

Concrete reuse

AFGC

Prof. Numa Bertola

04.12.25



Environmental impacts of the built environment

40 % of emissions

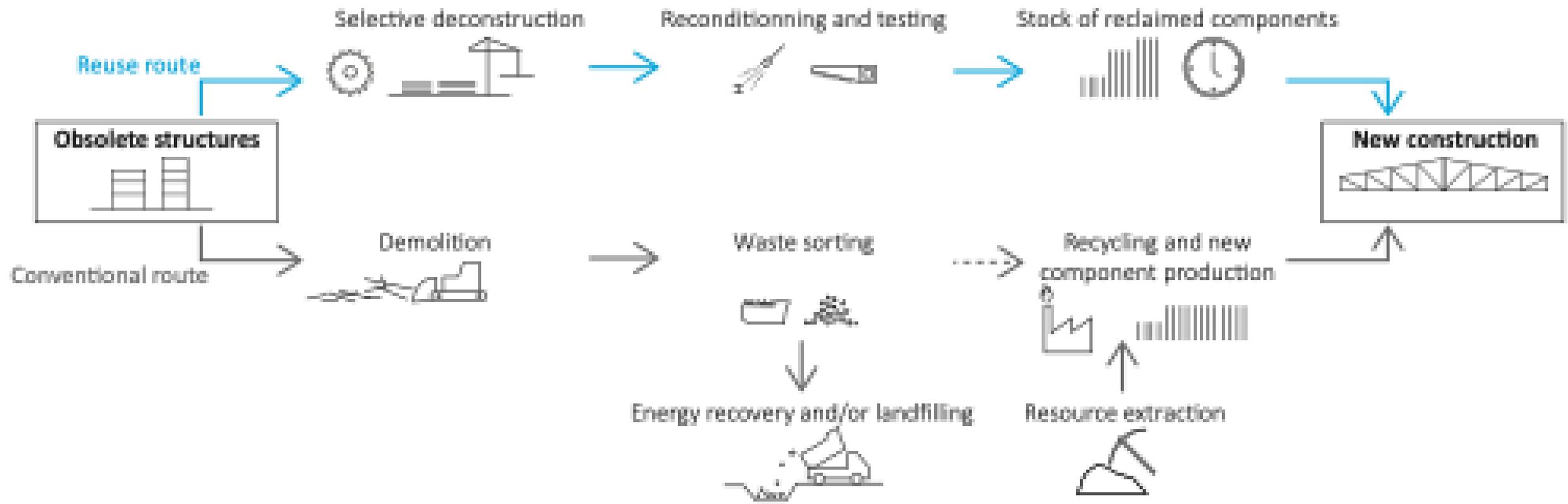
40 % of energy

40 % of resources

40 % of waste

Reuse tackles all concrete environmental impacts





Recycling vs reusing concrete

RECYCLING



≠

REUSE



50+ applications of reused concrete

Mostly prefabricated elements

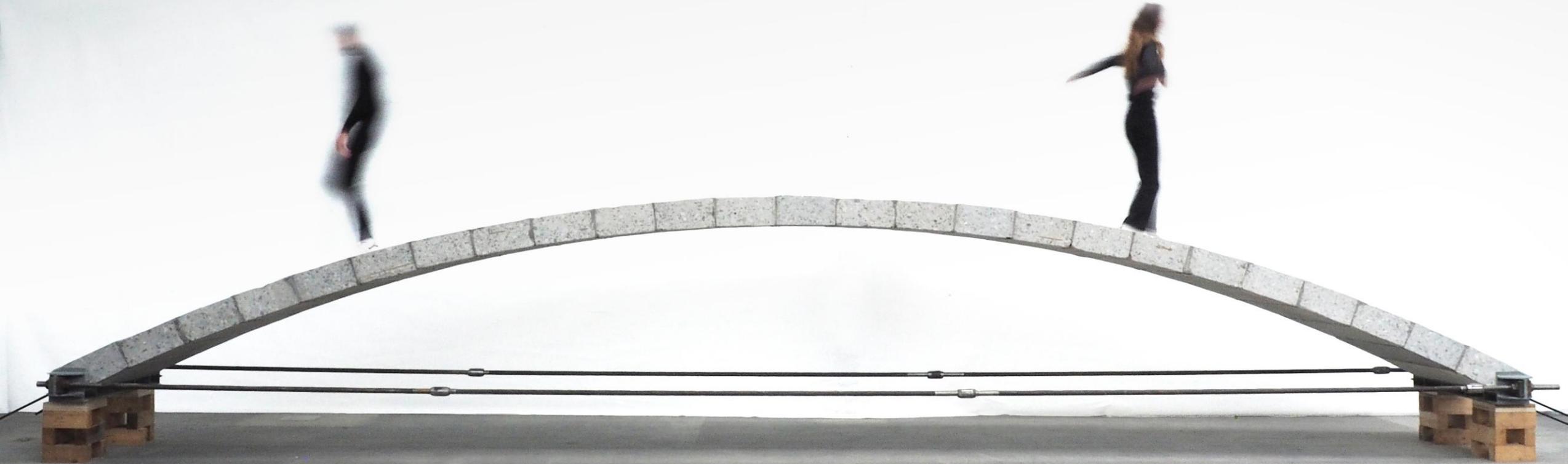


Küpfer, Bastien-Masse & Fivet, 2023. Reuse of concrete components in new construction projects: Critical review of 77 circular precedents. Journal of Cleaner Production



Eklund et al. 2003

Reusing blocks - Re:Crete footbridge



Devènes, Brütting, Küpfer, Bastien-Masse & Fivet (2022). "Re: Crete—Reuse of concrete blocks from cast-in-place building to arch footbridge". Structures.

