euro inox
The European Stainless Steel Development Association

Stainless Steel and Glass

Building Series, Vol. 13

Euro Inox

Euro Inox is the European market development association for stainless steel.
The members of Euro Inox include:

- European stainless steel producers
- National stainless steel development associations
- Development associations of the alloying element industries.

A prime objective of Euro Inox is to create awareness of the unique properties of stainless steels and to further their use in existing applications and in new markets. To assist this purpose, Euro Inox organises conferences and seminars, and issues guidance in printed form and electronic format, to enable architects, designers, specifiers, fabricators, and end users to become more familiar with the material. Euro Inox also supports technical and market research.

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Content

Introduction

When we look at the early iron-framed crystal 'palaces', arcades and station halls of the 19th century, and then at the high-tech steel and glass creations of today, it becomes clear just how much these two materials have influenced modern architecture – and vice versa. Technological progress, boosted by a desire for light, space and transparency, has given rise to new building forms. Glass as the building envelope is even taking on functions such as thermal and noise protection, and ever slimmer steel frames are fulfilling specifications regarded as unattainable until recently.

The examples presented in this brochure show the interplay of stainless steel and glass – two materials that are so different yet, because of their special characteristics, wonderfully complementary. In many applications for stainless steel, in particular when used as cladding, it is the diverse aesthetic qualities of the material that come to the fore and not just its corrosion resistance, longevity and ease of maintenance.

Frame elements and profiles in stainless steel are used to hold broad expanses of glazing in place in both interior and exterior applications. Depending on the size of the glass panes and the spans between supports, these elements can be designed with an extremely slim cross section. Further reduction of the metal parts of the frame can

Photos: Martina Helzel, Munich (left); Forster Profilsysteme, Arbon (bottom)

This covered glass entrance to an underground car park on the seafront at Barcelona is framed with slim stainless steel profiles that withstand the aggressive maritime climate.

Slim stainless steel profiles and excellent thermal-insulation properties are the distinguishing features of the post-and-rail façade of the Technology Centre in Steinach, Switzerland.

be achieved through the use of point-fixed glass. Here wind loads and dead load are directed to the building's frame via rigid or articulated point fixings that meet the very highest requirements in terms of corrosion resistance and longevity. Going one stage further, slim cable-tensioned systems featuring high-strength tie members in stainless steel open the way for spectacular façade and roof designs in which glass itself is used as a load-bearing material.

As yet, the more innovative applications for steel and glass still involve generally expensive testing procedures, in order to physically demonstrate the performance previously calculated on ever more powerful computers. Nevertheless, a number of systems now available do have general approval from the building authorities, e.g. for point-fixed façade constructions. However many of the present norms and standards are lagging behind current advances in technology, and there is often considerable variation between the different countries in Europe.

Despite these limitations, steel and glass are being used in combination in exciting and innovative ways, as demonstrated by the wide spectrum of examples presented in this brochure.

This bold, freeform grid shell of stainless steel mullions and insulating glass spans the inner courtyard of a bank in Berlin. The structure is braced by cables gathered together in cut stainless steel junction plates.

In this car showroom in Milan, the H-shaped four-point fixings of stainless steel transfer load from the surface of the 11-metre high all-glass façade.

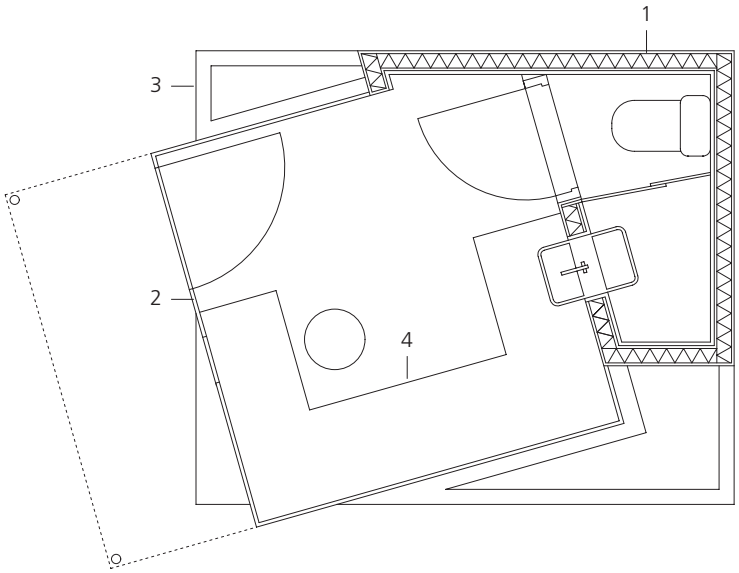
Photos: Roland Halbe/artur, Essen (top);
Frener & Reifer, Brixen (bottom)

The large, low-maintenance surfaces of tinted green glass and stainless steel emphasise the exciting shape of the bikehouse, created by simply offsetting two interpenetrating square volumes in relation to each other.

Gatehouse in The Hague, Netherlands

Client:
Stroom Den Haag
Design:
Andrea Blum, New York
Planning:
Heijmerink I Wagemakers bv, Nieuwegein

This tiny angular structure was built as part of a competition to design a 'bikehouse' for a cycle park at a shopping centre. Serving as a ticket office and shelter for the attendants, it is composed of two interpenetrating square blocks angled 20° towards each other. One section is entirely glazed with green glass, the other is clad with stainless steel sheet. On the outside this arrangement gives rise to two 'residual' geometrically shaped spaces which are used as planting tubs. A third space, in front of the ticket window, is left free for customers. Inside the bikehouse there is a work area, a kitchenette and a toilet.



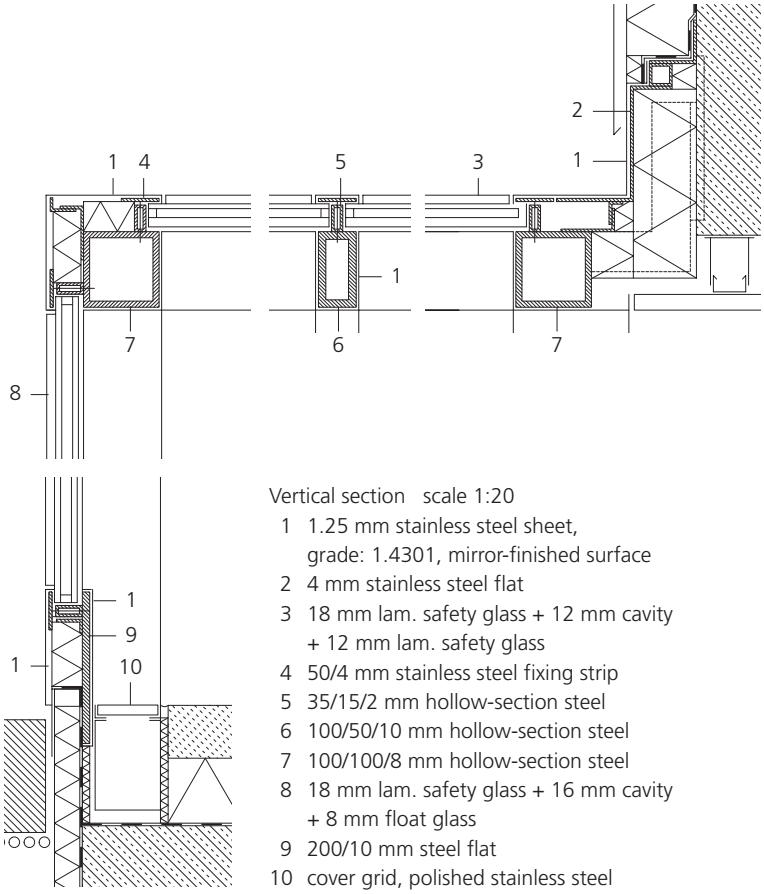
Floor plan scale 1:50
1 157 mm timber post-and-rail wall, cladding, 2 mm stainless steel, grade: 1.4401, polished finish (grit 320)
2 10 mm solar glazing, tinted green
3 plant tub, 100 mm concrete
4 cladding for built-in units, 1 and 1.5 mm stainless steel, grade: 1.4301, polished finish (grit 320)

Photos: Misha de Ridder, Amsterdam

Café in Berlin, Germany

Client:
Kunst-Werke in Berlin e.V.
Artist:
Dan Graham, New York
Architects:
Johanne Nalbach, Nalbach + Nalbach, Berlin
Structural engineers:
Strach & Riehn, Berlin

Located in the inner courtyard of a listed building complex, this café opens out to the space in the form of two fully glazed cubes set at an angle towards each other. The graduated laminated safety glass, with a layer of reflecting film on the outside, and the polished profile cover strips of stainless steel butt together on the outside to create a smooth, uninterrupted envelope. The reflecting surfaces ensure a constant interplay between inside and outside.



Vertical section scale 1:20

1 1.25 mm stainless steel sheet, grade: 1.4301, mirror-finished surface
2 4 mm stainless steel flat
3 18 mm lam. safety glass + 12 mm cavity + 12 mm lam. safety glass
4 50/4 mm stainless steel fixing strip
5 35/15/2 mm hollow-section steel
6 100/50/10 mm hollow-section steel
7 100/100/8 mm hollow-section steel
8 18 mm lam. safety glass + 16 mm cavity + 8 mm float glass
9 200/10 mm steel flat
10 cover grid, polished stainless steel

Photos: Martina Helzel, Munich

Matt-finished stainless steel surfaces and coloured glass, transparent and opaque, give a striking look to the design of the pavilion.

