CONSTRUCTION DEVELOPMENT ENERGY ENGINEERING FEATURE SUSTAINABILITY

Life Cycle Assessment & Reducing Embodied Carbon in Construction

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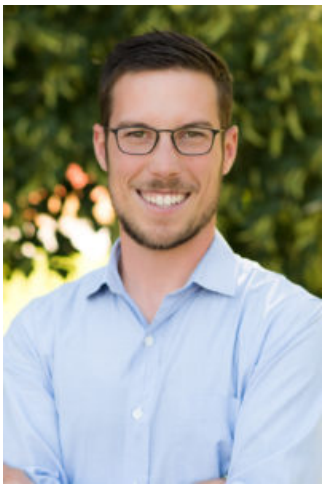
Group14 used a whole-building life-cycle assessment to reduce the embodied carbon on 6900 Layton at Belleview Station (Rendering: Gensler).



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In the last 20 years, the sustainable design industry has made great strides in building operations and energy efficiency. A combination of voluntary programs like the LEED green building rating system, combined with advanced code requirements specifically tailored to energy efficiency, have driven market transformation and a reduction in emissions across all sectors. As operational energy use — or the energy required for heating and cooling of buildings — shrinks as a result of energy efficiency codes and programs like LEED, the energy embodied in building materials has become the next frontier in the fight against climate change.

Embodied carbon is defined as the "sum of all the greenhouse gas (GHG) emissions resulting from the mining, harvesting, processing, manufacturing, transportation and installation of building materials." Annually, our built environment accounts for approximately 40 percent of GHG emissions and 11 percent of which accounts for the embodied carbon of building materials 1. This is a significant portion that has remained unchanged while our operational carbon continues to reduce over time.

In order to measure the embodied carbon of a building, engineers and designers use a tool called a Life Cycle Assessment (LCA). LCA measures energy and emissions involved in the production and use of a material in a building, tracking energy and material inputs from nature and emissions outputs to nature, including carbon dioxide, methane, and waste. As such, the LCA scope identifies the life of the product from raw material extract, its use, and to its end of life.

The primary ingredient to assembling the data required for an LCA are Environmental Product Declarations or EPDs. EPDs are independently verified data sets (following ISO standards 14040, 14044, and 21930) that assess the footprint of the manufactured building products and materials. EPDs are widely available and have become an industry standard primarily due to municipality requirements around the globe.

Building professionals have identified structural systems to be the largest source of embodied carbon. These systems include concrete, steel, and insulation:

Concrete is the most widely-used construction material in the world, and portland cement content in concrete is the largest source of embodied carbon. Many manufacturers are coming up with solutions to replace portland cement with recycled materials such as fly ash or slag (blast furnace byproducts).

Steel manufacturing practices can vary widely around the world. Most steel, particularly in China, is produced with low recycled content in plants that utilize outdated furnace technology requiring large amounts of energy input and produces huge amounts of CO2.

Insulation is an interesting example where we see embodied carbon and energy efficiency truly at odds. Many projects are turning to spray foam in order to meet ever increasing energy efficiency goals. However, EPDs show that spray foam typically has a huge embodied carbon footprint, which will likely never be fully paid back through operational energy efficiency gains.

Case Study:

Group14 Engineering has conducted numerous Whole-Building Life Cycle Assessments (LCA) to help reduce the embodied carbon of projects, with one recent example being Belleview Station, a 380,000-square-foot Class A, Core and Shell Office Building located in the Denver Tech Center.

Group14 was contracted to perform a Whole Building Life Cycle Assessment (LCA) for Belleview Station to help with their LEED v4 Gold pursuit. Early design analysis against a baseline building allowed the project team to tweak certain material specifications, such as the use of fly ash and reduction of portland cement in their concrete, to reduce their environmental footprint by at least 10 percent. As a result, the project diverted over 2,300 tons of CO2 from being emitted, which is equivalent to over a $115,000 social cost of carbon.

Conclusion

As our industry continues to see improvement in operating efficiency, the embodied carbon in our buildings is being revealed as a growing piece of the climate change puzzle. Group14's work with Life Cycle Assessments provides our clients with a measure of the carbon footprint of the materials in their buildings, and provides clear metrics to manage the reduction of embodied carbon in their projects. As the global economy becomes more carbon focused, we expect LCAs to be as commonplace as energy modeling is today.