

# Examples of Using Test Methods to Quantify Workability Properties

ACI Fall Convention 2009

New Orleans

- Why Am I Taking Measurements?
- Workability Range
- Testing and applying results to practice
  - Novel methods
  - Industry methods

# Why Am I Taking Measurements?

- What is the purpose of the data I generate?
- Is it to compare different materials in the same mixture?
- Is it for jobsite quality control?
- Is it to compare the relative performance between two concrete mixtures?
- Is it to develop a new method?



# Workability Continuum & Applications

**Stiff**

**Moderate**

**Fluid**



Block  
Paving  
Hollow Core



Slab on grade  
Walls



Vertical applications  
Walls  
columns

Testing needs to matter, it should not just generate numbers

# Stiff Concrete



- Placement is typically heavily dependent upon equipment.
  - Block, Paver, SRW production
  - Hollow core production
  - Paving
- More concerned with extrusion than flow for placement.
- Compaction energy requirement is important.
- Many times used without formwork.
  - Must resist “edge slump”
  - Are all 1-in. (25-mm) slumps the same?

# Stiff Concrete Placement Challenges

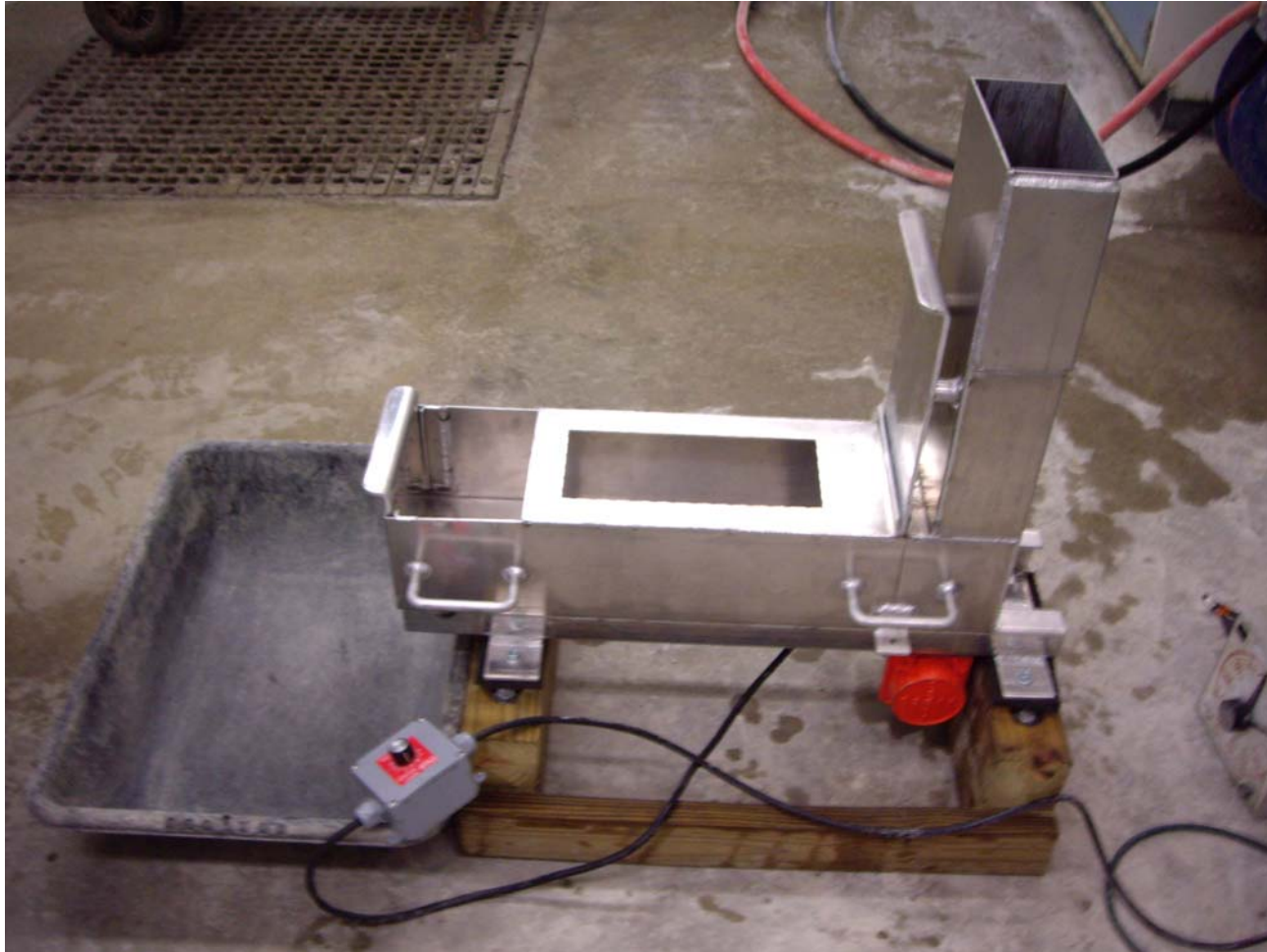
- **Low-slump concrete can be difficult and slow to extrude**
- **Surface appearance after extrusion**
  - **Often requires re-work for bugholes/tearing**
- **Wet mixes can result in edge slump**
- **Intense vibration can negatively affect air-void structure**



