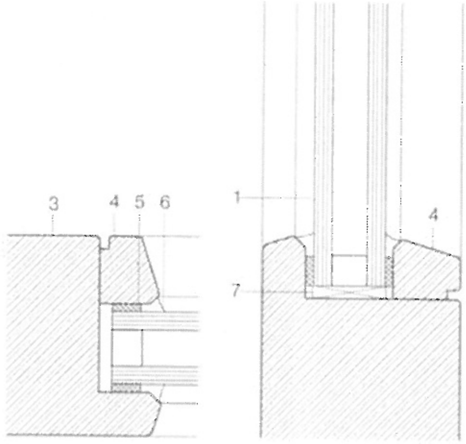
ROPER 2
LASI JA TERÄS
PERIAATEDETALJEJA
LÄHDE: BIRKHÄUSER,
GLASS BUILDING MANUAL

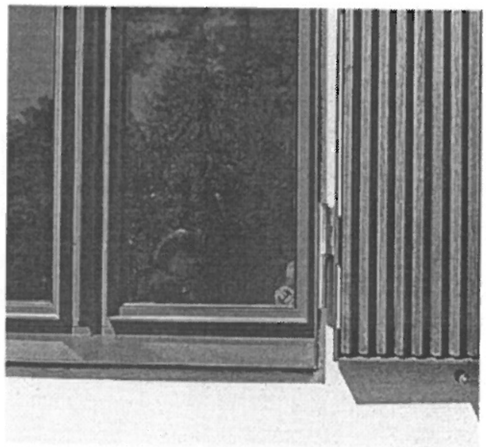
3.1 Fixings for glass

Glazing bead
Combined sealing and retaining function
Linear support

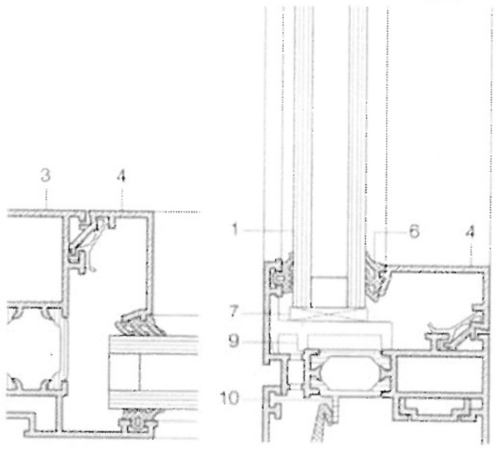
3.1.1 Wood
3.1.2 Aluminium
3.1.3 Steel
3.1.4 Plastic
3.1.5 – 3.1.7 EPDM profiles

Horizontal and vertical sections, scale 1:2.5





3.1.1



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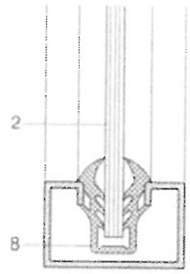
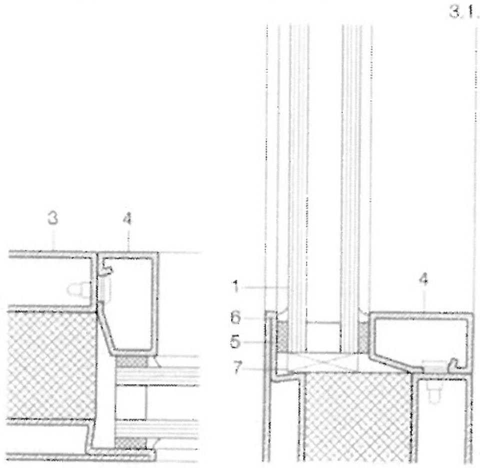


3.1.5

Fixing glass by means of glazing beads is still the most common method for windows (Figs 3.1.1 – 3.1.4). The weight of the glass is carried on setting blocks. Fig. 3.1.1 shows a typical wooden window with edge tape and sealing. The covered rebate remains free of sealant. Setting blocks should not hinder vapour-pressure equalization and drainage.
An aluminium frame with sealing profiles is shown in Fig 3.1.2. In this case the contact pressure exerted by the profile retains the pane and constitutes the seal. To allow for the uneven bearing caused by the thermal break, the setting blocks are carried on bridge setting blocks which guarantee an even bearing. Fig. 3.1.3 illustrates a steel window with integral thermal insulation, edge tape and sealing. Fig. 3.1.4 is a plastic frame with sealing profiles.
The examples shown in Figs 3.1.5 – 3.1.7 make use of EPDM profiles which both retain and seal the glass. These are mainly used for industrial glazing. In Fig. 3.1.7 the glass is first placed in the profile and then a continuous wedge inserted to stiffen the profile. In Figs 3.1.5 and 3.1.6 mechanical stability is achieved by inserting the profiles into metal frames. All the details of the glazing systems employing sealing profiles must be properly coordinated. The thickness tolerance of the glass pane is a crucial factor. All the examples shown here (Figs 3.1.1 – 3.1.7) have a glass pane which is free to rotate and thus introduces no restraint forces.



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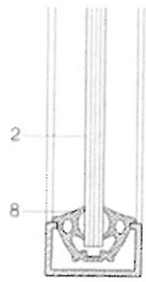

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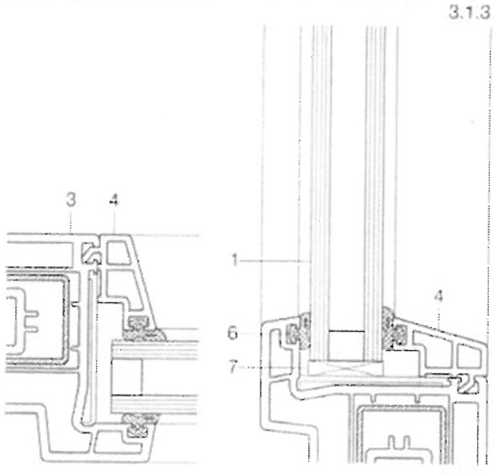
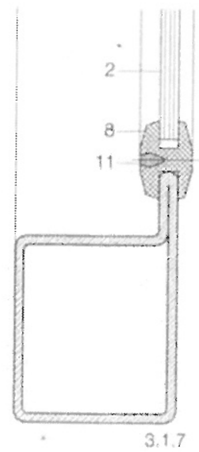


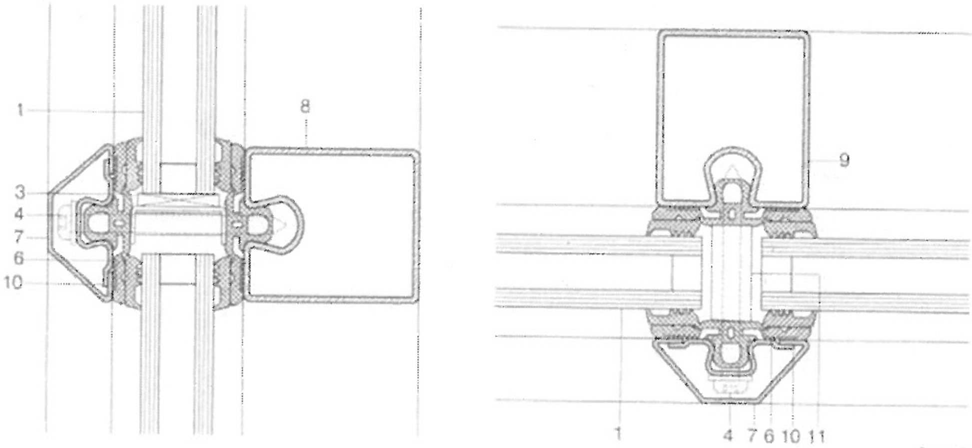
3.1.4

1 Double glazing
2 Single glazing
3 Window frame
4 Glazing bead
5 Edge tape
6 Seal
7 Setting block
8 Combined glass fixing/seal
9 Bridge setting block
10 Thermal break
11 Wedge insert



3.1.7

1 Double glazing
2 Pressure profile
3 Setting block
4 Screw
5 Insulating profile
6 Seal
7 Cover strip
8 Rail section
9 Post section
10 Glazing bar
11 Spacer sleeve
12 Clamping and sealing profile (integral profile)
13 Fixing and insulating profile



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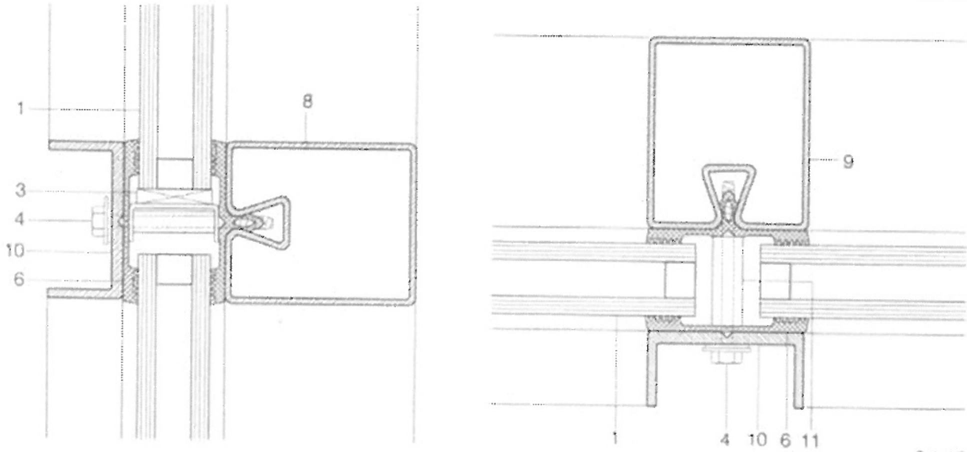

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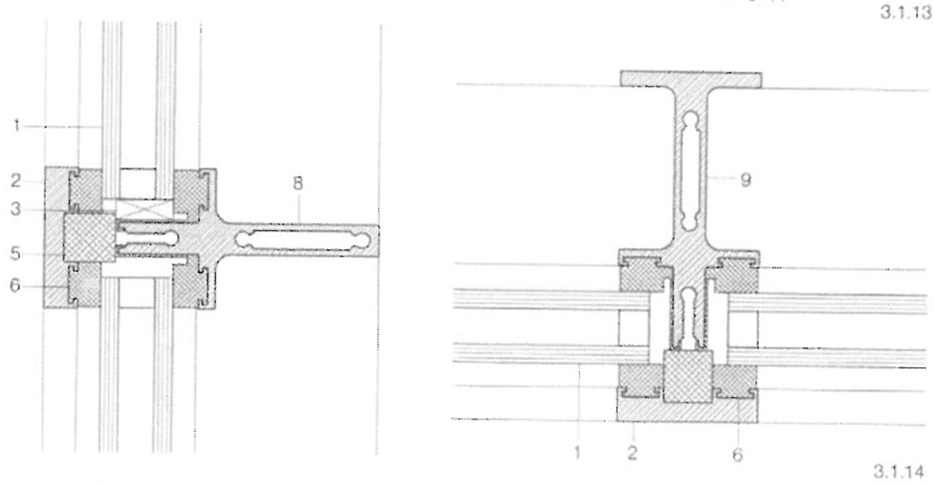

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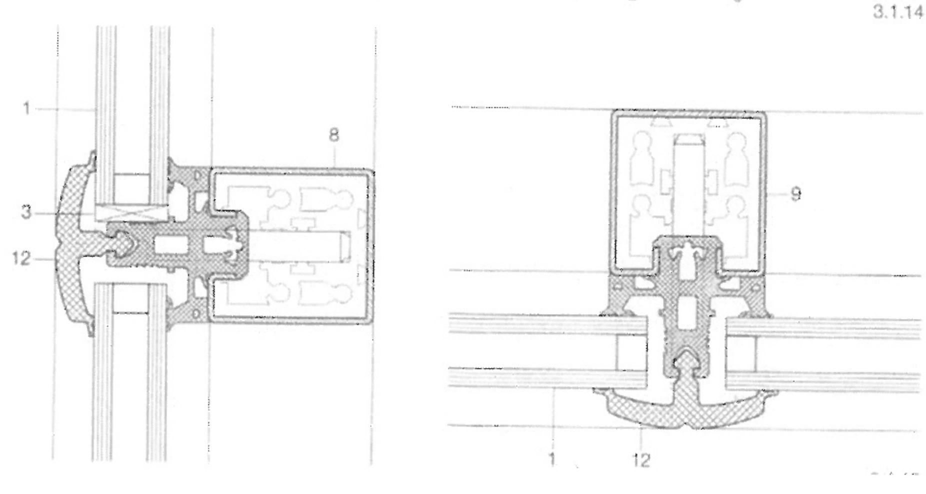


Clip-on cover strips to conceal the screws can be used with most systems (Figs 3.1.10, 3.1.11). Besides improving the overall appearance, these strips lessen the susceptibility to soiling. Fig. 3.1.12 shows a version in which the pressure and cover profiles are already assembled during production. To facilitate fixing to the building, the cover strip has holes that provide access to the screws. Metal glazing bars are available in a wide range of finishes. Aluminium has advantages over steel because of its corrosion resistance and, thanks to the extrusion process, a wide variety of profiles. The material of the glazing bar can be chosen independently of the material of the supporting construction.
A special type of glazing bar is shown in Fig. 3.1.15. Here, the permanently elastic (integral) plastic profile is clipped into the supporting construction and combines both clamping and sealing functions.
Aluminium or aluminium/wood glazing bars are often used in conjunction with a timber structure. These normally lead to slimmer profiles and also protect the timber from the weather (Figs 3.1.9, 3.1.10).
Auxiliary systems such as sunshading, safety harnesses, etc. should not be attached to glazing bars. This prevents the glass being subjected to any uncontrolled loads which might lead to fracture, and also prevents impairing the stability of the whole system.

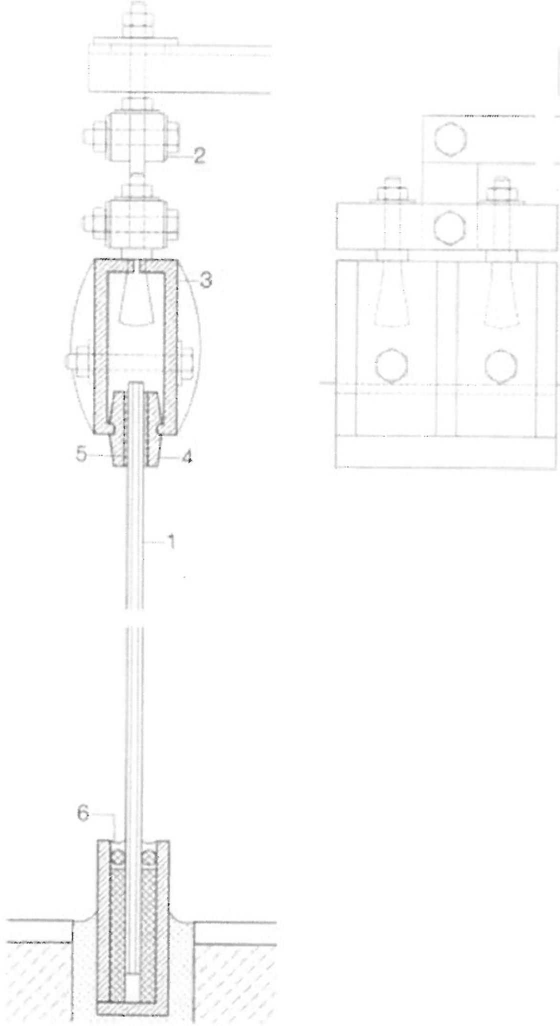
Suspended glazing

Discrete support

3.1.36 Glass suspended with clamping plates

Vertical section and elevation, scale 1:5

Instead of freestanding panes, a construction may employ glazing suspended from above. This method avoids the buckling of large panes and so allows thinner glass to be used. If the manufacturer's maximum pane size is exceeded, several panes may be hung on each other like a chain. When using suspended glazing it should be ensured that the suspension system does not induce any extra stresses in the panes. This can be avoided by using, for example, an articulated joint. The detail shown in Fig. 3.1.36 has the hangers glued to the glass; another possibility is to insert bolts in drilled holes. A suspension system involving vertical metal glazing bars is also conceivable. The bottom edges of the panes must be free to move; at this point they are sealed in grooved profiles in such a way that structural movement or deflections in the floor slab can be compensated for.
If a pane is fractured, then the advantage of suspended glazing is that the fragments do not drop like a guillotine but instead continue to hang from their supports.



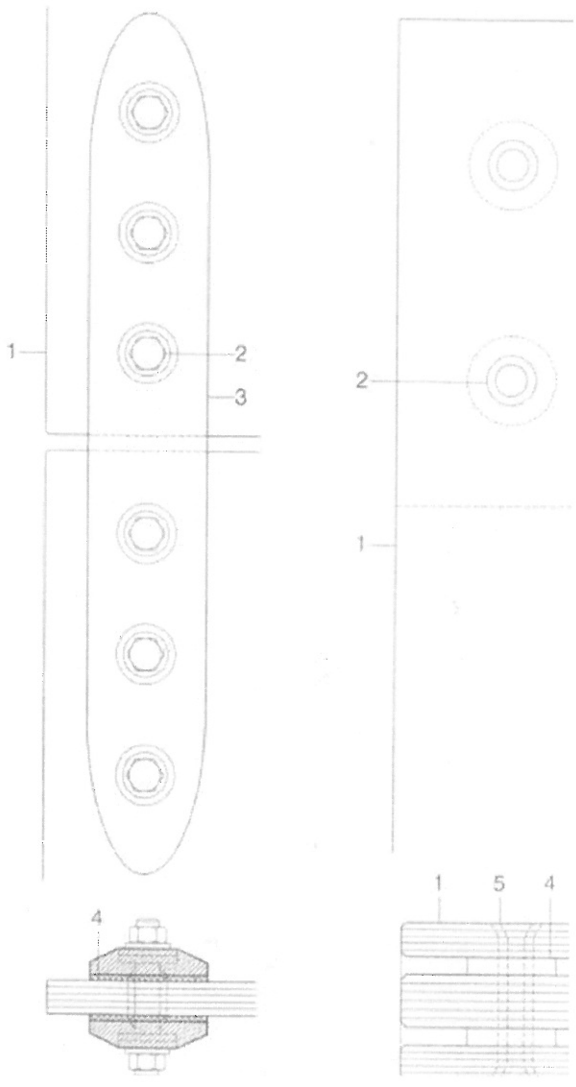
1 Glass
2 Articulated joint
3 Clamping plate
4 Glass fixing
5 Jointing cement
6 Permanently elastic joint

Splices

3.1.37 Glass fin
3.1.38 Screwed splice connection

Elevations and plans, scale 1:5

In a splice, the glass elements cannot move relative to each other. The screwed connections shown in 3.1.37 and 3.1.38 function as though the individual glass components were one piece. This is a rigid joint. The resulting properties must be taken into account when calculating the stresses in the glass. If an expansion joint is required, it cannot be incorporated at a splice.

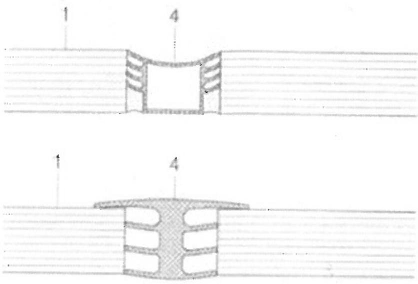


1 Glass
2 Bolt with locknut
3 Steel splice plate
4 Intermediate pad
5 Stainless steel fixing, rigid connection between beam and column

Joint at an unsupported edge

3.1.31 Joint detail, single glazing
3.1.32 Joint detail, laminated safety glass
3.1.33 Joint detail, double glazing
3.1.34 Junction with partition, double glazing
3.1.35 Corner detail, double glazing

Horizontal sections, scale 1:1



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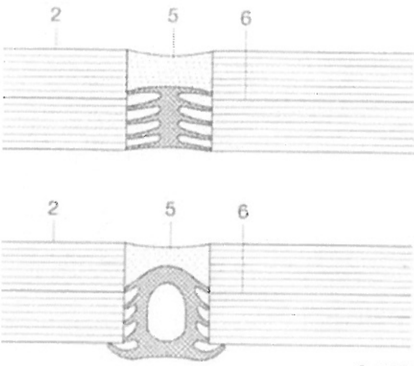

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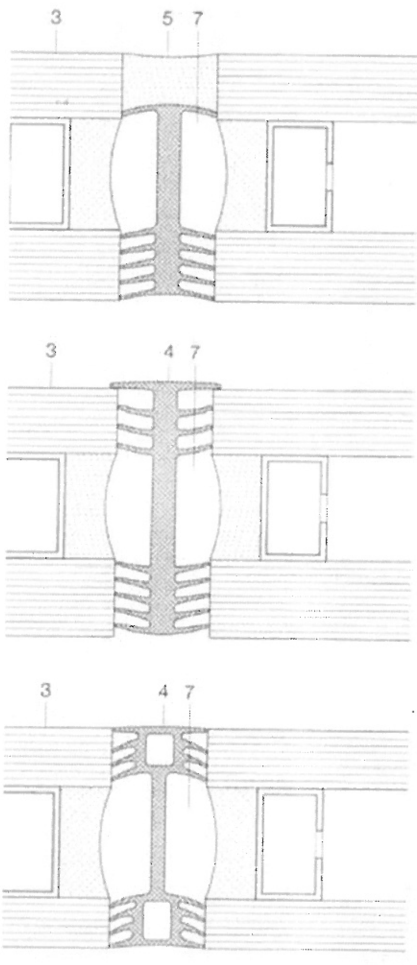
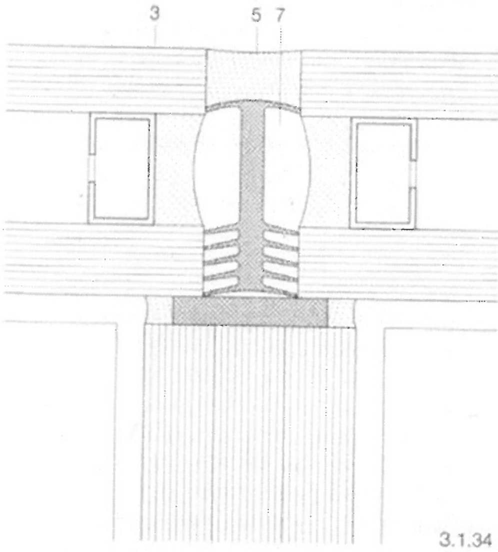


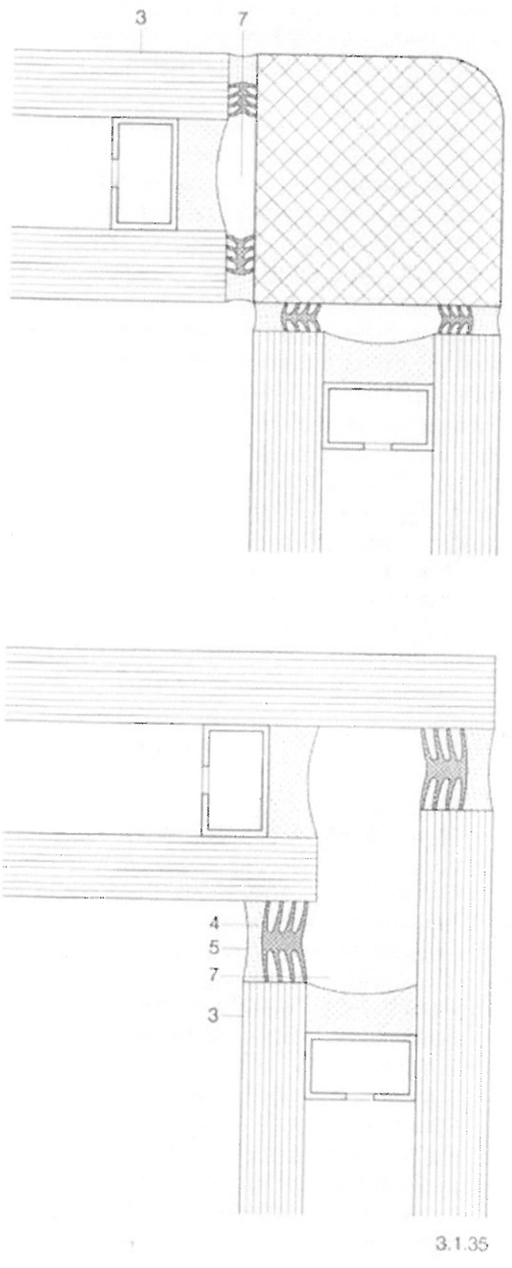
3.1.33

An essential characteristic of point fixings is the distinction between fixing and sealing. Figs 3.1.31 – 3.1.33 illustrate options for seals between glass elements without internal/external frames. The sealing profile – EPDM or silicone – is pressed into the joint; it should exhibit a certain prestress so that it fits tight. Such joints can be rapidly closed during installation; an injected sealant can be applied later. The covered rebates of insulating glass, laminated safety glass and wired glass must remain free of sealant so that vapour-pressure equalization and drainage are guaranteed. A backer rod must not be included here as this would block the open rebate and hinder the vapour-pressure equalization. Moisture escapes to the outside via the drainage system.
When using laminated safety glass, the sealing profile must cover the joint between panes so that, like with insulating glass, the edge seal and the exposed PVB interlayer or casting resin are in the area of the vapour-pressure equalization and hence no moisture builds up and remains trapped there over a longer period.
Fig. 3.1.34 shows a frameless connection between a glass partition and a double-glazed external wall.
Fig. 3.1.35 illustrates two different options for the corner detail of frameless double glazing. Here too, it must be ensured that the rebate remains free of sealant in order to guarantee the vapour-pressure equalization.

