The Road to Decarbonization: Unlocking State DOT Concrete Specifications

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DOTs can slash emissions through simple specification changes

In recent years, State Departments of Transportation (DOTs) across the United States have made progress to reduce the embodied carbon impact of concrete construction by deploying high-performance concrete mixes that reduce the most emissions-intensive component of concrete — ordinary portland cement (OPC). Supplementary cementitious materials (SCMs), such as slag and fly-ash, as well as portland limestone cement (PLC or Type 1L), have all been used successfully by State DOTs. Even with the wide availability of these materials, however, State DOTs face constraints in maximizing their use due to **overly prescriptive criteria in their concrete material specifications**.

DOTs have the potential to slash embodied carbon emissions from concrete materials by one-third through simple revisions to concrete material specifications to **reduce prescriptive cement content criteria, increase the use of SCMs**, and allow for **performance-based mix designs .**

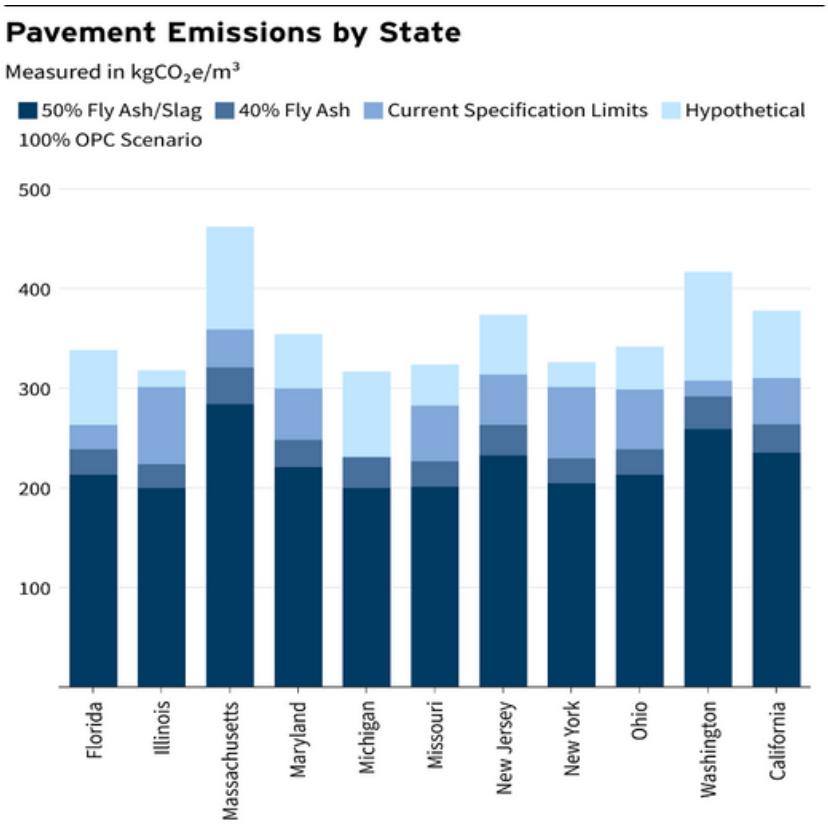

Figure 1: Concrete Pavement Emissions Optimization

RMI conducted an analysis to quantify the emissions savings benefits of simple specification adjustments, focused on cement content and SCM limits. GHG emissions were calculated based on benchmarks from the National Ready Mixed Concrete Association (NRMCA). Figure 1 highlights emissions reductions that can be achieved by eliminating cement minimum limits and expanding maximum SCM ratios to allow for 50% fly-ash/slag mixes.

Minimum cement limits are prevalent

RMI reviewed the concrete pavement specifications of 15 US State DOTs. As seen in Figure 2, the specifications of most states reviewed include a minimum cement limit requirement, which prescribes how much cement must be used in concrete mixes regardless of if that cement is actually needed to meet functional performance goals. Of the states reviewed (and as of December 2023), Texas, Minnesota, Colorado, and Oregon do not have minimum cement limits for pavements, enabling greater flexibility in developing high-performance, low-carbon mixes. Eliminating cement minimums has allowed these states to innovate with mix design, improving performance while reducing environmental impact.

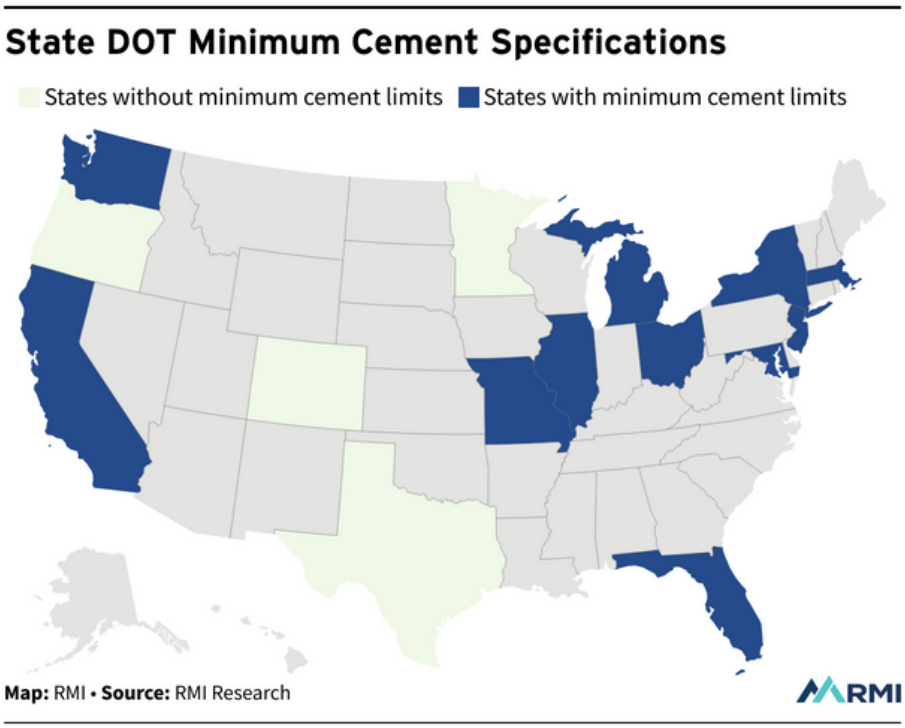

Figure 2: Minimum Cement Specifications in 15 States

DOTs should pursue the following specification adjustments:

- **Remove minimum cement limits** to unlock flexibility in concrete mix design and to allow for streamlined implementation of global warming potential (GWP) performance criteria for concrete. Removing cement minimum limits will catalyze innovation by mix designers, who will focus on delivering strength and performance over fixed material quantities.

- **Expand SCM maximum limits to allow for greater cement reductions.** Increasing allowable SCMs will allow for greater use of 40% and 50% SCM mixes and enable significant emissions reductions.

- **Revise approved material lists to enable wider use of blended cements and emerging alternative SCMs**, such as calcined clay. Materials that will allow for further cement replacement and emissions reductions are coming online; DOTs should be ready to embrace and pilot these technologies.

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