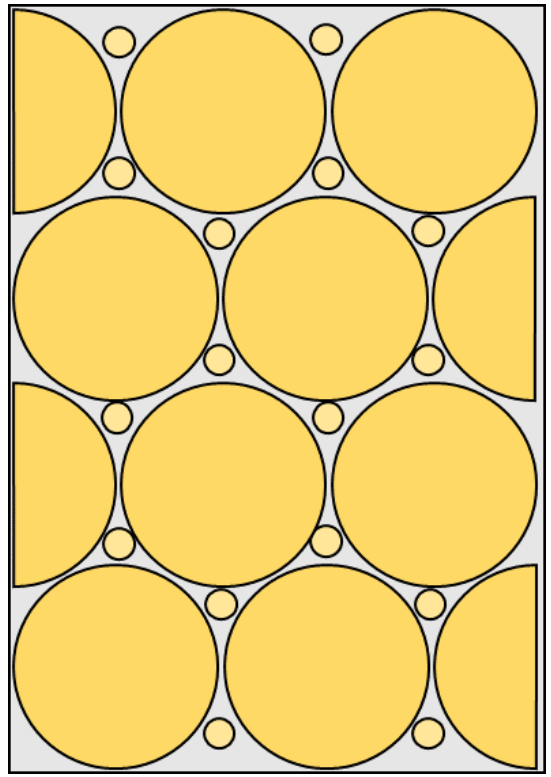
Other Parameters

- Surface durability
  - Bleed / set
- Consolidation and Segregation
  - Response to vibration
- Smoothness
  - Paste content

The mixture

- How do we prepare mixtures that meets these needs?

		Workability	Transport	Strength	Cold weather	Shrinkage	Aggregate stability
Aggregate System	Type, gradation	✓✓	-	-	-	-	✓✓
Paste quality	Air, w/cm, SCM type and dose	✓	✓✓	✓✓	✓✓	✓	✓
Paste quantity	Vp/Vv	✓	-	-	-	✓✓	-



That’s the theory – now for the reality!!!

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CONSULTING

TRAINING

CONSTRUCTION EQUIPMENT

"HELPING YOU BUILD BETTER CONCRETE"

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CONSULTING
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"HELPING YOU BUILD BETTER CONCRETE"

About the Presenters

- **Matt Fonte** is the president of **Fonte and Company**. A consulting company that specializes in all aspects of concrete pavements.
- **Matt** is also the President of **Fonte Equipment Company**. An equipment company that specializes in Concrete Batching Equipment.

- Matt has 25 years of experience on the heavy civil construction platform, and 19 of those years have been in the concrete paving industry.
- Throughout these years Matt has developed an extensive knowledge of all aspects of concrete pavements. Most notably in mix design, pavement smoothness, and equipment setup.
- Matt believes we should be good stewards of the taxpayer dollars, and one of the best ways to be a good stewards is investing in smooth long-lasting sustainable concrete pavements.

What defines good concrete?

