

MODERN CONSTRUCTION CASE STUDIES

Emerging Innovation in Building Techniques

ANDREW WATTS



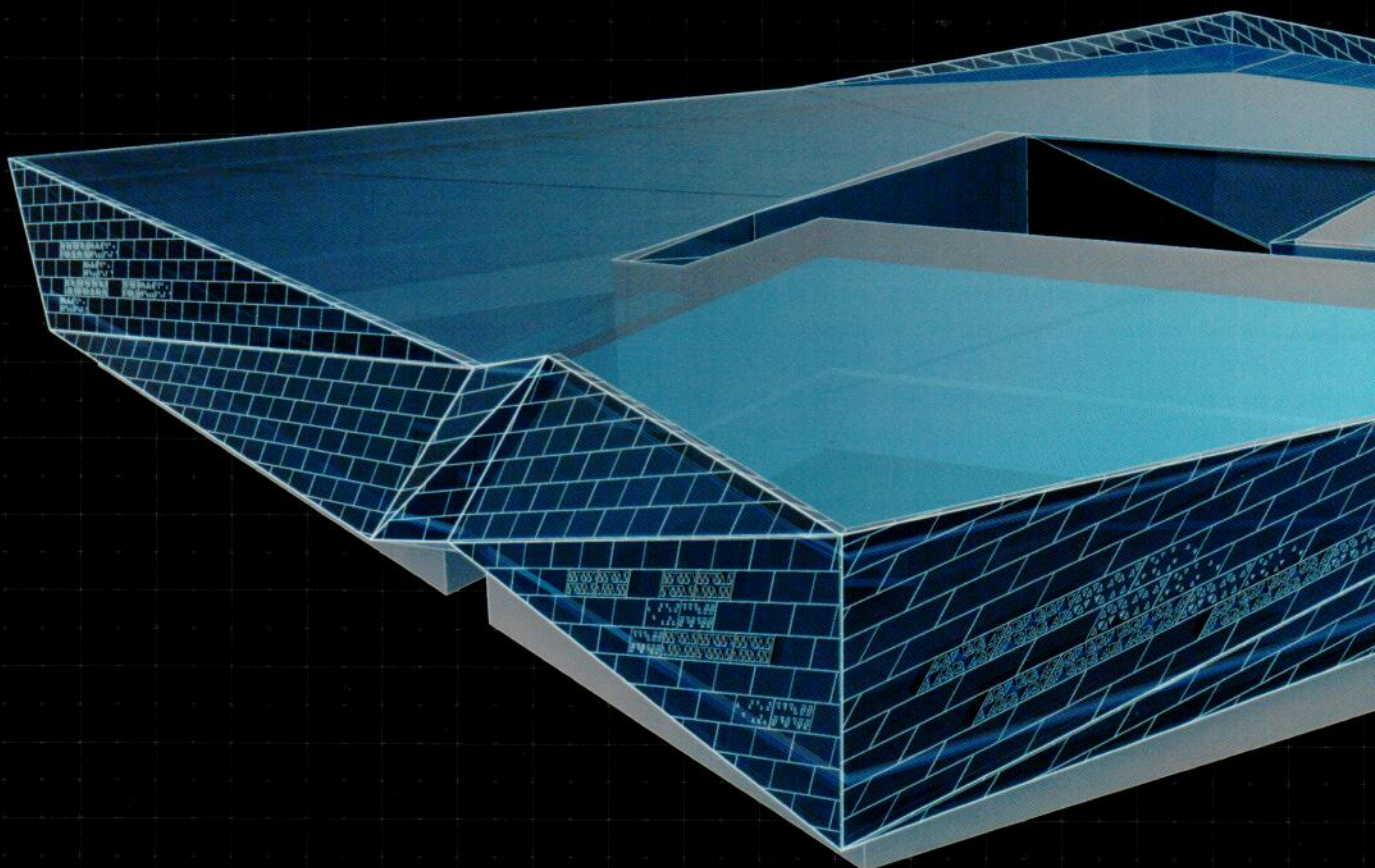
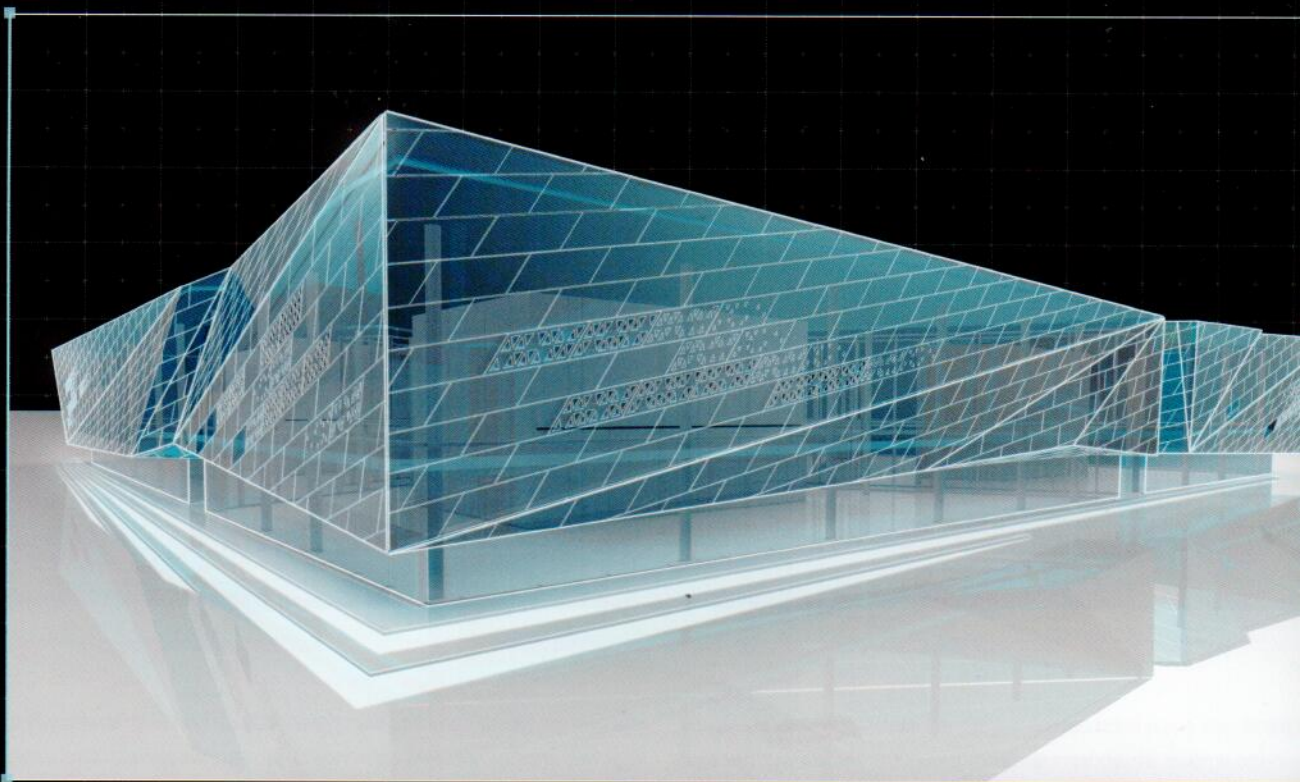
COMPLEX GEOMETRY



