STRESSHEAD Ltd
INNOVATIVE STRENGTHENING OF STRUCTURES

Reference List and Texts of Earthquake strengthening Industrial and high-rise buildings Bridges

Innovative Strengthening of Structures with post-tensioned CFRP plates

Tensioning System StressHead-CarboStress

2022

STRESSHEAD Ltd
INNOVATIVE STRENGTHENING OF STRUCTURES

Earthquake strengthening

Project	Reason for strengthening	Client	Year
Bâtiment APEMS, Prilly (CH)	Earthquake strengthening of masonry	BG Engineers Ltd	2022
Agency Mobiliar, Belp (CH)	Earthquake strengthening of masonry	Die Mobiliar AG	2022
High Mountain Clinic, Davos (CH)	Earthquake strengthening of masonry and closing of building separation joints	Kühne Real Estate AG	2021
Apartment building Zelglistr, Dietikon (CH)	Earthquake strengthening of masonry	Anlagestifung Migros-Pensionskasse	2021
Aeschenvorstadt 56, Basel (CH)	Earthquake strengthening of concrete	Credit Suisse AG	2021
Pumping station, Hettlingen (CH)	Earthquake strengthening of aerated concrete stone walls	Municipality of Hettlingen	2021
Shopping mall, Mels (CH)	Earthquake strengthening, closing of building separation joints	Credit Suisse AG	2021
Leuenhof, Zürich (CH)	Earthquake strengthening of concrete slabs	Swiss Prime Anlagestiftung	2020
Fluhmattstrasse 12, Luzern (CH)	Earthquake strengthening of masonry	Konstruktiv GmbH	2020
Aeschenvorstadt 56, Basel (CH)	Earthquake strengthening of concrete	Credit Suisse AG	2019
Monbijoustreet 114, Bern (CH)	Earthquake strengthening of masonry	SMT Engineers Ltd	2019
Limmattalstreet 400, Zurich (CH)	Earthquake strengthening of concrete walls	Immobilien Ltd	2019
School building Ried, Muotathal (CH)	Earthquake strengthening of masonry	Community Muotathal	2019
Irchelstreet 2, Zurich (CH)	Earthquake strengthening of masonry	Caprez Engineers Ltd	2018
Retirement Home, Herisau (CH)	Earthquake strengthening of masonry	Foundation care of elderly, Herisau	2017
Control Center armasuisse, Emmen (CH)	Earthquake strengthening of masonry	armasuisse	2017
Housing development, Goldach (CH)	Earthquake strengthening of masonry	Credit Suisse Real Estate Investment Management	2017
Bank building UBS, Altstetten ZH (CH)	Earthquake strengthening in elevator shaft	UBS AG Zürich	2017
Housing development, Dübendorf (CH)	Earthquake strengthening of masonry	Credit Suisse Real Estate Investment Management	2017
School building Wasgenring, Basel (CH)	Earthquake strengthening of concrete walls	Building Department canton Basel-City	2017
Bank for International Settlements BIS, Basel (CH)	Earthquake strengthening of concrete walls	Bank for International Settlements BIS	2017
Lonza Visp, Valais (CH)	Earthquake strengthening of concrete walls	Lonza AG	2016
TRUK Boltigen, Bern (CH)	Earthquake strengthening of masonry	armasuisse	2016
Stapfenstreet, Bern Bumpliz (CH)	Earthquake strengthening of precast concrete slabs	Housing and building cooperative Bumpliz	2015/16
Housing development, Horgen (CH)	Earthquake strengthening of concrete walls	Careal Holding Pensionskasse	2015

Project	Reason for strengthening	Client	Year
Housing development, Winterthur (CH)	Earthquake strengthening of masonry	Strabag AG	2015
Housing development Fellergut, Bern (CH)	Earthquake strengthening of concrete walls	Weiss+Appetito AG	2015
CS Uetlihof 1, Zurich (CH)	Earthquake strengthening of concrete walls	Credit Suisse	2015
Talgarten, Zurich (CH)	Earthquake strengthening of masonry	ASIG housing cooperative	2015
Highrise building, Bern Bumpliz (CH)	Earthquake strengthening of precast concrete slabs	Railway Building cooperative Bern	2014/15
Hospital, Aarau (CH)	Earthquake strengthening of coupling joint	Hospital Aarau AG	2014
Secondary school, Zurich (CH)	Earthquake strengthening of concrete walls	Municipality of Zurich	2014
Armory, Thun (CH)	Earthquake strengthening of concrete walls	Swiss Army	2013
Hospital, Aarau (CH)	Earthquake strengthening of coupling joint	Hospital Aarau AG	2013
Highrise Agrisano, Windisch (CH)	Earthquake strengthening of concrete walls	Health Insurance Agrisano	2013
Secondary school, Laufen (CH)	Earthquake strengthening of concrete walls	Building Department City of Lucerne	2013
Coop Wallisellenstrasse, Zurich (CH)	Earthquake strengthening of masonry	COOP Basel	2012/13
Roche Bldg.27, Basel (CH)	Earthquake strengthening of masonry	Hoffmann La Roche AG	2012
Weihermatt care home, Urdorf (CH)	Earthquake strengthening of masonry	Municipality of Urdorf	2012
Falkenstein care home, Basel (CH)	Earthquake strengthening of concrete walls	City of Basel	2011
Käfergrund 41/43/45, Aarau (CH)	Earthquake strengthening of masonry	Credit Suisse	2011
Aarmatt pumping station, Zuchwil (CH)	Earthquake strengthening of concrete walls	Regio Energie Solothurn	2010
Regio Energie HQ, Solothurn (CH)	Earthquake strengthening of masonry	Regio Energie Solothurn	2010
Agrisano office building, Windisch (CH)	Earthquake strengthening of concrete walls	Agrisano Health Insurance	2010
Community hall, Langendorf (CH)	Earthquake strengthening in lift shaft	Municipality of Langendorf	2010
Upper Valais hospital, Visp (CH)	Earthquake strengthening of concrete walls	Building Department Canton Valais	2009
Housing development Kürberg, Zürich (CH)	Earthquake strengthening of masonry	Halter AG, Zurich	2008
Wasgenring substation, Basel (CH)	Earthquake strengthening of concrete walls	IWB Indust. Werke Basel	2006
Gösgen nuclear power station, Däniken (CH)	Earthquake strengthening of cooling water tank	Kernkraftwerk Gösgen AG	2004
Fire station, Visp (CH)	Earthquake strengthening of masonry	Municipality of Visp	2002
Lucerne cantonal police, Lucerne (CH)	Earthquake strengthening of concrete walls	Building Department City of Lucerne	2000

