

RECREATE



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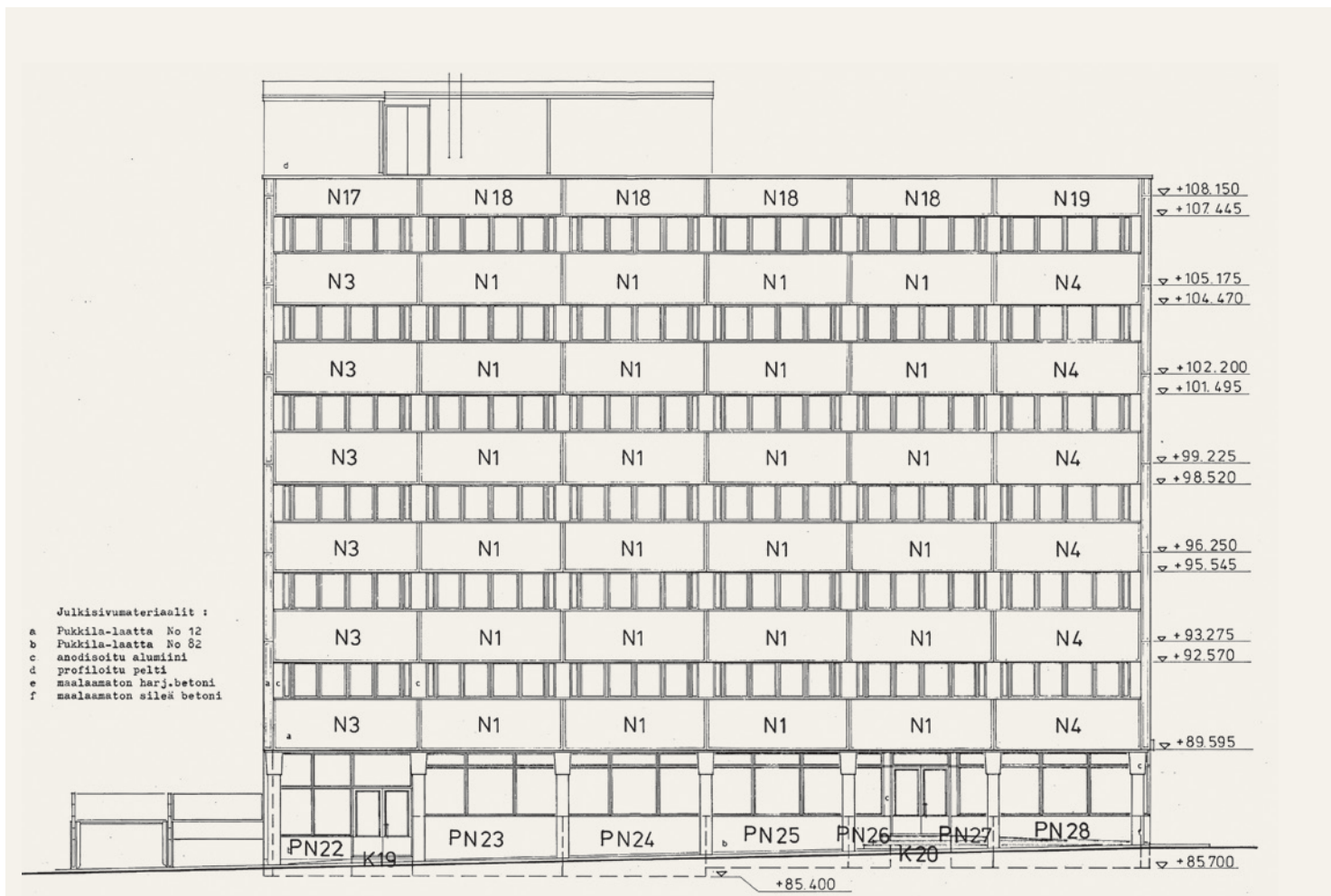
DECONSTRUCTION AND REUSE INSTEAD OF DEMOLITION AND WASTE

Architecture's footprint on the planet is not so easy to undo. However, some cases allow it. This research/action project looks for those concrete buildings that can be disassembled – instead of demolished – so that its parts can be recovered in search of future reuse. Thus, what once was pure waste can have a new life.