INNOVATIVE CONSTRUCTION



ENHANCED PERFORMANCE



CITY MUSEUM Istanbul, Istanbul

MUSEUM

41°01'04.9" N

28°55'15.2" E



ARCHITECT

SALON ARCHITECTS

STRUCTURAL ENGINEERING

BALKAR MÜHENDISLIK

FACADE ENGINEERING

NEWTECNIC



STRUCTURAL



FACADE



MEP



ENVIRONMENTAL



TESTING

FACADE ZONE (mm)

up to 1500



WEIGHT OF SECONDARY
STRUCTURE (kN/m²)

0.47



TOTAL WEIGHT
OF FACADE (kN/m²)

1.36



U-VALUE (W/m²K)

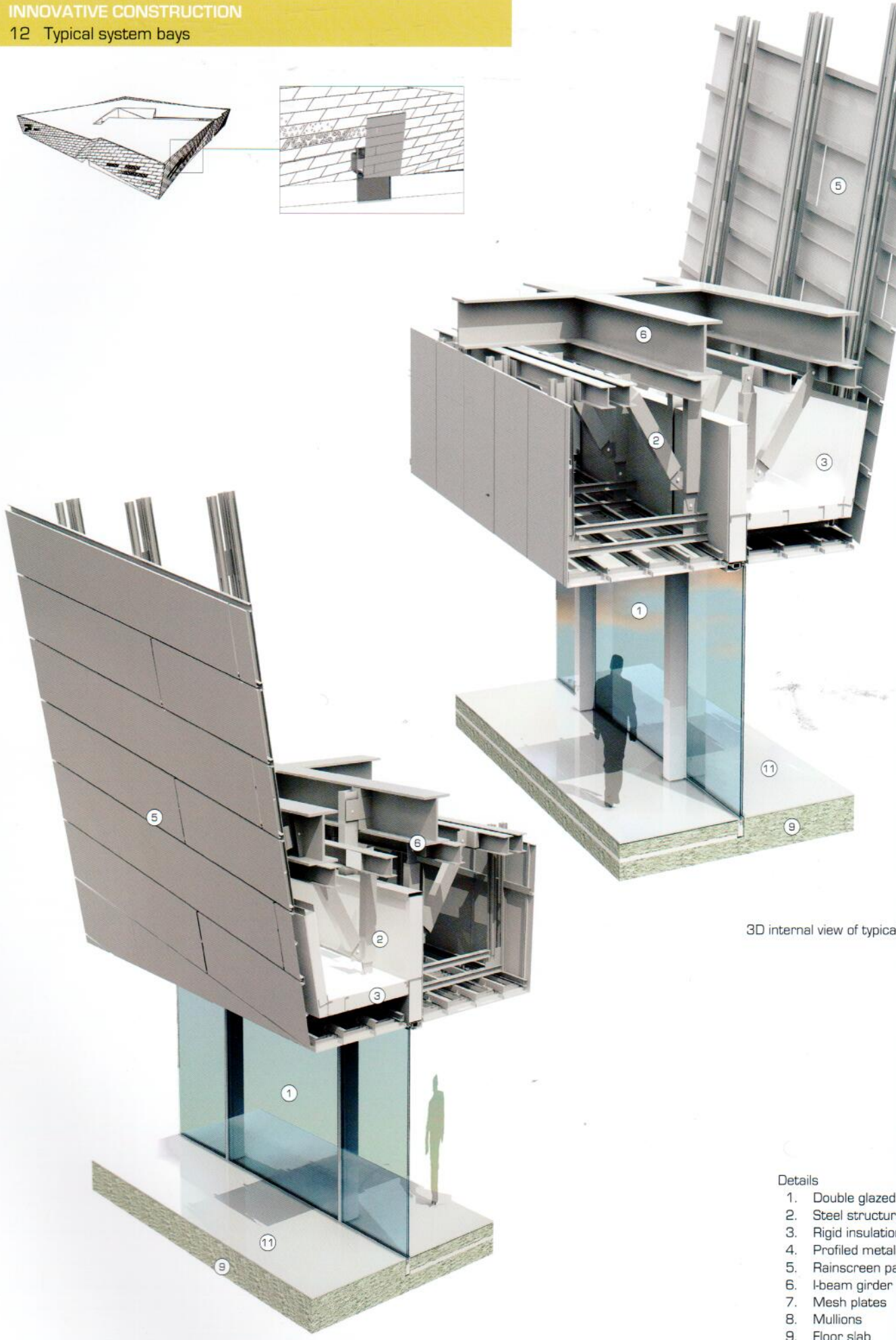
0.25



PRIMARY STRUCTURE TYPE
CONCRETE SLABS

