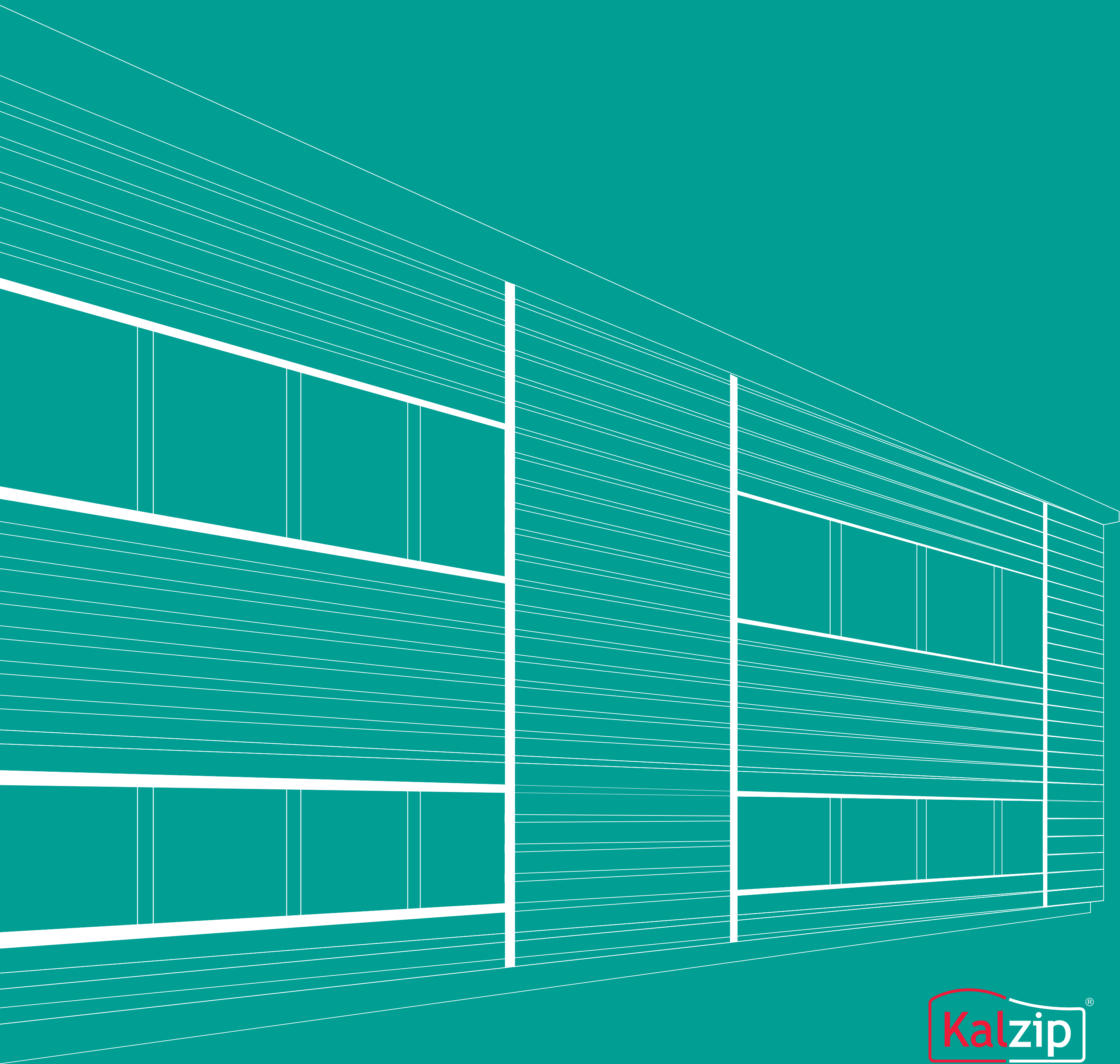
Facade System TF 37/800 R

Technical, design and construction manual




EP: Electro Helfrich

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Left:
Storage Electro Helfrich **Viernheim (D)**
Architects: Fischer Architekten, Viernheim

1. Introduction

1.1 Aluminium building envelope

Visually exquisite, technically well conceived aluminium facades in distinctive and clear-cut profiles have become an important design element in architecture. The desire of clients and architects to present a building of individual aesthetic quality which is also technically perfect in shape and function, requires integrated solutions that combine architecture and technology. As a material which retains its value, aluminium offers not only many technical advantages but also the ideal prerequisites for an aesthetically appealing and stable building envelope.

To allow unusual design concepts to be realised economically and yet to optimum effect, there is a special demand for building systems with low operating and maintenance expenditure, which also fulfil the requirements with regard to energy-saving building. Kalzip® Facade Systems are compatible with various substructures for both new building and also refurbishment projects, with their versatile profile and surface variants providing a long lasting and high-quality outer skin.

This brochure serves as a planning aid for the design and execution of facades. It shows areas of application, contains detailed product information and also the necessary design notes and rating tables. The rating is calculated in accordance with the rules and regulations applicable at present in the Federal Republic of Germany.

Other country-specific requirements must be checked and adapted to the requirements of the local/national regulations and standards.

1.2 New emphasis on architecture

For over 35 years Corus has developed, produced and marketed innovative aluminium roof and wall cladding systems. Todate more than 70 million m² of Kalzip® have been manufactured and installed. The introduction of the innovative Kalzip® Facade Systems concides with both clients and architects placing a new emphasis on 'architecture'. Kalzip® opens up almost limitless possibilities in the individual language of shapes and helps to characterise decisively the functional aesthetics of the structure. As a safe, low maintenance system, Kalzip® is also a truly economic solution.

1.3 Safety combined with quality

Standardised production processes combined with an efficient and advanced quality management system from raw material procurement right up to final inspection of the finished products guarantee optimum quality of the finished components. Underpinning this production process there is a safety management system regulated according to the standards of Det Norske Veritas (DNV). It has been proven that there is close interaction between quality and safety.

Corus was assessed by DNV in 2001 according to the requirements of the INTERNATIONAL SAFETY RATING SYSTEMS (ISRS®) and classed in level 7, which is regarded as a high grade achievement. Corus shares this classification with leading companies of the chemical industry and other hi-tec companies. The certification is used at the same time for the integration of other management systems, e.g. DIN EN ISO 14001, DIN EN 9001:2000.


CERTIFICATE


CERTIFICATE


CERTIFICATE

2. Kalzip® Facade Systems

As part of the exterior building envelope, metal facades characterise the appearance of modern functional buildings and help to present a contemporary and innovative image of the company. In addition to realising the design concept; the system offers many functional benefits which contribute to the overall quality and performance of the structure. Above all, system design must take into consideration diverse additional requirements of technical design and structural engineering.

Kalzip® Facade Systems offer architects and clients new perspectives for individualistic building design and construction. All elements are perfectly compatible with each other and are available in many colour variations. Efficient production processes combined with an economic and thereby ecologically sound use of materials allow the systems to fulfil all the requirements of modern construction. System advantages include:

- Unique, aesthetic design with a distinct long view visual appeal
- Economic efficiency and conservation of resources
- Low weight
- Wide range of acoustic and thermal insulation configurations
- System components. Fully integrated and interchangeable

For a perfectly integrated overall appearance; additional system components are available that have been specifically designed and manufactured for compatibility with Kalzip® facades. These components can be used to help create a distinctive appearance and a visual interesting arrangement of complete elevation.

Right:
Dimensions of the profile panel

2.1 Colours*

The comprehensive spectrum of colours available for Kalzip® Facade Systems offers planners and architects extensive scope for the realisation of modern architectural designs. High-quality coating processes in polyurethane /polyamide, polyester or PVDF ensure highly durable exterior life and colour stability.

Besides standard RAL colours and RAL special colours according to the Kalzip® colour range, Kalzip® facade sheets are offered in the following exclusive finishes:

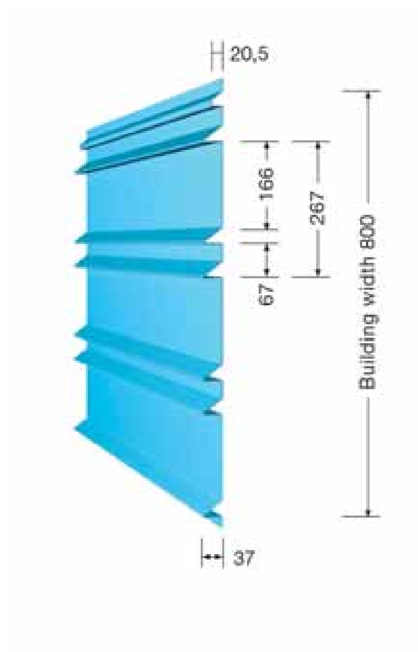
- TitanColor
- AntiGraffiti

These new finishes offer the benefits of specific performance characteristics and impart an individual visual effect to the building (for further information refer to the Kalzip® Colours and Surfaces brochure).

*Colour variance: Due to the different coating processes (conveyor or piece coating), colour differences between the profile panels and the extruded system components, even with similar RAL colours, cannot be ruled out.

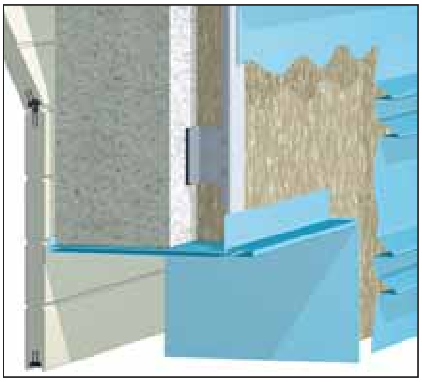
2.2 System overview

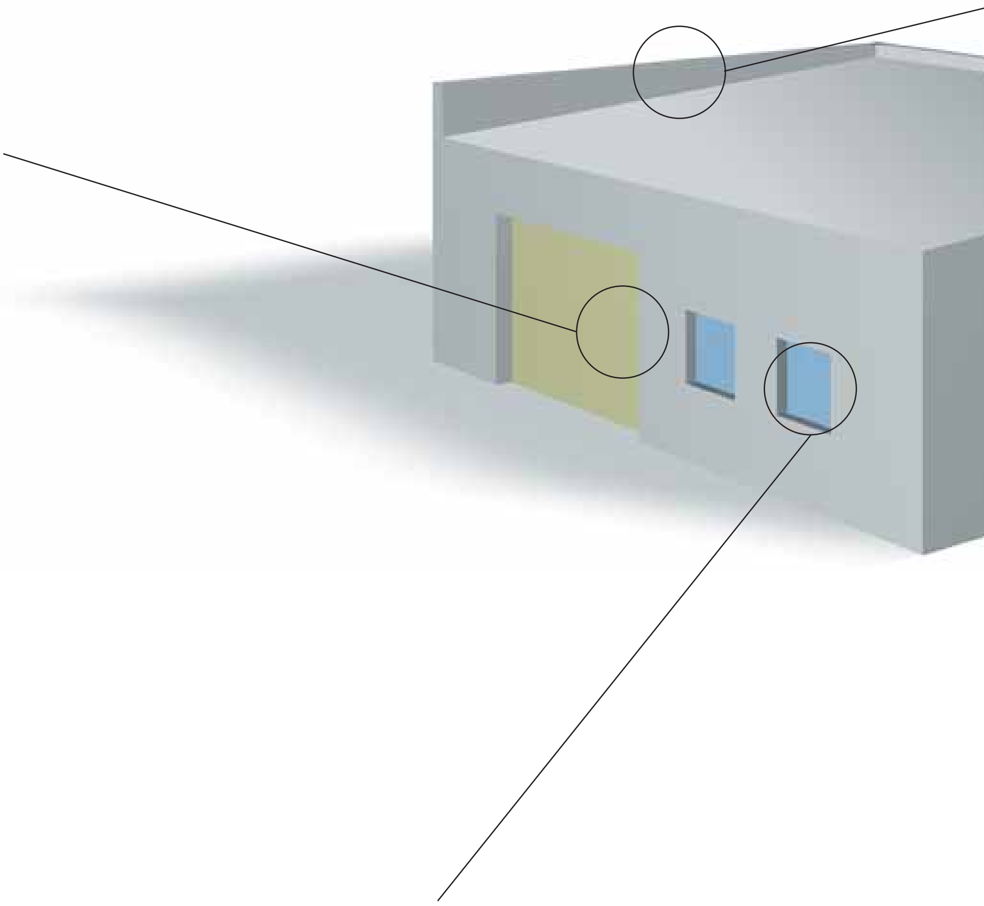
Kalzip® Facade System TF 37/800 R



3. Construction principles

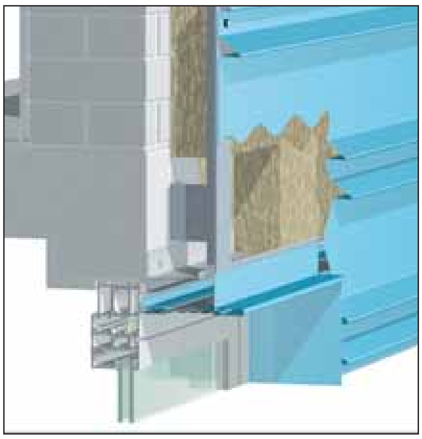
3.1 Kalzip® Facade Systems on walling and concrete