1 Single glazing
2 Laminated glass
3 Double glazing
4 Sealing profile
5 Permanently elastic joint
6 PVB interlayer
7 Drainage



3.1.34

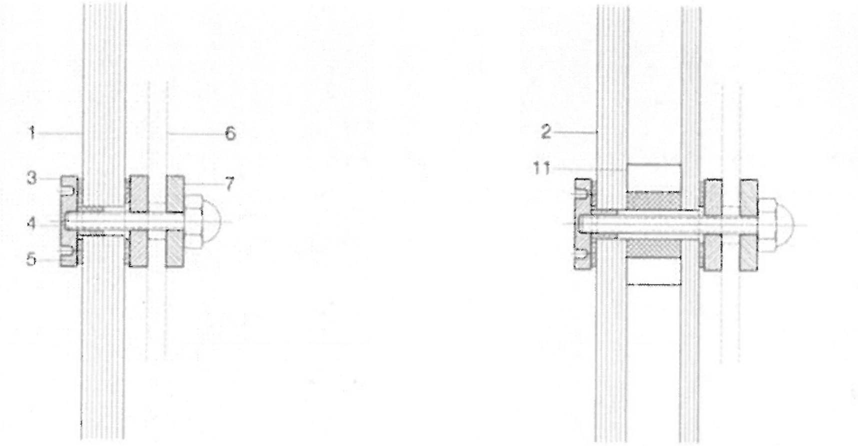


3.1.35

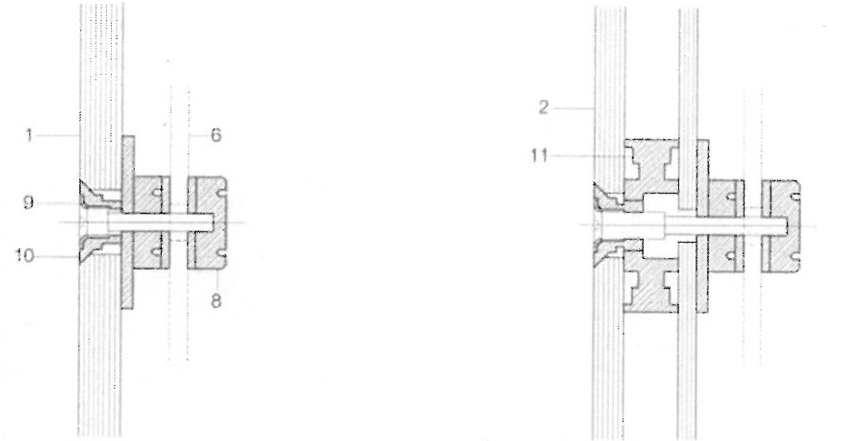
Point fixing with drilled hole
Discrete support

3.1.27 Non-flush, rigid
3.1.28 Flush, rigid
3.1.29 Non-flush, with articulated joint outside the glazing plane
3.1.30 Flush, with articulated joint in the glazing plane

Vertical sections for single and double glazing respectively, scale 1:2.5



3.1.27



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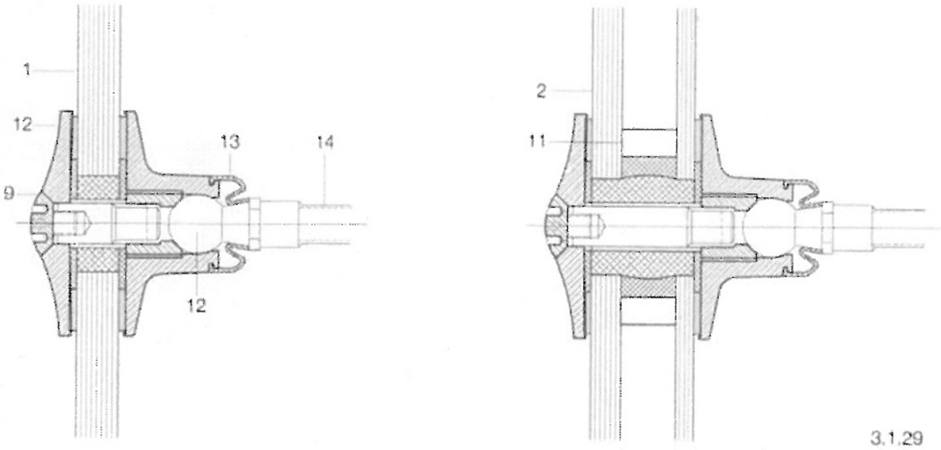

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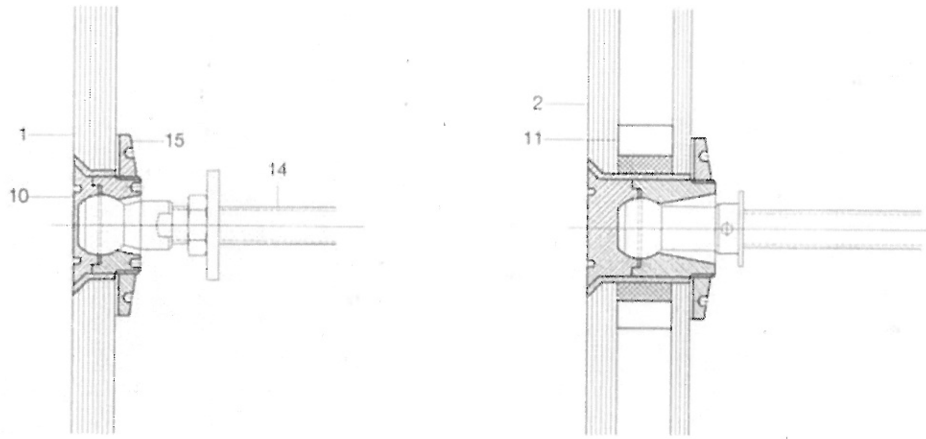


Point fixings which carry the panes via holes drilled through the glass are available in a multitude of (mainly patented) versions. A distinction is made between those flush (Figs 3.1.28, 3.1.30) and those not flush (Figs 3.1.27, 3.1.29) with the glass, as well as rigid (Figs 3.1.27, 3.1.28) and articulated (Figs 3.1.29, 3.1.30) types.
Since panes supported by point fixings are subjected to greater bending and shear stresses than those of equal size but supported continuously, using point fixings leads to thicker glass being required.
Glazing employing point fixings demands greater accuracy during manufacture and installation than glazing with linear supports; this applies to both the supporting construction and the positions of the holes in the panes. The inevitable tolerances must be observed. Contact between metal and glass must be permanently and reliably prevented by suitable intermediate pads. When using point fixings it must be ensured that the glass is not restrained; it must be able to follow its natural bending curve. Articulated fixings are employed to avoid stresses in the glass. The fixing with the joint in the plane of the glass (Fig. 3.1.30) results in the lowest stresses in the glass. Due to the joint being located outside the glazing plane in Fig. 3.1.29, an additional lever arm is created between joint and glass. On the other hand, this fixing is relatively easy to combine with other components, e.g. tension rods in trussed arrangements.

1 Single glazing
2 Double glazing
3 Clamping disc
4 Bolt
5 Intermediate pad/seal
6 Supporting construction
7 Nut
8 Cover sleeve
9 Screw
10 Countersunk head
11 Edge seal
12 Ball joint
13 Sealing gaiter
14 Threaded bar
15 Threaded disc

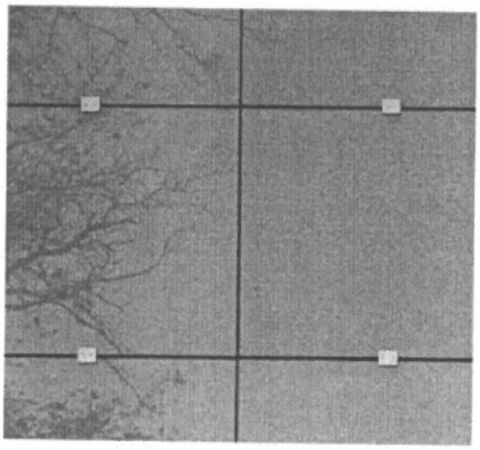
Point fixing without penetrating the glass pane
Discrete support

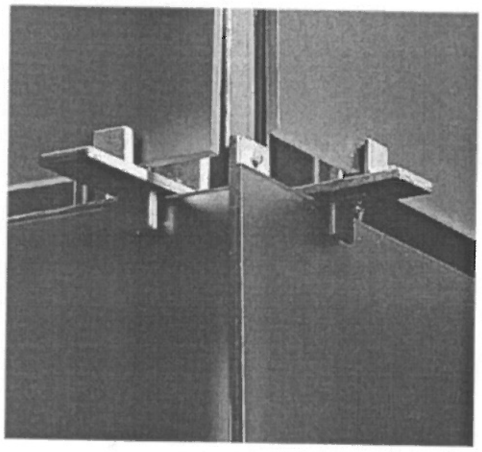
3.1.24 Four-point clamp
3.1.25 Point fixing in the joint

Elevations and sections, scale 1:2.5

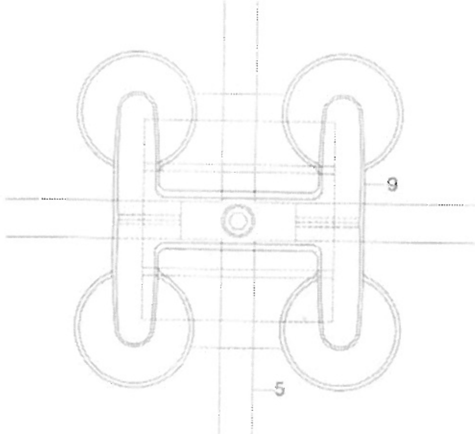
3.1.26 Fixing for shingle-type overlap

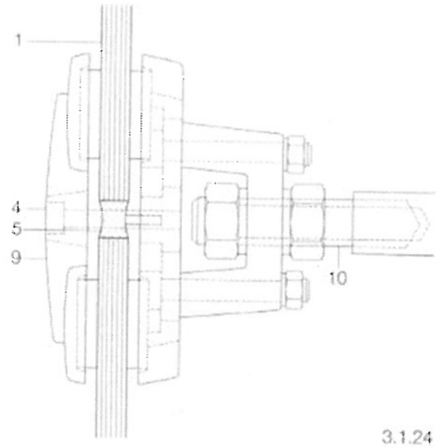
Plan and section, scale 1:5





Figs 3.1.24 – 3.1.26 show options for point fixings where the glass does not have to be drilled. With these details too it should be ensured that the glass is not restrained as the construction deflects under load, and that it can follow its natural bending curve. The cast aluminium clamp shown in Fig. 3.1.24 holds the corners of the panes. Fig. 3.1.25 illustrates one possible detail for point fixings in the joint. The self-weight of the glass is transferred via setting blocks to steel bolts (brackets) welded to the supporting construction. This method of point fixings in the joints is normally less expensive than point fixings through the panes because no expensive drilling (and provision of an edge seal around the holes in the case of insulating glass) is necessary. Fig. 3.1.26 is a detail of a stainless steel bracket which enables a shingle-type overlapping of the glass panes.





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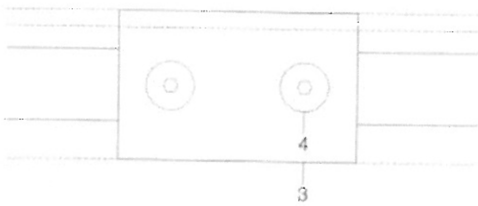
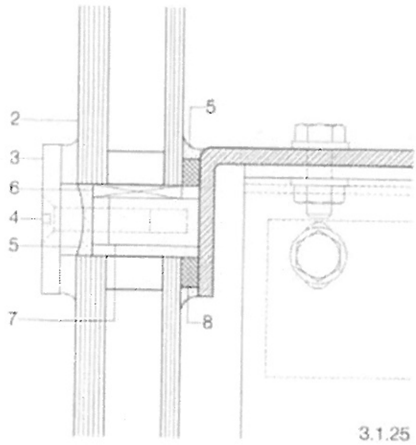
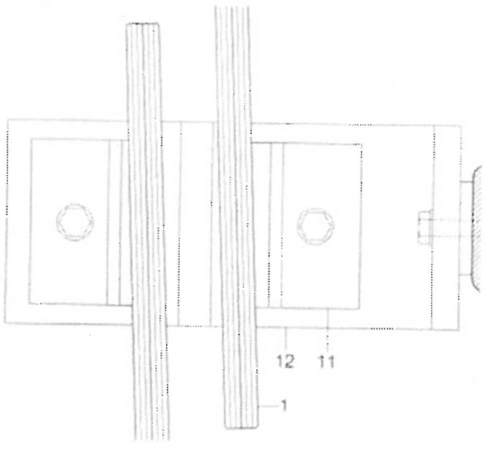
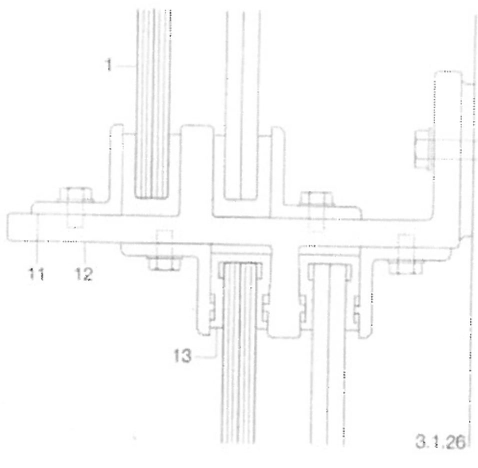




3.1.25

1 Single glazing
2 Double glazing
3 Clamping plate
4 Screw
5 Permanently elastic joint
6 Setting block
7 Welded bracket with internal thread
8 Edge tape
9 Four-point clamp
10 Adjusting bolt
11 Positioning angle, screwed on
12 Individual bracket
13 Silicone bearing profile, glued





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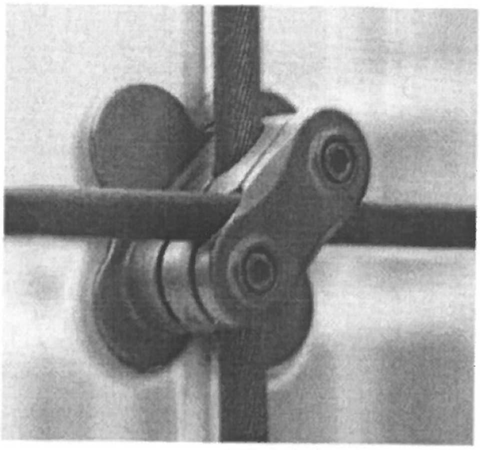
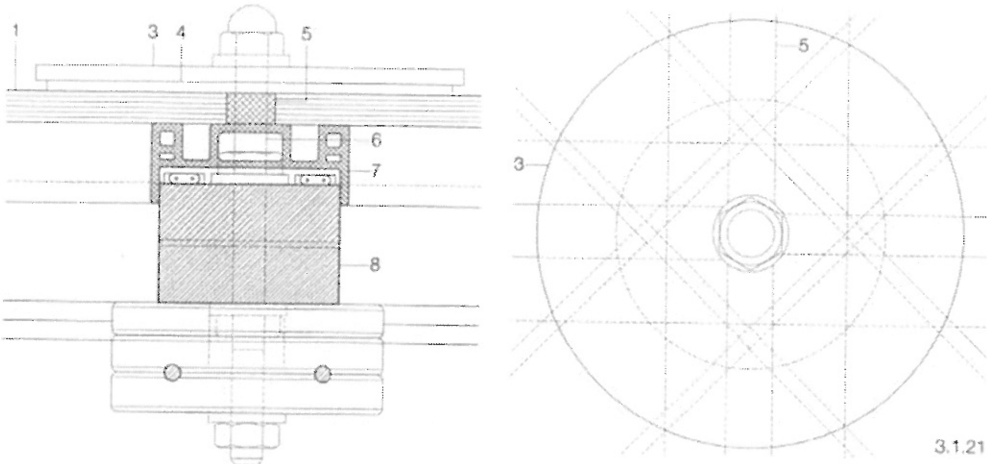


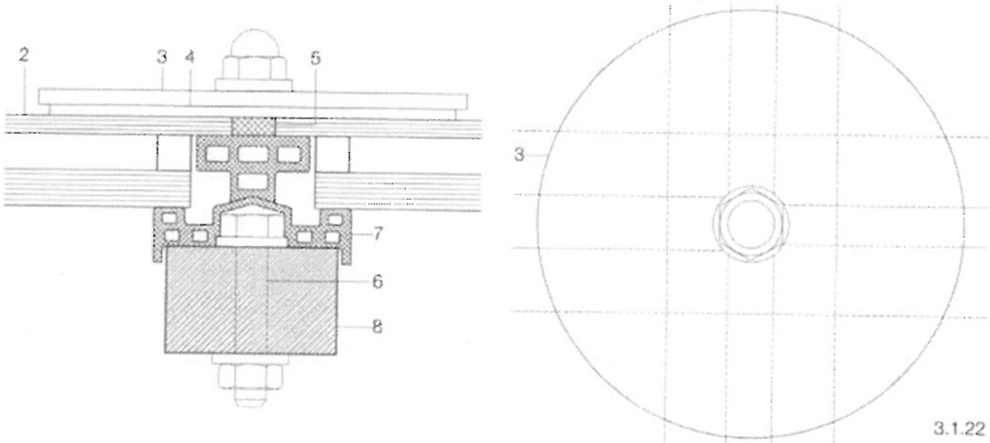
Clamping plate
Linear/point support

3.1.21 Single glazing
3.1.22 Double glazing
3.1.23 Single glazing

Sections and elevations, scale 1:2.5



3.1.21



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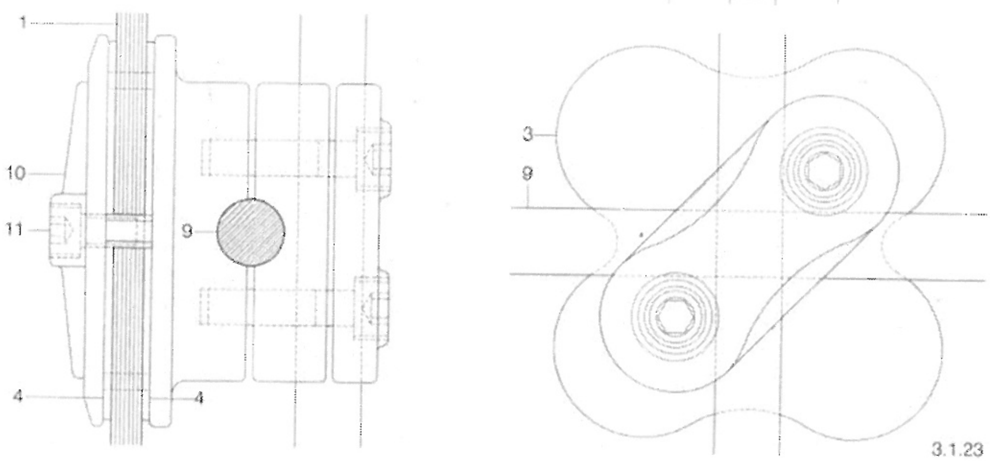


3.1.23

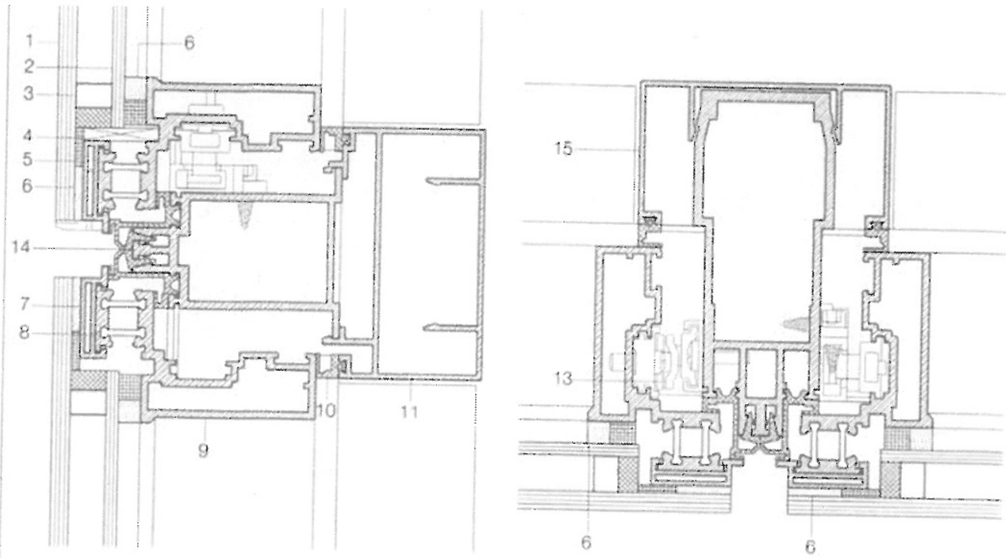
Fixing glass by means of clamping plates is a simple method which requires a minimum of material and enables the glass panes to be installed without edge contact. The glass can either be mounted on a linear support but held by point fixings (Figs 3.1.21, 3.1.22) or supported and held by point fixings (Fig. 3.1.23). Clamping plates in the form illustrated here are employed in, for example, lattice-shell and cable-net structures.
It must be ensured that the panes are not restrained; the glass should be able to follow its natural bending curve as the construction deflects under load. Any constraint will lead to increased stresses in the glass. As the pane deflects, the forces must be transferred into the supporting construction via the clamping plates. The position of the plate fulcrum is important.