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INNOVATIVE STRENGTHENING OF STRUCTURES

Industrial and high-rise buildings

Project	Reason for strengthening	Client	Year
Fresh water tank, Tel Aviv (ISR)	Closing cracks, replace missing reinforcement	Binyan Haaretz	2020
Railway station Bern, Bern (CH)	Concrete wall strengthening	SBB AG, real estate	2019
Tibits Restaurant, Bern (CH)	Deck strengthening	SBB AG, real estate	2018
Casino, Vienna (A)	Deck strengthening, removing column	Casinos Austria	2016
Secondary school Winterthur (CH)	Deck strengthening due to damaged prestressing	Municipality of Zurich	2014
Meat processor Meinen, Bern (CH)	Downstand strengthening	Meinen AG, Bern	2013
Park Hotel, Vitznau (CH)	Deck strengthening	Park Hotel Vitznau	2012
Burstwiesenstrasse, Zurich (CH)	Downstand strengthening	Wincasa AG, Winterthur	2010
Police building, Crans-Montana (CH)	Masonry strengthening		2008
Extension to Similasan, Jonen (CH)	Floor opening (lift)	Similasan AG, Jonen	2007
Reussmatten development, Sins (CH)	Shear reinforcement		2006
Conversion to Lacoste, Basel (CH)	Deck strengthening due to conversion	Lacbal SA	2005
Leutschenbach, Zurich (CH)	Deck strengthening due to stormwater tank	ARGE Leutschenbach	2005
VEBO multi-use building, Oensingen	Deck strengthening due to damaged prestressing	VEBO Oensingen	2004
Holcim AG, Würenlingen (CH)	Silo strengthening	Sika Services AG	2004
Auto Rondo, AMAG Zug (CH)	Downstand strengthening for wall penetration	AMAG Zug AG	2003
Aupoint Brandstetter, Salzburg (A)	Hall roof truss strengthening due to fire damage	Brandstetter GmbH	2003
Thurgauerhof, Weinfelden (CH)	Shear strengthening of concrete beams	Hotel Thurgauerhof	2003
Audi plant Hungary, Györ (H)	Sealing of expansion and movement gaps	Audi Hungary	2002
CS communications centre, Horgen (CH)	Strengthening of masonry and roof trusses	Credit Suisse, Zurich	2002
Shopping centre, Emmen (CH)	Strengthening of stairwell cores	Maus Frères SA	2001
Paper plant, Perlen (CH)	Façade underpinning with column removal	Perlen Papier AG	2000
Orly Center, Amsterdam (NL)	Needle beam strengthening in façade area	Orly Center AG	2000

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INNOVATIVE STRENGTHENING OF STRUCTURES

Bridges

Project	Reason for strengthening	Client	Year
Railway bridge, Strbske Pleso (SVK)	Additional pay load	ŽSR - Railways of the Slovak Republic	2022
Puente Manantiales, Ensenada (MX)	Temporary increase of pay load	CECCVIT	2022
3 Railway bridges, Tatranská Štrba (SVK)	Additional pay load	ŽSR - Railways of the Slovak Republic	2021
Bridge R.N.7, Pontcharra-sur-Turdine (F)	Prestressing cable replacement	DIR Centre-Est	2018
Sandacher Bridge, Spreitenbach (CH)	Strengthening of coupling joint	Swiss Railway SBB, ASTRA	2015 till 2017
Cavan Bridge (IRL)	Bending strengthening	John Cradock Ltd	2016
Semuy Bridge, Ardennes (F)	Bridge girder strengthening	Dép. Ardennes	2016
Bridge Exit N29, Qatar (QA)	Strengthening of web due to damaged prestressing cable	Public Works Authority of Qatar (Ashghal)	2015
Bridge, China (CHN)	Train bridge girder strengthening	via Sika Services AG	2014
Fortified Bridge Hagneck Biel (CH)	Prestressing cable replacement	BKW FMB Energie AG	2014
Bridge, China (CHN)	Train bridge girder strengthening	via Sika Services AG	2013
Commonwealth Bridge, Singapore (SIN)	Bridge stringer strengthening	VSL International AG	2008
Tschingeley Bridge, Grindelwald (CH)	Bridge strengthening and repair	Municipality of Grindelwald	2007
Stegweid Bridge, Spiez (CH)	Bridge cross beam shear strengthening	Ct. of Berne Civ.Eng. Dept.	2006
Bridge, China (CHN)	Bridge stringer strengthening	via Sika Services AG	2004
Bridge, Holland (NL)	Bridge stringer strengthening	via Sika Services AG	2004
Ländten Bridge, Biel (CH)	Bridge stringer strengthening for bending and shear	City of Biel Civ.Eng. Dept.	2004
Clinton & Hopkins Bridge, Ohio (USA)	Bridge stringer strengthening	State of Ohio, Dept. of Transportation	2003
Hütten Bridge, Werthenstein (CH)	Bridge stringer strengthening for bending and shear	Ct. of Lucerne Dept. of Agriculture	2003
Sung San Bridge, Seoul (KOR)	Bridge deck strengthening, longitudinal	Western Roads & Bridges Maintenance Office Seoul	2002
A3 Escher Canal Bridge, Glarus (CH)	Bridge deck strengthening, transverse	Ct. of Glarus Civ.Eng. Dept.	2002
A4 Reuss Bridge, Flüelen (CH)	Cross beam strengthening	Ct. of Uri Civ.Eng. Dept.	1999

Retirement Home, Herisau (CH)

Project

As part of various new construction and renovation work, the Waldegg building of the *Foundation care of elderly Herisau* was upgraded regarding earthquake resistance. The old building no longer met the requirements acc. the codes and therefore had to be reinforced for earthquakes.

Solution

On a total of three walls, classic bonded and prestressed CFRP plates were used to reinforce the masonry walls. Four of the prestressed CFRP plates run from the 3rd floor to the basement of the building. The anchorage of these four systems was connected to the slabs. The remaining prestressed CFRP lamellas were installed over 2 floors and the fixed anchorage was casted into the new built concrete walls.