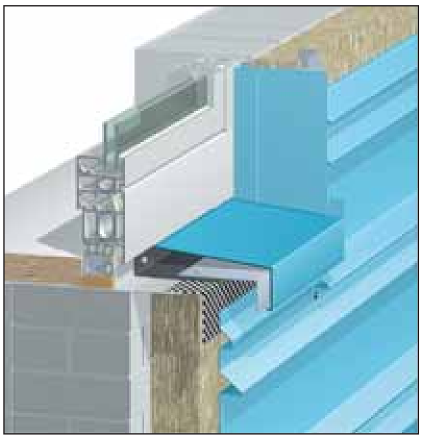


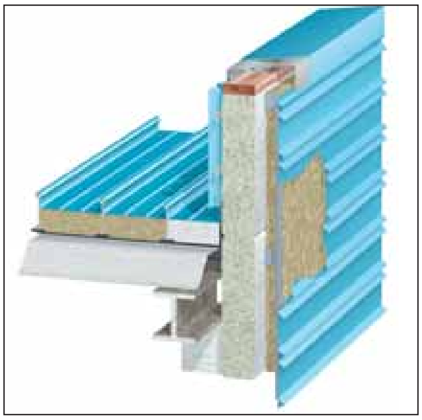


Top:
Wall construction
Kalzip® Facade Systems
Detail: Section door

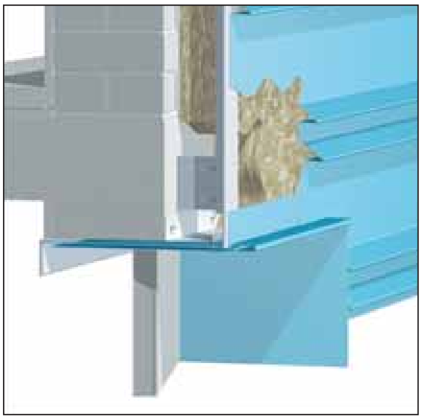
Right:
Wall construction
Kalzip® Facade Systems
Detail: Window

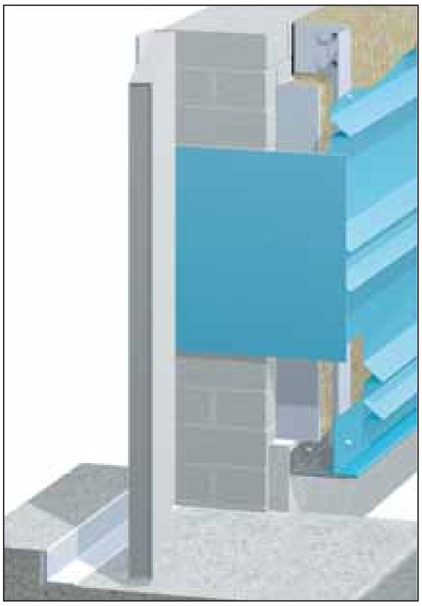




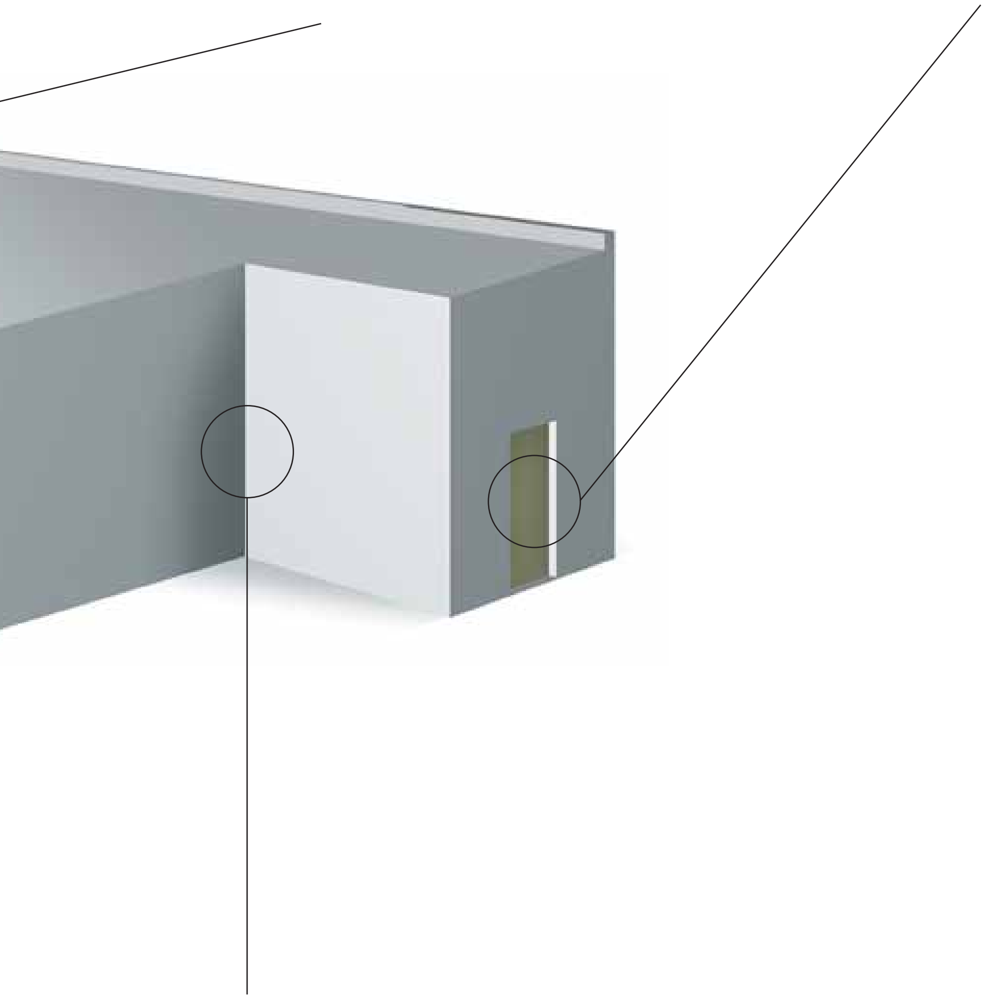


Left:
Wall construction
Kalzip® Facade Systems
Detail: Roof parapet



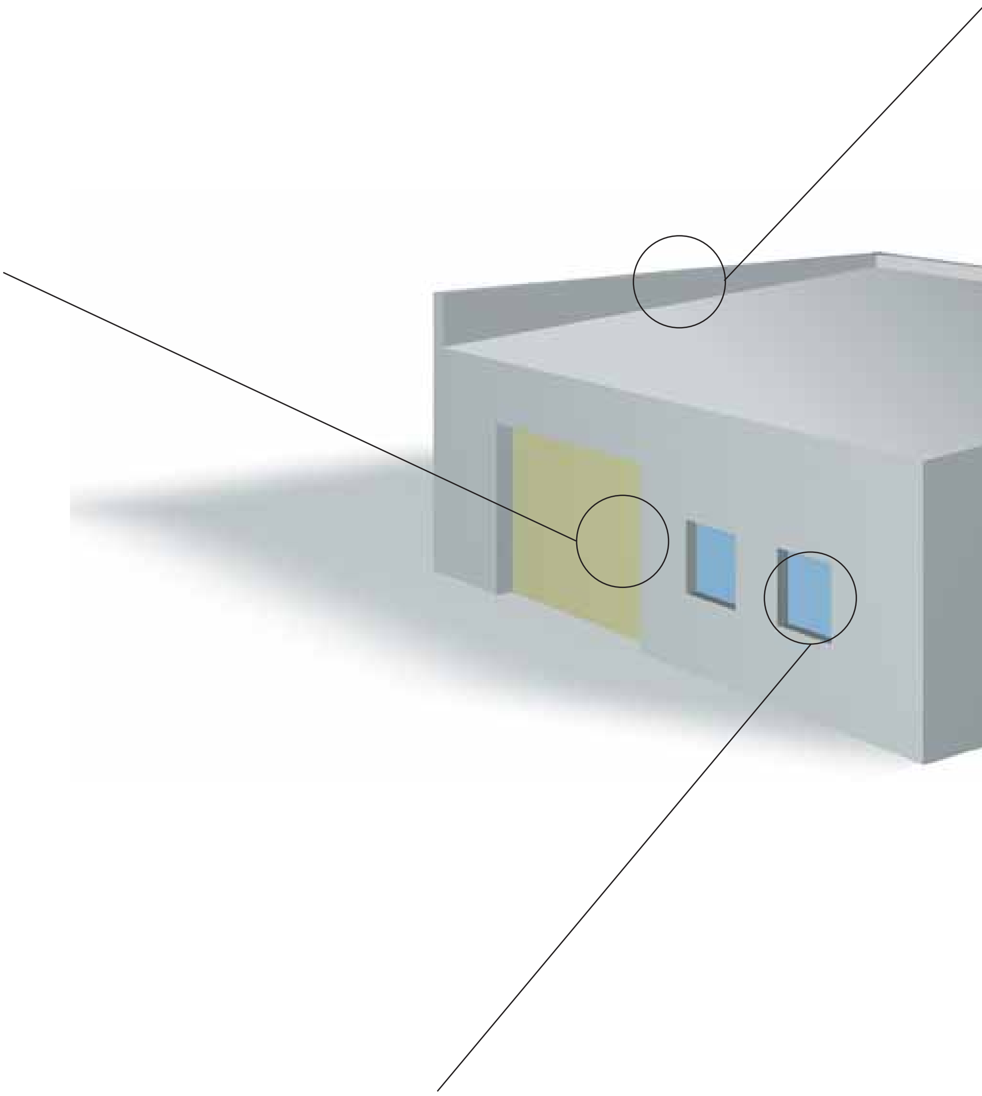


Top:
Wall construction
Kalzip® Facade Systems
Detail: Door

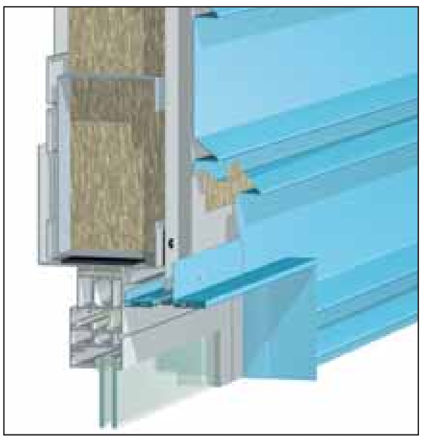


Left:
Wall construction
Kalzip® Facade Systems
Detail: Inside and outside corner

3.2 Kalzip® Facade Systems on cassettes



Top:
Wall construction
Kalzip® Facade Systems
Substructure cassette
Detail: Section door