J Dacz



# Novel Method and Custom Equipment



**Goal: Quantify rheology of low-slump mixtures**

☐ **Equipment – L Box**

➤ **customized, high-energy vibrator**

☐ **Fill vertical portion and consolidate**

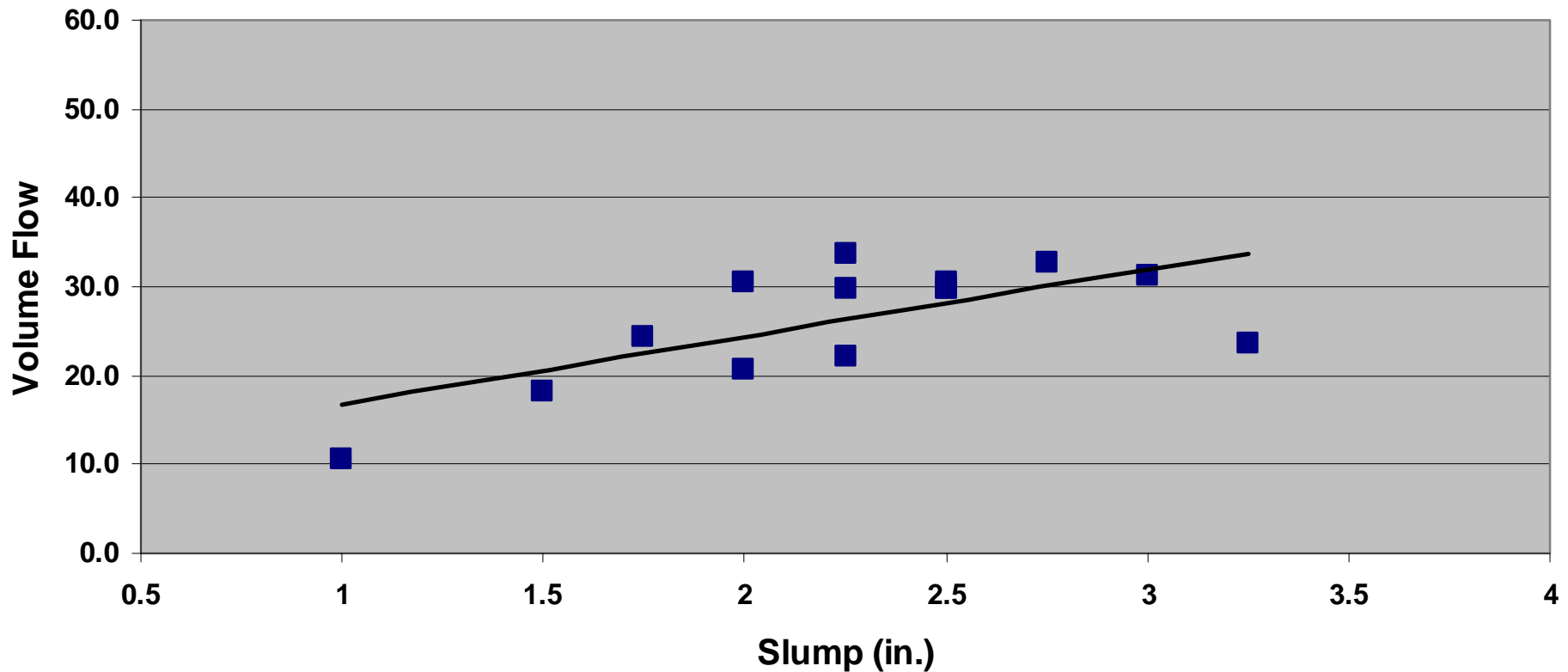
☐ **Vibration on for 10 sec.**