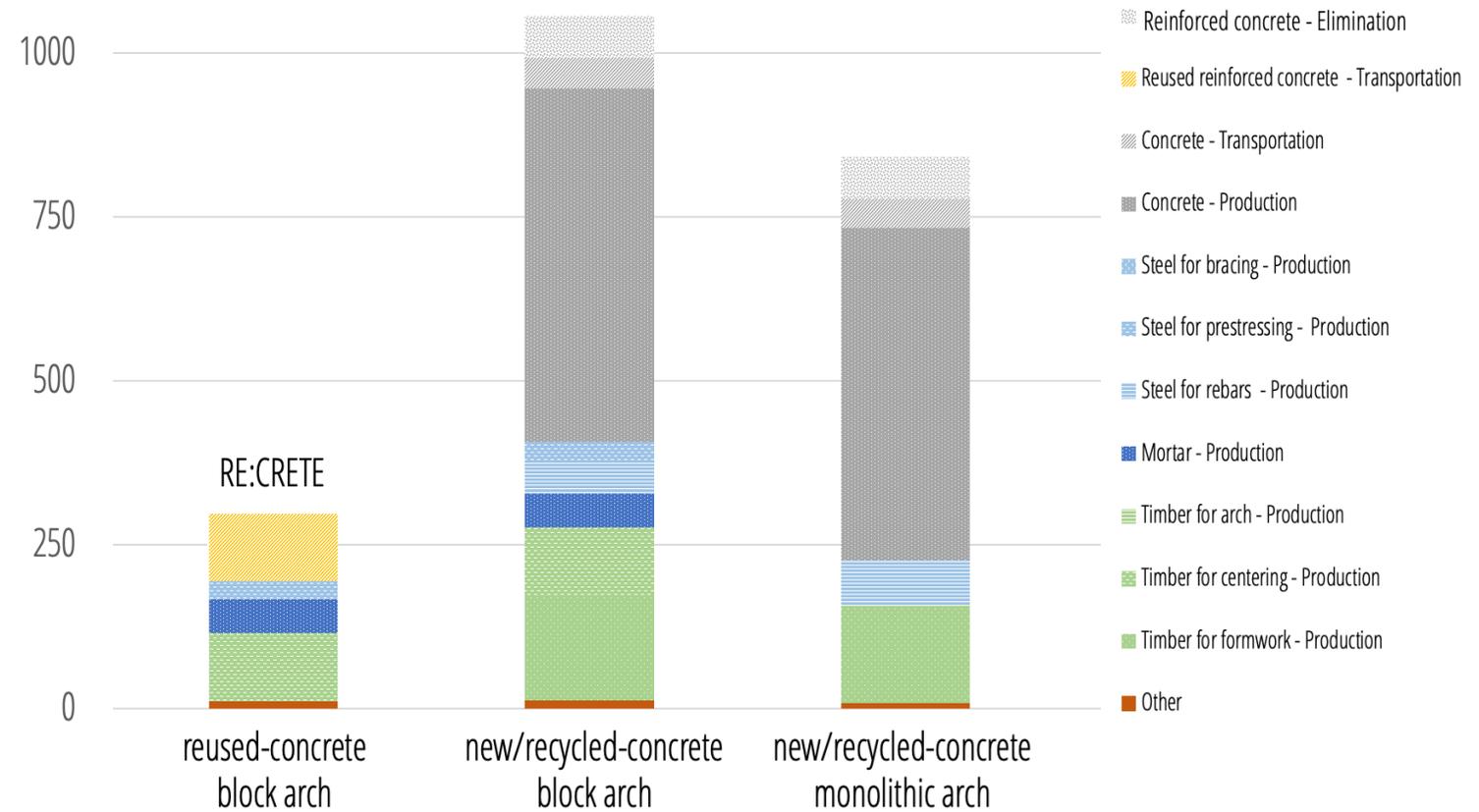
Concrete blocks





© EPFL

Upfront embodied carbon (kgCO₂e)