Parties involved in the Project:

Client:	Stiftung Altersbetreung; Herisau
Civil Engineer :	Urech Bärtschi Maurer AG, Zürich
Contractor:	Diamantbohr AG, St. Gallen
Tensioning System:	StressHead AG
Year:	2017

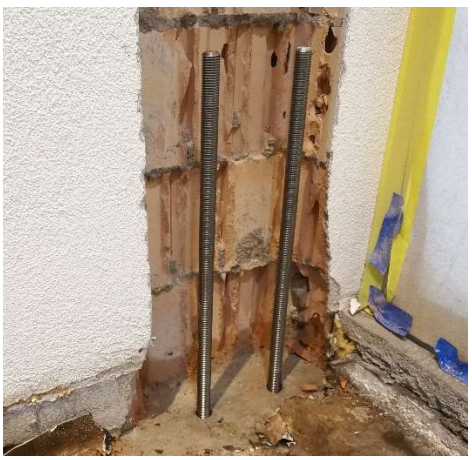
Control Center Armasuisse, Emmen(CH)

Project

The office building of the Emmen airfield command was strengthened for earthquakes as part of renovation work.

Solution

Since the project is a military facility, all preparation and tensioning work for the installation of the prestressed CFRP plates had to be carried out while the facility was in constant operation. A total of five plates were installed. A special system was used for the fixed anchoring. With the help of threaded rods drilled into the floor slab, as a fixed anchorage, the plates could be anchored to the lowest floor. This special system is called Swiss-lock.



Parties involved in the Project:

Client:	armasuisse
Civil Engineer :	IUB Bauingenieure, Luzern
Contractor:	Sika Bau AG, Zürich
Tensioning System:	StressHead AG
Year:	2017

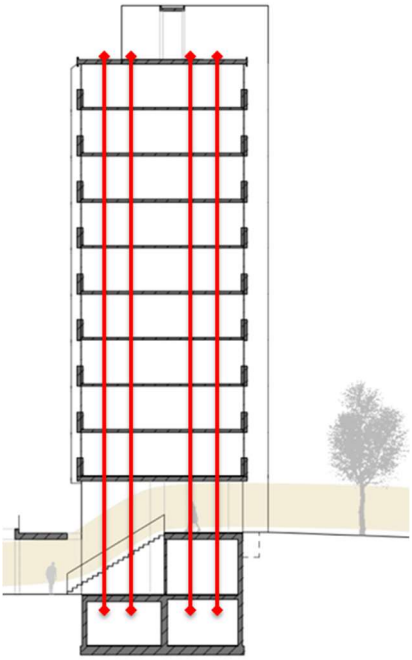
Fellergut, Bern (CH)

Project

The 10-storey building consists of precast concrete elements. These had insufficient resistance to earthquake loads. The building had to be posttensioned vertically and horizontally.

Solution

As reinforcement the building was clamped over the full height of the building. The systems with a length of about 30m were anchored in the basement and on the roof.



Parties involved in the Project:

Engineer:	SMT Ingenieure + Planer AG
Tensioning System:	StressHead AG
Year:	2015 - 2016

Käfergrund 41/43/45, Aarau (CH)

Project

A review of the earthquake resistance of this multi-occupancy building showed that it only had 25% of the current resistance requirements. Earthquake resistance strengthening was therefore necessary so that the building would meet the current standards.

Solution

Earthquake strengthening was carried out in the individual stairwells despite the confined space. This involved a total 12 systems, 4 in each house. The fixed anchorage for all these systems is in the basements. The post-tensioning force is anchored into concrete wall with a shear connector. The tensioning end of the systems is located on the 2nd floor above the landing. The post-tensioning force is transferred directly from the landings via a steel component into the deck slab and then onto the wall below. With this special anchoring system it was possible to strengthen the masonry walls without damaging them.

Parties involved in the Project:

Client:	Credit Suisse, Zürich
Civil Engineer :	Healy + Partner Engineering, Aarau
Contractor:	SIKA Bau AG, Aarau
Tensioning System:	StressHead AG
Year:	2011

Agrisano office building, Windisch (CH)

Project

The Agrisano 8-storey office building in Windisch did not meet the earthquake resistance requirements. A resistance of only 25% could be guaranteed without strengthening, making it essential.

Solution

The earthquake resistance was achieved with 16 post-tensioned CFRP plates applied directly on an external wall. The individual tendons differed in length to counteract the increasing bending moment from the impact of the earthquake. The tensioned end for all the systems is located on the ground floor. A special steel component was used for the fixed anchorage in the face of the deck slab.

Parties involved in the Project:

Client:	Krankenkasse Agrisano
Civil Engineer :	Gerber+Partner , Bauingenieure & Planer AG
Contractor:	SIKA Bau AG, Kirchberg
Tensioning System:	StressHead AG
Year:	2010

Langendorf community hall (CH)

Project

During alterations to Langendorf community hall, the building was found to be non-compliant with the current standards. Strengthening was necessary mainly in terms of earthquake resistance.

Solution

The newly designed lift shaft was suitable for the earthquake strengthening system, which was where 4 post-tensioned CFRP plates were applied. The plates pass through 4 storeys and are 17m in length. The fixed anchor is on the top floor. Because the masonry in this area is not load bearing, the walls could not be used to transfer the post-tensioning force. Therefore a steel component takes the force directly from the plate into the deck slab. The tensioning end is located in the basement, where the forces are introduced directly into the concrete wall by a shear connector.

Parties involved in the Project:

Client:	Gemeinde Langendorf
Civil Engineer :	Emch+Berger AG, Solothurn
Contractor:	SIKA Bau AG, Kirchberg
Tensioning System:	StressHead AG
Year:	2010

Wasgenring substation, Basel (CH)

Project

80% of the main power distribution centre building at the Wasgenring substation is underground. Only the one and two storey access structures such as the ventilation plant, stores, stairwell and assembly shop are located above ground. Analyses showed that the parts above ground only had just 30% of the required earthquake resistance. To guarantee the resistance, the City of Basel electricity supply substation had to be strengthened.

Solution

Because the building only had masonry walls and no other stiffening walls, two concrete cross walls were constructed and then strengthened with post-tensioned CFRP plates installed vertically. The 14 plates transfer the earthquake forces from the two new concrete walls into the solid underground storey.