Pavilion in Zürich, Switzerland

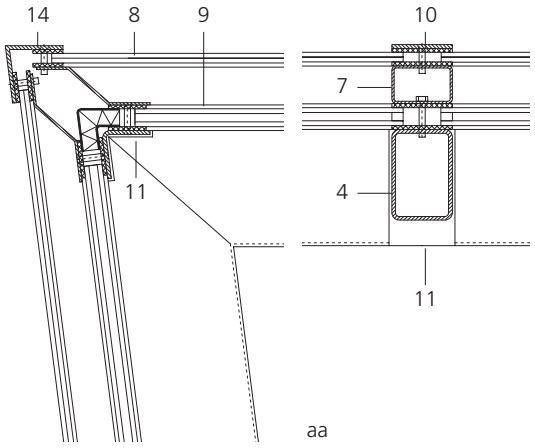
Client:
City of Zürich
Architects:
Andreas Fuhrimann & Gabrielle Hächler, Zürich
Structural engineers:
Bonomo engineer, Rüdlingen
mebatech AG, Baden

This new pavilion is located on a popular lakeside promenade at Riesbach. It enhances the public space and harmonises well with its setting in the historic park. Almost sculptural in ambition this polygonal-plan structure further confounds the observer with its unified treatment of façades – the hierarchy of front and back being largely eliminated.
Integrated into this light, quasi-transparent steel-framed building are a restaurant, with a summer terrace overlooking the lake, and public toilets at the rear. The loadbearing steel sections are clad in the interior and on the façade with matt stainless steel sheet. At night the illuminated pavilion glows mysteriously between the trees, inviting passers-by to come closer and investigate.

Photos: Andreas Fuhrimann/Gabrielle Hächler, Zürich

Broad expanses of glass and alternating colours create interesting rhythms and moods in the interior. The gentle, natural shades blend well with the park surroundings.

Sections scale 1:10
1 parapet cladding,
bent 3 mm stainless steel
2 180/100/10 mm hollow-section steel
3 80/80/8 mm support angle
4 façade post,
120/80/5 mm hollow-section steel
5 façade rail,
150/50/3 mm hollow-section steel
6 50/50/3 mm hollow-section steel
7 80/50/3 mm hollow-section steel
8 laminated safety glass
with coloured PVB foils
9 insulating glass
10 fixing strip,
50/5 mm stainless steel
11 cladding,
bent 1.25 mm stainless steel
12 150/50/3 mm steel section, bent
13 80/3 mm stainless steel
14 5 mm stainless steel, bent
15 30 mm polished terrazzo flooring
Stainless steel:
grade: 1.4301, bead-blasted finish



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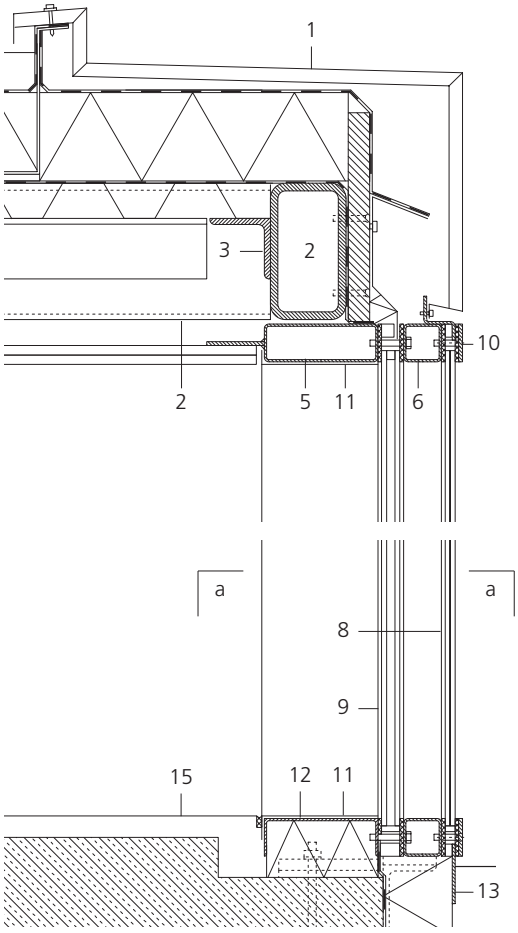
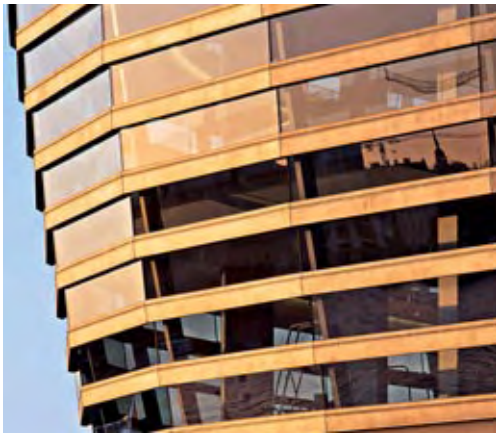


The large expanses of coloured glass set up a link between inside and outside, but give a brand new impression of the park landscape and lake.

Horizontal strips of stainless steel sheet pick out the rounded curves of the foyer façade.



Opera house in Copenhagen, Denmark

Client:
The A.P. Møller and Chastine Mc-Kinney Møller Foundation
Architects:
Henning Larsens Tegnestue Architects, Copenhagen
Structural engineers, foyer façade:
Waagner-Biro Stahlbau AG, Vienna

Copenhagen's eye-catching new opera house stands in a prominent position on a man-made island in the harbour and is instantly recognisable from all directions. At night a new dimension is added by the building's brightly lit foyer façade rising up above the water.

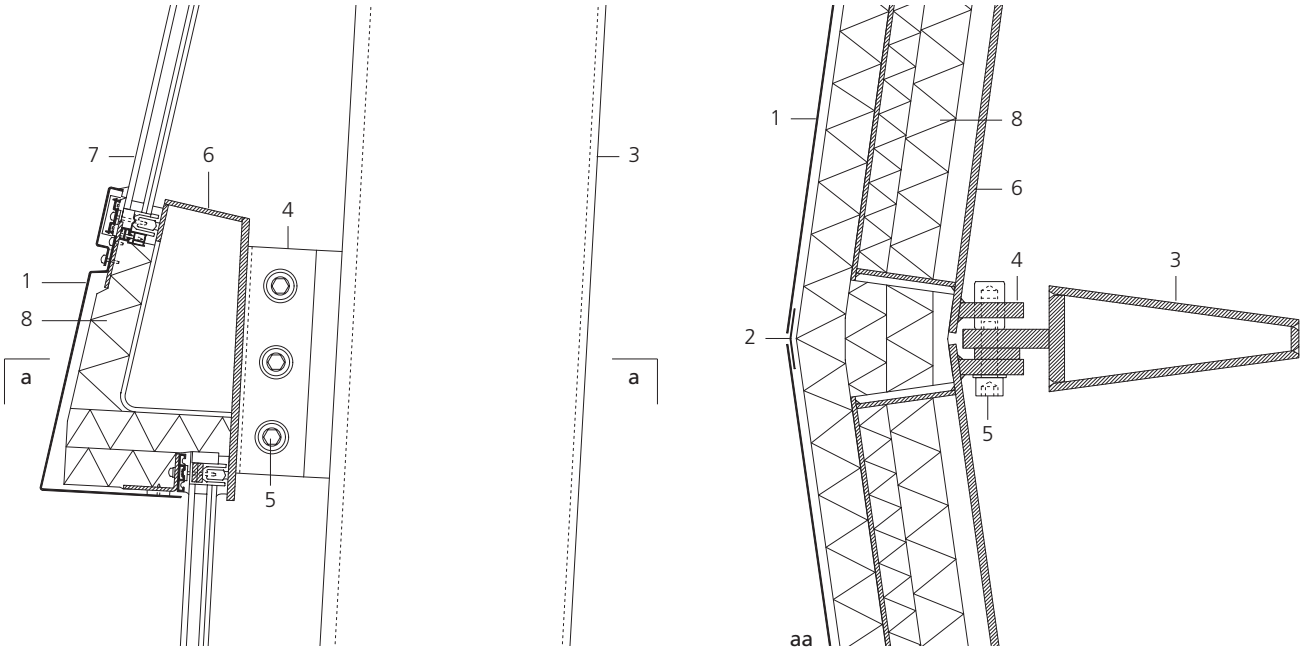
The materials used in the façades – sandstone, granite, metal and glass – set up a link with the immediate built environment. The distinctive roof over the opera house extends well beyond the horizontally articulated, double-curved glass façade of the foyer. Horizontal steel profiles, running in front of the curved façade columns, take up horizontal forces. Stainless steel sheet cladding is used on this façade, wrapped around the foyer like shining hoops along a length of 110 m.

The new opera house stands on a man-made island, concluding the historical axis that runs from Amalienborg Castle.

Photos: Adam Mørk, Copenhagen

The horizontal beams on the glass façade frame a view of ships entering the harbour.

