

**Weihermatt care home, Urdorf (CH)**



**Project**

During refurbishment and extension of the Weihermatt care home in Urdorf, its earthquake resistance was investigated. It was found that the building did not meet the current standards and earthquake strengthening was necessary.

**Solution**

To re-engineer the earthquake resistance, 8 masonry walls were strengthened with post-tensioned CFRP plates. In the basement the tensioning system is anchored directly in the deck slab. The tendons then pass through 6 storeys up to the roof of the care home, where the tensioning end is located. The tensioning force is transferred through the deck slab onto the walls below using threaded rods which anchor the StressHead in the slab.



Am Bau Beteiligte  
 Client: Gemeinde Urdorf  
 Civil Engineer : Urech Bärtschi Maurer AG, Zürich  
 Contractor: Suter Bautenschutz AG, Horgen  
 Tensioning System: StressHead AG  
 Year: 2012

**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.



Am Bau Beteiligte  
 Client: Credit Suisse, Zürich  
 Civil Engineer : Healy + Partner Engineering, Aarau  
 Contractor: SIKI 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.



Am Bau Beteiligte  
 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.



Am Bau Beteiligte  
 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

## Lucerne cantonal police, Lucerne (CH)

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### 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)

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### 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

## 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 : Teyssere & Candolfi AG, Visp  
 Contractor: VSL-Schweiz AG  
 Tensioning System: StressHead AG  
 Year: 2009