



# Michael Nelson

Concrete Engineer  
INDOT Division of Materials & Tests

# Outline

---

Type II Cement

Concrete Placement

E5 Memo Changes

Resonance Strength Meter (Wavelogix)



# Type 1L Cement

**FACT:**  
Type 1L cement is not as advertised



Ford Edsel-  
1959



New Coke -1985



Microsoft  
Zune HD  
2018

# Type 1L Cement

**FACT:**  
Type 1L cement is not as advertised

**NRMCA**

Concrete In Practice (CIP 45)

**Then 2021**

PLC is typically manufactured to achieve equivalence to portland cement; ready mixed concrete producers can replace portland cement with PLC on a 1:1 basis in concrete mixtures and continue to use the types and quantities of supplementary cementitious materials, admixtures, and other concrete materials without significant changes to established concrete mixtures with historical performance characteristics. Ready mixed

**Now**

PLC is typically manufactured to achieve equivalent performance to PC. Limestone, being a softer material, grinds preferentially finer than cement clinker. To achieve a similar fineness of clinker or similar strength, PLC is ground finer than PC from the same source. Finely ground limestone has been shown to be beneficial due to improved particle packing, provide nucleation sites for cement hydration, and formation of additional reaction products, especially when used with coal ash and slag cement, to contribute to workability and strength.

As with the use of any new material, ready mixed concrete producers evaluate the impact of replacing PC with PLC in their mixtures to achieve required performance of fresh and hardened concrete for projects and different applications. Concrete producers can continue to use the types and quantities of supplementary cementitious materials (SCMs), admixtures, and other concrete materials. Legacy concrete mixtures may need some modifications to achieve required performance. The limestone in PLC is not a SCM and should not be included in limits on SCMs in specifications or used to offset SCMs required for improved durability. Limestone is part of the blended cement and is not excluded when calculating the water-cementitious materials (w/cm) ratio of concrete.

# Type 1L Cement

---

**FACT:**  
Type 1L cement is not as advertised

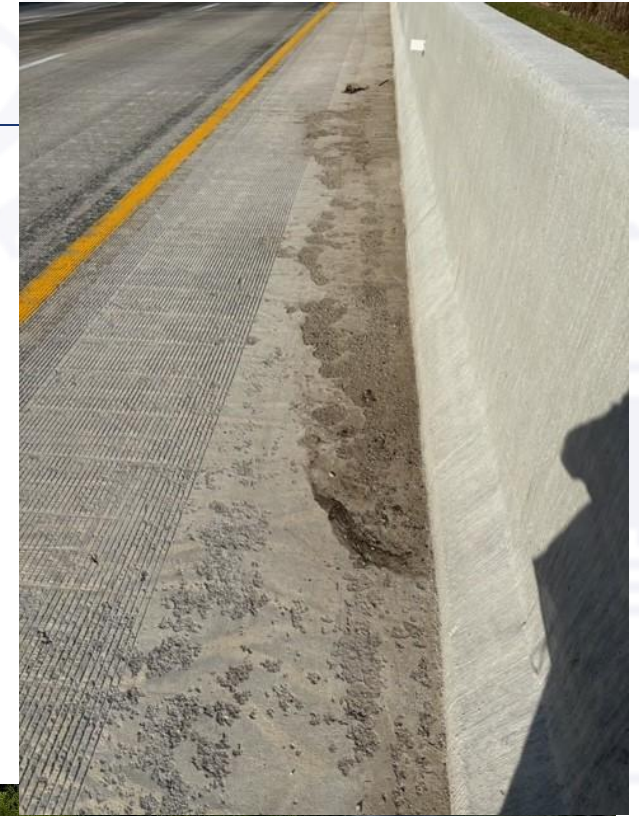
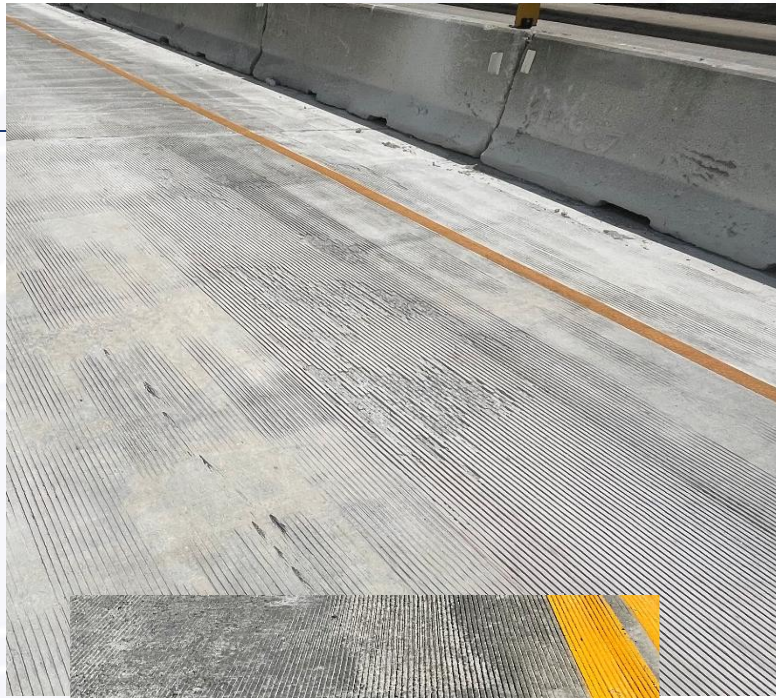
The key difference between traditional ASTM C150/C150M Type I/II/V cement and ASTM C595/C595M Type 1L cement is the maximum limestone content by mass of the blended cement (5% and 15%, respectively). While early promotional materials touted PLC as a one-for-one replacement for OPC, field observations and subsequent work have indicated that the changeover is not that simple. For example, the additional limestone in PLC can impact admixture effectiveness. Furthermore, PLC performance appears to be more sensitive to variances in physical properties and chemical composition. Changes in performance have been correlated with variations in product from the same cement mill and, more significantly, with differences in product from different cement mills.