SECONDARY STRUCTURE TYPE
RHS STEEL SECTIONS

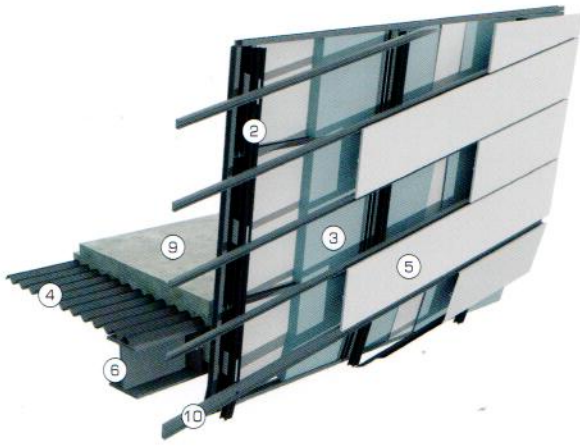
FACADE BRACKET TYPE
SEPRATED PLATES, WELDED AND BOLTED



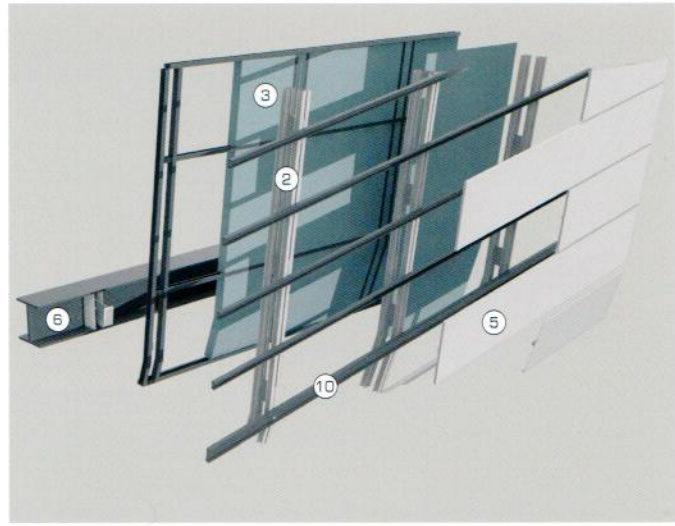
3D internal view of typical

3D external view of typical bay

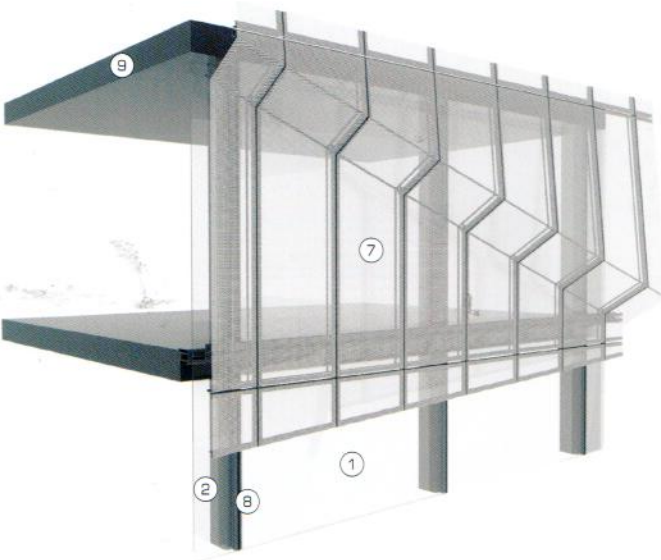
- Details
1. Double glazed
 2. Steel structure
 3. Rigid insulation
 4. Profiled metal
 5. Rainscreen panel
 6. I-beam girder
 7. Mesh plates
 8. Mullions
 9. Floor slab
 10. Cladding frame
 11. Floor finish



