



Our undercut technique is part of (German) construction culture

Hidden fastening allows for spectacular façades

As UNESCO stands for education, science and culture on an international basis, so does the Bundesstiftung Baukultur (Federal Foundation for Construction Culture) for construction culture in Germany. The independent organisation, based in Potsdam, aims to make our constructed environment a common area of concern and manifests itself as a stakeholder for high quality construction design and implementation in the Federal Republic of Germany (www.bundesstiftung-baukultur.de).

Apart from many other aspects, it is the key objective of the foundation to promote the architecturally and technically sophisticated design of sustainable façades. Therefore, the Federal Foundation declared the ventilated rainscreen with its many benefits concerning construction physics and visual effect a part of German construction culture.

An excellent façade for an excellent business school

It was decided that the new building of the School of Finance & Management in Frankfurt should also be clad in a ventilated rainscreen. Which of the many benefits of this design might have been the critical factor? The architectural possibilities? The benefits concerning construction physics, which are being achieved by a capillary separation of the weather protection from the thermal insulation and which provide a healthy and comfortable climate within the building? Was it the well-known durability and resilience against damage of the ventilated rainscreen, which were already referred to in 1997 on the 2. Deutschen Fassadentag® (German Façade Day) of the Fachverband Baustoffe und Bauteile für vorgehängte hinterlüftete Fassaden e.V. (professional association for construction materials and components for ventilated rainscreens [www.fvvhf.de]) and which were positively commented on in the Zweiten Bauschadensbericht (second constructional damage report) by the German government?

Economical and sustainable

Or was it the particular sustainability, which is a special feature of this kind of façade? This sustainability becomes apparent in many ways. Nowadays, when a sustainable building is being constructed, it is not only important that it is economic throughout its long operating life. Furthermore, the question arises what will become of the buildings and their built-in raw materials, once they have reached the end of their lifespan. Here, systems like the ventilated rainscreen are beneficial. They work on a modular system and can therefore be selectively dismantled and the material types can easily be separated and either re-used or recycled. Thus, the ventilated rainscreen has a positive effect on the assessment of the lifecycle of a building.

The sustainability of the ventilated rainscreen system is supported by its energetically well-designed effectiveness as an energy saving façade (Energieeinsparfassade®)



and the complete recyclability of its components. Furthermore, the economic efficiency of the ventilated rainscreen can be reliably calculated at the very beginning of the planning process.

The School of Finance building was clad in particularly long-lasting ceramics tiles, a porcelain stoneware product from the manufacturer Koninklijke Mosa bv from Maastricht, Netherlands. The KEIL undercut anchor KH is used for the safe fixing of this large-sized façade tile and is a permanent connection with the Systea supporting construction. “KEIL’s undercut anchor is the perfect match with our supporting structure. It is simple and easy to mount”, says Andreas Reinhardt, Managing Director Technics at Systea. “The supporting structure diverts the load of the tiles safely into the ground without creating thermal bridges, leaving space for the insulation and the air gap, which is vital for the system. The pre-cut agraffes cradle the torsion-free held KEIL undercut anchors, thus ensuring strain-free fixing and easy mounting.”

Due to the invisible fixing on the back side, the colours of the ceramics can come into their own – with lasting effect. As the tile is not penetrated by clamps, screws or rivets, no dirt will gather underneath them and the tile will remain clean.

Secure fixing in the background

The KEIL undercut anchor is the supporting pillar on the back side of the tile, a positive locking, purely mechanical fixing, which is free from expansion pressure and acts in the background. KEIL Befestigungstechnik manufacture these anchors from high-quality stainless steel in Engelskirchen in the area of Bergisches Land. Before Karl Eiseheid, the founder of KEIL, invented the KEIL undercut system, the company had been manufacturing high quality drill tools. Nowadays, the medium-sized, family-run company is being managed by the second generation, Petra and Jürgen Bergfelder.

A highly motivated team, consisting of experienced as well as young employees, manufacture this special fixing device and sell it worldwide. From Siberia to Kuwait, from Christchurch to Miami – façade tiles fixed with the KEIL undercut anchor brave the elements and environmental conditions. This fixing system can be relied upon – even in typhoons, hurricanes or earthquakes.

As far as constructional supervision is concerned, the tile fixing is subject to authorisation. Apart from a multitude of national and European authorisations or valuations respectively, there is also an ETA (Europäisch Technische Bewertung, European technical evaluation) for MOSA porcelain stoneware. Thus, for the façade of the School of Finance in Frankfurt, the ETA 09-0348 „KEIL Hinterschnittanker für Royal Mosa Feinsteinzeug“ (KEIL undercut anchor for Royal MOSA porcelain stoneware) was made to use. It regulates, how even the 36 metres high façade in Frankfurt could be safely built.



For the statistical proof of a thusly fastened façade tile, e.g. the publishings of Prof. Dr. Alfred Stein can be referred to (e.g.: *Fassadenplatten auf nachgiebiger Unterkonstruktion (Façade tiles on flexible supporting constructions)* Ebner Verlag Ulm). His calculations will be presented on the occasion of the DENAK forums. A TR (Technical Report) is currently being developed at the DIBT (German Institute for Building Technique), which will regulate the dimensioning of undercut fixing based upon the EAD 330030-00-0601.