Right:
Wall construction
Kalzip® Facade Systems
Substructure cassette
Detail: Window

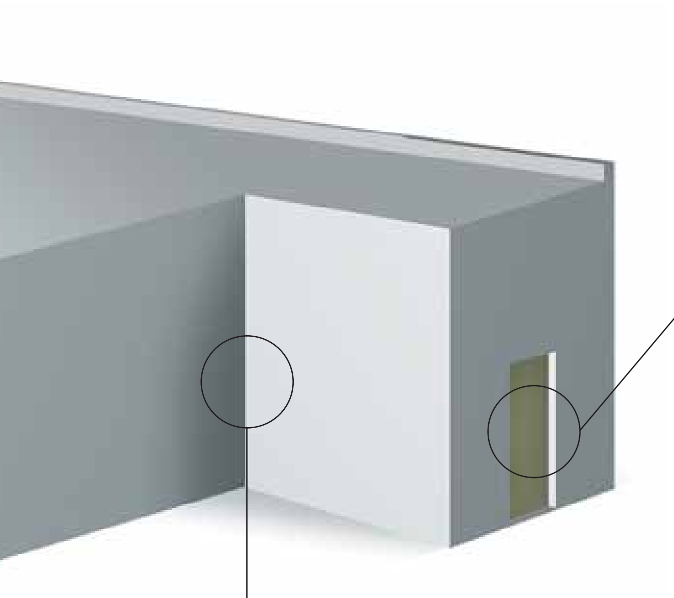
Left:

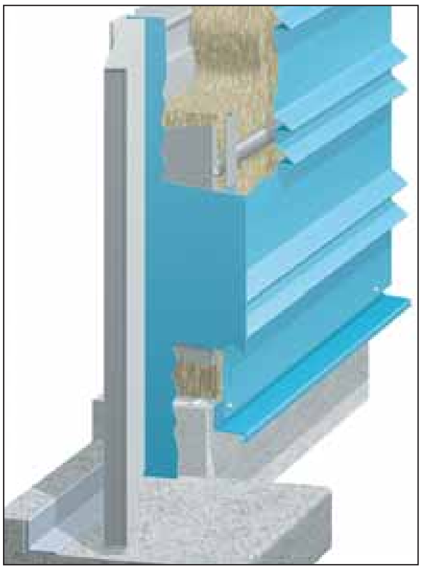
Wall construction

Kalzip® Facade Systems

Substructure cassette

Detail: Roof parapet





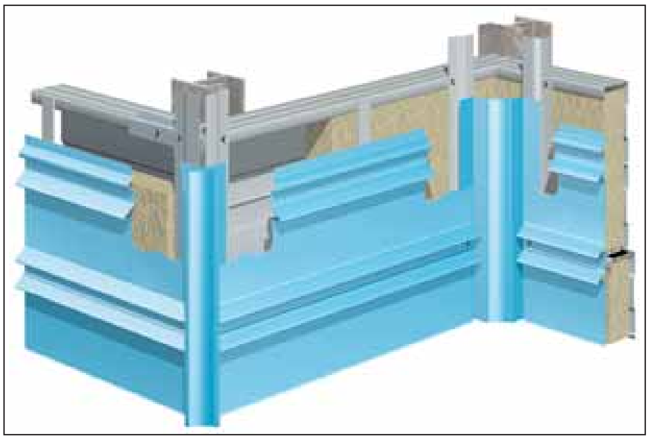
Top:

Wall construction

Kalzip® Facade Systems

Substructure cassette

Detail: Door



Left:

Wall construction

Kalzip® Facade Systems

Substructure cassette

Detail: Inside and outside corner

4. General data and characteristics

4.1 Material/corrosion resistance

An essential advantage of using Kalzip® profile sheets lies in the low dead weight of aluminium. Seawater-resistant alloys are used as base materials. Kalzip® aluminium profile sheets are reliably protected against corrosion in normal marine, urban or industrial conditions, by the formation of a natural oxide layer. With clad plated material this effect is further reinforced, because the plating layer protects the core material for many years against corrosion by acting as a sacrificial anode. There is increased corrosion risk in the immediate vicinity of industrial works which emit large quantities of aggressive chemicals – for example near copper mines. In such cases, suitable plastic coatings (minimum thickness 25 μm) are recommended for additional protection.

Contact corrosion

In the presence of moisture, aluminium forms a contact element in connection with other metals. This may lead to corrosion. Placing non-conductive materials (e.g. plastic coatings) in between the metals provides reliable protection against this effect.

The table below has been established on the basis of very extensive scientific investigations in Sweden and demonstrates that in normal building applications, the aluminium alloy from Kalzip® can be combined with most commonly used metals in a corrosion-proof manner.

Compatibility of aluminium with other materials

	Atmosphere		
Material pairing	**Country**	**Town/industry**	**Near the sea**
Zinc	no cause for concern	no cause for concern	no cause for concern
Stainless steel	no cause for concern	no cause for concern	no cause for concern*
Lead	no cause for concern	no cause for concern	cause for concern
Hot galvanized steel	no cause for concern	no cause for concern	no cause for concern
Unprotected steel	cause for concern	cause for concern	cause for concern
Copper	cause for concern	cause for concern	cause for concern

* This only applies to thread-forming screws and blind rivets made of stainless steel, when an electrolyte formation is to be excluded.

Fitting with other materials

Steel:
Direct contact between aluminium profile sheets and unprotected steel elements of the substructure must be prevented on a permanent basis. For this purpose, plastic foils and intermediate layers with bituminous or zinc chromate or chlorinated-rubber paint, can be used or steel parts in the contact zones can be galvanised.

Concrete and mortar:
Direct contact with fresh concrete and mortar is to be avoided, e.g. when applying mortar around other construction elements, e.g. windows.

4.2 Ecology

In common with all other materials, aluminium cannot be manufactured without energy expense and associated emissions. However, the industry has succeeded in achieving remarkable reductions in this area by means of process developments and environmental investment. Today, the amount of energy for the production of aluminium by electrolysis is just 60 % of the amount required 40 years ago.

During the useful life of the material (typically several decades) hardly any corrosion of the aluminium surface occurs. At the end of the building's life, building components are preferably recovered for recycling process. Aluminium is ideally suited for recycling because it is available in large quantities and is relatively pure in terms of grading. The recycling process uses just 5% of the energy required for original production. The melting process can be repeated as often as required with no loss of the intrinsic properties and performance of the metal. Aluminium constructions, therefore, contain an ever-increasing proportion of recycled material. Today, all aluminium scrap from construction is supplied to the recycling process.

The relatively high strength of Kalzip® allows important structural requirements such as room surround, weather protection and retaining value to be fulfilled at comparatively low material cost. This conservation of resources corresponds to one of the most important ecological demands.

4.3 Static proof

Because the use of Kalzip® Facade Systems as wall cladding is subject to the requirements of the buildings regulations law, the proof of stability and fitness for use has to be furnished for the profile sheets and their connections in each individual case.

For this the table printed in section 6 is to be used. It is based on the calculated determination of the load tested as type static.

Additionally, for the fixings, the proof 'Tearing out of the substructure' e.g. according to approval Z-14.1-4 'Connection elements ...' or DIN 18807 has to be furnished. Furthermore, possible reductions in the number of screw fixings in unsymmetrical thin-walled substructures are to be taken into consideration.

4.4 Transport/storage and fitting

The transportation of the profile sheets is generally effected from the works of the manufacturer direct to the building site by lorry or railway transport. During transport, the material must be protected against weather, particularly against rain. For this, tarpaulins, oil papers or foils may be used. Rubbing of the individual sheets against each other MUST be avoided.

Care must be taken to ensure that Kalzip® Facade Systems are transported and stored in dry and ventilated conditions. Open transport in changeable weather is to be avoided. Storage must be carried out in such a way that formation of condensation within the stacks is avoided. Storage is to be avoided in damp and warm rooms or where frequent temperature changes occur. Building site stores must covered and ventilated. Walking on the stacks without sufficient protection of the surface must be avoided. The protective foil must be left on and then removed immediately after installation.

Mechanical damage of the surface causes optical impairment but does not initiate corrosion processes in the aluminium. Every chemical attack on the surface leads to visible changes and therefore accumulations of dirt must not be treated with abrasive or caustic substances. Unloading at the building site is to be carried out with appropriate lifting gear.

4.5 Sheet metal thicknesses

The sheet metal thicknesses of the Kalzip® facade profile sheets are 1.0 and 1.2 mm. The load bearing values are determined according to DIN 18807.

4.6 Thermal protection

The required proof for thermal and moisture protection must be furnished, taking the interaction of all building materials and structural components into consideration, according to the current rules and regulations in Germany (DIN 4108, DIN 18807, DIN 18516, Energy saving regulation).

Due to the thermal conductivity of metals, the profile sheets and their connections make no contribution to the heat insulation effect of the wall construction. This depends essentially on the layer construction and the insulation materials used. Existing thermal bridges must be taken into consideration.

According to DIN 18516 'only such heat insulation materials must be used, which can be exposed to moisture influence, without their volume stability and insulating ability being essentially impaired'. They are to be installed permanently, without gaps, and be dimensionally stable.

4.7 Moisture protection/ ventilation at rear

For effective ventilation to the rear of external wall cladding, the following prerequisites are to be fulfilled (if more precise proof is not furnished):

- The ventilation space is to be arranged immediately behind the facade profile sheets.
- The gap between the inner surface of the facade profile sheets and the internal wall or the insulation material lying behind it should be at least 20 mm.
- The total cross-section of the ventilation space must be at least 200 cm^2/m (i.e. for a load span of 1 m the gap must be at least 2 cm wide).
- Even for a non-vertical arrangement of the substructure, the total cross-section of the ventilation space must be adhered to.
- The ventilation and exhaust vents at the base of the building and at the roof edge must have minimum cross-sections of 50 cm^2/m each.
- If protective grids or perforated plates are installed, the above requirements relate to the free cross-section.

4.8 Air tightness of the building envelope

Avoidance of heat loss due to air flow is important. For this an air barrier, which must be taken into consideration at the planning stage, must be designed and installed.

'Buildings ... are to be erected in such a way that the heat transferring surround surface, including the joints, is permanently impermeable to air in accordance with the state of the art.' Any existing joints in walls made of concrete, cellular concrete or walling must be sealed, before fitting the substructure for the facade profile sheets.

If the load bearing wall consists of trapezoidal sheets, then either their joints are to be sealed (inserting sealing tapes into the longitudinal and transverse joints or pasting over in case of obtuse transverse joints) or a vapour thermal barrier has to be applied to act as an air barrier (Bonding of the overlaps on the flanges of the trapezoidal profiles, or on inserted sheet metal strips, close connections to the structure and other construction parts, particularly in the case of penetrations, windows, doors etc.).