**ACI**

Concrete International Magazine  
August 2025

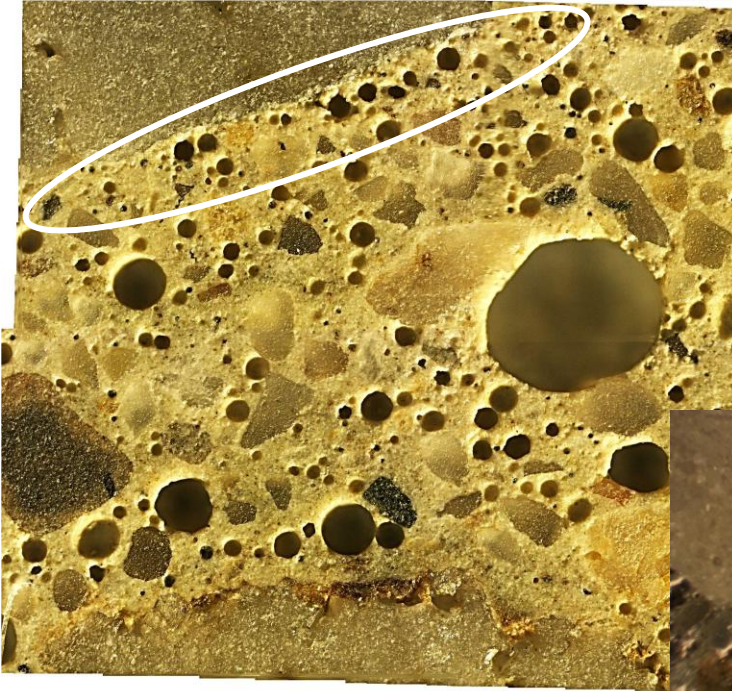
# Type II Cement

Cracking, Scaling,  
Surface issues

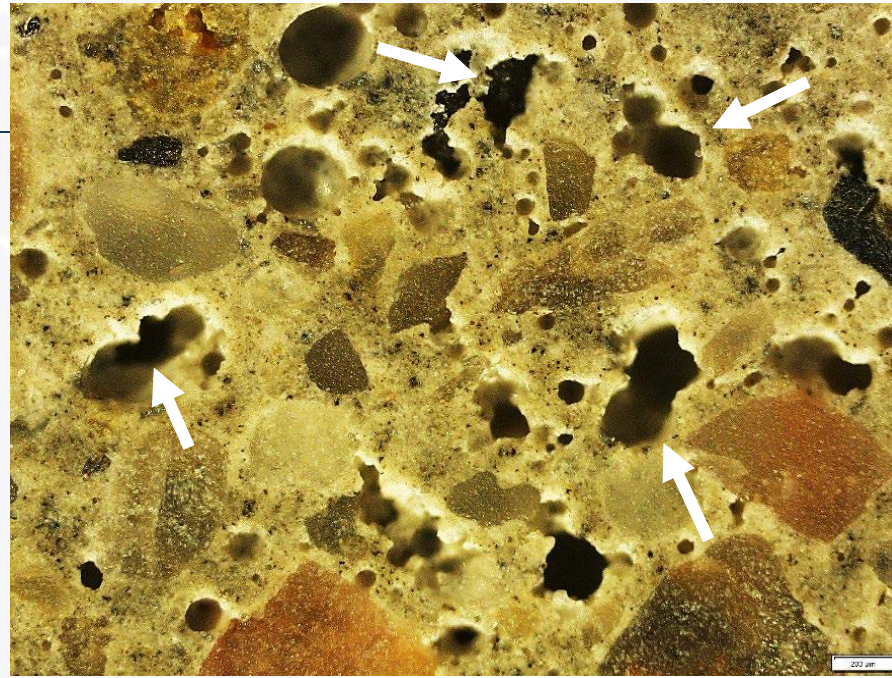