Parties involved in the Project:

Client:	IWB Industrielle Werke Basel
Civil Engineer :	Calenco Power Engineering AG, Baden
Contractor:	SIKA Bau AG, Muttenz, VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2006

Gösgen nuclear power station, Däniken (CH)

Project

In the course of a general seismic review, strengthening of the emergency feed building at Gösgen nuclear power station was found to be necessary. As a secondary measure, the four deionate (coolant water) tanks had to be strengthened. They did not meet the relevant standards.

Solution

Post-tensioned, chemically resistant CFRP plates were specified as the strengthening system. They could be applied in a very short time and at the ends transferred the post-tensioning forces through concentrated end anchors into the cross walls. Quality control of the CFRP plates had top priority. Every tendon was tested to a post-tensioning force of 110% at the production facility before being installed on the structure.

Parties involved in the Project:

Client:	Kernkraftwerk Gösgen AG
Civil Engineer :	PlüssMeyerPartner AG
Contractor:	Sika Bau AG Kriens, VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2004

Fire station, Visp (CH)

Project

The Visp fire service building dated from 1974. In addition to structural damage of various kinds, the load-bearing structure was also seriously defective. The masonry-infilled reinforced concrete gable walls frames behaved very poorly in earthquakes and could not transfer the seismic forces into the ground.
Operations at the fire station were only to be slightly restricted during the construction works.

Solution

The earthquake resistance of the gable walls could be guaranteed by four vertical CFRP plates at the ends of each wall. The plates were anchored and tensioned in the roof and on the basement walls. The additional vertical load from the tensioned CFRP plates is sufficient to increase the shear resistance of the masonry as required and therefore to produce the required earthquake resistance.

Parties involved in the Project:

Client:	Gemeinde Visp
Civil Engineer :	BIAG Visp
Contractor:	VSL-Schweiz AG, SIKA Bau AG, Steg
Tensioning System:	StressHead AG
Year:	2002

Upper Valais hospital, Visp (CH)

Project

It was found in the course of a structural re-analysis of the hospital centre on the basis of current structural standards that the earthquake resistance was not guaranteed. During the preliminary project phase two strengthening solutions were proposed.
The first option consisted of additional reinforced concrete panels by the conventional construction method. The second option was to strengthen with post-tensioned CFRP plates.

Solution

A comparison of the two options showed that it would be cheaper to strengthen the masonry with post-tensioned CFRP plates than to install the new RC panels. Another advantage of the CFRP strengthening system is its speed of application. The client decided in favour of the CFRP option. The 33 post-tensioned CFRP plates were installed in the lift shaft in record time.

Parties involved in the Project:

Client:	Gesundheitsamt Kanton Wallis
Civil Engineer :	Teysseire & Candolfi AG, Visp
Contractor:	VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2009

Lucerne cantonal police, Lucerne (CH)

Project

As part of the raising and general renovation of the nine-storey police headquarters, the building's earthquake resistance had to be guaranteed. To strengthen and stiffen the building, a new concrete panel was installed from the ground floor up to the full building height.

Solution

The new panel was fixed and anchored in the basement under very tight space conditions. The force was transferred from the new panel to the basement walls by CFRP plates located and post-tensioned on both sides.

Parties involved in the Project:

Client:	Hochbauamt des Kantons Luzern
Civil Engineer :	PlüssMeyerPartner AG
Contractor:	Stutz AG, Willisau
Tensioning System:	StressHead AG
Year:	2000

Kürberg housing development, Zurich (CH)

Project

The Kürberg housing development in Zurich was completed in 2005. It consists of a through basement garage and three multi-occupancy buildings. The structural analysis carried out following minor damage revealed that the earthquake resistance was inadequate.

Solution

Masonry walls were strengthened with post-tensioned CFRP plates to reinstate the earthquake resistance. The plates cover the full height of the building and are anchored in the basement garage deck slab. The fixed end anchor is located on the flat roofs of the buildings. The post-tensioning force is introduced into the deck slab face via a steel component. The tensioned end is in the garage. In all 20 systems were applied for the three buildings.

Parties involved in the Project:

Client:	Halter AG, Zürich
Civil Engineer :	Basler & Hoffmann, Zürich
Contractor:	Sika Bau AG, Zürich, VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2008

Fresh water tank, Tel Aviv (ISR)

Project

The water tank for fresh water is located in the region of Tel Aviv and was built in the 1940s. The water tank has a diameter of 8.4m, a height of 6.0m and a concrete wall thickness of 20cm. The water tank to be strengthened is located in a nature reserve. This was one of the reasons that a repair was preferred to a new construction.

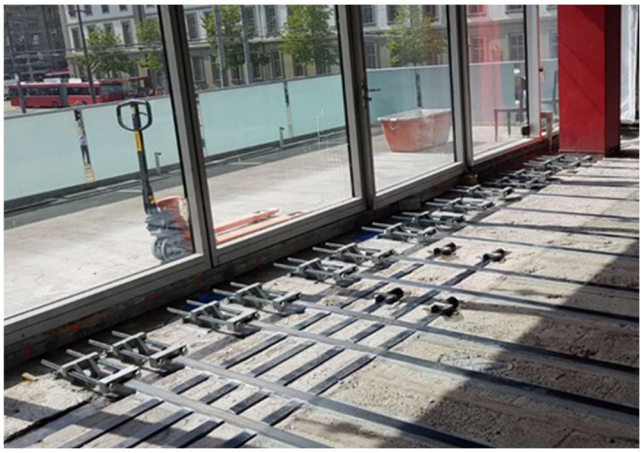
Over the years, the concrete structure has developed cracks. After detailed investigations and static examination of the supporting structure, a complete renovation with renewal of the waterproofing from the inside and an external reinforcement was ordered.

Solution

As static reinforcement, eight CarboStress systems were installed, each with 180kN tension force distributed over the height. In order to keep friction losses low during the tensioning process, the CarboStress systems were tensioned synchronously on both sides and the areas of the end anchorages were staggered around the tank. Due to the low dead weight of the tendons, no cranes or lifting equipment were required for the entire installation process of the CarboStress system. A simple scaffold was sufficient.

Parties involved in the Project:
Tensioning System: StressHead AG
Year: 2020

Restaurant TIBITS, Bern (CH)



Project

The two-storey restaurant Tibits is to be built at the main station in Bern. As a result, it was decided to implement a new internal elevator and stairway through the existing concrete ceiling. The existing reinforced concrete structure was examined with regard to its future structural suitability. Due to the balcony, the upper reinforcement was too low.

