Maryland Ready Mix Concrete Association (MRMCA)

MRMCA Position Statement for Low Carbon Concrete (ref MGBC Tasks for CSNA 2022)

This MRMCA Position Statement is provided to help guide the Maryland Green Building Council regarding the examination of the 5 points outlined below as stated in the Climate Solutions Now Act of 2022. For your use, as referenced throughout this document, this is a link to NRMCA Guide Specifications for Reducing Embodied Carbon.

As stated in the Climate Solutions Now Act of 2022 CSNA of 2022… the bill requires the Maryland Green Building Council (MGBC) to examine:

(1) the use of environmental product declarations to measure the climate impact of concrete procured by the State;

(2) the use of performance incentives to encourage adoption of low-carbon materials and methods by concrete manufacturers that provide concrete for State-funded projects;

(3) the establishment of an expedited product evaluation, testing, and approval protocol for low-carbon concrete products;

(4) the implementation of performance-based specification standards for concrete, as specified;

(5) the use of methods of compliance, including maximum cement content specifications and specifications based on maximum potential for global warming.

In examining these topics, MGBC must consult with (1) any relevant associations that set industry standards for the procurement of low-carbon concrete and (2) affected contractors and subcontractors to consider both environmental and health and safety impacts. MGBC must report its findings and recommendations to the Governor and the General Assembly by December 1, 2022.

(1) the use of environmental product declarations to measure the climate impact of concrete procured by the State;

MRMCA Position / Background / Supporting Information

The State could start by collecting EPDs from Maryland cement/concrete producers for a period of no less than 12 months to establish a baseline for benchmarking levels for program going forward

Environmental Product Declarations (EPDs) are an important tool to understand a product's environmental impacts including only embodied carbon emissions. The State of Maryland should establish and communicate the correct intent and use of EPDs. EPDs are not to be used, nor is it appropriate, for a comparison between different building materials for the purposes of procurement or building material selection. For example, concrete cannot be compared to asphalt simply by comparing the number in their EPD's as they are not measuring the same data.

The current North American PCR for concrete and the EPDs that are developed from it are imperfect tools. They were established for credit achievement in green rating systems and not a comparison tool. The PCR lacks details and definitions of strength classes that are used in design, does not require performance application specificity such as flow rheology and cure time, and is limited in the accounting of impacts in other life cycle stages of the product.

Not all EPDs, even within one type of material and using the same PCR, have the same granularity of the underlying data. For example, an EPD of one concrete mix may have specific supply chain-specific data for some of the constituent components, disclosing detailed impacts from a specific cement used in that concrete mix. Conversely, another mix's EPD may not have access to that cement-specific data and rely on less granular industry average data for that ingredient.

While Cradle-to-Gate EPD evaluations are a focus on the up-front carbon impacts after a design is completed, and are meaningful for carbon reduction decision making, Cradle-to-Grave Whole Building/Project Life Cycle Assessment (WBLCA) analyzes all life cycle phases and should be used by design teams to evaluate structural alternatives, for confirming early design decisions. Vetted early design decisions, including long-term durability, resiliency, and re-use impacts, should be considered WBLCA decision making to most holistically achieve carbon optimized construction.

(2) the use of performance incentives to encourage adoption of low-carbon materials and methods by concrete manufacturers that provide concrete for State-funded projects;

MRMCA Position / Background / Supporting Information

The last ten years have seen rapid and exponential interest in disclosing the environmental impacts of products, and in particular, building materials. Environmental Product Declarations (EPDs) are the driving force of much of this disclosure, particularly the impacts of greenhouse gasses. While the uptake of published EPD from Maryland's manufacturers is starting – only a few unique products currently in the Embodied Carbon in Construction Calculator (EC3) Database – it's important to realize that this is concentrated in only a few industries at a few manufacturing locations or batch plants.

Unlike steel or wood or other materials that are shipped from a point source in a final finished form, the significance of concrete is that it is a dynamic material that can be modified to adopt to construction scheduling, production, and overcome design challenges to facilitate efficient and timely construction. Mix design changes and materials used can change while the project is underway to accommodate unanticipated, necessary or desirable changes. Any procurement regulation would fundamentally preclude necessary flexibility during construction to offset delays by weather, material shortages or other developments. There are other challenges: a procurement approach prevents fulfilling the objectives of the Act and equally as important, for a state structure, may significantly complicate construction and delivery of a publicly funded project on time or within budget.

Providing financial assistance to manufacturers to facilitate the production of environmental product declarations and the reporting mechanism based on life-cycle analysis will improve the state's ability to make purchasing decisions that align with state carbon reduction goals, will ensure that small manufacturers and rural areas are not put at a competitive disadvantage in state contracting as a result of the requirements of this law, and and will allow rural areas to successfully participate and support rural carbon reduction goals.

