Re:Crete Footbridge

by Julie Devènes / 2022-05-19 00:00:00 / France / 1952 / FR

Primary energy need :
kWhep/m^2.an
(Calculation method :)

ENERGY CONSUMPTION

Economical building *Building*

< 50	A
51 à 90	B
91 à 150	C
151 à 230	D
231 à 330	E
331 à 450	F
> 450	G

Energy-intensive building

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 m^2
Construction/refurbishment cost : 67 000 €
Cost/m2 : 5583.33 €/m^2

Proposed by :

General information

The Re:Crete Walkway, designed and built by EPFL's Structural Xploration Lab (SXL), is a **pedestrian walkway made of concrete blocks sawn into the walls of a building under renovation and reassembled into a prestressed arch**. Initially produced as a research prototype, this footbridge demonstrates for the first time the feasibility of reusing non-prefabricated concrete elements in new load-bearing structures. Concrete is the most widely used building material in the world and is the major source of the construction industry's environmental impacts. Its reuse by sawing elements offers a new extension of life to obsolete concrete, thus avoiding its premature crushing, while promising a great potential for reducing greenhouse gases, demolition waste and extraction of raw materials.

In collaboration with the State of Valais, a site was found to install the prototype and make it accessible to the public. The structure was therefore equipped with guardrails, also made of reused materials, and set up for a period of 2 years on the Morge river in Valais (Switzerland). It is used for pedestrian mobility during the duration of the works on the bridge of the adjacent cantonal road.

The concrete blocks are extracted from the wall using a circular saw with a diamond blade, then cored to allow the passage of the prestressing cables. The blocks are then placed on a wooden hanger by passing the sheaths and prestressing cables through the core drillings. Before tensioning the cables and removing the handlebar, the joints are filled with mortar to ensure contact between each block. In order to make the footbridge permanent and suitable for outdoor use, the exposed reinforcing steels were covered with an anti-corrosion paint, a hydrophobic impregnation was applied to the concrete faces and the joints were covered

with strips of tightness. However, the characteristic texture of sawn concrete, patchworks of aggregates and reinforcement spacers, is kept 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 uprights and the handrail of the guardrail were made by recombining metal elements reused from an old marquee and the lattices are taken from old industrial shelves.

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 wood (+9%).

If you had to do it again?

This pioneering experience of reusing concrete elements extracted from a cast-in-place structure validated a new way of designing structures. The technologies used (e.g. concrete sawing and prestressing) proved to be appropriate for the reuse of concrete blocks to design a new structure. Nevertheless, we have identified various points 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 of the stages of preparation of the concrete elements to be reused - Consideration of the durability aspects 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

Federal Polytechnic School of 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 : Corentin 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 : Structural work / Structure - Masonry - Facade

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 research activities of a university, the study costs have not been quantified. Financial aid comes from internal funding at EPFL as well as corporate sponsorship.

Instead, reuse resulted in an additional cost of approximately 30% compared to a conventional variant in another material. However, we believe that this additional cost is mainly due to the novel nature of the approach. Optimization of the acquisition, assembly and maintenance process should provide a reduction in costs. It should also be noted that these costs are compared to a conventional variant whose aesthetics are not the same. Replicating an aesthetic similar to the Re:Crete Walkway 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
- Sub-tie: 22 linear meters

Locksmith-Metallery:

- Steel posts and handrail: 40 linear meters
- Trellis: 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 22788 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 $KgCO_2$ /m^2

Building lifetime : 15,00 année(s)

GHG Cradle to Grave : 25,00 $KgCO_2$ /m^2

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

Life Cycle Analysis

Contest

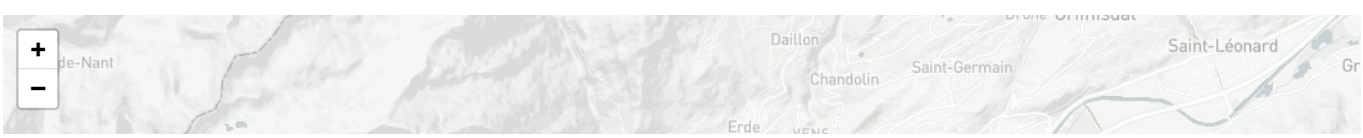
Reasons for participating in the competition(s)

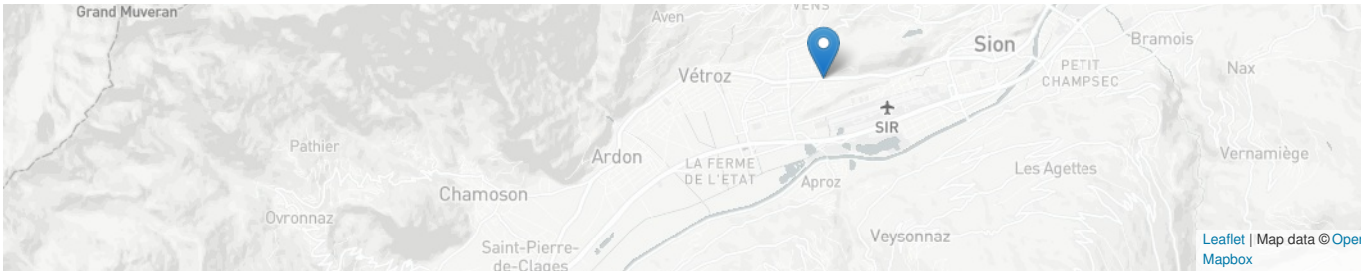
La passerelle Re:Crete est un projet inédit qui **intègre pour la première fois le réemploi structural d'éléments de béton issus d'un bâtiment existant en béton coulé sur place**. Elle démontre la faisabilité technique tout en utilisant des technologies connues par l'industrie de la construction tels que le sciage du béton et la précontrainte. Pour garantir la durabilité à long-terme d'éléments réemployés en béton, la structure a été adaptée, par des méthodes simples, à une utilisation extérieure. Les garde-corps sont également conçus avec des matériaux de réemploi.

Confirmant que **les éléments de béton sciés sont un nouveau matériau structural de réemploi,** ce projet étend l'application des principes de l'économie circulaire dans l'industrie de la construction. Un nouveau champ d'activité est créé, avec à la clé le réemploi d'éléments en béton scié pour la construction de bâtiments traditionnels. En outre, ce premier prototype démontre de manière convaincante que l'approche permet de réduire drastiquement émissions de gaz à effet de serre, déchets de chantiers et extraction de matières premières. Sa généralisation offre de nouvelles perspectives pour rapidement contribuer à l'atténuation du réchauffement climatique et augmenter la durabilité de l'industrie de la construction.

Building candidate in the category

Prix du public





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