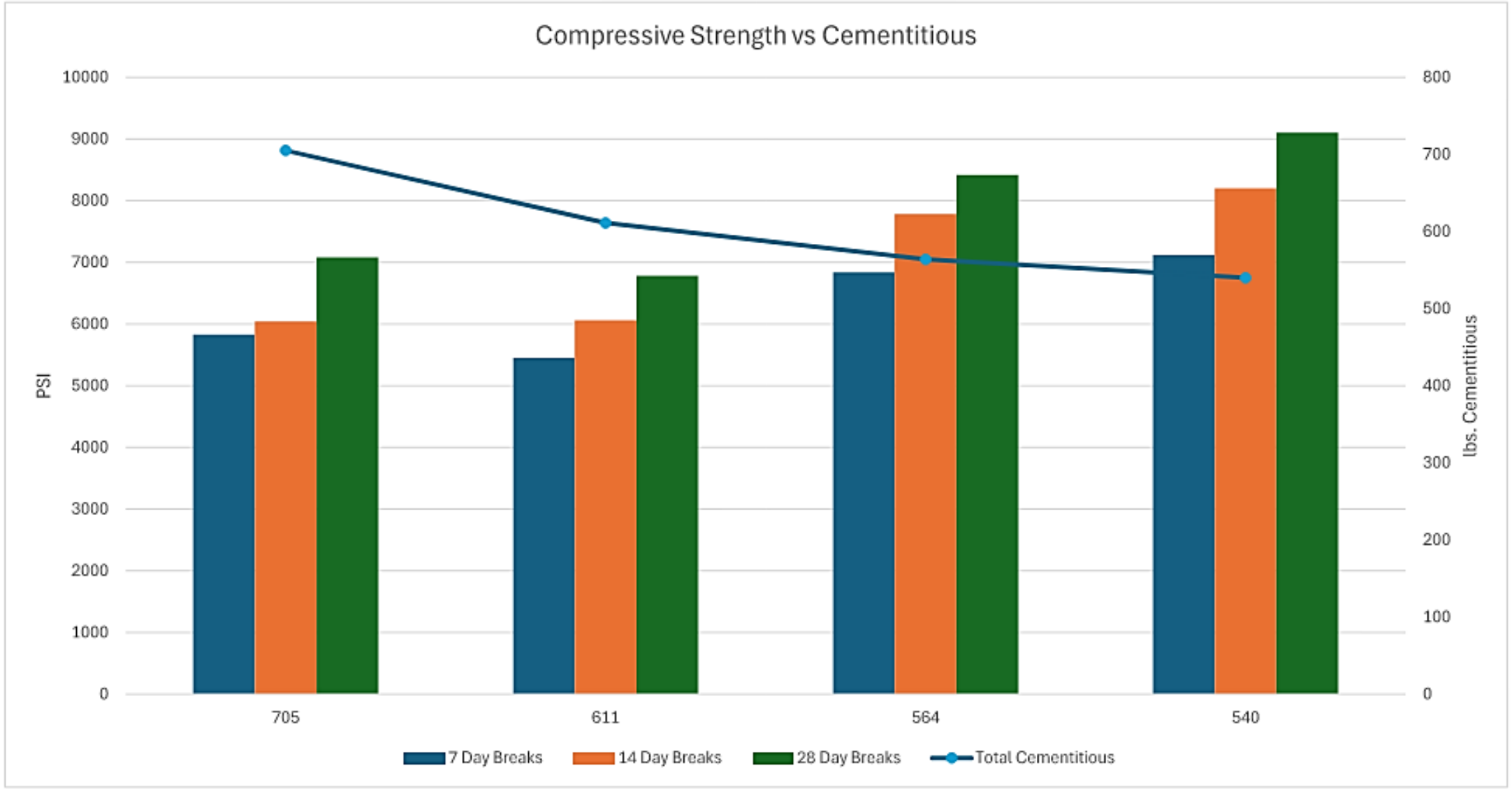
- Long service life
- Durable – Able to withstand wear, pressure, or damage
- Workable – Ability to close holes with minimal energy.
- Ability to hold an edge
- Not segregated
- Strength??

- All the above starts with the proper Mix Design.

Cement Content

Nevada Mix

Sack	Total Cementitious	Cement	Class N	#4 Rock	#57 Rock	#89 Rock	Sand	W/CM	Gallons	7 Day Breaks	14 Day Breaks	28 Day Breaks
7.5	705	564	141	550	825	275	1100	0.40	34.17	5830	6040	7080
6.5	611	489	122	587	881	294	1174	0.40	29.38	5450	6060	6780
6	564	452	112	604	906	302	1208	0.40	27.34	6840	7780	8420
5.74	540	432	108	615	923	308	1230	0.40	25.78	7120	8200	9100



