960 W 7th Street

A New Benchmark for Reducing High-Rise Construction Costs and Carbon Footprints

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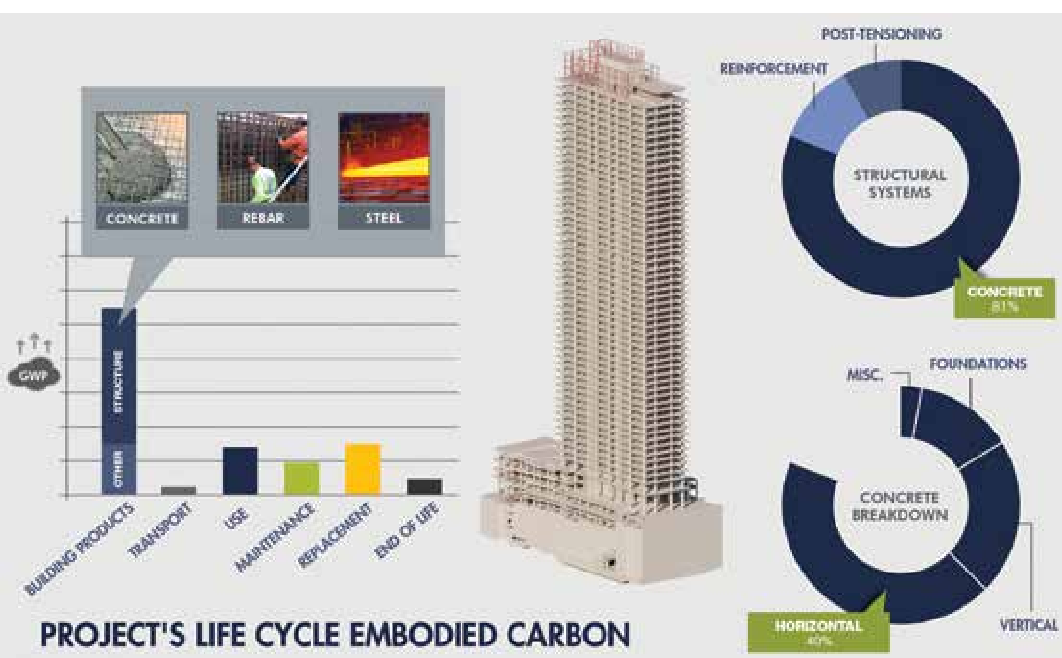
How do you successfully design and construct a high-rise residential tower, being mindful of costs while also reducing its environmental impacts? This was a challenge posed to the design team, contractor, and subcontractors behind Brookfield Properties' 960 W 7th Street project in downtown Los Angeles, California.

Currently under construction, the 57-story mixed-use residential tower will include 11 levels of parking above and below grade, street-level retail spaces, and residential amenities on Levels 3, 35, and 57. Upon completion, the 960 W 7th Street tower will rise 614 feet measured to the top of its core. The tower is situated between two existing structures – a parking garage to the west and a retail center to the east and northeast – also owned by Brookfield Properties.

960 W 7th Street project in downtown Los Angeles, CA. Courtesy of Brookfield Properties.

To successfully deliver this high-rise building, Magnusson Klemencic Associates (MKA) worked with the design and construction teams to find collaborative solutions that met tight site and budget constraints while achieving low-carbon goals – all without compromising high-quality standards. The team's collective problem-solving approaches included a double-bottom-line materials procurement process and a critical look at the supply chain to avoid extra materials and costs. As a result, the project has become a benchmark of win-win scenarios for other projects to consider when seeking to reduce both costs and embodied carbon.



Often, the structure accounts for the highest embodied carbon.

You Can't Manage What You Don't Measure

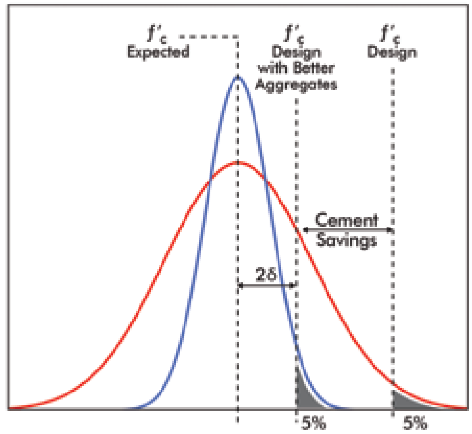
Two factors contributed to credibly measuring, reducing, and then reporting the 960 W 7th Street project's concrete carbon footprint.