Proceso de deconstrucción del edificio donante alemán. Los dos primeros pisos aún estaban ocupados durante la deconstrucción y continuarán siendo utilizados después de que se eliminen los tres pisos superiores. /
Deconstruction process of the German donor building. The first two floors were still occupied during the deconstruction and will continue to be used after the top three floors are removed.

Keywords Concrete
Disassemble
Reuse
Project
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Elevación del edificio donante finlandés en Tampere. / Elevation drawing of the Finnish donor building in Tampere.

Beginning in the 1980's, Germany, Finland, the Netherlands, and Sweden have embarked on various pilot projects relating to the reuse of prefabricated concrete elements. The experience gathered from these small-scale prototypes is now being pooled, shared within the EU, and developed further through the international research project ReCreate: Reusing precast concrete for a circular economy (European Union's Horizon 2020 research and innovation programme grant agreement no. 958200).

The built environment must constantly be adapted to new needs and changing lifestyles. Unfortunately, it is usually both easier and cheaper to demolish a building and treat old building material as waste than to see it as a resource that can be reused in new projects. This 'landfill' mentality is the result of a linear economic model that relies on raw materials being inexhaustible and products being produced, consumed, and discarded at a rapid rate to create the need for new products. Consequently, the building and construction sector is the largest consumer of virgin materials and a huge contributor to the global carbon footprint. For example, cement production alone is accountable for 5-8% of all global carbon emissions and 450-500 million tons of construction and demolition waste is generated annually in the EU, a third of which is concrete.

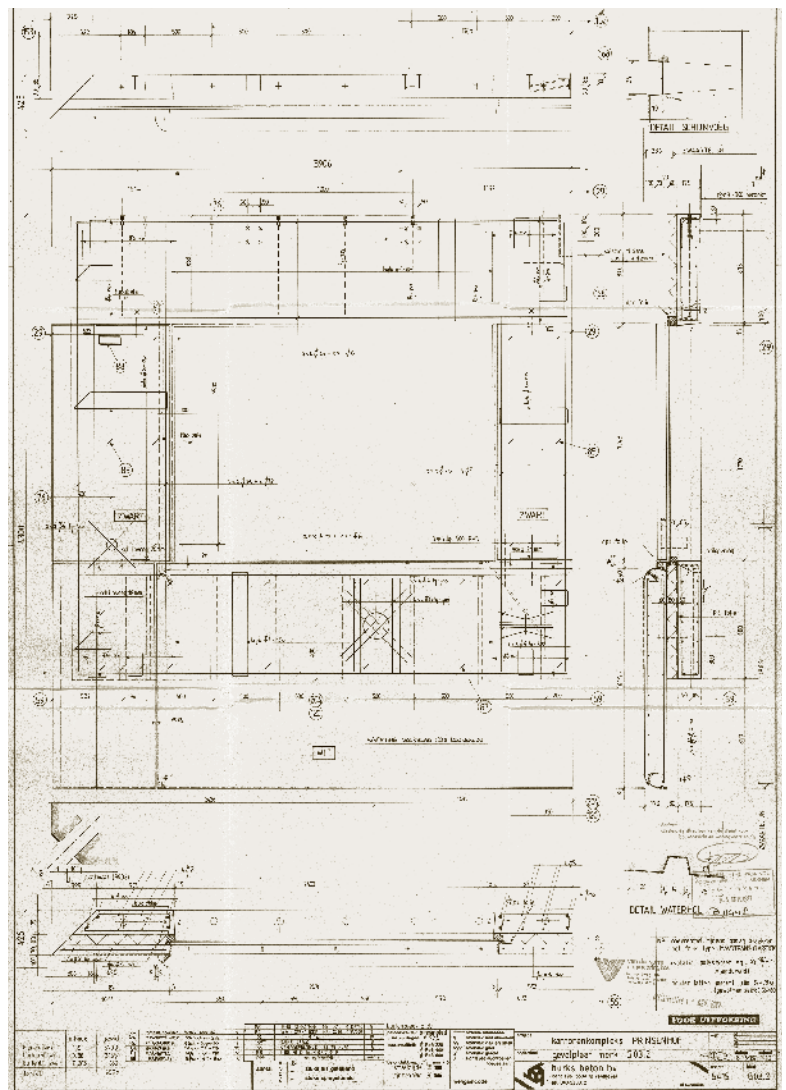
The ReCreate project investigates another avenue than demolition and waste: that concrete elements can be deconstructed and reused in their entirety in new constructions. Frames of precast concrete elements that were initially prefabricated to be easily assembled on site also open the possibility of a reverse process where the building elements can be disassembled and reused instead of being demolished.