Solution

As reinforcement 35 StressHead-CarboStress-systems were assembled. This replaced the required upper reinforcement layer. Thanks to the low height of the StressHead system, it was possible to realize the strengthening in the underlay. With a new anchoring system, the prestressing forces of up to 220 kN per system (22 tons) could be introduced into the concrete with minimal drilling and milling work.

Parties involved in the Project:
Engineer: Rothpletz, Lienhard + Cie AG
Contractor: SikaBau AG
Tensioning System: StressHead AG
Year: 2018

Burstwiesenstrasse, Zurich (CH)

Project

During the refurbishment of the building covering numbers 17 to 21 Burstwiesen Strasse in Zurich, it was discovered that 2 downstand beams in the basement garage did not have sufficient reserve load capacity. The span of the beams was 7.50m. The bending resistance of both of these beams had to be increased.

Solution

The beams were strengthened using a tensioning system. Because the clear height of the basement could not be reduced and the existing concentrated reinforcement at the bottom of the downstand beams was not to be damaged by drilling for anchors, the two tensioning systems were applied on the sides of the beams. The anchorage was formed using threaded rods which were fixed into the adjacent walls.

Parties involved in the Project:

Client:	Wincasa AG, Winterthur
Civil Engineer :	wlw Civil Engineer e AG, Zürich
Contractor:	SIKA Bau AG, Kirchberg
Tensioning System:	StressHead AG
Year:	2010

Reussmatten development, Sins (CH)

Project

When a development with several multi-occupancy buildings and a communal basement garage was built, the punching shear reinforcement was found to be missing from 2 of the columns. Both of these columns therefore had inadequate punching shear resistance and had to be post-strengthened.

Solution

The punching shear resistance was increased by installing 3 plates on top of each deck slab. Since the seating area of an apartment in a multi-occupancy building was directly above, the anchors and plates were fully mortared in and are no longer visible.

Parties involved in the Project:

Client:	
Civil Engineer :	T. Leuthard, Ingenieur HTL, Merenschwand
Contractor:	SIKA Bau AG, Kriens, VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2006

VEBO multi-use building, Oensingen

Project

During alterations to the VEBO (Disabled Integration Society) multi-use building, 3 stressed cables were accidentally cut during drilling. The original prestressing force had to be restored under confined space conditions.

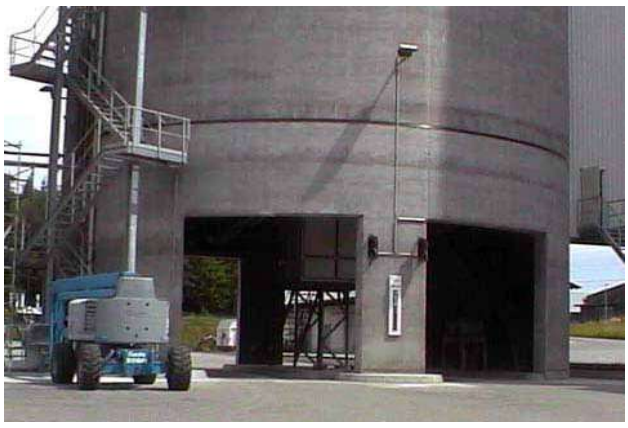
Solution

The deck slab was strengthened with post-tensioned CFRP plates from below and from above directly on its surface. The installation level of 5cm maximum was crucial because the existing installations could not be changed. The original prestressing force was finally restored.

Parties involved in the Project:

Client:	VEBO Oensingen
Civil Engineer :	TSW Ingenieure und Planer, Olten
Contractor:	SIKA Bau AG, Kriens, VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2004

Holcim AG, Würenlingen (CH)



Project

Silos are used for storing a range of products such as foodstuffs, crude oil, cement, etc. The operations to fill and empty the contents cause stresses on the silo structure which were not well known until a few years ago. This was the reason for developing post-strengthening with the StressHead system, which acts as a chemical bond.

Solution

StressHead AG, in collaboration with Sika AG and VSL-Schweiz AG, developed a special anchor for post- strengthening of silos with tensioned CFRP plates.

Parties involved in the Project:

Client:	Sika Services AG
Civil Engineer :	Arthur Hauser AG, Kleindöttingen
Contractor:	SIKA Bau AG, Kriens, VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2004

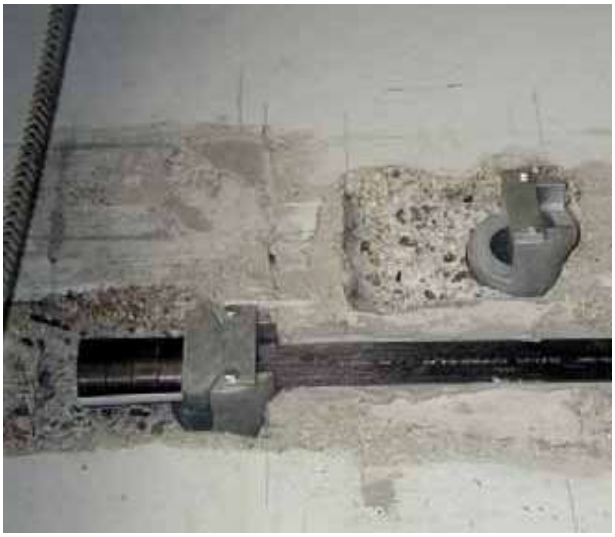
Auto Rondo, AMAG Zug (CH)

Project

When the AMAG Zug building was extended, the sales and operational areas were rearranged. An opening was cut in an existing concrete wall. The wall around the new opening had first to be strengthened.

Solution

Two post-tensioned CFRP plates were applied on both sides of the wall. The end anchorage of the plates was formed by concentrated transfer of forces into the concrete.



Parties involved in the Project:

Client:	AMAG Zug AG
Civil Engineer :	PlüssMeyerPartner AG
Contractor:	Arnet AG, Root, SIKA Bau AG, Kriens VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2003

Aupoint Brandstetter, Salzburg (A)

Project

The load bearing structure of the factory roof was damaged due to a fire. The 14m long prefabricated RC trusses had to be strengthened in the area affected by the fire. The strengthening operations had to be completed in 1½ days so that production would not be affected. The requirements for low component depth and structural fire protection also had to be met.

Solution

External post-tensioning with a tensioning force approximately the same as the live load stress was a suitable method. All the conditions were met in full with post-tensioned CFRP plates.

