

Re:Crete Footbridge

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Building Type : Other building
Construction Year : 2022
Delivery year : 2022
Address 1 - street : Rte Cantonale / Rte de la Morge 1964 CONTHEY, Suisse
Climate zone : [Cfb] Marine Mild Winter, warm summer, no dry season.

Net Floor Area : 12 m² Autre type de surface nette
Construction/refurbishment cost : 67 000 €
Cost/m2 : 5583.33 €/m²

General information

Re:Crete, designed and built by EPFL's Structural Xploration Lab (SXL), is a **footbridge made of concrete blocks saw cut from the walls of a building under renovation and reassembled into a post-tensioned segmented arch**. Created as a research prototype, this footbridge demonstrates for the first time the feasibility of reusing concrete elements extracted from a cast-in-place structure in a new load-bearing structure. Concrete is the most widely used building material in the world and is a major source of the construction industry's environmental impacts. Reusing saw cut elements extends the use life of obsolete concrete. It avoids its premature crushing, while reducing greenhouse gases, demolition waste and raw material extraction.

In collaboration with the State of Wallis, in Switzerland, the prototype could be installed over the Morge river for a period of 2 years, where it is accessible to the public. The structure was therefore equipped with handrails, also made of reused materials. It is used for pedestrian mobility during the construction works on the adjacent road bridge.

The concrete blocks are extracted from the walls of the source building using a circular diamond saw. The sides of the blocks are then drilled to allow the passage of the post-tensioning cables. For the assembly of the arch, the blocks are placed on a timber centering and the post-tensioning ducts and cables are threaded through the side holes. Before tensioning the cables and removing the centering, the joints are filled with mortar to ensure contact between each block. To make the footbridge permanent and suitable for outdoor use, the exposed cut rebars were covered with an anti-corrosion paint, a hydrophobic impregnation was applied on the concrete faces and the joints were covered with waterproofing strips. However, the characteristic texture of sawn concrete, showing aggregates and rebars, remains visible on the side faces of the arch. The materiality of the bridge expresses both the source of the material, with its own history preceding that of the bridge, and the technique used to implement it. Finally, the railing was made with metal tubes from obsolete festival tents and steel wire meshes from shop furniture.

Besides providing a new design material for architects and engineers, the reuse of concrete elements is an effective solution to reduce the demand for cement, CO₂ emissions and concrete waste. A detailed life cycle analysis shows that the Re:Crete footbridge has a **lower environmental impact than similar solutions in reinforced concrete** (-63%) or steel (-75%) and approximately similar to that of a solution in new timber (+9%).

If you had to do it again?

This pioneering experience of reusing concrete elements extracted from a cast-in-place structure confirmed a new way of designing structures. The technologies used (e.g. concrete sawing and post-tensioning) proved to be appropriate for the reuse of concrete blocks to design a new structure. Nevertheless, we have identified ways to further increase the environmental benefits of the approach:

- Minimization of transport distances for reused materials
- Verification of the properties of reused materials before their deconstruction or acquisition
- Minimization preparation work required on the reclaimed concrete elements
- Consideration of the durability of reused concrete through adequate construction details

See more details about this project

<https://www.epfl.ch/labs/sxl/index-html/research/reuse-of-concrete/>

Photo credit

Ecole Polytechnique Fédérale de Lausanne (EPFL), Structural Xploration Lab (SXL)

Stakeholders

Contractor

Name : Etat du Valais

Contact : Jean-Baptiste Luyet (ingénieur Ouvrages d'art et Transports Exceptionnels)

<https://www.vs.ch/web/dmte>

Construction Manager

Name : Ecole Polytechnique Fédérale de Lausanne (EPFL), Laboratoire d'exploration structurale (SXL)

Contact : Coentim Fivet (professeur et responsable du Laboratoire d'exploration structurale (SXL))

<https://sxl.epfl.ch>

Stakeholders

Function : Company

Diamcoupe SA

Guillaume Mittnacht (chef de région, Suisse Romande)

<https://diamantbohr.com/fr/>

The Diamcoupe company supplied and prepared the concrete blocks. It sawed blocks in the walls of the source building and drilled cores for the passage of prestressing cables.

Function : Company

Freyssinet SA

Adrian Motte (directeur d'agence, Suisse)

<https://www.freyssinet.com/>

Freyssinet supplied the sheaths and prestressing cables. It proceeded with the tensioning of the cables and the injection of the sheaths.

Function : Environmental consultancy

Bridgology SA

Alexis Kalogeropoulos (fondateur et directeur)

<https://bridgology.com/fr/>

Bridgology carried out non-destructive measurements on the structure to determine the cover of the pre-existing reinforcing bars and check the condition of the concrete.

Function : Company

Sika Suisse SA

Cédric Chetelat (ingénieur conseil, Suisse Romande)

<https://che.sika.com/fr/home.html>

The Sika company supplied the products applied to the footbridge to protect it from water (anti-corrosion paint, hydrophobic impregnation, sealing strips).

Function : Company

Emil Egger Romandie SA

Frédéric Marilley (chef de projet)

<https://www.ete.ch/fr/>

Emil Egger transported the footbridge from its manufacturing site in Friborg (Switzerland) to its installation site in Conthey (Switzerland). It also carried out the lifting for the installation of the footbridge over the river.

