



Footbridge using reinforced-concrete blocks from walls of a building being renovated

Building out of concrete, but without pouring concrete

EPFL researchers have built a footbridge prototype using reinforced-concrete blocks from walls of EPFL researchers have built a footbridge prototype using reinforced-concrete blocks from walls of a building being renovated. The blocks were cut into individual pieces on site and assembled into a prestressed arch. This project, which marks the first time concrete has been reused in this way, is part of an initiative to substantially shrink the construction industry's carbon footprint by adopting a circular economy approach.

"People are hesitant to reuse concrete due to a variety of concerns," says Corentin Fivet, a tenure-track assistant professor at EPFL and head of the Structural Exploration Lab (SXL) within the Smart Living Lab. "But we wanted to show that those concerns are largely unfounded. Blocks of concrete that are selected for reuse are just as reliable and useful as new blocks." Fivet has been studying potential applications of the circular economy in the construction industry for years. His team at SXL, which is part of EPFL's School of Architecture, Civil and Environmental Engineering (ENAC), initially looked at metal and now also turns its attention to concrete. This project in particular involved building a 10m-wide footbridge out of 25 blocks of concrete taken from walls destined to be torn down. The project engineers have now finished load-testing the new structure.



Corentin Fivet

Tenure Track Assistant Professor EPFL,
Structural Exploration Lab (SXL)

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Jan Brütting, a recent PhD graduate from SXL who initiated this project, conducted this research as part of his postdoc along with fellow EPFL postdoc Maléna Bastien Masse. For concrete to be reused effectively, new design methods are needed that are based on exploiting existing concrete sections, rather than the conventional approach of pouring fresh concrete in line with each project's specifications. The catch is that the properties of existing sections can vary and are not always known ahead of time. To help engineers employ these new methods, SXL recently developed a computer program that automates the process of selecting reclaimed elements from a given stock and minimizes a new structure's carbon footprint.

Proving its worth in practical applications

In practice, builders are often reluctant to reuse concrete due to the perceived additional risk. But the SXL team believes there are only benefits to be had. That's where their project of building a footbridge prototype comes in: to demonstrate, quickly and efficiently, that the procedure is safe and relevant. "We gave ourselves two months to find a source building in the region and a demolition company that would be interested in working with us," says Bastien Masse. That company turned out to be Diamcoupe, which had been commissioned to renovate a building erected less than 10 years ago; this renovation site was the perfect opportunity to source viable blocks of concrete. "We asked Diamcoupe to cut the concrete into the sizes we needed and to drill holes through them for our prestressing cables. These cables were provided by Freyssinet and used to build the arch," she adds.

The engineers were thus able to obtain 20cm-thick concrete blocks for the footbridge. They added mortar in places to smooth out the slight differences in dimensions, which are inevitable anytime objects are reused. "Arches are actually the ideal structure for repurposing concrete blocks, since the material is only subject to compression forces," says Brütting.

New horizons oriented towards the circular economy

Fivet explains: "Most buildings in Switzerland are made out of concrete, and producing this raw material accounts for 7% of CO₂ emissions from anthropogenic activity. What's more, concrete makes up 50% of demolition waste. When the material reaches its end of life, it's at best broken down into gravel or granulate to create recycled forms – but that consumes a lot of energy. If we were instead to cut up concrete blocks and reuse them, we could both prevent the need to produce more concrete and eliminate the inert waste. The carbon emissions from this process wouldn't necessarily be zero, but they would be drastically reduced. We would delay the need to downcycle obsolete concrete." Under this circular economy approach, demolition companies – which until now have been at the end of the value chain – would also become producers, kicking off a new cycle.

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Project pictures: EPFL. Profile picture: STEMUTZ.



The project in brief

Titel

RE:CRETE Reuse of Reinforced Concrete Elements for load-bearing purposes

Direction

Corentin Fivet

Team

Maléna Bastien Masse, Jan Brütting, Julie Devènes, Célia Küpfer

Domain

Construction technologies

Group

Structural Xploration Lab (SXL, EPFL)

Partners

Diamcoupe, Freyssinet, Bridgology

Start-End

2020-2024

Keywords

Circular Economy
Reuse

Website

www.smartlivinglab.ch/en/projects/recrete