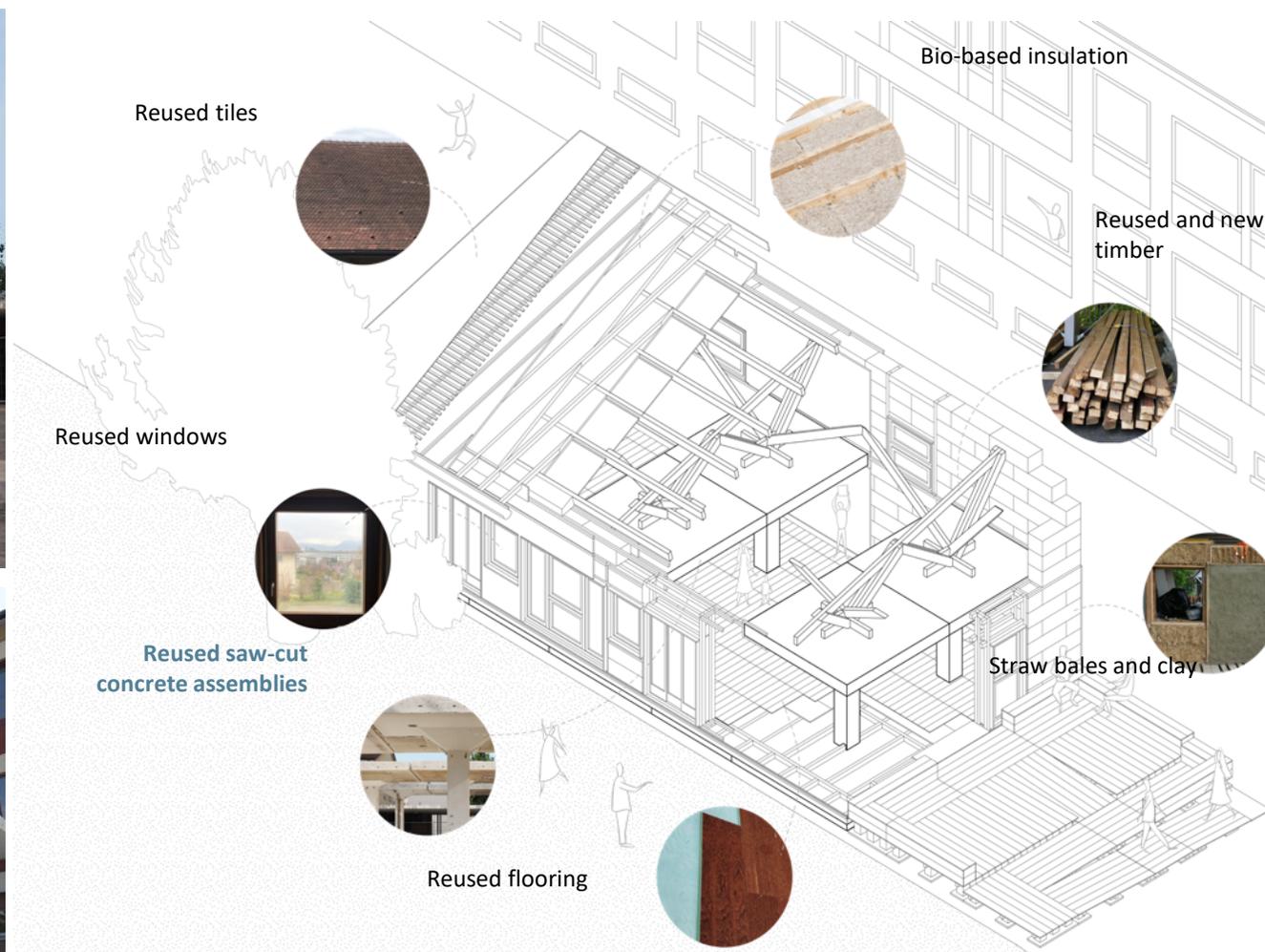


Re:Crete footbridge





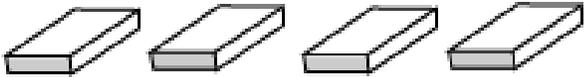
© P.-J. Renau



rebuilT association. First phase: main academic support: EPFL/SXL, civil eng.: 2401

Küpfer, Bastien-Masse, Grangeot, Meier, Graulich, Pathé & Fivet, 2024. From soon-to-be demolished mushroom column slabs to reused