CL - RESTRAP

Why Use Carbon Solutions for Structural Reinforcements?

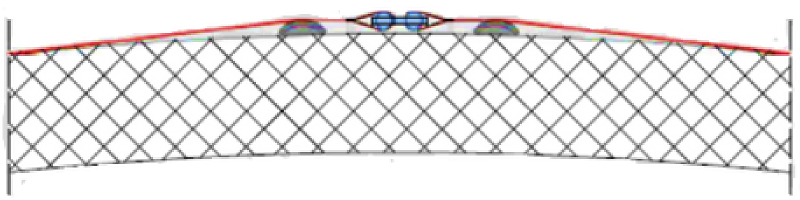
- Outstanding material behaviour related to fatigue and relaxation
- Large tensioning-elongation ($\varepsilon_{p0} \approx 6.3‰$), small tensioning losses with concrete creep
- Active tensioning system leads to simple calculation
- Feather-light system
- Easy handling and installation
- Low space requirement
- No corrosion and chemical resistant
- Loop dimension variable

Structural Strengthening with Tensioned CFRP Loops

CL-RESTRAP is an external posttensioning system made of carbon fiber reinforced plastic (CFRP) tapes that are wound endlessly into a loop. The use of thin, multilayer tapes allows very small bending radii, with no interconnection between the individual layers. The loops can be produced in any length and dimension, have excellent long-term behaviour and are easy to assemble by hand due to their feather-light weight.

Typical usage

- Shear strengthening of beams and joists
- External post-tensioning of Silos, Watertanks, Chimneys, etc.



Ex. Compression ring around a Silo / Tank / Chimney

Ex. Shear strengthening

Tensioning System CL-RESTRAP

A standard CL-RESTRAP loop is designated according to its posttensioning force. The associated ultimate loads and posttensioning forces are defined in the table below. It should be noted that the posttensioning force can be doubled in the case of shear reinforcement due to both-sided installation.

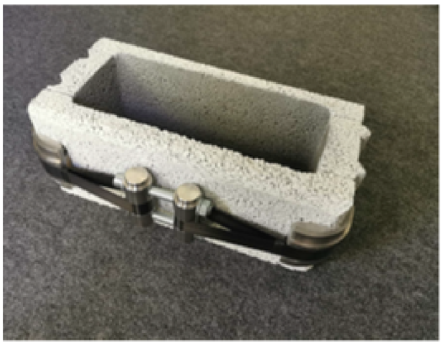
Name	Ultimate Load [kN]	Tensioning force [kN]	Width [mm]	Thickness [mm]	EA [MN]	Weight [g/m]	Elongation [mm/m]
CL-RESTRAP...	*Larger dimensions are fabricated on request project specific*						
CL-RESTRAP 100	200	100	25.4	3.8	15.68	144	6.4
CL-RESTRAP 90	180	90	25.4	3.6	14.70	135	6.1
CL-RESTRAP 80	160	80	25.4	3.1	12.74	117	6.3
CL-RESTRAP 70	140	70	25.4	2.6	10.78	99	6.5
CL-RESTRAP 60	120	60	25.4	2.4	9.80	90	6.1
CL-RESTRAP 50	100	50	25.4	1.9	7.84	72	6.4

Table 1: Dimension and post-tensioning forces. Other dimensions available on request.

Application CL-RESTRAP

The posttensioning system is tensioned like a tension belt around the element to be reinforced. In the case of small radii, it is pulled around deflection saddles. Bolts are placed in the ends of the loops, which are tightened and locked using hydraulic clamping pliers. The loop is thereby pre-tensioned.

