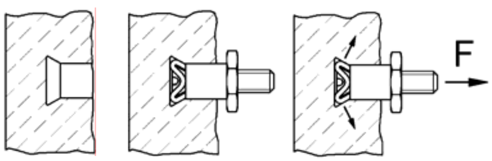
A | C | T

Fischer's **A**dvanced **C**urtain wall **T**echnique (ACT) specializes in rainscreen wall technology.

Advantages of FZP-undercut-anchors

Invisible mechanical fixing method:

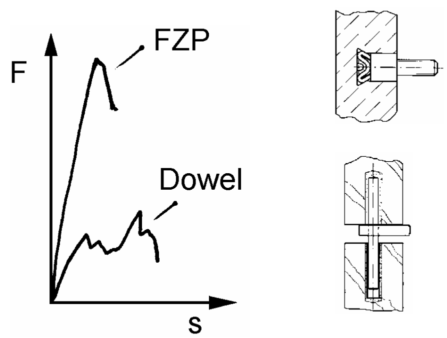


a.) b.) c.)

a.) undercut hole
b.) stress free anchoring = no expansion forces
in the material
c.) stress forces in stone material only if
external forces are applied to the anchor

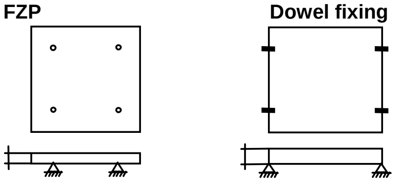
Maximum possible pull-out loads:

Comparison of the systems: FZP – Dowel
Load – displacement graph:
(Performance factor 2-7 higher for FZP than dowel)



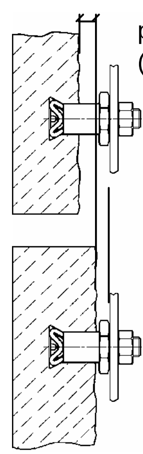
Optimal position of anchors:

Necessary panel thickness for comparable performance of FZP and dowel systems:



Positions of FZP anchors are optimzsed and so the maximum bending stress is reduced by 50%. This allows reduction of panel thicknesses d in relation to dowel system by factor 1 : 1.4.
(= 30% less material for the same performance)

Compensation of slab thickness tolerances:



panel thickness tolerances
(4mm, e.g. 20-24mm)

constant distance between
panel surface and anchor
due to adapted drill hole depth

⇒ flush finish facade

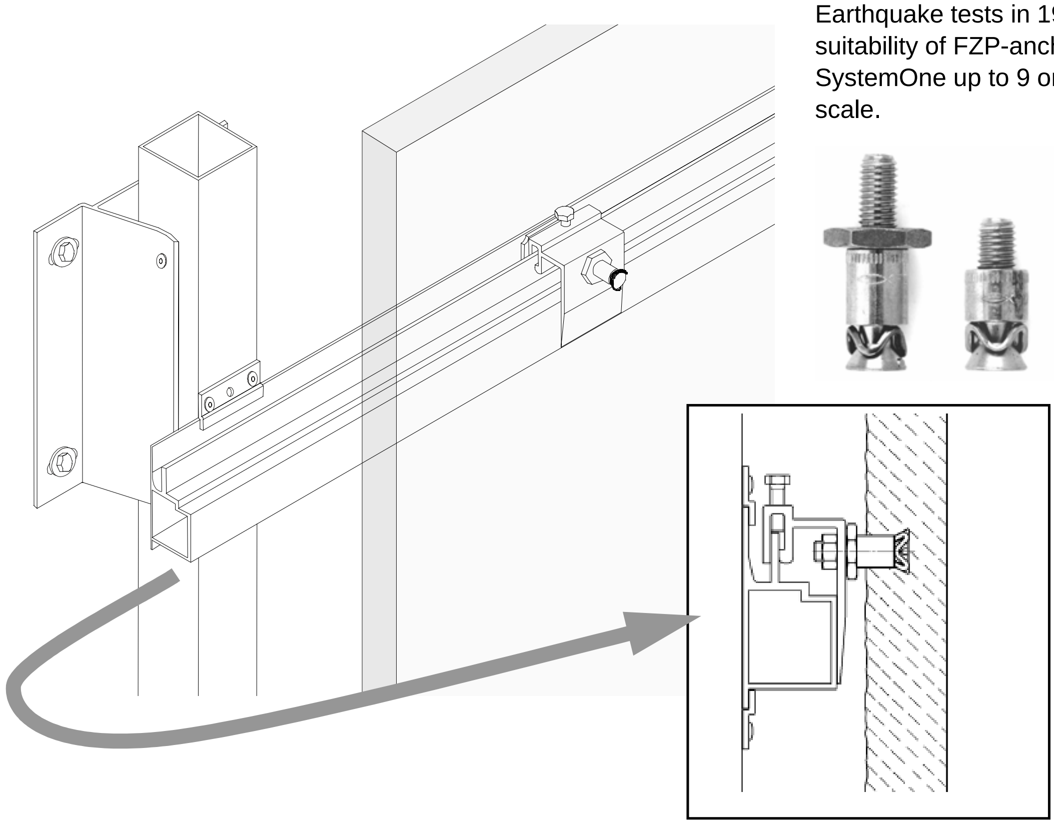
These advantages allow:

- perfectly aligned facades with clear open joints
- less design restrictions
- thinner and lighter panels possible
- installation is non-dependant on weather and temperature
- panels interchangeable and repairable

fischer framework solution

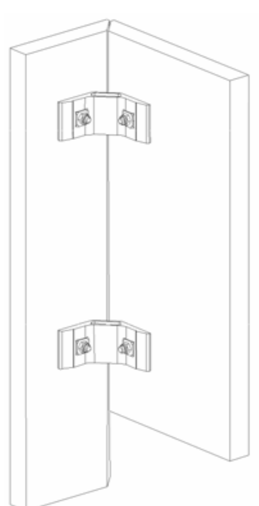
SystemOne bracket solution for rainscreen claddings
Fixing of natural stone slabs

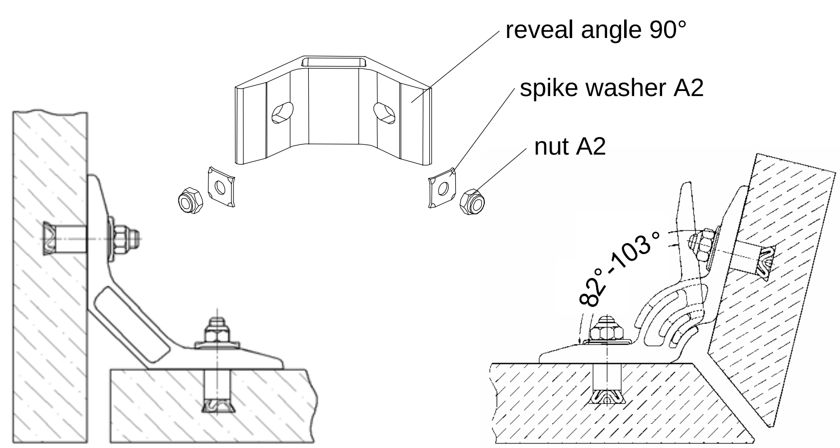
Earthquake tests in 1999 proved suitability of FZP-anchor and SystemOne up to 9 on the Richter scale.



Reveal fixing with reveal-angle and FZP-anchors

two different types of reveal angles available (90° and flexible)