When using cassettes as a load bearing wall, their longitudinal joints are to a sealed by inserting sealing tapes and (obtuse) transverse joints are either to be sealed by pasting over the joints from inside the cassettes or by inserting of sealing tapes between the broad cassette flange and the bearing supports. In the case of refurbishment of existing buildings, the disposition of the level impermeable to air must be separately assessed.

4.9 Fire protection

Requirements regarding fire protection of building materials, building elements etc. are defined in the official building regulations. Aluminium alloys are in accordance with DIN 4102-4 without proof, building materials of the classification A1 ('not flammable').

4.10 Lightning protection

Lightning protection is a necessary protection to preventing damage to buildings and injury to persons. Metal facades, contrary to the widely held view, do not 'attract' lightning flashes. The conductive facade of Kalzip® facade sheets can serve, in case of a lightning strike, according to DIN EN V 61024-1 both as lightning arrester (if melting is permitted) and also path to earth, provided that the profile sheets are conductively connected (e.g. screwed to each other or to a metal substructure) and are connected at a distance of less than 10 m to an earth conductor.

For building heights up to 60 m the amperages of the lightning flashes which may hit the facades are too low to cause damage to the profile sheets. Even in a building with an external lightning protection system installed according to standard it is possible that due to the induced electromagnetic field in the interior, owing to the flash current flowing away on the outside, electronic installations (e.g. communications, or process control) can be damaged or destroyed. The most practical and economic protective measure is screening. By this means the flash current is distributed over as many conduction paths as possible. With an appropriate design specification, the profile sheets can be used as a screen. Details must be discussed with a specialist company for lighting protection technology.

4.11 Temperature-dependent change of length

Temperature-dependent changes of length are to be taken into consideration. The thermal coefficient of the expansion of aluminium in the considered temperature range is approx. 24 x 10-6/K. For an assumed temperature of 20°C during installation of the profile sheets, in the summer (+ 80°C) an extension of approx. 1.5 mm/m sheet length and in the winter (- 20°C) a shortening of approx. 1 mm/m sheet length results. However, as the adjacent building elements are also exposed to temperature fluctuations and the substructures as a rule are able to absorb deformations, from a building practice point of view, a motion tolerance of ± 0.5 mm/m sheet length may be assumed. If these prerequisites are not met, one must calculate in line with the maximum values stated above.

In addition, in terms of design, the length tolerances arising from the manufacture of the profile sheets are to be taken into consideration. For these reasons, on pilaster strips, window embrasures, door frames or the like, for the recommended sheet length of 6 m, a minimum distance of the profile sheet ends to the other building elements of 5 mm is to be provided.

4.12 Tolerances

For the profile sheets the tolerances, having also to be adhered to on the finished building, are determined in DIN 18807. If higher demands are made on the building construction, these values may be too large, e.g. in case of clearly visible pilaster strips or shadow joints. According to standard, a 6 m long facade profile sheet may be 20 mm longer or 5 mm shorter than the nominal dimension, in addition from the permitted deviation from the right angle, an offset of 4 mm to the adjacent sheet metal ('triangular toothing') is possible.

Both phenomena may be more or less clearly visible depending on the distance of the viewer and the brightness or colour of the background.

Kalzip® facade profile sheets are used in prestigious building constructions. Where required, it is possible to manufacture the profile sheets on request and according to tighter tolerances. These measures, however, require additional input during both manufacture and inspection leading to higher costs. Therefore, the aspects mentioned below should be considered:

It is recommended to agree the tolerances between the installer and the supplier.
For the installer it is particularly important,
- to thoroughly check the substructure prior to fitting,
- to report reservations, if their deviations from the basic size are too great,
- to have necessary compensation measures for the correction of the substructure carried out by the previous trades, before starting with the fitting,
- to claim additional costs from the start, if he carries out the compensation measures himself or installs adjustable substructures.

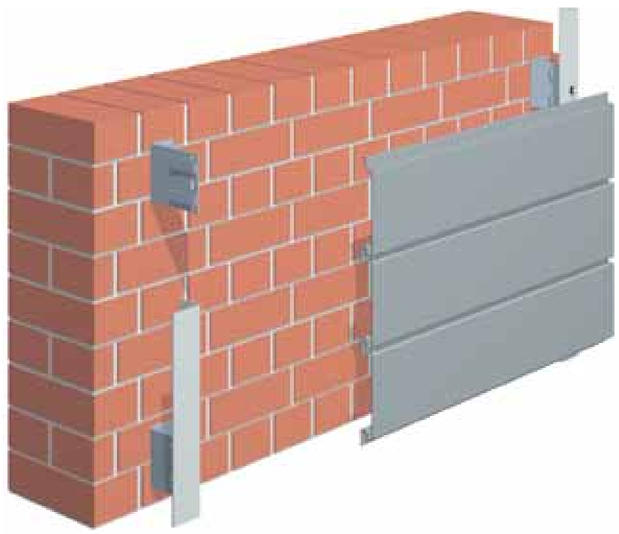
Right:
CMT Zeiss Oberkochen (D)
Architect:
SIAT Bauplanung und
Ingenieurleistungen GmbH

5. Design notes

5.1 Substructure made of concrete, brickwork

The Kalzip® Facade System offers extensive design possibilities for aesthetic/technical architecture. At the same time it offers a truly economic solution because the low dead weight leads to considerable cost savings with regard to the substructure.

For the substructure, generally multi-part, adjustable sections made of steel or aluminium are used. They may consist of short or long rails and have the ability to compensate for the inaccuracies of the external wall materials such as concrete or brickwork. This frame and spacer section system must have correspondingly low tolerances, in order to permit a construction free of tension and dents on the outer shell. Attention must be paid to the fulfilment of the requirements of DIN 18516 regarding materials and corrosion resistance characteristics



Right:
Industrial hall Marxer Friedberg (D)
Architect: Dieter W. Hoppstaedter
Page 16:
Storage Electro Helfrich Viernheim (D)
Architects: Fischer Architekten, Viernheim
Page 17:
Kalzip® TF 37/800 R system components

5.2 Substructure made of cassettes, trapezoidal profile sheets, posts/frames

Steel cassettes

This space surround is frequently employed in industrial construction. By selecting the cassette depth (= max. thickness of the insulation material) and the appropriate insulation material it is possible to achieve the required insulating effect. At close intervals, the cassettes are braced by vertical running frames (e.g. flat steel) for static conditions.

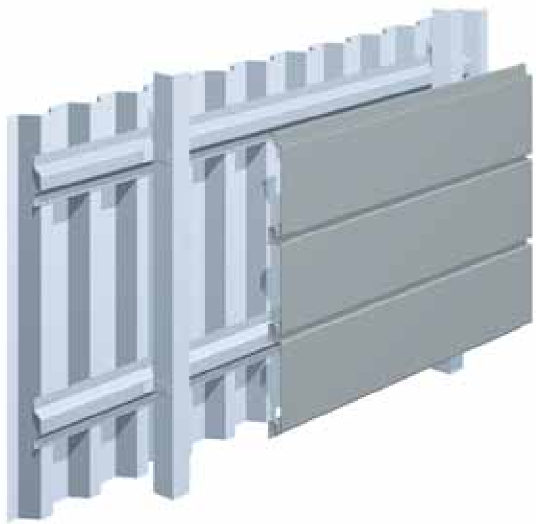
Subsequently the fastening of multi-part, adjustable sections made of steel and aluminium allows for the compensation of inaccuracies and variable tolerances. Following this, the Kalzip® Facade System can be fitted free of tension and dents.

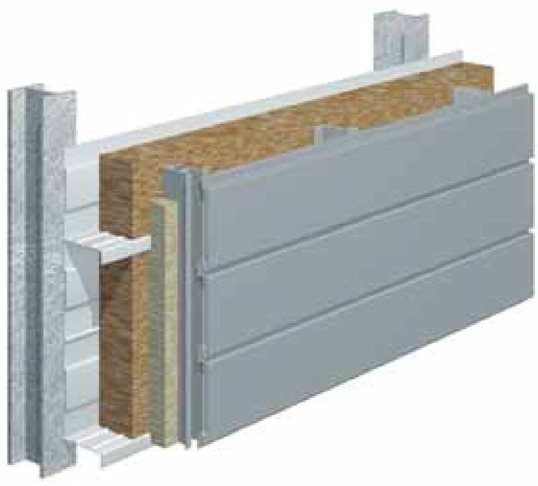
Trapezoidal sheets

The fitting onto trapezoidal sheets is a typical refurbishment situation. Horizontal hat section are screwed onto the existing external wall profiles. This is followed by the fastening of a vertical multi-part and adjustable frame and spacer construction made of cold-formed steel profiles.

Post and frame system

With this variant, lie lateral U-sections between the structural supports on which wall frames with angle profiles are fitted vertically.





5.3 Intermediate construction for cassettes

Vertical spacer sections made of steel or -aluminium are required between the horizontally laid Kalzip® facade profile sheets and also horizontal cassettes as a substructure for the Kalzip® facade profile sheets and as bracing for the small flanges and webs of the cassette. Therefore, their intervals are determined by both criteria. If the permissible load spans of Kalzip® facade profile sheets are greater than the permissible intervals of the cassette bracings, further spacer sections must be installed, if the load spans of the cassettes are to be fully utilised. The spacer sections are to be connected to other ’fixed points‘, e.g. base rail or eaves frame. If flat steels or sheet metal strips are used as spacer sections, they have to be connected to ’fixed points‘ at both ends.

6. Kalzip® Facade System TF 37/800 R

6.1 System components

The system is suitable only for horizontal or slightly inclined installation on the facade elevation. Profiles for outside corners, pilaster strips, inside corners and intrados (reveals) are available as system components.

6.2 Connections

For connecting the profile sheets with the substructure all building regulations approved screws and blind rivets may be used which are judged suitable for this application. In doing so, their intervals are determined by statical requirements.

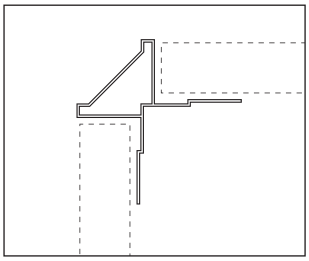
The use of 'irius SX-L12-A10-5.5xL' screws produced by SFS intec, is recommended. Then the maximum possible load spans can be taken from the type-tested design tables in section 6. The installation instructions of the connection element manufacturer are to be adhered to, e.g. the essential use of a bit stop.

6.3 Construction detail inside, outside

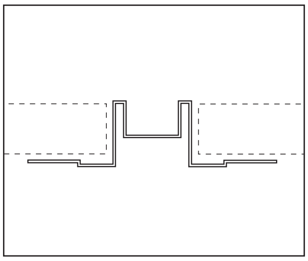
All subsequent detail cross-sections can also be obtained from Corus on CD-ROM.