➤ **measure drop and run**

☐ **Volume Flow = cc/sec**

# Conventional Stiff Concrete

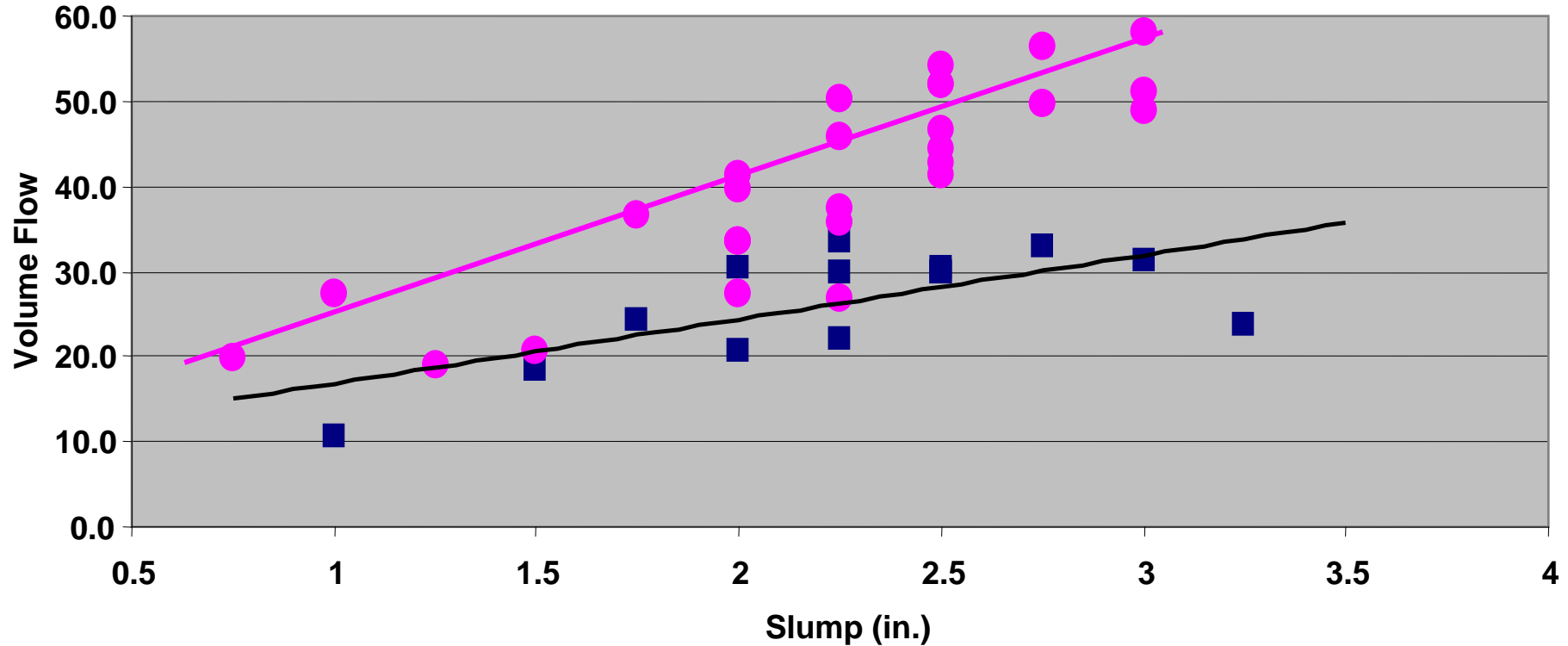
Concrete Volume Flow with Vibration



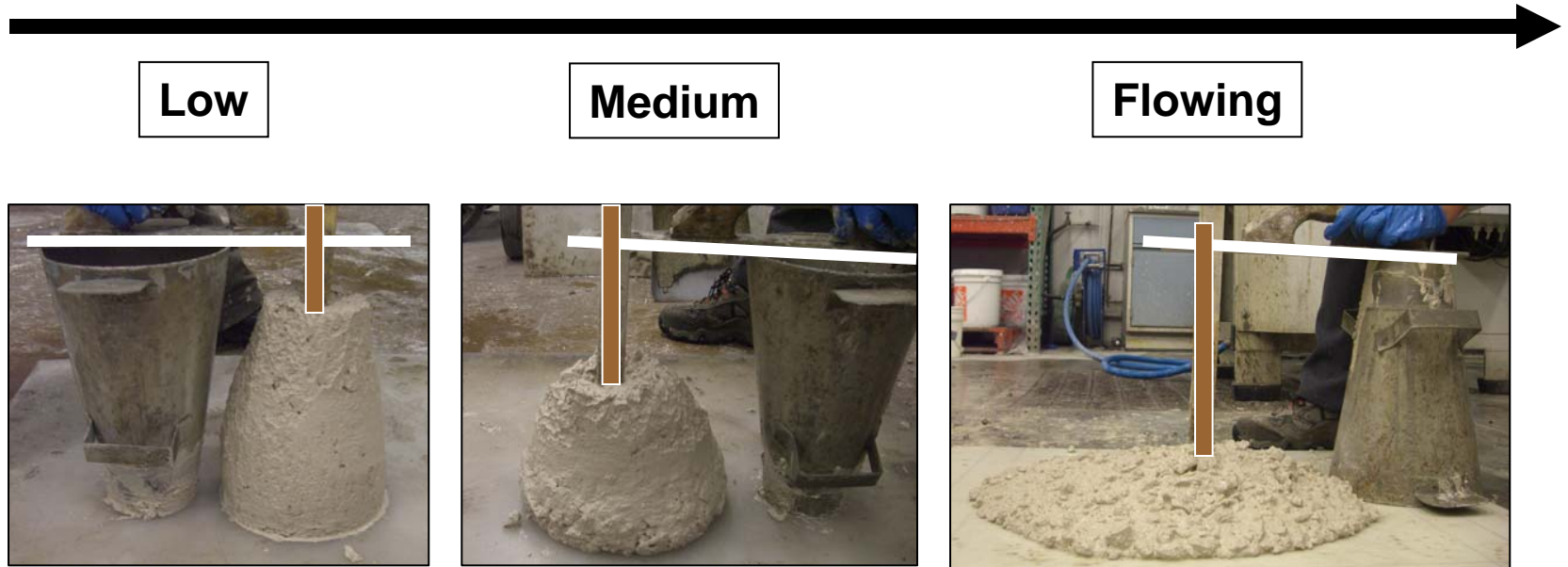


# Data Comparison

Comparison of Concrete Volume Flow with Navitas 33