1 Single glazing
2 Double glazing
3 Clamping plate
4 Intermediate pad
5 Permanently elastic joint
6 Bolt
7 Sealing profile
8 Continuous metal supporting construction
9 Steel cable
10 Clamping plate
11 Screw

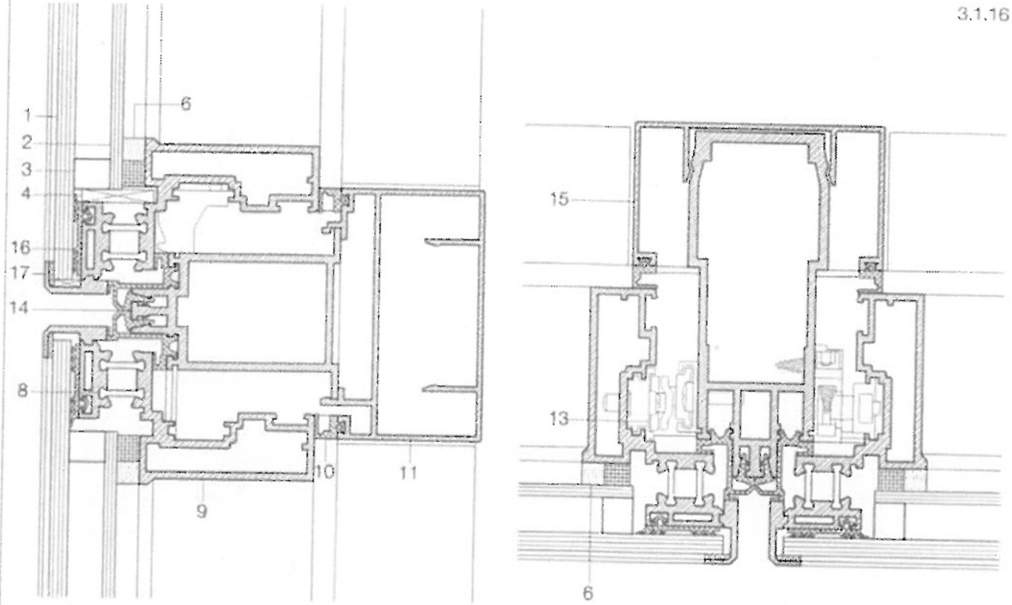
Structural sealant glazing
Linear support

3.1.16 Without mechanical fixings
3.1.17 and 3.1.18 Continuous mechanical fixings
3.1.19 Mechanical fixing and seal combined in one profile
3.1.20 Special solution for double-leaf façade with point mechanical fixings

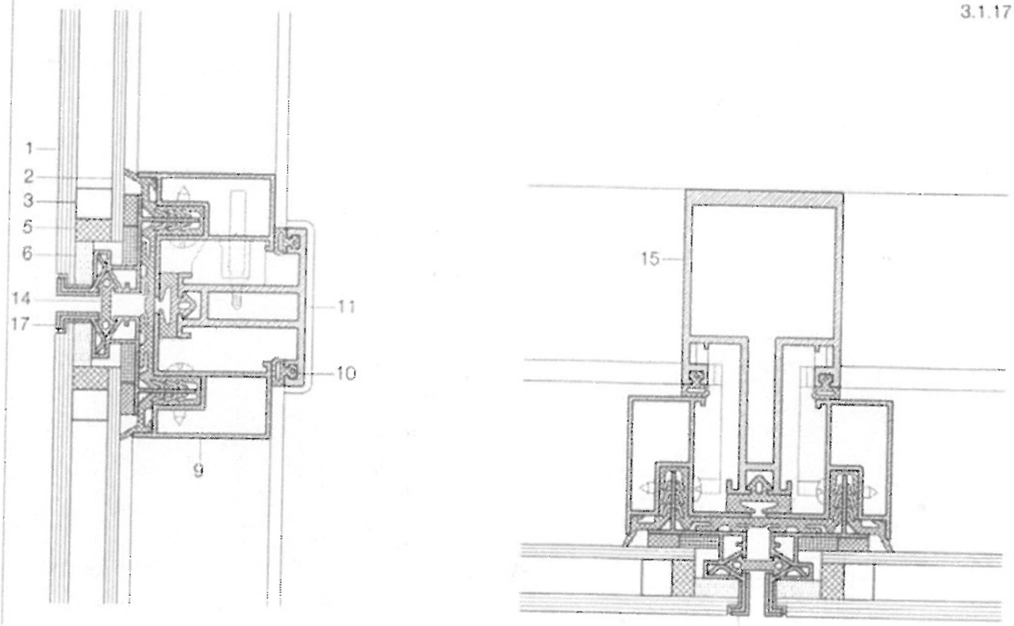
Vertical and horizontal sections, scale 1:2.5



3.1.16



3.1.17



3.1.18

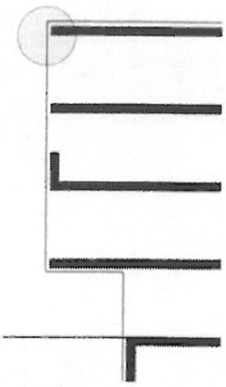
Glueing the glass elements directly to an adapter frame fitted to the supporting construction makes façades without frames or mechanical fixings possible. The peripheral glueing, besides providing an unrestrained mounting, can have a sound-insulating and, in some cases, a thermal break effect. The adhesive is always applied under precisely controlled factory conditions and must comply with very stringent specifications on its resistance to moisture, light, temperature and micro-organisms. Metal frames (adapter frames) and glass are supplied as complete elements and generally fixed to a post-and-rail construction on site. The frame is usually of steel or aluminium; however, steel must be protected against corrosion by means of galvanizing.
If both panes of a double glazing unit are glued to the frame, one of the adhesive joints must be softer than the other, otherwise shear stresses will occur in the edge seal as a result of glass movements caused by temperature fluctuations. Such stresses can lead to breakdown of the edge seal and leaks. In Germany the exclusive use of adhesive to fix panes is permitted only on elements no higher than 8 m above ground level (Fig. 3.1.16). For greater heights, an additional mechanical fixing is required to retain the panes. This mechanical retention

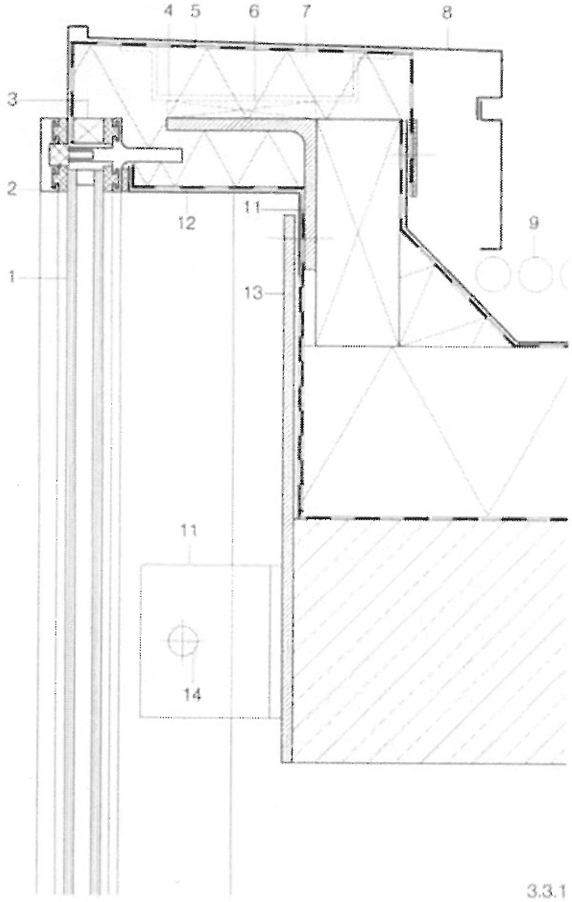
3.3 Architectural details

Flat roof junction

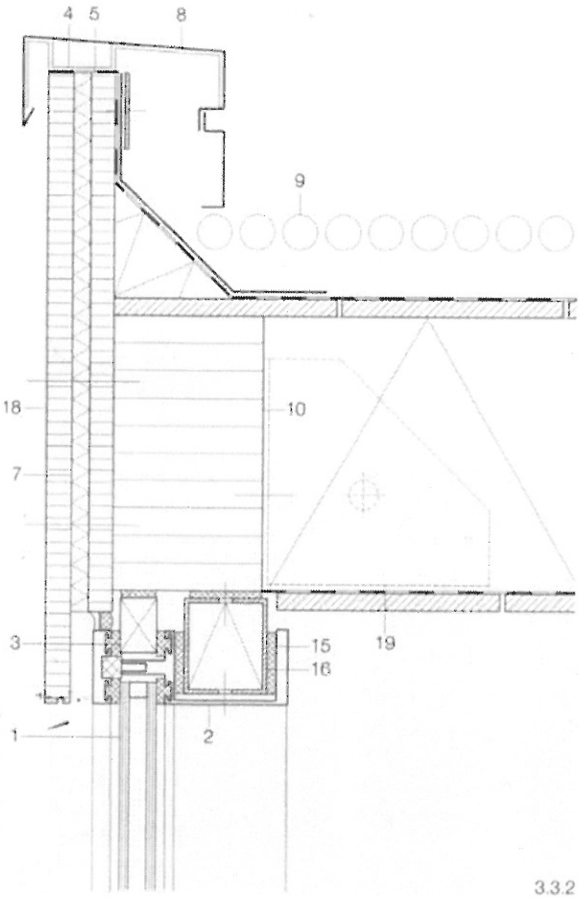
3.3.1 Concrete construction
3.3.2 Timber construction
3.3.3 Steel construction / penetration
3.3.4 Fascia plate / sunshade

Vertical sections, scale 1:5





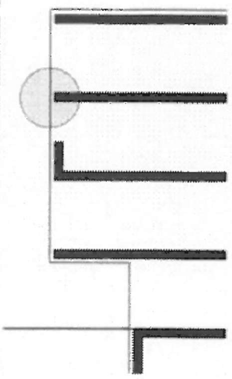
3.3.1



3.3.2

1 Double glazing
2 Aluminium façade rail
3 Plastic spacer block
4 Sheet metal cleat
5 Vapour barrier
6 EPDM pad
7 Thermal insulation
8 Anodised aluminium sheet
9 Roof construction:
chippings
waterproofing
thermal insulation
vapour barrier
10 Glulam beam
11 Steel angle
12 Vapour barrier
13 Steel plate
14 Screw in elongated hole
15 Permanently elastic seal
16 Aluminium section, insulated, with thermal break
17 Movement joint
18 Plywood, with waterproof adhesive
19 Joist hanger
20 Aluminium angle fixed to supporting construction
21 Fabric sunshade
22 Steel bracket
23 Insulated façade panel
24 Cast-in slotted channel
25 Perforated steel beam
26 Stainless steel plate, screwed on
27 Steel tube
28 Steel trapezoidal sheeting

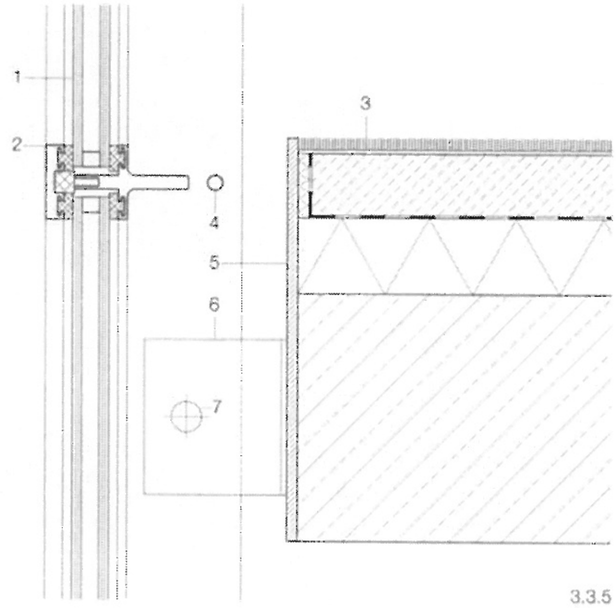
Fig. 3.3.1. The primary structure here is reinforced concrete. The edge of the slab and the overlying roof construction are clad with a steel plate anchored to the concrete. The posts are fixed to angles welded to this plate. The connection of the upper façade rail to the edge plate is diffusion-tight and airtight. The clearance between glazing and plate should be wide enough to allow cleaning of the glass. Heat reflected from the edge of the slab could lead to stresses in the glass caused by varying heating effects. A stationary layer of air can lead to condensation occurring; the inclusion of ventilation louvres is an advantage.
Fig. 3.3.2. The primary structure here is an insulated timber lattice; timber panels form the fascia. The junction with the façade is achieved two-fold: in the plane of the glass by a clamped plastic block, and in the structural plane by an insulated aluminium hollow section with thermal break. The connection must be able to accommodate movements in the façade as well as deformation of the primary structure caused by imposed loads, thermal expansion etc. It must also remain diffusion-tight and airtight and be thermally insulated.
Fig. 3.3.3. The primary structure here is steel. The façade posts are fixed to the main structure via steel angles. The steel beams penetrating the façade represent thermal bridges. Condensation may occur and this should be drained away in a controlled manner (e.g. condensation channel). The joint between external skin and beam must be able to accommodate the various movements of the façade and loadbearing structure (especially thermal expansion and wind loads). It must also be diffusion-tight and airtight. Such a joint is normally covered by a stainless steel sleeve fitted to the outside.
Fig. 3.3.4. The primary structure here is reinforced concrete. The façade posts are fixed to the main structure via a cast-in slotted channel. The connection of the upper façade panel is to be diffusion-tight. Sunshading in front of the façade should be fixed independently of the façade construction (warranty problems). A fascia panel conceals the sunshading installation.



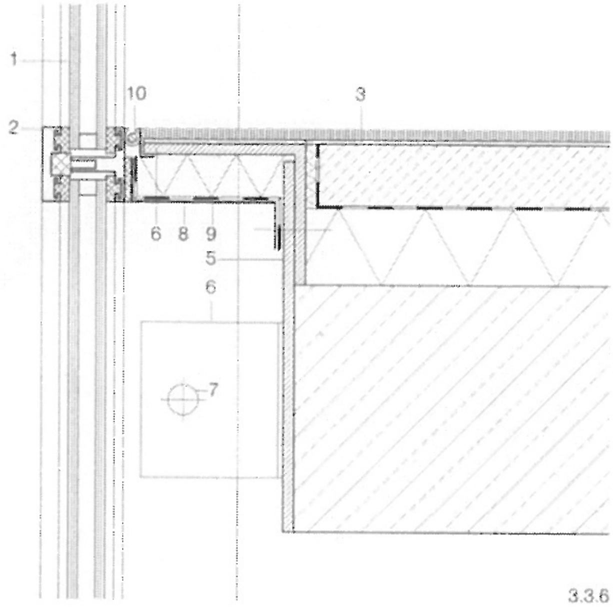
Floor junction

3.3.5 Continuous façade
3.3.6 Floor covering extending to external skin
3.3.7 Smoke-tight junction
3.3.8 Smoke-tight junction, louvre blind
3.3.9 Smoke-tight junction, awning
3.3.10 Smoke-tight junction, lattice
3.3.11 Junction in timber construction

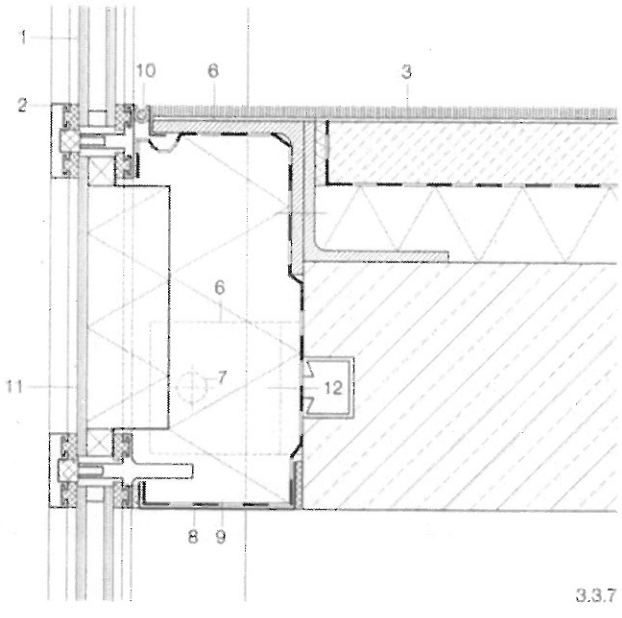
Vertical sections, scale 1:5



3.3.5



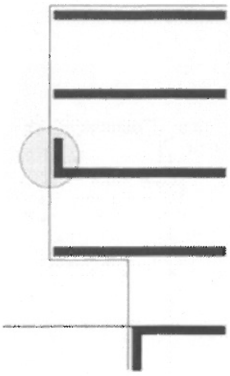
3.3.6

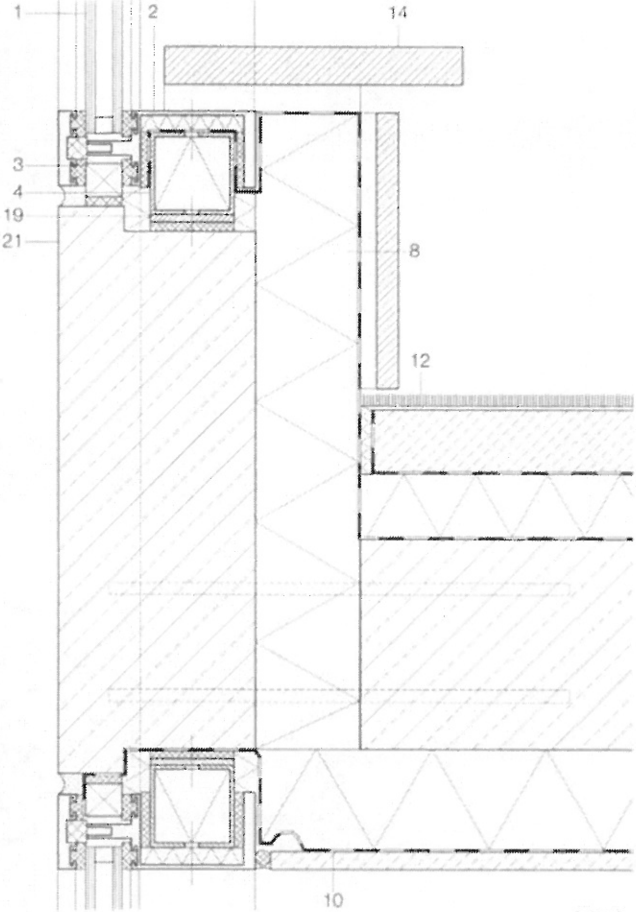


3.3.7

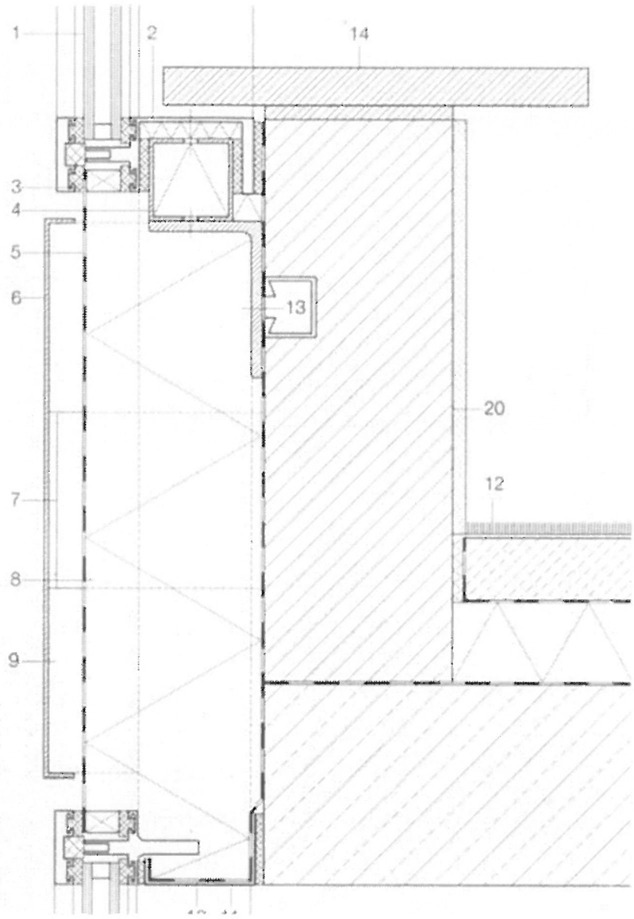
1 Double glazing
2 Aluminium façade rail
3 Floor construction:
fabric floor covering
screed
isolating membrane
thermal insulation
floor structure
4 Safety grid, stainless steel tube
5 Steel plate, hot-dip galvanized
6 Steel angle, hot-dip galvanized
7 Screw in elongated hole
8 Aluminium sheet cover and vapour barrier
9 Thermal insulation
10 Movement joint, permanently elastic seal
11 Façade panel:
toughened safety glass, printed
insulation
aluminium sheet
12 Cast-in slotted channel
13 Steel bracket, hot-dip galvanized
14 Timber lattice
15 Aluminium section, insulated, with thermal break
16 Plastic spacer block
17 EPDM pad
18 Façade panel:
aluminium sheet
thermal insulation
19 Wooden panelling
20 Horizontal louvre blind
21 Fabric sunshade
22 Vapour barrier

The floor junction details shown here differ in their specifications regarding fire protection, thermal insulation and sound insulation. If the glazing continues to the floor, then it must be remembered that cleaning equipment or other movable items could damage the glass and cause chips from which cracks can develop. If there is a risk of falling, inner panes must be made of safety glass with a thickness appropriate to the circumstances.
Fig. 3.3.5. The façade passes in front of the edge of the floor, which is covered by a steel plate. The joint between floor and façade is open. The post is fixed to the main structure by a welded plate. If the gap between floor and façade is ≥ 60 mm, a safety grid is normally required. The respective regional building authority stipulates what is necessary.
Fig. 3.3.6 corresponds to Fig. 3.3.5 but here the floor covering continues to meet the façade. Floor loads may not be transferred to the façade. The junction must include a permanently elastic seal but it is not smoke-tight and does not comply with the sound insulation requirements of DIN 4109.
Figs 3.3.7 – 3.3.10. The façade is interrupted at the floor. The connections are smoke-tight, diffusion-tight and airtight. The façade is to be checked for flanking sound transmissions in the case of a higher sound insulation specification (DIN 4109). Penetrations for the purpose of attaching sunshading (Figs 3.3.8 – 3.3.10) represent thermal bridges. Diffusion-tight and airtight connections and carefully designed insulation details are required. In addition, the joint in the glass panel must be capable of accommodating movements in the façade, the fascia and the primary structure, and must include a permanently elastic seal. If the vertical blind is fixed by means of a mounting fitted in the groove for the screw fixing, the outer skin is not penetrated. Such a detail demands exact coordination with façade and sunshade manufacturers (warranty).
Fig. 3.3.11. The primary structure is formed by an insulated timber lattice. The façade is interrupted at each floor by the timber beams. If the façade bears on the floor, then the upper joint must be able to accommodate movement.