reinforced concrete saw-cut assemblies: the case of the rebuilT pavilion. World Sustainable Built Environment Conference.

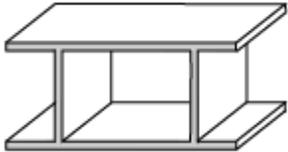
Cast-in-place concrete reuse approaches



Blocks

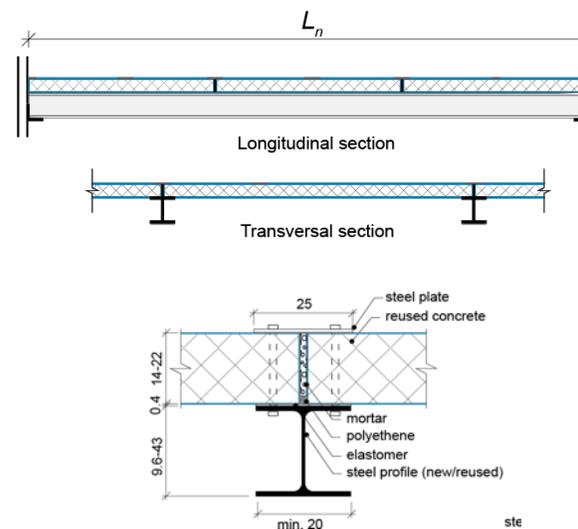
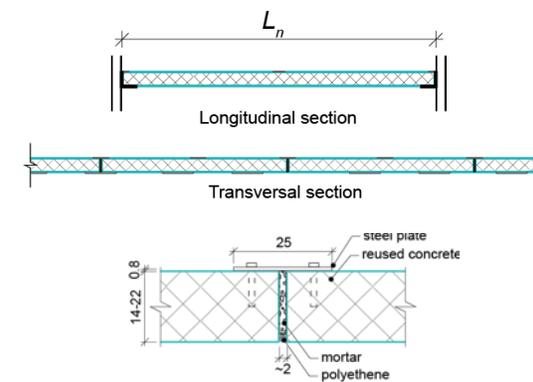
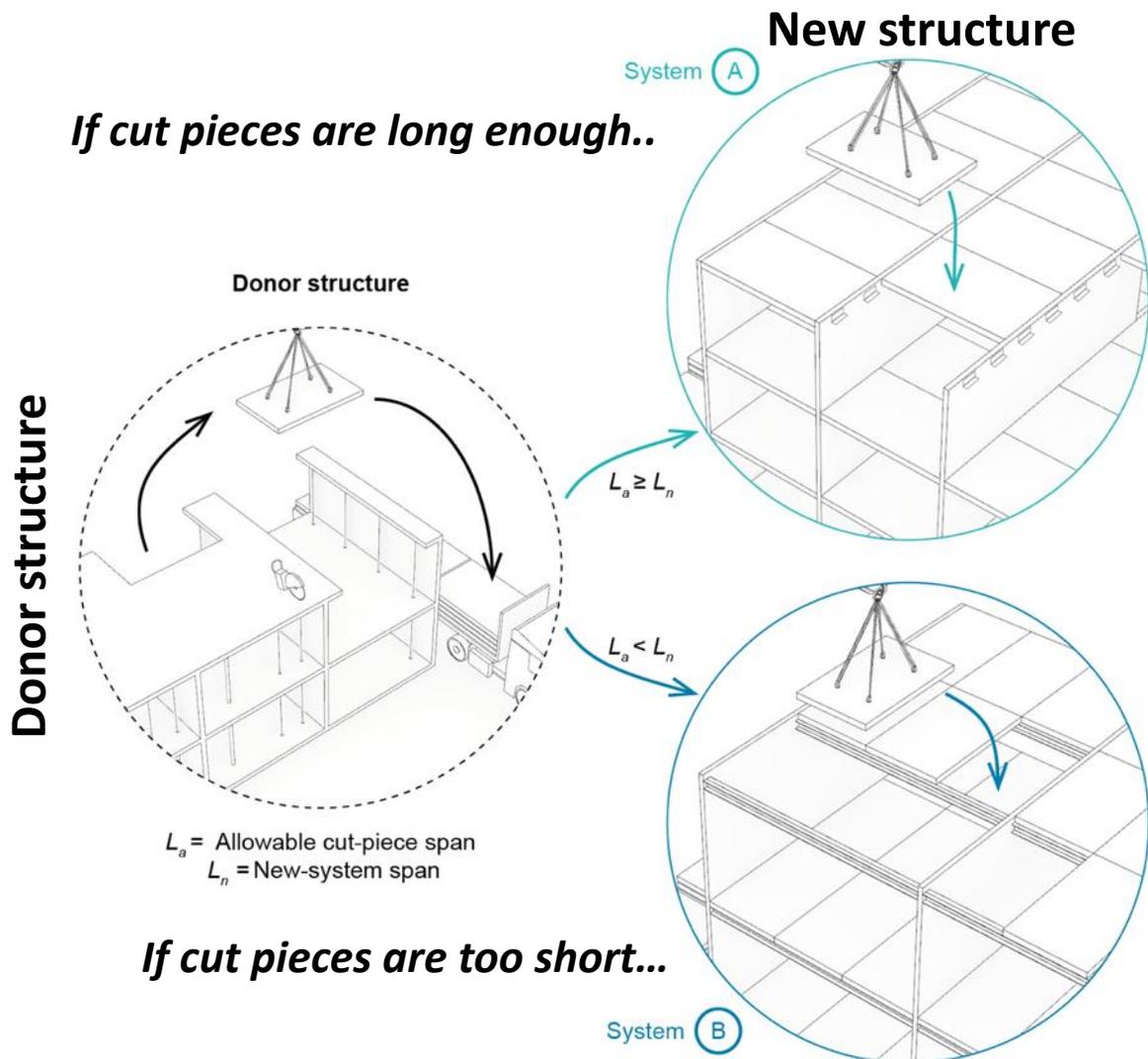


