

Digital Innovation for a Circular Built Environment

Prof. Dr. ir. arch. Catherine De Wolf, ETH Zurich

This research presents matching reused architectural materials & projects through digitalization for circularity. Building design projects are often complex, multi-variant problems addressed by numerous parties working in separate silos. The construction industry can learn from other sectors about adopting digital technologies and circular strategies. Automating the reuse of materials in architecture can fill this gap by connecting actors across the value chain. To take on this challenge, an interdisciplinary team of civil engineers, architects, computer scientists, environmental engineers, and industrial ecologists is needed to conduct research in two main areas: digitalization and circularity. We combine tools such as building-information modeling (BIM), computational design algorithms, Light Detection and Ranging (LiDAR) scanning, digital fabrication, machine learning (ML / AI), and computer vision to logistically coordinate the value chain across diverse actors, so that we can use buildings, instead of the earth, as material mines and depots. We test our research outcomes in collaboration with practitioners on prototypes as well as real-world buildings and cities.

To fully upscale the reuse of materials from the existing building stock, we need:

1. Data to predict when and where materials are available on the urban scale ;
2. New detection methods to scan and inventory materials on building scale,
3. Smart disassembly protocols for deconstructing rather than demolishing buildings,
4. Distribution technologies for tracking, tracing, and trading materials, and
5. Computational design algorithms and digital fabrication techniques helping design and build with reused materials more efficiently.

The value chain of the construction industry needs to be completely disrupted in order to transition from a linear to a circular economy model. The dome case study of the Chair of Circular Engineering for Architecture illustrates this disruptions through the digital technologies mentioned above.