Kalzip® TF 37/800 R system components

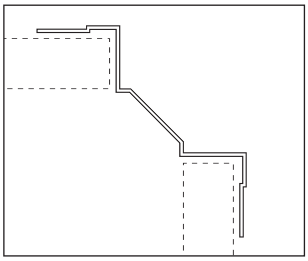
Dimensions maximum profile length 6000mm



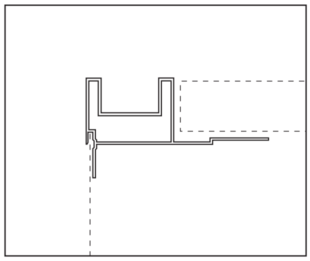
Kalzip® outside corner profile A-S2



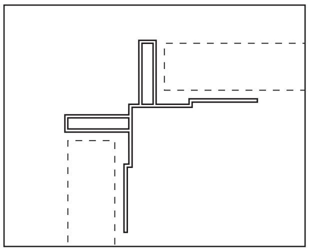
Kalzip® joining detail L-S2



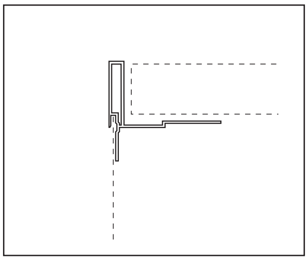
Kalzip® inside corner profile I-S1



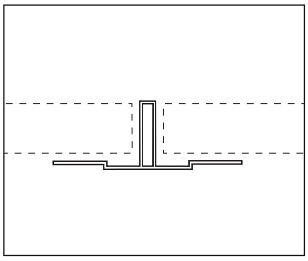
Kalzip® reveal profile LA-S2



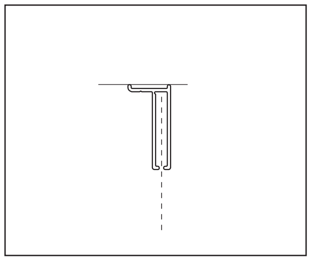
Kalzip® outside corner profile A-S1



Kalzip® reveal profile LA-S1

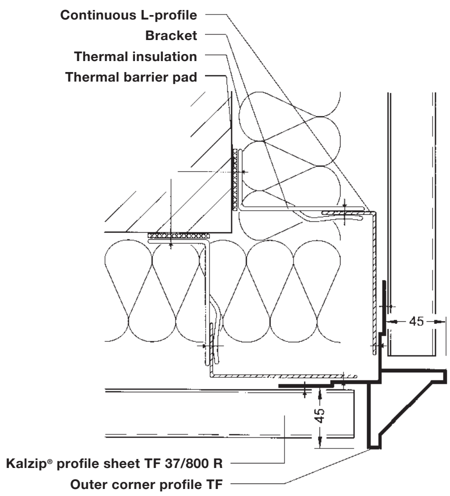


Kalzip® joining detail L-S1

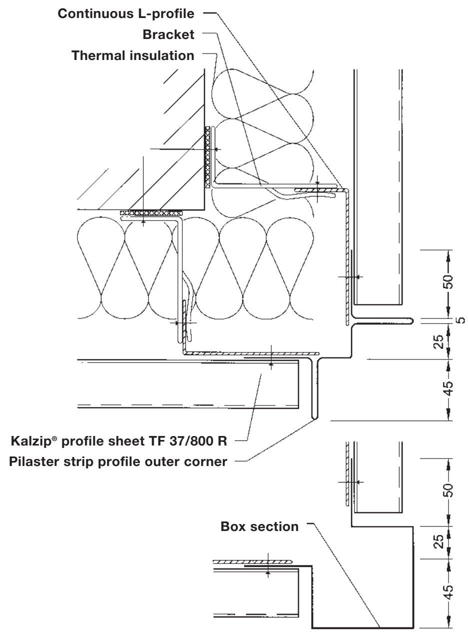


Kalzip® F profile F-S1

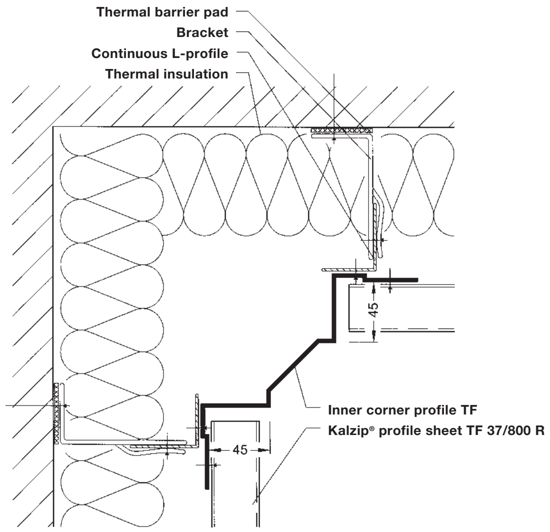
6.4 Construction detail: Pilaster strips



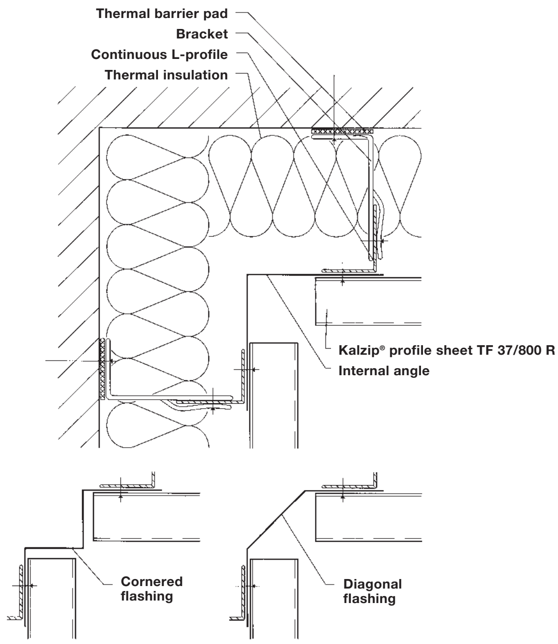
Kalzip® Facade System TF 37/800 R
Outer corner with outer corner profile TF



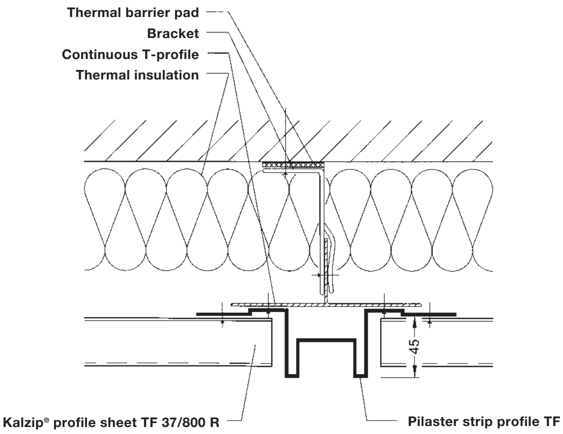
Kalzip® Facade System TF 37/800 R
Outer corner with flashing

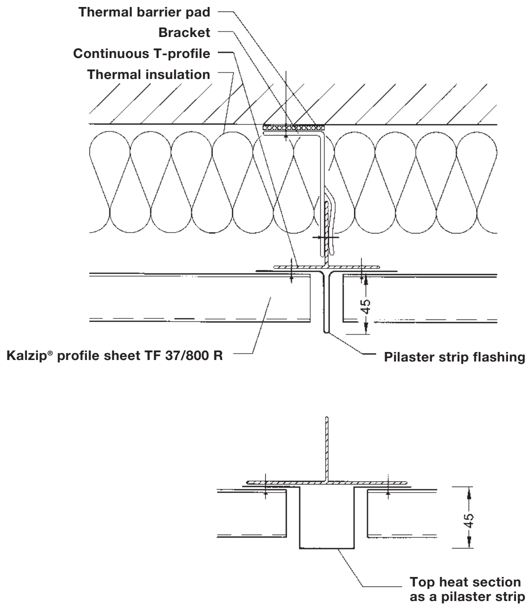


Kalzip® Facade System TF 37/800 R
Inner corner with inner corner profile TF



Kalzip® Facade System TF 37/800 R
Inner corner with flashing

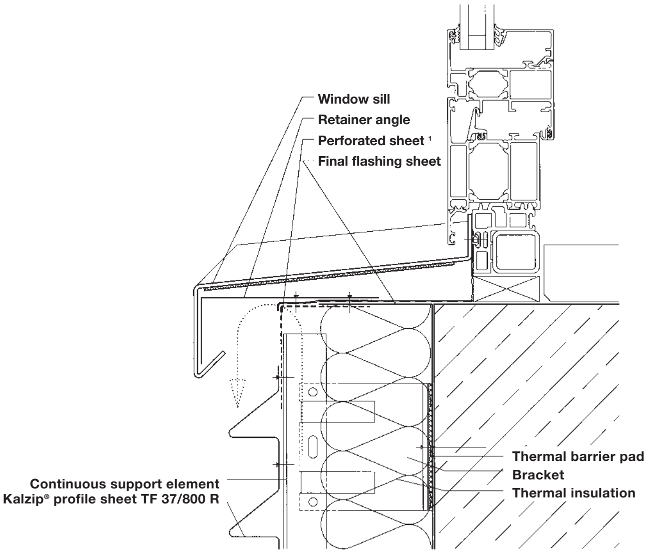


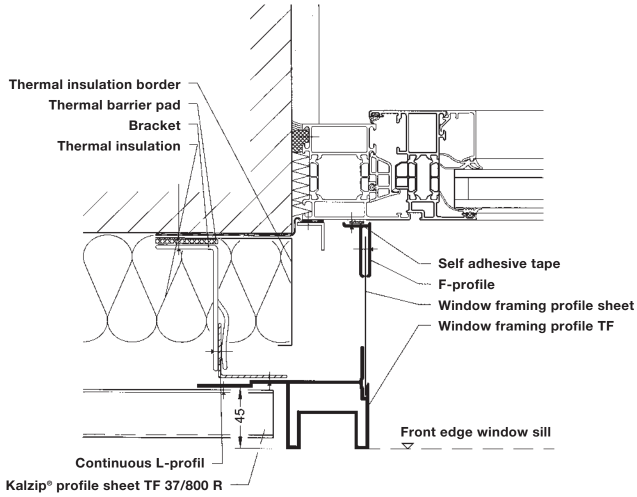


Kalzip® Facade System TF 37/800 R
Lap joint with pilaster strip TF

Kalzip® Facade System TF 37/800 R
Lap joint with flashing

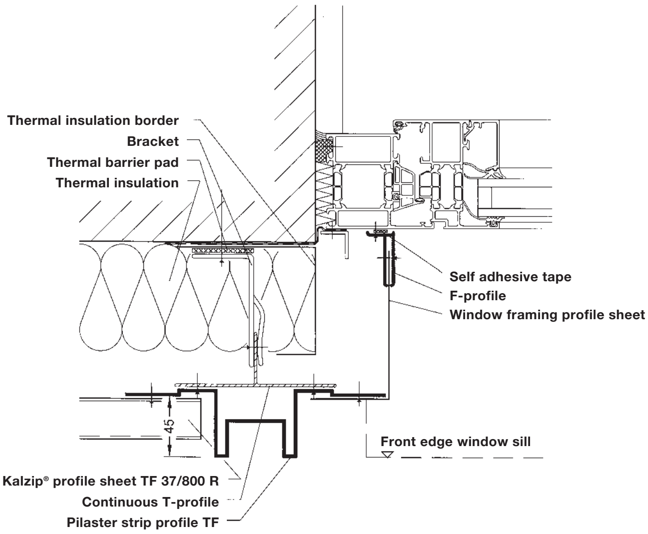
6.5 Construction detail: Window (top, side, window sill)

