

Case Study: Sustainable Concrete Cube Competition

A Journey into Low-Carbon Innovation in Temporary Works

In the autumn of 2024, a new kind of engineering challenge took shape—one that blended technical rigour with environmental responsibility. The Sustainable Concrete Cube Competition, launched by Tony Gee and the Institution of Civil Engineers (ICE) in collaboration with several UK universities, set out to answer a deceptively simple question: *Can we make concrete that's strong enough for temporary works, but with a much smaller carbon footprint?*

This wasn't just a theoretical exercise. It was a hands-on, two-part competition where teams of students, graduates, and professionals designed, cast, and tested concrete cubes. The goal? To strike the best balance between compressive strength and embodied carbon—a challenge that demanded creativity, collaboration, and a deep understanding of materials.

The First Round: Surrey Sparks Innovation

The inaugural event took place at the University of Surrey in September 2024. Six teams entered, each bringing a unique mix of academic insight and practical experience. Among them was Tony Gee's Esher Rail team, represented by Sophie Freeland, Rohan Sapkal, and Jacob Whalley.

After a week of curing, the cubes were tested. The winning entry came from a PhD team whose mix achieved an impressive 56–58 MPa of strength with just $\sim 150 \text{ kgCO}_2\text{e/m}^3$ of embodied carbon. Tony Gee's team wasn't far behind, earning recognition for the second-best strength-to-carbon ratio—a testament to their thoughtful design and sustainable approach.

Round Two: Hertfordshire and Material Exploration



By May 2025, the competition had grown. The second round, hosted by the University of Hertfordshire, welcomed seven teams and introduced three judging categories: strongest cube, most sustainable mix, and best presentation. This time, innovation took centre stage. The winning mix incorporated steel wool fibres and GGBS, showcasing how industrial by-products could enhance performance. Tony Gee's team experimented with coconut coir and oyster shell, achieving joint second place in strength with a cube reaching 33.8 MPa—a remarkable result given the unconventional materials.

Beyond the Cube: Industry Impact

While the competition itself was engaging, its ripple effects were even more significant. Led by Mark Scrivener and Natalie Cropp, Tony Gee began applying lessons from the competition to real-world



projects. Their work on carbon reduction in temporary works was presented at the Temporary Works Forum (TWf) in Manchester and used to develop guidance for Babcock's Devonport site.

This guidance introduced a framework for categorising interventions by carbon impact and project phase, helping engineers make informed decisions throughout the lifecycle of temporary works. The approach was well received, sparking interest in developing an industry-wide guidance note.

Learning and Engagement

One of the most powerful aspects of the competition was its ability to bring people together. Students, graduates, and professionals worked side by side, sharing ideas and learning from each other. Participants reported gaining valuable insights into low-carbon concrete design, feeling more engaged in their work, and being inspired to think differently about sustainability in engineering.

The event also served as a rich educational resource, offering real-world data and case studies for use in civil engineering and materials science courses. It encouraged experimentation, critical thinking, and a deeper appreciation for the environmental impact of construction materials.

Research and Data Value



The open-source data generated by the competition has proven valuable for both academia and industry. Researchers now have access to empirical results that can validate models and support comparative studies. Meanwhile, industry professionals can use the data to refine carbon calculators, inform specifications, and guide procurement decisions.

The competition has also helped demonstrate the viability of non-traditional materials, paving the way for their inclusion in future standards and guidance documents.

Conclusion

The Sustainable Concrete Cube Competition has shown that sustainability and performance can go hand in hand—even in temporary works. Through collaboration, experimentation, and a shared commitment to innovation, participants have helped push the boundaries of what's possible in low-carbon concrete design.

More than just a competition, it has become a platform for learning, research, and industry change. And as the conversation around net-zero continues to evolve, the lessons from this initiative will remain both relevant and impactful.