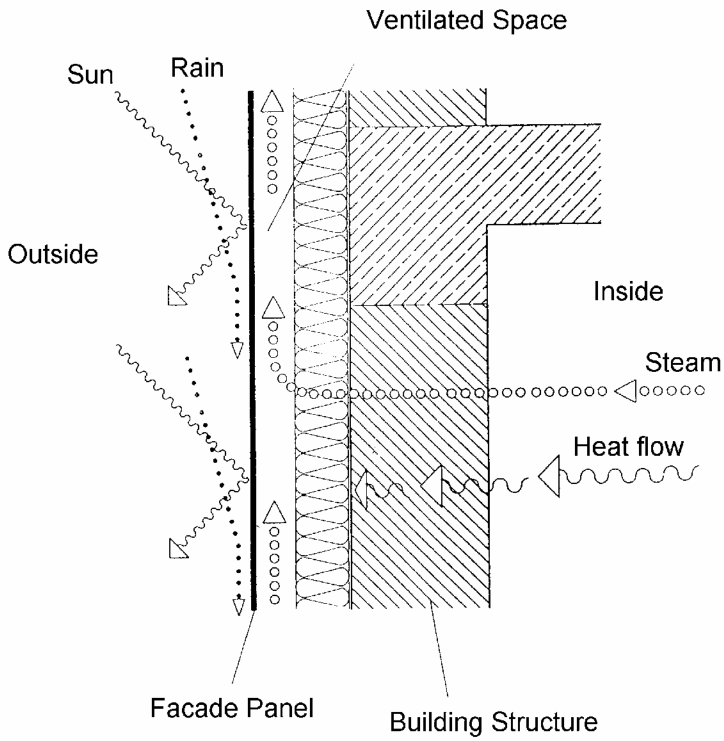


Ventilated facade

There is an increasing demand for well designed and thermally efficient external wall construction. The ventilated cladding facade has proved to be an excellent alternative to standard non ventilated facade.

Basic principles

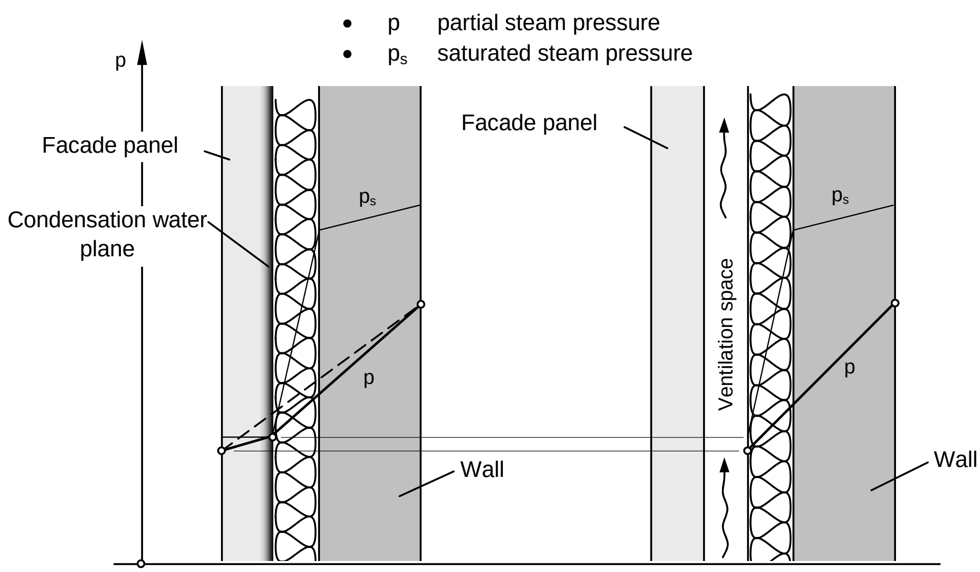
The following picture shows the basic principles of ventilated cladding.



The advantages

- building structure is protected from heavy moisture and damaging effect of solar radiation
- facade can “breathe”, providing optimal interior climate conditions
- condensation risks are eliminated = no structural decay and better insulation performance
- less heat transfer
- incoming rainwater and moisture from the building can be transported out quickly via ventilated cavity

Condensation and dew point



Basic presentation of diffusion diagrams for non-ventilated and ventilated surfaces

In non-ventilated wall construction, the steam impermeability of the facade panels has a considerable influence on the moisture content of the outer wall. There is a risk that interstitial condensation occurs when the temperature gradient falls below the dew point temperature gradient. This will have a significant deteriorating effect on the insulation performance with subsequent increase in heat losses.

Condensation is eliminated if the outer skin is allowed to “breathe”in the outside air as in ventilated facade design. It allows vapors to escape but also may permit any vapors still condensing within the cavity to evaporate to the outside air. Insulation shall remain dry and therefore shall achieve its full thermal capacity.

National and international standards

Fischer’s **A**dvanced **C**urtain wall **T**echnique (ACT) specializes in rainscreen wall technology.

The system consists of

- **FZP** undercut anchors for natural stone, ceramics, HPL and glass panels.
- **SystemOne** subframe for attaching cladding panels to the load bearing substrate.
- **fixings** for connecting SystemOne to the substrate
- **design** of the System and **project advice**

Ventilated facade technology is well known and its principles have been briefly explained above.. Material specification and design of Fische’sr SystemOne subframe for ventilated facade is done in accordance with general German approval *DIN 18516 Part 1 `Backventilated, non-loadbearing, external enclosures of buildings´ and Part 3* which specializes in stone panels.