Background and Methodology

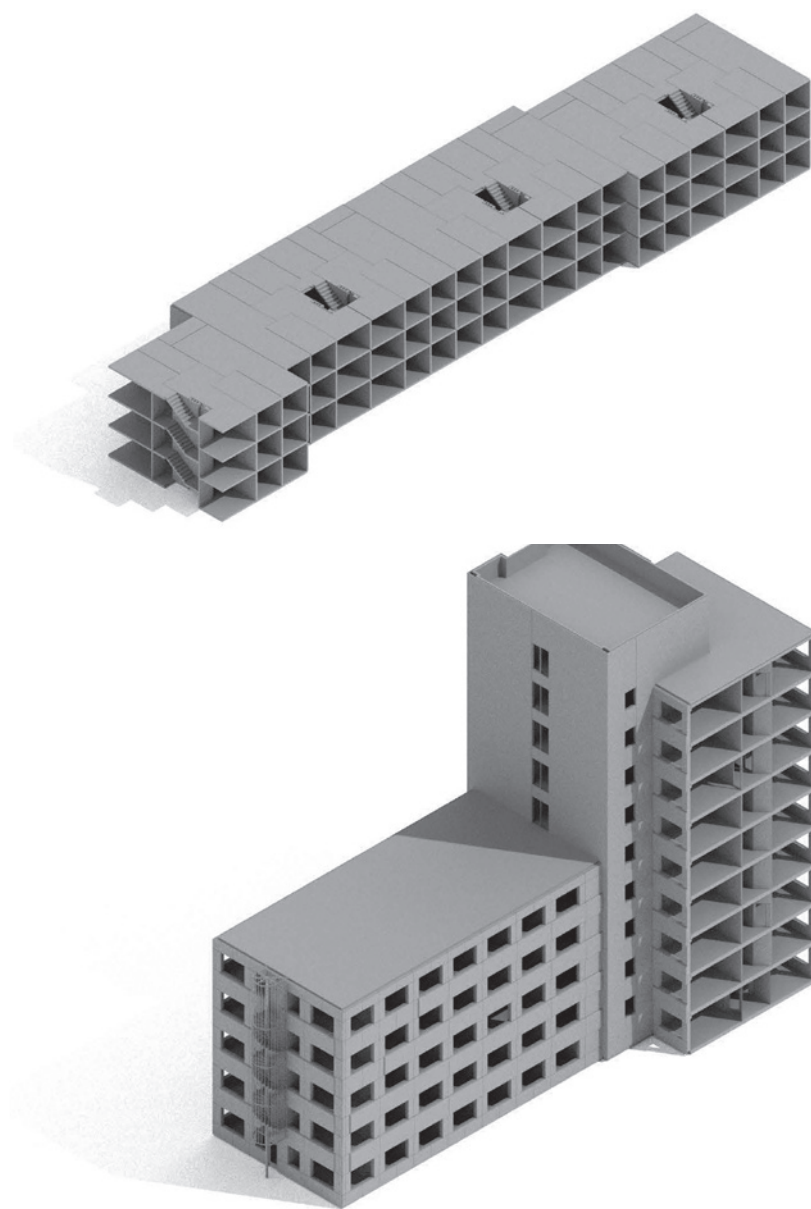
Prefabricated concrete structures can be found across the globe: in commercial, industrial, institutional, and residential buildings of all sizes. As the society around them has changed drastically compared to when they erected, many of these structures are approaching the end of their economic or functional lifespan. However, the lifespan of the concrete they are made of is far from over. These prefabricated and primarily load-bearing elements can have significantly longer lifespan if they remain protected from environmental agents and frost, in other words, are properly maintained and cared for in another construction cycle.

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Dibujos originales de uno de los elementos de la fachada en Prinsenhof, el edificio donante para el piloto holandés. / Original drawings of one of the façade elements in Prinsenhof, the donor building for the Dutch pilot.



