

Practical Workability Tests for Paving Concrete



Observations from the FHWA Mobile Concrete Technology Center (MCTC)

New Workability Tests for Paving Concrete: Two new tests have emerged that provide an enhanced assessment of workability with today's slip-formed concrete paving mixtures, the Box Test and the VKelly Test. The common theme of both these tests is that they *measure concrete's response to vibration* and better assess the workability of concrete during field placement. Though both tests can be used in the field, the primary use is during mix design/approval for optimizing the mixtures.

What Is Workability: Workability is the ease with which concrete can be worked, placed, and finished. Historically, the concrete community has relied on the slump test to assess workability. Achieving good workability for concrete used in slip-formed paving can be a challenge. In addition to the typical consolidation and finishability requirements, it has the unique need to avoid slumping at the edges of the pavement after it is placed and finished.

Box Test (AASHTO TP 137): The Box Test, developed at Oklahoma State University, is a simple and economic test method to evaluate if a concrete mixture is suitable for slip formed concrete paving.

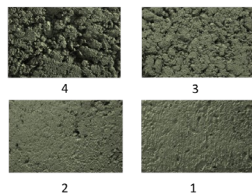
- ✓ Freshly placed concrete in a formed box (12"x12"x12") is consolidated by a vibrator. Once forms are removed, the sides of the concrete are inspected for degree of consolidation and edge trueness (edge slumping). Through visual observation, a score of 1-4 can be assigned, with 1-2 being preferable.
- ✓ The test mimics a concrete paver and indicates how concrete would respond during actual paving operations.

VKelly Test (AASHTO TP 129): The VKelly Test, developed at Iowa State University, is a modification to the Kelly Ball test that was developed in the 1950s.

- ✓ The test measures the rate of penetration (or the VKelly index) of a Kelly Ball, attached to a vibrator, placed in a trough of concrete.
- ✓ The VKelly index provides a metric to measure the fundamental property (flowability) of the concrete under vibration.
- ✓ The VKelly test can be used efficiently to optimize slip formed concrete paving mixtures for workability.



Box Test



Consolidation Ranking



VKelly Test

Additional Information:
<https://intrans.iastate.edu/app/uploads/sites/7/2018/12/Procedure-Vibrating-Kelly-Ball.pdf>

Technology in the Practice: Using the Box and VKelly Test, one Iowa contractor optimized its mix by decreasing the amount of cement by 45 lbs per cubic yard.

Slump: Slump is the most common test that many assume measures workability of concrete. It was adopted as an ASTM test method (ASTM C123) in 1922 and was an appropriate test to use when concrete consisted solely of cement, aggregates, and water. Slump was directly proportional to the amount of water introduced into the mixture. Today's concrete often contains a variety of admixtures and SCMs that can vary the slump significantly without changing the water in the mixture. While slump remains an appropriate uniformity tool, it no longer provides the insight into concrete quality and therefore should not be an acceptance test.

Limitations of the Slump Cone for slip formed concrete

- ✓ Does not consider the effect of vibration on consolidation.
- ✓ Does not truly indicate the potential for consolidation or edge slump issues in the field.

Summary: These modern workability tests can be used to guide the design of slip formed concrete mixtures.

This ability to rapidly investigate different material proportions can allow mixtures to be designed with improved cost, sustainability, and durability. Furthermore, the tests can be used to ensure that the pavement can be properly consolidated, minimize edge slumping, and possibly improve ride quality.

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