THIS IS **NOT THE END**

Circular economy thinking has enormous potential to reduce the carbon impact of the built environment, by keeping valuable resources in use at their highest value for as long as possible.

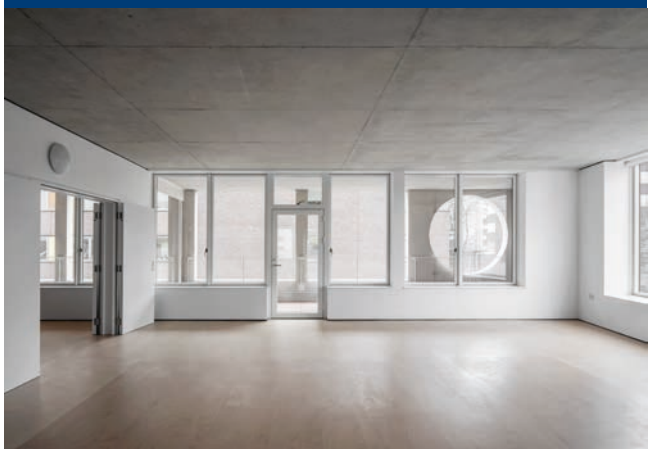
This is at the heart of the transition away from a linear "take-make-dispose" approach, and towards a model where consumption of raw materials is greatly reduced and waste is eliminated. In this world, designing concrete buildings becomes a balance between efficiency and flexibility. It means using the minimum amount of materials to achieve the desired goal, while looking towards the second, third or fourth lives of a structural frame and ensuring that it can be readily repurposed to fulfil new uses and shelter future generations. Through a net-zero lens, obsolete buildings are no longer problems to solve, but low-carbon resources, full of potential.

Elsewhere in this magazine, we've looked at how the concrete industry is lowering the embodied carbon of its products (pages 4-9), and supporting its customers to make the most carbon-efficient choices (10-13). This article is about how we keep those resources in circulation for as long as possible, and how we can derive the greatest value from them when they finally reach the end of their lives.

RETAIN

Designing for longevity

The best way to keep a concrete structure at its highest value is to reuse it. Designers can facilitate this by thinking about the future lives of their buildings when they are designing their first iterations, and making them adaptable for other uses. This might mean considering optimal spans, loads, grids and floor-to-ceiling heights, and making partitions removable so that internal layouts can be reconfigured. Creating an as-built digital twin will also be invaluable for future designers.



Photos: Johan Dehlin (left); Laing O'Rourke (below)

Right At Apparata Architects' A House for Artists, soft spots in party walls and external circulation allow flats to be completely reconfigured
Below right The deep facade of Henley Halebrown's 100 Kingsland Road helps to conceal the residential function, improving future flexibility
Below Lifschutz Davidson Sandilands' Hoxton Southwark features long spans and open spaces, enabling it to switch between hotel, residential and office functions

Photos: Paul Riddle (right); Nick Kane (far right)

Photo: Skanska

Left Derwent's Featherstone Building in London has a demountable glass-reinforced concrete facade fixed to its concrete frame, so that it can be easily removed and replaced in the future

Below left The Hylo Building, where structural engineer AKT II added 15 storeys to a 1960s office block, reusing much of the existing concrete structure

RECYCLE

Designing for disassembly

Disassembly offers an alternative route for keeping structural elements in use for as long as possible. For some types of building, precast systems that are designed to be demountable will enable the components to be reused again when they have fulfilled their first function. Another route to circularity is to retain the building structure, but design all the layers attached to it so that they can be disassembled, replaced and potentially used elsewhere.

Renewing and adapting

Reusing existing buildings is not only extremely efficient in terms of embodied carbon, it also preserves their social and cultural value, as well as the fabric of our towns and cities. Existing buildings may have been designed for a lifespan as short as 25 years. But concrete structures can last for well over a century, and they may be able to support much greater loads than originally intended.

Structures may be renewed and reused for the same purpose – with shorter lifespan elements such as facades, building systems and internal finishes upgraded to meet modern performance standards. Or the original structure and foundations can become the base for a larger building – with the benefit of today's digital tools, designers are identifying spare load-bearing capacity that can help to meet higher demand in growing cities, without expending new resources.

Below Laing O'Rourke recently trialled its M Frame system as part of a kit of parts for housing and schools. The floor slabs require no structural topping and connections are made with steel bolts and removable low-strength grout

End of life

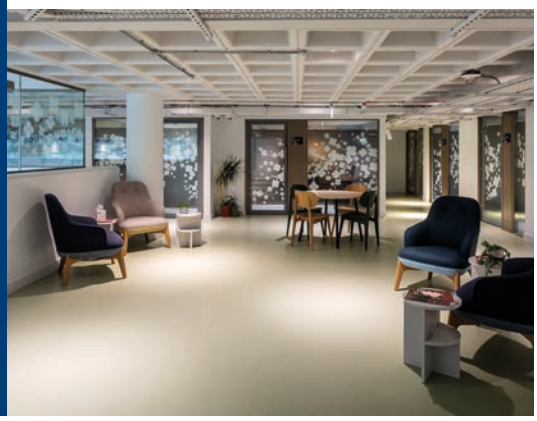
At the end of its serviceable life, concrete can be recycled ad infinitum as a low-carbon resource. In the UK, virtually all concrete from demolished buildings is recycled – whether as aggregate within new concrete or hardcore for load-bearing surfaces, it goes on to have a second useful life often even longer than the first.

Carbonation is another important element of concrete's lifespan. All concrete absorbs CO2 from the air over time, storing it permanently within its chemical structure. Crushing concrete increases the rate of absorption. Research is underway to maximise this carbon-sequestration potential in both new products and in recycled concrete.

New technologies are also in development to more effectively separate old concrete into its component parts of aggregate and cement, and reprocess them into a new source of materials – holding the promise of yet another way of closing the loop.

Round again to pages 4-9

Below Page/Park's Health Centre at the University of Edinburgh. Original 1970s features, such as the coffered slabs, have been exposed and celebrated



Photos: Keith Hunter Photography (left); Jan Friedlein (above left)