

Is Workability Part of Your Quality Workplan for Concrete

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Most Engineers Strive for Quality in Their Projects

**Return Business is a Good Reason Why
but**

Avoidance of Messes is Another Reason

Yet Progress in Managing Workability for Concrete Projects is Slow

**An Old, Natty, Out-of-Date
Restrictive Spec is the Culprit**

The 3" Slump is No Friend

- **A 3" slump takes about twice the energy to consolidate in comparison to a 6" slump mix**
 - **Result: Potential for poor consolidation (removal of entrapped air)**
 - **Bug Holes/Honey Comb**
 - **Low strength**
 - **Poor contact with rebar**
 - **Poor durability through over-working**

History of Restricting Slump

- **Quality concrete was originally attainable basically through restriction of water content of mixes (pre-1985 +/-)**
- **Before the advent of admixtures for workability, i.e. water reducers**
- **Before the science of floating coarse aggregates**

My 1973 Civil Engineering Classmates are Part of the Problem

- **We now control the specification**
- **We are very risk averse**
- **We don't spend the time to keep up on technology like we should**
- **We train the young engineers in our companies**

Risk-Averse

- Thinking that a 3" slump will keep me out of trouble
- Making certain that the **mix will not segregate** will keep me out of trouble



Yes, good consolidation effort will work with a 3" slump

- **First, insert the vibrator into the mix rapidly**
- **Vibrate until a sheen is evident in the surface of the vibrated concrete**
- **Remove vibrator slowly and move to next location**

OK, maybe segregation is not
a big deal

**The sheen is evidence that vibration
causes segregation**

Especially egregious application of the 3" slump restriction

- **Walls/Tanks/Form Liners**
 - Cold Joints & Leaks
- **Aesthetic Issues**
 - Bug (air) Holes
 - Cold Joints
 - Honey-comb
- **Low Strength/Delays/Problems**

What Else?

- **Pavements**

- **Aesthetics due to low surface air entrainment**

- **Cause: Overworking of low slump mixes**
- **Drives air entrainment from surface paste**