# Moderate Workability Range

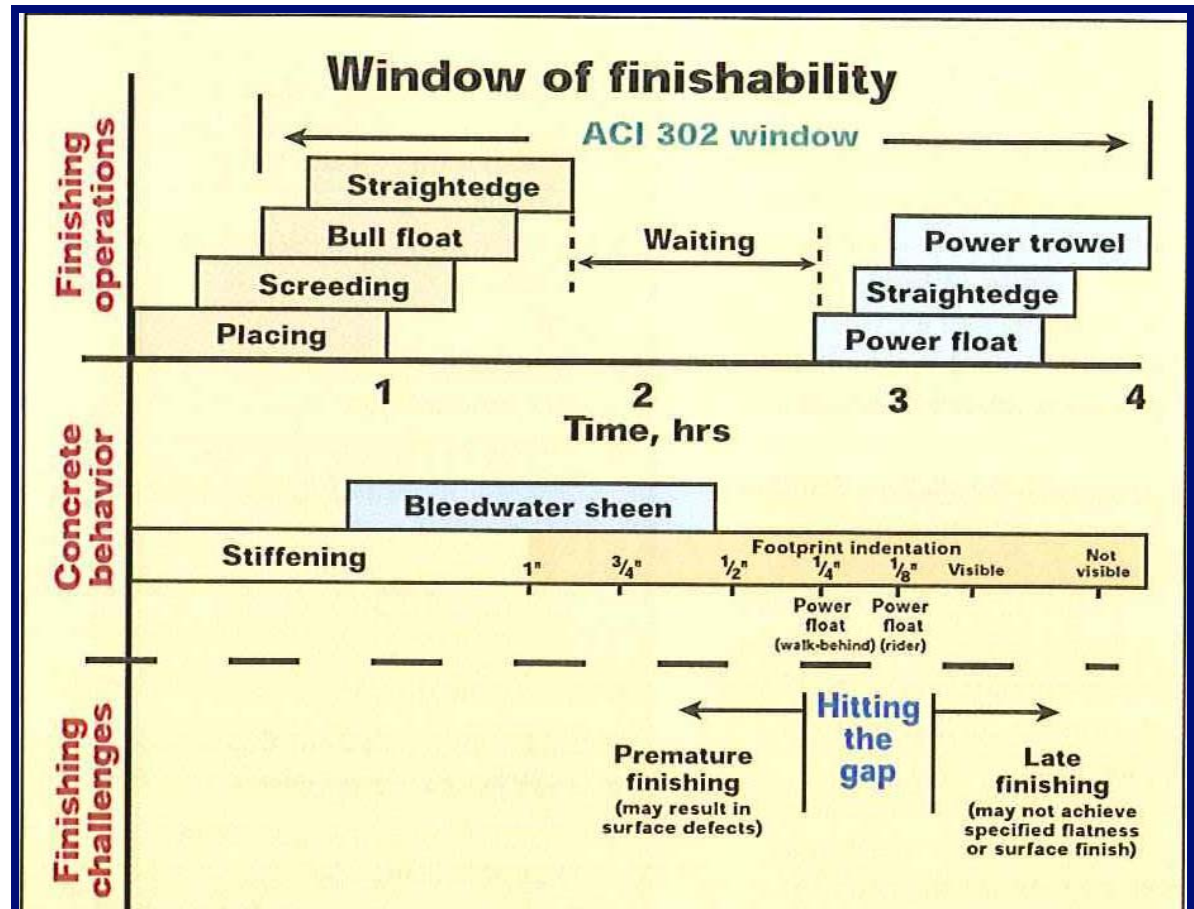


**Is slump enough?**

# Slab on Grade

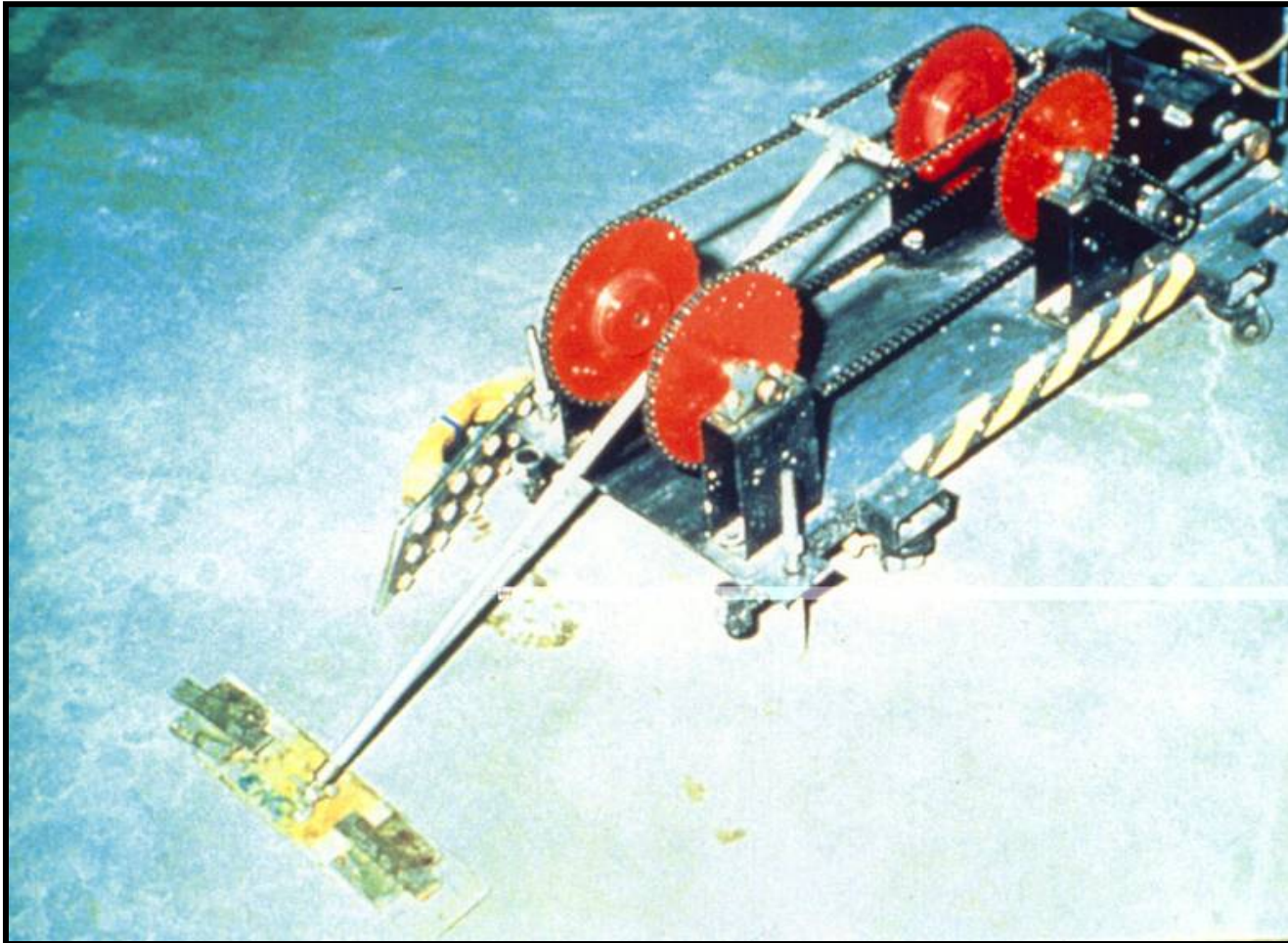
- A slump measurement may provide some indication of the relative ease of placement and screeding.
  - But what about mixtures with the same slump?
  