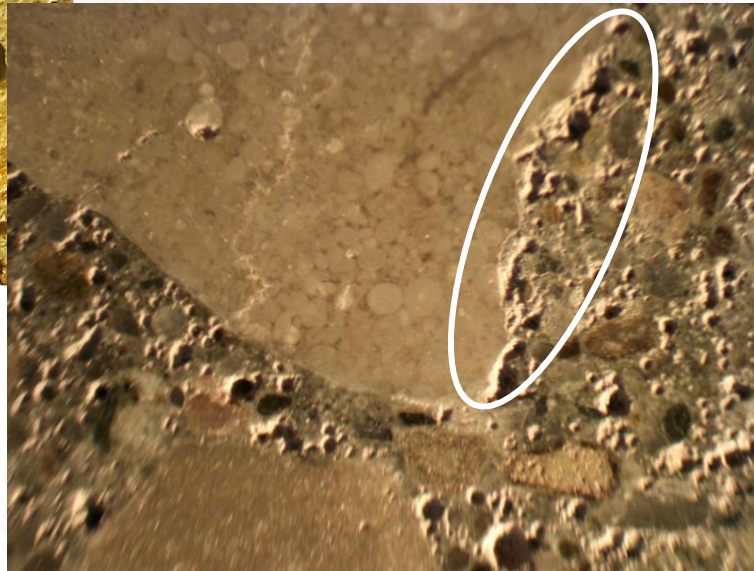


# Type IL Cement

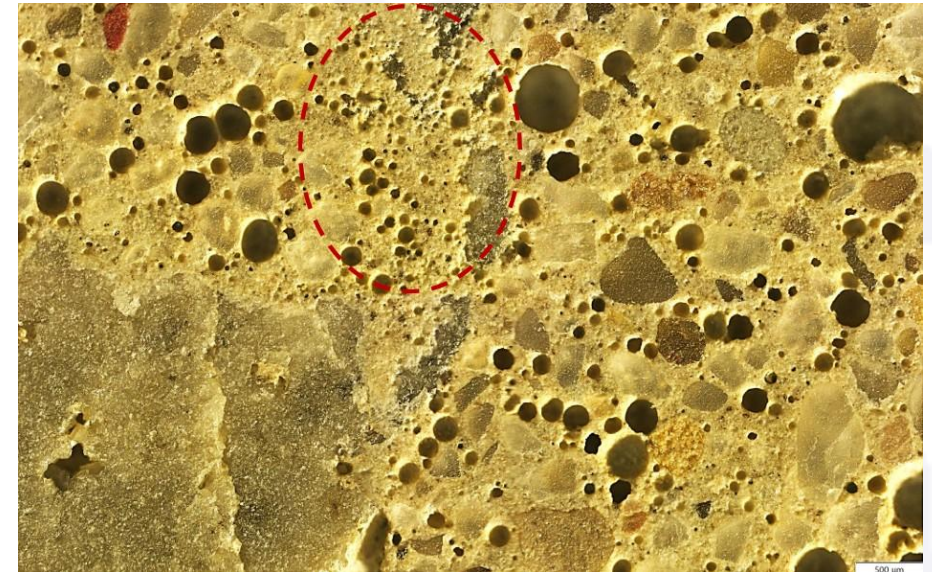
## Admixture Incompatibilities & Chemistry Changes