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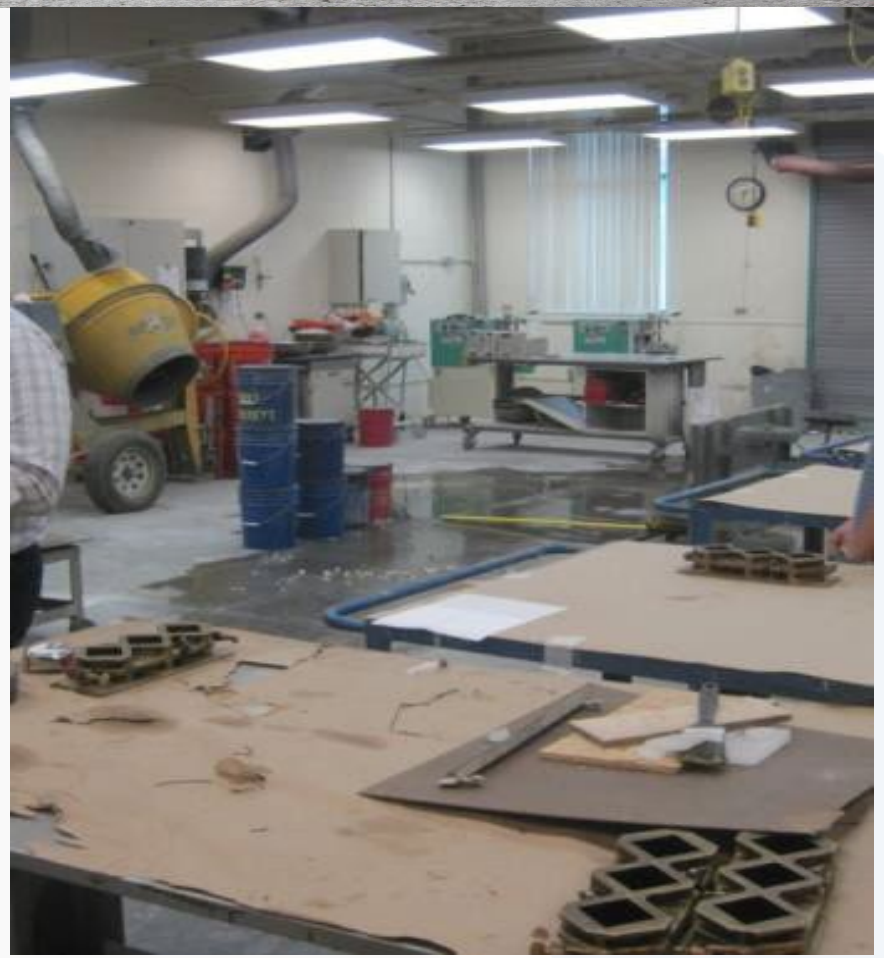
Trial Batch

Scott Blanton - Delta Industries - Limestone (564) 4-4-2025 Test														
Material	0.04 CU YD	1 CU FT	Moisture Adjustment	Actual lbs.	Moisture %	Agg Abs %	Agg Water	Milliliter Target	OZ/CWT Target	Milliliter Actual	Ounces Actual	OZ/CWT Actual	OZ/CY Actual	W/CM Target
Hannibal IL Continental	451	16.70		16.7										0.381
ECO Miller Class C Flyash	113	4.19		4.19										W/CM
1" Limestone #57	1236	45.76	46.17	45.76	2.0%	1.1%	0.41							Actual
Limestone #8	665	24.64	24.93	26.64	2.0%	0.8%	0.32							0.382
Pea Gravel #8	0	0.00	0.00	0	2.0%	4.5%	0.00							Air
Concrete Sand	1267	46.93	49.80	46.93	7.0%	0.9%	2.86							6.0%
Municipal Water	215	7.96	4.38	4.4			7.99							Slump
Chryso Air 1000	12	0.44		0.53			0.96	13.1	2.13	13.1	0.443	2.12	11.96	1.0"
Chryso Zyla 610	0	0.00		Gallons			Gallons	0.0	0.00	0	0.000	0.00	0.00	Box Test
Chryso ADVA 140	16	0.59						17.5	2.84	17.5	0.592	2.83	15.98	5-15%
Chryso V-MAR F100	35	1.30						38.3	6.21	38.3	1.295	6.20	34.97	Mix Time
Chryso Recover	22	0.81						24.1	3.90	24.1	0.815	3.90	22.00	35 min

Trial Batching

- Introduce Aggregates, Cementitious, and Water. (Air Entrainment on the Sand)
- Stop to ensure all materials are mixed. (Scrape the corners if needed)
- Introduce Add Mixtures and visibly look for a change in the concrete. Thoroughly Mix the concrete and test physical properties (Slump, Air, Unit Weight, and The Box Test)
- Simulate the haul. (Agitated or Non-Agitated)
- Test the physical properties again. (Slump, Air, Unit Weight, and The Box Test)
- Is your mix workable at the point of placement?



The Box Test

- This test is mandatory for slipform paving (and more)
- This test will tell you how the mix will respond to your paver.
- How well will the mix close up holes
- How well will the mix hold an edge

Should we start over?

Water Reducer

- Mix Designs should always include water reducer effectiveness testing.
- The water reducer can have the second largest impact in the mix.

