

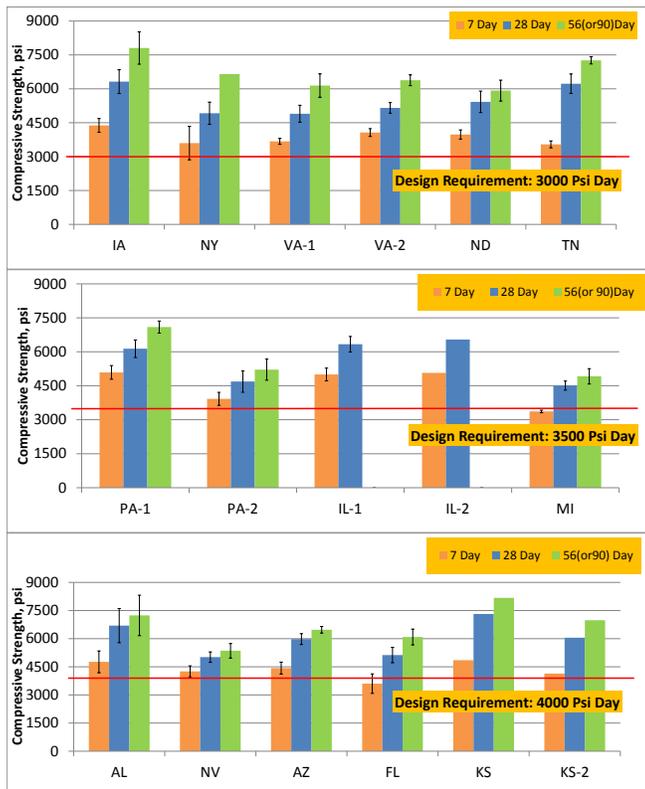
# Improving Concrete through Reduced Cement Factors

## Findings from the FHWA Mobile Concrete Trailer (MCT)

Data collected by the FHWA MCT from 17 concrete paving projects in 13 states shows:

- 28-day strength requirements are being met in 7 days
- 28-day strength requirements are exceeded by more than 60%
- 56 to 90-day strengths exceed the 28-day strength requirement by more than 80%

High cement content is nearly always the primary cause. The use of more cement than needed to meet the specification requirement may be driven by the language in the specification itself, suppliers adding additional cement due to inconsistent production, and, most often, the desire for high early strength to allow for faster construction and earlier opening of the facility to the public.



Compressive Strength Data from Projects in 13 States

### Negative Impacts of High Cement Contents

- Increased cracking potential
- Higher permeability
- Higher cost
- Less workable concrete
- Increased production of carbon dioxide

### Ways to Reduce Cement Content

- Optimize aggregate gradation
- Use supplementary cementitious materials
- Move to performance-type specification language and eliminate mandatory cement content requirements
- Use maturity testing to determine opening times
- Promote quality control in the plant to provide more consistent production

Optimizing aggregate gradations (1) will help increase workability and lower the paste content. Lower paste contents helps in reducing thermal and drying shrinkage (lower cracking potential). Lower paste contents also reduce permeability, thereby enhancing long term durability. The desire for high early strengths for opening pavements to traffic can be addressed by the concept of maturity (2) which relies on actual strength gain of concrete in the field. By lowering the cement factors, not only can we make **higher-quality, more durable** concrete, but we can do so while also **lowering the cost of production** and at the same time **reducing CO<sub>2</sub> emissions**.

### References

- 1: <http://www.fhwa.dot.gov/pavement/concrete/pubs/hif15019.pdf> (Optimizing Aggregate Gradations)
- 2: <https://www.fhwa.dot.gov/pavement/pccp/pubs/06004/06004.pdf> (Concept of Maturity)