Slabs



Assemblies

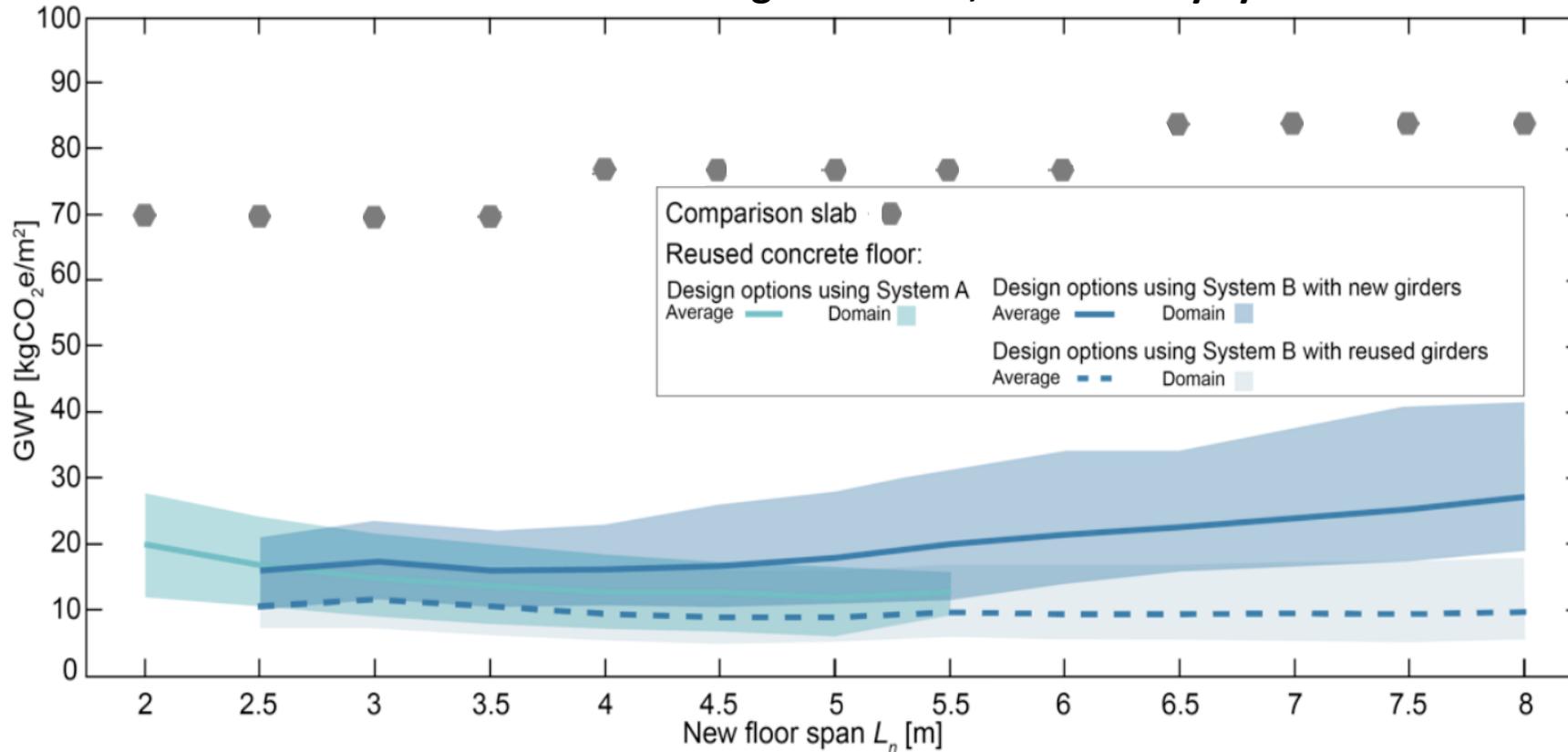
Two floor systems



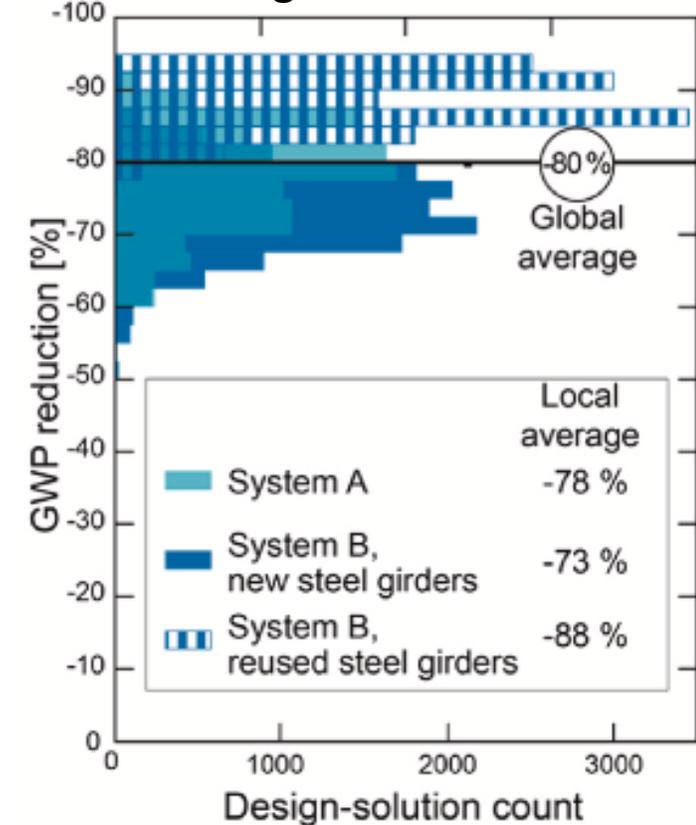
Carbon-emission savings

Simulation-based approach 20'280 combinations of donor and receiving floors

Embodied carbon of the design solutions, classified by system



Average GWP reduction



Cut-off approach

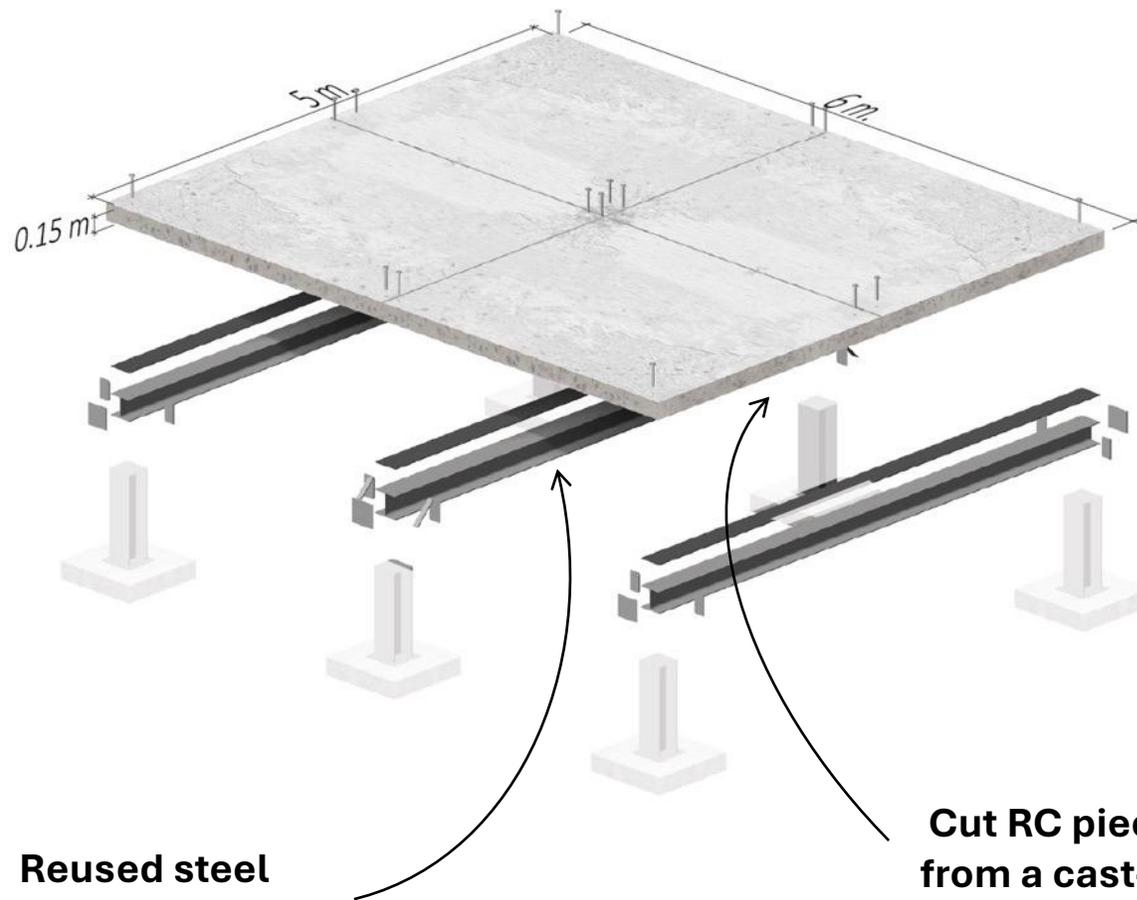
C1-C5 of the donor building + A1-A5 of the receiving system In Switzerland

Küpfer, Bertola & Fivet, 2024. Reuse of cut concrete slabs in new buildings for circular low-carbon floor designs.