Photos: Adam Mørk, Copenhagen (top); Waagner-Biro Stahlbau AG, Vienna (bottom)



Sections scale 1:10

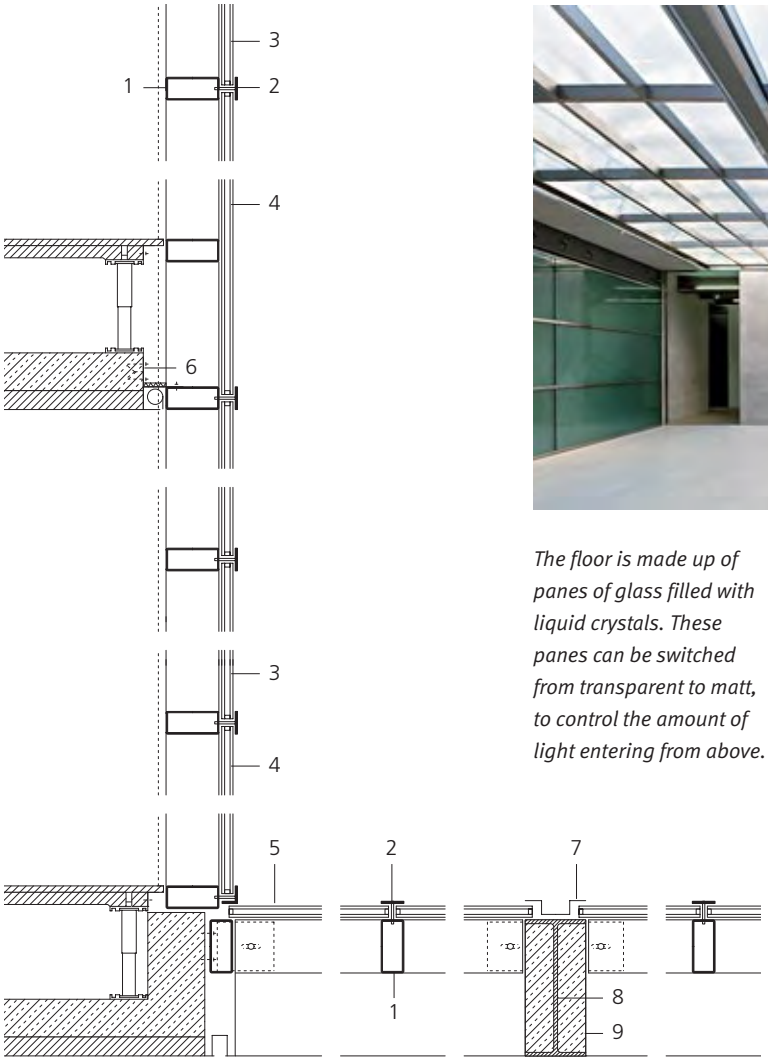
1 2 mm stainless steel, grade: 1.4435
2 50/50/1 mm stainless steel sheet, grade: 1.4435
3 140/330 mm steel column, welded from 10-20 mm steel flats
4 connection between horizontal section and column via 15-25 mm steel flats
5 M20 bolt connection
6 steel section welded from 6–10 mm steel flats
7 insulating glass, 8 mm + 16 mm cavity + 2x 6 mm
8 insulation

Bank building in Vienna, Austria

Client:
Schoellerbank AG, Vienna
Architects:
Jabornegg & Pálffy, Vienna
Structural engineer:
Karlheinz Wagner, Vienna

Hidden behind the façade of this former Rothschild town palace is a surprisingly spacious light-filled interior. The requirements of modern use were met through an extensive renovation programme which involved stripping out entire sections and refurbishing others. Sections deemed to be of historic value remained intact. The roof over the inner courtyard is a pressurised air-cushion construction, supported on graceful arches of stainless steel. Daylight can penetrate through the glass floor inserted above the ground-floor entrance hall. The degree of light-penetration through this floor is separately controlled.

The inner courtyard has a slim post-and-rail façade of stainless steel profiles and insulating glass. The glass balustrades are matt finished.



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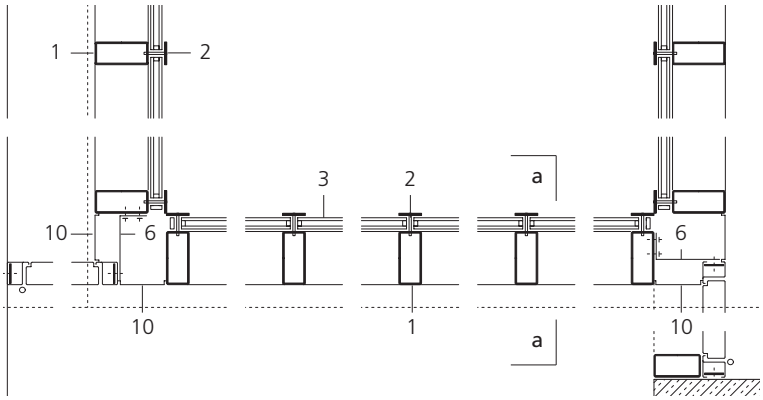
The floor is made up of panes of glass filled with liquid crystals. These panes can be switched from transparent to matt, to control the amount of light entering from above.

Sections scale 1:20

1 140/60/4 mm hollow-section stainless steel
2 60/6 mm fixing strip, stainless steel
3 insulating glass, 2x 8 mm + 16 mm cavity
4 G30 glass around balustrade
5 G30 insulating glass above main hall, LC glass with controls for adjusting lighting levels, laminated safety glass: 3x 6 mm toughened safety glass + 16 mm cavity + 12 mm toughened safety glass
6 2 mm stainless steel sheet, bent
7 gutter, 2 mm stainless steel sheet
8 360/160 mm steel girder
9 cladding, 1.5 mm stainless steel sheet
10 panel covering, 1.5 mm stainless steel

Stainless steel: grade: 1.4301, polished finish (grit 320)



Photos: Werner Kaligofsky, Vienna

Photos: Glas Trösch AG, Bützberg

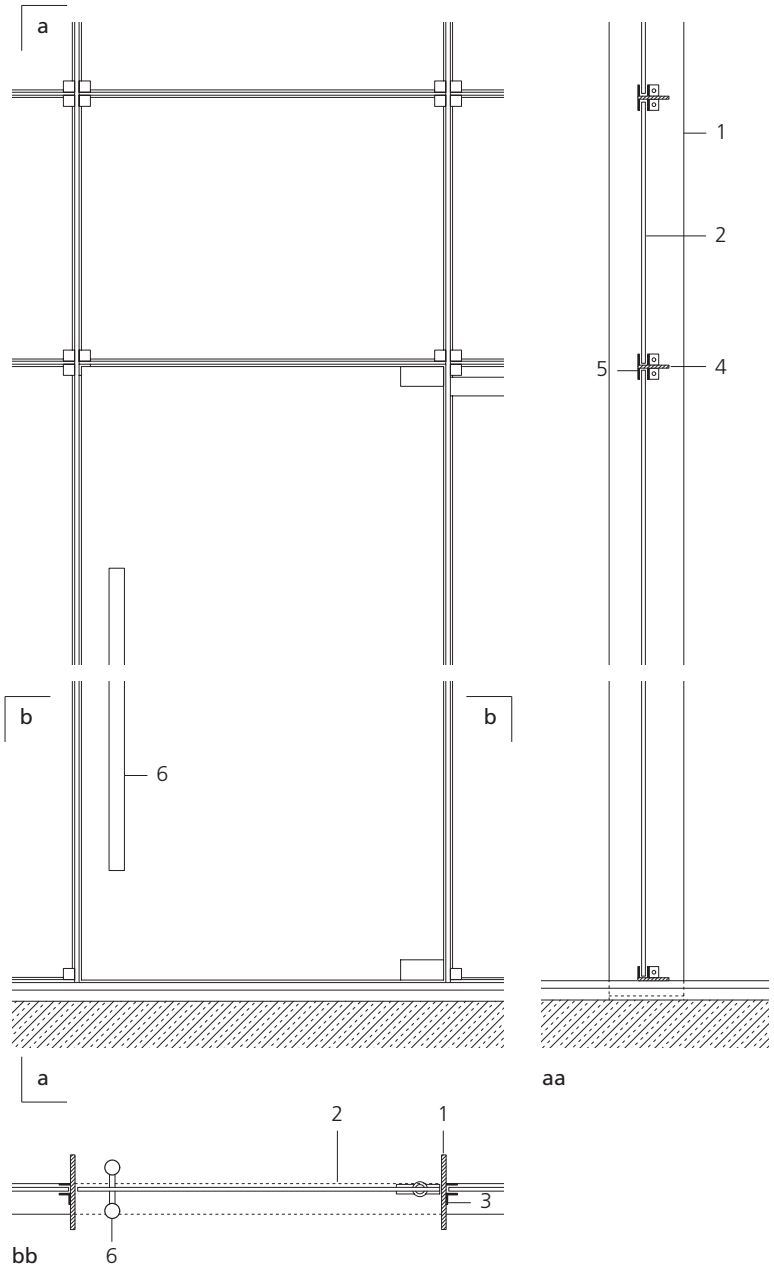
The high glass wall between the restaurant and the 'wine room' is framed with slim profiles of stainless steel.

Hotel restaurant in Zürich, Switzerland

Client:
Hyatt International, Zürich
Architects:
Andreas Ramseier & Associates Ltd., Zürich

From the outside this five-star hotel in Zürich is pure Swiss rationalism but inside the atmosphere is one of luxury and tradition. Passing through the main doors, the guest enters a double-height central hall before reaching the reception desk. Grouped around this foyer are a ballroom, conference rooms, bar and the 'Parkhuus' restaurant. With its high ceiling and wall of glass and polished stainless steel, the restaurant has an appropriately exclusive, urban feel. Carefully worked details with sharp-edged profiles and generous expanses of glass in this two-storey wall underline the overall sense of quality.

