

# Concrete Strength Testing Practices for Acceptance

## *Observations from the FHWA Mobile Concrete Trailer*

Compressive strength is widely used as an acceptance test for concrete. Specifications for concrete paving typically require compressive strengths between 3000 and 4000 psi at 28 days. Observations from FHWA's Mobile Concrete Trailer (MCT) field visits across the country indicate that majority of states use one of two approaches to measure concrete compressive strength for acceptance:

- 1) **Cylinders:** Cylinders are cast in the field and standard cured in accordance with AASHTO T23. Eight hours after final set and before 48 hours, they are transferred to a laboratory and cured in water/moist room under standard laboratory conditions (73.5°±3.5°F) until test age, typically 28 days and tested in accordance with AASHTO T22.
- 2) **Cores:** Cores are taken from the pavement after construction and then tested for strength in accordance with AASHTO T24M/T24.

Cylinders and cores produce different test results. Since compressive strength is a fundamental aspect of concrete pavement design and construction, the difference between the two approaches to measure strength should be clearly understood by practitioners. However, discussions with agency and contractor staff during the MCT field visits/open houses indicate that there is lack of clarity or appreciation of the two approaches mentioned above for acceptance. The text boxes below describe the primary differences between the two methods and provide a better understanding of the characteristics of each.

### Differences Between Testing Cylinders and Cores

#### Testing Cylinders

1. Measures the strength of concrete delivered to the project.
2. Strength test results are more closely related to quality of concrete produced.
  - Consistent concrete material ingredients, production, and testing would yield consistent test results.
3. Simplifies the quality control process for the production of concrete to achieve the required strength.
  - Not necessary to overdesign for strength to account for other factors such as weather and workmanship.
  - Cement content to achieve required strength can be optimized.
4. Casting cylinders is an established process for which technicians are certified.
  - Higher testing frequency is feasible at minimum cost.
5. Lower variability of strength test results would be expected.
  - Test specimen curing under standard conditions.

**Something to Consider:** Quality can only be controlled when a property can be monitored. The use of cores for acceptance does not allow the producer to isolate a mixture problem from a weather or workmanship issue. If cores are used for acceptance, the producer should also utilize QC cylinders to monitor mixture properties.

#### Testing Cores

1. Measures the strength of the pavement in place.
2. Test results include components of variation due to weather, installation, curing, process and location of coring.
  - Difficult to isolate and control quality of concrete related to production.
3. Making mix adjustments is difficult because the factors listed above cause unpredictable variations in strength test results.
  - To minimize risk, producers are forced to overdesign concrete mixtures for these unpredictable variations.
  - Could lead to higher cement content in concrete mixtures (less durable product at a higher cost).
4. Taking cores is a labor-intensive process requiring additional proficiency of technicians.
  - Limited number of cores for acceptance.
5. Higher variability would be expected.
  - Test specimen curing not performed under standard conditions.
6. Damage is sustained during drilling the core (ACI 318).
7. Adequacy of curing and protection afforded to the pavement can be indirectly assessed through compressive strength testing.
8. Workmanship issues such as consolidation and segregation in the final product can be identified.