Air Clustering at ITZ  
(next to the aggregate)



Irregular  
shaped  
air voids



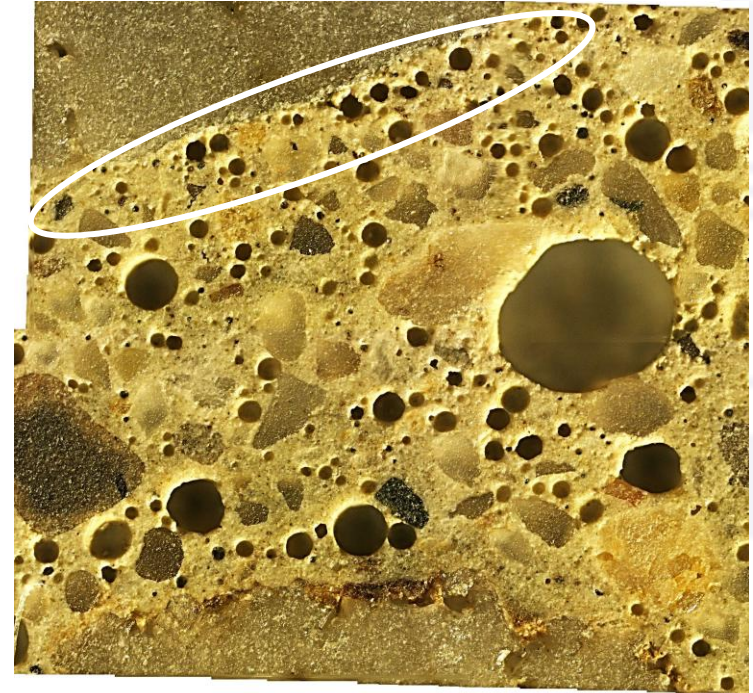
High air and uneven distribution

# Type II Cement

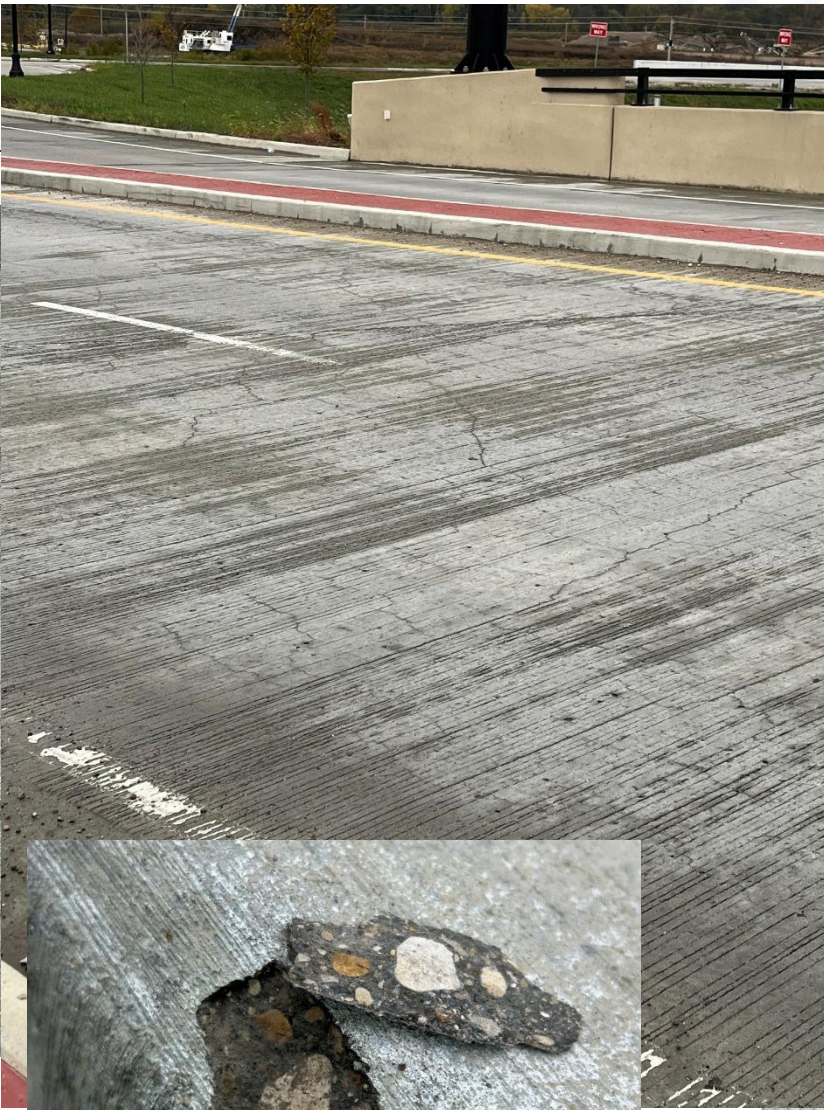
---

**Notify M&T of unusually low flex breaks**

- Include mix design



# Type IL Cement



**Notify M&T of cracking**

If possible, include:

- Pictures & location
- Mix design & year placed



# Type 1L Cement

---

RSP 901-M-069 (12/1/2025)

All Type 1L cement on the QPL is capped at 10% limestone

# Outline

---

Type IL Cement

**Concrete Placement**

E5 Memo Changes

Resonance Strength Meter



# Placement Problems

---

Poor placement practices are not new

Type 1L highlighted this, but we could have always done better

Now compounding with other Type 1L problems

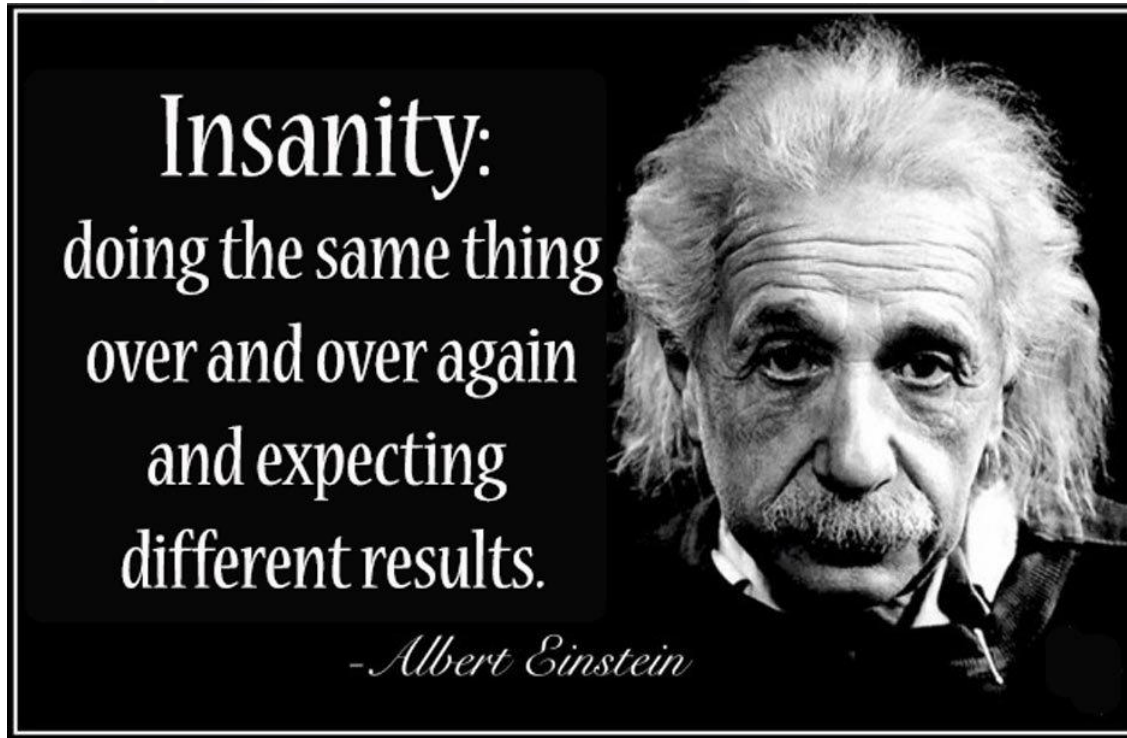
- Bleed rate is slower
- Less tolerant of surface water
- Timing for finishers has changed
- Admixture incompatibilities

Smooth surface for machine grooving does not hide poor finishing

# Placement Problems

---

How do we fix it ??



Culture & industry must change !!