Stainless steel fittings shimmer amidst generous expanses of glass and warm wood tones.

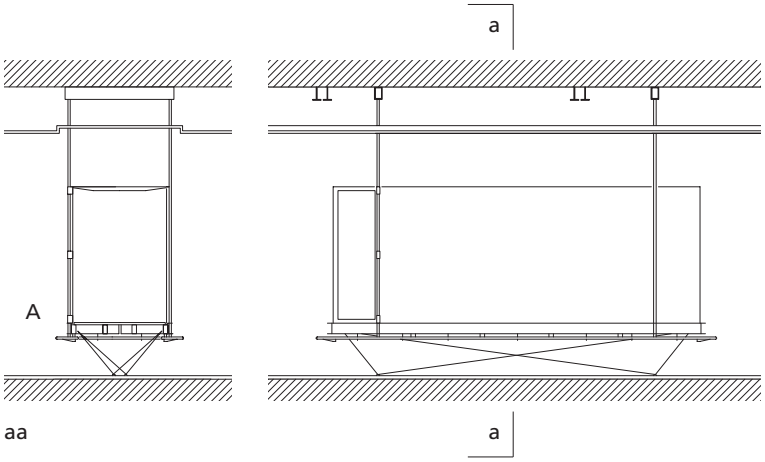


The wines are stored in specially designed shelving reaching the full height of the space.

Sections scale 1:20

1 200/12 mm stainless steel flat, grade: 1.4301
2 glazing, 8 mm toughened safety glass
3 glass retaining angle, 40/40 mm stainless steel, grade: 1.4301
4 8 mm stainless steel flat, grade: 1.4301
5 bracket, 40/40 mm stainless steel, grade: 1.4301
6 push handle, stainless steel, Ø 40 mm, grade: 1.4301

The clear lines of the interior fittings form a counterpart to the 19th-century architecture.



Elevation · Cross section
scale 1:100

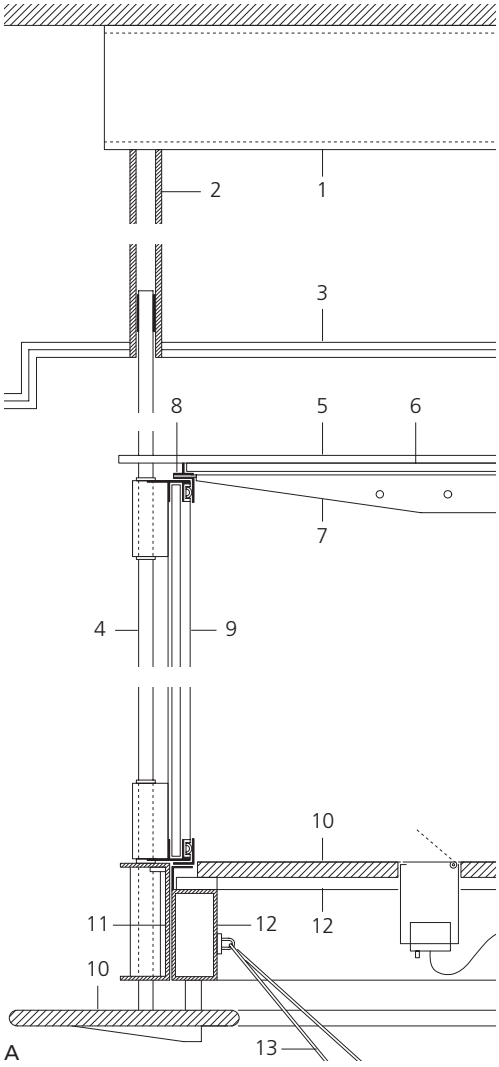
Museum in Paris, France

Client:
ÉMOC, Paris
Architects:
Bernard Desmoulin, Paris
Design of showcases:
Laboratorio Museotecnico Goppion, Milan

The Musée des Arts Décoratifs, fronting onto Rue de Rivoli, is in a wing of the Palais du Louvre that has been dedicated to the decorative arts since 1898. After an extensive period of renovation the museum now meets all the requirements of a modern exhibition landscape. The rooms, designed by Desmoulin, comprise a gallery of toys, a two-floor study gallery and the Espace Dubuffet, housing a donated collection of 160 sculptures and drawings. Glass showcases suspended from the ceilings divide the rooms into separate galleries.

Photos: Sébastien Andreï, Tours

The different showcases are all made of broad expanses of glass and slim, stainless steel profiles.



Sectional detail scale 1:10

1 100/100/10 mm hollow-section steel
2 Ø 50 mm steel tube with internal thread
3 suspended ceiling
4 suspension rod, Ø 20/4 mm stainless steel
5 50/10 mm stainless steel flat
6 glazing, 12 mm laminated safety glass, burglar-resistant
7 support, 40/4 mm stainless steel
8 bracket 30/30/4 mm stainless steel
9 opening pane, lockable
10 1 mm stainless steel on backing board
11 edge profile, 155/68/4 mm stainless steel
12 120/60/2 mm hollow-section steel
13 tensioning, Ø 2 mm stainless steel cables

Stainless steel: grade: 1.4307

Some exhibits are displayed in long glass cases along the walls.

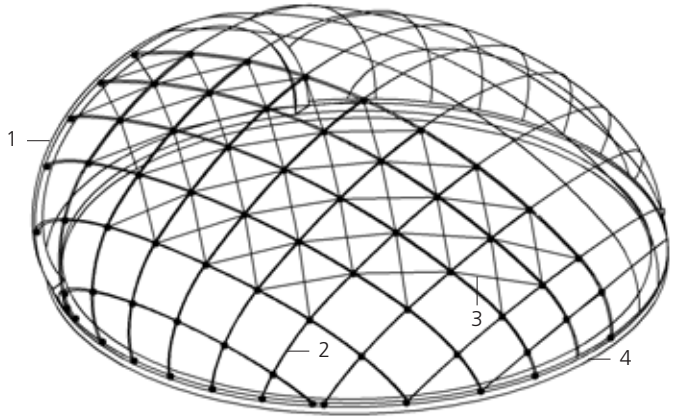
The simple, minimalist design of the showcases further emphasises the richness of the collections.

Photos: Didier Boy de la Tour, Paris

Metro station in Paris, France

Client:
RATP, Paris
Architects:
Arte Charpentier, Paris
Structural engineers:
RFR, Paris

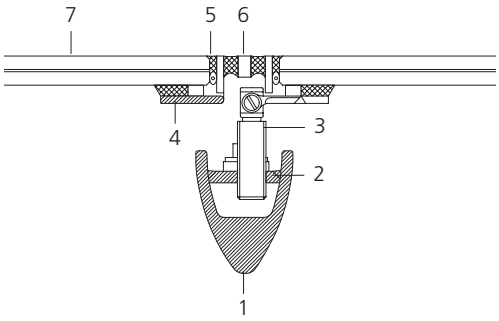
By extending the Météor metro line through to Saint-Lazare station, the public transport authorities in Paris improved connections on this busy route. The only above-ground indication of the new station is the roof over the entrance, a lens-shaped, steel-and-glass structure rising out of the ground in front of the historic station façade.
The frame for this lens structure is based on an orthogonal grid. Because of the high structural loading, stainless steel profiles were preferred as they permitted a much slimmer cross section than the circular hollow-section steel originally envisaged.



Isometric projection of the support frame
1 gateway arch
2 load-bearing profile
3 bracing
4 ring girder

The glass dome in front of Saint-Lazare station in Paris marks the entrance to the new station on Metro line 14. At night curved gates of metal mesh slide across the opening, completing the convex form.

The slimly dimensioned load-bearing frame and the ultra-white glass impinge only minimally on the view of the old station façade.



Horizontal section scale 1:5

1 extruded load-bearing section, stainless steel, grade: 1.4404
2 strap for glass fixings
3 joint to accommodate tolerances, stainless steel, grade: 1.4404
4 frame, 40/6 mm stainless steel sheet, grade: 1.4404, welded and curved, ground finish (grit 220)
5 silicon sealing profile
6 extruded silicon sealing profile
7 10/10/2 mm glass, ultra-white

The curved profiles with pointed-arch cross-section are fixed to a perimeter ring girder and welded to cast components in the junctions.

The glass skin is composed of 108 doubly-curved panes of glass. In the upper part of the roof, the panes are almost rectangular, but the angles shift the closer the panes are to the edge. Each pane is attached by means of 16 articulated point fixings which are covered by the support profiles. To achieve maximum transparency the architects used ultra-white glass which allows light to penetrate undistorted down into the concourse below.

Emperor Charles VI began to turn this mediaeval monastery into a Baroque summer residence.