- What about bull floating, straight edging and finishing? How do we measure properties related to these techniques?

# Slab on Grade



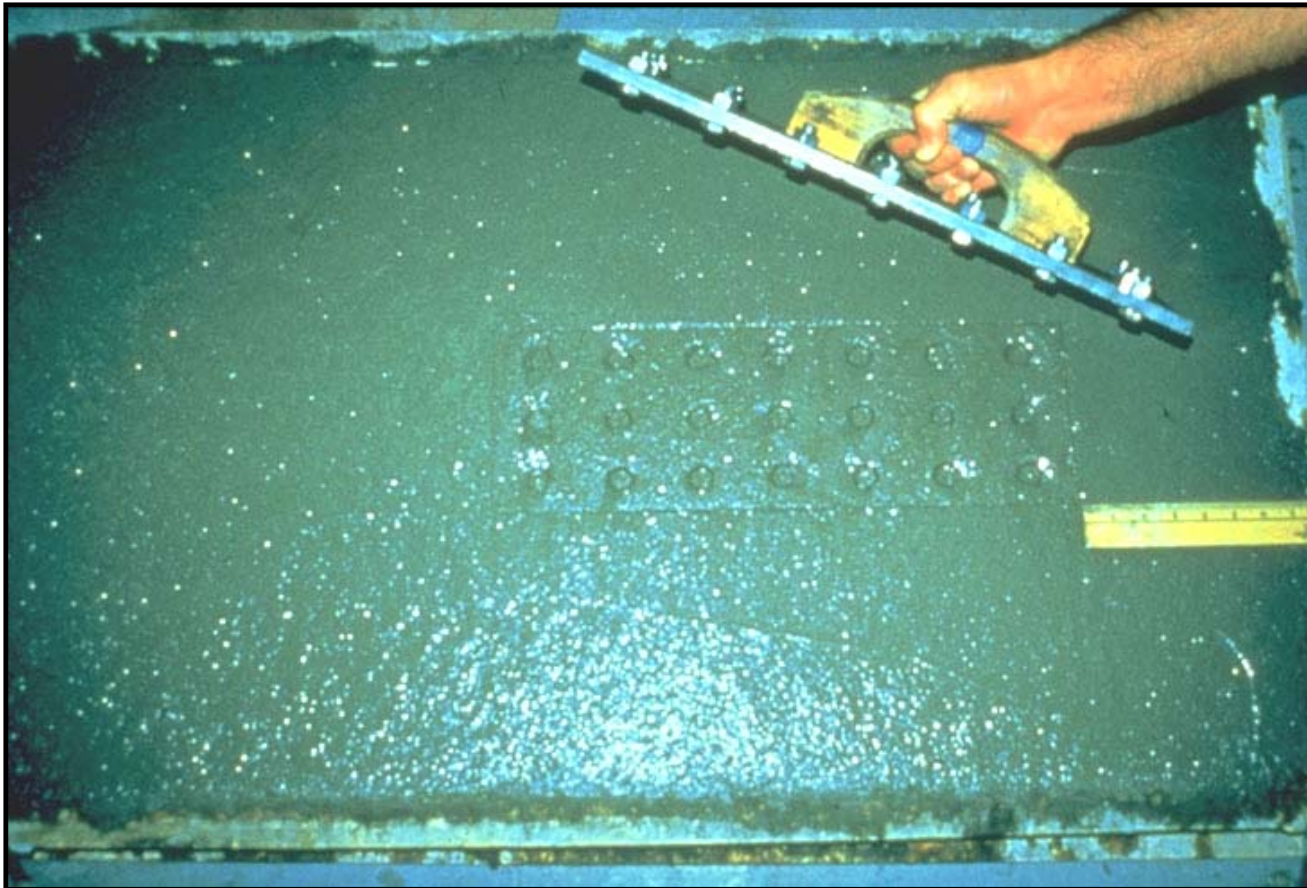
Workability need transitions from a bulk to a surface property