3.3.12



1 Double glazing
2 Aluminium façade rail
3 Plastic spacer block
4 Aluminium section, insulated, with thermal break
5 Vapour barrier
6 Anodised aluminium sheet
7 Steel angle
8 Thermal insulation
9 Air gap for ventilation
10 Vapour barrier
11 Aluminium sheet, 1.5 mm
12 Floor construction: fabric floor covering floating screed isolating membrane impact sound insulation
13 Cast-in slotted channel
14 Window sill on framing
15 Permanently elastic joint
16 Stainless steel fixed anchor
17 Reconstituted stone facing
18 Stainless steel movable anchor
19 Steel flat
20 Solid spandrel panel, concrete or masonry
21 Prefabricated reinforced concrete element

Spandrel panel

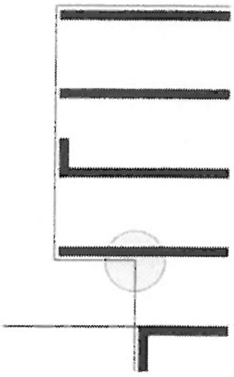
3.3.12 Prefabricated fair-face concrete spandrel panel
3.3.13 Metal spandrel panel
3.3.14 Reconstituted stone spandrel panel

Vertical sections, scale 1:5

Shown here are three examples of spandrel panels with varying architectural and constructional approaches, as well as different materials.

Fig. 3.3.12. The primary structure here is reinforced concrete. The spandrel panel is made from a prefabricated fair-face concrete element and is thermally isolated from the reinforced concrete floor slab. It is connected by a special, thermally insulated reinforcing cage. The spandrel panel must be insulated on the inside and a vapour barrier – protected against damage – attached to the inner face. Consequently, the mass storage effect of the spandrel panel cannot be used for the internal climate. The surface finish of the spandrel panel is of fair-face quality. The façade bears on or is suspended from each floor. Connections are therefore either rigid or flexible. Fixing is by means of a façade rail fitted to an insulated aluminium hollow section with thermal break. Its position is adjusted by means of steel plates fitted underneath and it is fixed to the spandrel panel using stainless steel screws. To avoid galvanic corrosion, an intermediate pad (e.g. EPDM) must be placed between steel and aluminium. The connections must be permanently elastic, diffusion-tight and airtight.

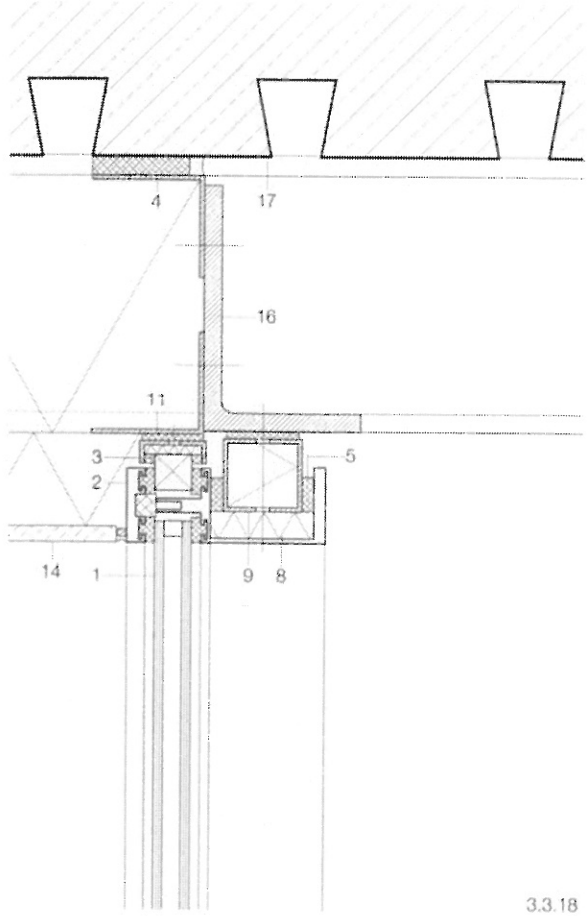
Fig. 3.3.13. The primary structure here is reinforced concrete. In this example the façade post continues past the spandrel panel and the façade is freestanding. Load transfer is at the top of the spandrel panel by an insulated aluminium hollow section with thermal break, steel angle and cast-in slotted channel in the solid spandrel panel. The upper connection fixes the façade horizontally and must be able to accommodate thermal expansion, movements due to wind load and structural movements; it must remain diffusion-tight and airtight. The façade is fixed to the main structure via an insulated steel angle integrated in the façade rail. Insulation is affixed to the outside of the spandrel panel. The vapour barrier must be correctly positioned and the insulation protected against dampness. There is an air gap behind the spandrel panel for ventilation



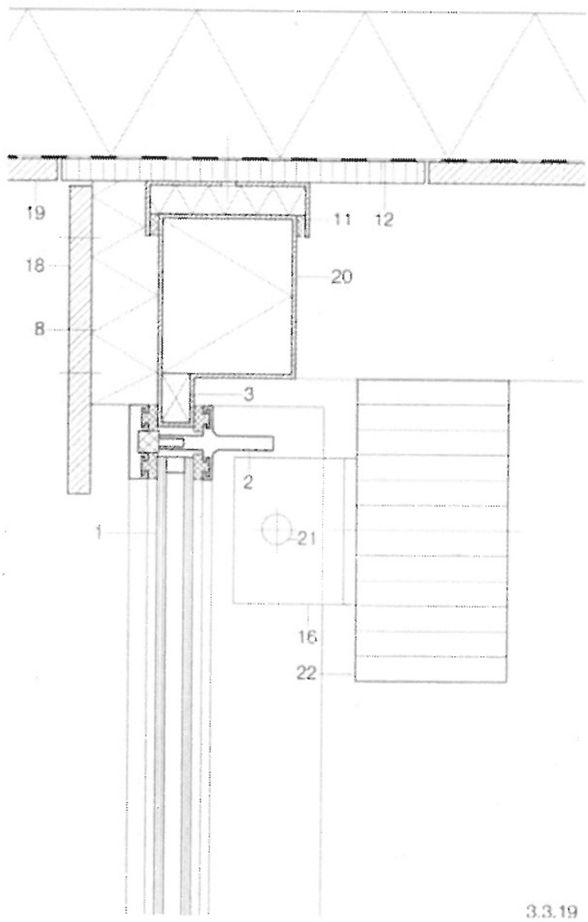
Junction with underside of floor

3.3.18 Junction with steel construction
3.3.19 Underside of timber construction
3.3.20 Underside of double-leaf construction
3.3.21 Underside of floor, external insulation
3.3.22 Underside of floor, with thermal break
3.3.23 Underside of floor, internal insulation

Vertical sections, scale 1:5



3.3.18



3.3.19

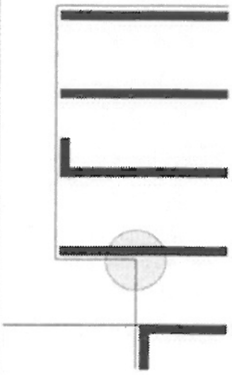
Details in Figs 3.3.18 – 3.3.23 illustrate connections between a post-and-rail façade and various horizontal floor soffits which can occur, for example, with re-entrant façades.
Details in Figs 3.3.20 – 3.3.23 show different aesthetic intentions, e.g. whether the underside of a concrete slab is to be exposed, partly covered or fully concealed. In all cases the upper façade/floor connection must be designed in such a way that movements of the floor (caused by imposed loads, settlement etc.) do not induce any compression in the glass. A sliding joint must be incorporated if necessary.
Fig. 3.3.18. The primary structure here is steel. The floor comprises steel trapezoidal sheeting with a concrete topping supported on I-beam sections. The beams and trapezoidal sheeting penetrate the outer skin. The entire steel construction is insulated externally in order to prevent internal condensation. The connection between façade and main structure is via a steel angle and allows for differential movement. Insulation is fitted between the beams. The external cladding should be removable. On the inside, the connection must be permanently elastic as well as diffusion-tight and airtight.
Fig. 3.3.19. The primary structure here is timber. The façade is freestanding. The post is connected to the main structure via elongated holes to enable it to slide vertically. An insulated make-up piece, clamped in the upper façade rail and inserted via a channel section (as movement joint, with thermal break) so that it can move, connects the façade to the timber construction. A narrow fascia covers the joint. This should be removable so that the cover strip can be detached following breakage of the glass. The façade junction must be diffusion-tight and airtight on the inside.
Fig. 3.3.20. The primary structure here is reinforced concrete. The façade is freestanding so the upper junction must be fixed horizontally

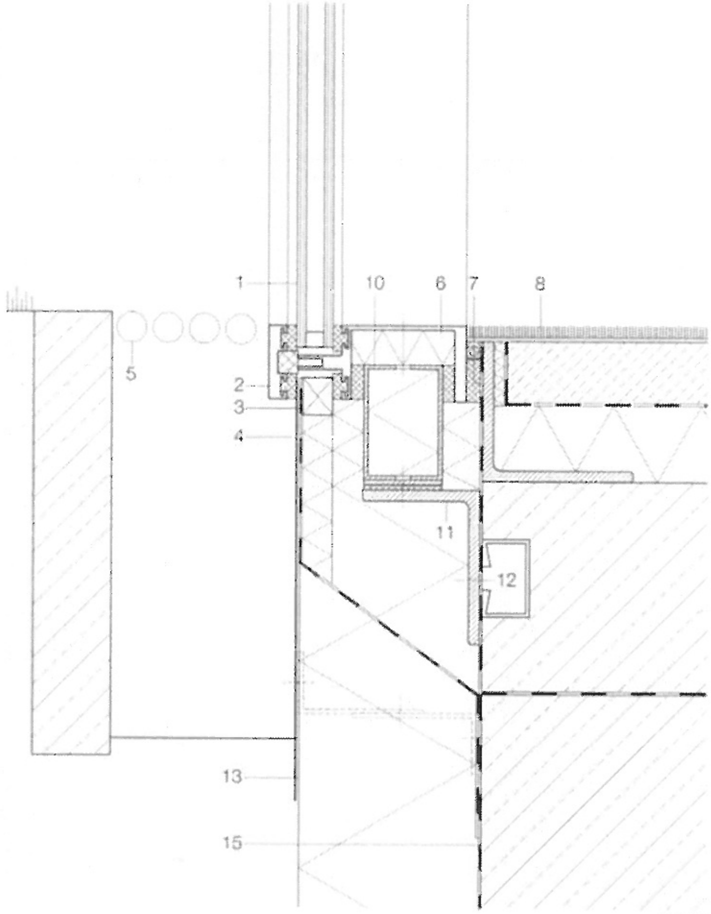
1 Double glazing
2 Aluminium façade rail
3 Plastic spacer block
4 Elastic sealing tape
5 Permanently elastic seal
6 Plastic angle
7 Anodised aluminium angle
8 Thermal insulation
9 Insulated aluminium section
10 Thermal break
11 Insulated aluminium section, with thermal break
12 Vapour barrier
13 Plasterboard ceiling on framing
14 Fibre-reinforced cement slabs on framing
15 Insulation-grade plaster
16 Steel angle, hot-dip galvanized
17 Steel trapezoidal sheeting
18 Timber fascia
19 Wooden panelling
20 Aluminium sheet façade panel
21 Screw in elongated hole
22 Glulam beam

Base, level transition between inside and outside

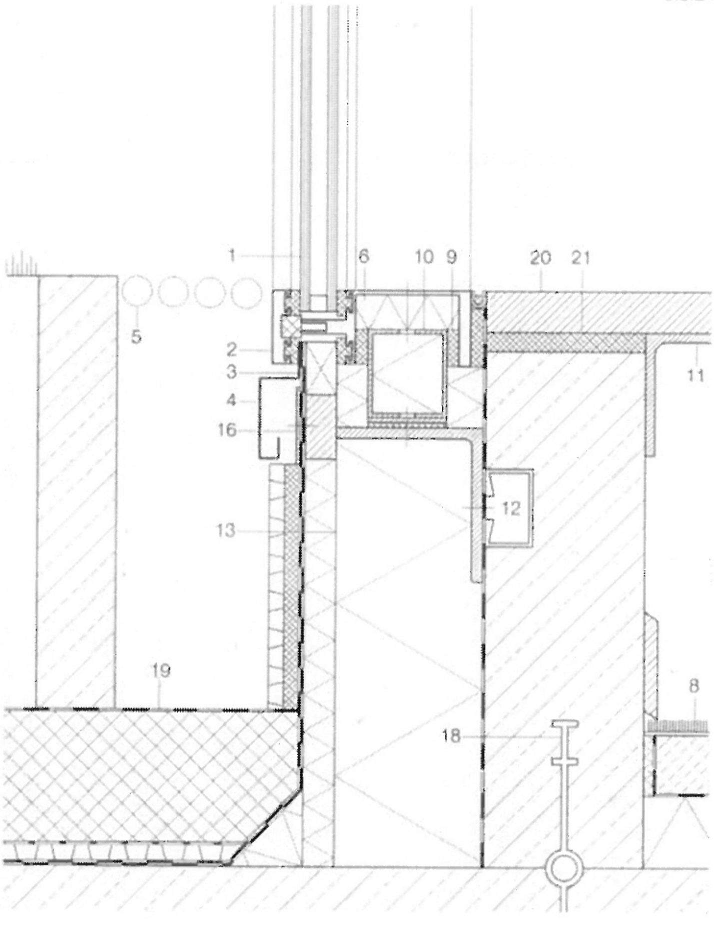
3.3.24 Level transition to outside
3.3.25 Junction with grass-covered flat roof
3.3.26 Junction with terrace/balcony
3.3.27 Junction with grass-covered flat roof

Vertical sections, scale 1:5





3.3.24



1 Double glazing
2 Aluminium façade rail
3 Plastic spacer block
4 Anodised aluminium sheet
5 Gravel-filled trench
6 Thermal insulation
7 Vapour barrier
8 Floor construction: fabric floor covering screed isolating membrane impact sound insulation
9 Permanently elastic seal
10 Insulated aluminium section
11 Steel angle, hot-dip galvanized
12 Cast-in slotted channel
13 Perimeter insulation
14 Raised timber grid
15 Lean-mix concrete blinding
16 Steel flat
17 Floor supports
18 Water bar
19 Drainage slab
20 Timber tread
21 Elastic sealing tape

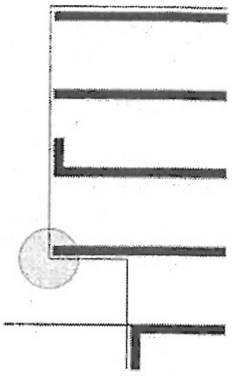
Figs. 3.3.24 – 3.3.27 illustrate base details for a post-and-rail façade. These details could occur on flat roofs and terraces, but above all at ground floor level. This is where façade, structural, fitting-out and sealing trades all meet. Careful detailing is therefore required with respect to workmanship, scheduling and clarification of warranty issues. A permanent seal is essential at this transition. The min. 150 mm height difference between water run-off level and bottom seal on façade rail as laid down in the standards can be reduced or waived only in agreement with the owner/developer and contractor.
The inner or outer pane – depending on function – must be made from safety glass to prevent injury.
Figs. 3.3.24. The primary structure here is reinforced concrete. This a level transition between inside and outside. The façade is freestanding. The load is transferred via an insulated hollow section (with thermal break) which is fixed to the main structure by means of a steel angle and cast-in slotted channel. The connection can be adjusted in three directions. The floor construction is trimmed with a steel angle. The gap between façade and edge of slab is packed with suitable insulation, sealed permanently diffusion-tight on the inner face to prevent the insulation from becoming damp. The overlap of the façade and sealing trades is a problem. The façade erector clamps a sheeting overlap under the façade rail which is subsequently welded to the seal on the outer wall of the basement by the sealing crew. The offset in the sealing plane above the perimeter insulation is also critical. According to the relevant standards, the seal must be ≥ 150 mm above the water run-off level. The gap to the façade is filled with 16/32 filter gravel.
Fig. 3.3.25. The primary structure here is reinforced concrete. The different levels of the ground/floor constructions inside and outside are a problem here. A level transition is possible by means of a raised floor internally or by providing a step in the floor slab. In the example shown, there is a step on the inside. The freestanding façade is connected to the main structure via a thermally isolated and insulated hollow section, steel angle and cast-in slotted channel, which transfers the forces but still remains adjustable in three directions. The facade section is insulated with a permanent

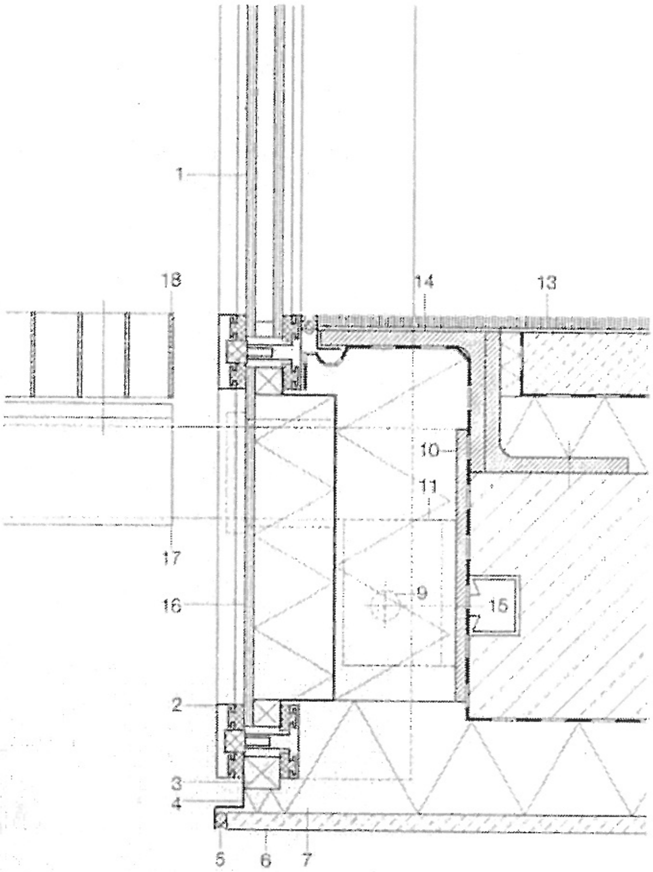
Re-entrant façade

3.3.15 Panel corner, with penetration
3.3.16 Panel corner, with penetration
3.3.17 Glazed corner

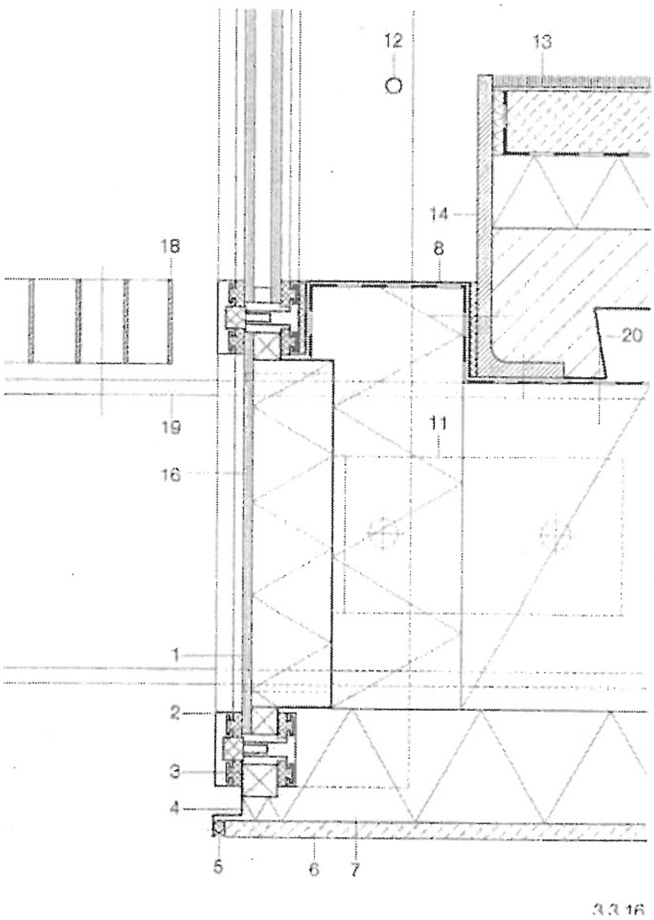
Vertical sections, scale 1:5

Details in Figs 3.3.15 – 3.3.17 illustrate typical corner arrangements in post-and-rail construction for recessed or projecting sections in a vertical façade.
Façades may be designed as freestanding or suspended. In the freestanding case, the junction at the corner must be formed as a fixed support and be able to accommodate horizontal and vertical loads. For suspended façades, the junction need only accommodate horizontal loads. It must be able to slide vertically in order to enable movement caused by thermal expansion and wind loads; this is achieved by having elongated fixing holes.
Fig. 3.3.15. The primary structure here is reinforced concrete. The glass pane continues to finished floor level. The gap between façade and structure is bridged by a steel angle screwed on. The edge of the slab is covered by a glass panel with suitable insulation and permanently elastic, diffusion-tight and airtight sealing. The façade is firmly fixed to the structure via cast-in slotted channel and steel angles adjustable in three directions. The façade panel is penetrated at individual places by glass fins for attaching sunshades, escape balconies etc. This penetration must incorporate a permanently elastic seal to prevent the insulation from becoming damp.
Fig. 3.3.16. The primary structure here is steel. The construction consists of continuous steel beams and steel trapezoidal sheeting with concrete topping. The steel beam penetrates the outer skin. This point represents a thermal bridge which must be carefully detailed. The spaces between the beams are filled with glass panels. Joints must have permanently elastic seals and be able to accommodate movements caused by thermal expansion, different loading cases, etc. The junction between façade rail and steel beam must be able to accommodate the various tolerances in the façade and structural steelwork and also permit movements brought about by loads (wind, imposed etc.) and thermal stresses. The steel beam passes from cold outside air to heated interior and so constitutes a thermal bridge. It must therefore be completely insulated in order to prevent the occurrence of condensation. The inner face of the insulation is to be provided with a diffusion-tight and airtight vapour barrier.