Los cuatro edificios donantes para los pilotos ReCreate en Finlandia, Alemania, Suecia y los Países Bajos. / *The four donor buildings for the ReCreate pilots in Finland, Germany, Sweden and the Netherlands.*

The methodology of ReCreate is multi- and interdisciplinary. Acquiring the necessary historical information on the potential urban mines (prefabricated building stocks) and their details draw from an archival and historical research approach but relies on digital data handling and visualization to store, process, and share this information. The technical part of the project takes advantage of technologies developed for other fields and applies them in the context of deconstruction and reuse in order to demonstrate and consolidate an integrated and cost-efficient value chain that can become profitable at an industrial scale.

The methodology further draws from the research of human and industrial processes and their optimization with the help of smart digital tools for surveying, tracking, and modelling. Technological solutions specific to deconstruction and reuse, such as equipment for neat disassembling and retrofit connectors, are innovated and engineered. Underlying the project's technological focus is an understanding of the business sectors as networks of actors, both companies and individuals, and the values and beliefs that influence their actions.

Pilots: Germany, Finland, Netherlands, and Sweden

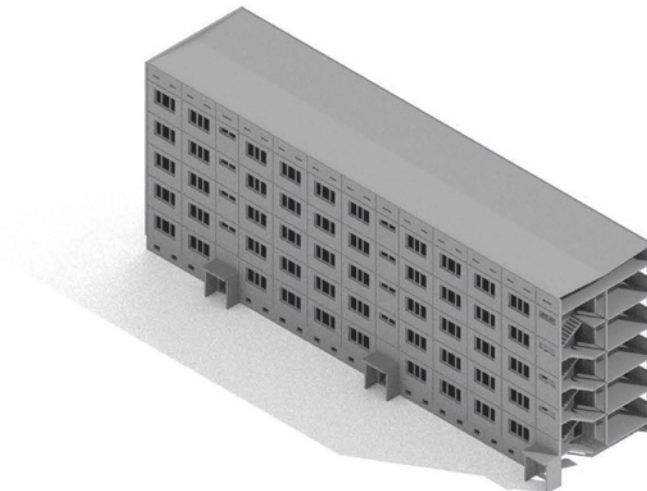
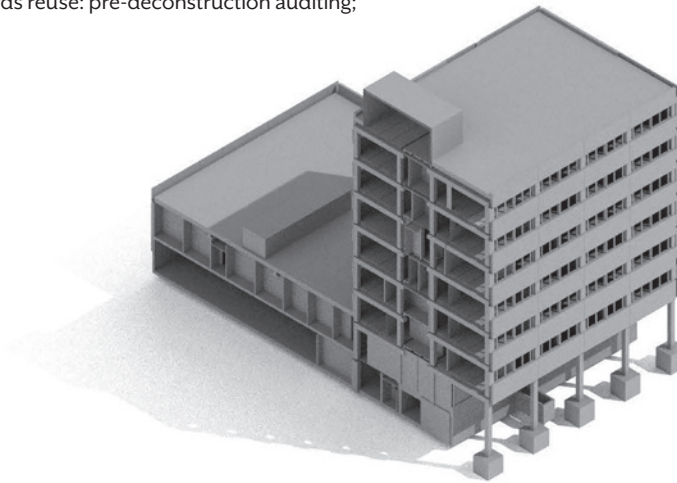
Four pilot donor buildings are currently in different stages of the step-by-step process towards reuse: pre-deconstruction auditing;