Water Reducer

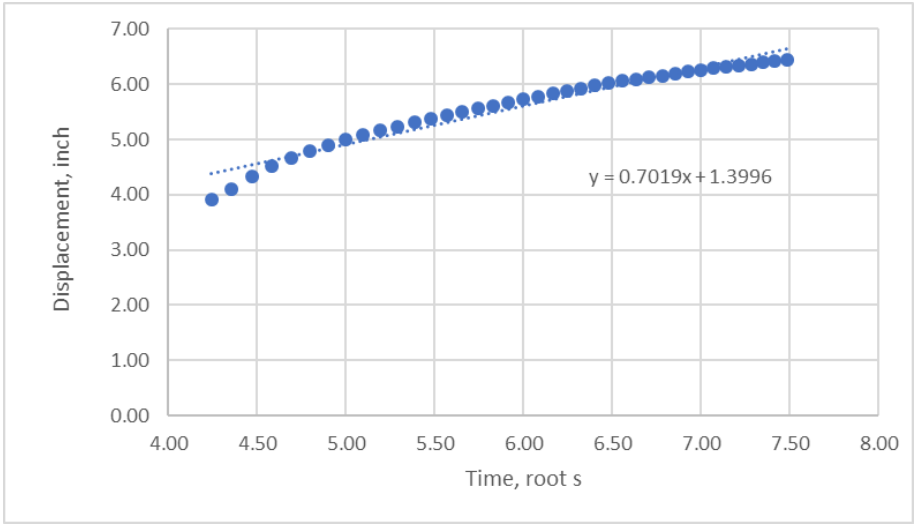
- Mix Designs should always include water reducer effectiveness testing.
- The water reducer can have the second largest impact in the mix.
- 60 ounces of fluid made the difference in this mix.

VKelly

- VKelly
  - Does tell about response to vibration
  - Adjust aggregate gradation and paste content to achieve desired numbers
  - Prequalification

VKelly

- Measure initial slump (initial penetration)
- Start vibrator for 36 seconds at 4000 vpm
- Record depth periodically
- Plot on root time
- Calculate slope = VKelly Index



VKelly

- Can be correlated to field performance

VKelly = 0.60

VKelly = 0.46

Trial Batch

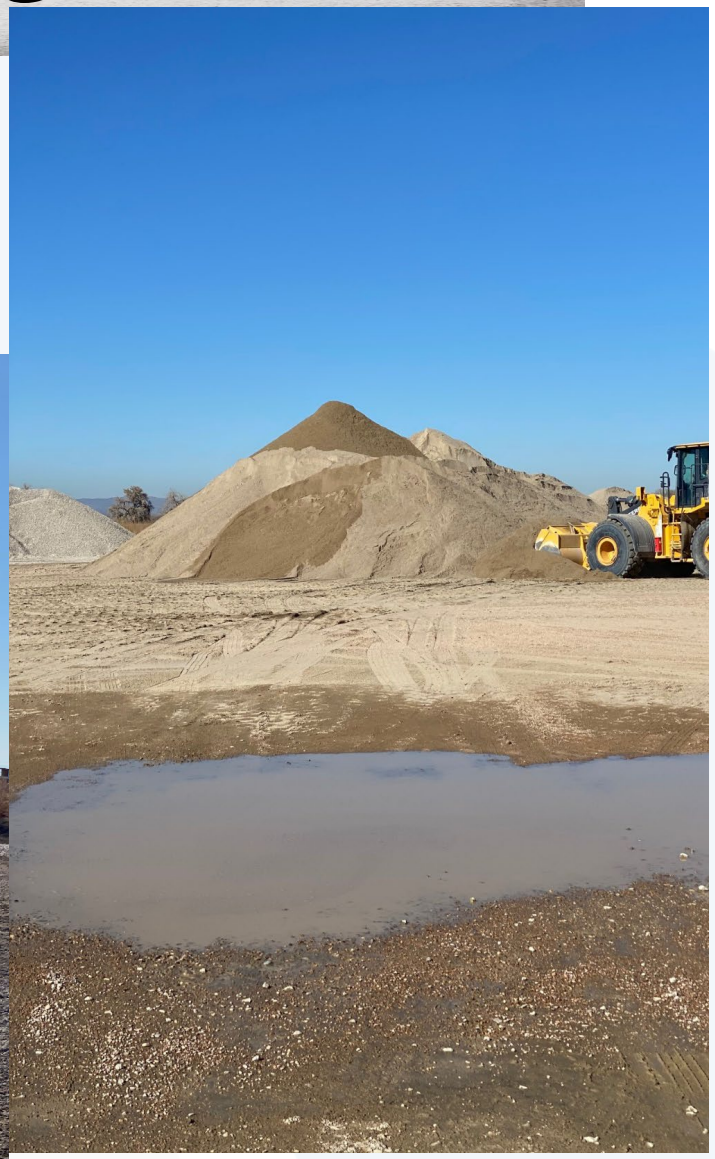
- Is the trial batch and the field batch the same concrete?
- Material Variability
- #57 Stone?