3.3.15



3.3.16

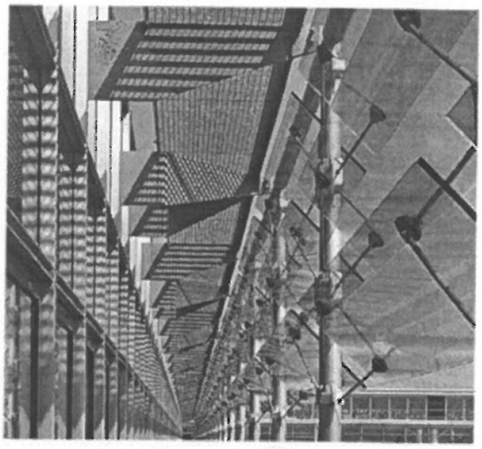
1 Double glazing
2 Aluminium façade rail
3 Plastic spacer block
4 Anodised aluminium sheet
5 Permanently elastic joint
6 Fibre-reinforced cement slabs on framing
7 Thermal insulation
8 Aluminium sheet cover plus vapour barrier
9 Screw in elongated hole
10 Steel plate, hot-dip galvanized
11 Aluminium angle
12 Safety grid, stainless steel tube
13 Floor construction: fabric floor covering floating screed isolating membrane impact sound insulation
14 Steel angle, hot-dip galvanized
15 Cast-in slotted channel
16 Façade panel: toughened safety glass, printed thermal insulation aluminium sheet
17 Steel bracket with end plate, hot-dip galvanized
18 Open-grid flooring, hot-dip galvanized
19 Steel beam, hot-dip galvanized
20 Steel trapezoidal sheeting

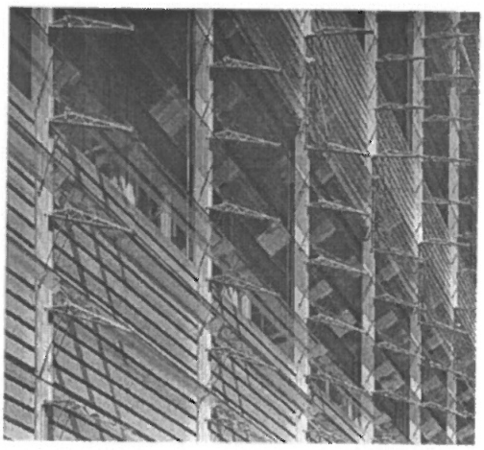
Louvres

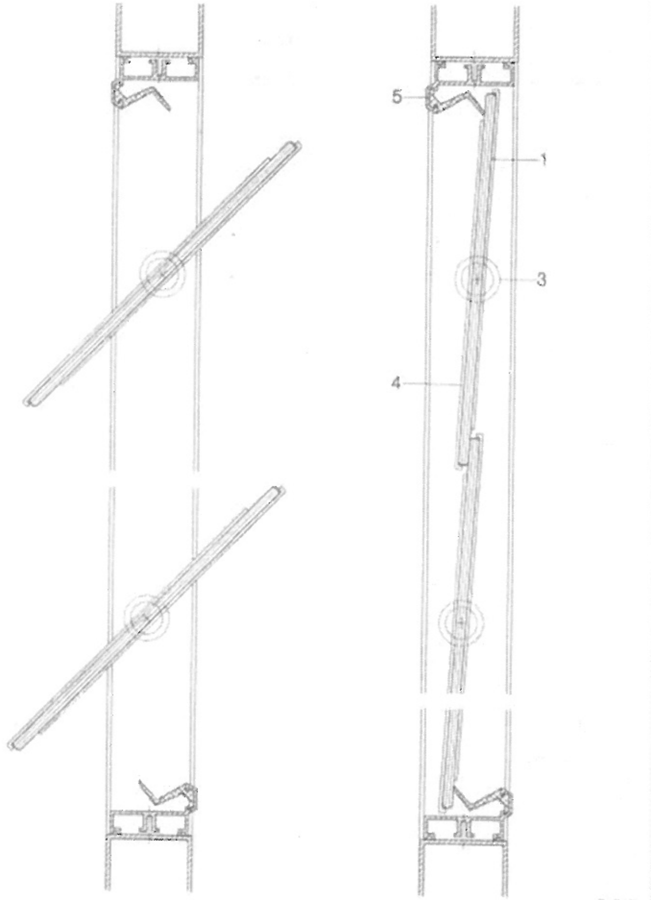
3.2.9 Single glazing, frameless
3.2.10 Double glazing with thermal break in frame

Vertical sections, scale 1:5

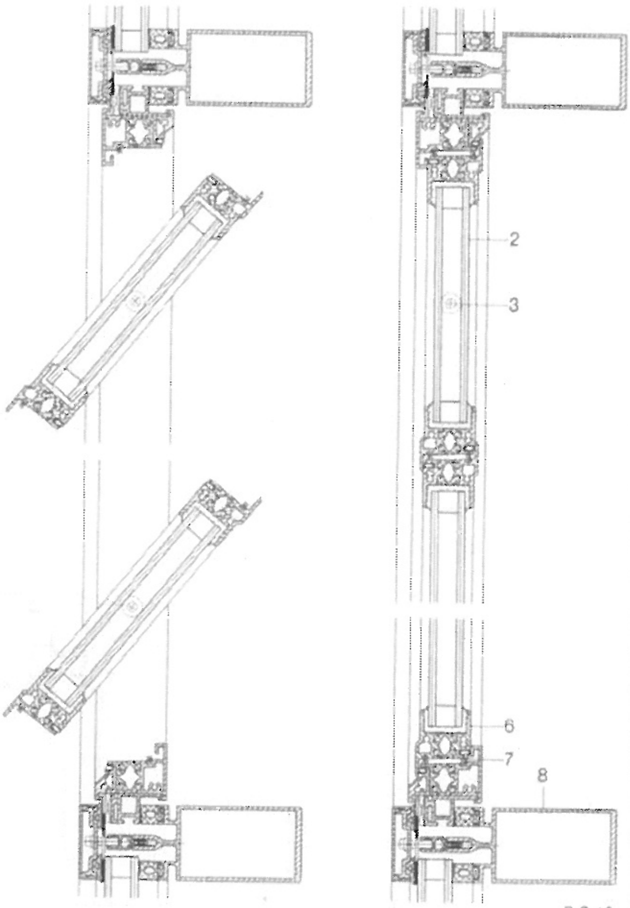
Louvre windows are suitable for fine regulation of the venting of rooms or multi-skin façades. They can also be used as smoke and heat vents. Countless variations are available in single or double glazing, with or without frames. The basic structural considerations apply like for a vertically pivoted window, for example.







3.2.9

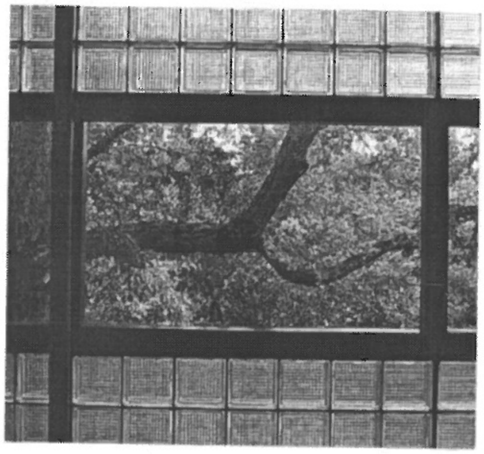


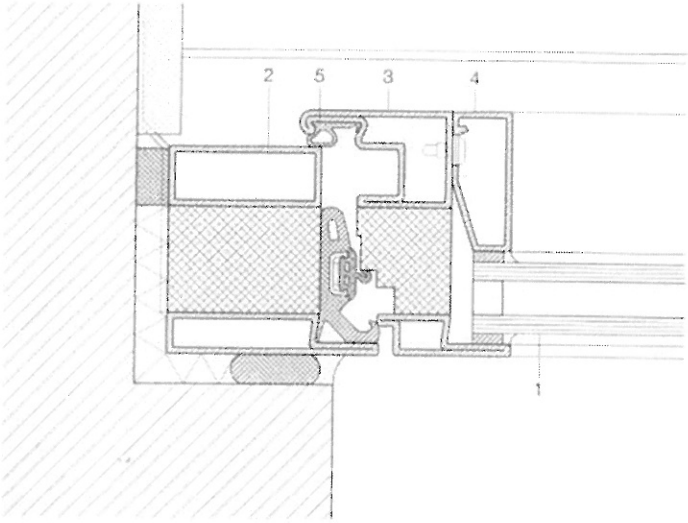
3.2.10

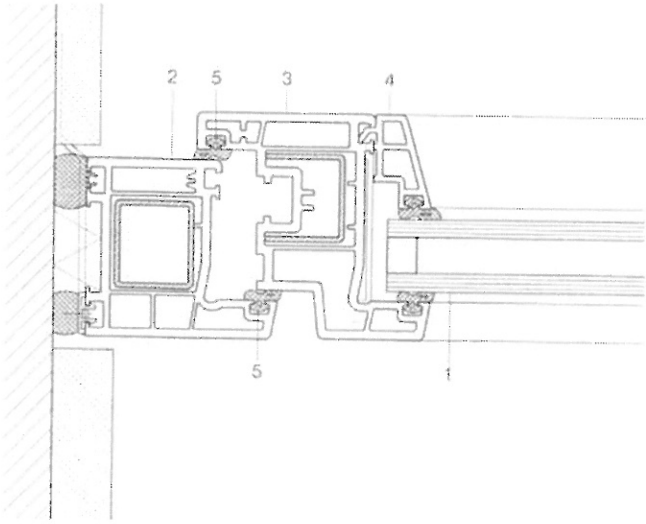
1 Single glazing
2 Double glazing
3 Pivot
4 Glass retainers at ends
5 Edge seal
6 Frame profile with thermal break
7 Brush type weatherstrip
8 Frame / installation frame

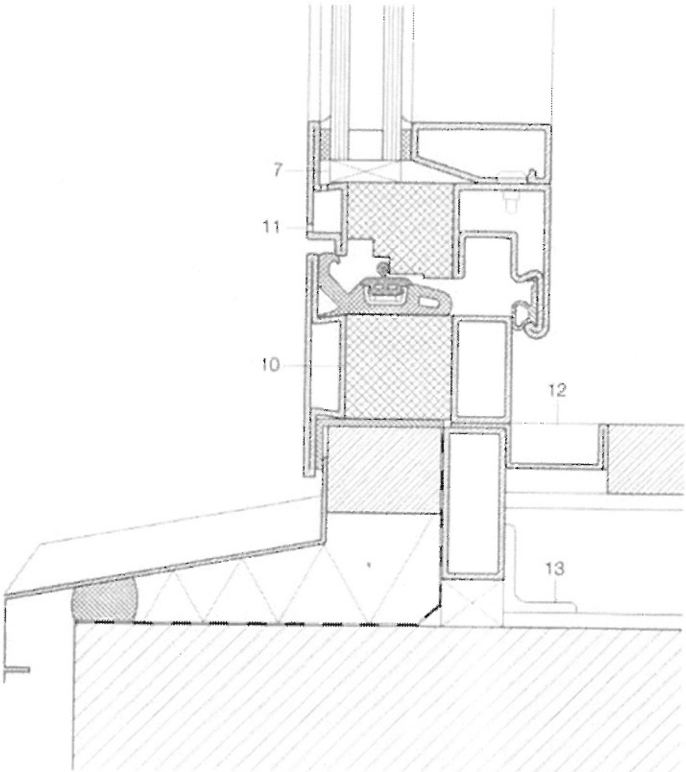
opening light. However, two seals are better for thermal insulation, as shown in Figs 3.2.3 and 3.2.4. An edge and a middle seal are incorporated in 3.2.3. In this case drainage and vapour-pressure equalization take place in front of the outer seal. Drainage in metal or plastic profiles is relatively easy to accomplish; in wooden windows this is best achieved via the mortise and tenon joint of the bottom rail.

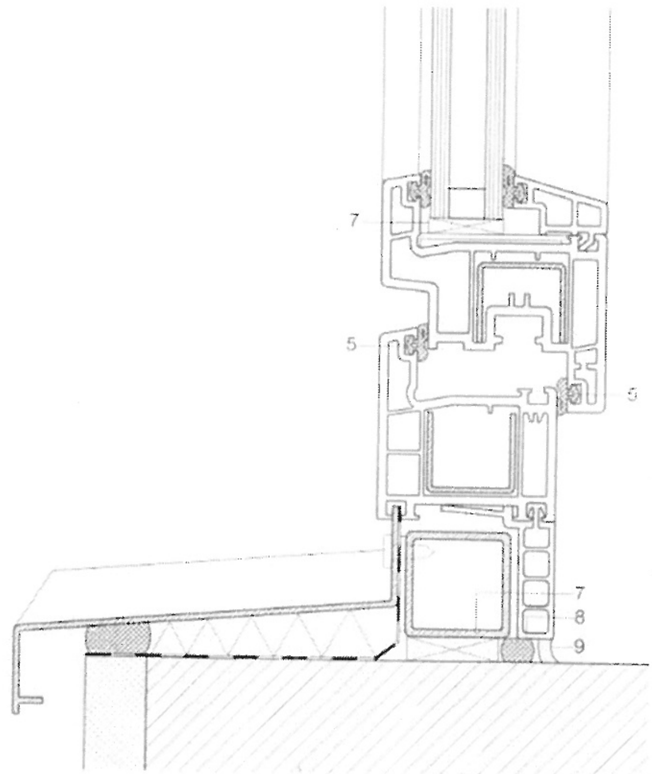
1 Double glazing
2 Window frame
3 Sash framing
4 Glazing bead
5 Seal
6 Rainwater channel
7 Setting block
8 Edge tape
9 Permanently elastic joint
10 Thermal break
11 Weep hole
12 Drainage channel
13 Fixing







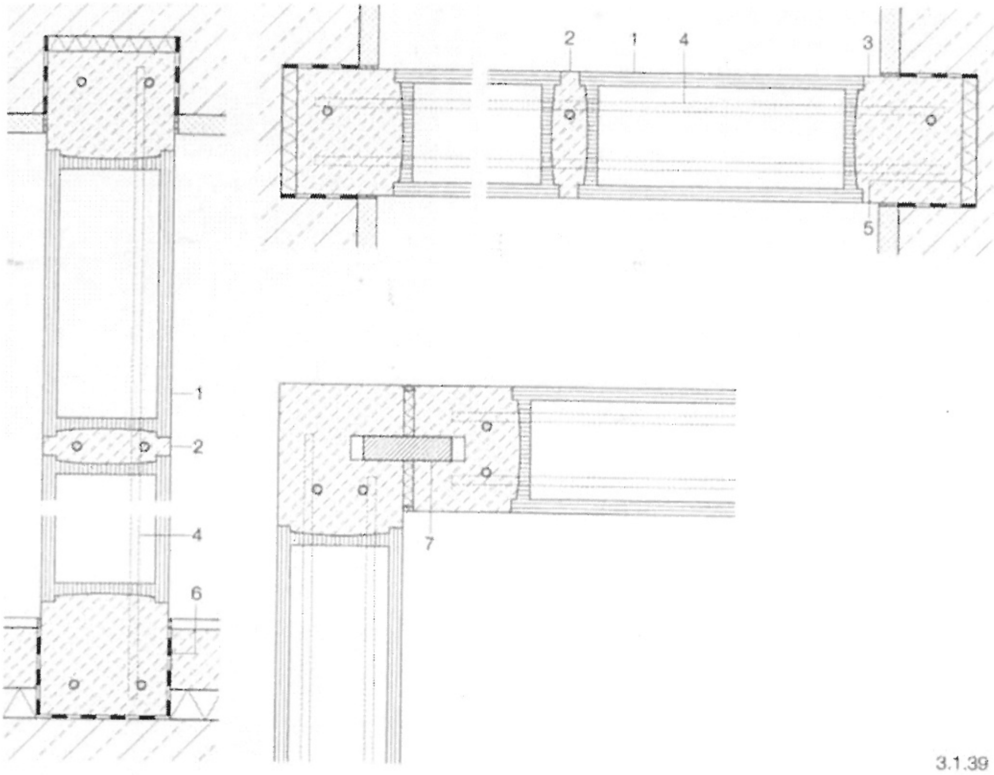




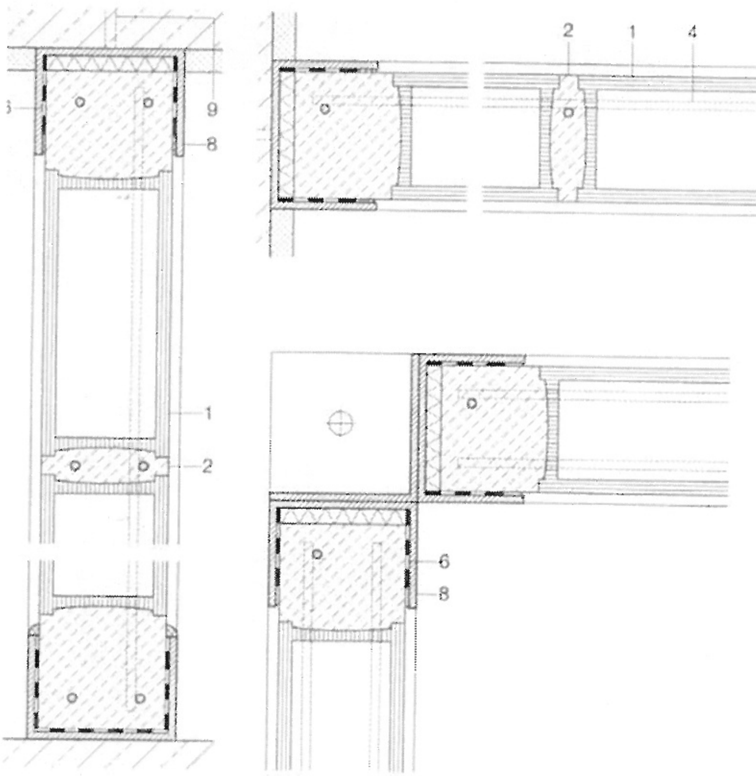
Walls and floors of glass blocks

3.1.39 Glass block wall fitted into masonry chases
3.1.40 Glass block wall fitted into channel section
3.1.41 Glass floor made of hollow blocks

Vertical and horizontal sections, scale 1:5

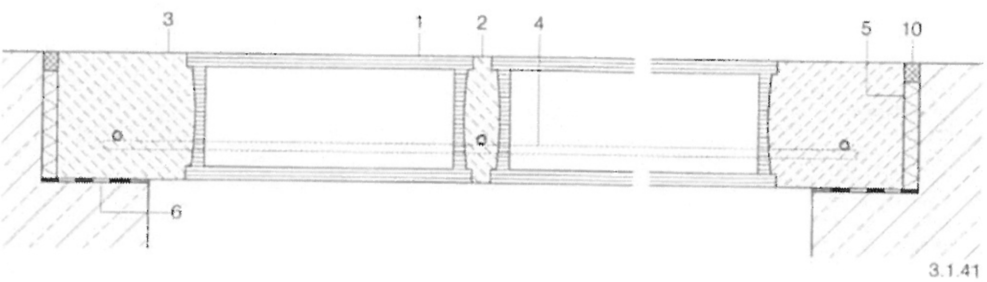


3.1.39



1 Glass block
2 Mortar joint
3 Border
4 Reinforcement
5 Movement joint / insulation
6 Sliding bearing (bituminous board)
7 Corner profile
8 Steel channel section
9 Masonry anchor
10 Permanently elastic seal

3.1.40



3.1.41

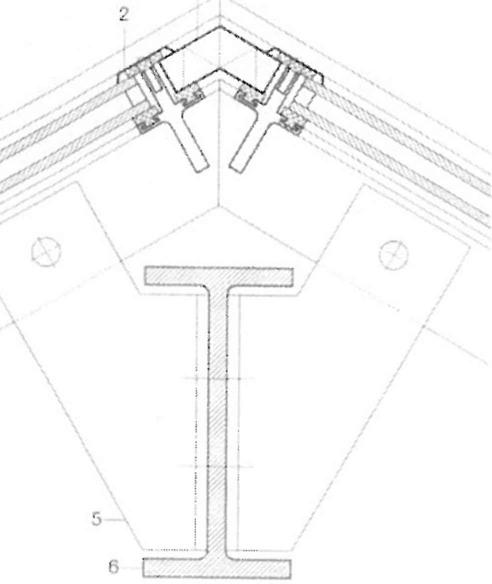
Glass blocks must be built into a wall without restraint; no loads from the structure may be transferred to the glass blocks. Continuous expansion joints, filled with polystyrene or similar, are required at the sides and along the top. The bottom border should be laid on a sliding joint of plain bituminous board (Fig. 3.1.39). If fitted into channel sections (Fig. 3.1.40), then a sliding joint of oiled paper or plain bituminous board should be placed in the steel section. The lateral fixings to the building are to be designed as sliding anchors. The concrete between the glass blocks should not be too hard (max. grade B 25), so that the glass blocks are not compressed and damaged as a result of temperature fluctuations. The borders should be no wider than 100 mm to avoid thermal restraint. Reinforcement is to be calculated in line with structural requirements and should consist of galvanized or stainless steel bars. To reduce the restraint forces in glass block walls, expansion joints should be incorporated every 6 m; they should take account of the horizontal forces acting on the component. The coating to the sides of the individual blocks must remain intact – it ensures a good bond with the concrete. Joints must be sufficiently impervious to prevent the mortar ribs from becoming damp. Glazing with glass blocks can be erected to suit varying classes of fire protection.
Fig. 3.1.41 shows a hollow glass block floor. With appropriate detailing, both constructions can also be used for flat roofs. In the case of loadbearing glass block floors or glass and concrete floors, the interaction of the glass block, concrete and reinforcement causes the glass to be loaded as well. The glass block must therefore be bonded to the surrounding concrete so that it can accept the forces transferred from the total construction. The glass blocks used in such a case must be capable of carrying unrestricted foot traffic. Glass and concrete constructions are to be protected against restraint forces induced by the rest of the structure by means of expansion and sliding joints.