Museum in Stift Klosterneuburg, Austria

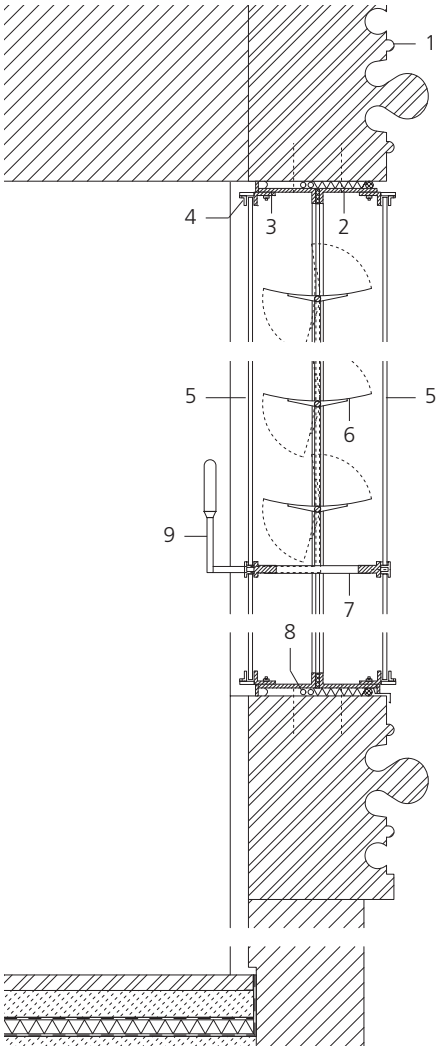
Client:
Stift Klosterneuburg
Architect:
Georg Driendl, Vienna
Structural engineers:
Bernard Ingenieure, Vienna

An 18th-century undertaking to turn the monastery at Klosterneuburg near Vienna into a summer residence was not completed. Recently part of the 1000-year-old complex was converted again, into a contemporary museum for the monastery, which has a valuable art collection and wine cellars. The existing fabric – including the unfinished measures – in combination with the new plays a large part in the charm of the exhibition rooms. The only new additions were the units necessary for displaying the exhibits. Steel and glass are used as a complementary counterpart to the Baroque interior.

The 'Sala Terrena', or garden hall, now serves as the museum entrance. The six-metre high window openings were stripped back and new windows inserted to bring as much natural light as possible into the vaulted hall. Prefabricated window frames of burnished stainless steel now sit in the stone alcoves, with stainless steel louvres sandwiched between the panes of glass. The highly polished louvres can be operated mechanically to deflect light to the back of the space.

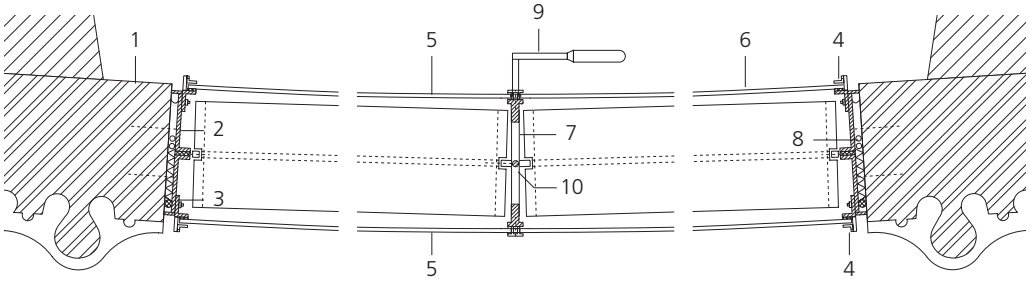
Photos: Roland Krauss, Vienna (top left); Lew Rodin, Moscow

In a more recent conversion, light was maximised in the interior by using highly polished stainless steel louvres sandwiched between the double glazing of the tall arched windows.



Sections through window scale 1:20
1 stone arch (existing)
2 thermal-break frame, 2x 150/40/10 mm, stainless steel angle profiles, burnished finish
3 55/35/8 mm stainless steel angle profile
4 26/18/5 mm stainless steel fixing angle
5 10 mm toughened safety glass, curved
6 light-deflecting louvre, 0.75 mm stainless steel, polished finish
7 3/10 mm stainless steel spacer
8 component heating
9 handle, Ø 30 mm stainless steel
10 centre rail, Ø 10 mm stainless steel
Stainless steel: grade: 1.4948

Prefabricated window assemblies with frames of burnished stainless steel and louvres of highly reflective stainless steel were inserted into the existing window openings.



The façade of the new extension to the university sets up a distinct contrast to the surrounding buildings.

University in Paris, France

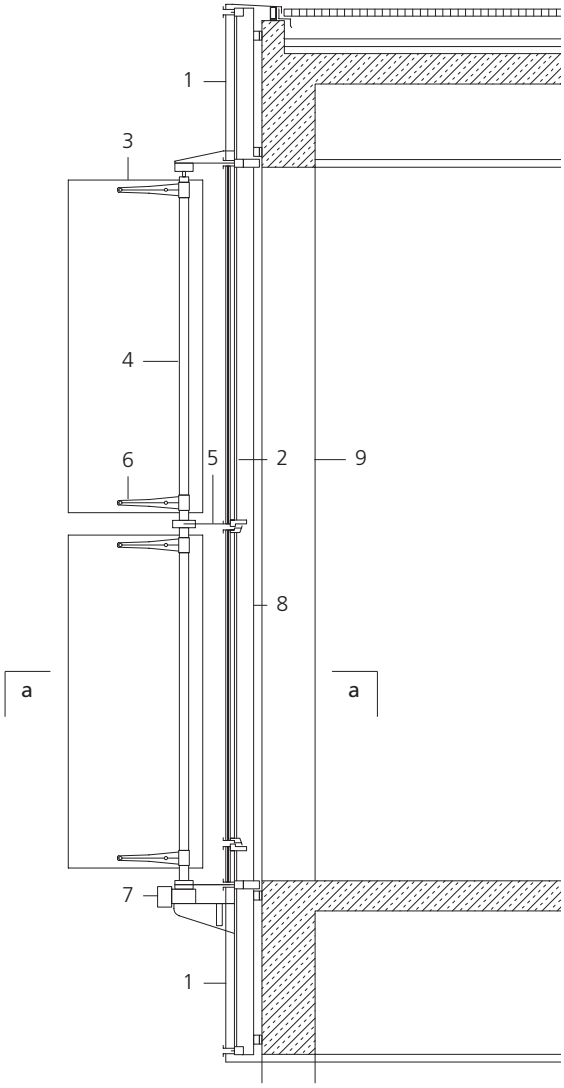
Client:
Région Ile de la France,
represented by S.A.E.R.P., Paris
Architect:
Philippe Gazeau, Paris
Structural engineers:
Projetud, Paris

In order to meet rising space needs at the élite state university near the Panthéon, an existing 1950s wing was demolished and a new building erected in its place to accommodate the institution's important library. The new structure is skilfully blended into the ensemble on the narrow plot. Its outline tapers towards the top – the three upper floors with student apartments are set back from the façade and therefore barely visible from the street.

On the outside, the dominant materials are exposed concrete, steel and glass, setting up a deliberate contrast to the neighbouring buildings. Vertical, adjustable glass louvres give a high-tech feel to the façade as does the perforated stainless steel sheet sandwiched in the laminated safety glass. Because of the very fine perforations in the sheet, the louvres shift in impression from reflecting to transparent as the angle of light changes.

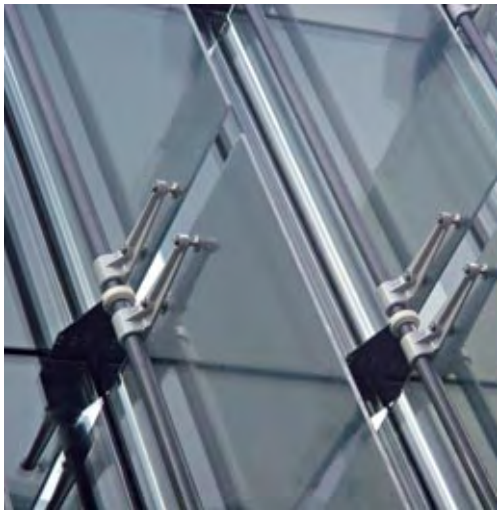
Depending on how the light falls, the contours of the fragile-looking glass louvres seem to disappear and blur the lines of the façade.

Photos:
Luc Boegly, Paris (top);
Glaverbel, Saint Priest (bottom)

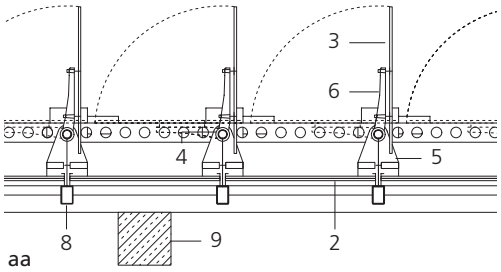


Sections scale 1:50

1 glazing, float glass
2 adhesion-fixed all-glass façade with insulating glass
3 solar-shading sandwich panel, EVA foil and 0.6 mm perforated stainless steel sheet (grade: 1.4016) sandwiched between 2x 8 mm toughened safety glass, Ø 2.5 mm perforations
4 rotating axis, Ø 60 mm steel tube, divided in two
5 painted steel sheet, to hold the steel tube, welded to façade profiles
6 cantilever arm, cast aluminium
7 electric motor for operating the solar shading
8 120/80 mm hollow-section steel
9 concrete column



The electrically operated shading louvres can turn through 90° along their vertical axis. Cantilever arms of cast aluminium support the 150 kg glazing units.



Light is filtered through the perforated stainless steel sheet between the panes of glass.