# Type IL Cement

---

## Draft spec

- Performance vs prescriptive mix design requirements
- Changes for deck and overlay placement
- New equipment requirements

Spec has not passed standards, but includes good basic practices

# Placement Problems

## Proper equipment

Magnesium  
Aluminum  
Composite



## No steel floats or trowels

- Seal the surface too tight too early and trap bleed water which is very slow to reach the surface with Type 1L



# Placement Problems

## Screed Changes

### Reduce vibration

- No external surface vibrator on roller carriage
  - Bidwell – turn off
  - Gomaco – doesn't have one

### No burlap drag

- Promotes more touching of the surface
- Promotes more wetting by laborers



# Placement Problems

---

## Internal Vibration (spud)

Do not walk in concrete after vibration

*Placement operations shall be staged to prevent concrete that has been vibrated from being disturbed by foot traffic. All voids created by workers shall be reconsolidated.*



# Placement Problems

---

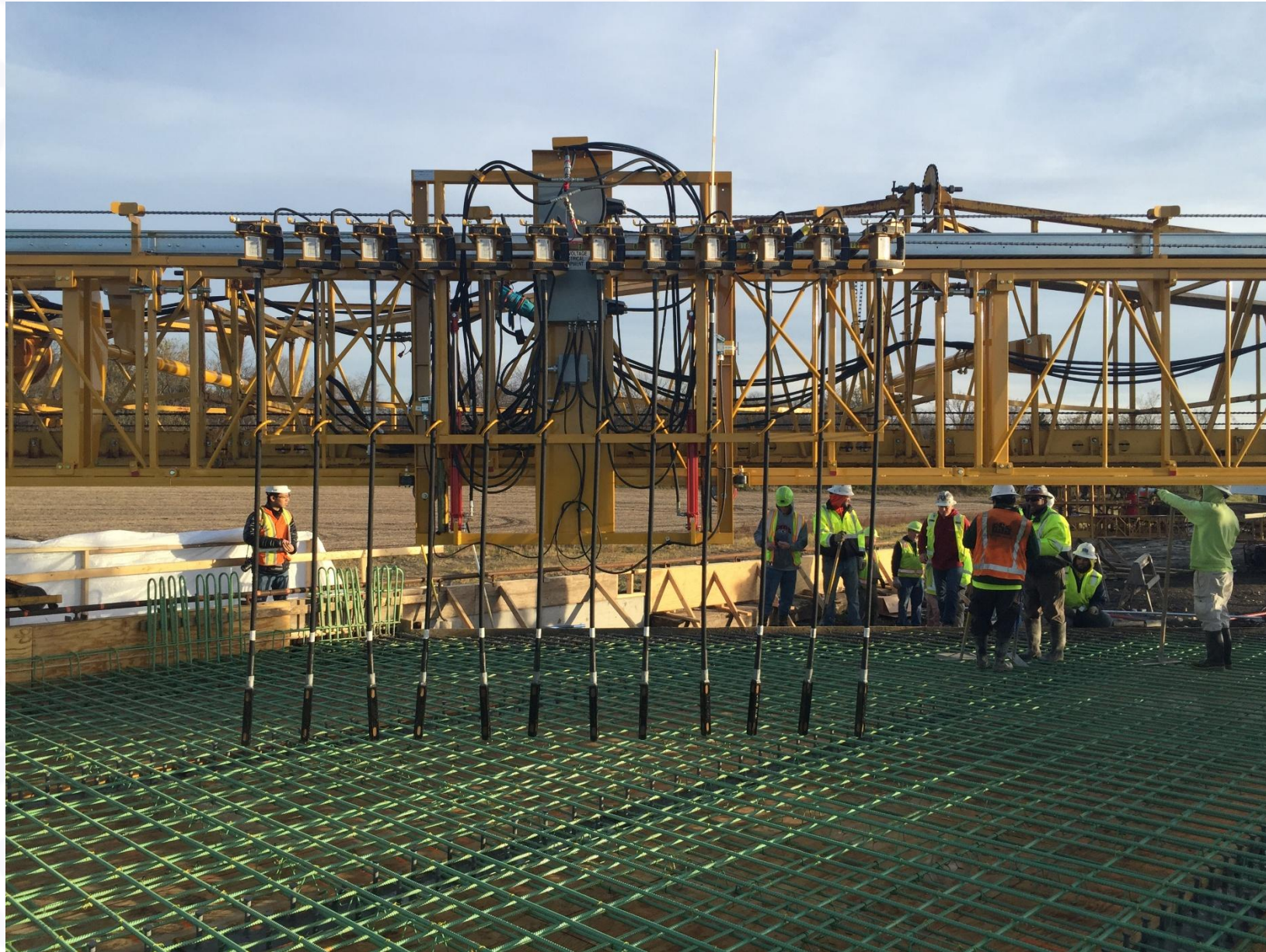
## Internal Vibration (spud)

