The Following Needs Have Been Identified by our Partners on the National Ready Mixed Concrete Association's Research, Engineering & Standards Committee as of June 2021

This document is meant to serve as a guide to researchers wishing to perform research on concrete materials topics of interest to the ready mixed concrete industry. It does not reflect a guarantee that a particular topic will be funded, nor does it preclude funding of research on topics not included.

1. **Concrete Technology – Entrained Air in high-strength concrete**

Exterior structural members designed for higher strength (typically 8000 psi or higher) are required by the ACI 318 Building Code to be assigned to an exposure class that requires entrained air in regions that see freezing temperatures. Developing air-entrained mixtures for higher strength, increases the cementitious materials content, increasing the potential for thermal or shrinkage cracking, and impacts sustainability goals. Research is invited that would look at potentially waiving the requirement for entraining air in concrete beyond some minimum specified strength or to propose alternative means or data that assures designers of the durability of these members in freeze-thaw exposure. The research should develop field and laboratory data to support a Code change.

2. **Sustainability – Low Carbon Concrete**

There are several national and regional initiatives to reduce the embodied carbon of the built environment. These initiatives also establish maximum targets or reduction goals for the carbon footprint of concrete mixtures. The PCA has developed a 2050 roadmap on reducing embodied carbon in cement and concrete. Research or other programs are invited to assist the ready-mixed concrete industry to achieve reduced embodied carbon while meeting project needs. These programs can include education, certification, technology developments, simplified tools to quantify embodied carbon, and Code/spec changes.

3. **Sustainability – Concrete with recycled content**

Competing materials to concrete such as steel and wood can claim a much higher recycled content than can be typically used or quantified in concrete. Proposals are invited in the area of establishing QC programs to manage the variability of recycled materials, and quantifying performance and structural behavior of concrete with recycled materials. The research should help address specifications for materials and provide confidence to designers to permit the increased use of recycled content in concrete mixtures.

4. **Performance – Performance Alternative for Durability**

ACI 318 and most specifications for concrete currently rely on maximum *w/cm* limits for durability. The benefit provided by SCMs in improving the transport properties of concrete (permeability) is not recognized. This prevents concrete mixtures to be better optimized for improved performance and sustainability. Electrical-measurement tests such as resistivity are being increasingly specified as a measure of concrete's transport properties that impact durability. Research is invited to develop data to evaluate performance tests and criteria for improved durability that can be used as performance-based alternatives to *w/cm* in ACI 318 and other specifications. These can include exposures to freezing and thawing cycles, corrosion protection of reinforcement, exposure to water and other chemicals and sulfates. The study should suggest Code change provisions, i.e. performance alternatives to *w/cm* for all exposure classes.

5. **Performance – Performance-based criteria for concrete for floors**

Current specifications for warehouse and industrial floor slabs are prescriptive in terms of minimum cement content, combined aggregate grading requirements, maximum w/cm, maximum air content, etc. Many of these recommendations are from ACI Committee 302 to address workability, volume change as it impacts joint spacing or curling, bleeding, and setting time characteristics that impact finishability to prevent surface defects and to control problems associated with slab moisture emissions that affect floor coverings. Research is invited to propose alternative performance-based criteria that would address these issues.

6. Performance – Implementation of Performance Test Methods

Test methods or other evaluations based on sound scientific principles are often developed by researchers to measure properties of concrete that could be used for the development of mixtures, quality control, or quality assurance. Some of these test methods may require expensive equipment, higher operator proficiency, or require extended duration. In many cases, the precision of these test methods has not been established. In some cases, these test methods are promoted for use in a pilot evaluation process on projects. Research is invited to evaluate the potential of one or more test methods, evaluate potential improvements through a ruggedness evaluation, and suggest improvements for reliable adoption by industry stakeholders. If the test is used for acceptance the research should suggest criteria that take into account the precision of the test.

7. Performance – A Software Tool for Implementing Performance-Based Specifications

Many specifying engineers are not knowledgeable about performance-based specifications and criteria for their projects. This acts as an obstacle to the widespread adoption of performance-based specifications. It is well understood that the key in introducing any new approach is to reduce friction and make it easy and simple to adopt. A software tool that requires the engineer to input some information about the project and provides an output of performance criteria in specification language can help alleviate the complexity in the adoption of performance-based specifications. Proposals are invited to develop such a tool that can be run on a website such as at www.nrmca.org/P2P. It is envisioned that this tool will be the centerpiece of that website which will be reorganized to serve as a one-stop-shop for any project stakeholder interested in implementing projects with performance-based specifications.

8. Quality – Approaches to Reduce Concrete Material and Manufacturing Variability

Concrete variability which is typically measured by its compressive strength standard deviation depends on ingredient material variability, manufacturing variability, and testing variability. Proposals are invited to manage and reduce these variabilities through improvements in admixture technology, manufacturing technology. Approaches to streamlining concrete mixture development to reduce the mixture portfolio of a plant or company can be considered. Simplified tools and methods to monitor and address the variability of concrete ingredient materials and proposed corrective action can be considered.

9. Quality – Approaches to Reduce Concrete Testing Variability

Proposals are invited to manage and reduce variabilities through ensuring acceptance testing is in accordance with standards, developing alternative methods to acceptance testing, improving the predictability of concrete performance through increased collection and monitoring of applicable data at the material and manufacturing level that will help reduce the need for acceptance testing.

10. Innovations

Research is invited to support the use of new materials, processing techniques, and measurement approaches in concrete that would help improve concrete's performance, lowers costs, quality, and reduce its carbon footprint. The innovation considered should not be proprietary and should be readily available without geographic restrictions and should be commercially viable. The industry faces challenges with a potential diminishing supply of concrete ingredient materials such as fly ash, natural sand, and potable water while at the same faced with increasing regulations related to lowering its environmental impact.