Sika at Work

Using post-tensioning with the Sika® CarboStress System to allow the Removal of Walls

A Case Study

Removing Walls to increase the usable Area with pos
at the Hohenems Agricultural College, Austria

Overview

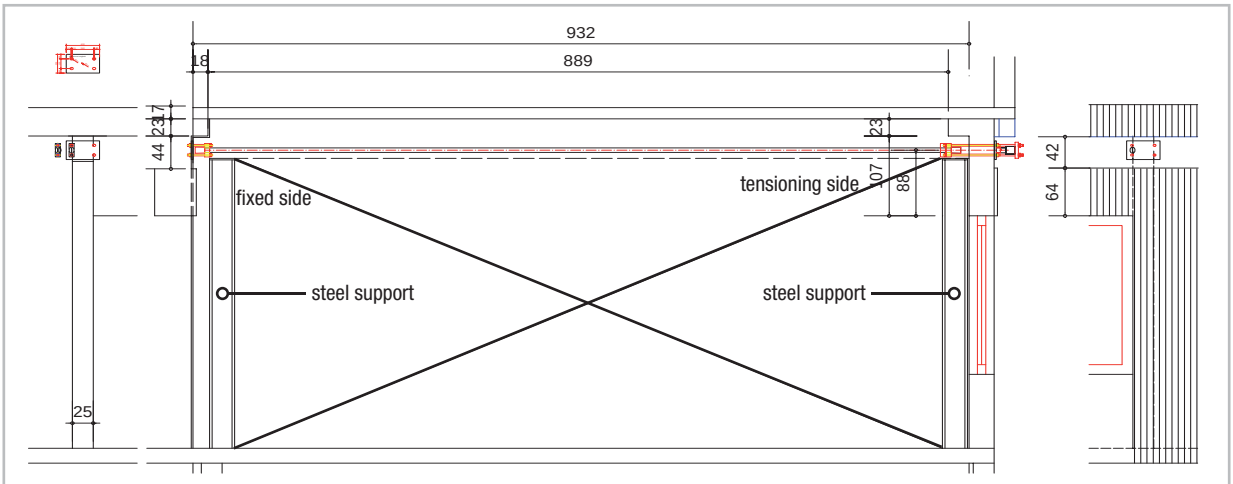
To obtain a more spacious layout, two walls were removed from the ground floor of the existing building. As a result of proposals made by the contractor, the traditional solution originally planned by the structural engineer was changed in favour of a more efficient alternative using **Sika® CarboDur®**, post-tensioned CFRP (carbon fibre reinforced plastic) tendons. The alterations at Hohenems Agricultural College also included structural strengthening of several floor slabs with untensioned **Sika® CarboDur® CFRP** plates.

The two walls left and right of the window had to be removed

The Sika Solution

From the existing walls, a 30 cm high «downstand beam» had to be left within the suspended ceiling area as a beam. Conventional steel supports were installed on the two external faces to support this.

In order for this beam to accommodate bending moments, despite the lack of internal reinforcement, a **Sika® CarboDur® CFRP** plate was bonded on each side. These plates had to be post-tensioned to provide the necessary shear resistance.



Section through the existing corridor with a view to one of the walls

The Anchorage System Design

Due to its capacity to introduce the forces around the end anchors exactly where they are required, the **Sika® CarboStress®** system was selected. Another advantage of this post-tensioning system for this type of application, is that it can be used on site with low labour requirements and precisely defined results.

The bond between the post-tensioned CFRP plates and the downstand beam was achieved using **Sikadur®-30** adhesive. To minimise any preparatory work around the end anchors, the CFRP plates were applied at a distance of about 2 cm from the downstand beam.

The Works

Because the other building alterations were already almost complete on the upper floors and in the basement, the requirements and limitations for the strengthening work on this project increased significantly. On the upper floors some walls had already been re-tiled and in the basement the planned concrete cutting works could not be allowed to lead to water ingress or additional moisture penetration.

Consequently, in the immediate area of the walls it was necessary to provide a horizontal waterproofing membrane over the concrete floor slab, plus a vertical waterproofing membrane to contain the concrete cutting water until it could be pumped away.

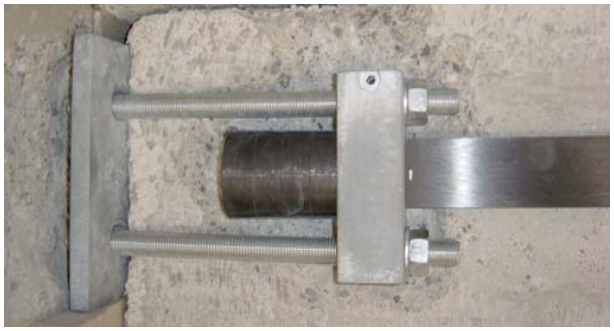
st-tensioned Sika® CarboDur® CFRP Plates

Application and post-tensioning of the CFRP Plates

On the inside, the steel base plates for the fixed end anchors (20 mm thick) were staggered along a building isolation joint, which had the advantage that no drilling was required. The base plates on the tensioning side were staggered along the outside of the building. Holes with a diameter of 30 mm were drilled to pass the threaded anchoring bolts through the concrete wall.

When the base plates had been fixed and bonded, the tensioning works were carried out. To prevent cracking on the upper floors, the 4 CFRP tendons had to be tensioned to 200 kN.

On each downstand beam, the tensioning forces had to be applied to both CFRP plates simultaneously. This necessitated working with two jacks to tension both plates at the same time. The selected tensioning force of 200 kN and the plate length of 8.87 m gave a tensioning path of 67 mm.



End anchor in the building isolation joint

End anchor on the outside of the building

Room A during post-tensioning works

Post-tensioning jacks in operation

After tensioning, the threaded bolts nuts were all tightened and the jacks were removed. The bond line between the CFRP plates and the concrete was then filled with **Sikadur®-30**.

Installation of Steel Supports

Staggered positioning of the steel supports on the outside of the beams took place after the **Sikadur®-30** bonding adhesive had cured. Vertical slots were cut in the reinforced concrete walls and a concrete section was removed. The steel sections were then inserted, grouted and sealed with **SikaGrout®** and also anchored vertically.

Cutting the vertical slots

Steel support installed on the outside wall

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Removal of the Walls

To enable the existing walls to be removed from the building, it was necessary to cut them into sections about 1 m^2 in size. To do this, cores with a diameter of 20 cm were taken at the top and bottom. Access was then possible for the equipment to make the horizontal and vertical cuts.

Wall after cutting into 1 m^2 sections

Removing the cut concrete sections

Walls before the start of the works

Completion of the works with the walls removed

Finishing works

The requirements for fire protection were met by the application of 2 layers of 30 mm thick calcium silicate board around the remaining downstand beam. The steel supports were also given a fireproof coating.

The room before the start of the works

The much enlarged room on completion of works, with a far greater useable area exactly as the client required

Conclusion

The works using the **Sika® CarboStress®** system were carried out to the complete satisfaction of the main contractor and the client. A thorough inspection of the upper floors above the strengthened area, has confirmed that absolutely no cracking had occurred in any other floors or walls during or after the works .

Project Details

Main Contractor:	I+R Schertler-Alge GmbH. - Lauterach
Structural Engineer:	DI Paul Frick - Rankweil
PT-Design:	Ingenieurbüro Mader-Flatz - Bregenz
Post-tensioning System:	BAM Metzler - Götzis
Post-tensioning works:	Grund-, Pfahl- und Sonderbau GmbH - Himberg (Vienna)

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