

# Frankfurt/Main Airport, Terminal 2: C/D Pier, T1 Passageway Link



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Architect/designer: *JSK Dipl. Ing. Architekten, Frankfurt/Main*  
Client: *Fraport AG, Frankfurt/Main*  
Curtain wall package: *Anders Metallbau GmbH, Fritzlar*

# Mission

The highly acclaimed architectural practice JSK drew up a unique concept for a pier at Frankfurt Airport to accommodate the new generation of wide-body aircraft. A glazed front as spotlight overlooks the apron, the clearly structured facility speeds up boarding procedures, facilitates orientation and offers passengers comfortable waiting areas and an exclusive lounge in which to relax.

■ **Frankfurt International Airport: all set to handle the new wide-body aircraft**

Frankfurt Airport is one of the world's most important aviation hubs: in 2009 alone, it was the starting point for 50.9 million passengers bound for countless destinations across the globe. To allow handling of the new-generation Airbus A380 wide-body airliners, Fraport AG commissioned the Frankfurt-based architectural practice JSK Dipl. Ing. Architekten to remodel terminal section T2 as well as its centre-piece, the C/D pier with its 32,000 sqm gross floor area. A 320 m passageway linking the new C/D pier to Concourse C was also designed and implemented by JSK Dipl. Ing. Architekten.



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View of C/D pier from apron



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Top: C/D pier at night; Bottom: View of C/D pier from apron



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■ **Architecture for globally unique boarding concept**

In the field of transport facility design, JSK Dipl. Ing. Architekten ranks among the international crème de la crème – a leadership role emphatically underlined by the architectural and organizational refashioning of Terminal 2. The new C/D pier is configured to allow simultaneous handling of three A380 plus one A340-600. The docking points at the individual gates additionally cater for all other aircraft types. The novel feature consists in the three movable air bridges provided for the Airbus A380, one of which runs 8 m above ground level over the wings of the wide-body plane. This concept allows for two-level boarding, whereby the 550 passengers simultaneously enter the Airbus on both its main and

upper deck. Boasting expansive glass fronts that sit on stilts over the apron level, the pier takes its cue from the architectural language of the existing structures while offering passengers visual links across the airfield. The glass facades, wall and ceiling finishes plus the entire building services installations were designed by JSK Dipl. Ing. Architekten in line with state-of-the-art energy-efficiency standards.

■ **C/D pier**

The C/D pier, which is located between Concourses C and D of Terminals 1 and 2, came into service at the end of March 2008. The extendable, open-plan gate areas of the new pier are spread over two levels. While Level 2 is equipped with seating areas and snack bars for Economy passengers, Level 3 is

reserved for First-Class and Business travellers. The generous glass facades create a bright, welcoming atmosphere and a pleasant working environment. The waiting zones, bistro areas and a stylish lounge command an intriguing view of flight operations. The open-plan gate layout allows free movement throughout the passenger handling area.

■ **T1 passageway link**

The new 320 m passageway links the gates of the new C/D pier to the Concourse C extension building. Wide escalators and moving walkways provide passengers with swift and convenient access to the new gates while a staggered arrangement of windows on the southern front offers views of the aprons and runways.

# Facade Design

The schemes of JSK Dipl. Ing. Architekten bear an unmistakable architectural signature and place high demands in terms of technical realization. Solutions were developed by Anders Metallbau to meet a wide diversity of requirements. Our services embraced the energy-optimized glass facade of the new C/D pier as well as the glass fronts and fire-rated curtain walls for the passageway link to Concourse C.

## Anders Metallbau – curtain wall specialist

In autumn 2006, we were contracted by Fraport AG to construct the curtain walls for the new C/D pier and the T1 passageway link to Concourse C. We also supplied four lift towers topped by lighting masts and the complete cladding system for the new apron control towers. The entire route taken



by passengers heading directly to the new Airbus A380 pier from Terminal 1 is thus enclosed by facades that were designed and installed by Anders Metallbau.