Detail loop



Mockup, detail bolts

Tensioning process with clamping plier


1. Threading


2. Deflection


3. Retraction


4. Assembly


5. Pretension


6. Fire Protection

Reasons for the Need of Shear Reinforcement

- Renovation of existing buildings (dimensioning according to current standards)
- Increasing the load-bearing capacity (increasing the live or traffic loads on ceilings, beams and bridges, conversion of buildings, installation of heavier machinery and equipment in industry, stabilization in the event of vibrations and oscillations)
- Increasing serviceability (reduction of crack widths, reduction of deflection, reduction of steel stresses, reduction of fatigue phenomena)
- Damage to structural components as a result of:
  - corrosion of the steel reinforcement
  - ageing of building materials
  - damage to the structure due to fire, earthquake, impact, etc.
- Modification of the load-bearing system as a result of:
  - removal of columns and walls
  - creation of recesses in ceilings
  - increase in resistance to earthquakes - design/execution errors

Current State of Technology

Steel slats
External “brackets” in the form of steel slats

Slack CFRP slats
External “brackets” in the form of slack CFRP slats

Unidirectional CFRP slats
are glued loosely around the beam

Threaded rods are drilled through the ceiling

Principle of the Shear Strengthening

The tensioning system strengthens the concrete beam in all 4 factors that affect the shear strength of concrete beams:

- Due to the looping effect of the CL-RESTRAP system, the missing cross-section is added to the stirrup reinforcement by means of CFRP. Furthermore, the prestressing improves the bond between concrete and existing reinforcement.
- The multiaxial stress state achieved by the prestressing in the concrete increases the strength of the concrete in compression.
- The additional reinforcements at regular intervals shorten the free length of the longitudinal reinforcement and improve the dowel action.
- The prestressing reduces the crack width, which means that the interlocking of the aggregates in the concrete is also improved.

Translated from Norm SIA166:2004

3.1.7.3.4: If a bending girder is to be reinforced for shear force that already exhibits shear cracks in the unreinforced service condition, stirrups that enclose the entire height of the girder and can be prestressed must be used. The adhesive effect therefore has only a constructive character.

Calculation of the Shear Strengthening

The entire shear force that cannot be transferred by existing reinforcement is to be absorbed by the posttensioning in the CL-RESTRAP system.

Compared to bonded reinforcement, posttensioning has the advantage that the shear force is absorbed directly by the CL-RESTRAP's without the need for further deformation of the structure. On the other hand, the existing cracks are closed.

The CL-RESTRAP system can be individually adapted to the construction project in terms of length and pretensioning force.

$$\mathbf{V_{d,s} = V_d \cdot s / z}$$

Where:

- $V_{d,s}$ = Required resistance of the CL-RESTRAP (2-section)
- V_d = Shear force that cannot be absorbed by existing reinforcement
- s = Spacing CL-RESTRAP's
- z = Inner distance between compression and tension belt (norm. 0.9h)
- h = Height of the beam

Based on $V_{d,s}$, a CL-RESTRAP can be chosen according to Table 1.

Fire Protection and Coverage

The loops can be covered with a fire protection mortar after pre-stressing. With a mortar thickness of 15 mm, a fire resistance class of REI60 can be achieved.

Coverage of beam with reinforcement loops

Fire protection mortar covers the connection bolts

Advantages of Using CL-RESTRAP

Structural advantages

- Reinforcement acts directly thanks to pre-tensioning
- No bonding necessary
- No corrosion
- Prestressing in all directions

Advantages during installation

- Simple installation
- No heavy steel parts
- Low dead weight
- Controlled assembly and pretensioning

Design advantages

- Low installation height
- Fire protection easily possible
- Good adhesion between mortar and CFRP