Parties involved in the Project:

Client:	Brandstetter GmbH
Civil Engineer :	Dipl. Ing. N. Baueregger, Salzburg
Contractor:	GPS-Himberg bei Wien, SIKA AG, Österreich
Tensioning System:	StressHead AG
Year:	2003

Audi plant Hungary, Györ (H)

Project

An existing facility at Audi Hungary was equipped with a new machine tool. Vibration and temperature changes caused excessive differential deformation of the existing expansion joints. This differential deformation had to be eliminated around the new machine tool. The gaps could then be sealed and the individual base panels of the floor slab could be joined together.

Solution

The gaps in the base panels were grouted and joined with post-tensioned CFRP plates.

Parties involved in the Project:

Client:	Audi Ungarn
Civil Engineer :	Kempen Ingenieurgesellschaft, Aachen
Contractor:	STRABAG Ungarn
Tensioning System:	SIKA AG-StressHead AG
Year:	2002

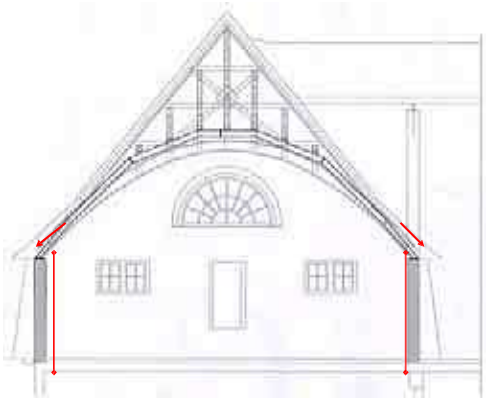
CS communications centre, Horgen (CH)

Project

The indoor riding arena on the Bocken estate – a listed building -was converted to a communications centre for Credit Suisse. The complex has a basement covering the full building footprint. The murals on the arena façades had to be preserved, the masonry had to be secured and the roofing had to be stabilised.

Solution

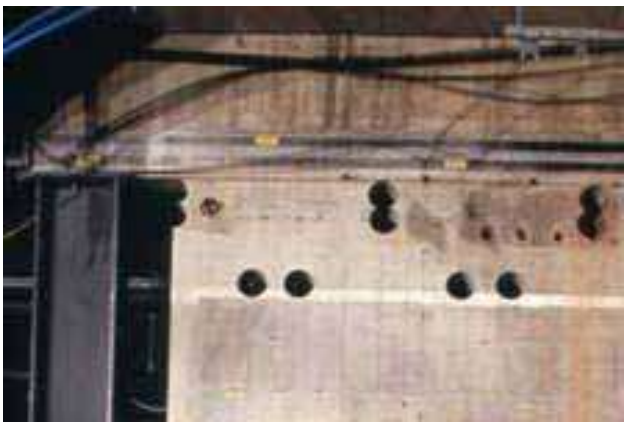
A horizontal tie beam of post-tensioned CFRP plates was installed around the arena supports. The additional loads on the roof trusses were transferred to the newly built basement through masonry piers which were strengthened with internal post-tensioned CFRP plates. To prevent cracks in the façades, the masonry walls were first stabilised vertically and horizontally with CFRP plates.



Parties involved in the Project:

Client:	Credit Suisse, Zürich
Civil Engineer :	PlüssMeyerPartner AG
Contractor:	Dangel & Co AG, Zürich, Sika Bau AG
Tensioning System:	StressHead AG
Year:	2002

Shopping centre, Emmen (CH)



Project

As part of the general renovations to Emmen shopping centre, various structural alterations were carried out and earthquake strengthening was installed. Some stiffening stairwell cores and wall panels were removed. Therefore other stiffening components had to be strengthened.

Solution

So that the forces from a tie rod at the bottom of a wall panel could be correctly anchored, post-applied CFRP plates were routed behind the support and anchored in a concentrated arrangement. The end anchorage of the CFRP plates was formed by a perforated end panel in which the plates were fixed by pressed-on StressHeads.

Parties involved in the Project:

Client:	Maus Frères SA
Civil Engineer :	PlüssMeyerPartner AG
Contractor	Anliker AG, Emmen
Tensioning System:	StressHead AG
Year:	2001

Paper plant, Perlen (CH)

Project

The installation of a new paper machine required an existing opening in a façade to be enlarged. Two existing columns on an upstand beam had to be moved for this.

Solution

In the upstand beam support area, the existing columns were drilled through horizontally and the CRRP plates were fed through and tensioned. The end anchors were integrated in the newly constructed columns and the old columns were then demolished.

Parties involved in the Project:

Client:	Perlen Papier AG
Civil Engineer :	PlüssMeyerPartner AG
Contractor:	Wüest AG, Luzern
Tensioning System:	StressHead AG
Year:	2000

Orly Center, Amsterdam (NL)

Project

During the construction phase of an eight-storey office building of prefabricated concrete units, large cracks appeared in the needle beams above the ground floor around the columns. A halt to construction was ordered. The top reinforcement around the columns was inadequate to divert the reaction forces from the façade elements situated above. The forces acted eccentrically to the bearing, as well as the bending stress.

Solution

The requirement was a post-tensioned strengthening system which would project by a maximum of 3mm behind the façade elements around the columns and could be applied in a very short time. The strengthening works above 12 columns took 1½ days. The building could then be approved.

Parties involved in the Project:

Client:	Orly Center AG
Contractor:	HABAU, Hoch- und Tiefbau GmbH, Heringen
Tensioning System:	StressHead AG
Year:	2000

Park Hotel, Vitznau (CH)

Project

At the Park Hotel in Vitznau, a deck slab was strengthened during alterations and renovations. To enable the additional loads to be absorbed, the deck slab was strengthened with untensioned CFRP plates. Because there was little space available for the anchor at one end of the slab, short transfer of force was necessary.

Solution

The StressHead CFRP tensioning system was not post-tensioned for this project. The StressHead was used only for transfer of force. With the compact end anchor, the CFRP plate was fixed a very short distance behind the support.

Parties involved in the Project:

Client:	Parkhotel Vitznau
Civil Engineer :	Leuthard Civil Engineer GmbH, Luzern
Contractor:	Fero-Tekt AG, Buchrain
Tensioning System:	StressHead AG
Year:	2012

Bridge R.N.7, Pontcharra-sur-Turdine (FR)

Project

The French highway bridge R.N.7 spans the main road R.D.27 through Pontcharra-sur-Turdine with a span of about 11m.
The bridge of prestressed prefabricated parts was damaged due to a vehicle impact. The fourth beam away from the edge was torn open and the longitudinal reinforcement damaged.