First, MKA asked for supplier-specific, third-party verified Environmental Product Declarations (EPDs), which report the "Product Stage" embodied carbon of the measured materials. This includes the extraction of raw materials, transportation of these materials to the manufacturing site, and manufacturing these materials. EPD collection efforts focused on concrete, rebar, and structural steel, which make up the largest carbon footprint of the building components and represent some of the most effective targets for meaningful embodied-carbon reductions.

Second, the project was an early test case for the Embodied Carbon in Construction Calculator (EC3), which was valuable for identifying lower embodied carbon opportunities previously overlooked. EC3 is a growing, free-to-use national database of EPDs that includes a tool for tracking and comparing embodied carbon emissions across construction material suppliers. This allows easy organization of project material quantities and access to EPD carbon emissions data that help compare and reduce overall emissions during the design and construction of a project.

Incentivizing the Concrete Procurement Process

The 960 W 7th Street project team started with a performance-based concrete mix specification to lower the project's embodied carbon footprint. The specification afforded flexibility to both the contractor and the concrete supplier while still defining critical mix criteria, such as strength, shrinkage, modulus of elasticity, and set-time for stripping formwork and finishing. As the experts in how to best create their material, concrete suppliers were given the freedom to optimize their unique mixes with fewer restrictions. Still, they were asked to disclose their cost and carbon footprint data prior to bid, creating a double-bottom-line competition.



By minimizing variability, cement content can be reduced.

Suppliers were informed that the selection process would consider both cost *and* carbon levels. Brookfield Properties made it clear that cost-effective, low-carbon material procurement was a valued aspect of this project, creating competition among suppliers to provide the most economical, lowest-carbon concrete available.

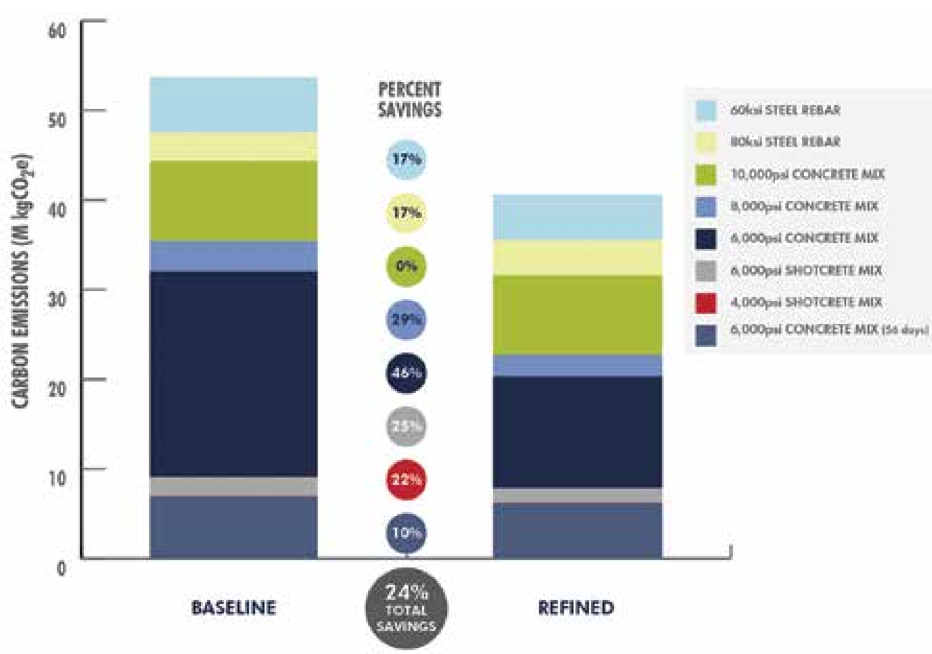
Comparatively, trying to beat preset embodied carbon caps per concrete strength (something considered early on for the specifications but not used) would not have been an incentive to go as low as responsibly possible and could have led to added cost for requesting something unique. Instead, contractors and their suppliers were incentivized to find the best approach to lower-carbon concrete while minimizing ownership costs. This approach also meant the responsibility and liability for the mix performance and construction schedule remained with the construction team. Should the mixes not meet specified final strength requirements, responsibility and liability for that outcome clearly remained with the contractor and their ready-mix supplier, not the owner.