1. Provide **matching grant funds** for smaller building material manufacturers in Maryland to produce product-specific Environmental Product Declarations. Since producing EPDs require a collection of 12 months of data, funding should not be delayed so smaller manufacturers can begin this data collection now to be ready for future disclosure requirements and maintain their long-term competitiveness. The external costs for a single facility to produce EPD's is comprised of data collection and analysis costs (site and facility specific), EPD generation by a EPD provider approximate $10,000, plus subscription fees, third party verification costs of $3,000 or more with ongoing annual maintenance fees of $2,000 per facility.

2. **Fund a publicly accessible database** of completed projects with embodied carbon, material type and quantity data; the project name, the project team members, and suppliers/manufacture names shall be redacted. PCR and EPDs are regularly updated and need to be maintained to ensure fair comparisons between projects, the database should also include more granular information such as the type(s) of the structural systems, the types of concrete applications, and the project location.

3. **Carbon reduction targets incentivize project carbon performance.** Setting a project-specific carbon budget can provide both rigor (measurement against published industry averages) with flexibility (the ability for contractors to offset higher emitting materials with lower emitting materials in equal measure). Require quantifiable embodied carbon budgets and identify the baseline for measuring the budgets. In addition, consider requiring quantifiable carbon reduction targets for operational carbon, such as obtaining energy use intensity (EUI) targets below code-required levels as material decisions can affect operation carbon emissions.

   Upon completion of the project, the project analysis shall calculate and summarize the resulting embodied carbon levels as achieved by the project.

   (i) If the project meets the published project carbon reductions, a bonus of X% shall be paid and distributed to the project contractor and his contributing material suppliers and others upon verification of the embodied carbon reduction as contributed to the project.

(ii) If the project exceeds the published project carbon reductions, a bonus of X+% shall be paid and distributed to the project contractor and his contributing material suppliers and others upon verification of the embodied carbon reduction as contributed to the project.
(iii) A standard bonus formula for exceeding embodied carbon reductions shall be determined and published by the Dept of General Services and incorporated by the awarding agency into their state funded construction project specifications

4. **Reward Manufacturing and Transportation Reductions.** Provide a financial/point bonus during bid award analysis for manufacturing facilities which have reduced manufacturing energy usage and process emission through participation in programs such as Energy Star Plant Certification, the Concrete Sustainability Council or conversion of diesel equipment and delivery trucks to either renewable diesel, CNG (RNG) or electric.

(3) the establishment of an expedited product evaluation, testing, and approval protocol for low-carbon concrete products;

MRMCA Position / Background / Supporting Information

The State should specify minimum qualifications for the concrete producer, installer, and testing facility. See Section 1.7 of NRMCA Guide Specification.

Concrete is made from local materials and its performance can be affected by weather conditions, variability of materials, delivery, placing, handling, and testing. Although the materials used to make concrete meet rigorous standards, the variability can be quite high. Concrete rarely tests well when proper manufacturing, installation, and testing protocols are not followed. If test results consistently show lower strength, then the only way to overcome that is to increase overdesign, which generally raises cementitious material content.

For example, if poor testing increases the necessary over design from 600 to 1000 psi, the content of the cementitious materials would increase by roughly 40 lbs to 4,000 psi, increasing the embodied carbon footprint by as much as 6%.

This results in increased cost and does not support sustainable development. Selection of testing agencies should be based on quality of work and having certified personnel conducting tests. Test reports should be distributed to producers as soon as available to help identify potential problems early.

ACI 318, ACI 301, and ASTM C94 require that testing agencies contracted to perform acceptance testing should comply with ASTM C1077. This clause is included in the AIA MasterSpec. Compliance with ASTM C1077 can be a documented laboratory inspection by organizations such as the Cement and Concrete Reference Laboratory (CCRL) or accreditation by the AASHTO Accreditation Program (AAP). These programs involve a thorough evaluation of laboratory equipment, procedures, personnel qualifications, and certifications and require participation in reference sample testing program to assure proficiency of testing. ASTM C1077 establishes the requirements and criteria for evaluating the proficiency of testing laboratories involved in testing concrete and aggregates.

Results of concrete testing are sensitive to how specimens are fabricated, cured, handled, and tested. Procedural requirements for acceptance testing are addressed in ASTM C94/C94M and the referenced standard practices and test methods. Field and laboratory procedures that conform to established standards are essential to achieving reliable results. Deviations from standardized procedures will most often result in unacceptable results that increase project costs and delay schedules. Hence, technician certification is essential. Equivalent certifications to ACI should include a component whereby the technician physically demonstrates the performance of the test method and practices, and written examination on the content of the applicable standards.