Glass roofs

3.3.31 and 3.3.32
Ridge details
3.3.33 to 3.3.35
Eaves details
3.3.36 Upper junction with sloping component
3.3.37 and 3.3.38
Lateral junction with sloping component

Vertical sections, scale 1:5

These details illustrate typical solutions for pitched glass roofs. In principle, the same materials may be used here as in vertical glazed façades. However, owing to the higher thermal and the different mechanical stresses compared to vertical glazing, special constructional measures are necessary. The sections used as posts and rails in the preceding façade details have been used again here for the longitudinal and transverse members. The connection to the main structure (steel) is by way of steel brackets that permit adjustment in three directions. The drainage system of the supporting construction should be modified to suit the sloping arrangement so that water can run off to the outside. Transverse clamping bars on the roof are flat and bevelled so that rainwater can drain properly. For overhead glazing in general, the lower pane should be a type which retains fragments upon fracture (e.g. laminated safety glass, or wired glass up to a certain size). For glazing subject to restricted/unrestricted foot traffic, the type of glass must be chosen accordingly. Gutters are required for larger roof areas.
Fig. 3.3.31. For reasons of appearance, the transverse rails should be located as near to the ridge as possible. The ridge is closed off with an insulated panel folded to the appropriate angle. The sloping rails have mitred joints and are connected together by the groove for screw fixings.
Fig. 3.3.32. The ridge is finished with a cover plate fitted into the screw groove of the ridge purlin.
Fig. 3.3.33. For reasons of appearance, the transverse rails are located as near to the corner as possible. The corner is closed off with an insulated panel bent to the appropriate angle. The façade posts and the pitched roof rails are mitred and joined together



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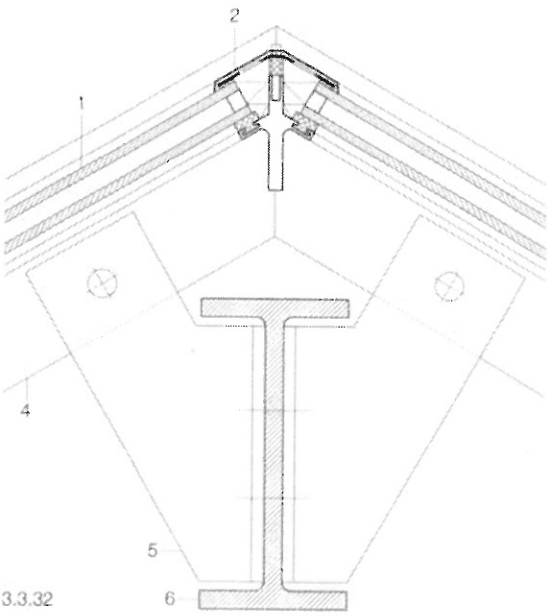

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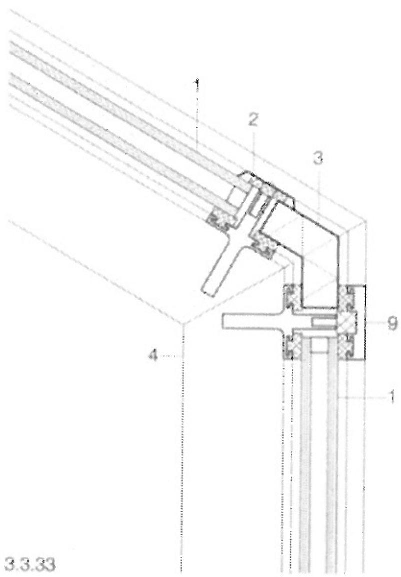

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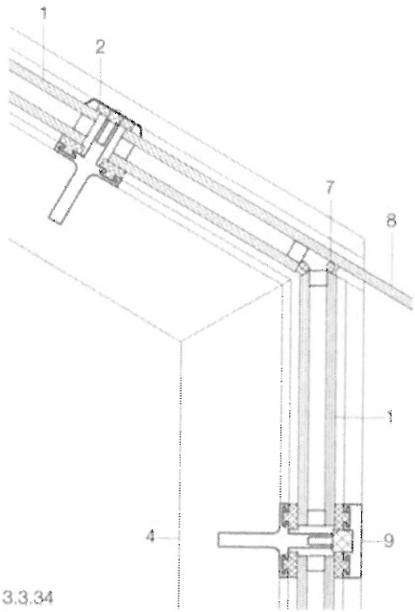
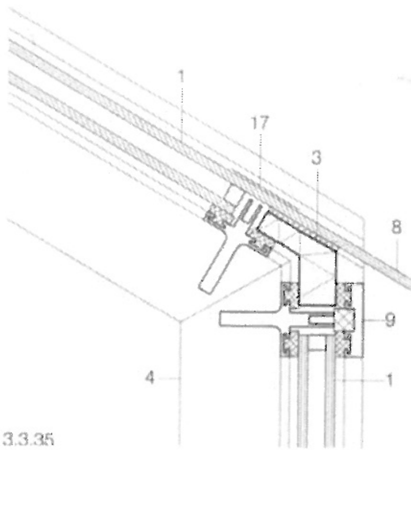
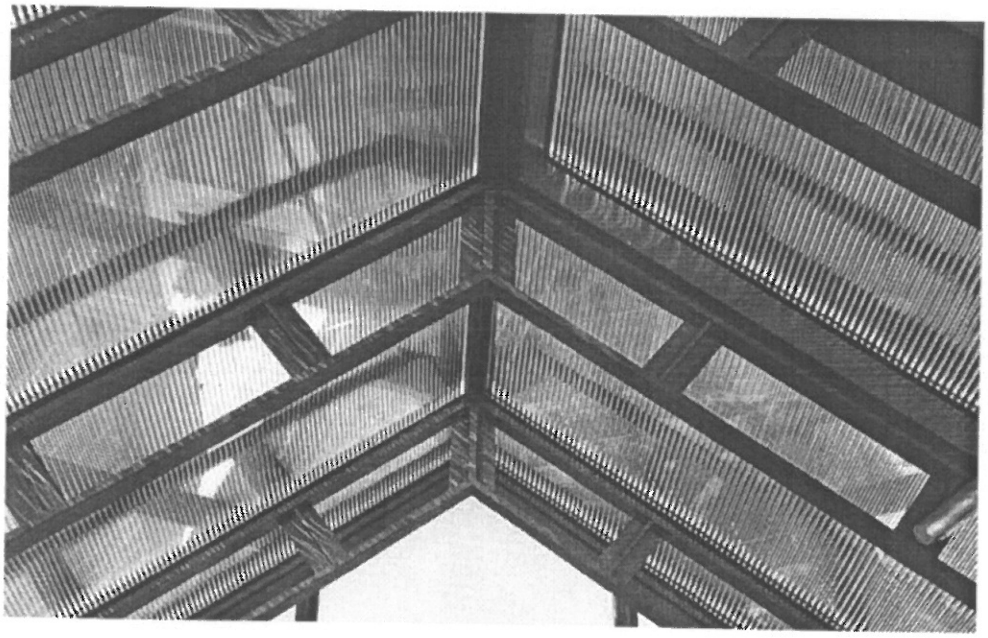


3.3.34



3.3.35

1 Double glazing
2 Bevelled glazing bar
3 Insulated façade panel
4 Aluminium façade rail
5 Steel angle
6 Steel beam
7 Permanently elastic joint
8 Toughened safety glass
9 Insulated aluminium section, with thermal break
10 Cover plate
11 Insulation
12 Square timber
13 PVC profiled rail
14 Aluminium angle
15 Cast-in slotted channel
16 Sheet metal gutter
17 Ceramic-ink printing



using steel angles or the screw. A channel for collecting the dirty condensate water is recommended for roofs without overhanging eaves.

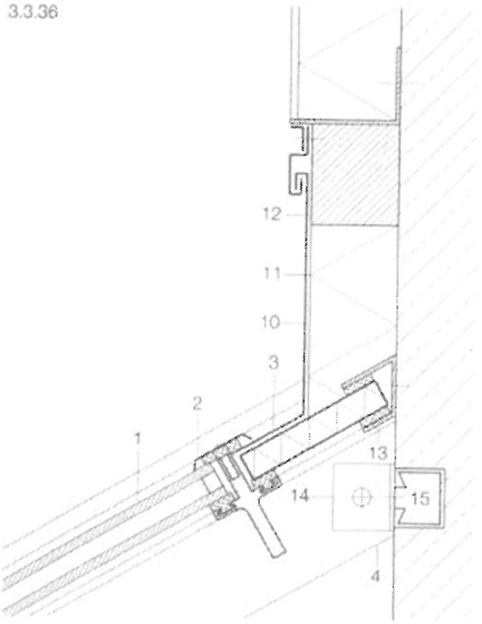
Fig. 3.3.34. This shows a fully glazed corner. The uppermost sloping glass pane extends beyond the façade to form an eaves overhang. The joints between vertical glazing and roof are sealed with permanently elastic material. In this detail, chosen for reasons of appearance, the mounting for the upper pane must be properly executed and the drained joint tends to leak if the workmanship is not adequate. Only a silicone seal works here.

Fig. 3.3.35. This corner is closed with an insulated panel. The upper glass pane of the inclined double glazing is glued to the panel and extends beyond the façade to form an eaves overhang. The exposed edge seal of the double glazing in Figs 3.3.34 and 3.3.35 must be suitably protected against UV radiation (e.g. printing).

Fig. 3.3.36 shows the upper junction of a pitched glass roof with a taller, insulated, reinforced concrete wall. The sloping rails are connected to the main structure via elongated holes, steel angles and a cast-in slotted channel, adjustable in three directions. The glass roof is joined to the structure using an insulated panel, PVC angle and sealing tapes, permanently elastic, diffusion-tight and airtight. In line with the standards, the flashing continues 150 mm above the water run-off level.

Figs 3.3.37 and 3.3.38. The lateral junction with a sloping component can be realized with or without a gutter. The glass roof is joined to the structure using an insulated panel, a PVC angle and sealing tapes, permanently elastic, diffusion-tight and airtight. The gutter in Fig. 3.3.37 uses the depth of the inclined loadbearing rail. In the case of shallow pitches (< 10°), it may be necessary to heat the gutter in winter. Even on frost-free days, the gutter may become blocked (e.g. by leaves). The thermal transmittance of the adjacent insulation should match that of the insulating glass in order to avoid thermal bridges.

3.3.36



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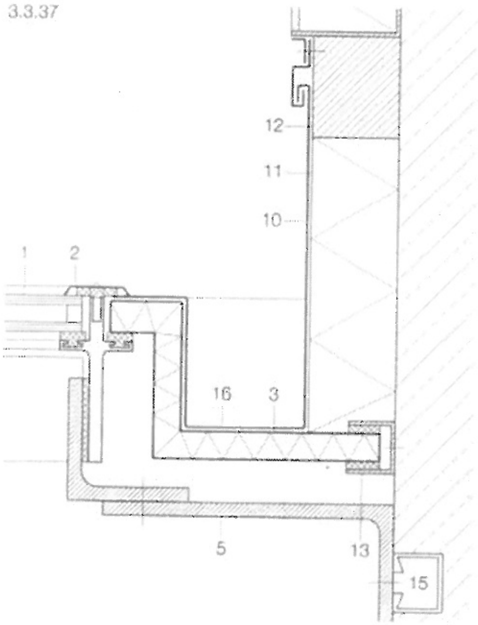

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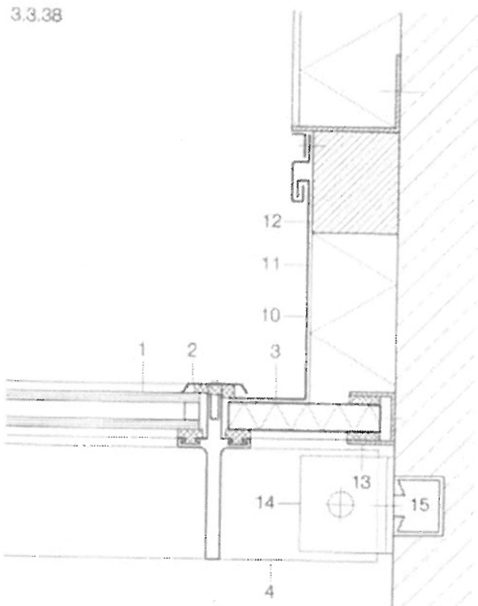
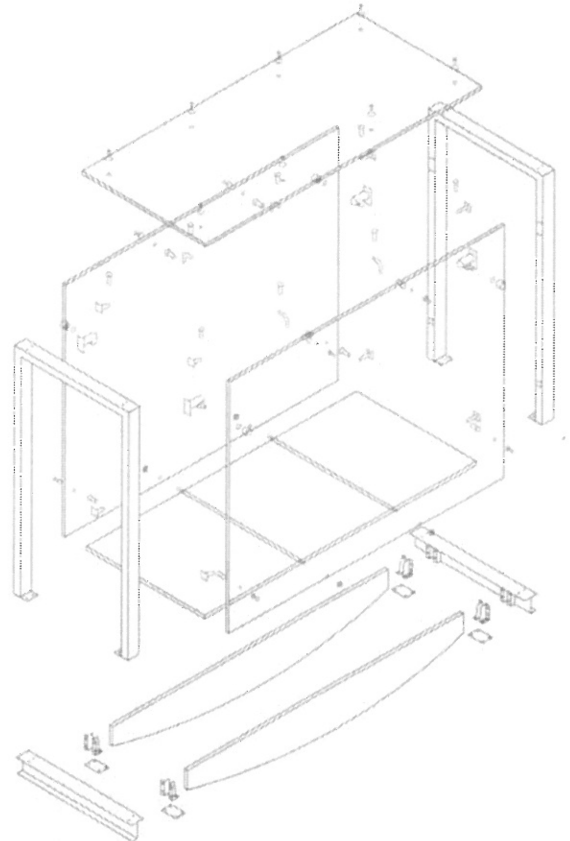


Glass Bridge in Rotterdam, The Netherlands

1994

Architects:
Dirk Jan Postel
Kraaijvanger · Urbis, Rotterdam
Structural engineers:
Rob Nijsse
ABT Velp, Arnheim

Exploded diagram

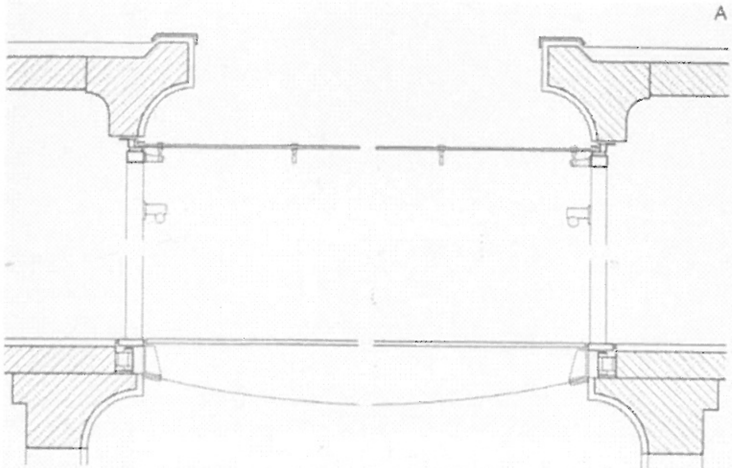


A Vertical section
B Horizontal section
scale 1:50

C Vertical section aa
D Vertical section bb: abutment with wall
scale 1:5

1 laminated safety glass: 10 mm toughened glass externally; 6 mm heat strengthened glass internally
2 stainless steel point fixing
3 7 mm laser-cut stainless steel plate
4 1.5 mm painted sheet-aluminium gutter on 18 mm waterproof-bonded plywood
5 70x70x7 mm angle
6 80x120x6.3 mm steel RHS
7 2 panes 15 mm laminated safety glass floor
8 3 mm sheet stainless steel bent to shape; on 2 sheets 18 mm plywood
9 2 No. 90x90x9 mm angles
10 160 mm channel filled with concrete
11 60x60x6 mm steel SHS
12 steel joist hanger
13 glass beam: 3 x 10 mm laminated safety glass

This enclosed, all-glass bridge spans a distance of 3.20 m across a road and links the rooms of the Kraaijvanger Urbis architectural practice. The architects took the brief as the chance for an experiment to explore the design and structural possibilities of glass as a building material. Non-slip printing on the floor sheet was deliberately omitted. Walking out on to the bridge represents a "step into the unknown"; a sense of fear has to be overcome. On the other hand, there are also a number of surprising, but less breathtaking, experiences to be made. These include lighting effects and the sensation that one's own shadow disappears and then reappears several metres below in the form of a silhouette on the pavement. The floor consists of a sheet of laminated safety glass. It is supported by two glass beams, the form of which reflects the line of the moment diagram. To make the system of forces within the construction visible, the minimally dimensioned metal connectors are designed in different forms. They consist of standard point fixings with additional stainless steel plates that reflect the flow of forces at individual points. The complete transparency of the bridge forms a striking contrast to the solid buildings it links.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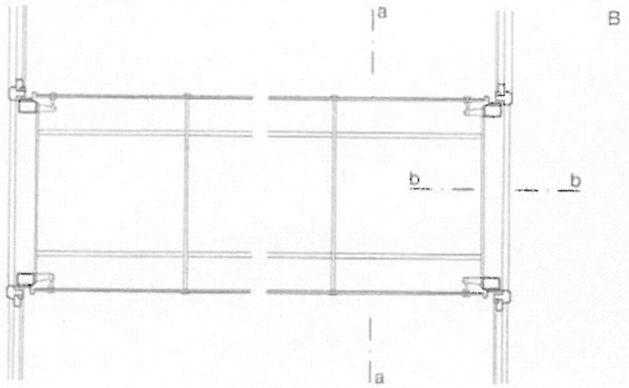
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b
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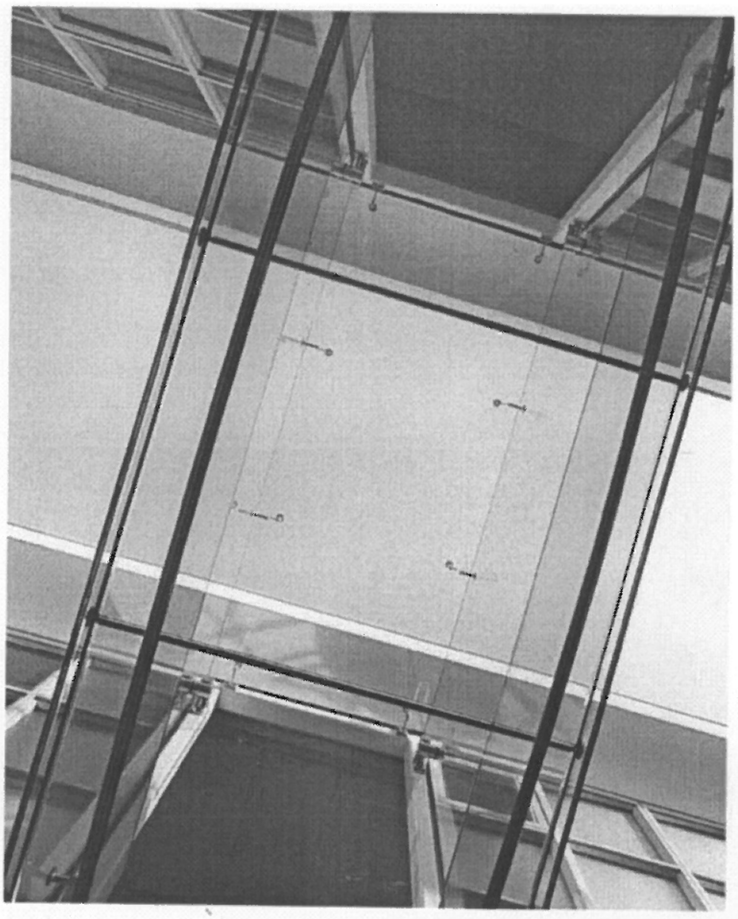