Solution

The shear resistance was restored with SIKA-Wrap and the damaged prestressing cables were replaced by two StressHead-CarboStress-Systems. Due to the limited space between the beams and for no damaging the remaining longitudinal reinforcement in the beam, a special anchorage was developed.

Parties involved in the Project:
Contractor: Eiffage Génie Civil, Vélizy-Villacoublay F
Tensioning System: StressHead AG
Year: 2018

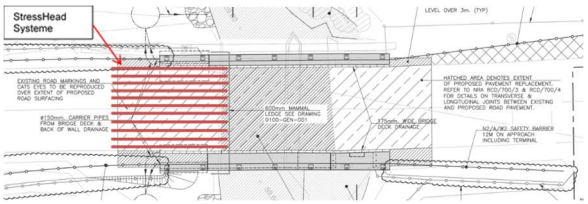
Borim-Bridge, Cavan (IRL)

Project

The Gavan Bridge, also called Borim Bridge, spans the river in two short, single fields. The plans of the bridge cross section show that the bridge was probably built in two stages. The soffits of the two bridge plates are not in one plane. The bridge plate is insufficiently reinforced and the concrete quality of the underside of the bridge does not comply with the standards today.

Solution

The required reinforcement on the underside of the slab is achieved with tensioned CFRP slats. The total of 30 StressHead CarboStress systems are anchored directly in the area of the abutments and the bridge pillar. The force has been reduced due to the moderate quality of concrete and all steel parts are executed due to the strong weathering in stainless chrome steel.



Parties involved in the Project:
Civil Engineer: Basler & Hofmann AG, CH
Contractor: John Cradock Ltd., Mr. Victor Smyth, Ireland
Tensioning System: StressHead AG
Year: 2016

Bridge, Semuy (FR)

Project

The reinforced concrete bridge spans the river Ardennes near Semuy in the department of Ardennes. The condition of the reinforced concrete structure was judged to be "bad". Some of the tension cables in the bridge longitudinal direction are heavily corroded. The load capacity of the bridge is insufficient.

Solution

The bridge beam were reinforced by external prestressing with CFRP slats. The systems were assembled on the side of the beam to be protected in the event of a ship impact

Parties involved in the Project:

Contractor:	E.S.T.S., Ludres F
Tensioning System:	StressHead AG
Year:	2016

Sandacher-Bridge, Spreitenbach (CH)

Project

The Sandacher bridge was originally built in 1969/70 and is a prestressed concrete structure and crosses the N1 national highway. Routine structural surveys revealed that - amongst other things - all four coupling joints in the main post tensioned structure were cracked. These were separate cracks each of about 1 mm maximum width.

Solution

To close the joints, the cracks were cleaned out and then they were compressed locally by the installation of the external post-tensioning system.
Each coupling joint was strengthened with 18 StressHead CarboStress® systems at 220 kN post-tensioning force. (Total force about 4’000 kN per joint)

Parties involved in the Project:

Engineer:	dsp Ingenieure & Planer AG
Contractor:	SikaBau AG
Tensioning System:	StressHead AG
Year:	2014 - 2015

Barrage Hagneck, Biel (CH)

Project

During refurbishment work on the barrage Hagneck in Biel, a tensioning cable was cut through with a deck tiller. The destroyed tension cable had to be replaced locally.

Solution

The destroyed cable was replaced by 9 post-tensioned cfrp slats. Because the strengthening is under the asphalt, the anchors of the systems had to be completely sunk into the concrete. The reinforcement is thus no longer visible under the new surface.

Parties involved in the Project:
Tensioning System: StressHead AG
Year: 2014

Heron Bridge, Ottawa (CAN)

Project

The Heron Bridge in Ottawa is a multi-span bridge with a total span of 275m and is divided in two halves. There is a separate main bridge support beam or girder for both sides. Both have 9 stringers which are connected together by the deck and transverse beams.
The bridge was in poor condition and already had some cracks. Repair and strengthening was necessary.

Solution

In addition to concrete repairs on the bridge deck, the transverse beams were strengthened against bending forces with post-tensioned CFRP plates. The concrete quality at the end of the girder made concentrated transfer of force by anchors impossible. Therefore the compressive force was transferred onto a larger area through a flat steel plate. In all, 36 StressHead systems were installed.

Parties involved in the construction
Client: Ottawa Infrastructure Services Department (W. Newell, Project ENG.)
Civil Engineer : Remisz Consulting Engineers Ltd. Ottawa, Ontario
Pomerleau Montréal Canada
Tensioning System: StressHead AG
Year: 2011/12

Tschingeley Bridge, Grindelwald (CH)

Project

The Tschingeley Bridge in Grindelwald spans the Schwarze Lütschine river near Burglauenen. It consists of a deck with 2 longitudinal stringer beams. The bridge was in a seriously defective condition and because it had to be used as the main access to a landfill site for the next 10 years, it had to be strengthened. The aims of the repair were to restore its efficiency for the next 10 years and increase its bearing capacity to accommodate 40 tonne loads.

Solution

Four tensioning systems were installed on each stringer beam to strengthen the bridge. Since 2 systems were sufficient for strengthening at the outer ends of the bridge, 2 systems were only located in the centre of the span. Six tendons were already installed in both stringers, which made the choice of suitable anchorage points difficult. The concentrated transfer of the post-tensioning force was achieved with a steel shear connector designed and installed to cause only minimal weakening of the existing concrete structure.

Parties involved in the construction

Client:	Gemeinde Grindelwald
Civil Engineer :	PlüssMeyerPartner AG, Luzern
Contractor:	Walo Bertschinger AG BE, VSL Schweiz AG
Tensioning System:	StressHead AG
Year:	2007

Ländten Bridge, Biel (CH)

Project

The 65 year old bridge on Ländtenstrasse Ost in Biel had been designed for maximum load capacity of 20 tonnes as its requirement many years ago. The bridge now had to withstand the current maximum load of 40 tonne loads, which therefore required extensive strengthening work.

Solution

The design of the downstand beams with side arches made them well suited to a structural strengthening system using CFRP plates. The bending resistance and shear resistance both beams had to be increased. Two post-tensioning systems were therefore installed on each downstand beam and they were end-anchored in the bridge abutments.