Photos: Glaverbel, Saint Priest

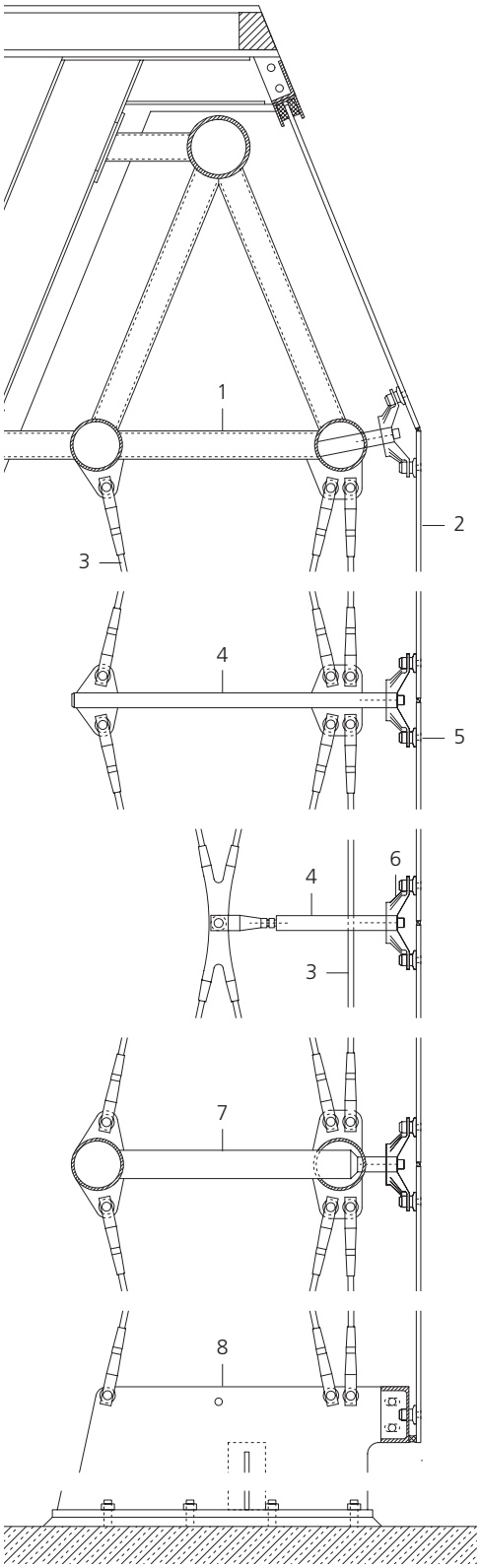
This glazed atrium is part of a new four-storey building at the famous public school for girls, Cheltenham Ladies' College. Adjacent to an existing Victorian block, it accommodates a staircase and serves as a light-filled foyer. The primary support structure for the glass façade is a space frame at roof level and a horizontal Vierendeel girder, connected at half height with the paired corner columns and the frame of the new block. Between these members is a tensile structure of diagonally braced, 16 mm thick stainless steel bars. Four-point connectors of cast stainless steel, fixed to horizontal compression bars, support the panes of glass ranging in size up to 1.5 x 2 m.

College extension in Cheltenham, England

Client:
Cheltenham Ladies' College
Architects:
Oxford Architects Partnership, Bristol
Structural engineers:
Whitbybird, Bristol

A tensile system of stainless steel bars supports the glass façade, which is attached to the structural frame via cast four-point connectors.

The transparent steel and glass atrium opens up a view of the older adjacent façades.



Photos: Jerry Moiran, Studio Edmark, Oxford

At night the four-storey glazed atrium is transformed into a beacon of light.

Section through façade frame scale 1:20

1 space-frame girder,
top chord, Ø 168.3/10.0 mm
circular hollow-section steel
bottom chords, Ø 139.7/6.3 mm
circular hollow-section steel
diagonals, Ø 76.1/5.0 mm
circular hollow-section steel
2 12 mm toughened safety glass
3 tie bar, Ø 16 mm stainless steel,
grade: 1.4401
4 compression bar,
Ø 40 mm stainless steel
5 glass fixing, stainless steel
6 cross-shaped four-point connector,
cast stainless steel, grade: 1.4401
7 horizontal Vierendeel girder,
chords, Ø 139.7/8.0 mm circular
hollow-section steel
rails, Ø 76.1 mm steel bar
8 12 mm steel sheet

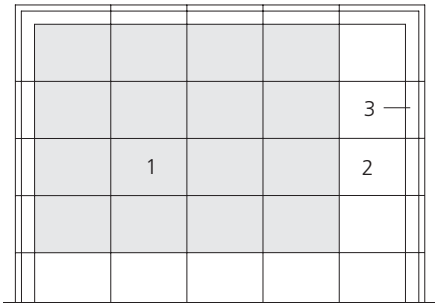
Café in Vienna, Austria

Client:
Siemens AG Austria, Vienna
Architects:
LindnerArchitektur ZT GmbH, Baden
Structural engineers:
gmeiner haferl, Vienna

The café on the Siemens' Erdberg site in Vienna looks from the outside like a giant shop window that gradually changes colour like a chameleon. The high-tech glass in this façade, the biggest public projection screen in the city, is used for showing films, video art and even for surfing on the Internet. Designed as a cafeteria for employees and company visitors, the two-floor building is also used for events and presentations. The glazing fixtures and support frame for the façade had be kept as slim as possible to give maximum impact to the projected images.

Four video beamers inside project images onto the coated insulating glass on the façade.

The media façade of projection glass is held in place by a tensile net of stainless steel cables.

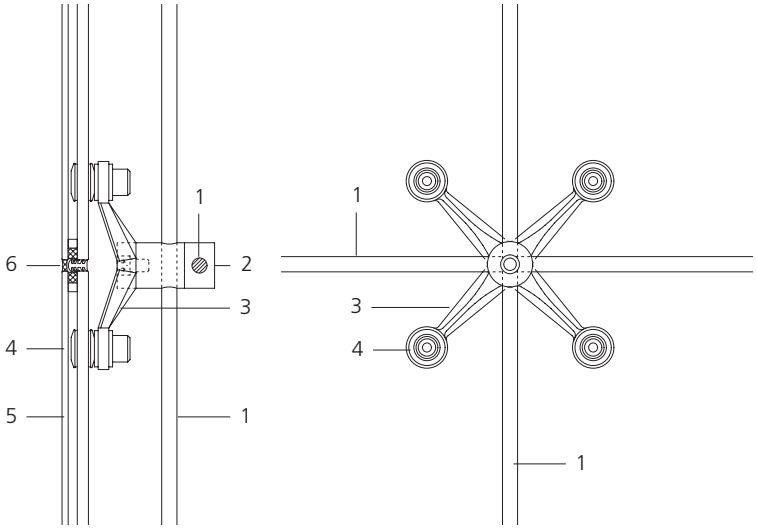


Elevation scale 1:200
1 glass with projection coating
2 transparent glass
3 glass with enamel coating

Photos: LindnerArchitektur, Baden

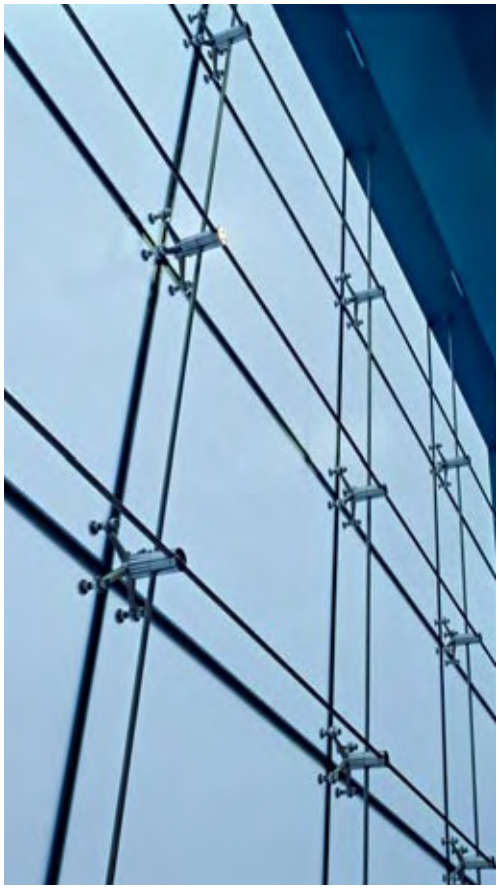
The solution lay in a pretensioned cable-stayed façade set out on an orthogonal grid. In-plane point holders support the 25 glass panes, each roughly 2 x 1.50 m in size. The point holders are fixed to four-point connectors. The insulating glass has excellent thermal-break properties thanks to the mechanical fixing of the inner pane without a connection through to the outer pane. In order not to exceed the permissible deformation of the façade and the individual panes, high pretensioniong loads were applied to the cables; these are taken up by the steel perimeter frame and the cellar foundations.

The cables, four-point connectors and point holders are made of stainless steel.



Section · Elevation scale 1:5

1 pre-tensioned cable, Ø 20 mm stainless steel, grade: 1.4404
2 cylinder, Ø 60 mm stainless steel, grade: 1.4404
3 cross-shaped four-point connector, stainless steel, grade: 1.4404
4 stainless steel fixing, grade: 1.4404
5 insulating glass,
8 mm toughened safety glass, 15 mm cavity,
2x 6 mm laminated safety glass
6 black silicone seal



Bank building in Lodi, Italy

Client:
Banca Popolare di Lodi
Architects:
Renzo Piano Building Workshop, Genoa
Structural engineers:
Studio Tecnico M.S.C., Milan

One of northern Italy's largest banks has its head office on this shared site in Lodi. The complex consists of four cylindrical towers and a linear block arranged around a central glass-covered public space. A net of 38 cables, spreading out from the tallest tower to the adjacent façades, supports the almost flat glass canopy. Tension cables under the glass secure the canopy against wind suction.