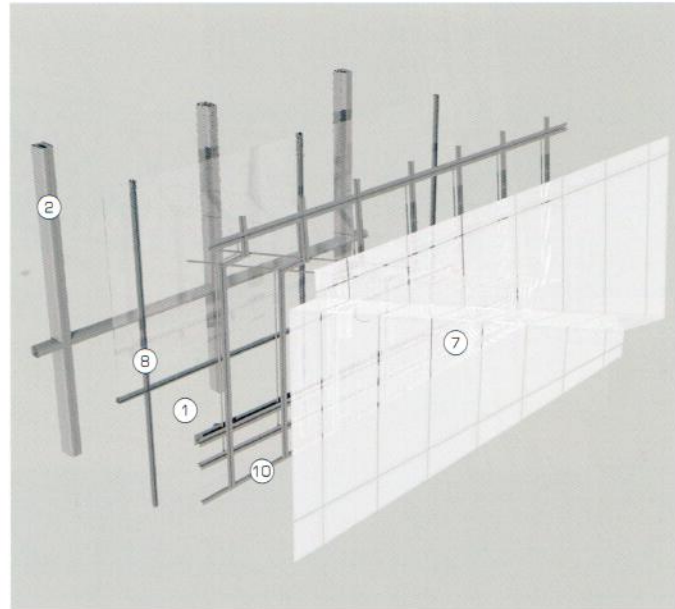
3D view of cladding system



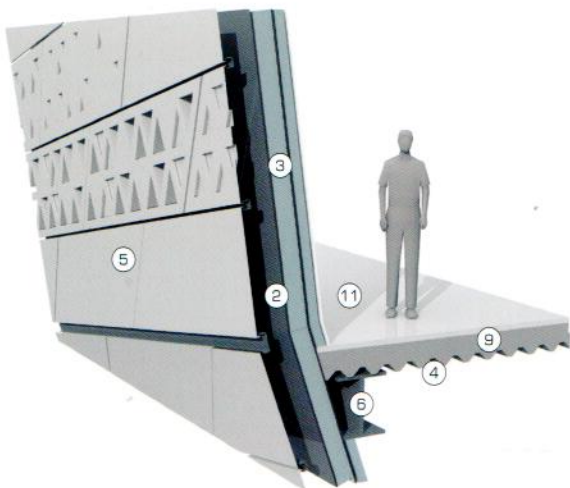
3D exploded view of cladding system



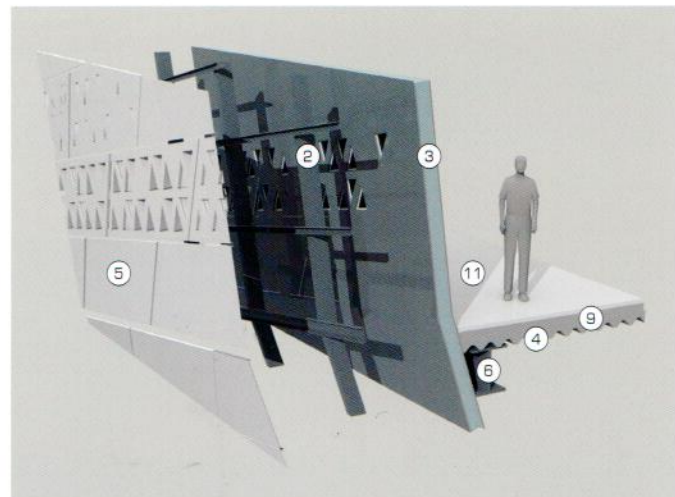
3D view of cladding system



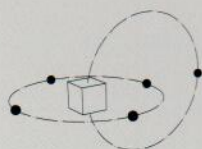
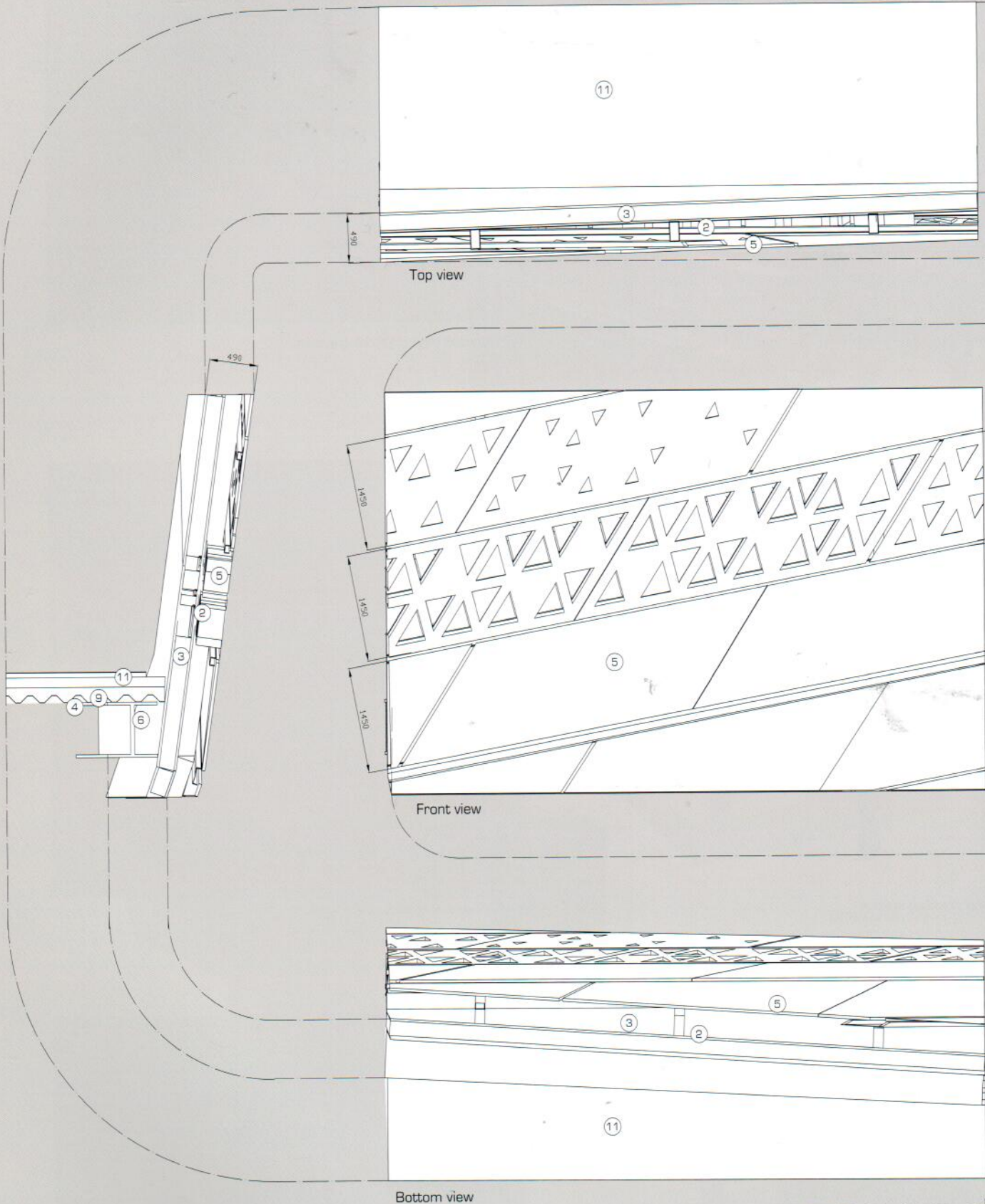
3D exploded view of cladding system