Many ready mixed concrete companies have well equipped laboratory facilities and can perform most of the common tests on concrete and concrete materials. A separate testing agency should not be required if the laboratory can perform mixture development and most of the standard test methods. There may be some tests that could be contracted out to an independent testing agency to perform.

Many specifications include a clause requiring a single source of cement for the duration of the project. It is sometimes not practical to use single sources of cementitious materials for the duration of the project. Even single supply sources of cementitious materials vary over time and in periods of high demand there may be some changes in point sources of manufacture of cement or the collection of supplementary cementitious materials (SCMs) such as fly ash, slag cement, and silica fume. Cement companies and suppliers of supplementary cementitious materials attempt to control the uniformity of products shipped to the concrete producer. It is also the responsibility of the concrete supplier to make minor changes to concrete mixture proportions to address these material source variations. These minor adjustments should not typically require re-submittals. Single source is appropriate for architectural concrete and concrete producers will generally isolate a sufficient supply of such materials for the duration of a project.

(4) the implementation of performance-based specification standards for concrete, as specified;

MRMCA Position for performance-based specifications:

- The engineer should minimize prescriptive requirements on concrete mixtures and construction means and methods and increase the focus on measurable performance attributes when appropriate.
- Avoid specifying maximum w/cm, air content, cement type requirements if they are not applicable to the anticipated service conditions of the structural members.
- The engineer should avoid specifying a maximum or target slump as it may impact constructability.
- The specification should avoid specifying minimum contents for cementitious materials. Likewise, a maximum cement content should not be specified for concrete mixtures. Cement content requirements vary considerably for constructability, early strength and other properties and should not be limited based on design strength of structural members.
- Do not restrict the minimum or maximum percentage of SCM except unless there is a particular requirement in local building codes.
- Avoid limiting the types of admixtures that can be used unless there is a specific reason. Listing brand name products should be avoided.

MRMCA Position / Background / Supporting Information

The proportions of ingredients used for concrete mixtures can have a significant influence on the environmental footprint of concrete, but this determination should not be limited to the mixture composition – the impacts to constructability, schedule, and performance of the structure must also be considered. Specifications for concrete in construction documents establish project requirements where the contractor and material suppliers must comply. Project specifications that adhere to industry standard specifications, such as *ACI 301 Specification for Structural Concrete*, generally applicable for buildings, are supportive of performance-based criteria and sustainable concrete construction and can be adopted by reference in a project specification. Concrete products must still meet the current life safety codes.

A **performance-based specification** outlines the characteristics of the fresh and hardened concrete, depending on the application and aspects of the construction process that are necessary. These requirements should not restrict innovations by the concrete producer or the concrete contractor. A **prescriptive specification**, on the other hand, imposes constraints on concrete mixture proportions or means and methods of construction.

Performance specifications should clearly specify the test methods and the acceptance criteria that will be used to verify and enforce the performance criteria. Performance specifications should provide the necessary flexibility to the contractor and producer to provide concrete mixtures that meet the performance criteria.

The State of Maryland is interested in a concrete structure that provides a long service life without significant defects and has a low environmental footprint, not necessarily how much cement it contains. Using a performance-based specification, the concrete producer is free to select the mixture proportions and is held responsible for meeting the performance criteria. Since performance specifications would allow for mixture optimization and mixture adjustments during the project, there is an incentive for the producer to invest in improved quality, technology and lab facilities. With a performance specification, a quality concrete producer can improve product quality, stimulate innovation, reduce construction cost and minimize construction time – while reducing environmental footprint.

Carbon Performance in Specifications Option:

For sustainability goals, the project team should establish a **carbon budget** for ALL materials including concrete on a project – this permits tradeoffs between different types of member requirements. Alternatively, reduction in carbon footprint relative to typical mixtures or industry benchmarks could be used. By establishing upfront that the project has a carbon reduction goal, it provides the concrete contractor and producer an indication that they should develop mix designs that not only meet the typical performance criteria for concrete, such as strength, durability and other physical properties, but they should also take into account concrete mixtures with lower carbon footprint than typical concrete mixtures. It also encourages the use of innovative products and processes to meet these goals.

(5) the use of methods of compliance, including maximum cement content specifications and specifications based on maximum potential for global warming.

MRMCA Position / Background / Supporting Information
The State should include a table in the specification that lists performance criteria, such as strength and exposure class, without limitations on material quantities. See Section 2.11 of the NRMCA Guide Specification.

