Rock Products Committee
SCOPING DOCUMENT
Volumetric Mixers for Proportioning Rapid Strength Concrete (RSC)
October 27, 2015

Task Group

Concrete Task Group

Problem Process

☒ Annual

☐ Expedited

☐ Emerging Initiative

Title

Use of Volumetric Mixers for Proportioning Rapid Strength Concrete (RSC) for Concrete Pavement

Issue/Problem Statement

Volumetrically proportioned rapid strength concrete (RSC) has been used to make pavement slab replacements expected to have a life of up to 10 years. Volumetric proportioning of RSC is not permitted in the existing standard specification for lane replacements, which can be designed for up to a 40 year life. Specifying volumetrically proportioned RSC for lane replacement or construction work that is expected to have a life of multiple decades as compared to slab replacement work needs investigation. A thorough understanding is required of the factors affecting uniformity, quality, and performance of volumetrically proportioned concrete.

Prior to standardizing the use of volumetric mixers for RSC used for jointed plain concrete pavement (JPCP), best practices for ensuring consistency and quality of the RSC and RSC pavement must be incorporated into the specification requirements.

Background

Over the past 15 years, as the volume of individual slab replacement work increased, the use of volumetric mixing equipment for concrete pavement rehabilitation also increased. This type of mixing equipment has separate bins and containers for each of the ingredients. Fresh concrete is proportioned by drawing each ingredient from the separate bins and containers at calibrated rates and mixing them together immediately before use. Fresh concrete produced at the location of placement is advantageous for RSC because there are no haul times or transport delays that add time to the concrete age.

In 2011, Caltrans wrote a non-standard special provision (nSSP) for using RSC for JPCP that allowed volumetric mixers for proportioning. The nSSP was based on the slab replacement specification without consideration of the difference in design life for the pavement. In 2013, a standard special provision was adopted for long life JPCP constructed with RSC that excluded volumetric proportioning because no historical long term volumetrically proportioned RSC performance information was available.

Volumetric mixers are calibrated and certified for a 30-day period. Each mixer is calibrated based on an ability to repeat "runs" of each ingredient within specified percentage requirements. Unlike single volumetric mixing for slab replacement and traditional batch mixing, multiple volumetric mixers and operators are likely to be used on a project within a single work shift, which may introduce other variability factors (e.g. operator qualifications, handling of constituent materials, consistency of constituents such as moisture content of aggregates, etc.) that can affect uniformity and quality of the concrete.

The construction industry asserts that excluding volumetric proportioning has resulted in instances of less productive construction operations that may compromise quality and increase construction costs. The construction industry also believes that competition between material suppliers is reduced by this exclusion, and in some cases is eliminated. The construction industry also feels they were not adequately consulted prior to the adoption of the standard special provision that excludes volumetric proportioning of RSC for JPCP.

In January 2015, an nSSP was made available to District 7 and District 8 to allow the use of volumetric mixers for projects with RSC used for JPCP. The construction industry would like to see volumetric mixers as an available option statewide for RSC used for JPCP application.

Purpose

Consider standardization of volumetric mixer use for all RSC pavement work. Evaluate the use of volumetric proportioning for RSC used for JPCP in meeting design requirements and performance needs associated with JPCP widening applications. Ensure volumetrically proportioned RSC used for JPCP meets consistency and quality requirements during construction operations. Recommend any necessary improvements in specifications, such as, quality control, calibration procedures, qualifications, and training to implement volumetric proportioning for RSC used for JPCP as a standardized specification.

Objectives/Deliverables

Analyze the use of volumetric mixers for proportioning RSC for JPCP to provide consistent and high-quality materials similar to those produced by batch mixing.

1. Evaluate petrographic test reports on samples of RSC that have demonstrated poor durability to understand the cause of poor durability.
2. Perform a review of nationwide practices (applications of use, quality control requirements, calibration requirements, training, etc.) concerning volumetric proportioning of concrete/RSC for concrete pavements.
3. Perform a review of Caltrans practices concerning volumetric proportioning of RSC for slab replacement/ lane construction and pavement performance pertaining to the uniformity, durability, and strength.

4. Perform a literature search for volumetric mixing of concrete pertaining to the uniformity, durability, strength, and performance of concrete pavements/structures in comparison to batch mixed concrete.
5. Gather quality assurance data including post construction testing for batch mixing and volumetric mixing, and analyze to evaluate volumetrically mixed concrete consistency, uniformity and durability including concrete produced from multiple mixers.
6. Document findings in a report and recommend whether or not it is appropriate to adopt the use of volumetric proportioning as a permanent option for RSC in JPCP applications.
7. Review existing volumetric proportioning specifications and recommend improvements (e.g. JITT, quality control testing, qualifications, etc.) as needed.

Timeline

Deliverables	Target Completion Date
1. Decision document with findings and recommendation whether or not it is appropriate to adopt the use of volumetric proportioning as a permanent option for RSC in JPCP applications.	September 30, 2016
2. Review existing volumetric proportioning specifications and recommend improvements (e.g. JITT, quality control testing, qualifications, etc.) as needed.	October 30, 2016

Benefits

- Increased competition between ready mix and volumetric concrete producers, cement manufacturers, and admix suppliers.
- Potential for lower costs on RSC projects.
- Allows contractor flexibility.

Impacts

- Increased use of volumetric mixers may increase resources required for equipment calibration.
- Increased support costs for training and increased construction costs for JITT.
- Risk of reduction in pavement life.

Resource Requirements

	Evaluate petrographic test reports on samples of RSC	Review of nationwide practices	Review of Caltrans practices	Literature search for volumetric mixing	Analyze existing data to evaluate volumetrically mixed concrete consistency and uniformity	Review existing volumetric proportioning specifications	Document findings	Total PYE
Caltrans Pavement	0.02	0.04	0.04	0.04	0.02	0.04	0.02	0.22
DES METS	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.11
Construction		0.02	0.02	0.02	0.04	0.02	0.02	0.14
District			0.01			0.01	0.01	0.03
OE						0.02		0.02
Legal						0.02		0.02
Caltrans Total PYE's								0.54
Others								
Industry	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07
FHWA						0.02		0.02
Total PYEs								0.62

Impediments to Completion of Deliverables

1. Lack of resources
2. Lack of coordination and contribution of task group members
3. Lack of support from managers

Recommendation and Approval

This scoping document for use of *Volumetric Mixers for Proportioning Rapid Strength Concrete (RSC*) for Concrete Pavement was prepared by the Concrete *Task Group* to address an issue that has statewide significance and is within the Rock Products Committee mission. The Task Group Co-Chairs have determined the scope, resources required, and timeline for delivery of this project to ensure that the deliverables are achievable in a timely manner.

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Concrete Task Group
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Approval Date: 1/20/2016