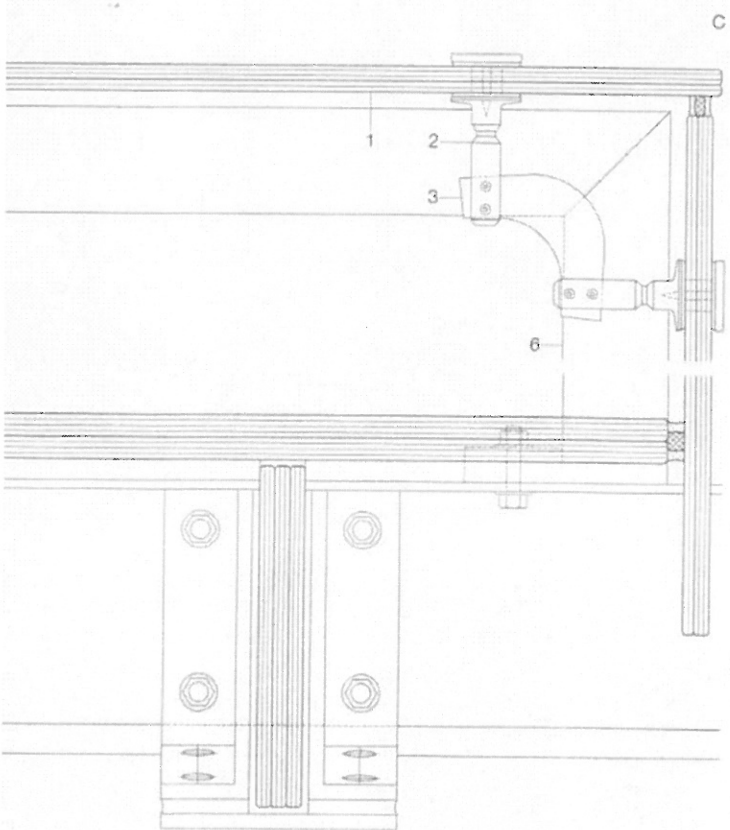
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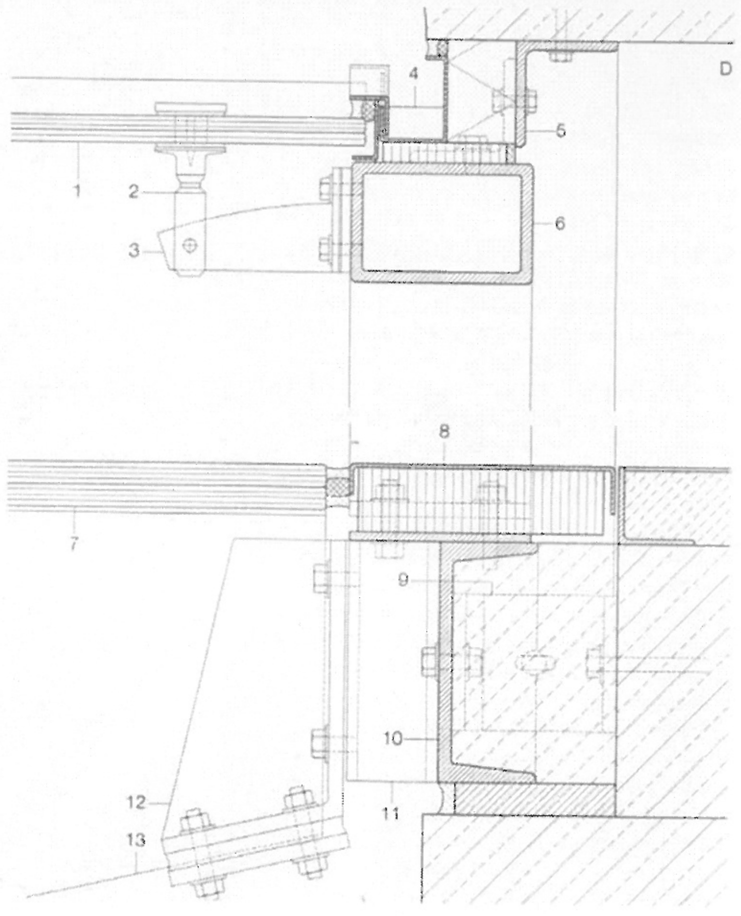
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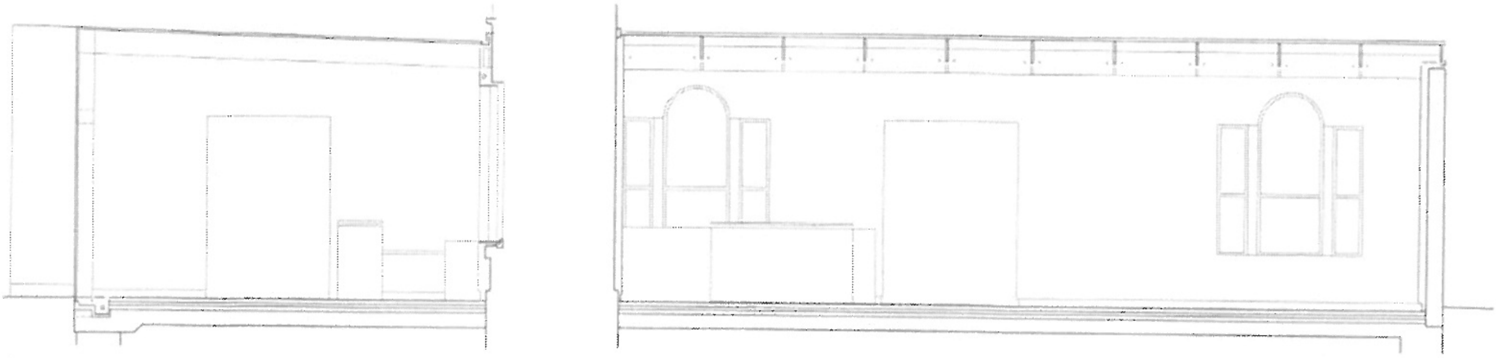
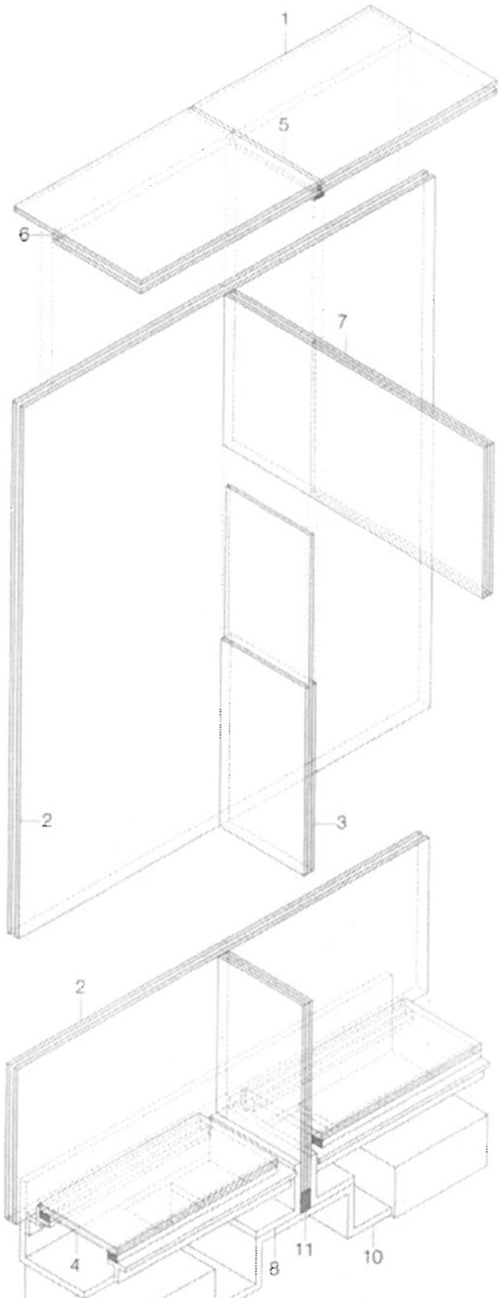
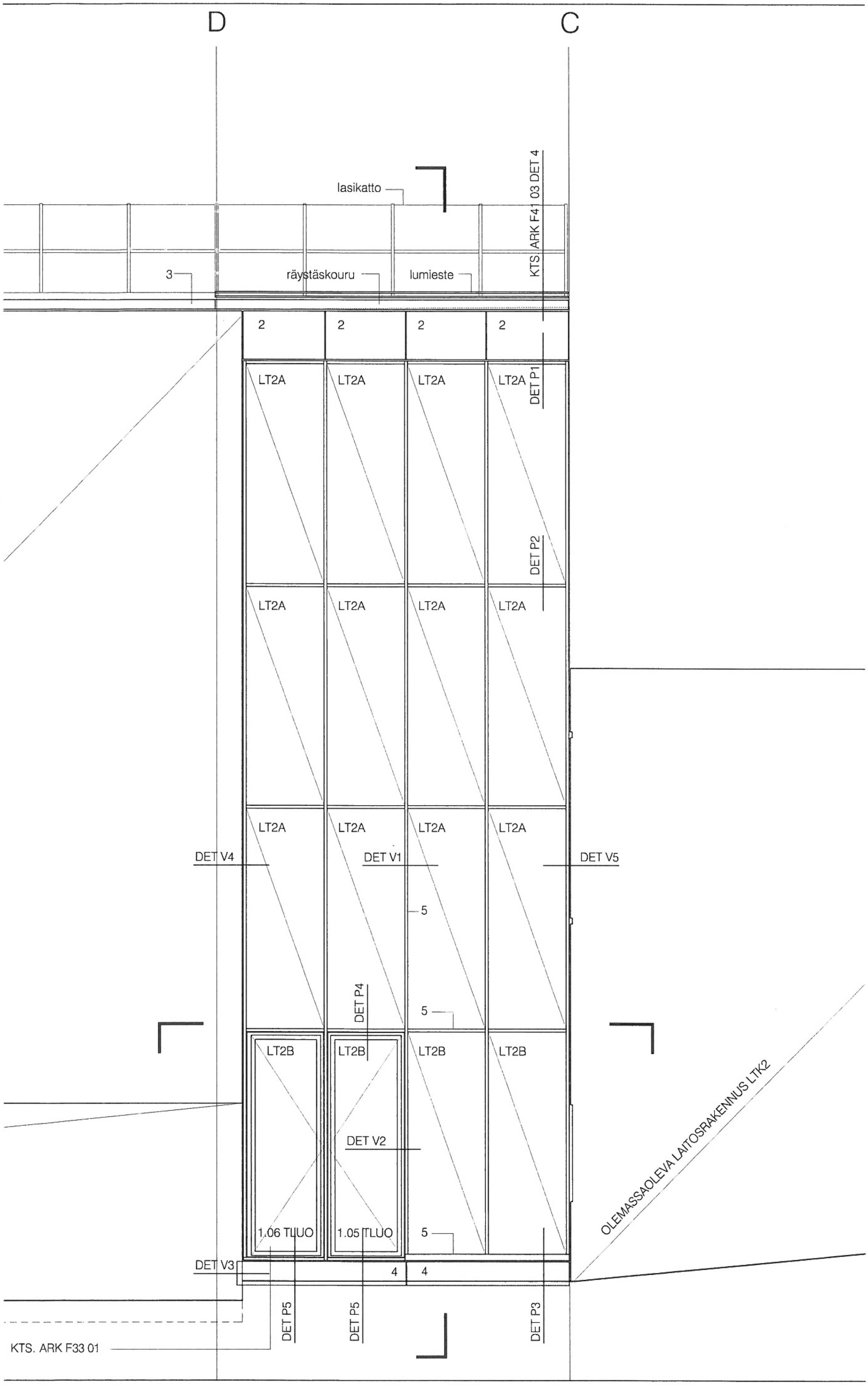


Cross-section and longitudinal section through extension scale 1:100



Axonometric (not to scale)



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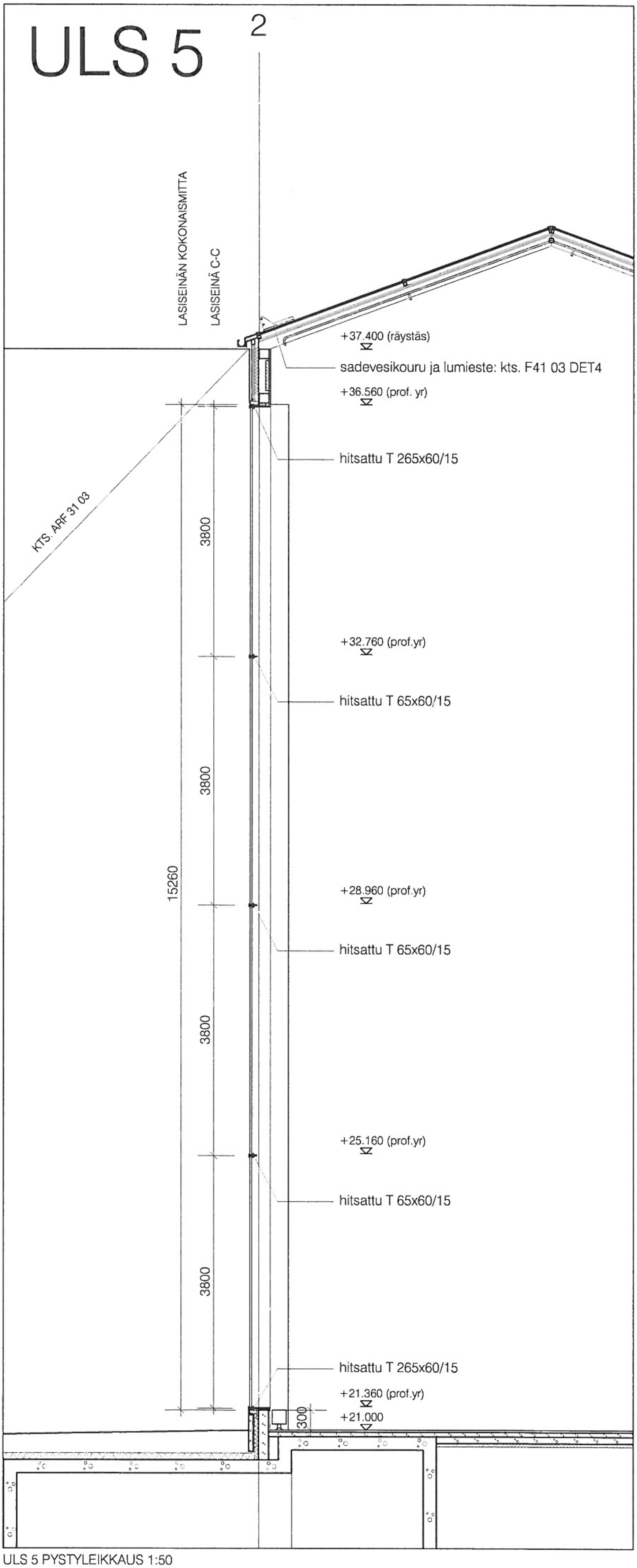
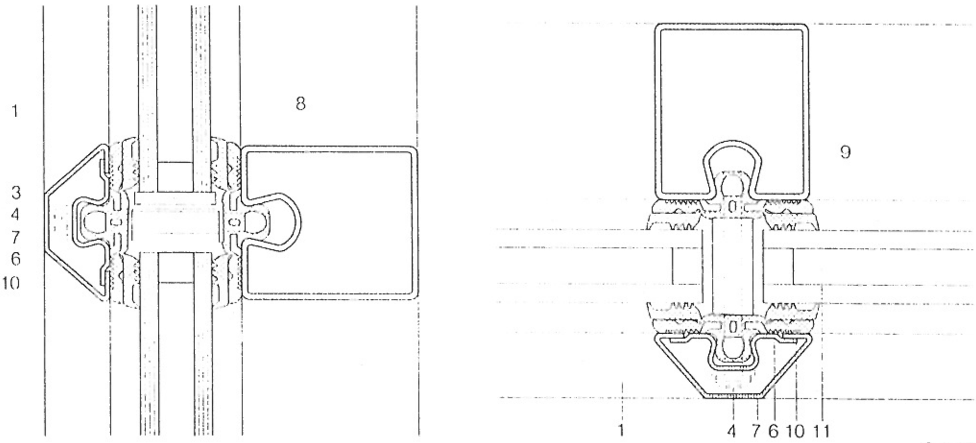


ULS 5 PYSTYLEIKKAUS 1:50



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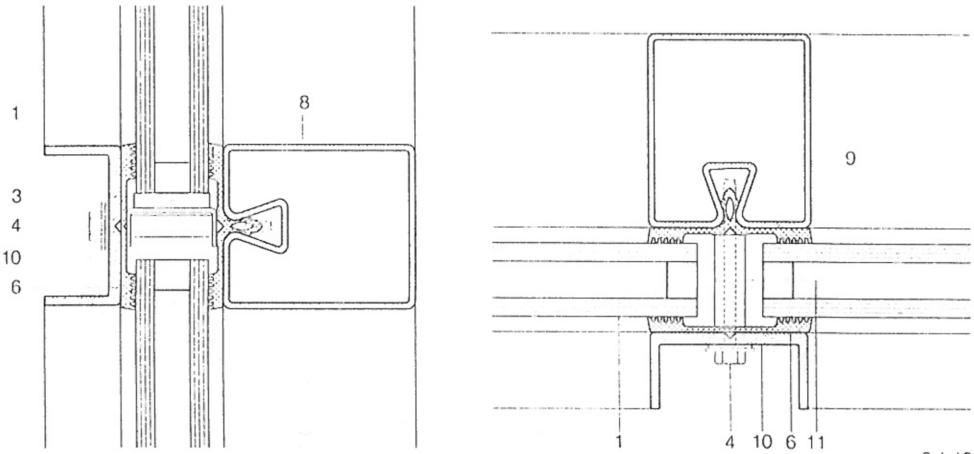

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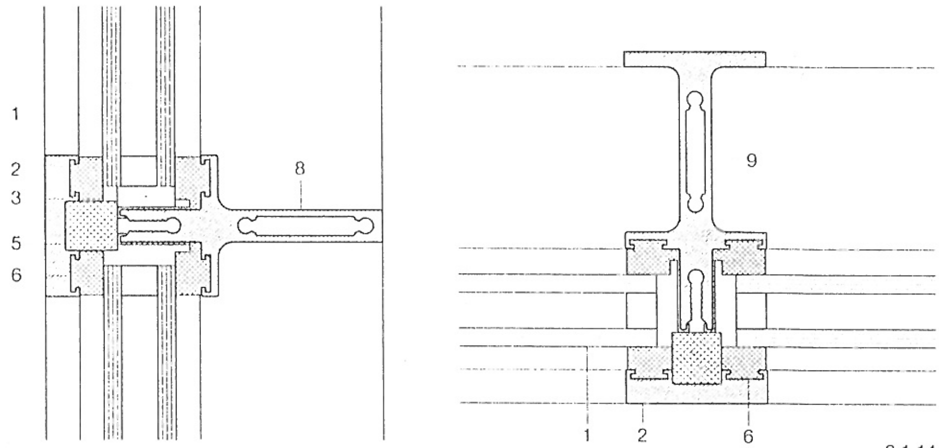

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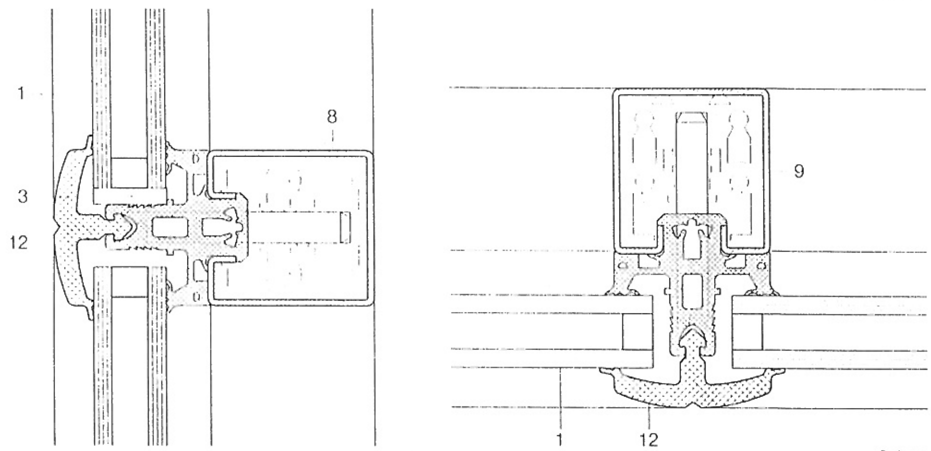

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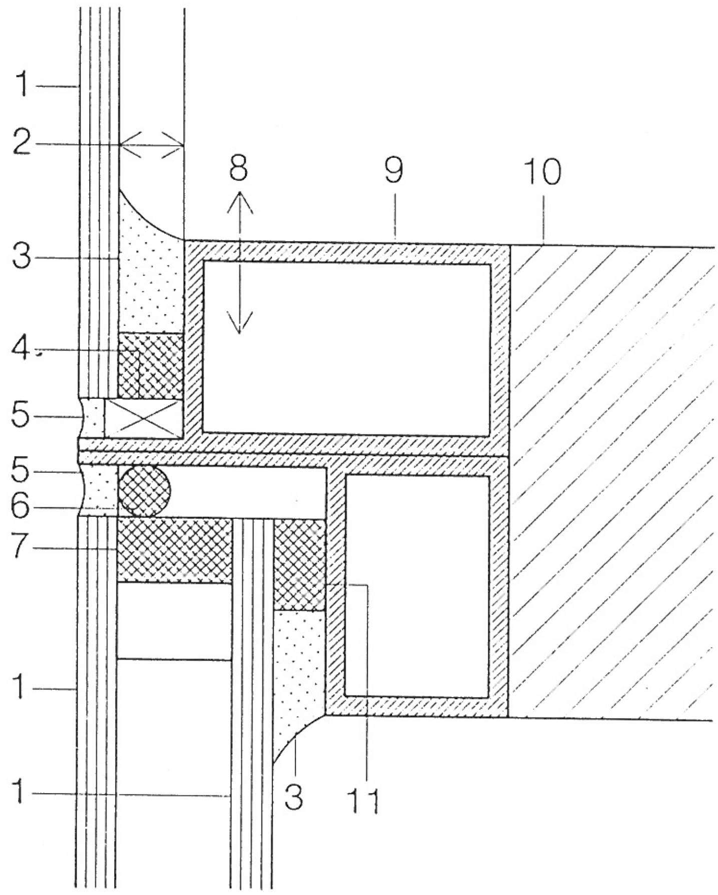
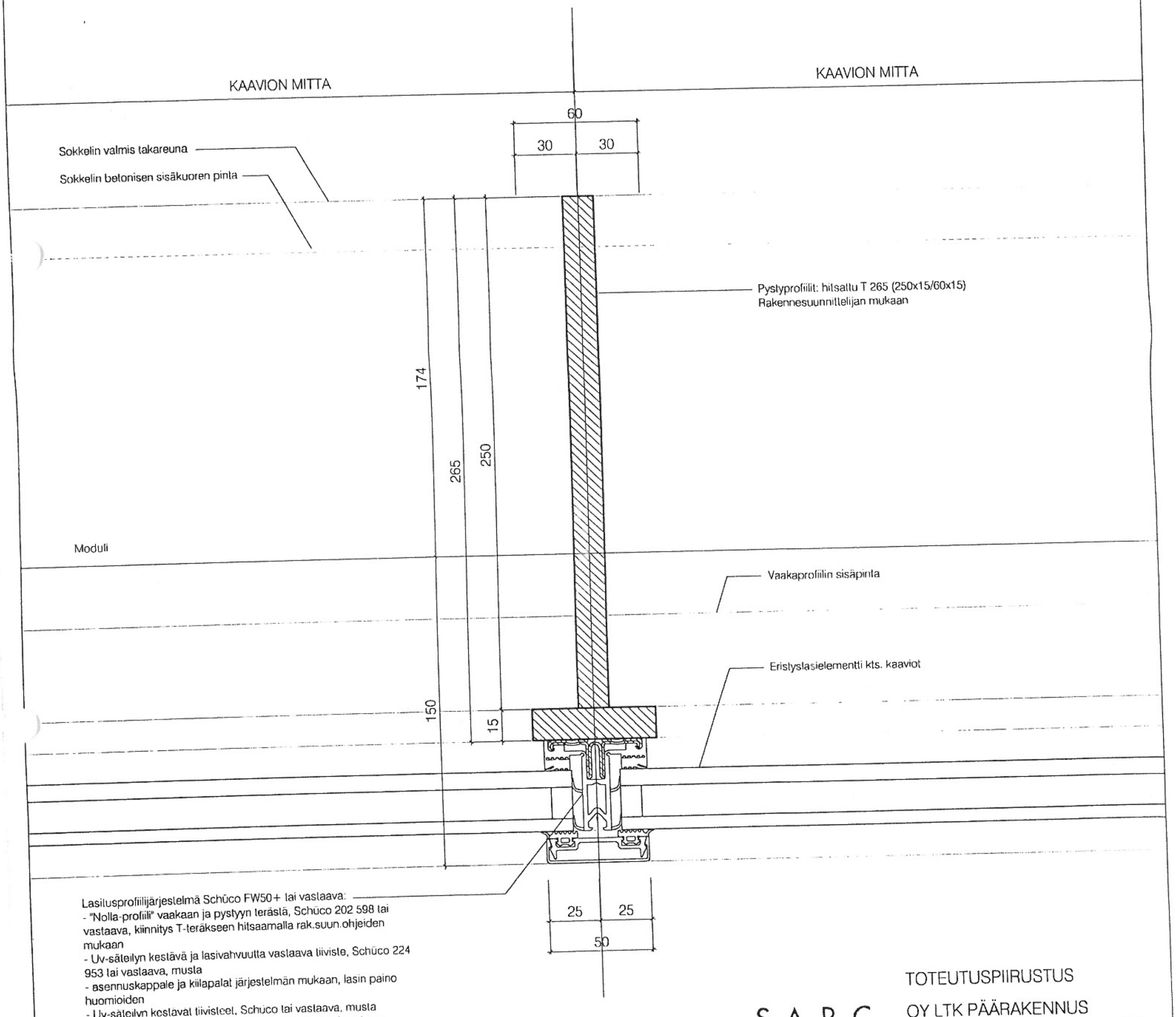