## C/D pier facades

On the apron front, the unitized curtain wall areas of Gates C13-C16 alternate with the transparent stick-system facades of the bridge structures over a length of around 270 m. The individual gates are separated by the four bold steelwork assemblies of the lift towers and the stairwell enclosures



View of C/D pier facades from apron

with their metal rain screen cladding. The C/D pier is crowned by the outwardly inclined glass facade of the 40 m high apron control tower. This full range of the curtain wall was designed, fabricated and installed by Anders Metallbau.

## Facade design for T1 passageway link

Internally, the envelope of the approx. 320 m passageway is dominated by exposed steel columns spanning between the structural slabs of the two



levels. Externally, these steel columns are faced with high-grade F90-fire-rated panels. The rhythm of the passageway exterior is interrupted by a staggered arrangement of ribbon windows. The rooftop plantrooms are clad in corrugated metal. The passageway component of the scheme was specially designed and built to cater for the possible future extension of individual facade areas. The fire-rated curtain walls are similarly adaptable to the evolving needs of a major airport.



Front and rear view of passageway facades



### C/D pier

- Construction period: 20 months
- Investment volume: € 140 million
- Gross floor area: Approx. 32,000 sqm
- Three of four new gates purpose-designed for Airbus A380
- Two-level boarding for 550 passengers per flight
- Extendable gates spread over two levels
- Comfortable waiting zones and lounge areas
- Incorporated materials: 3,000 t steel, 18,000 cu m concrete

### T1 passageway link

- Construction period: 13 months
- Investment volume: € 50 million
- Gross floor area: 13,300 sqm
- Total length: 320 m
- Total height: 21 m
- Built on 170 foundation piles
- Southern facade as temporary solution (later connection to front C pier section is planned)
- Incorporated materials: 2,500 t steel, 10,000 cu m concrete

# Fabrication & Installation

Facade detailing is key to the design of building envelopes. The curtain wall systems selected by internationally distinguished architects such as Frankfurt-based JSK Dipl. Ing. Architekten are subject to the very highest standards of safety, energy efficiency and aesthetic appeal.



External view of a gate facade



Internal view of a gate facade

## Gate area facades

The individual facade areas of the C/D pier gate areas were designed as "part-unitized" modules based on a modified version of Schüco's SFC 85 stick-frame series. Reinforced on the interior by steel rectangular hollow sections, the mullions were suspended in brackets fixed to the upper slabs at standard centres of 1.92 m. Once the mullions were in place, the transoms were bolted between them. The shop-preassembled and pre-glazed modules, measuring 1.92 m by 0.92 m (w x h), were then fitted into the stick system on site by our installer teams. The facade also incorporates motorized top-hung casements serving as fire vents, with integrated drives. Appearing identical to the fixed-light modules when viewed from the outside, they in no way detract from the homogeneous exterior. Sunshade guide rails fitted in the mullion sections allow the Schüco facade blinds to be positioned as required. The curtain wall members were also specially adapted to house concealed heating and cable management systems. These services are hidden behind snap-fitted cover caps while remaining accessible for maintenance whenever necessary. In developing these facade sections, Anders Metallbau drew on its extensive know-how and experience to marry aesthetic appeal with functional efficiency.

## Bridge structure facades

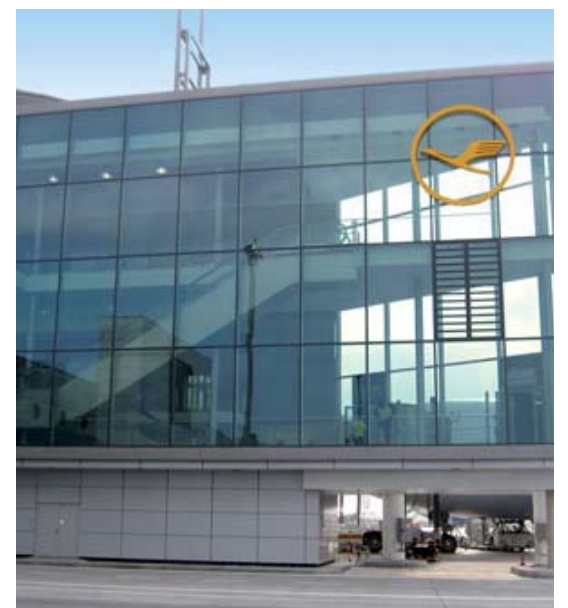
The stick-system curtain walls of the bridge structures are carried by mullions spanning the full, approx. 13 m height of the facade. They are suspended from the uppermost structural slab and secured by pre-mounted steel brackets at the upturned coping. The 80 mm wide, 300 mm deep mullions take the form of welded steel box sections. After these had been installed, the transoms consisting out of steel rectangular hollow sections were fixed between them by means of hidden screwed connections. The up to 480 kg heavy thermally insulating/solar-control