Journal of Cleaner Production.



Office-floor mock-up



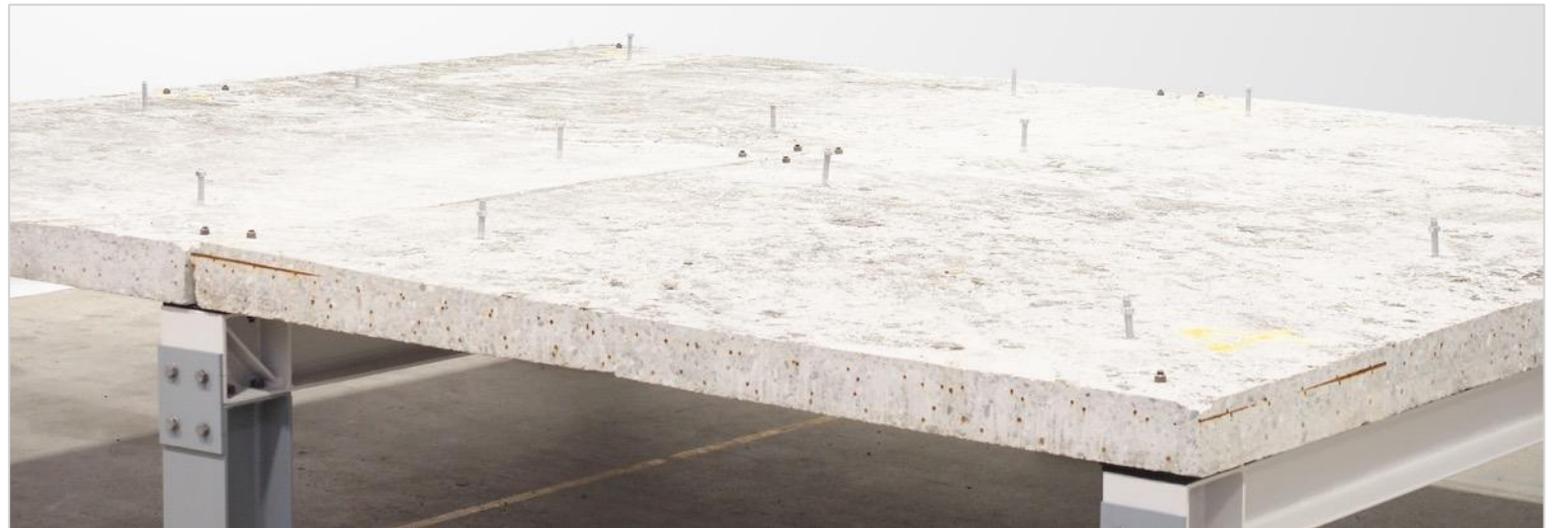
Reused steel profiles

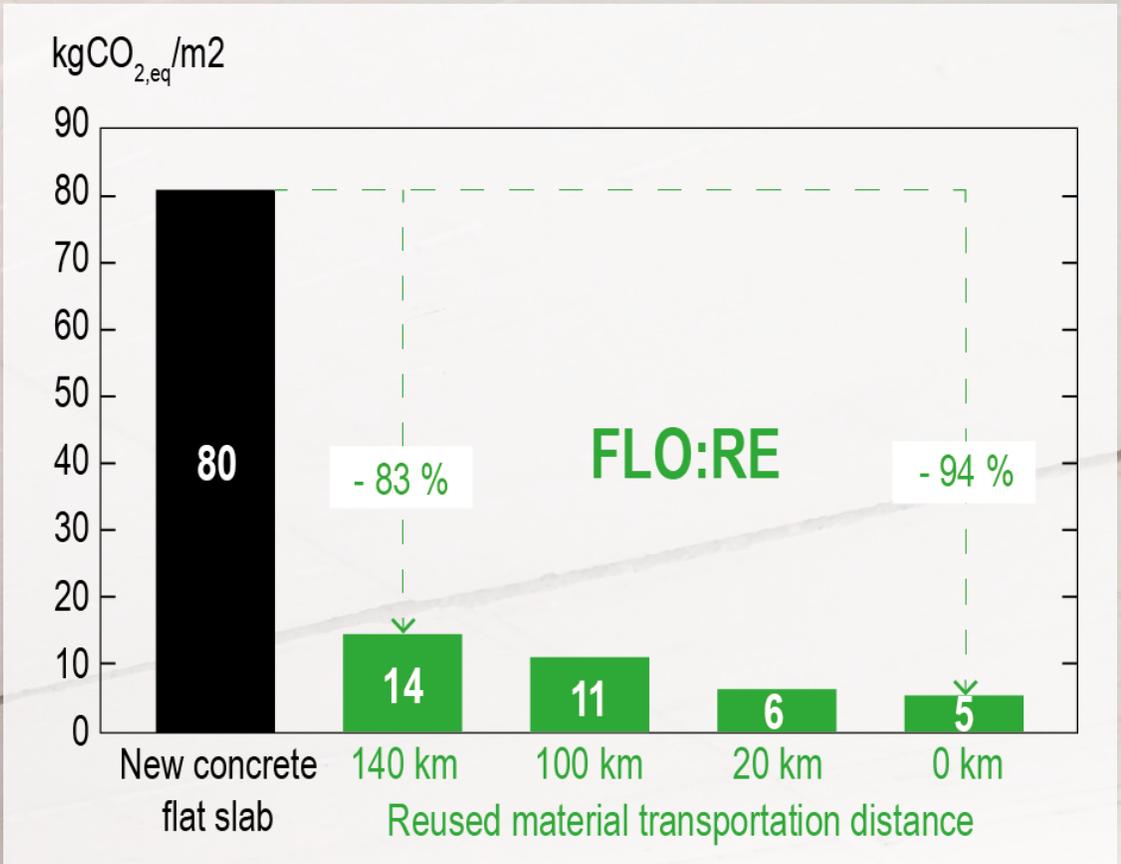
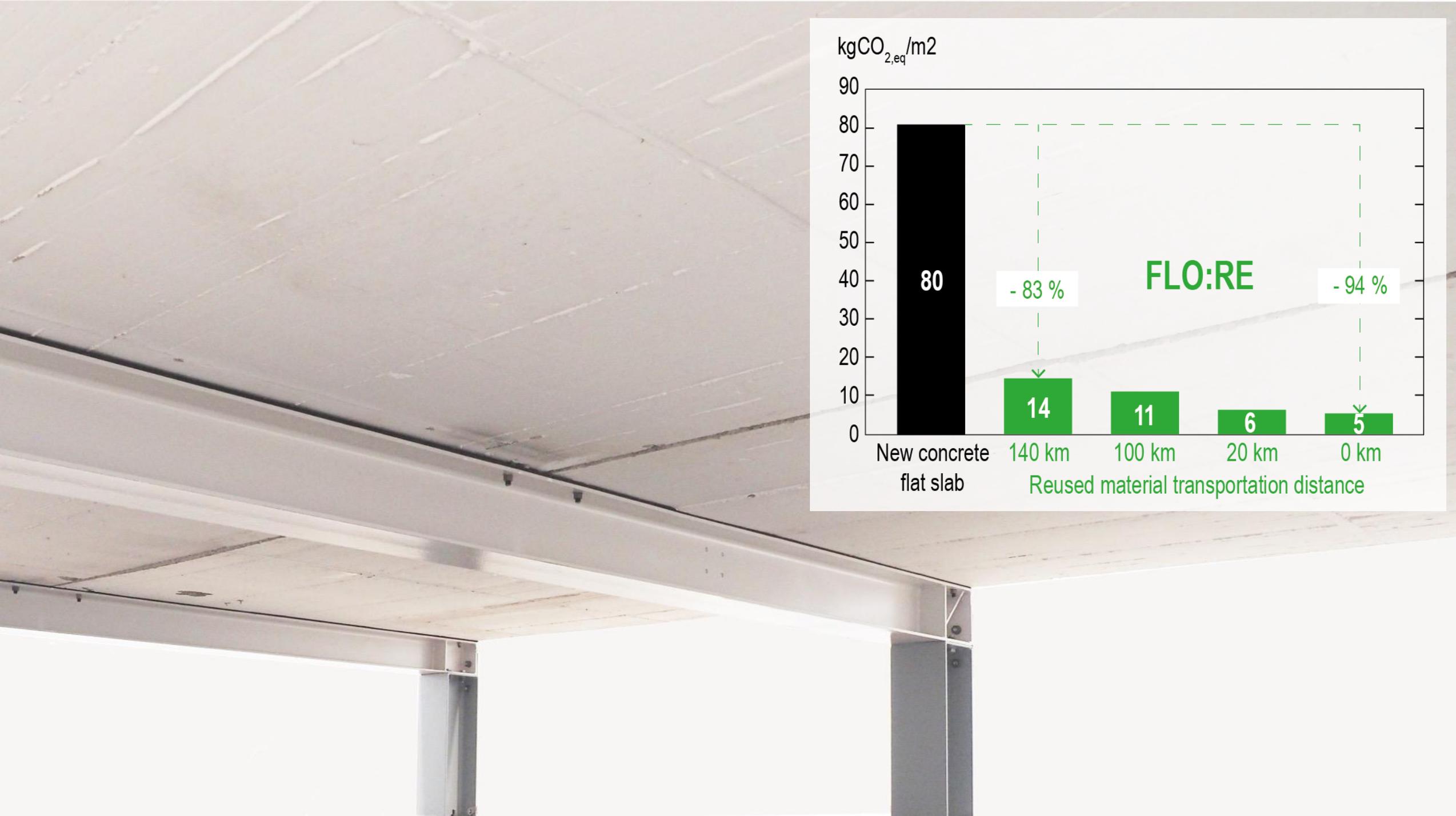
Cut RC pieces from a cast-in-place roof slab



Bertola, Küpfer, Bastien-Masse & Fivet, 2024. FLO:RE – A new floor system made of reused reinforced concrete and steel elements. IABSE Symposium Manchester 2024.