Scaled pavement surface

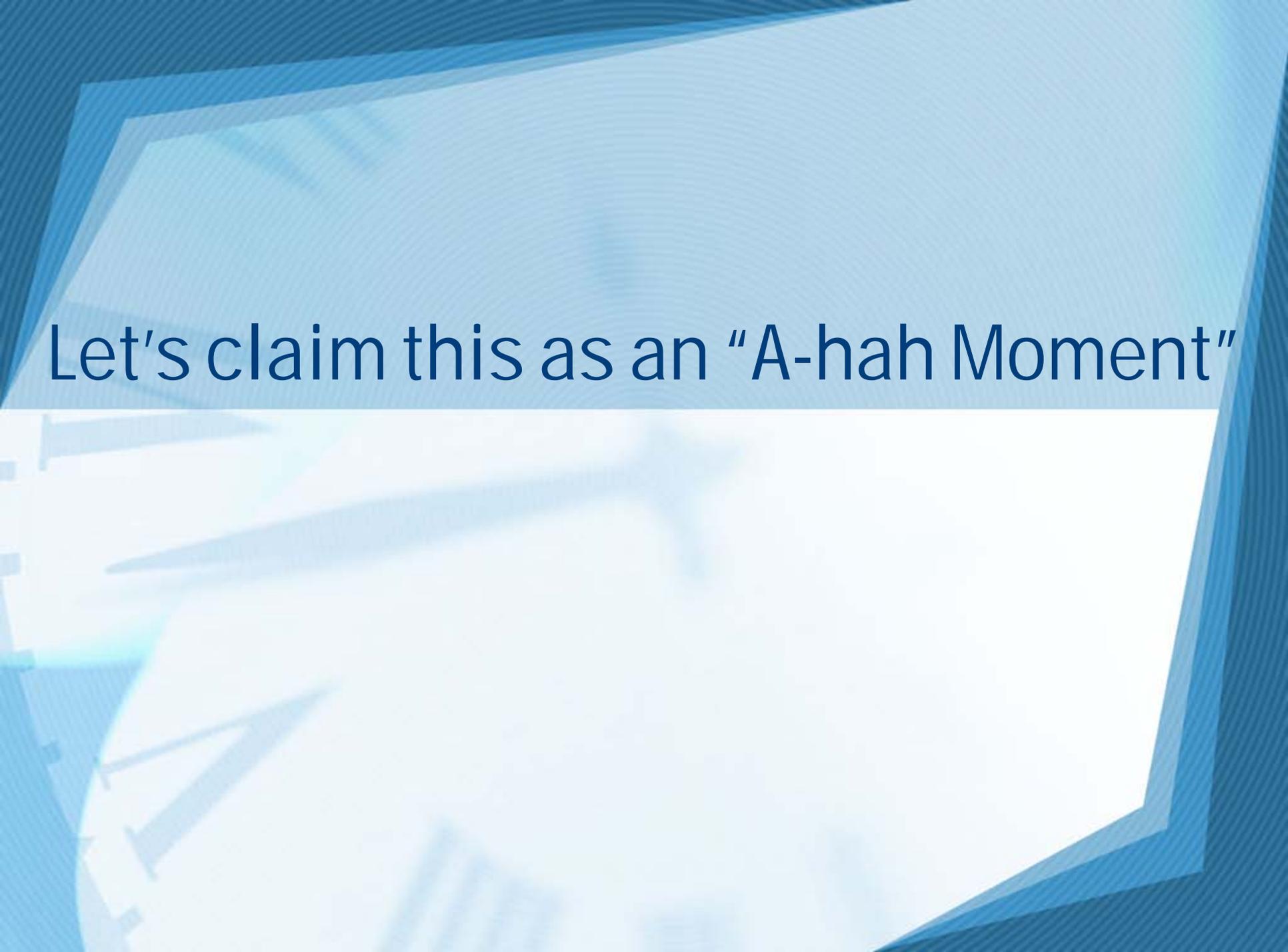


The image features a blue-tinted background with a subtle grid pattern. A large, white, semi-transparent rectangular area is positioned in the center, serving as a backdrop for the text. The text is written in a dark blue, serif font and is centered within the white area.

That pretty much covers everything

The Devil is in the Details

Why a 3" slump is not very risk-averse



Let's claim this as an "A-hah Moment"

“Preservation” of Slump is the Issue

While we may start with a three inch slump at the beginning of unloading a RM truck, we cannot assume that that slump will be maintained through out the unloading

Why?

- **A mix begins losing slump continuously with time**
- **Problems especially are worse with:**
 - **Slow unloading conditions**
 - **Warm/Hot weather accelerating hydration (i.e. water loss)**
 - **Backup of trucks, etc.**
 - **Breakdowns/delays during unloading**
 - **Delays in Transit**

The Solution: Start with More Slump

- **Lower risk to concrete finisher**
- **Expect professional performance**
 - Fast placement
 - No demand for water as finishing aid
 - Earliest possible curing
 - Lower costs to project
 - Recognition of engineering team as leader in quality through technology

Self Consolidating Concrete



Fargo Project Ongoing

Self Consolidating Concrete

- Specified at <0.41 with up to 40% flyash
- Actual is $w/c=0.37$ with a 25" spread
- 650 lb. total cementitious will get 7000 psi

Timberline Flood Walls



So, what do we use?

- 1 to 2 inch slump – slip form paving
- 3 to 4 inch slump - standard
- Middle range (5 to 8 inch) ???
- SCC – 9" slump = 18" spread or so
 - Workhorse SCC is 23 to 27 inch spread
 - Use on tight steel, form liners and hard to access locations & more

High Range Water Reducer

- Learn about this admixture
- Also called “Superplasticizer”
- Get great fluidity with your mix at a low w/c ratio
- Use this, not water to get workability
- Use in the Middle Range of slumps

So we go from a 3" slump to SCC

- **What about the middle: What about the 5" to 8" slump specification?**
- **Many projects can benefit with slumps in this range**
- **A little water reducer goes a long way**
 - **Get the workability**
 - **Little risk**
 - **Low cost assurance**

What projects can use this middle ground in slump range of 5" to 8"

- **Footings**
- **Walls**
- **Wet wells**
- **Lift station walls**
- **Bridge Abutments**
- **Bridge rails**
- **Water plants/tanks**

Use your concrete tools for workability

- **Make your project go easier**
- **Listen to your contractor or ready mix supplier**
- **Minimize your risk**
- **Get stronger concrete**
- **Make testing easier to make cylinders**
- **Get a better project**
- **Get a less expensive project**

Use New Technologies

CHALLENGE THOSE AROUND YOU

Comments or Questions?

Contact Dave Sethre at 701-371-4497 for assistance in optimizing your specification for concrete

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