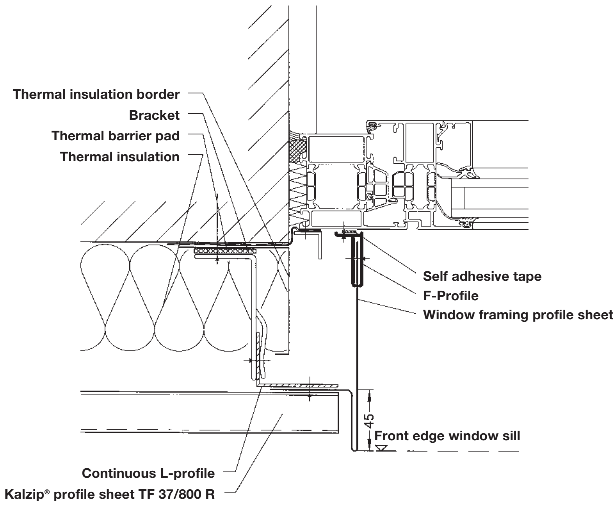




Kalzip® Facade System TF 37/800 R
Window sill

Kalzip® Facade System TF 37/800 R
Window jamb with framing profile TF

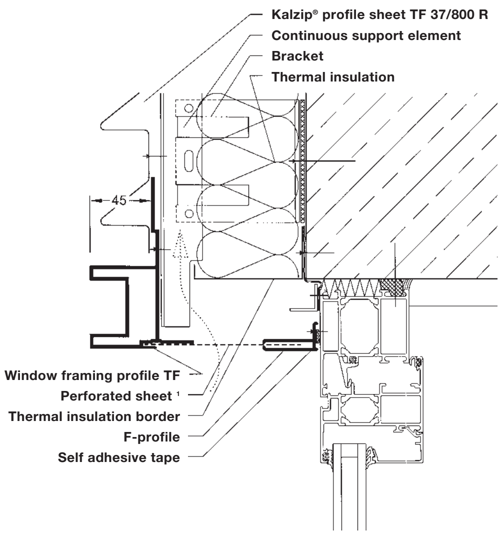




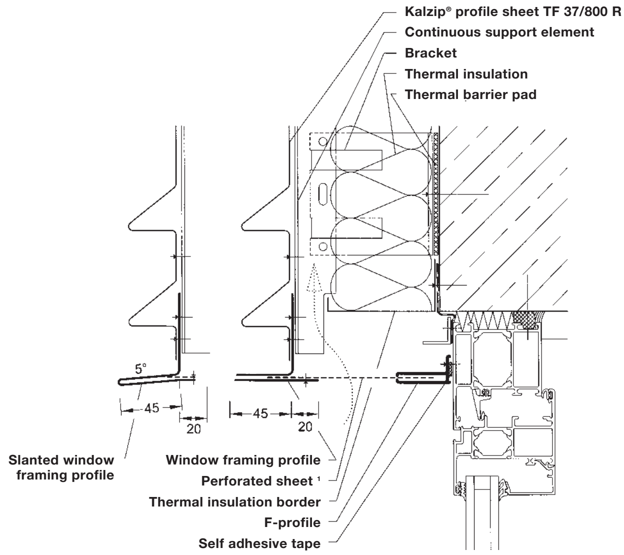
Kalzip® Facade System TF 37/800 R
Window jamb with pilaster strip TF

Kalzip® Facade System TF 37/800 R
Window frame with flashing

6.6 Construction detail: Door (top, side)

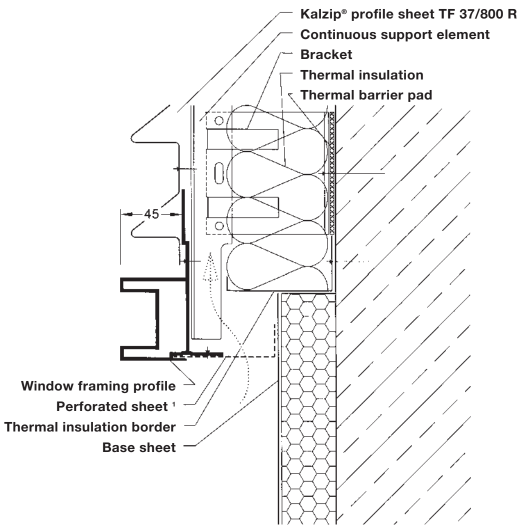


Kalzip® Facade System TF 37/800 R
Lintel with window framing profile TF

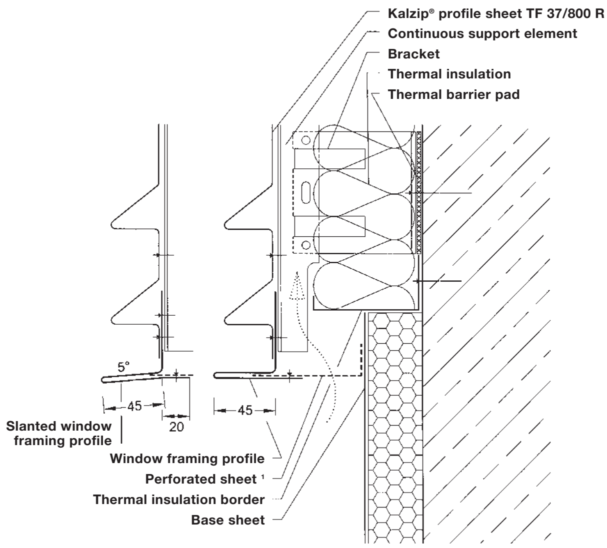


Kalzip® Facade System TF 37/800 R
Lintel with flashing

6.7 Construction detail: Wall connection (top, bottom, bracing angle(s), drip tray)



Kalzip® Facade System TF 37/800 R
Base with framing profile TF



¹ Observe required ventilation area according to national standards

Kalzip® Facade System TF 37/800 R
Base with flashing

6.8 Load spans Kalzip® TF 37/800 R

Load bearing capacity of Kalzip® TF 37/800 R

Aluminium- Trapezprofil **Kalzip TF 800**

Querschnitts- und Schubfeldwerte nach DIN 18807, Teil 6

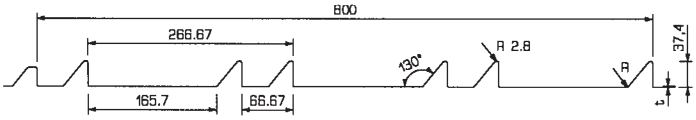
Anlage 1

Als Typen-Bemessungstabelle in statischer Hinsicht geprüft
hierzu Prüfbericht Nr. 1-08/01 *
mit Geltungsdauer bis 30.04.2006
Darmstadt, den 07.02.2002
Hessische Landesprüfstelle für Baustatik
Der Leiter: Der Bearbeiter:
Dr.-I. Dr.-Ing.

*und Änderungsbescheid vom 07.02.2002

Profiltafel in **Positivlage**

Maße in mm



Radius R= 3 mm

Nennwert der Spannung an der 0,2%- Dehngrenze: $R_{p0,2}$ = 185 N/mm²

Maßgebende Querschnittswerte

Blech-dicke	Eigen-last	Biegung [1]		Normalkraftbeanspruchung: nicht reduzierter Querschnitt			Normalkraftbeanspruchung: wirksamer Querschnitt [2]			Grenzstützweiten [3]: Einfeld-träger	Grenzstützweiten [3]: Mehrfeld-träger
t	g	I^+_{ef}	I^-_{ef}	A_g	i_g	z_g	A_{ef}	i_{ef}	z_{ef}	l_{gr}	l_{gr}
mm	kN/m²	cm⁴/m	cm⁴/m	cm²/m	cm	cm	cm²/m	cm	cm	m	m
1,0	0,0405	17,96	13,45								
1,2	0,0486	21,56	16,69								

Schubfeldwerte

t	L_S [4]	$T_{1,k}$ [4]	$T_{3,k} = G_S/750$ [kN/m]; $G_S=10^4/(k'_1+k'_2/L_S)$: k'_1	k'_2	k^*_1 [5]	k^*_2 [5]	k_3 [6]
mm	m	kN/m	m/kN	m²/kN	kN⁻¹	m²/kN	-

[1] Wirksame Trägheitsmomente für Lastrichtung nach unten (+) bzw. oben (-).

[2] Wirksamer Querschnitt für eine konstante Druckspannung $\sigma = R_{p0,2}$

[3] Maximale Stützweiten, bis zu denen das Trapezprofil ohne lastverteilende Maßnahmen begangen werden darf.

[4] Für Einzelstützweiten $L_{Si} \leq L_R$ darf $T_{1,k}$ aus der Tabelle entnommen oder mit $(L_R/L_{Si})^2$ erhöht werden; für $L_{Si} > L_R$ muß $T_{1,k}$ mit $(L_R/L_{Si})^2$ abgemindert werden. Für Einfeldträger ist $T_{1,k}$= 2 x Tabellenwert.

[5] Falls erforderlich, darf die Gesamtverformung eines Schubfeldes wie folgt ermittelt werden:

$$f=\left[\left(k'_1+k^*_1 \cdot e_L\right)+\left(k'_2+k^*_2\right)/L_S\right]\cdot 10^{-1}\cdot a \cdot \mathrm{vorh}T$$

mit e_L = Abstand der Verbindungen im Längsstoß in m
a = Schubfeldbreite in m, senkrecht zur Profilierrichtung
T = vorhandener Schubfluß in kN/m

[6] $T \times k_3 + A \leq R_{A,k}/\gamma_M$, mit T= γ_F- facher Schubfluß

Stand: 04. Februar 2002

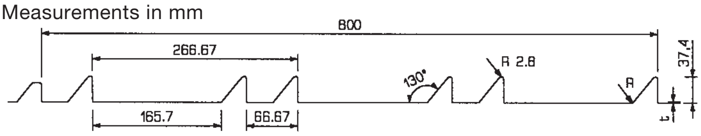
Translation of the official test report No. 1-08/01 produced in Germany

Aluminium trapezoidal profile **Kalzip® TF 37/800**
Cross section and diaphragm action values according to DIN 18807, part 6
Trapezoidal sheeting in buildings / structural engineering (Aluminium trapezoidal profiles and their connections: Determination of the load bearing capacity values by calculation)

Enclosure 1

Tested as type-design table tested in terms of static see test report No. 1-08/01* with validity until: 30.04.2006
Darmstadt: 07.02.2002
Examining Office for structural analysis of the 'Land' of Hessen
*and amendment notification dated 07.02.2002

Profile sheets in **positive position**
Measurements in mm



Radius R = 3 mm

Nominal value of yield strength at 0.2% proof stress: $R_{p0.2}$ = 185 N/mm²

Cross-section properties

Thickness of sheet metal	Dead weight	Moment of inertia [1]		Normal force						Limit spans [3]	
				non-reduced cross-section			effective cross-section [2]			single-span beam	continuous beam
t mm	g kN/m²	I^+_{ef} cm⁴/m	I^-_{ef} cm⁴/m	A_g cm²/m	i_g cm	z_g cm	A_{ef} cm²/m	i_{ef} cm	z_{ef} cm	l_{gr} m	l_{gr} m
1.0	0.0405	17.96	13.45								
1.2	0.0486	21.56	16.69								

Shear field values

			$T_{3,k} = G_S /750$ [kN/m]				
			$G_S = 10^4/(k'_1+k'_2/L_S)$				
t mm	L_S [4] m	$T_{1,k}$ [4] kN/m	k'_1 m/kN	k'_2 m²/kN	k^*_1 [5] kN⁻¹	k^*_2 [5] m²/kN	k_3 [6] -

[1] Effective moments of inertia for downward load direction (+) or upward (-).
[2] Effective cross-section for a constant compressive stress $\sigma = R_{p0,2}$
[3] Maximum spans, up to which the trapezoidal profile may be walked on without load distributing measures.
[4] For single spans $L_{Si} \leq L_R$ $T_{1,k}$ may be taken from the table or increased with $(L_R/L_{Si})^2$;
for $L_{Si} > L_R$ $T_{1,k}$ $(L_R/L_{Si})^2$ must be reduced. For single-span beams $T_{1,k}$ = 2 x table value.
[5] If necessary, the total deformation of a diaphragm may be determined as follows:
$f=\left[\left(k'_1+k^*_1 \cdot e_L\right)+\left(k'_2+k^*_2\right)/L_S\right]\cdot 10^{-1}\cdot a\cdot \text{vorhT}$ (existing T)
with e_L = Distance of the connection in the longitudinal joint in m
a = Diaphragm width in m, vertical to the profile direction
T = Existing diaphragm in kN/m
[6] $T^x\ k_3+A \leq R_{A,k}/\gamma_M$, with T=$\gamma_F$-times shear action.