Material testing and load testing results

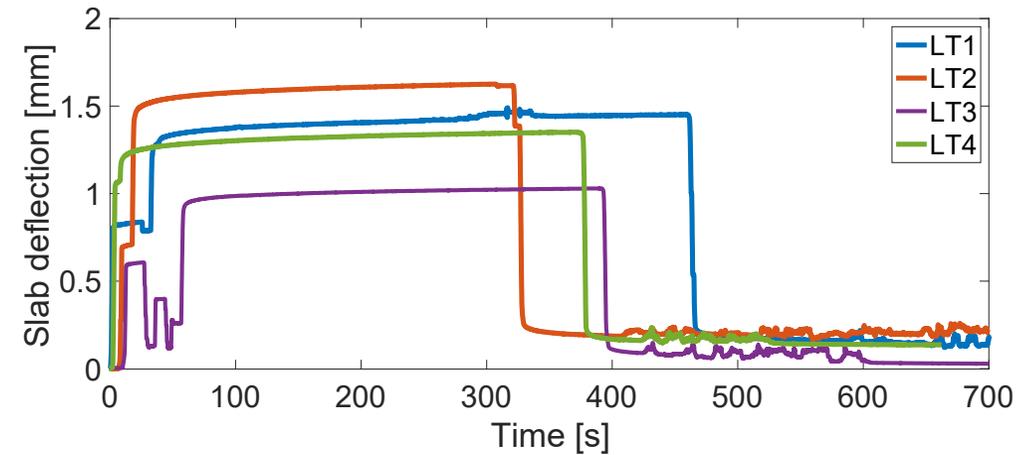


Material-property validation through destructive and non-destructive testing

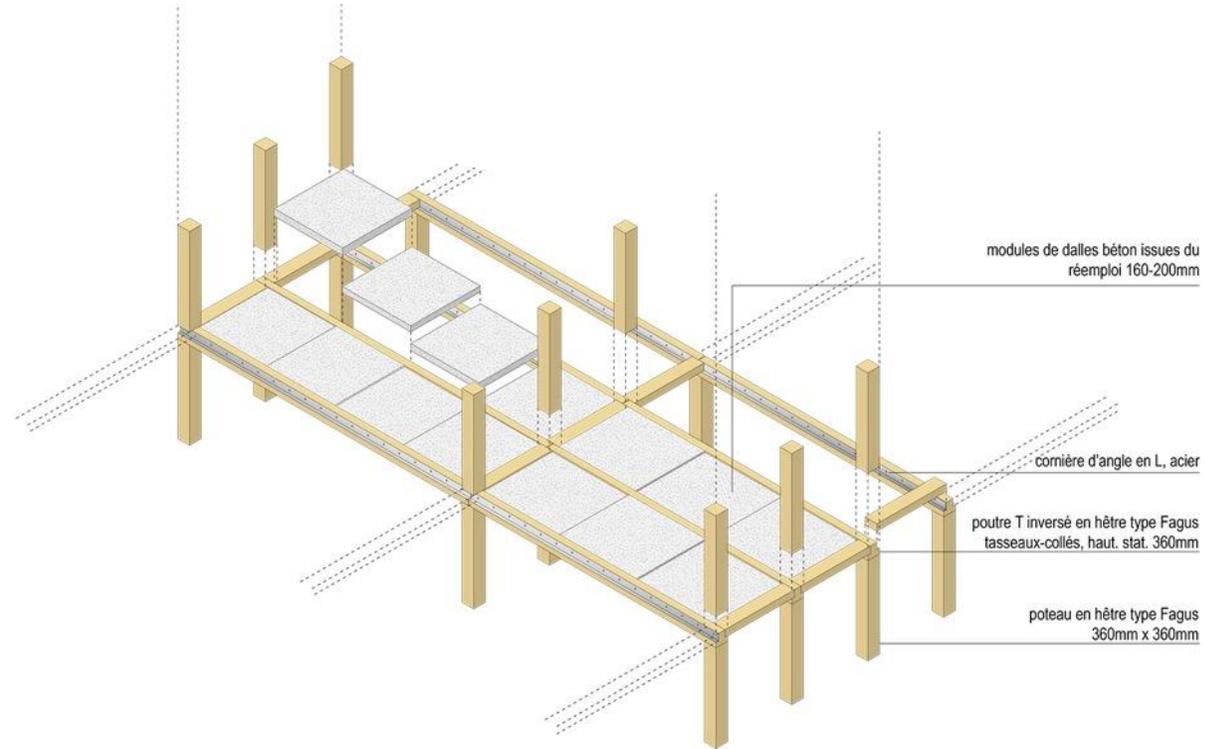
Material strengths testing

Concrete durability

Load testing of the structural system (service condition):

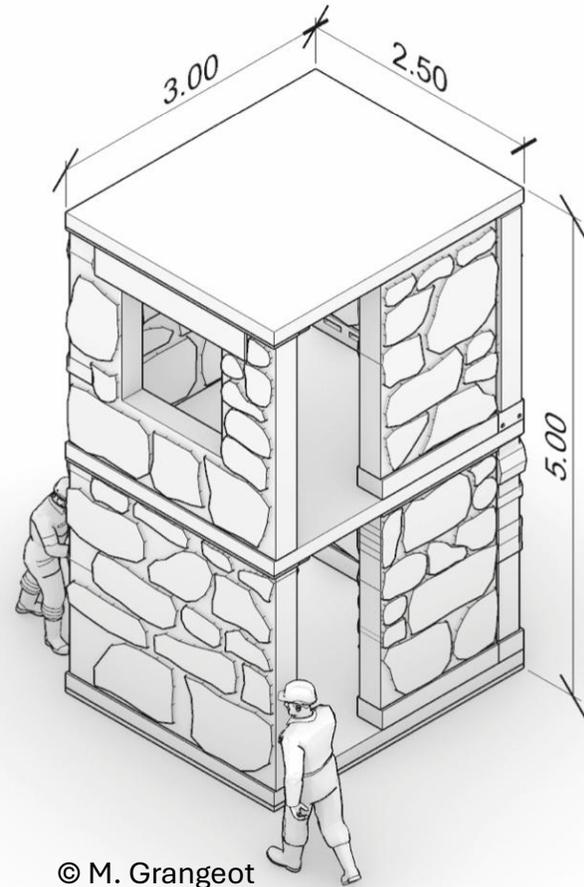


→ Design validation and conservative hypotheses



Images and project Kunik de Morsier + Bonnard & Woffray, 2024

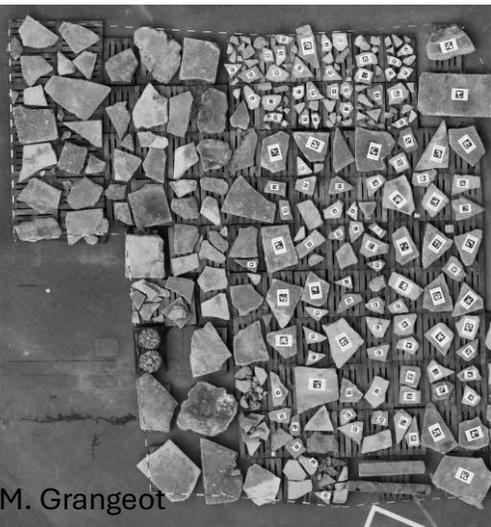
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