# Slab on Grade – Novel Method and Custom Equipment





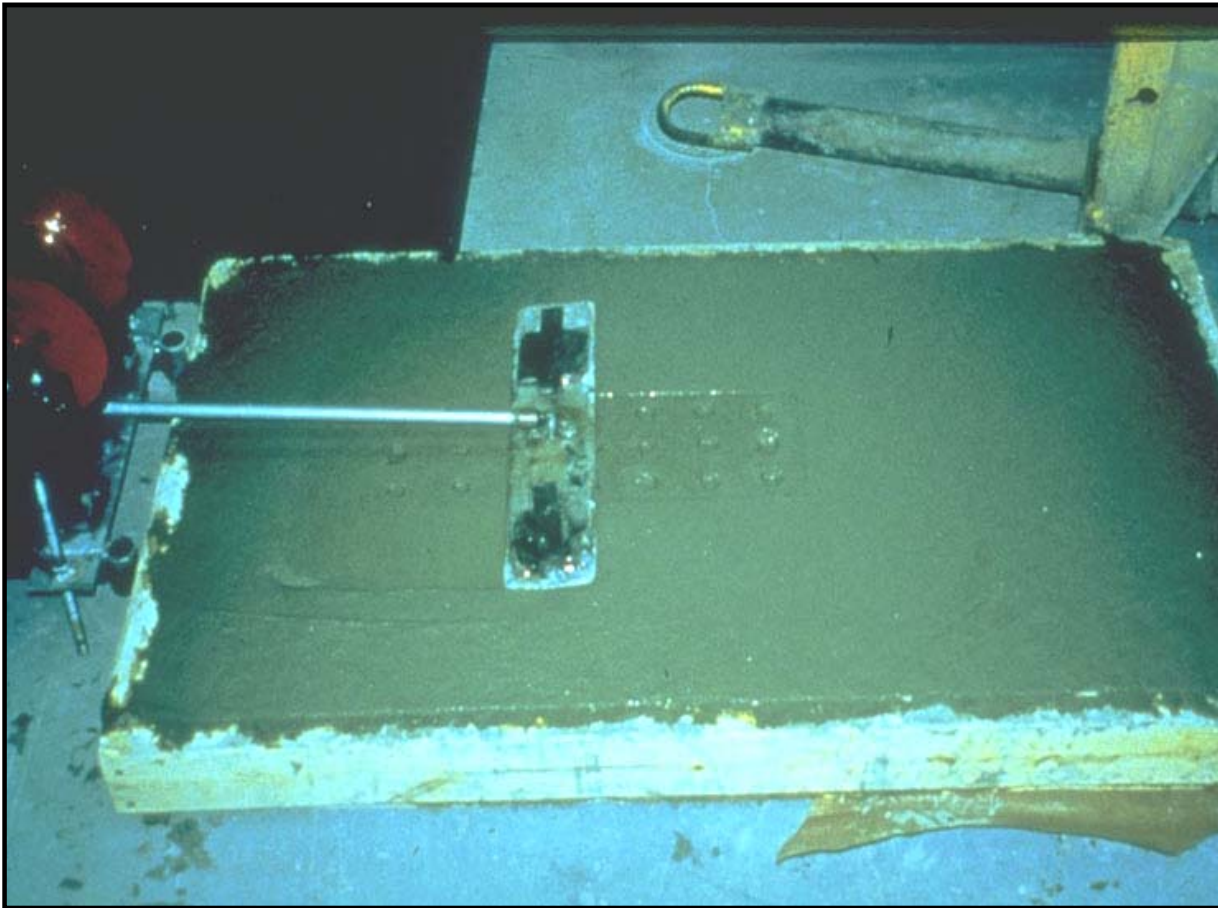
# Quantify “Finishing”