As a purely mechanical fixing, the KEIL undercut anchors could be mounted in Frankfurt without any trouble and regardless of the weather, as neither temperature nor humidity affect the high bearing capacity of the fixings. The façade was built by the Frankfurt-based company HBG-Fassaden GmbH. It is due to their professionalism, from planning throughout the preparations up to the mounting, that a new piece of construction culture can shine in Frankfurt.

55,000 undercut anchors are keeping the Frankfurt façade in place.

„That, however, was a long way to go”, Christian Wolf, CEO at HBG reports. “Not only did we have to mount the more than 55,000 KEIL undercut anchors, but we also had to drill the 55,000 necessary undercut holes into the hard MOSA porcelain stoneware tiles ourselves.” For this, KEIL’s sound drilling technology was employed. It was developed to economically drill even this porcelain stoneware, which, in terms of hardness is second only to the diamond itself, with the KEIL façade drill. First, the cylindrical drill hole is mechanically cut to the required depth. After that, the façade drill is forcibly tilted in order to manufacture the undercut. This process of drilling and undercutting takes all but 8,5 seconds. Because of this short processing time, it is more often than not the delivery and collection of the tiles which becomes a bottleneck. The Frankfurt-based façade company, however, mastered the logistical challenge, even with this high number of tiles. “All in all, the undercut system had been excellently prepared by KEIL, so that we were able to mount the porcelain stoneware tiles without any problems”, says Wolf.

A life expectancy of 50 years and more

The design of Danish architect Hennig Larsen and the decision of the building’s owners for the durable ceramic were successfully implemented in a high-quality façade. With this architecturally and technically sophisticated, sustainable façade a new piece of constructional culture was created.

It remains to be seen, how the sustainability of the façade will present itself in the year 2068. This is when the life span, which underlies the authorisation of the KEIL undercut anchor for Mosa porcelain stoneware tiles, will end. In fifty years time, the components of the façade might be separated and sorted, as pointed out in the silver Cradle to Cradle® certificate. On the other hand, the façade might also be surveyed and considered constructional culture for even more decades to come.



Architect: Henning Larsen, Dänemark
Façade tiles: Koninklijke Mosa bv, Maastricht
Façade engineering: HBG Fassaden GmbH
Supporting construction: Systema Pohl
Fixing: KEIL Befestigungstechnik GmbH

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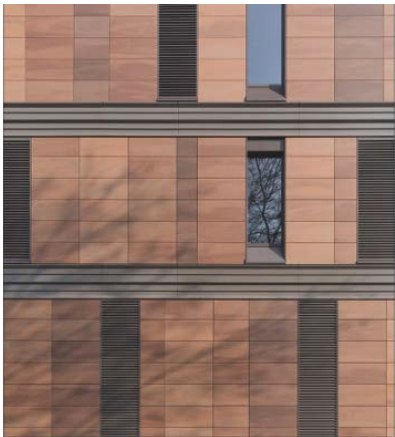
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School of Finance
Photo: Royal Mosa



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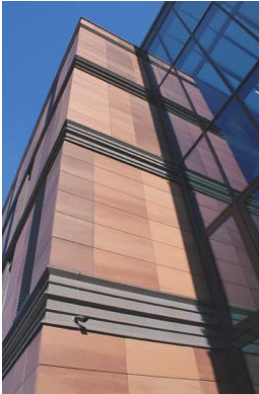
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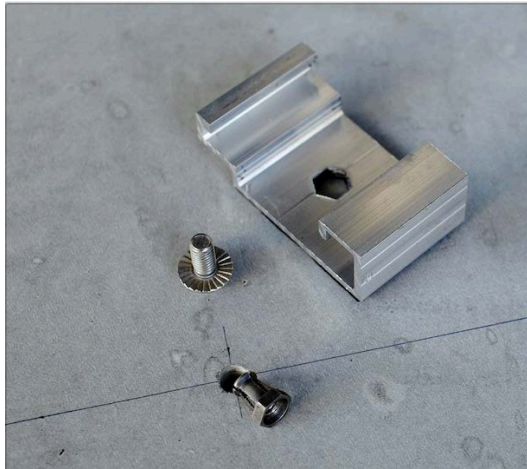
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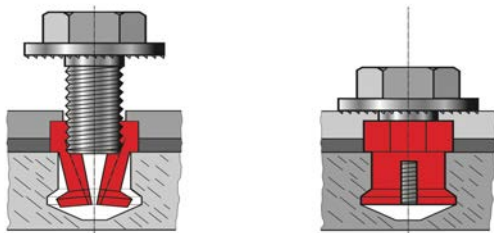
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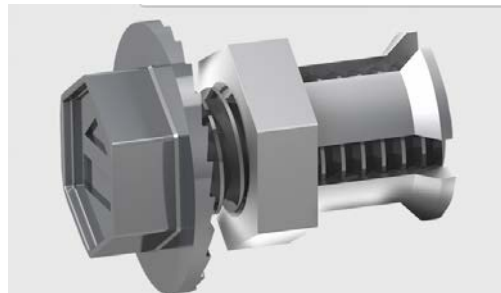
KEIL undercut technique: The fixing points are on the back of the tile and therefore not visible after mounting
Photo: KEIL Befestigungstechnik



Mounting the tile onto the supporting construction
Photo: KEIL Befestigungstechnik



Undercut system: When the screw is turned, the anchor sleeve will settle itself positive-locking and without expansion pressure into the undercut drill hole.
Illustration: KEIL Befestigungstechnik



The undercut anchor consists of the anchor sleeve and the hexagon screw.
Photo: KEIL Befestigungstechnik