State: 04 February 2002

Load bearing capacity of Kalzip® TF 37/800 R

Aluminium- Trapezprofil **Kalzip TF 800**

Charakteristische Tragfähigkeitswerte nach DIN 18807, Teil 6

Profiltafel in **Positivlage**

Anlage 2
Als Typen-Bemessungstabelle in statischer Hinsicht geprüft
hierzu Prüfbericht Nr. 1-08/01*
mit Geltungsdauer bis 30.04.2006
Darmstadt, den 07.02.2002
Hessische Landesprüfstelle für Baustatik
Der Leiter: Dr.-Ing. Der Bearbeiter: Dr.-Ing.

*und Änderungsbescheid vom 07.02.2002

Tragfähigkeitswerte für nach unten gerichtete und andrückende Flächen- Belastung [1)]
Als Teilsicherheitsbeiwert ist γ_M= 1,1 zu setzen.

Blechdicke	Feldmoment	Endauflagerkraft	Elastisch aufnehmbare Schnittgrößen an Zwischenstützen [5)]							
					max. Stützmoment	max. Auflagerkraft			max. Stützmoment	max. Auflagerkraft
t	$M_{F,k}$	$R_{A,k}$	$M^0_{B,k}$	$R^0_{B,k}$	max $M_{B,k}$	max $R_{B,k}$	$M^0_{B,k}$	$R^0_{B,k}$	max $M_{B,k}$	max $R_{B,k}$
mm	kNm/m	kN/m	kNm/m	kN/m	kNm/m	kN/m	kNm/m	kN/m	kNm/m	kN/m
		b_A= 40 mm [2)]	Zwischenauflagerbreite [3)] $b_B \geq$ 0 mm, ε = 2				Zwischenauflagerbreite [4)] $b_B \geq$ 40 mm, ε = 2			
1,0	1,196	7,34	1,039	13,17	1,039	11,78	1,039	16,41	1,039	14,68
1,2	1,454	10,8	1,284	19,31	1,284	17,27	1,284	24,07	1,284	21,53

Tragfähigkeitswerte für nach oben gerichtete und abhebende Flächen- Belastung [1)]
Als Teilsicherheitsbeiwert ist γ_M= 1,1 zu setzen.

Blechdicke	Feldmoment	Verbindung in jedem anliegenden Gurt					Verbindung in jedem 2. anliegenden Gurt				
		Endauflager	Zwischenauflager [5)]				Endauflager	Zwischenauflager [5)]			
t	$M_{F,k}$	$R_{A,k}$	$M^0_{B,k}$	$R^0_{B,k}$	max $M_{B,k}$	max V_k	$R_{A,k}$	$M^0_{B,k}$	$R^0_{B,k}$	max $M_{B,k}$	max V_k
mm	kNm/m	kN/m	kNm/m	kN/m	kNm/m	kN/m	kN/m	kNm/m	kN/m	kNm/m	kN/m
1,0	1,039	28,95			1,196	28,95	14,47			0,598	14,47
1,2	1,284	38,49			1,454	38,49	19,25			0,727	19,24

1) An den Stellen von Linienlasten quer zur Spannrichtung und von Einzellasten ist der Nachweis nicht mit dem Feldmoment $M_{F,k}$, sondern mit dem Stützmoment max $M_{B,k}$ für die entgegengesetzte Lastrichtung zu führen

2) b_A= Endauflagerbreite. Bei einem Profiltafelüberstand ü > s_w/t dürfen die R_A- Werte um 20% erhöht werden.

3) Für kleinere Auflagerbreiten b_B als angegeben müssen die aufnehmbaren Tragfähigkeitswerte linear im entsprechenden Verhältnis reduziert werden. Für b_B< 10 mm, z.B. bei Rohren, darf b_B = 10 mm eingesetzt werden.

4) Bei Auflagerbreiten, die zwischen den aufgeführten Werten liegen, dürfen die aufnehmbaren Tragfähigkeitswerte jeweils linear interpoliert werden.

5) Interaktionsbeziehung für M und R:

$$\frac{M}{\max M^0_{B,k}/\gamma_M} + \left(\frac{R}{R^0_{B,k}/\gamma_M}\right)^2 \leq 1$$

Interaktionsbeziehung für M und V:

$$\frac{M}{\max M_{B,k}/\gamma_M} + \frac{V}{\max V_k/\gamma_M} \leq 1{,}3$$

Hessische Landesprüfstelle für Baustatik Darmstadt

Stand: 04. Februar 2002

Translation of the official test report No. 1-08/01 produced in Germany

Aluminium trapezoidal profile sheet **Kalzip® TF 37/800** Characteristic load bearing capacity according to DIN 18807, part 6	Enclosure 2 Tested as type-design table tested in terms of static see test report No. 1-08/01* with validity until: 30.04.2006 Darmstadt: 07.02.2002 Examining Office for structural analysis of the 'Land' of Hessen *and amendment notification dated 07.02.2002
Profile sheets in **positive position**	

Load bearing values for downward loading [1]
As partial safety coefficient is to be set $\gamma_M = 1.1$.

Thickness of sheet metal	Field moment	End support reaction	Combined bending moment and support reaction at intermediate supports [5]							
					Max. support moment	Max. support force reaction			Max. support moment	Max. support force reaction
t mm	$M_{F,k}$ kNm/m	$R_{A,k}$ kN/m	$M^0_{B,k}$ kN/m	$R^0_{B,k}$ kN/m	max $M_{B,k}$ kNm/m	max $R_{B,k}$ kN/m	$M^0_{B,k}$ kNm/m	$R^0_{B,k}$ kN/m	max $M_{B,k}$ kNm/m	max $R_{B,k}$ kN/m
		b_A= 40 mm [2]	Intermediate bearing (support) width [3] $b_B \geq 0$ mm, $\varepsilon = 2$				Intermediate bearing (support) width [4] $b_B \geq 40$ mm, $\varepsilon = 2$			
1.0	1.196	7.34	1.039	13.17	1.039	11.78	1.039	16.41	1.039	14.68
1.2	1.454	10.8	1.284	19.31	1.284	17.27	1.284	24.07	1.284	21.53

Load bearing values for uplift loading [1]
As partial safety coefficient is to be set γ_M= 1.1.

Thickness of sheet metal	Field moment	Connection in each adjacent flange					Connection in each 2nd adjacent flange				
		end support	Intermediate support [5]				end support	Intermediate support [5]			
t mm	$M_{F,k}$ kNm/m	$R_{A,k}$ kN/m	$M^0_{B,k}$ kN/m	$R^0_{B,k}$ kN/m	max $M_{B,k}$ kNm/m	max V_k kN/m	$R_{A,k}$ kN/m	$M^0_{B,k}$ kNm/m	$R^0_{B,k}$ kN/m	max $M_{B,k}$ kNm/m	max V_k kN/m
1.0	1.039	28.95			1.196	28.95	14.47			0.598	14.47
1.2	1.284	38.49			1.454	38.49	19.25			0.727	19.24

[1] At the areas of line loads perpendicular to the tension direction and of single loads, the proof is not to be furnished with the field moment $M_{F,k}$, but with the moment at support max $M_{B,k}$ for the opposite load direction.
[2] b_A = end support width. In case of a profile overhang (projection) > s_w/t the R_A values may be increased by 20%.
[3] For smaller support widths b_B than stated, the absorbable load bearing capacity values must be reduced linear in the relevant ratio. For b_b< 10 mm, e.g. in case of pipes b_b = 10 mm may be inserted.
[4] In case of support widths lying between the values stated, the absorbable load bearing capacity values can be linear interpolated in each case.
[5] Interaction relationship between M and R

$$\frac{M}{\max M^0_{B,k}/\gamma_M} + \left(\frac{R}{R^0_{B,k}/\gamma_M}\right)^2 \leq 1$$

Interaction relationship for M and V

$$\frac{M}{\max M_{B,k}/\gamma_M} + \frac{V}{\max V_k/\gamma_M} \leq 1{,}3$$

State: 04 February 2002

Load bearing capacity of Kalzip® TF 37/800 R

Aluminium- Trapezprofil **Kalzip TF 800**

Charakteristische Tragfähigkeitswerte für Verbindungen nach DIN 18807, Teil 6

Anlage 3

Als Typen - Bemessungstabelle in statischer Hinsicht geprüft
hierzu Prüfbericht Nr. 1-08/01 *
mit Geltungsdauer bis 30.04.2006
Darmstadt, den 07.02.2002
Hessische Landesprüfstelle für Baustatik
Der Leiter: Dr.-Ing. Der Bearbeiter: Dr.-Ing.

Profiltafel in **Positivlage**

*und Änderungsbescheid vom 07.02.2002

Aufnehmbare Zugkraft Z_k in kN pro Verbindungselement in Abhängigkeit von der Blechdicke t in mm und dem Scheibendurchmesser d in mm. [1) 2)]
Als Teilsicherheitsbeiwert ist γ_M= 1,33 zu setzen. Zugfestigkeit: R_m = 220 N/mm².

Verbindung	t = 1,00		t = 1,20		t =		t =	
	d= 10	d= 14	d= 10	d= 14	d= 10	d= 14	d= 10	d= 14
	0,964	1,14	1,16	1,37				

1) $Z_{kl} = \alpha_L \cdot \alpha_M \cdot \alpha_E \cdot Z_k$

mit

α_L = Beiwert zur Berücksichtigung der Biegezugspannung im angeschlossenen Gurt nach DIN 18807, Teil 6, Tabelle 2 (α_L = 1,0 bei Befestigung am Endauflager)

α_M = Beiwert zur Berücksichtigung des Werkstoffs der Dichtscheiben nach DIN 18807, Teil 6, Tabelle 3

α_E = Beiwert zur Berücksichtigung der Anordnung der Verbindungen nach DIN 18807, Teil 6, Tabelle 4

2) Es ist außerdem die aufnehmbare Zugkraft für die Verbindung mit der jeweiligen Unterkonstruktion und für das Verbindungselement selbst zu berücksichtigen.

Stand: 06. Februar 2002

HESSISCHE LANDESPRÜFSTELLE FÜR BAUSTATIK DARMSTADT

Translation of the load bearing capacity of Kalzip® TF 37/800 R

Aluminium trapezoidal profile sheet **Kalzip® TF 37/800** Characteristic load bearing capacity for fasteners DIN 18807, part 6 Profile sheet in **positive position**	Enclosure 3 Tested as type-design table tested in terms of static see test report No. 1-08/01* with validity until: 30.04.2006 Darmstadt: 07.02.2002 Examining Office for structural analysis of the 'Land' of Hessen *and amendment notification dated 07.02.2002

Characeristic tensile force Z_k in kN per connection element, dependent on the sheet metal thickness t in mm and the washer diameter d in mm. [1) 2)]
As partial safety value is to be set γ_M= 1.33. Tensile stress: R_m = 220 N/mm².

Connection	t = 1.00		t = 1.20		t =		t =	
	d= 10	d= 14	d= 10	d= 14	d= 10	d= 14	d= 10	d= 14
	0.964	1.14	1.16	1.37				

[1)] $Z_{kl} = \alpha_L \cdot \alpha_M \cdot \alpha_E \cdot Z_k$
with
α_L = Coefficient to take into account of the bending tensile stress in the connected flange according to DIN 18807, part 6. Table 2 (α_L = 1.0 in case of fastening at the end support)
α_M = Coefficient of the material of the sealing washers according to DIN 18807, part 6, table 3.
α_E = Coefficient of the arrangement of the connections according to DIN 18807, part 6, table 4.
[2)] The characteristic tensile force for the connection with the relevant substructure and for the connection element itself must be taken into consideration.