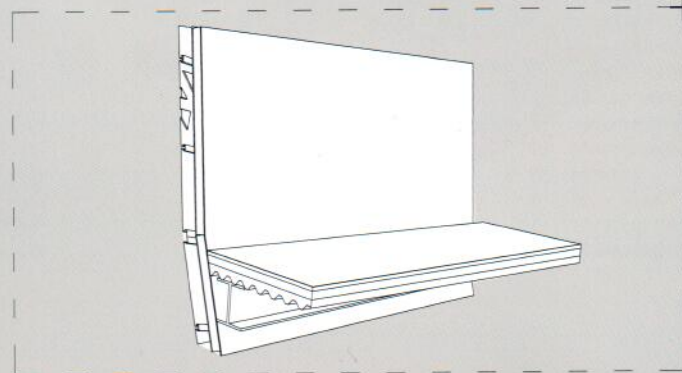
3D view of of cladding system

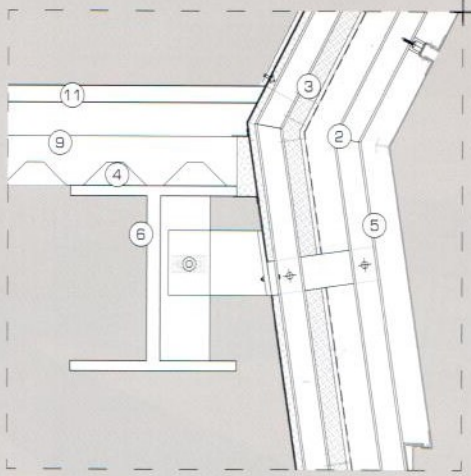


3D exploded view of cladding system

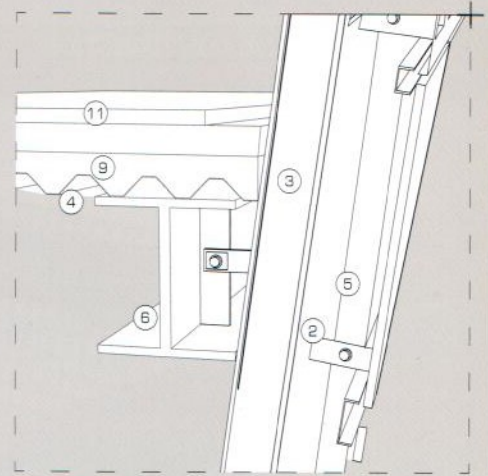


Third angle projection. Scale 1:50

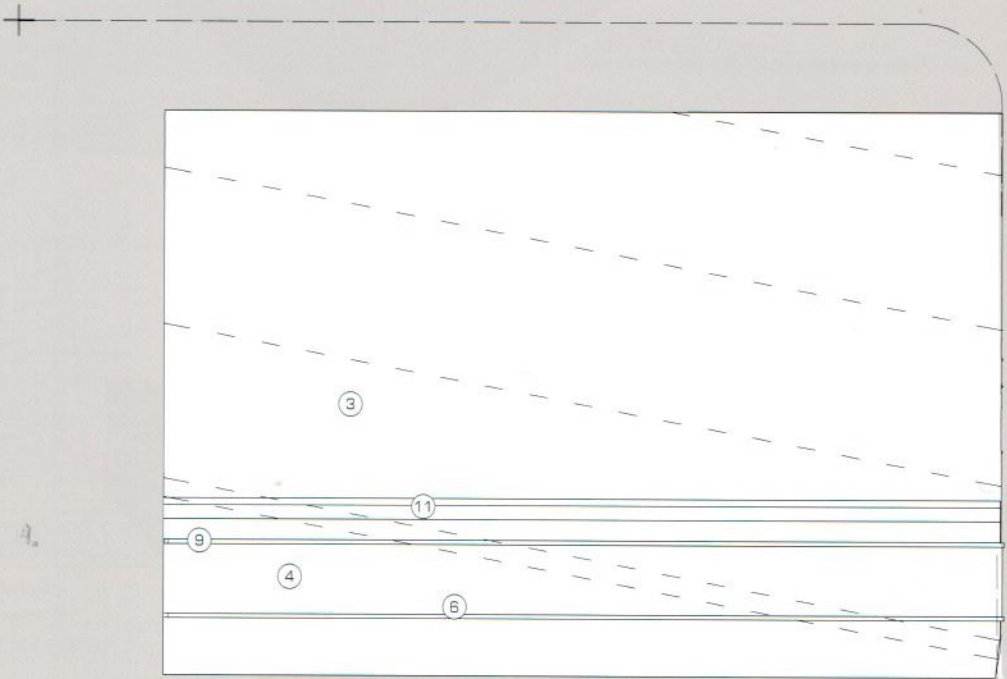
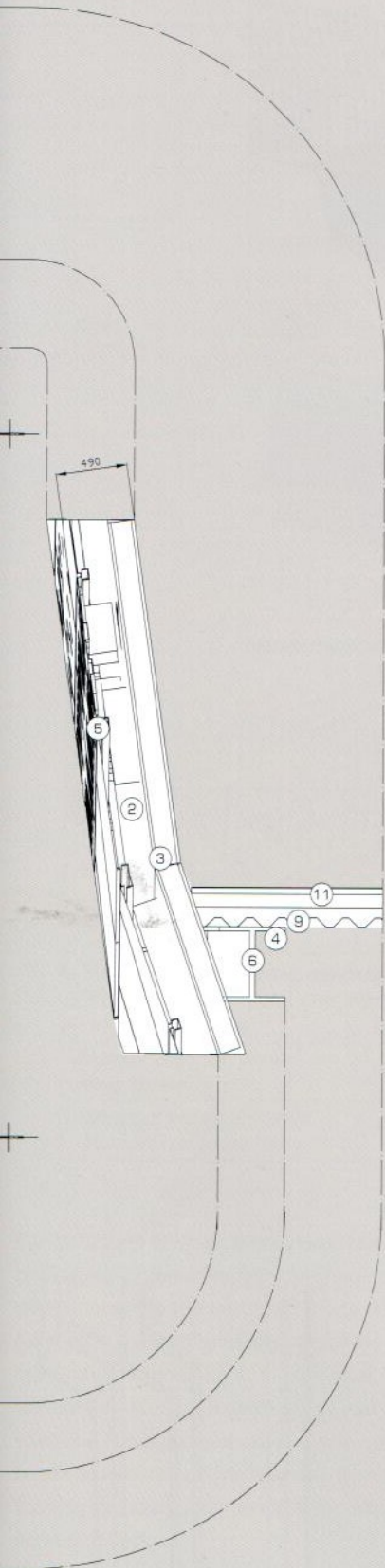




