



---

## **CL RESTRAP**

---

**Pre-tensioned CFRP shear reinforcement**

---

**Sustainability through longevity & durability**

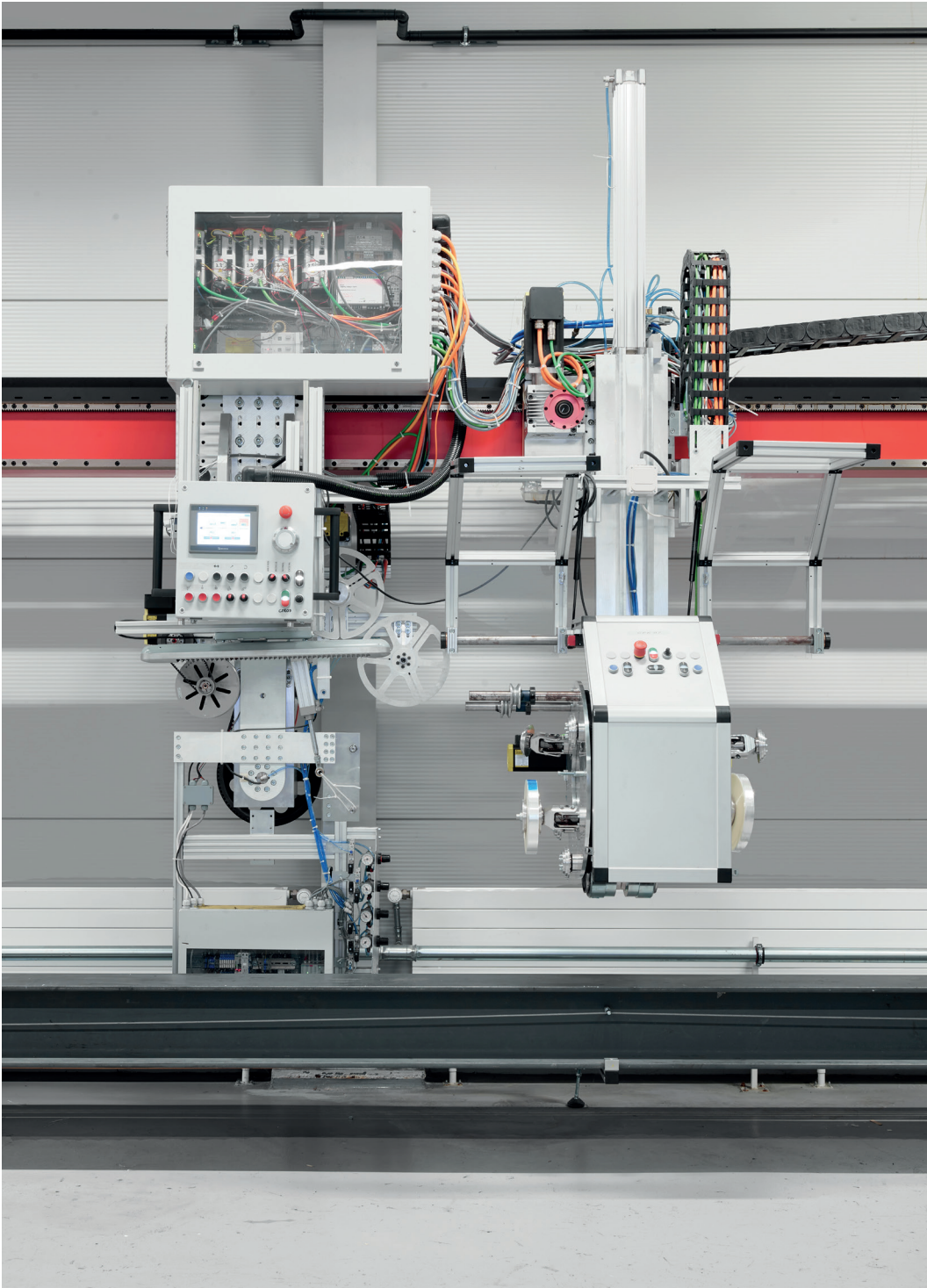
---

**Made in Switzerland**

---

**[www.carbo-link.com](http://www.carbo-link.com)**

---



---

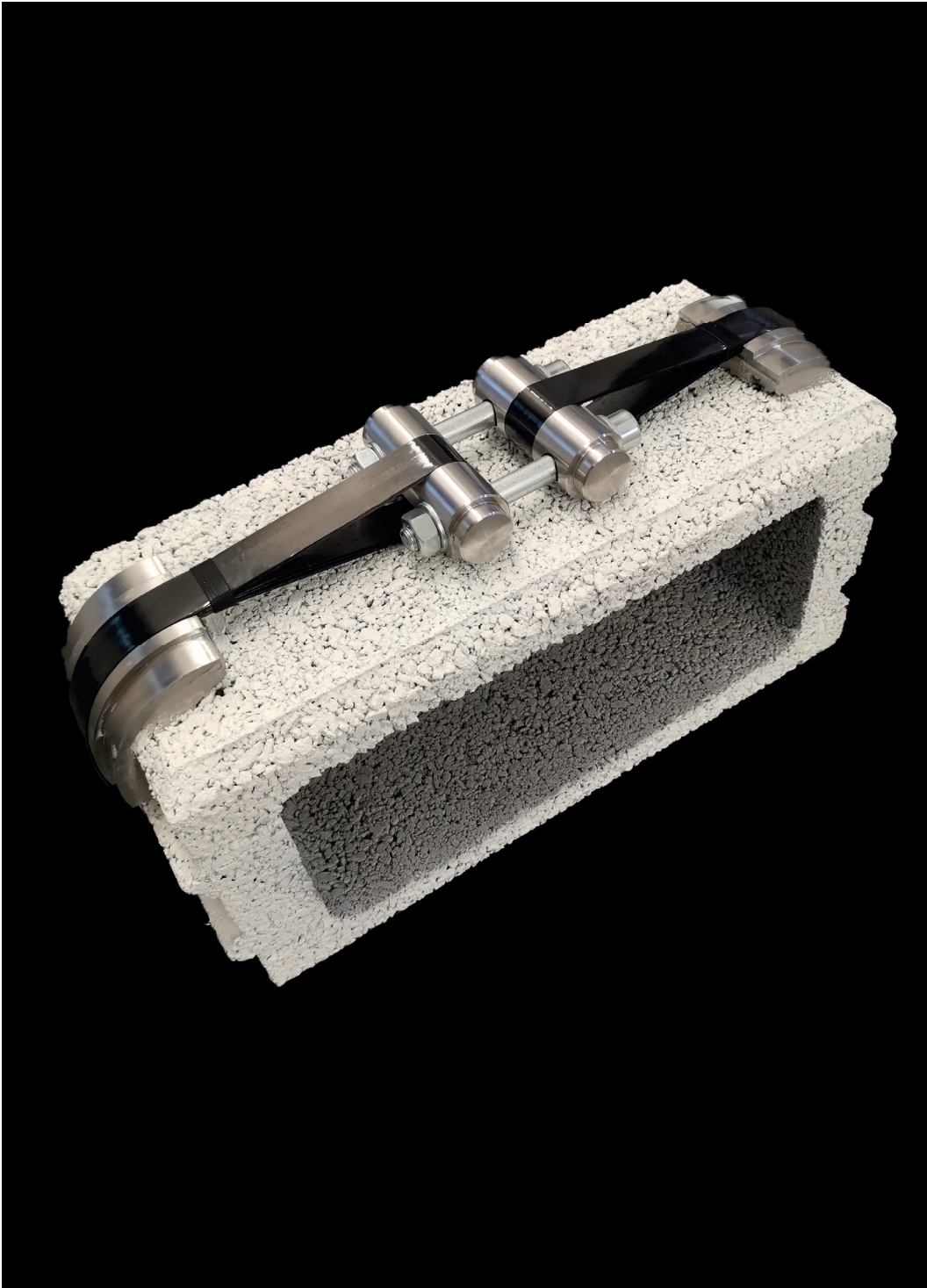
## Carbo-Link

Founded in 2000 as a spin-off from EMPA (Swiss Federal Laboratories for Material Science and Technology), Carbo-Link specialises in the design, engineering and manufacture of CFRP structural elements for high loads. Carbo-Link is AS9100D Aerospace & Defence certified, with multiple solutions DNV Type approved. All solutions are made in Switzerland.

## Mission

Contribute to increased structural efficiency & sustainability of global infrastructure through the use of long lasting, reliable & cost effective CFRP solutions in new construction & existing structure rehabilitation.

---



---

## CL RESTRAP

### Pre-tensioned shear reinforcement

A flexible CFRP tension member made up of continuous unidirectional carbon tapes wound into a loop with two ends. The ends are fastened together with a pin & bolt system for simple pre-tensioning. CL RESTRAP can be engineered and manufactured for any pretension load and length.

The tape layers are not bonded together, allowing relative displacement between the layers. This increases system flexibility allowing the CL RESTRAP to be installed and tensioned around varying structure shapes and sizes, much like a traditional ratchet strap.