Not all Drums are Created Equal

Hand Pour Test

- This test is important before you go to production
- Pour the handwork with the same slump you plan to use under your paver
- Vibrate the concrete the same as you would a piece of handwork
- How easily are you able to close up the holes on the surface
- DO NOT ADD WATER TO THE SURFACE!

Aggregate Moisture



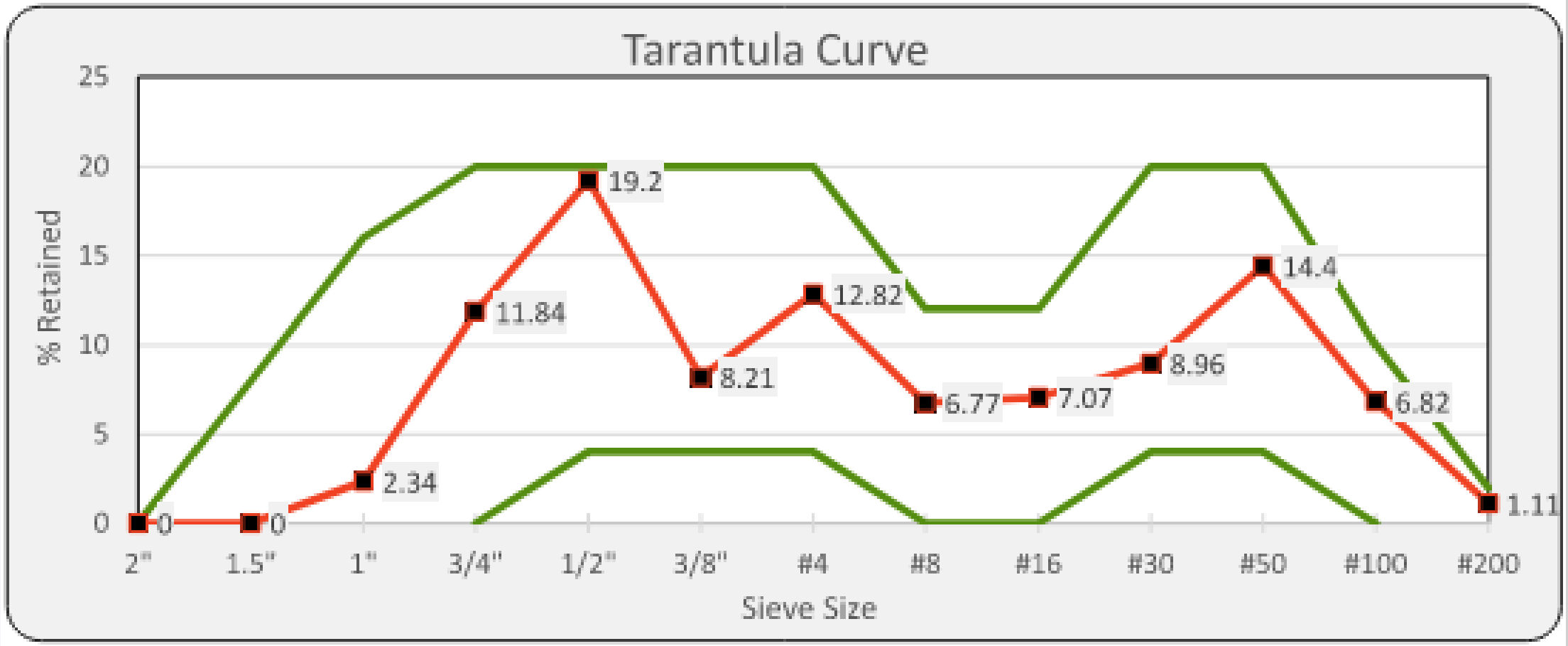
Aggregate Moisture

Aggregate Moisture

- 520 total cementitious
- 218 lbs. water
- W/CM 0.42
- 3215 lbs. aggregate
- 1% change in aggregate moistures
- 218+32 lbs. water
- 250/520=0.48