State: 06 February 2002

Bemessungstafeln WAND

Maximal mögliche Stützweiten in m

HESSISCHE LANDESPRÜFSTELLE FÜR BAUSTATIK DARMSTADT

Kalzip TF 800		Gebäudehöhe								
Verbindung in jedem 2. schmalen Untergurt, Dichtscheibe aus Stahl Ø10	t mm	0 - 8 m			> 8 - 20 m			> 20 - 100 m		
		D[1)]	NB[2)]	RB[2)3)]	D[1)]	NB[2)]	RB[2)3)]	D[1)]	NB[2)]	RB[2)3)]
Einfeldträger [4)5)]	1,0 1,2	2,34 2,49	3,79 4,22	1,81 2,11	2,00 2,13	3,00 3,33	1,13 1,36	1,80 1,92	2,35 2,83	0,82 0,99
Zweifeldträger [4)]	1,0 1,2	3,08 3,34	1,92 2,20	0,72 0,87	2,39 2,71	1,29 1,55	0,45 0,55	2,01 2,29	0,94 1,13	0,33 0,40
Dreifeldträger [4)]	1,0 1,2	2,90 3,08	2,11 2,40	0,81 0,93	2,48 2,63	1,47 1,71	0,51 0,62	2,23 2,37	1,07 1,29	0,37 0,45

1) D: Zulässige Stützweiten unter Berücksichtigung der Profiltragfähigkeit und der Durchbiegungsbeschränkung $f \leq L/150$ für andrückende Belastung. Auflagerbreiten $b_A, \geq 40$ mm, $b_B \geq 0$ mm
2) Windsog für Wände nach DIN 1055 Teil 4 (NB = Normalbereich, RB = Randbereich).
Zulässige Stützweiten unter Berücksichtigung der Profiltragfähigkeit und der Tragfähigkeit der Verbindungen bzgl. Versagen im Bauteil I (Überknöpfen). Der Nachweis der Verbindungstragfähigkeit bzgl. Versagen im Bauteil II (Ausreißen aus der Unterkonstruktion) ist zusätzlich zu führen. Bei dünnwandiger unsymmetrischer Unterkonstruktionen (Abminderung der aufnehmbaren Verbindungs- Zugkräfte auf 70%) sind die Verbindungen im Einzelfall nachzuweisen. Vereinfachend dürfen die angegebenen zulässigen Stützweiten um 30% reduziert werden.
3) Bei Verbindung in jedem schmalen Gurt dürfen die in der Spalte "Randbereich" angegebenen zulässigen Spannweiten verdoppelt werden.
4) Konstruktive Empfehlung: Tafellänge $L \leq 6$ m oder besondere Maßnahmen für die Aufnahme der Temperaturverformungen vorsehen.
5) Die Tabelle gilt für Einfeldträger ohne Überlappung (jedes Tafelende für sich mit der Unterkonstruktion verbunden).
Falls Einfeldträger hintereinander überlappend mit einer gemeinsamen Verbindung mit der Unterkonstruktion ausgeführt werden, sind die Verbindungen gesondert nachzuweisen. Vereinfachend darf auch die angegebene Stützweite halbiert oder, falls konstruktiv möglich, die Anzahl der Verbindungselemente verdoppelt werden.

Stand: 04. Februar 2002

Als Typen-Bemessungstabelle in statischer Hinsicht geprüft
hierzu Prüfbericht Nr. 1-08/01 *
mit Geltungsdauer bis 30.04.2006
Darmstadt, den 07.02.2002
Hessische Landesprüfstelle für Baustatik
Der Leiter: Dr.-Ing. Der Bearbeiter: Dr.-Ing.

* und Änderungsbescheid vom 07.02.2002

Design tables WALL

Maximum possible load spans in m

According to German DIN 1055, part 4 (wind loading). For a safe rating the national valid standard for wind loading must be taken into consideration in each case. According to wind load distribution stated below.

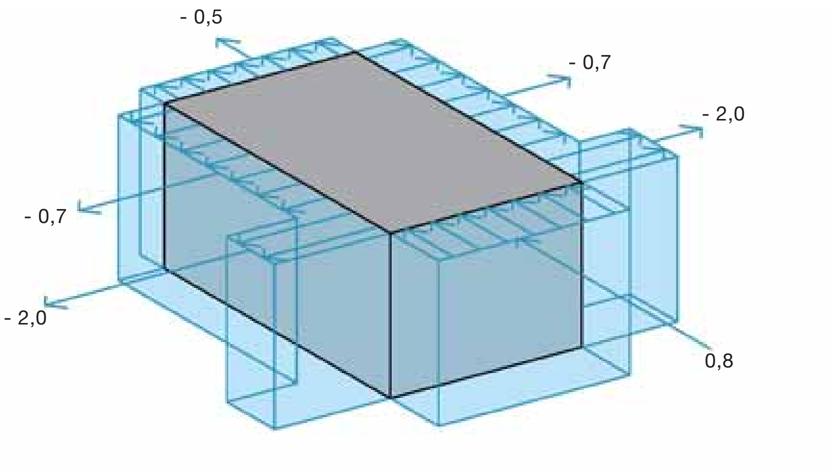
Kalzip® TF 37/800		Height of building								
Connection in every 2nd small lower flange, sealing washer made of steel Ø 10		Windload kN/m²								
		+ 0.5	+ 0.8	+ 1.1	- 0.35	- 0.56	- 0.77	- 1.0	-1.6	- 2.2
	t/mm									
Single-span beam [1) 2)]	1.0	2.34	2.00	1.80	3.79	3.00	2.35	1.81	1.13	0.82
	1.2	2.49	2.13	1.92	4.22	3.33	2.83	2.11	1.36	0.99
Double-span beam [1)]	1.0	3.08	2.39	2.01	1.92	1.29	0.94	0.72	0.45	0.33
	1.2	3.34	2.71	2.29	2.20	1.55	1.13	0.87	0.55	0.40
Triple-span beam [1)]	1.0	2.90	2.48	2.23	2.11	1.47	1.07	0.81	0.51	0.37
	1.2	3.08	2.63	2.37	2.40	1.71	1.29	0.93	0.62	0.45

1) Design recommendation: Sheet length L ≤ 6 m m or special measures provided for absorbing the temperature deformations.

2) The table applies to single-span beams without overlapping for itself connected with the substructure. If single-span beams are constructed successively overlapping with a common connection with the substructure, then proof for the connections must be furnished separately. In order to simplify matters, the load bearing width may be halved or, if possible from a design point of view, the number of connection elements doubled.

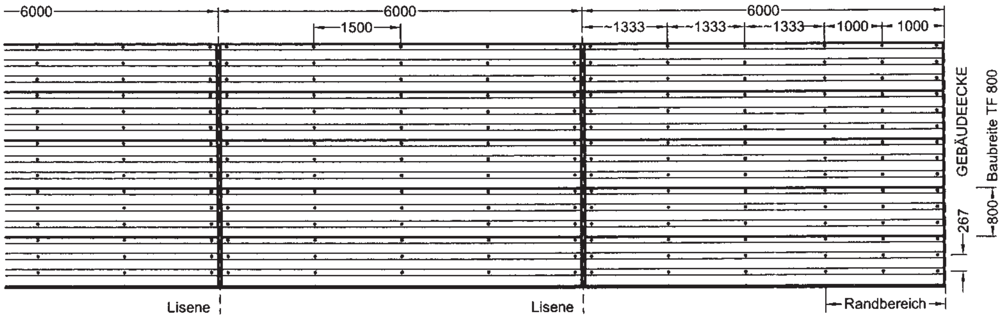
State: 04 February 2002

Type-design table prooved in terms of static see test report No. 1-08/01*
with validity until: 30.04.2006
Darmstadt: 07.02.2002
Examining Office for structural analysis of the 'Land' of Hessen
*and amendment notification dated 07.02.2002

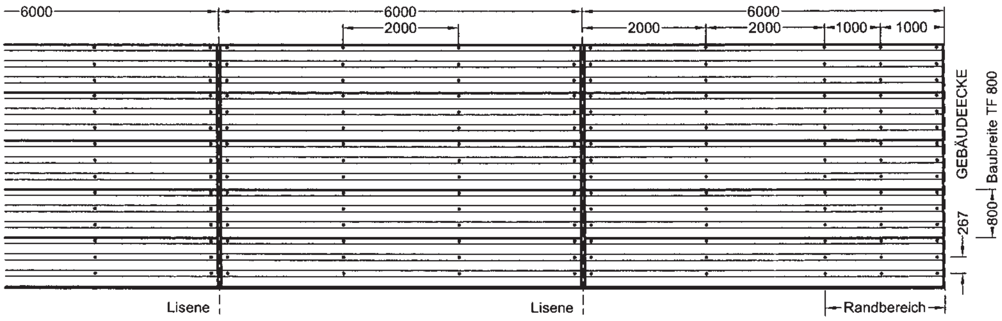


6.9 Screw arrangement

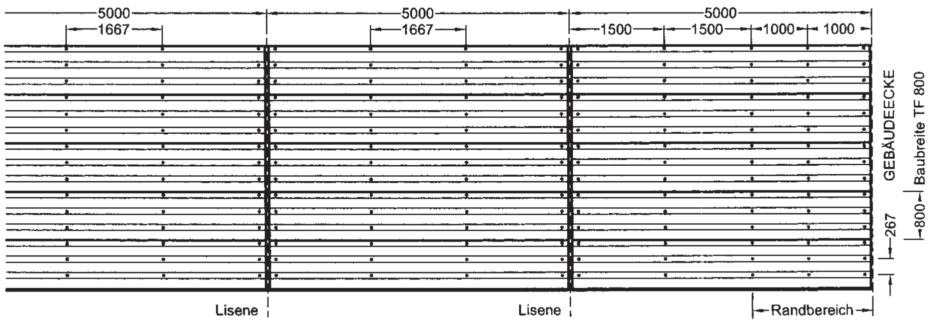
Structural module 6 m for height of building 8 - 20 m



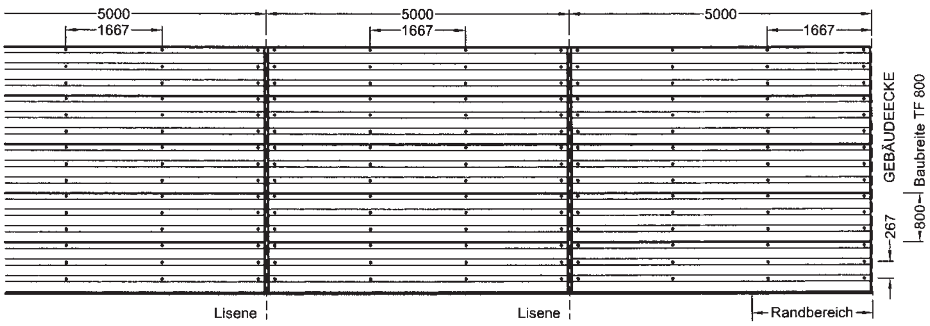
Structural module 6 m for height of building 0 - 8 m



Structural module 5 m for height of building 8 - 20 m



Structural module 5 m for height of building 0 - 8 m



M 1:100

Load span widths and screw spacing according to static requirements (see design table)

At the profile sheet ends fastening at every small flange (spacing 267 mm)

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