FZP undercut anchors

Requirements for anchoring panels are given in DIN 18516 Part 3 Section 5 `Fixing of panels´. Appendix A to this chapter refers to undercut anchors. It states that “The fixing of panel with undercut anchors is allowed. For this a general approval or an official consent (in Germany) is required.”
For fischer **FZP** undercut anchors there is a general approval from the official Deutsches Institut für Bautechnik (Z-21.9-1275) for granite and hard stone and the approval Z-21.9-1555 for Lime- and Sandstones. The thickness of the stones is dependent on technical data of the material, e.g. pull out tests.

The FZP anchors have been used successfully world wide in many different stones including soft stones such as lime- and sandstones on buildings up to over 100 m high. This is possible due to many years of experience, test database of different materials and calculation methods based on the latest research.

SystemOne subframe

DIN 18516, Part 1 Section 3.1 b) states that subframe consisting of metal profiles is allowed. **SystemOne** subframe complies fully with DIN 18516 Part 1 and 3. It is produced from alloy AlMgSi0.5 (EN AW-6060, as per *DIN EN 573-3*) in accordance with *DIN 4113-1/A1 “Aluminium Structural Parts”* Table 1, as specified in DIN 18516, Part 1, section 7.2.2.
Fixings to connect aluminium parts have to be made of aluminium or at least A2 stainless steel (see DIN 4113).

Fixings

For fischer fixings DIN 18516 Part 1, Section 3.4, 6.7.2 and 7.3.2 apply. These parts state that only approved fixings can be used.

Design

In accordance with DIN 18516, Part 1, section 6.3.1., all parts of the facade system have to be calculated according to the relevant standards, especially regarding safety factors e.g. for permissible loads.

Legislation in other countries.

Example UK

There is no equivalent BS standard to DIN 18516, as stated in National Building Specification, Version H92, Rainscreen Cladding: “There is no specific British Standard for ventilated rainscreen walls. *BS 8200, `Code of practice for design of non-loadbearing external vertical structures´*, includes general details about principles of drained and ventilated and pressure equalised systems. Published in 1985 with no subsequent revisions the standard does not fully reflect current rainscreen technology. A number of system manufactures test to DIN 18516-1 `Backventilated, non-loadbearing, external enclosures of buildings´.”
Very commonly designers refer to *BS 8298, `Code of practice for Design and Installation of natural stone cladding and lining´*. It is important to realise that this standard was written for traditional stone cladding and so it is not applicable to systems with metal subframe such as SystemOne (see Foreword to BS 8298 : 1994).

Further useful codes and guides relevant to ventilated rainscreen facades are:

- National Building Specification H92 – Rainscreen cladding
- National Building Specification H51 – Natural stone slab cladding
- Centre for Window and Cladding Technology (CWCT): Guide to good Practice for Facades, Standard for Walls with Ventilated Rainscreens, Guide to the Selection & Testing of Stone Panels for External Use, Standard for Testing of Ventilated Rainscreens, Test Methods for Ventilated Rainscreens.

Others

In other countries there may other local legislation apply and shall be observed. If there is no local legislation for ventilated facade, the German DIN 18516 can be referred to.

Other relevant codes and approvals

- The company fischer, including ACT department and subsidiaries, are certified according to DIN EN ISO 9001.
- Earthquake testing was successfully done with SystemOne including FZP by the China Academy of Building research in 1999 according to the `Code for Seismic Design of Buildings´ (GBJ11-89) up to 9 on the Richter scale.
- For the project “National Federal Bank of Russia” in Moscow extensive testing was carried out regarding long term performance of FZP in extreme climate conditions (freeze-thaw cycles testing).

Special topics

Panel design (size and thickness)

The panel size according to the German approval is limited. This is because the approval is based on the worst case scenario regarding flexural strength, pull out load and acting loads. The German approval allows hanging up individual stones up to an installation height of 100m, even in the corner areas. This is permitted even for very poor stones with a low flexural strength and pull out values. The minimum thickness for weather resistant stone is 20 mm.