- Concrete slab
- 1/4 in. deep indentations



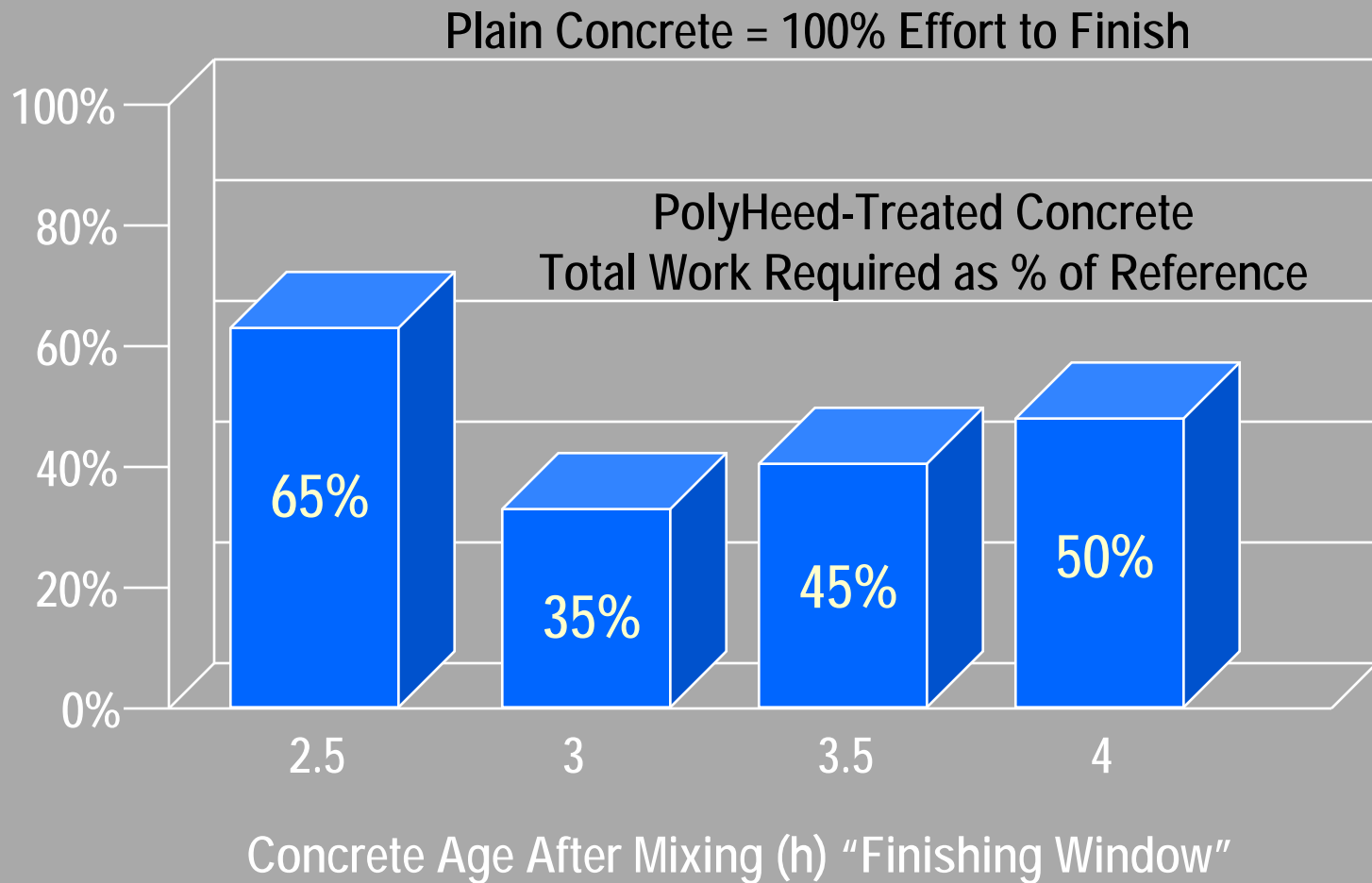
# Quantify “Finishing”



- Position “finishing machine”
- Determine number of strokes to close indentations?

