

MINIMUM CEMENTITIOUS MATERIALS CONTENT IN SPECIFICATIONS

The issue

This TechNote discusses the implications of minimum cementitious materials content in project specifications (NRMCA 2015a). Prescriptive specifications for concrete construction projects often include a clause that requires a minimum cement content to be used in concrete mixtures (Obla and Lobo 2015). The typical clause in specifications for concrete states:

Concrete for XXX members shall comply with the following:

Minimum cement content xxx lb/yd³ (kg/m³)

OR

Minimum cementitious materials content xxx lb/yd³ (kg/m³)

Question

Is it appropriate to specify minimum cement or cementitious materials content, in addition to specifying strength and durability requirements for concrete mixtures?

Response

Unless a prevailing industry standard requires it, the requirement is unnecessary and prevents the development of an optimized concrete mixture.

Discussion

The reason for this prescriptive requirement needs to be explicitly stated to avoid expectations that may not be attained. Prescriptive requirements often prevent the concrete producer from developing an optimized concrete mixture to satisfy the project's performance requirements. Concrete mixtures with higher content of cementitious materials than needed for specified performance have a higher propensity for cracking, shrinkage and creep, increased permeability, and other detrimental performance properties. It increases the cost to the owner and results in concrete construction being less competitive. Higher quantities of cementitious materials in concrete mixtures without performance-based benefits is at odds with sustainable construction initiatives.

Industry standards

The following are relevant to this topic in current industry standards:

- There is no requirement for minimum cement or cementitious materials content in ACI 318.
- ACI 350 requires minimum cementitious materials content for some portions of environmental structures. The commentary suggests that a minimum amount of cementitious materials is necessary for long-term durability.
- ACI 301 has minimum cementitious materials content requirements for interior floor slabs. The intent is to ensure adequate paste to facilitate finishability. A test slab placement is permitted as an alternative to the minimum cementitious materials content requirement.
- The ordering information section of ASTM C94/C94M includes Option C, whereby the purchaser can state a minimum cementitious materials content in addition to a strength requirement. The manufacturer is responsible to comply with the strength requirement.

As shown in Table 1, minimum limits for cementitious materials in ACI standards are considerably lower than that seen in some project specifications (Obla and Lobo 2015).