In cases where the wind loads are lower or the stone has a high flexural strength, the stress in the stone and the acting pull out force of the FZP will be usually calculated and proved against the allowed values. For the proofs a global safety factor of 3.0 against the characteristic values according the German DIN 18616 T3 is used. All the calculations can be made to the state of the art for example according to publications and recommendations of Professor A. Stein (Trier, Germany).

Bi-metallic corrosion

Bi-metallic corrosion will occur whenever two different types of metallic materials are connected. For a subframe this can be in case there is stainless steel, aluminium and galvanised steel in contact. In presence of electrolyte, electrochemical displacement can take place. Any water and humidity present will act as an electrolyte. As a result, stainless steel will corrode aluminium and galvanised steel, aluminium will corrode galvanised steel.

Regarding the bi-metallic corrosion there are two cases to differentiate between a) the corrosion between the stainless steel parts (FZP, rivets and bolts or self drilling screws) and the aluminium subframe parts and b) the corrosion between the aluminium subframe or stainless steel self-drilling screws and the galvanised primary and secondary steelwork.

For case a) it can be said that there is corrosion in between the fasteners (stainless steel A2) and the aluminium, there also can be an electrolyte. But the very tiny amount of stainless steel will not corrode the very large amount of aluminium in a way that can damage the frame or even can be seen. There is no corrosion in a practical point of view and we can say that corrosion is negligible. That is why stainless steel fixings can be used with aluminium subframes and why this is approved in codes, for example in the German DIN 4113 for aluminium constructions and in National Building Specification H51 – Natural stone slab cladding, section 3.5 and table 3.

For case b) the problems can occur in case there are nearly equal amounts of aluminium and the steel and at the same time if water can reach the contact zone between the two materials. This can be due to bad or wrong insulation. Therefore a separation layer has to be used between the aluminium wallholders and the galvanised steel. Stainless steel self-drilling screws will not corrode the big amount of galvanised steel nor the aluminium subframe. To avoid contact corrosion a separation layer, e.g. some kind of bituminous foil or paint must be used. In addition it should be assured that no water or moisture would reach the contact area of steel structure and screw.

Cold Bridges

A proper designed ventilated facade is best regarding thermal losses of the building. Due to the interaction of ventilation and insulation, thermal losses can be minimised. Attention has to be given to cold bridges due to wallholders or brackets. The aim is to minimise the number of wallholders. A rail

system as the fischer SystemOne has the great advantage that via the rail the load of the facade panels can be summarized and focused on a few points, the fix point and sliding point wallholders.
Compared to the traditional dowel fixing with brackets where at least two brackets per panel have to be used, the fischer SystemOne noticeably reduces the possible cold bridges. In addition using a special type of insulation material in between wallholder and a load bearing structure, the energy loss will be minimized using fischer SystemOne framework.

Aluminium and concrete

According to DIN 18516, Part 1, section 7.2.2 b) aluminium parts of the subframe like wallholders can be put directly on concrete parts if it is assured that no moistness can come in between. Otherwise contact corrosion between the basic concrete and the aluminium can occur. Usually this is avoided when the insulation is installed properly.

Ventilation

Ventilated cladding means that there is an exchange of air between the outside and a cavity behind the facade panels to transport moisture away from the building and to improve the climate conditions inside the building.
According to DIN 18516 Part 1 section 4.2 and BS 8200, sufficient ventilation is given when there is at least one opening at the bottom and the top of the building with an area of 50 cm^2 per meter length. The distance between the insulation and the back of the facade panel should be at least 20mm, which can be reduced locally to 5mm, for example in areas around subframe. According to BS 8200, the minimum cavity width should be 10mm.
In Switzerland the SFHF code recommends a cavity of 20mm for facades up to 6m height, 30mm up to 22m height and 40mm for facades more than 22m high. The EMPA recommends for the case of open joints 50mm cavity.

Rain water and open joints

Tests conductued by the German association for ventilated facades (FVHF) showed that 5-15% (at horizontal + vertical open joints) of the wind-blown rain gets into the ventilated area through the joints, without wetting of the suitable insulation. The quantity of the wind-blown rain drains off on the back side of the panel and in the ventilated cavity. An outlet has to be planned in the base area during the design stage to allow for draining of the cavity.
It is also important that a suitable waterproof insulation for ventilated claddings is specified. Almost every supplier has a special insulation for this purpose.