# Finishing Comparison

## Plain Concrete vs. Admixture-Treated Concrete

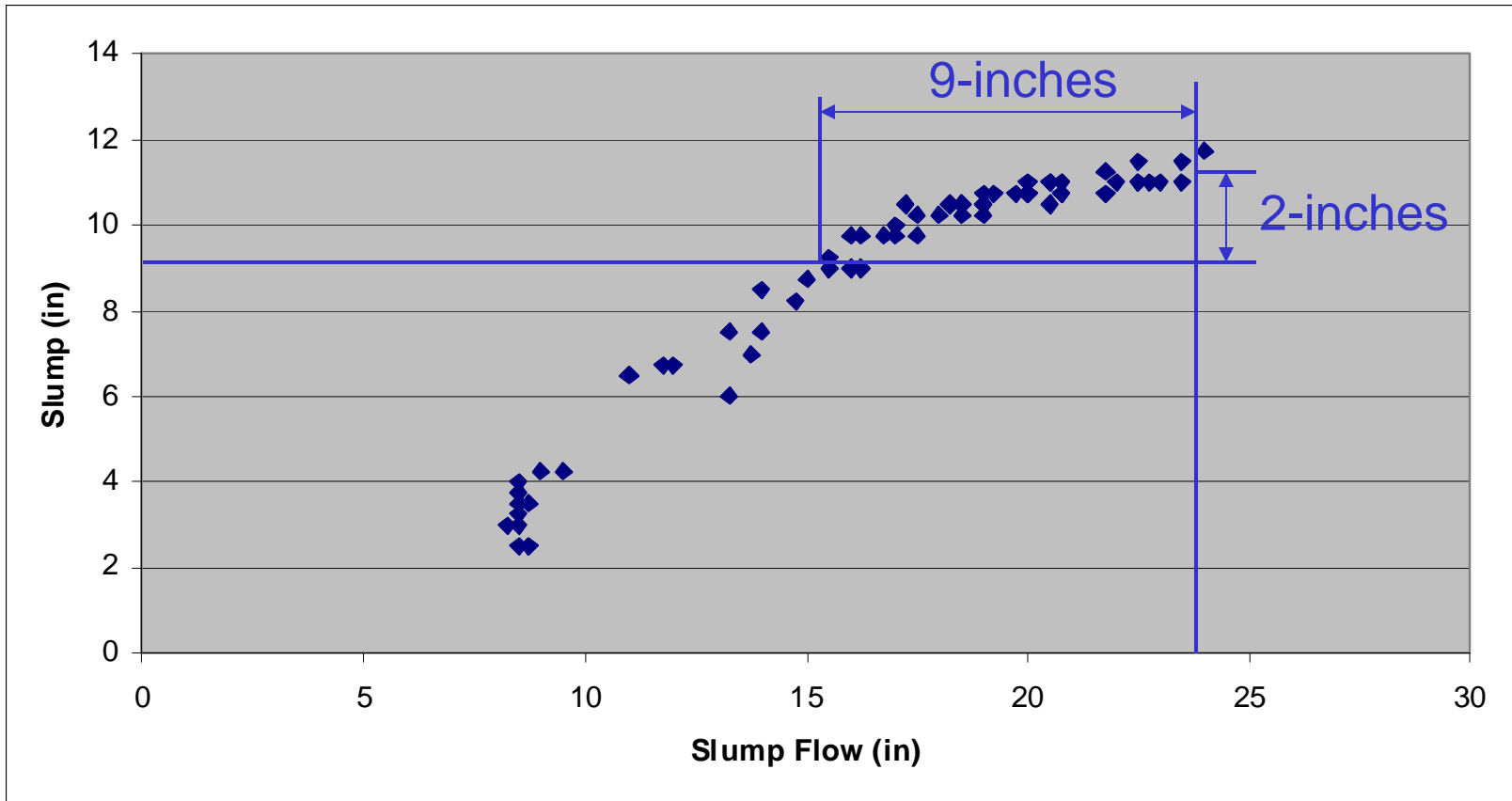


# Flowing Concrete and SCC



- Transition from high slump to SCC is a gray Zone
- Recommend measuring the spread as well as the slump for all mixtures with slumps greater than 8 inches (200-mm).

# The Gray Zone



# Testing SCC

## ■ Fluidity

- Slump Flow (C 1611)

## ■ Passing Ability

- J-Ring (C 1621)

## ■ Stability

- VSI (C 1611) - optional
- Column segregation (C 1610)
- *Rapid penetration*



*Chairman: Mark A. Bury*  
*Secretary: John Schemmel*



# Slump Flow





# Visual Stability Index

0



1



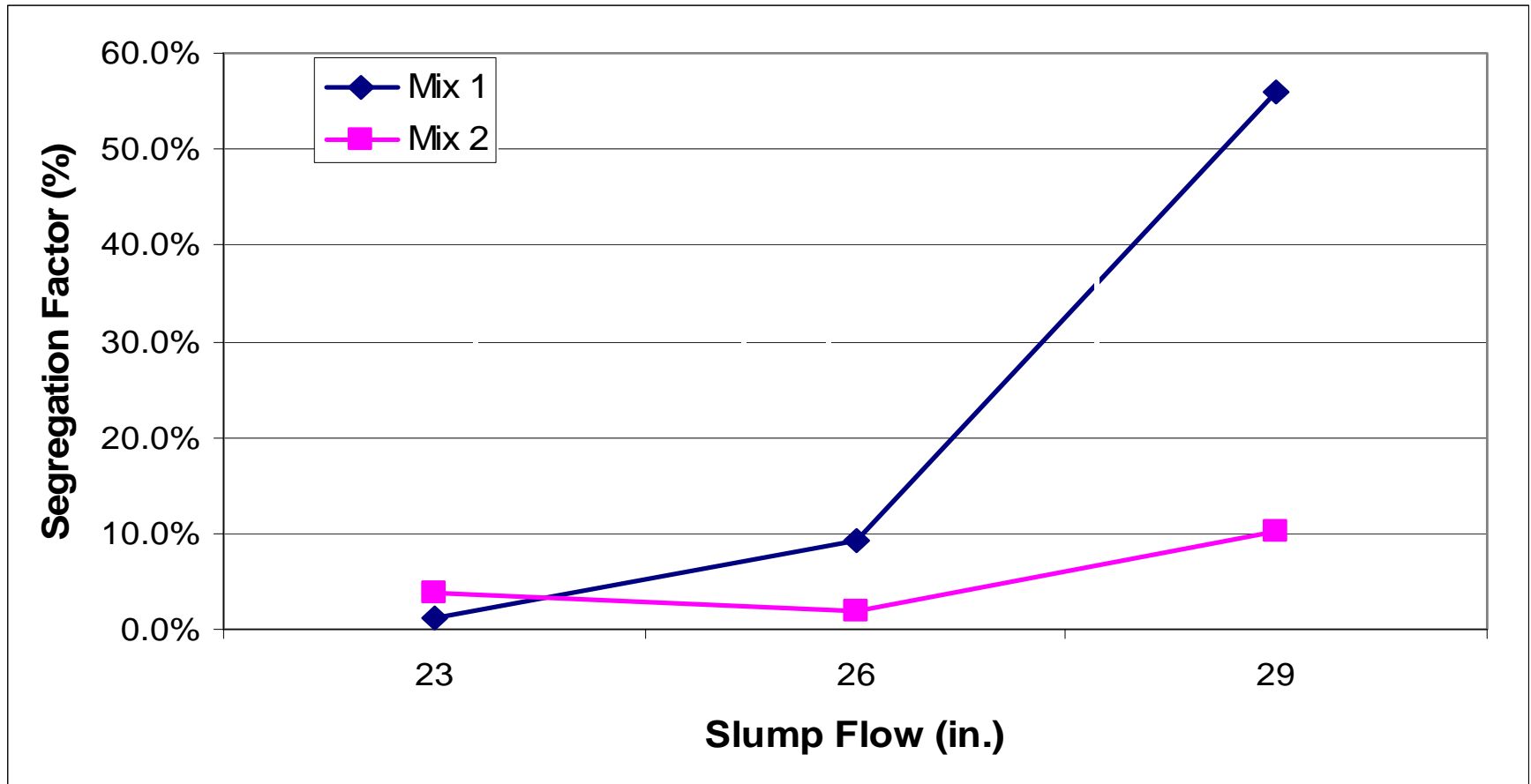
2



3



# Establishing the Correct QC Parameters



# Conclusions

- Many test methods exist for quantifying some aspect of workability.
- First priority is to be clear on how the test values are to be used.
- Many times new methods can be developed to help us measure an important practical property.
- Combining multiple tests provide us with a more thorough view of a mixtures characteristics.