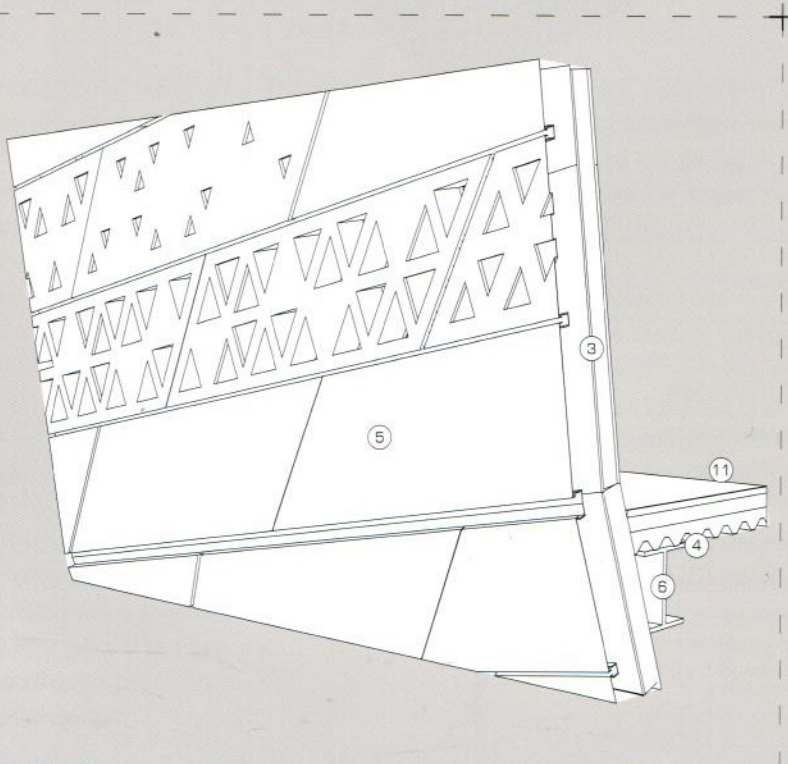
2D detail. Scale 1:5



3D view of detail



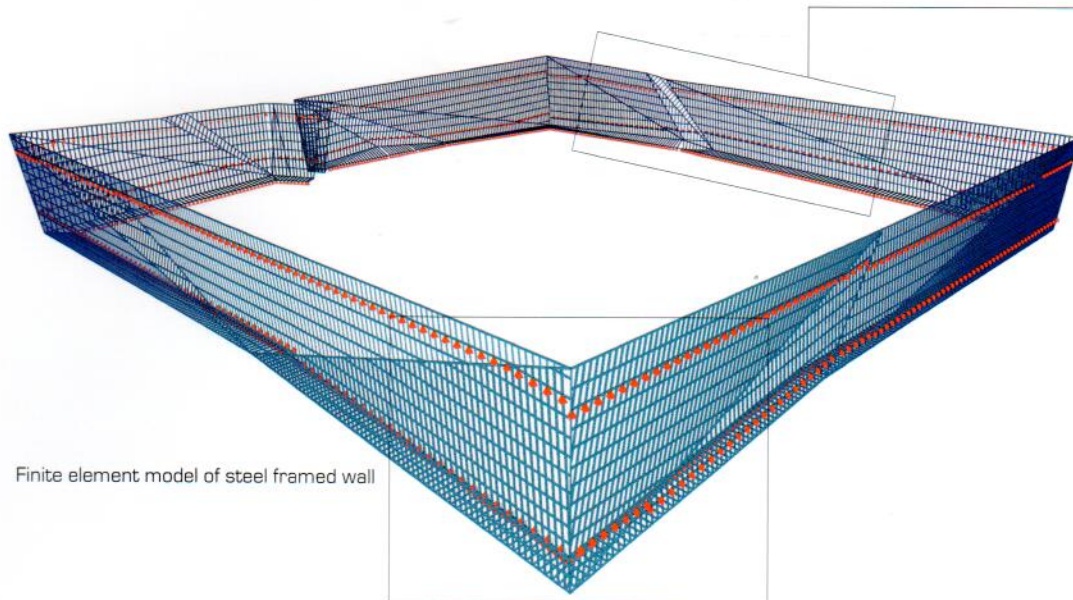
Back view



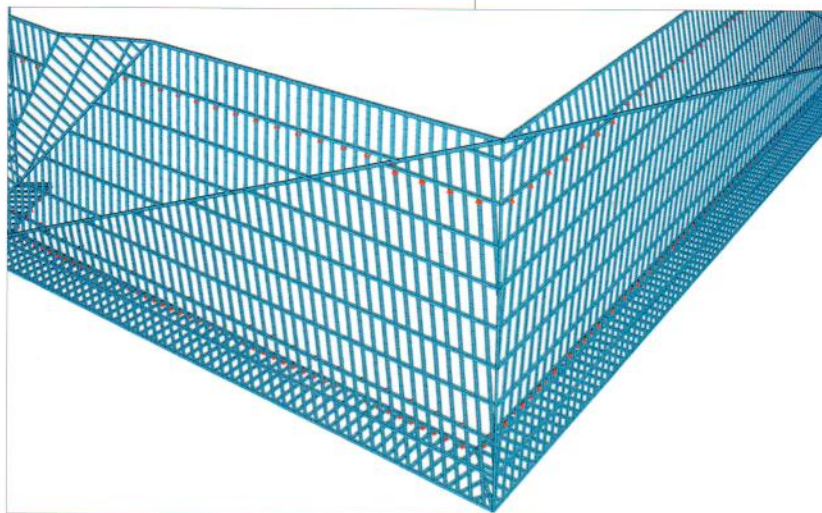
3D view of assembly

Details

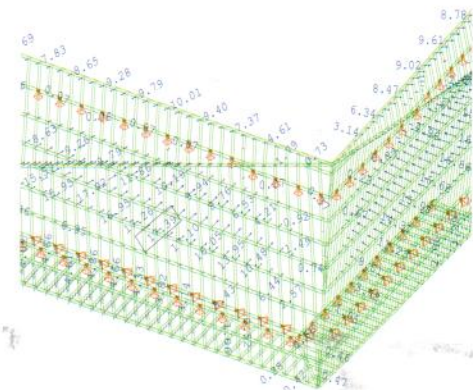
1. Double glazed unit
2. Steel structure
3. Rigid insulation
4. Profiled metal sheet
5. Rainscreen panels
6. I-beam girder
7. Mesh plates
8. Mullions
9. Floor slab
10. Cladding frame
11. Floor finish



Finite element model of steel framed wall



Finite element model of typical bay