The glass canopy is made up of panes of printed laminated safety glass in 264 different dimensions. Groups of four panes are joined together at the angled corners by means of special glass fixings. Sealing profiles between the panes accommodate any expansion movement. Horizontal steel flats above the glass space the stainless steel suspenders and brace the whole construction.

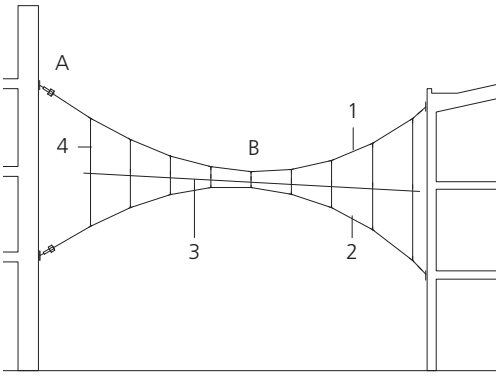
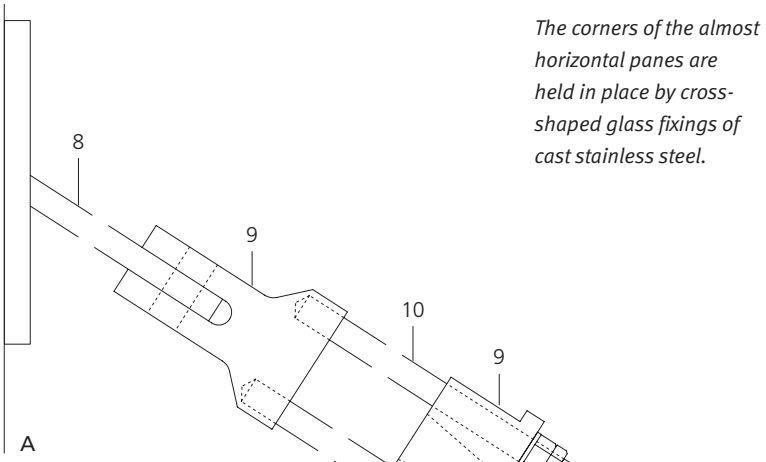


Diagram of load-bearing system
1 suspension cable
2 cable stays
3 glass plane
4 suspenders

Photos: Enrico Cano, Milan

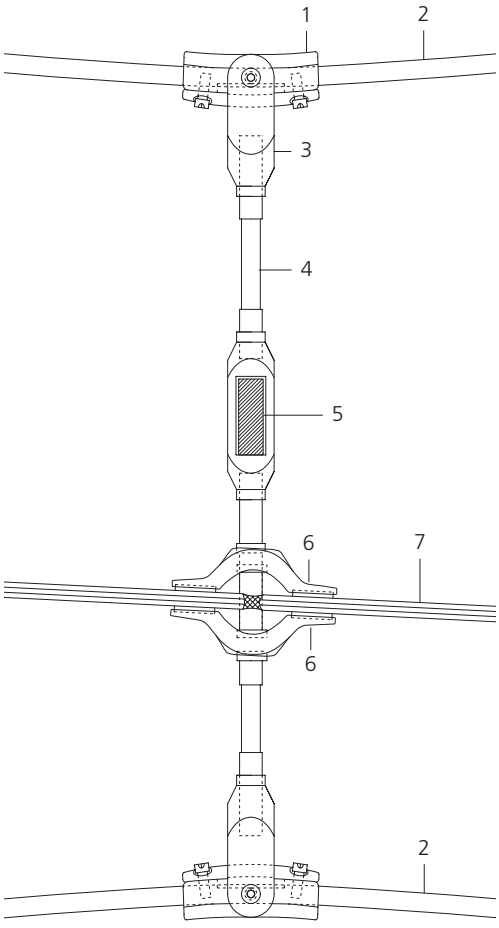
The suspension cables and cable stays are sheathed in stainless steel.



The corners of the almost horizontal panes are held in place by cross-shaped glass fixings of cast stainless steel.

Glass suspension system scale 1:10

1 2-part cable clamp
2 Ø 35 mm steel cable, sheathed with stainless steel, grade: 1.4401
3 U-shaped steel bracket
4 suspender, Ø 25 mm steel bar
5 100/30 mm steel flat, horizontal bracing
6 cross-shaped glass fixing, stainless steel, grade: 1.4404, on neoprene layer
7 20 mm laminated safety glass, printed, inclined at 5°
8 anchor plate, 38 mm steel flat
9 cable anchor, steel pipe fitting
10 M39 threaded bar



B

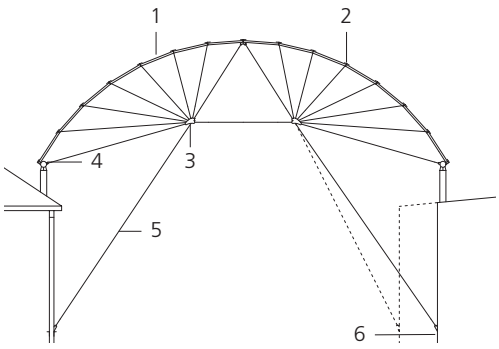
Museum in Augsburg, Germany

Client:
City of Augsburg, Municipal Buildings Dept.
Architects:
City of Augsburg, Municipal Buildings Dept.
Structural engineers:
Seele GmbH & Co.KG, Gersthofen
and Ludwig & Weiler, Augsburg

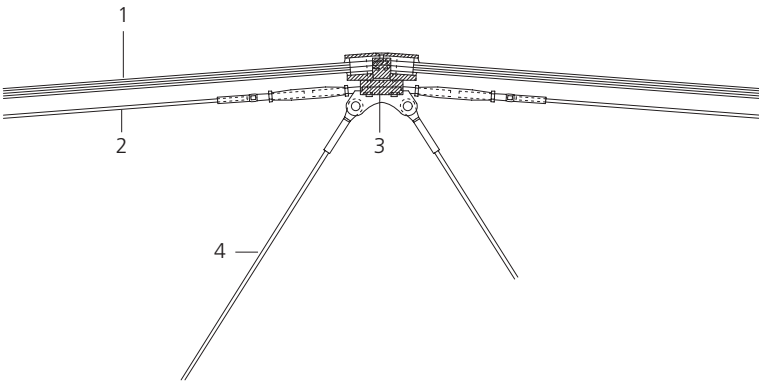
A lightweight, self-supporting glass roof enabled the respectful treatment of the historic building substance.

The museum housing the art collections of the City of Augsburg spans a variety of patrician houses built during the Renaissance period. As part of a refurbishment programme the inner courtyard around which the buildings are grouped was covered over, thus providing additional sheltered space for exhibitions. The light tensile glass roof, measuring 37 x 14 m, seems to float above the historic building structure. Its barrel shape is indicated only by the frame of tubular steel supporting the all-glass shell. This frame in turn rests on slim supporting members adapted to the different situations found at each bearing point.

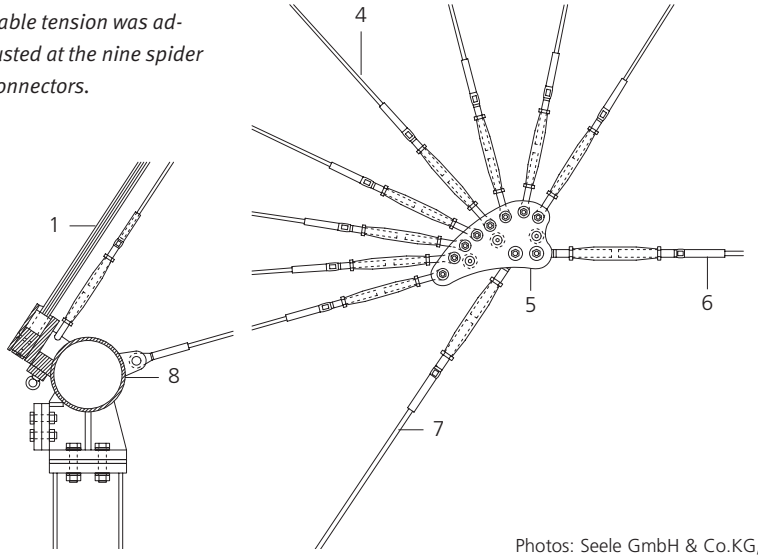
Because the barrel-vault of the shell load-bearing structure curves in only one direction, it was possible to reduce costs by using a single-sized pane format. A tensioned cable net on two levels ensures the stability and load-bearing capacity of the glass even under snow load and when panes break. Parallel to the glass skin, the steel shoes of



Cross section scale 1:250
1 diagonal cable stays below the glass
2 cable clamping plates
3 spider connector
4 bearing point of tubular steel frame
5 cable guy
6 outer edge of masonry wall



Cable tension was adjusted at the nine spider connectors.