1	Glas	6	Hinterfüllmaterial
2	Glasfalzbreite	7	Randverbund
3	Flächenbündige Verklebung	8	Glasfalzhöhe
4	Tragklotz	9	Adapterrahmen
5	Versiegelung	10	Bauwerk
		11	Abstandshalter

2.1.57 Glaskonstruktion mit lastabtragender Verklebung (Structural Sealant Glazing)



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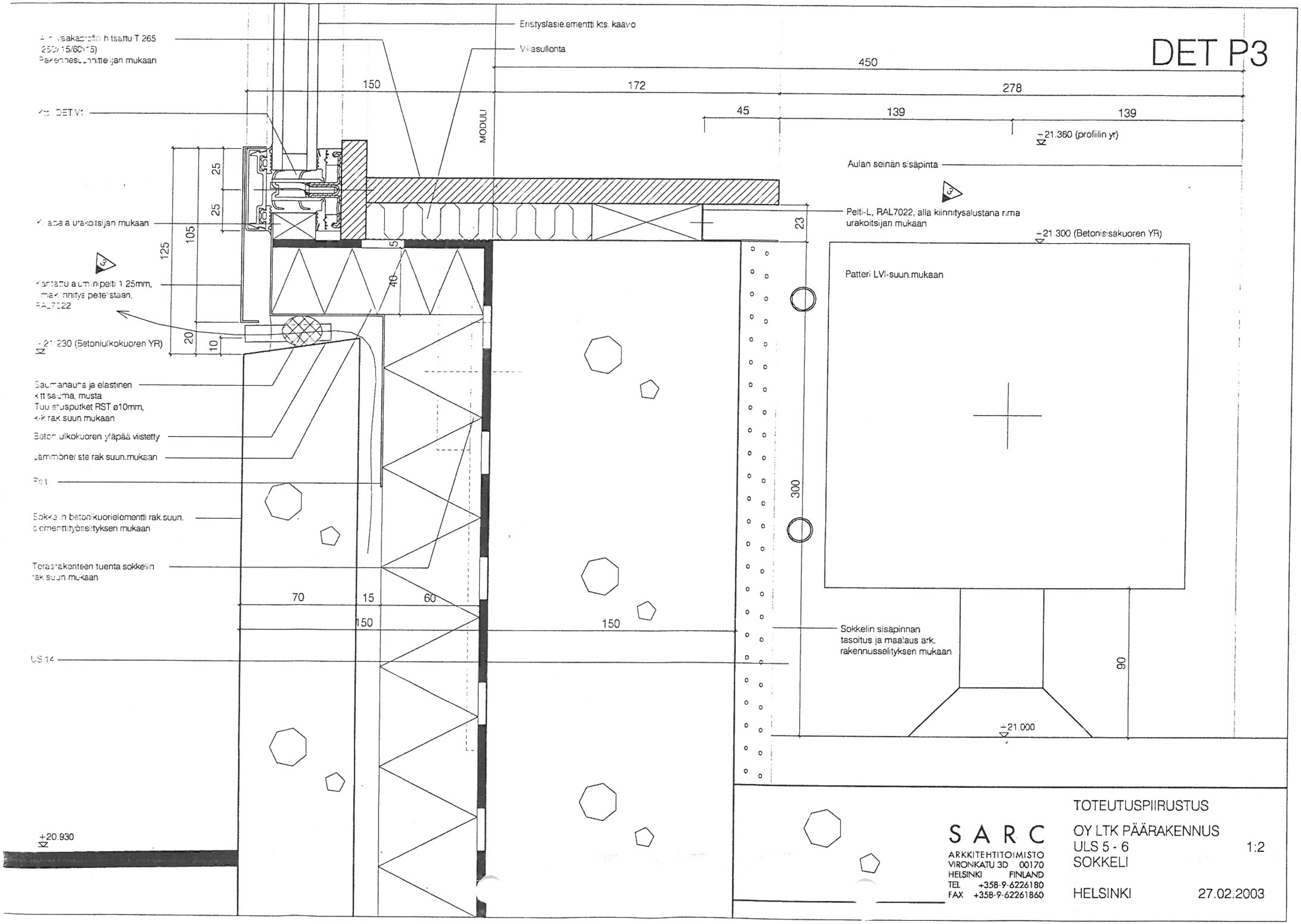

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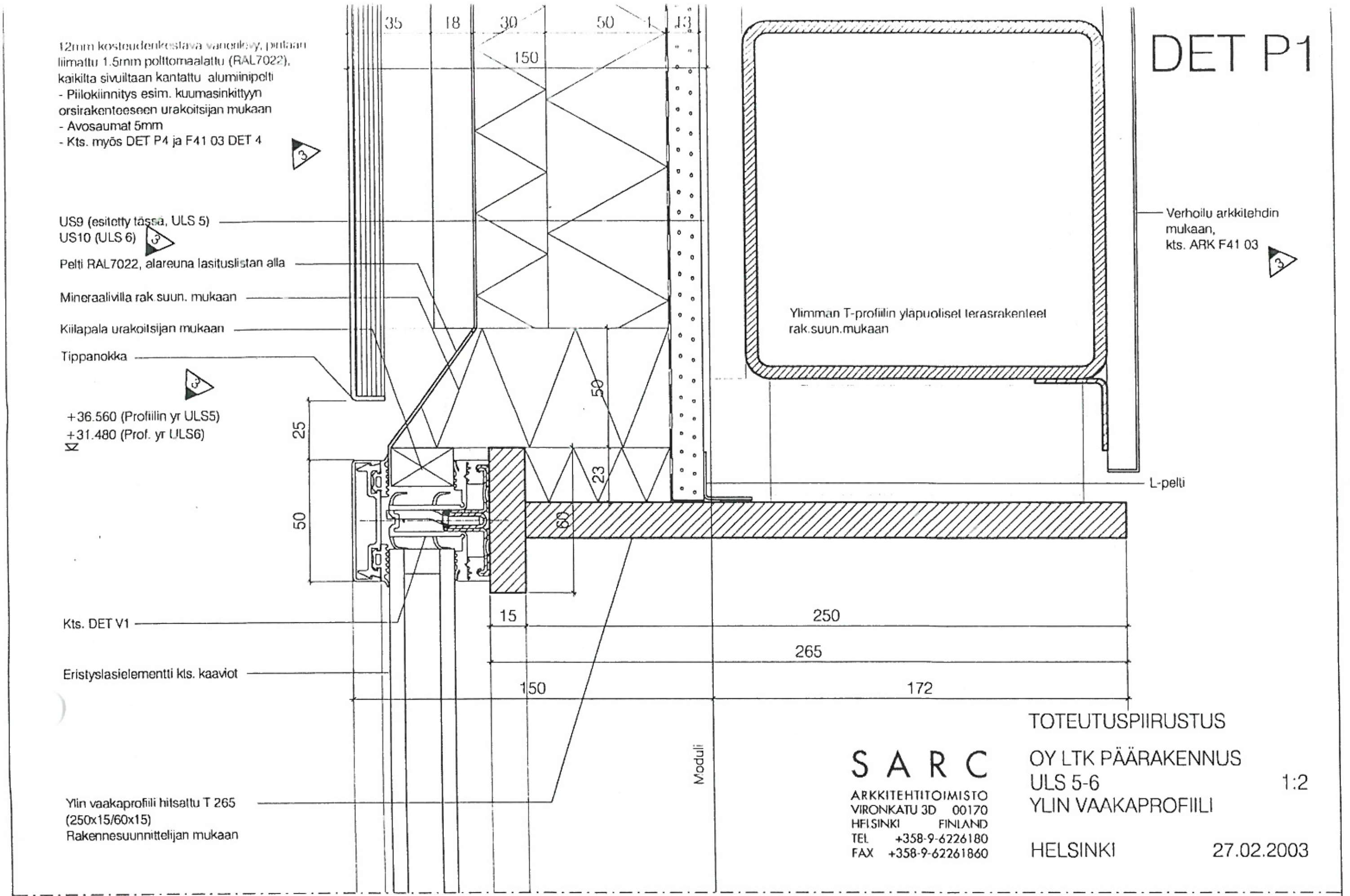

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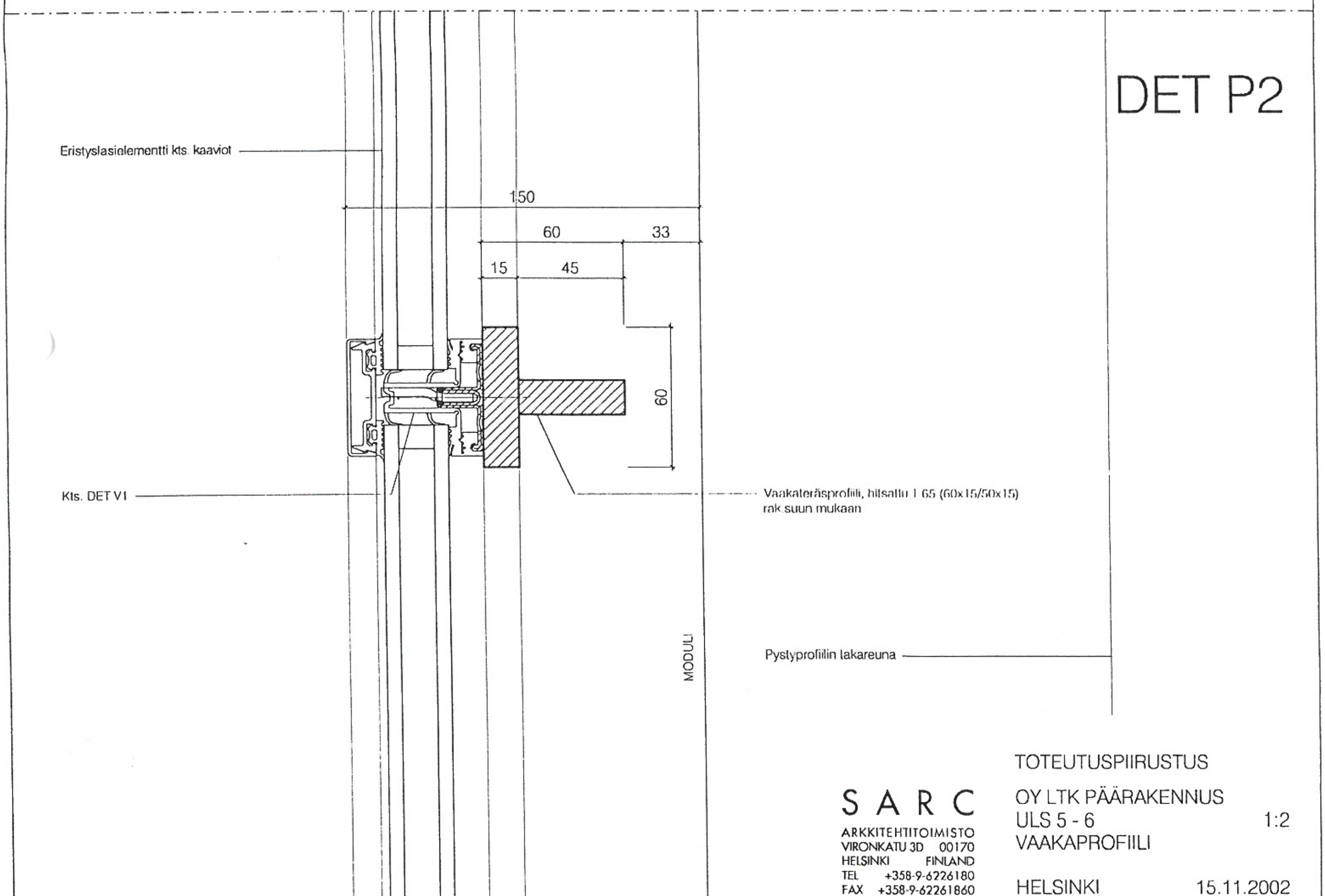

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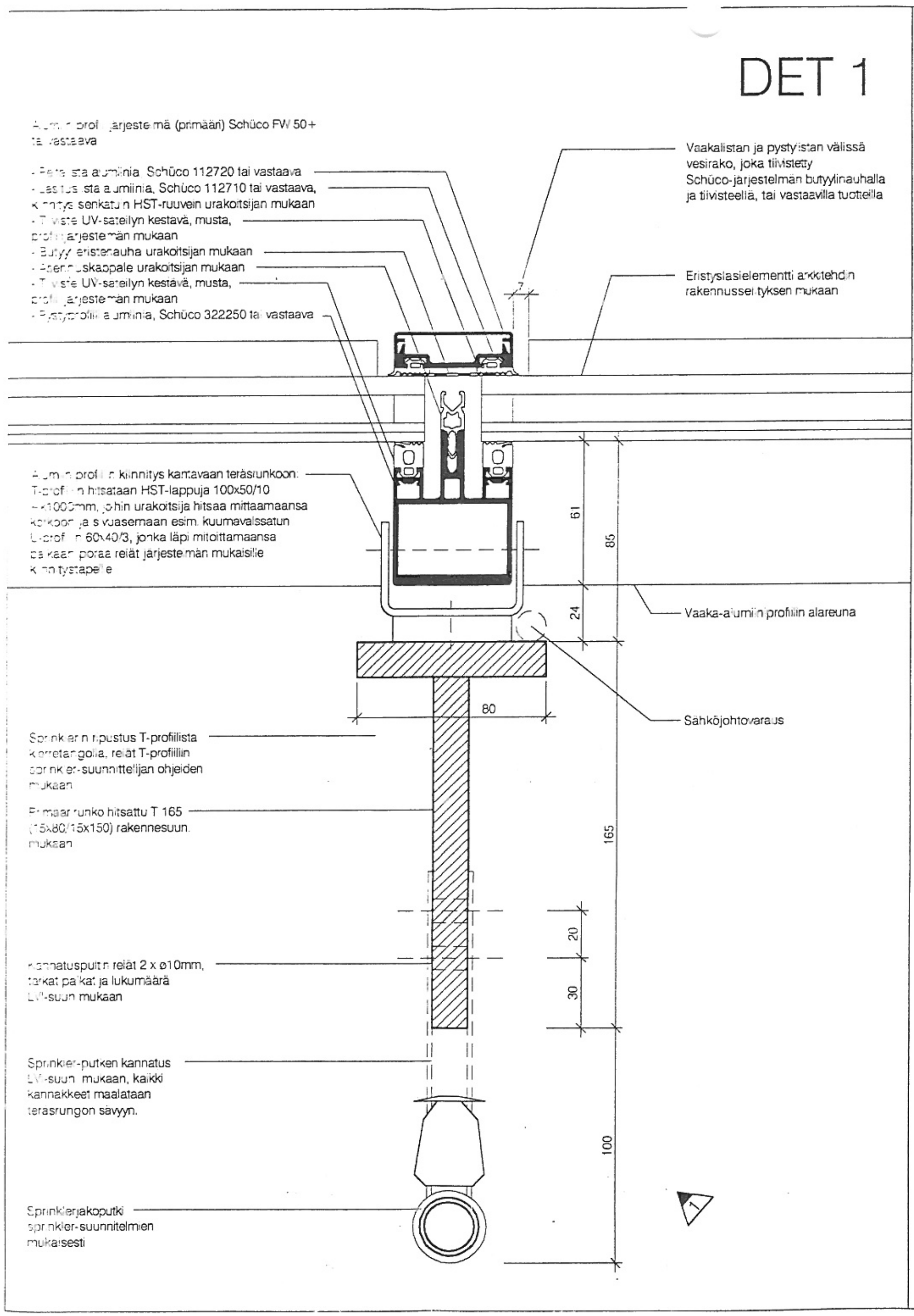

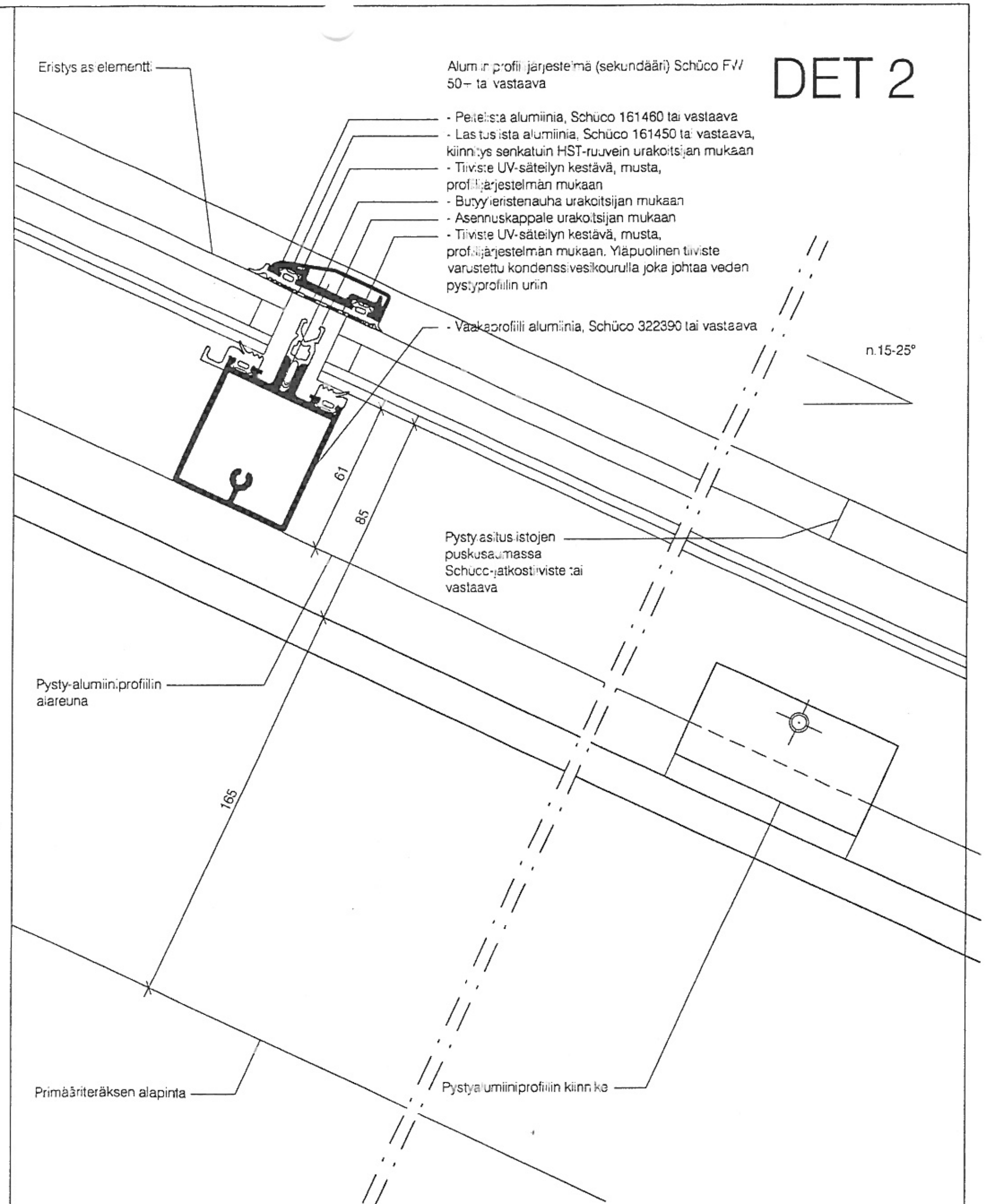

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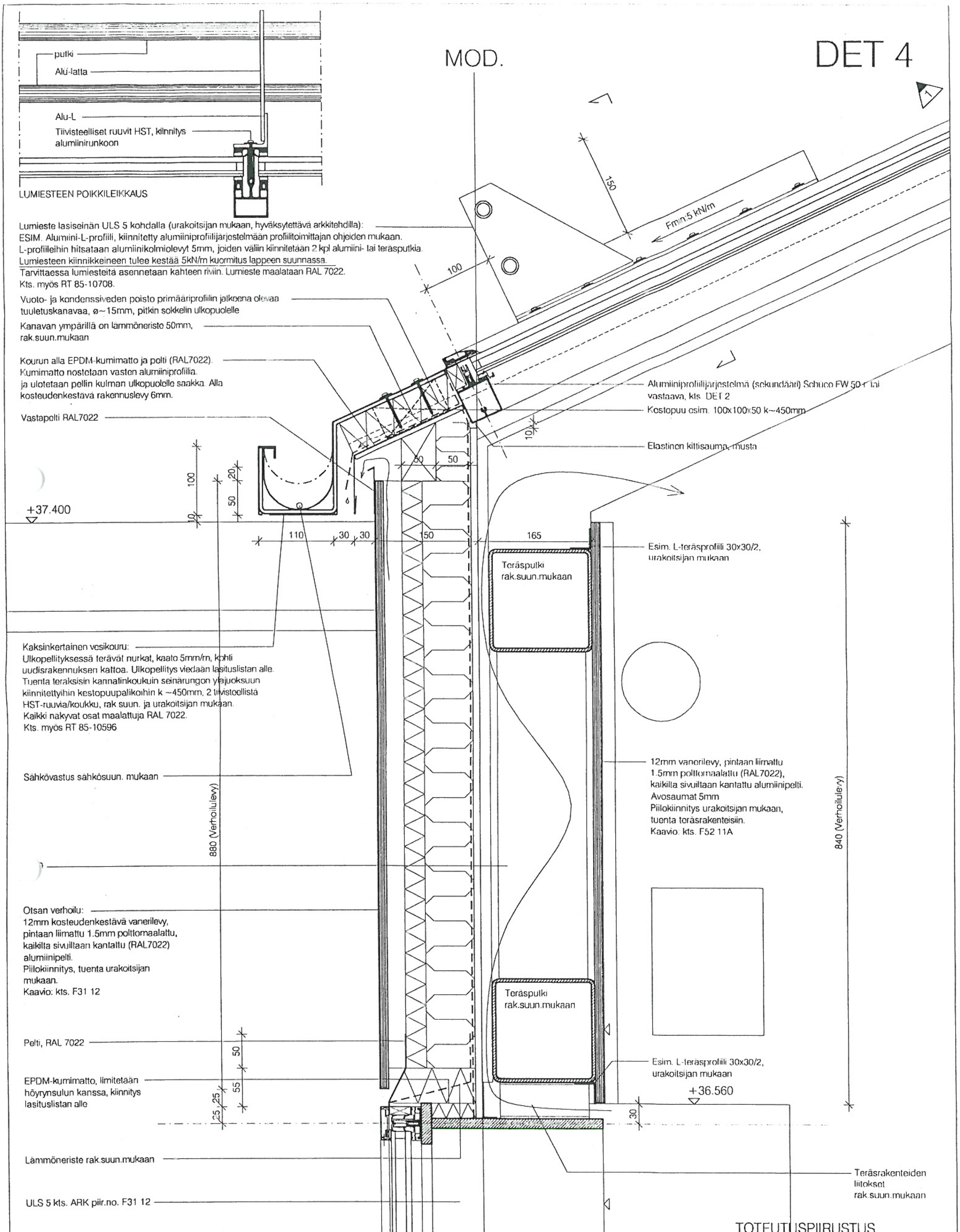

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