Use gang vibrators

- Manual or automated



# Placement Problems



# Placement Problems



# Placement Problems



# Placement Problems

Manual process with counterweight

Laborers incorrect position

sequence worker in between 1



# Placement Problems

## Proper leveling



Leveling with straightedge - min. 10' width

- Std spec 704.05
- Operate transversely across entire surface

# Placement Problems

---

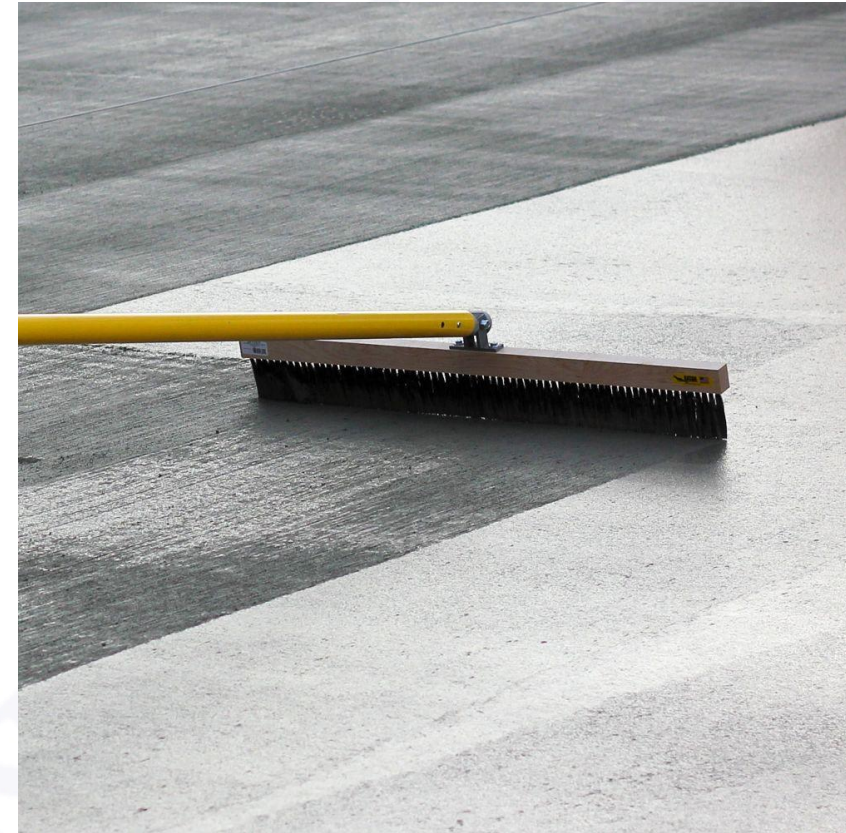
## Proper finishing

Bull float – min. 6' width

- Handle length will be an issue with adjacent traffic

Light brooming

- *After all other finishing operations are complete the concrete shall be transversely textured with a light broom finish that does not expose or pull aggregate.*



# Placement Problems

## Proper finishing

No water applied to surface (for any reason)

- Use finishing aids (QPL)
- Do not use evaporation retardants (90% water)

**No pressure washers**



# Placement Problems

## Proper finishing

Type 1L cement is not water tolerant

Do not push ponded water with concrete

Do not pour over ponded water

- Water will eventually bleed to surface
- Blow it off or vacuum

Do not pour in rain

Take video



# Placement Problems

---

## Curing

The timing for applying water cure with Type 1L cement is different

- Draft spec removes the 60-minute window
- Apply wet (well drained) burlap early
- Do not start hoses until a few hours after set to avoid ponding water in flow lines

If opting out of E5, more prone to plastic and shrinkage cracking

# Outline

---

Type IL Cement

Concrete Placement

**E5 Memo Changes**

Resonance Strength Meter



# E5 Memo

---

Need clarity on the coming spec before changes are made

E5 does not fix:

- Poor placement practices
- Poor admixture compatibility
- Poor mix designs
  - INDOT prescriptive with gap graded aggregate



# Outline

---

Type II Cement

Concrete Placement

E5 Memo Changes

**Resonance Strength Meter**



# Resonance Strength Meter

Implementation coming in 2026  
USP, memo, or both ?



**Sensor installed at Deck**

---

# Questions?