The CFRP tapes are manufactured in-house using bespoke, Aerospace certified, prep-preg production techniques. All fibres are aligned perfectly in the load path direction, reinforced with a toughened resin matrix, and tape widths and thickness's are customised for each project.

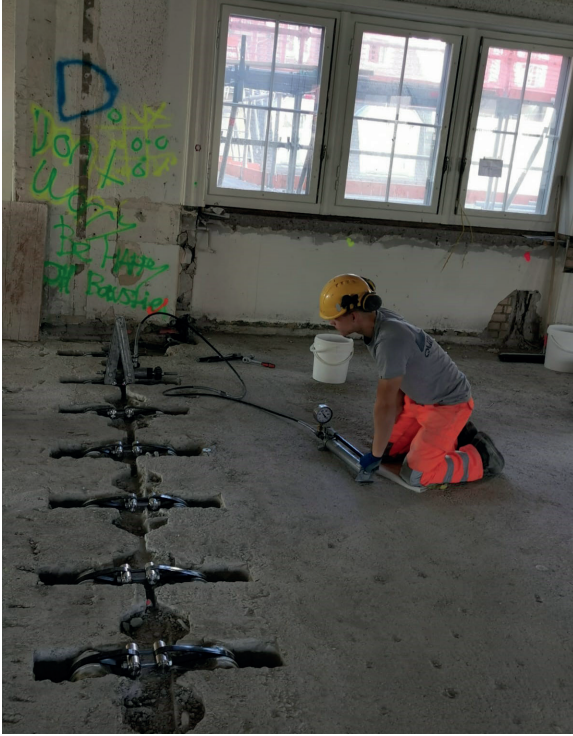
---

## APPLICATIONS

Shear reinforcement of concrete girders can be required, or even mandatory, for rehabilitation, strengthening and repair of existing structures.

- Enhancement of a structures load capacity
- Modification of the load-bearing system due to:
  - Removal of pillars and walls
  - Necessary cut-outs
  - Seismic reinforcement
  - Errors due to bad workmanship





## **CASE STUDY: BANK LEUEHOF, ZURICH**

A venerable Art Nouveau building in the centre of Zurich was completely renovated and re-purposed to become the home of an international Bank. The interior and exterior of the building are listed, requiring a considered approach both structurally and aesthetically.

In 1914, office payloads were only 200kg/m<sup>2</sup>. Today's international standard is 300kg/m<sup>2</sup>. For the upper floors of the building, complete preservation of the supporting structure was planned, but the installation of mechanical ventilation required local core drilling through the joists. Here, too, the payload was to be adapted as far as possible to today's standards with minimal additive measures.

For this purpose, the concrete girders were to be strengthened in shear by CL RESTRAP.

The engineering office 'WaltGalmarini' calculated each girder separately and assessed how many core holes were required, how much load the existing stirrup reinforcement could carry, and how many prestressed CFRP laminations were needed to ensure a load-bearing structure according to current standards.



## ADVANTAGES: STRUCTURAL

All 4 contributing factors to the shear capacity of a concrete structure are enhanced:

### 1. Stirrups

- Enhanced shear capacity due to added cross sectional area of the carbon

### 2. Concrete in the compression zone

- [M. D. Kotsovos]: enhanced shear capacity due to multiaxial state of stress

### 3. Dowel-action of the longitudinal steel

- [R. C. Fenwick, T. Paulay]: enhanced shear capacity due to reduced free length

### 4. Aggregate interlocking

- [J. C. Walraven]: enhanced shear capacity due to reduced crack width

## ADVANTAGES: STANDARDS / CODES

- Pre-tensioning to become a standard shear reinforcement requirement
- Example: SIA 166:2004
  - "If a bending beam for shear force is to be reinforced which already shows shear cracks in its unreinforced state of use, stirrups should be used which cover the entire height of the beam and can be pre-tensioned."



## ADVANTAGES: CONSTRUCTION & INSTALLATION

- Easy installation
- No bonding necessary
- No heavy steel parts
- Low self weight
- Easy and fast mounting
- Simple & effective pre-tensioning without heavy equipment
  
- Small panel height: system is easy to hide within floor or ceiling
- Fire protection due to applied mortar (R60)

## ADVANTAGES: COMPLETE SYSTEM PROPERTIES

- Significant increase in break load of structural concrete
- Enhance de-formability of shear girders
- Significant reduction in crack widths of concrete
- Shift from brittle shear failure to a ductile flexural failure mode
- CL RESTRAP encapsulates tension and compression chord



---

## Contact

+41 (0) 58 201 25 00  
info@carbo-link.ch  
www.carbo-link.com

---