Contractor and Concrete Supplier Selection

A thorough and competitive selection process resulted in Webcor Builders being chosen as the 960 W 7th Street project contractor. In addition to showing diligent management of the project's construction, schedule, and procurement processes, Webcor Builders proposed the early engagement of material suppliers. In addition, they embraced a collaborative relationship with the design team to fine-tune the design for both costs and embodied carbon.

One of Webcor Builders' early moves was to include a request for supplier-specific EPDs from the concrete and rebar suppliers in their bids. As this was a first for the Los Angeles market, it was not surprising that such EPDs were not yet available from most of the bidders. However, by making the delivery of these EPDs a condition of the bid award, the winning concrete supplier, National Ready Mixed Concrete Co., eventually secured these EPDs far in advance of project completion.

Since the EPDs were not available for material supplier mix comparisons during the bid selection process, the MKA team had to use alternative resources for comparative evaluations. Evaluations included comparing the amount of cement within competing supplier mix designs, comparing the carbon footprint of those mixes with other similar mixes within the EC3 database, and comparing the average carbon footprint of the electrical grid at the rebar mill locations of competing suppliers.



Through collaboration, the project team achieved significant carbon savings.

Once MKA had supplier-specific EPDs in hand, they could look back at the concrete mixes initially proposed and compare them to the final project mixes, which were more carbon optimized, thereby documenting the project's final design and construction reductions.

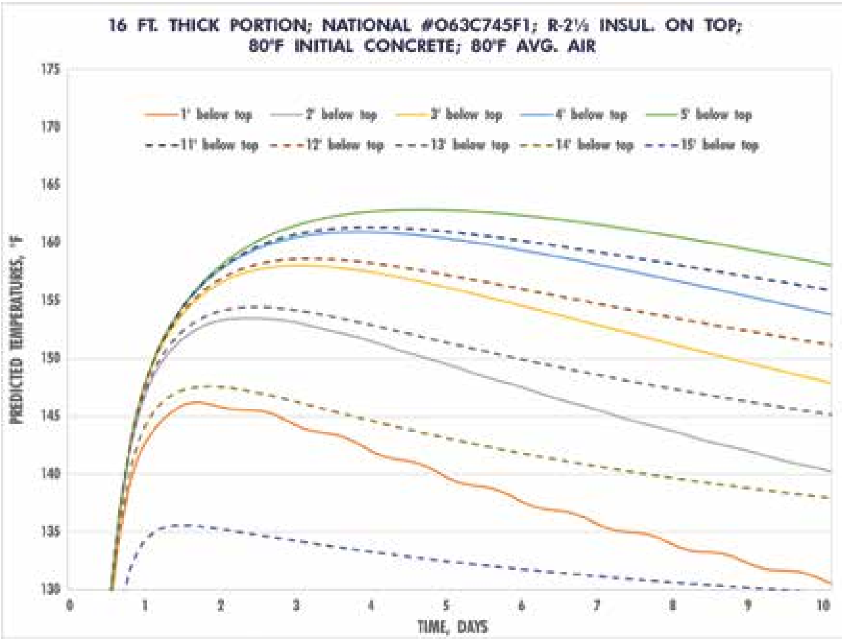
Asking for EPDs benefited this project and will impact future projects within the Los Angeles region that can now take advantage of these EPDs. It means increased transparency from the local concrete suppliers and a more straightforward ask when considering supplier-specific EPDs at early project stages for double-bottom-line comparisons.

Winning Concrete Mixes

Asking for EPDs and focusing on embodied carbon led MKA to early, collaborative discussions with Webcor Builders and National Concrete and an experimentation process to consider new mix options.

MKA noticed each supplier's "business as usual" mixes had a much higher cement content than were seen in other cities for similar mixes within the EC3 database. While MKA did not have the EPD data to compare embodied carbon values per mix, looking at the amount of cement within each mix provided a good indication of relative carbon impacts. National Concrete explained some of the challenges of why this was the case and offered solutions to reduce their mix cement contents if they could adjust their initially proposed mixes.