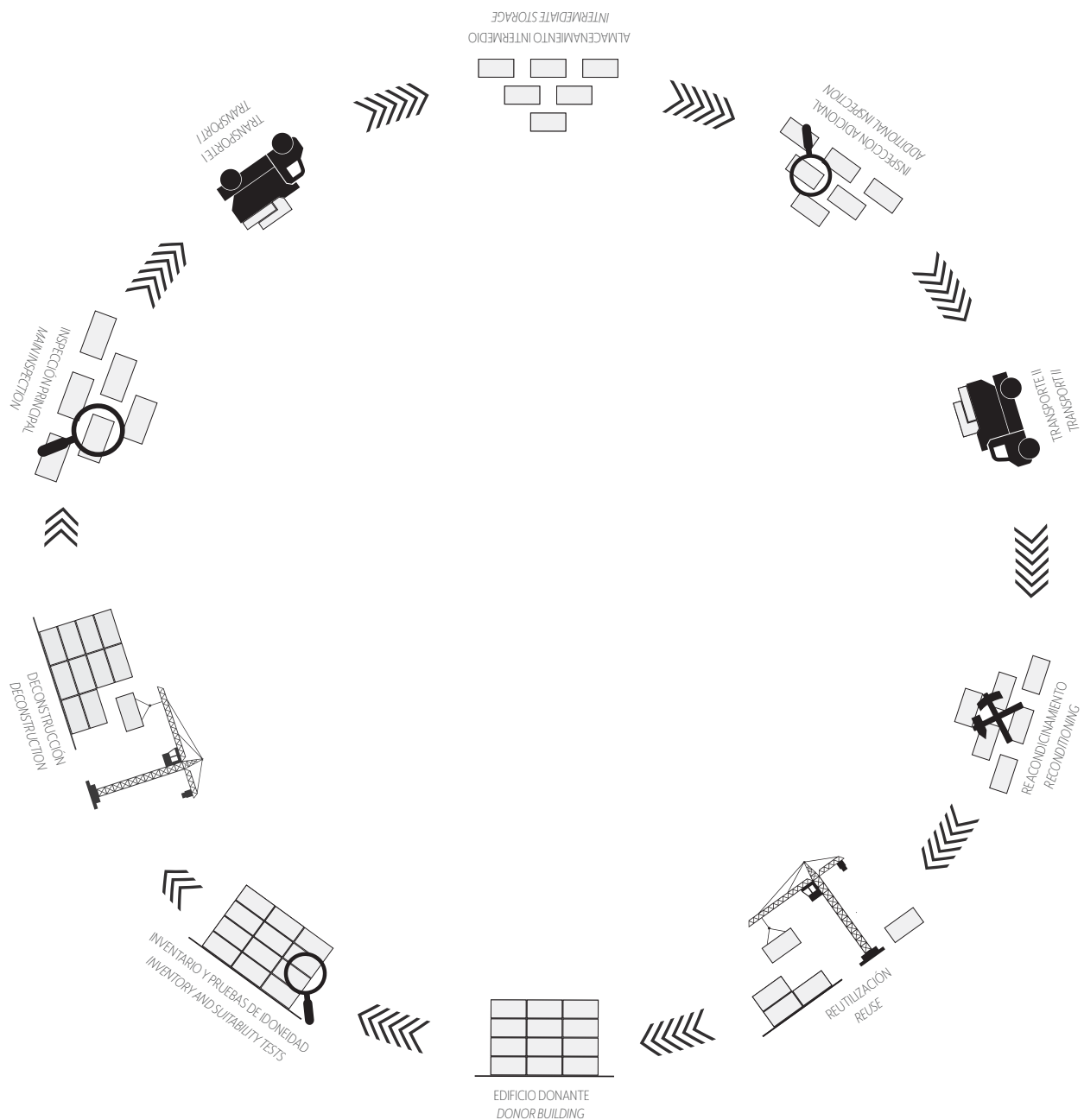
deconstruction; storage; processing and quality control; transport; and finally, reassembly.

The German pilot consists of a partial dismantling of 36 residential units in two floors and with six entrances. The dismantling takes place while the rest of the building remains occupied, so the affected tenants have to leave the apartments during the dismantling work. The (re)construction of a youth center in Hohenmölsen with 800 m² GFA is planned for the end of 2023. In the course of the new construction, up to 150 dismantled concrete elements are to be reused.

The dismantling is implemented with the help of two work teams (one in the building and the other on the ground), a crane driver and an excavator driver. The concrete elements are loosened from the building structure manually and also with mini excavators lifted by the crane, and carefully laid down. Elements that will not be reused are pre-crushed with a hydraulic pulverizer.

The donor building of elements for the Finnish reuse pilot is located in the City of Tampere, the third largest city in Finland, where ReCreate's coordinator Tampere University is based. The donor structure is a 7-floor office building with circa 3,000 m² GFA,







Pruebas de carbonatación en muestras del edificio donante finlandés. La carbonatación juega un papel importante en la corrosión del refuerzo y, por lo tanto, es un buen predictor para la vida útil restante de un edificio de hormigón. /
Carbonation tests on samples from the Finish donor building. Carbonation plays an important role in the corrosion of the reinforcement and is therefore a good predictor for the remaining service life of a concrete building.



El edificio donante finlandés antes de la deconstrucción. / The Finnish donor building before deconstruction.

built in the early 1980s, with a fully prefabricated concrete frame: columns, beams, hollow-core slabs, and sandwich exterior panels. The building has been scheduled for removal due to land use change from a commercial to a residential function. The plan in ReCreate is to deconstruct the prefabricated building frame, mainly focusing on the columns, beams, and hollow-core slabs, which have been protected from weathering by the building envelope.