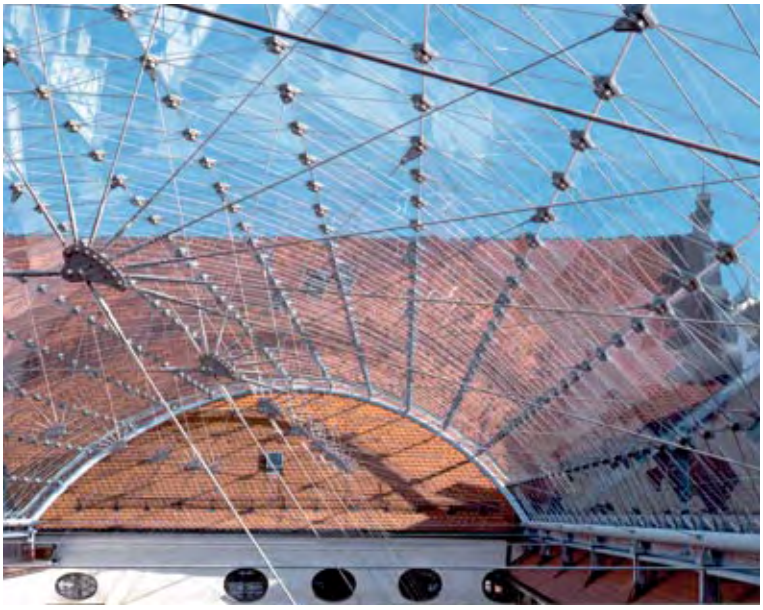


Section scale 1:20

1 glass: 1.52 mm PVB foil sandwiched between 2x 12 mm heat-strengthened glass, pane size 1170/960 mm
2 diagonal cable stays, Ø 8 mm stainless steel, grade: 1.4401
3 cable clamping plate, stainless steel, grade: 1.4301
4 tensioning cable, Ø 10 mm stainless steel, grade: 1.4401
5 spider connector, stainless steel, grade: 1.4301
6 Ø 12 mm tie cable, stainless steel, grade: 1.4401
7 tensioning cable, Ø 12 mm stainless steel, grade: 1.4401
8 Ø 197.3/8.8 mm tubular steel frame

Photos: Seele GmbH & Co.KG, Gersthofen

the panes are connected into a network via central nodes with clamping plates. The specially developed junctions serve on the one hand to guide the spiral cables and on the other, in conjunction with the laminated safety glass, for transferring compression loads. All the spider fittings, cable clamping plates and cable stays are made of stainless steel.



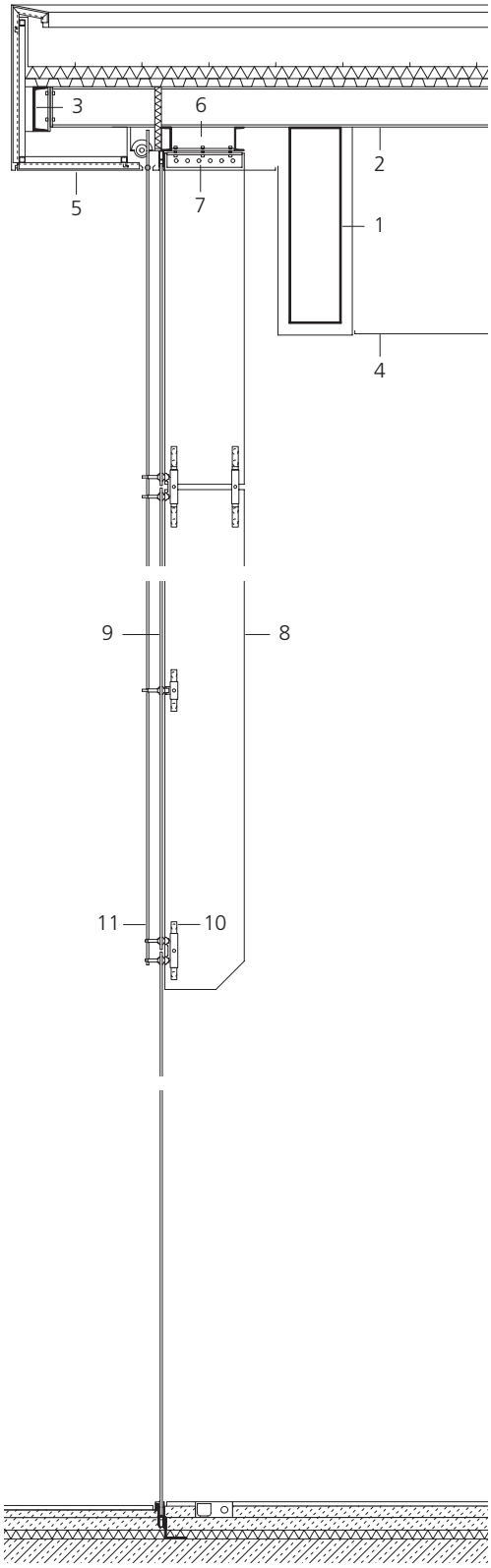
Showroom in Milan, Italy

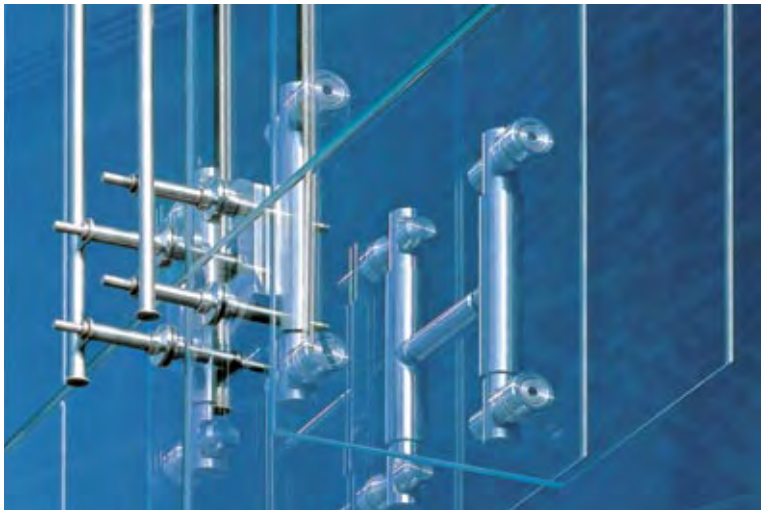
Client:
BMW Italia Leasing S.p.A., Client
Architects:
Kenzo Tange Associates, Tokyo/Paris/N.Y.
Structural engineers, glass façade:
Frener & Reifer, Brixen

This car manufacturer's showroom, adjacent to the company's eight-storey headquarters, has an impressive, eleven-metre-high all-glass façade. The individual panes, held in place by point fixings, are supported on vertical glass fins suspended from the roof and ending 3.50 m above the floor. For this project a frameless glazing system was adapted to the requirements of the design, a process which involved producing 20 new connection components. The fixings, which hold the ultra-white panes of glass, are made of stainless steel. They ensure uninterrupted load transfer from the glass panes, compensate for differential movement between the floor and the roof and provide a profile-free corner solution.

The use of stainless steel and glass in this building underlines the engineering expertise of the company behind it.

Photo: Pilkington Germany AG, Gladbeck





Photos: Frener & Reifer, Brixen

The glass panes in the façade are suspended on glass fins descending from above and held in place by point fixings of stainless steel.

Section of façade scale 1:50

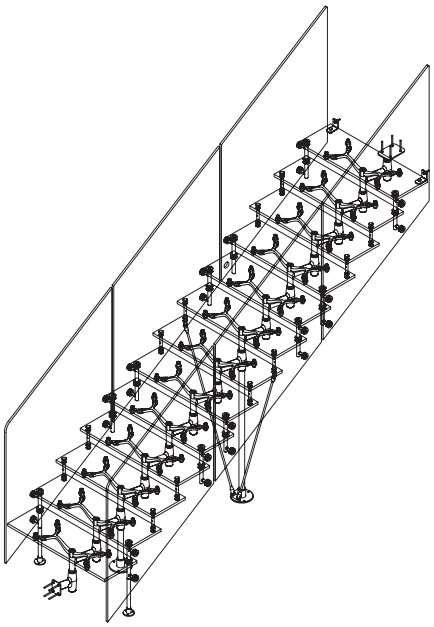
1 girder, 1320/350/10 mm hollow-section steel, welded
2 roof girder, IPE 270 steel section
3 edge girder, U 300 steel channel section
4 interior cladding, 2 mm aluminium sheet
5 exterior cladding, 3 mm aluminium sheet
6 bracket for glass fin, 2x U 160 steel channel sections and 1/2 IPE 330
7 2x 100/75/11 mm steel angle profile
8 glass fin, 12 mm float glass, ultra white
9 façade pane, 12 mm float glass, ultra white
10 glass fixing, stainless steel, grade: 1.4401
11 guide rail for sun screen, Ø 15 mm stainless steel bar

External sun screens run on special rails of stainless steel attached to the point fixings.

Staircase in an exhibition room in Bologna, Italy

Design and construction:
Faraone, Tortoreto

Both support frame and railings of this straight staircase are made of polished stainless steel (grade: 1.4301). Branching off either side of the step-like central carriage are cantilevered arms which divide to provide two support points. Each glass tread is thus supported on four point fixings.



Depending on the required length or the particular position, this flexible staircase system can be supported on a centre carriage, as shown here, or a side carriage, for fixing to a wall.

Photos: Faraone, Tortoreto

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The European Stainless Steel Development Association

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