

Semi-precast solution

A new semi-precast system with two-way spherical hollow void forming made from recycled plastic is quicker and is up to 35% lighter than traditional solid concrete slab construction.

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(Photos: Cobiax Technologies.)



In Britain, steel and wood structures are often chosen over concrete because they are lighter and considered easier to erect, as well as having less curing and drying time. Many modern prefabrication techniques are available in steel and wood. In mainland Europe it is quite the opposite.

Precast and semi-precast techniques remove critical work from site and reduce time and effort. Void-forming techniques lighten the structures. Where these structures truly outperform steel and wood is in their fire, acoustic, thermal, and resonance performance, and – if designed well – appearance.

Traditional concrete frames with simple flat slab construction are hard to beat for durability, thermal mass, reduced interfaces and being free of obstruction when finished. The problem is that concrete frames with flat slabs are not all that easy to build when compared to steel buildings or factory buildings available on the market today, and they are not without limitations.

Spans are relatively short before beams or thick decks with heavy reinforcement are required. Construction is slow and labour intensive. Although flat slab formwork is more efficient than other designs with beams or voids, the requirements are still significant. The buildings are heavy and they have a high carbon footprint. Good finishes require special effort to control.

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Cobiax Technologies and Hanson Building Products have been delivering Cobiaxdeck, a semi-precast solution with two-way void forming that significantly reduces the limitations of in-situ flat slab construction and introduces advanced and automated construction techniques to traditional concrete structures. The approach has been to remove the critical elements to factory production while maintaining or even improving the same structural integrity as traditional in-situ flat slab structures.

The semi-precast system with two-way spherical hol-

low void forming made from recycled plastic is quicker and up to 35% lighter than traditional solid concrete slab construction by strategically removing the non-working dead load of flat slabs, with no beams, while maintaining biaxial strength. In other words, the slabs can be designed to the existing standards of flat slab design with a much lighter void formed structure. This gives advantages of permanent formwork with factory production and finish, meaning that no finishing works are required on site. As a consequence, on-site labour is substantially reduced and construction time is being reduced by up to 40%, a huge critical factor for concrete frames.

Removing non-working dead load will of course have many benefits. Cobiax Technologies has been improving its product and techniques so that benefits are maximised. One of the big savings is steel, another is concrete. Reinforcement savings are 15% on average compared to solid flat slab; sometimes they are much higher. Concrete savings are approximately 35%. While concrete is cheap compared to most building materials, the carbon emissions generated are high. In a recent project of 6000m² of deck area, the direct carbon reduction through the use of Cobiax void formers is 184 tonnes, the equivalent of 60 car-years of CO₂ emissions.

Perhaps the best reward is in the life-cycle. Economic analysis that was done by David Weight of Currie and Brown for *Building Magazine* showed that over a 30-year period concrete structures were more cost-efficient than steel, primarily due to reduced energy requirements to heat and cool the building during use, due to the thermal mass benefits of the structure. The carbon footprint is also smaller. Even though there is a high carbon input at the build stage the energy savings over the life-cycle outweigh the input. Cobiaxdeck really improves this balance for the following reasons:

- The factory finish is ideal for exposed concrete soffits.
- Void-formed slabs actually outperform solid slabs because they more effectively match the use requirements. The solid slabs act as an energy sink, holding the warmth or cool in during the desired use period, whereas void-formed slabs act in reverse.
- Through void-forming CO₂ is significantly reduced during the build stage.

Cobiax has also developed techniques to deliver its void

Figure 1 far left: Towards zero energy concrete core activation at the University of Essen.

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Figure 2: Fairface soffits at Sheffield University.



Hanson Building Products



Figure 3 top: New profile void former for residential applications.

Figure 4 above: Speed of construction and no beams at the Newcastle College School of Art, Beauty, Sport and Leisure.

Figure 5 right: Fair face soffits and curved layouts at Huddersfield University.



forming benefits to traditional in-situ construction and has created new void formers that suit shorter spans and thinner decks. Although in this application the benefits of permanent formwork are now not gained, the void-forming benefits can be applied to existing technologies. Delivered as cages or as cassettes, the addition of the void-forming is very simple and cost savings are gained on the displacement of concrete, the elimination of reinforcement chairs and the reduction of reinforcement. Cobiax has also developed a low-profile void former that can be efficiently used in decks as thin as 200mm.

Going forward, thermal mass will become increasingly important in the choice of structural materials. Depletion of non-renewable fuels will greatly affect the cost and availability of energy to heat and cool. Zero energy or near zero energy designs cannot be achieved without thermal mass. One of the best places to achieve this is in the structural deck. It's all about balance, however. Concrete is a great way to deliver thermal mass but common cement comes from a fossil source itself and requires high energy to produce. Therefore it is essential to design these structures efficiently and use the thermal mass to its highest benefit.

In Britain, Cobiax and Hanson are on their fifth project where exposed soffits are being used for solar gain and night cooling passive thermal heating and cooling. Foremost of these has been facilities at Newcastle College, Sheffield University and Huddersfield University. In Europe, near-zero energy projects for the University of Essen and Novartis have been achieved with Cobiaxdeck solutions combined with active fluid thermal designs. The principle behind these designs is maintaining the core temperature of the buildings.

Concluding remarks

It's all about balance. The concrete is used efficiently and effectively by eliminating the non-working materials. Removing the critical production offsite to modern production facilities delivers the equivalent of traditional concrete frames in advanced and automated ways.