Renewables & systems

Systems

Heating system :

- No heating system

Hot water system :

- No domestic hot water system

Cooling system :

- No cooling system

Ventilation system :

- Double flow

Renewable systems :

- No renewable energy systems

Environment

Risks

Hazards to which the building is exposed :

- Frost

Risks measures put in place :

The concrete structure is exposed to rainwater and frost, which can accelerate its degradation.

The concrete elements, as well as the sensitive parts of the structure, were protected from water by simple and common solutions in the industry. These make it possible to guarantee the durability of the structure for a longer period. The solutions implemented are as follows:

- the cut rebars, visible on the cut faces of the concrete blocks, were protected with anti-corrosion paint;
- the exposed concrete faces have been impregnated with a hydrophobe;
- the sheaths of the prestressing cables were injected with mortar;
- the joints were sealed with glued plastic strips.

Urban environment

This project was initially designed as a prototype to demonstrate the feasibility of reusing concrete blocks. The width of the Morge river at the Cantonal Road site matched the span of the Re:Crete footbridge and this site was therefore an opportunity to adapt the prototype for outdoor use. Its implementation in the Swiss Alps allows a dialogue between the minerality of the slices of exposed cut concrete and the surrounding mountains.

Products

Product

Diamcoupe SA

Guillaume Mittnacht (chef de région, Suisse Romande)

Product category : Gros œuvre / Structure, maçonnerie, façade



Freyssinet SA

Adrian Motte (directeur d'agence, Suisse)



Costs

Construction and exploitation costs

Total cost of the building :67 000 €

Subsidies : 25 900 €

Additional information on costs :

As the project was carried out within the framework of academic research activities, the design costs have not been quantified. Financial aid comes from internal funding at EPFL as well as corporate sponsorship.

The reuse was estimated to result in an approximately 30% increase of cost compared to a conventional alternative. However, we believe that this additional cost is mainly due to the novelty of the method. Optimization of the sourcing, assembly and rehabilitation processes should provide a reduction in costs. Moreover, these costs are compared to a conventional alternatives whose aesthetics are not the same. Replicating an aesthetic similar to the Re:Crete footbridge with conventional materials would likely increase costs.

Circular Economy

Reuse : same function or different function

Batches concerned by reuse :

- Structural works
- Locksmithing-Metalwork

For each batch : Reused Materials / Products / Equipments :

Major work :

- Concrete blocks: 2.43 m³
- Tie rod: 22 linear meters

Locksmith-Metallery:

- Steel posts and handrail: 40 linear meters
- Steel wire mesh: 44 m²

Field of use and material origin :

Big work :

- Concrete blocks: sawn into the walls of a hotel basement undergoing transformation in the canton of Vaud, reused as the structure of the arch. Supplied by the sawing company.
- Sub-tie rods: salvaged from an EPFL structural testing hall in Lausanne, reused.

Locksmith-Metallery:

- Steel posts and handrails: come from an old marquee used for festivals. Retrieved from a resource center (<https://www.la-ressourcerie.ch/>).
- Trellis: from old industrial shelves. Recovered in a resource center (<https://www.ecocube.ch/>).

Environmental assessment

Impacts avoided : water, waste, CO₂ :

The re-use operation saved the equivalent of 22'788 kilometres travelled by a small car, or 26 trips from Paris to Nice, 117 rectangular bathtubs filled with water and 15 years of household waste for a French person.

In order to calculate the avoided impacts, the material "breeze block - with concrete filling" was used as an equivalent to concrete blocks. To compensate for the different densities and assumptions about the future of the materials, the amount of concrete was increased proportionally. It is therefore assumed here that the entire quantity of concrete blocks would have been eliminated if they had not been re-used.

Economic assessment

Total cost of reuse : 19 200 €

Cost of reuse in percentage of the operation :29 %

Carbon

GHG emissions

Methodology used :

The calculation is made according to the LCA method and the Swiss KBOB database. The system considers all procedures related to deconstruction, preparation of elements, production of new materials, transport and construction works.

GHG before use : 25,00 KgCO₂ /m²

Building lifetime : 15,00 année(s)

GHG Cradle to Grave : 25,00 KgCO₂ /m²

Only the bridge structure was evaluated. CO₂ emissions related to the construction of guardrails are not included in this figure.

Contest

Reasons for participating in the competition(s)

The Re:Crete footbridge is an original project which **integrates for the first time the structural reuse of concrete elements extracted from an existing cast-in-place concrete building**. It demonstrates the technical feasibility while using technologies known by the construction industry such as concrete sawing and post-tensioning. To guarantee the long-term durability of reused concrete elements, the structure was adapted, by simple methods, to outdoor use. The railings are also designed with reclaimed materials.

Confirming that **sawn concrete is a new reusable structural material**, this project extends the application of circular economy principles to the construction industry. A new field of activity is created, where sawn concrete elements are used for the construction of traditional buildings. In addition, this first prototype convincingly demonstrates that the approach can drastically reduce greenhouse gas emissions, construction waste and raw material extraction. Its generalization offers new perspectives to quickly contribute to the mitigation of global warming and increase the sustainability of the construction industry.



COMPETITION WINNER