Gradations

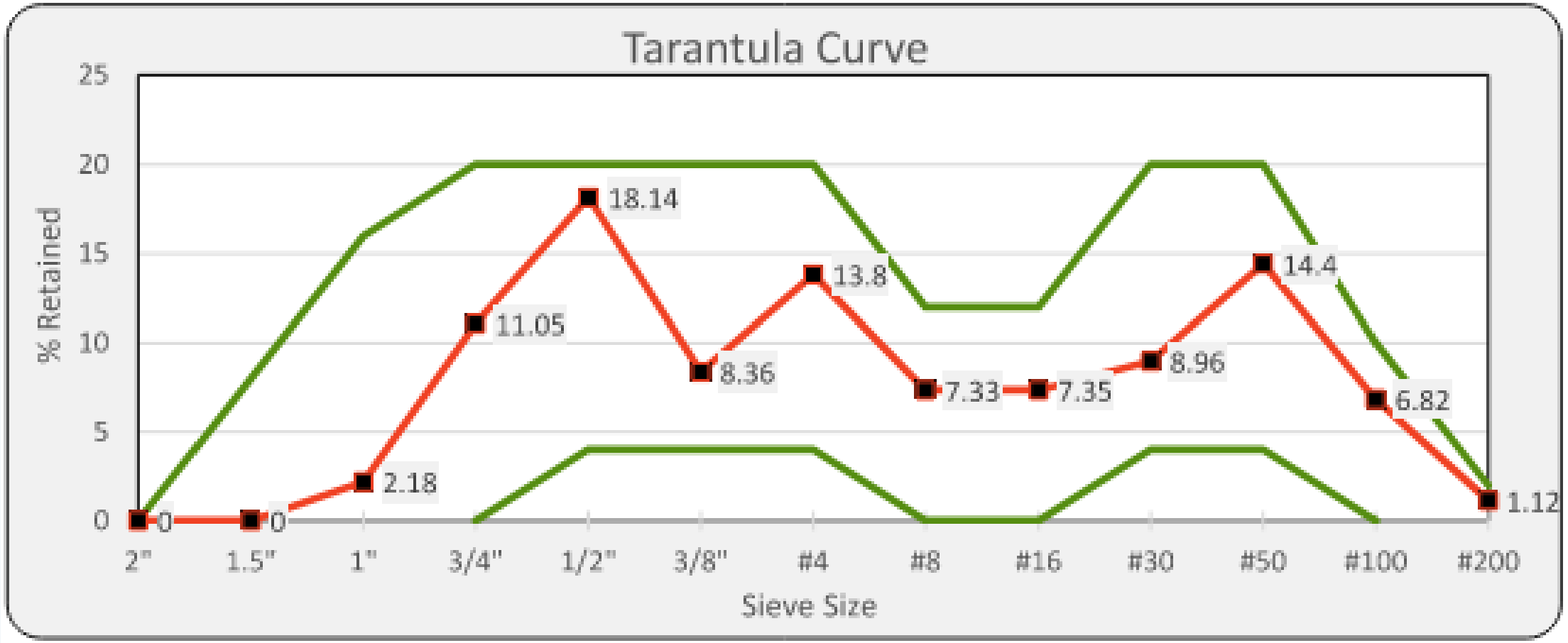
- This mix produced IRI in the 60's & 70's




Panasonic FZ-G1
TOUGHPAD
MainWindow
File
View
Setup
Report
Help
Trace 1
74.87 in/mi
29+99 st
30+62 st
31+24 st
Trace 2
65.56 in/mi
29+99 st
30+62 st
31+24 st
Speed
3.6 ft/min
09202024-1
Logging
Realtime
History
Stop
G+
GSI
Vbs
ACC
Test
A1
A2

Gradations

- This mix produced IRI in the 30's



- Swap 70 lbs of rock for intermediate.
- Reduced the high range water reducer from 2oz/cwt to 1oz/cwt
- Lowered the vibrator VPM’s