The discussions that followed focused on the local aggregate supply and its variability. The Los Angeles ready-mix suppliers were compensating for this variability with more cement to ensure they achieved



By creating a temperature-management plan, win-win scenarios were discovered.

the engineer's design strength requirements. And, since the project's low-carbon intentions were communicated early enough to give National Concrete time to react, and before finalizing the concrete supply bid awards, a strategy was agreed upon to change the aggregate supply and move to imported and higher quality 'Orca' aggregates shipped from the Pacific Northwest. This allowed National Concrete to achieve the same compressive strength (f'_c) of their mixes with less overall cement. As a result, the aggregate variability and the mix strength variability were reduced.

This was not the first project to use Orca aggregates in Los Angeles. MKA and others have previously encouraged its use for meeting modulus of elasticity and higher concrete strength requirements. But the decision to use Orca aggregates to reduce the 960 W 7th Street project's carbon footprint was new. It began by asking National Concrete what it could do to support lower-carbon goals, rather than telling National Concrete how to make its concrete. Finding ways to adjust the design criteria and promote collaboration between the design team and the contractor and their supply chain allowed everyone to come out ahead.

The carbon footprint of transporting Orca aggregates by barge down the West Coast proved to be a minor carbon impact compared to reducing cement content. This one intervention resulted in a 24% reduction in the project's total embodied carbon footprint. On the post-tensioned (PT) slab mixes alone, moving to the imported aggregate reduced that mix's carbon footprint by 47%.

Even more impressive, National Concrete achieved this goal at no additional cost to the 960 W 7th Street project. Imported aggregate is more expensive, but using less cement allowed National Concrete to be more cost-competitive, even with the more expensive aggregate. It was the win-win type of strategy the project team was targeting.

National Concrete now has on-demand mix design EPDs available for any of their projects. As these are created, they are also digitally uploaded into the EC3 national EPD database.

Hot-Weather Concrete's Challenge and Solution

Another way the project team and MKA collaborated with Webcor Builders and National Concrete involved alternative approaches to address hot-weather concrete for the mass concrete foundation pour, which occurred in August 2020 during the sweltering summertime heat.

Installation of chiller pipes within the mat to control heat during summer concrete placement was initially proposed. Although this process was used earlier during the construction of a high-rise tower located across the street, it came with a significant price, time detriments, and an embodied-carbon-intensive use of non-recoverable piping and refrigerant cooling.

Instead, MKA, Webcor Builders, and National Concrete arrived at a different solution. Step one was a temperature-management plan that included scenario planning for what might occur during the mat pouring and curing. Next, they established criteria for controlled use of ice within the mixes based upon temperatures on the day of the pour. Finally, an early mix-testing program evaluated lower cement mixes and the strength-gain impacts due to heat. In-situ mat thermocouples and pre-established in-situ cylinders for concrete strength testing validation, cured and then extracted from within the mat, were also included.

The most valuable strategy for eliminating the chilled piping system from within the mat involved evaluating each step of the material supply-and-delivery chain and looking for opportunities. Ultimately, nature lent a hand, as the team relied upon marine air to cool the materials prior to mixing them at the batch plant.

The batch plant was inland and in a much hotter location than the port, where the imported aggregates were first unloaded after being barged down the West Coast. By changing where the aggregates were stored (specifically, leaving them at the port instead of the batch plant until just before use) and under a covered area out of the sun, the batched concrete's temperature was lowered by 15 to 20 degrees. It was enough to eliminate the need for the chilled piping system, thereby reducing the mat cooling costs by two-thirds.

Conclusion

The lower carbon concrete mix strategies presented in this article prevented approximately 13,650 metric tons of verifiable equivalent carbon dioxide from being released into the atmosphere during the project's construction, based on comparing the first bid to final construction choices. That savings is equal to released carbon dioxide associated with 42,971 barrels of crude oil, or 2,962 vehicles not being on the road for one year.

Low-carbon alternatives and cost savings in high-rise construction do not have to be independent objectives. To achieve both, it takes an owner who incentivizes double-bottom-line decision-making and a collaborative engineer, contractor, and material supplier to step across traditional industry silos and agree to work together for common goals. When completed, the 960 W 7th Street project will be an exciting new addition to Los Angeles' urban core and an example of what is possible when teams agree to collaborate.▪

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