The donor pilot in the Netherlands is called Prinsenhof A. It is an office building located in Arnhem city center. The building has a low-rise part (five stories), a high-rise part (nine stories) and a core that connects them. The total GFA is approximately 7,400 m². The building is owned by the province of Gelderland and was constructed in 1986. The structure consists of hollow-core slabs spanning 13 m between precast concrete load-bearing façade elements.

The precast elements will be used in the construction of two new buildings. About 80 hollow-core slabs will go into a new sporting center of the city of Arnhem. The remaining hollow-core slabs and the façade elements will be used for a new knowledge center for circular building and disassembly by Lagemaat.

The Swedish pilot used prefabricated concrete elements from the Drottninghög neighborhood, where the municipal housing company Helsingborgshem owns a majority of the dwellings. The building from which the exhibited elements came was located at

Kvarteret Drottninghög Västra 1. The apartment building, built in 1967-68, had a total of approximately 2,250 m² and contained 24 apartments. The structure was a bookshelf frame with transverse load-bearing inner walls of prefabricated concrete elements from the factory in Helsingborg.

The housing area Drottninghög is undergoing a 20-year process of regeneration and revitalization. Some original housing blocks from the 1960's have already been demolished and some more are under review in the planning process. The ambition is to promote the careful reuse of concrete elements from the original housing in new future housing.

Through the development of these four pilots, ReCreate aims to demonstrate the feasibility and profitability of reuse. This requires developing the technical expertise for reuse and the integration of technologies and workflows to facilitate the integration of different parts of the supply chain towards a circular economy. **ARQ**



Elementos de hormigón deconstruidos del edificio donante holandés. / Concrete elements deconstructed from the Dutch donor building.



Construcción del piloto sueco con elementos reutilizados de tres donantes diferentes. / Construction of the Swedish pilot with reused elements from three different donors.

RECREATE

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Socios académicos / Academic partners: BTU Brandenburg University of Technology, DE; Tampere University, FI; Eindhoven University of Technology, NL; KTH Royal Institute of Technology, SE

Socios de proyectos / Project partners: BTU Brandenburg University of Technology (DE); Tampere University (FI); Eindhoven University of Technology (NL); KTH Royal Institute of Technology (SE); ecosoil Ost GmbH (DE); Dreetz und Partner (DE); P. Jähne Ingenieurbüro GmbH (DE); LIKE Oy Arkkitehtistudio (FI); Consolis Group (FI); City of Tampere (FI); Ramboll Finland (FI); Umacon (FI); Skanska (FI); IMD Structural Engineers (NE); Lagemaat Design & Construction (NL); Helsingborgshem (SE); Croatia Green Building Council (HR); TNO (NL); Circular Structural Design (DE)

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Architect and Associate Professor in Architecture at the KTH School of Architecture in Stockholm, Sweden. He is currently teaching a master's level housing studio, participating in European and regional research initiatives, and conducting housing research. During 2021-2025, Stenberg is leading the Swedish part of ReCreate, an EU Horizon 2020-funded research project that focuses on the reuse of prefabricated concrete elements that were not intended for disassembly.



El proyecto ReCreate en la exposición "Cycles" (comisarios Pamela Prado, Pedro Alonso), parte de Terra, Trienal de Arquitectura de Lisboa 2022. / *The ReCreate project at the "Cycle's" exhibition (curators Pamela Prado, Pedro Alonso), part of Terra, Lisbon Architecture Triennale 2022.*

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Architect and PhD candidate at the department Civil and Architectural Engineering at KTH in Stockholm. His current research focuses on developing design-to-manufacture workflows for robotic fabrication with concrete, for the development of optimised 3D printed concrete elements. He is part of the Swedish team of ReCreate, working on the integration of digital fabrication and reuse as a sustainable alternative for concrete construction.

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As the associate professor (tenure track) for sustainable renovation at the Tampere University School of Architecture, Satu Huuhka leads the ReCET research group (Renovation and Circular Economy Transition). She has 14 years of research experience into all aspects of circular construction, particularly on reusing existing assets – whole buildings and their components and materials. Her mission is to catalyse the circularity transition in the construction sector, and ReCreate is one of the many projects she has initiated and lead, in Finland and internationally.