FAQs for County of Marin Low Carbon Concrete Code

The following questions are derived from issues raised by various stakeholders during the development of the low-carbon concrete code language and its companion model specifications.

1. *Will this apply to all concrete in the jurisdiction?*
No, only to concrete *placed* in the jurisdiction. Precast elements and concrete masonry are exempted, though may be considered in future code cycles.

2. *What part do structural engineers play?*
A very big one. The American Concrete Institute is already urging engineers to end longstanding practices like specifying minimum cement content, or maximum water/cement ratios, or requiring concrete strength to be reached in only 28 days when it very often has many months more before being put into service. Instead, engineers should make clear what performance measures are needed, such as maximum shrinkage, pumpability, or permeability, and what the real "ultimate strength" must be at, for instance, one year's time.

3. *Isn't it easy to "game" this by specifying higher-than-needed concrete strength so as to get higher allowable cement/GWP content?*
Possibly, though it would cost the user money, as cement is typically the most expensive component of concrete. In the longer run, as concrete suppliers become comfortable with low-carbon mixes, we hope those will increasingly be simply what they offer.

4. *What about flatwork and other cases that typically call for high early strength even if they don't need much long-term strength?*
Replacing cement with supplementary cementitious materials (SCMs) such as fly ash and slag typically slows initial strength gain while increasing long-term gain. That makes a problem for, e.g., a public sidewalk that must be put into service as soon as possible. Adding extra cement has always been the simplest way to "kick start" a concrete, but there are widely available chemical additives called *accelerators* that can accomplish the same thing without adding to the mix's GWP. Accelerators can add cost, but that can be weighed against the savings from using less cement.

The code includes an allowable increase of 30% for concretes demonstrated as requiring high early strength, including but not limited to precast, prestressed concrete; beams and slabs above grade; and shotcrete.

5. *What about concrete that calls for high early strength AND long-term strength?*
Same response as above, though there will be cases where a higher cement content is simply needed. Again, the standards allow for increases in certain concretes requiring high early strength.

6. *Why does this code only address concrete? What about steel, wood, glass, insulation and other high-carbon materials?*
Local government policies around embodied carbon are a new practice across the country. Concrete is a starting place start regulating embodied carbon, both because of its global impact (estimated to be between 6 and 10% of global emissions), and because of the concrete industry's years of work developing standards for lower-emission alternatives to cement, resulting in multiple opportunities for emission reductions.

7. *Can I use this code outside the Bay Area?*

The general code language may work in jurisdictions outside the Bay Area, but should be checked for applicability and congruity with standards already in place in each planning and building department. However, the numerical limits of cement content and embodied carbon should not be copied directly to other jurisdictions without review from a stakeholder group that at a minimum consists of local concrete suppliers, contractors, and structural engineers; and ideally also any other concrete experts familiar with local materials, conceivably from testing labs, universities, consulting firms, government agencies, and industry groups. Setting appropriate limits requires engaging local stakeholders because concrete mix design is highly dependent on local conditions, which include but are not limited to:

- Type, gradation, consistency, and other qualities of available aggregates
- Type, efficacy, consistency, and other qualities of supplementary cementitious materials
- Capabilities of the concrete batch plants, such as the number of different materials they can store
- History of experience formulating, mixing, placing, and finishing low-cement mixes
- Familiarity of concrete producers with use of admixtures
- Weather and traffic conditions and how the contractor must be prepared for unexpected changes during concrete delivery and pours
- Restrictions on cement types, often dictated by state transportation agencies
- Cost margins on concrete materials
- Market expectations on construction speed

For example, a logical extension of this code might be to Southern California jurisdictions. However, the aggregate in Southern California is notoriously weak, and thus the concrete producers need to compensate for it with greater amounts of cement than is often used in the Bay Area. Introducing this code could prompt a lifecycle emissions study on whether barging higher quality aggregate from northern regions could still result in lower carbon emissions for concretes in Southern California. Outside the Bay Area, there may also be fewer producers with Environmental Product Declarations. Making the embodied carbon limit pathway a viable option might entail more relaxed embodied carbon limits compared to the cement limits, to incentivize production of a sufficient number of EPDs. In any case, the numerical limits need tuning to allow for achievability while still requiring improvement from the current norm.

8. *Is it realistic to get to zero by 2050?*

While a completely zero-emission concrete may not be on the shelf already, the BALCC stakeholder group identified some of the biggest hurdles in getting there. Here are some of the top issues the Bay Area will need to tackle if the limits are to become more aggressive in future code cycles:

- Financial support for small ready-mix plants to add silos or do other infrastructure upgrades that entail notable capital cost
- Caltrans needs to accept blended cements, e.g. Type IL blended limestone cements, and not just Type II/V
- Gap-grading of aggregates and pros and cons of moving towards increasingly well-graded aggregate profiles that will enable less reliance on cement
- Natural pozzolans, such as calcined clay, need to be further studied and codified. The variability in these materials needs to be addressed, such as through technologies or safety factors, so that they can be used more widely. Will help push public works if Caltrans adopts first.
- Acceptance/codification of sequestering technologies like Blue Planet aggregate and CarbonCure.

- Availability of other cement substitutes such as ground glass pozzolan
- Need precast to start producing product-specific EPDs
- Add CMU to scope of code requirements so that it doesn't eventually become a loop hole. Is ok for now because CMU typically uses around half the cement per cyd compared to ready-mix, and would not require twice the volume for same structural element. If the NRMCA reduction target was to be increased to 50%, CMU should be incorporated with the appropriate limits.
- Cement producers, and vertically integrated concrete producers, may need new business models
- Caltrans needs to establish top-down programs/policies to implement their Green Concrete specs on projects