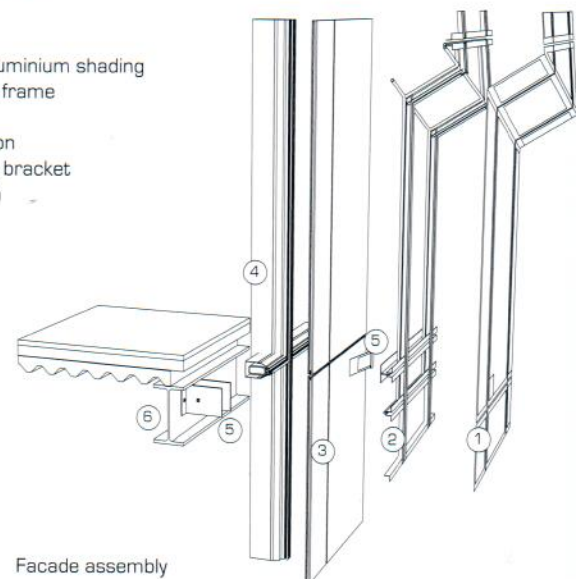


Lateral displacements distribution in cold pressed steel elements (mm)

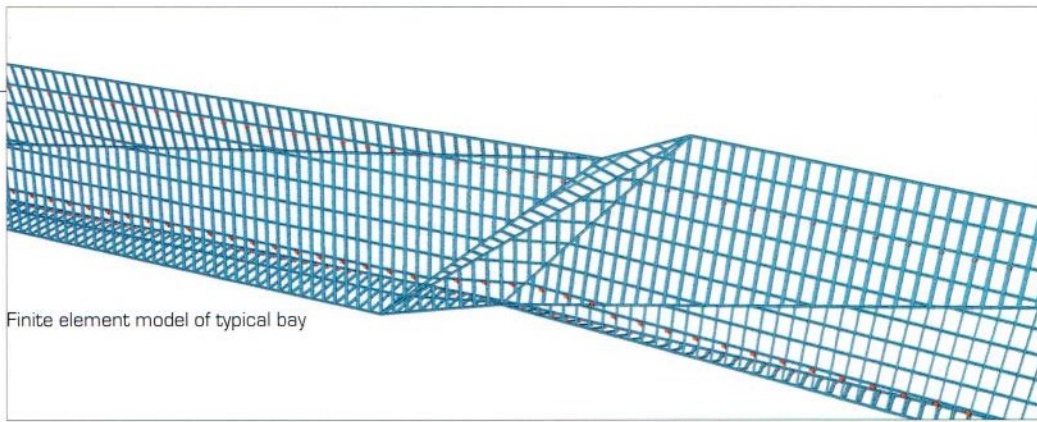
Facade system	Full-height glazed facade with external aluminium mesh.
Facade zone	up to 1500 mm
Primary structure type	Composite concrete slabs.
Secondary structure type	RHS steel sections.
Weight of secondary structure [kN/m ²]	0.47
Facade bracket type	Serrated plates; welded and bolted.
Number of components in fixing system	5
Weight of facade, including secondary structure [kN/m ²]	1.36