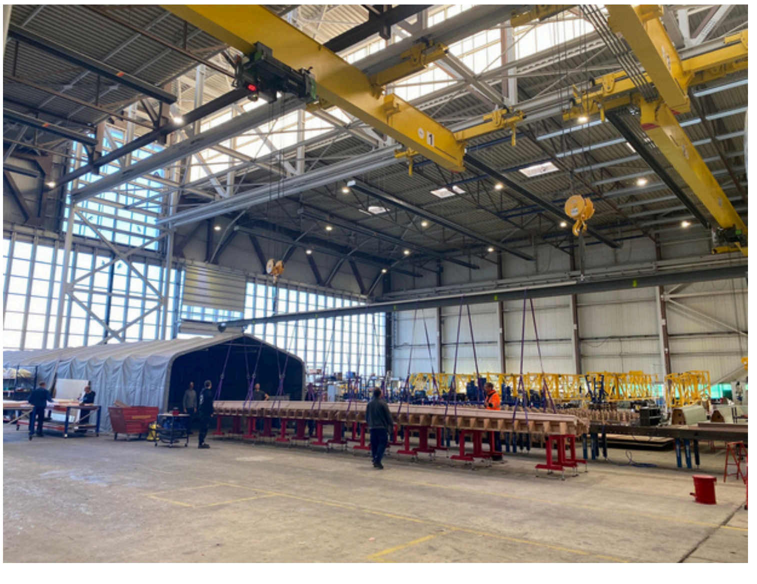
Project: Shear Reinforcement at Bank Leuenhof, Zürich

Production Facilities

Carbo-Link is headquartered in Switzerland, where our main production facility and offices are located, ensuring precision engineering and high-quality manufacturing. As we continue to grow, we have expanded our operations to Germany, where we are increasingly ramping up production to meet the rising demand for our advanced CFRP solutions. This expansion enhances our ability to deliver innovative, high-performance products while maintaining the highest standards of quality.

Carbo-Link AG, Fehraltorf, Switzerland

The Swiss facility is the heart of our engineering and innovation. It is here that all of our design and development work takes place, ensuring that every product meets the highest standards of performance and quality. Currently, the Swiss production focuses primarily on the manufacturing of crane and rigging cables. The Swiss location remains a key pillar in our commitment to excellence and cutting-edge innovation.



Carbo-Link Germany GmbH, Lemwerder, Germany

Carbo-Link's expansion into Germany focuses on the production of high-performance masts, allowing us to increase capacity and strengthen our ability to deliver advanced CFRP solutions for the yacht industry and beyond.

Further Carbo-Link Products

small intro about having production in switzerland and germany. mention that Switzerland is hq with all the offices and is main production. now we have expanded to Germanywhere we start to produce more and more.

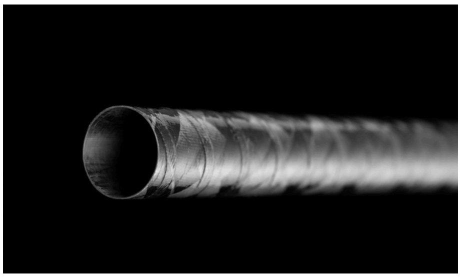
CL-CRANE

High-strength, lightweight CFRP cables for lifting and load-bearing applications, made from toughened pre-preg carbon tapes, are continuously wound around rotary end thimbles and consolidated into a high-strength, lightweight round rod.

CL-RESTRAP

A flexible CFRP shear reinforcement solution, designed as an unbonded vertical prestressing tendon, utilizing continuous unidirectional carbon tapes to enhance the shear capacity of concrete girders and beams.

CL-TRUSS / CL TORQUE



Ultra-lightweight, high-stiffness CFRP structural solutions engineered for exceptional strength, torsional rigidity, and performance in demanding aerospace, motorsport, and industrial applications.

CL-PUSH-PULL

A CFRP tension and compression linkage featuring continuous carbon fiber routing around end fittings, ensuring direct force transfer without bonding for high-performance applications in aerospace, automotive, and infrastructure.

YACHT RIGGING

CL SOLID carbon rigging is a high-performance solution featuring continuously wound unidirectional prepreg carbon fiber, integrated titanium terminations, and unmatched stiffness, durability, and minimal maintenance for peak rigging performance.

Certified Management System
SQS
EN 9100

CL-CRANE

CL-BRIDGE

NEWSLETTER

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