Parties involved in the Project:

Client:	Tiefbauamt Stadt Biel
Civil Engineer :	Aeschbacher & Partner AG, Bauingenieure und Planer, Biel
Contractor:	De Luca AG, Sika Bau AG, Kriens VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2004

Clinton & Hopkins Bridge, Ohio (USA)

Project

The two multi-span bridges were originally prefabricated. Up to 16 box girder beams were prefabricated by the prestressed bed process and then joined together on site. Leaking drainage pipes and defective mains drainage routing had eventually caused corrosion damage over time to the tendons, making strengthening of the box girder beams necessary.

Solution

The prefabricated box beams were very slender in form. In the CFRP plate end anchor areas, the concrete was therefore locally strengthened horizontally with CFRP fabric. Tensioned CFRP plates supplemented the damaged bending reinforcement and the tendons. The bearing capacity was then restored.

Parties involved in the Project:

Client:	State of Ohio, Dept. of Transportation
Civil Engineer :	WOOLPERT LLP, Dept. Of Transportation, University of Dayton, Dept. of Civil Engineering
Contractor:	SPS/VSL (Structural Preservation Systems)
Tensioning System:	SIKA AG-StressHead AG
Year:	2003

Hütten Bridge, Werthenstein (CH)

Project

The Hütten Bridge was built in the 1950s and was then designed for vehicles with a maximum total load of 28 tonnes. The management of the surrounding forests now required the bridge to be usable by timber transporters and trucks with loads of up to 40 tonnes. The two stringers on the three-span bridge could not take that stress and therefore had to be strengthened for bending and shear.

Solution

The two bridge stringers were strengthened on both sides with post-tensioned CFRP plates up to 30m long. The end anchorage of the tensioned plates was formed by shear connectors right through the stringers, which concentrated the post-tensioning forces within them. CFRP fibre loops were then used for the shear strengthening. Vertical slots were first cut in the bridge deck so that the loops could completely surround both the tension and compression zones of the stringers. The loops were threaded through in several layers and then bonded.

Parties involved in the Project:

Client:	Landwirtschaftsamt Kanton Luzern
Civil Engineer :	Peter Stalder Ingenieur AG, Malters
Contractor	SIKA Bau AG, Kriens, VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2003

Sung San Bridge, Seoul (KOR)

Project

The deck of this multi-span bridge had large transverse cracks in several places. The cracks were the result of the ever-increasing traffic loads for which the longitudinal deck reinforcement was not designed. Soffit-mounted bending strengthening was required, and specifically around the abutments and supports. Part of the transfer of force of the CFRP plate end anchors had to be located right by the support, in other words in the arches.

Solution

The longitudinal strengthening was carried out with post-tensioned CFRP plates. The plates were rerouted in the arch areas by a steel saddle to prevent them detaching. The plate end anchorage force could thus be transferred in the sloping part of the arch.

Parties involved in the Project:

Client:	Western Roads & Bridges Maintenance Office Seoul
Civil Engineer :	SUKWOO Corporation
Contractor:	Sika Korea Ltd, SUKWOO Corporation
Tensioning System:	SIKA AG-StressHead AG
Year:	2002

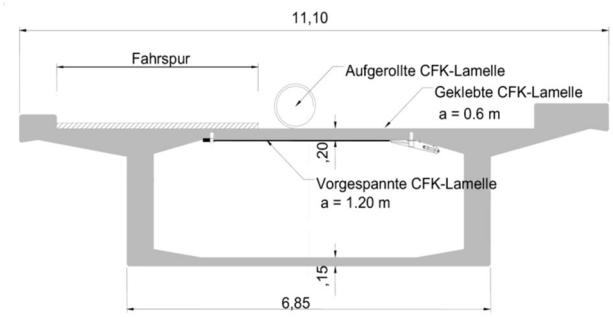
A3 Escher Canal Bridge, Glarus (CH)

Project

The three-span bridge on the A3 Sargans-Zurich motorway was built in 1957 and crosses the Escher Canal near Weesen. The superstructure is a fully prestressed box beam. During routine inspection a crack was found to extend along the whole length of the bridge in the centre of the deck soffit. Strengthening was required

Solution

The deck was strengthened transversely in the span in the bay for positive and negative moments with CFRP plates. The tensioned CFRP plates on the deck soffit act as external post-tensioning. The post-tensioning force is transferred into the concrete at the plate ends only, and so could be located where it was required to achieve the optimum strengthening effect.



Parties involved in the Project:

Client:	Amt für Tiefbau Kanton Glarus
Civil Engineer :	Ingenieurbüro Locher AG, Zürich
Contractor:	Spaltenstein AG, Zürich SIKA Bau AG, VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2002

Commonwealth Bridge, Singapore (SIN)

Project

The Commonwealth Bridge in Singapore, with a span of 23m, crosses a railway line. Three lanes of traffic use the prestressed bridge, which carries these loads with a single beam. A review under the new structural standards showed that the load bearing capacity was no longer assured. The bridges load bearing capacity therefore had to be increased by 20%

Solution

Two options were proposed to strengthen the bridge. The first option using 3 additional prestressed steel systems was rejected, due to the complex construction works required and the additional dead weight placed on the bridge. It was decide to alternatively strengthen the structure with post-tensioned CFRP plates. Therefore 16 StressHead systems in total were installed for strengthening of the stringers.

Parties involved in the Project:

Client:	VSL-International AG
Civil Engineer :	Dr. Tan Kiang Hwee, Department of Civil Engineer, National University of Singapore
Contractor:	VSL-International AG
Tensioning System:	StressHead AG
Year:	2008

Stegweid Bridge, Spiez (CH)

Project

A live load increase from 28 to 40 tonnes was specified for the Stegweid Bridge in Spiez. This meant that the two transverse beams had to be strengthened because they could not withstand the new loading.

Solution

To increase the shear resistance of the transverse beams, the two existing concrete beams were strengthened with post-tensioned CFRP plates. The post-tensioning force was transferred to the structure at both ends of the transverse beams via a special anchoring plate, which distributed the forces into the beams. It only required minor concrete surface scabbling to allow the CFRP plates to be fixed with an anchoring plate.

Parties involved in the Project:

Client:	Tiefbauamt Kanton Bern
Civil Engineer :	IUB Ingenieur-Unternehmung AG, Bern
Contractor:	SIKA Bau AG, Kirchberg, VSL-Schweiz AG
Tensioning System:	StressHead AG
Year:	2006