Details

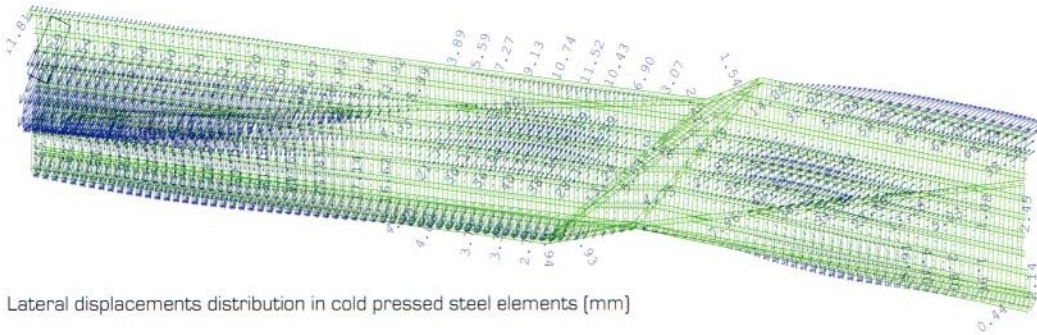
1. External aluminium shading
2. Aluminium frame
3. Glazing
4. Steel mullion
5. Steel fixing bracket
6. Edge beam



Facade assembly

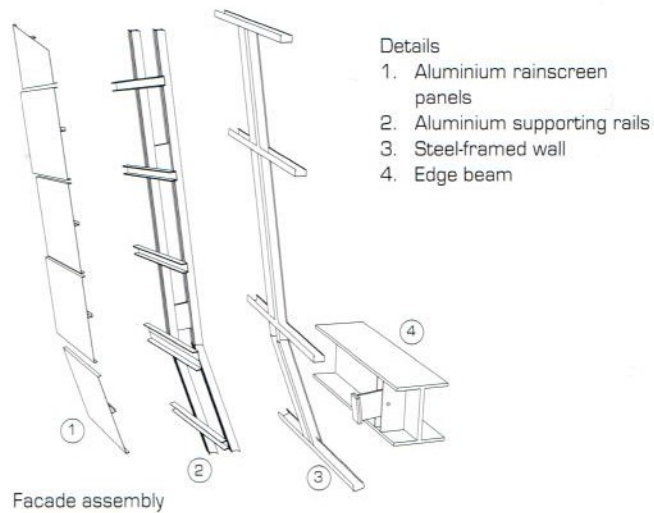


Finite element model of typical bay



Lateral displacements distribution in cold pressed steel elements (mm)

Facade system	Aluminium rainscreen supported on steel framed wall.
Facade zone	480 mm
Primary structure type	Composite concrete slabs
Secondary structure type	Steel framed wall, cold formed profiles.
Weight of secondary structure [kN/m ²]	0.22
Facade bracket type	Bolted steel plates
Number of components in fixing system	5
Weight of facade, including secondary structure [kN/m ²]	1.05



Facade assembly

Details

1. Aluminium rainscreen panels
2. Aluminium supporting rails
3. Steel-framed wall
4. Edge beam

The structural envelope is composed of a continuous framed wall which is designed to accommodate the sharp folds that define both the internal and external architectural surface, which closely follows the same geometry. The structural concept for the framed wall follows the direction of the frame elements in each facet to form the folded surface, as well as the structural depth of the wall required to achieve sufficient stiffness. The structural depth of the cold pressed steel members is balanced with the spacing between them as well as the ability of the wall framing to incorporate connections with the exterior aluminium rainscreen cladding.

Two layers of outer wall are used: a framed backing wall and an outer rainscreen cladding which is supported on rails. The external open-jointed cladding is set out along diagonal lines and supported on aluminium rails, which are fixed to the framed wall in order to minimise the number of penetrations of both thermal and waterproofing envelope. The framed wall construction provides the required global stiffness to support the cladding. Localised forces, which result from the use of thin cold pressed sections, are accommodated at folds in the facade.

The continuous framed wall envelope is top-hung from the slab edge of the highest floor and is restrained by slab edges on floors beneath, as well as at the interface with the ground floor glazing. At these points the restraint is only for out-of-plane movement and allows the hanging folded facade to move freely.

The framed wall incorporates movement joints only at corner locations, in order to allow unrestrained thermal movements to be accommodated for each side of the building. Framing members run in the two perpendicular directions within the plane of each facet, which introduces diaphragm action and provides global stability to the envelope. The setting out and installation of the framed wall is performed through semi-prefabricated modules, where thermal insulation, membrane and interior finishes are site-assembled. The rails are fixed directly to the framed wall through adjustable thermally broken brackets in order to support aluminium panels along the long edge.