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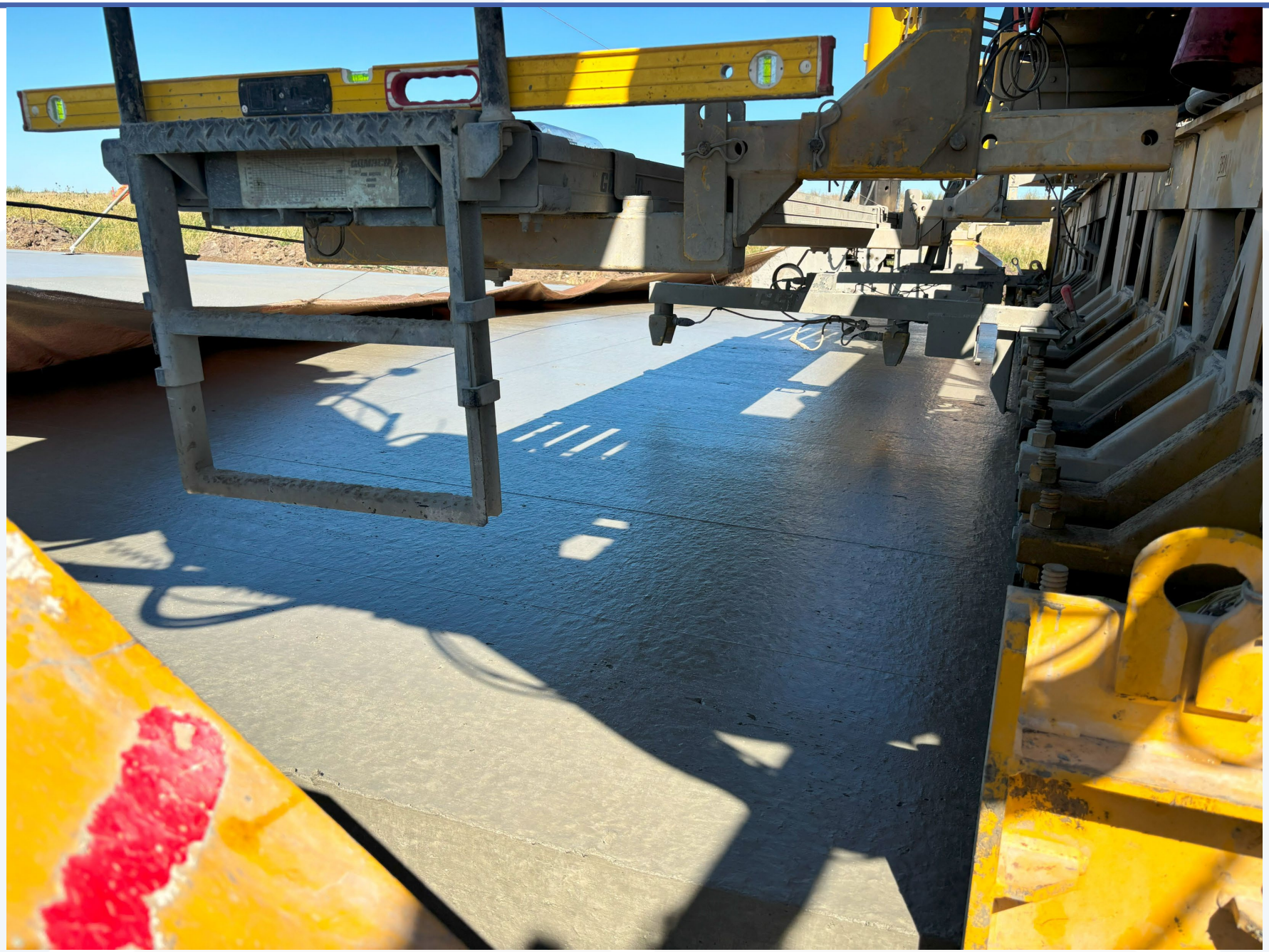

What About Handwork?

- How do I increase slump?
- What does my admixture package look like?

Finishing Aid

Evaporation Retarder

No paint brushes EVER!!!

Spray Bar System

- Little water, frequently
- Timers 10 seconds on 60 seconds off

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Scaling

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Summary

- Trail Batching is essential
- Test for effectiveness of admixtures is critical
- Allow for calculated adjustments to the mix during production
- Adjust the mix to improve workability in the field
- Adding water the surface is bad
- Evaporation Retarders are not designed to be finished into the surface
- Minor changes in aggregate moistures can have a big change on your W/CM

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Thank You

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