Concrete is unique among building materials. Its formulation is highly influenced by its application. Design professionals and contractors have a greater influence on concrete formulation than they do with other building products. Concrete formulation has the greatest impact on the carbon footprint of concrete.

Imposing minimum or maximum cement content for different classes of concrete constrains the innovation of the concrete producer to optimize concrete mixtures, and can result in inherent incompatibility with other requirements of the specifications, such as strength or w/cm. These can result in unintended consequences, such as increased volume changes due to temperature or drying shrinkage that will result in cracking or reduced durability. It is a fallacy to assume that higher cement content results in improved durability. Minimum cement content requirements can impact cost and the environment with questionable benefits to quality, performance, and durability. On the other hand, attempts to force green construction should not set limits on maximum cement content. This could compromise constructability or performance of concrete in the structure resulting in reduced service life.

Additional Background / Suggestions / Recommendations:

Specify a target Global Warming Potential (GWP) for all the concrete on the project by using NRMCA Industry Wide Environmental Product Declarations and Benchmarks to compare proposed designs to a baseline (or benchmark). See Section 2.11 of NRMCA's Guide Specification. A calculation can be shown that the Global Warming Potential (GWP) of all the concrete supplied for the project will be lower than the GWP target.

- For each concrete mixture, supply a plant specific EPD. EPDs are third party verified reports listing environmental impacts of products. They list a multitude of environmental impacts including GWP. They are the basis for calculating the embodied carbon footprint for the building.
- The calculation showing that the GWP of the concrete supplied for the building is lower than the target shown in Section 2.11 is simple. Sophisticated LCA software can be used for this calculation, or the simple math equations can be used:

  Equation 1: GWPB = (GWPB1)(V1) + (GWPB2)(V2)…(GWPBn)(Vn)
  Equation 2: GWPP = (GWPP1)((V1))+(GWPP2)(V2)…(GWPPn)(Vn)
  Where:
    - GWPB = Global Warming Potential of Benchmark Building
    - GWPB1, GWPB2, etc. = Global Warming Potential of each different concrete mix or class of concrete on the project from the Benchmark Report
    - GWPP = Global Warming Potential of Proposed Building
    - GWPP1, GWPP2, etc. = Global Warming Potential of each proposed concrete mix or class of concrete as selected from the Industry-Wide EPD or from product specific EPDs if available at time of design (unlikely).
    - V1, V2, etc. = Volume of each different concrete mix used on the project.
    - n = Number of concrete mix designs or classes of concrete.

Whole Building LCA Option:
A better tool for evaluating projects is a Whole Building Life Cycle Assessment (WBLCA). The Life Cycle Assessment (LCA) will provide the cumulative amount of greenhouse gas emissions that were produced through the life of the project. With the advent of LCA tools, design professionals can determine the most applicable materials when modeling the entire project life cycle, i.e., raw material extraction, manufacturing, installation, operational & maintenance, repair and end-of-life decisions. Only when considering a project's entire life (60, 75 or 100 years) is when true environmental impacts can be evaluated. Holistic project LCA provides opportunities to compare alternative designs and/or materials for selecting the optimal path to meet both environmental and performance objectives. EPDs are still important because the quantified environmental impacts found in an EPD can then be used to help calculate the entire LCA for a project, whether it's a building or infrastructure project.

Use industry-average benchmarks to establish a baseline and use industry-wide environmental product declarations to establish a carbon budget. It is still necessary to have a general idea of what the carbon footprint of each mix will be to set a carbon budget for the building. By setting a carbon budget for all the concrete, it provides enough flexibility to the contractor and concrete producer to meet the all the performance criteria, such as strength and durability, while also meeting carbon reduction goals.

Specifications can require that product suppliers submit Life Cycle Inventory (LCI) data for their products or Environmental Product Declarations (EPDs) to help the design team conduct a Whole Building LCA. There are several LCA tools in the market including Tally and Athena's Impact Estimator.

Specification language options:

- Option 1
  Supply concrete mixtures such that the total Global Warming Potential (GWP) of all concrete on the project is less than or equal to 4,298,000 kg of CO_2 equivalents as calculated using the Athena Impact Estimator for Buildings Software available at www.athenasmi.org.
- Option 2
  Supply concrete mixtures such that the total Global Warming Potential (GWP) of all concrete on the project is 30% or more below the GWP of a reference building using stipulated benchmark mixes. Submit a summary report of all the concrete mixtures, their quantities and their GWP to demonstrate that the total GWP of the building is 30% or more below the GWP of the reference building. Contractor may use the Athena Impact Estimator for Buildings software available at www.athenasmi.org or other similar software with the capability of calculating GWP of different mix designs.