glass units were then reliably mounted using the Schüco (FW60+ AOS) add-on construction.

A special cover cap, only 8 mm deep with 60 mm face width, ensures that the facade retains maximum transparency. Fitted with laminated-safety glazing, the facades of the four bridge structures have a total area of around 1,800 sqm. The full-depth glass fronts afford passengers a clear view over the airfield. Particularly notable is the corner area of Air Bridge C13, which cantilevers over the apron with glazing on three sides.



View through gate facade over airfield



Bridge structure facade

# Fabrication & Installation

In response to the architect's specifications, we developed a wide variety of aesthetically pleasing and functionally efficient curtain wall solutions for the new terminal – ranging from the glass facades for the gate areas and stick assemblies for the bridge structures to the fire-rated curtain walling for the passageway link.

## Access routes to air bridges – fixed gangways

From the boarding zone of the bridge structure, passengers enter the air bridge via the so-called "fixed gangways". The steel-frame constructions for these gangways, which sit on circular legs anchored in the apron concrete, were fabricated and installed by Anders Metallbau. Special provision was made to accommodate three-dimensional movement at the support points. The steel cubes were tied back to the bridge structure by means of welded steel brackets on the facades and fixtures in the structural slabs. The steelwork assemblies, which project by up to 6 m, were clad on three sides in metal cassettes and topped by a bitumen-sealed, trapezoidal metal roof with concealed drainage.

## Lift towers

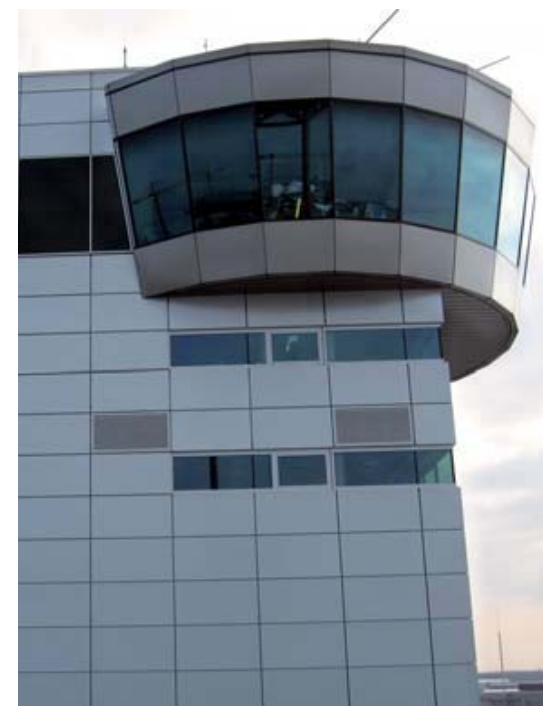
Towering over the new terminal area are four lift enclosures, one flanking each bridge structure. Masts were welded on top of the steelwork frames to carry the apron lighting at a height of 40 m. The lift towers were built from coated hollow steel sections with ends covered by bolted-on steel sheets to give them the look of enclosed box sections. The cable management and drainage systems are concealed within

the steel sections. The gliding connections between the lift enclosure and the lighting tower sections above were developed by Anders Metallbau in close collaboration with the architect and glass lift manufacturer. We were also responsible for installing the two-side-supported, laminated-safety glazing in the steel frame structure and the lift enclosures at the three access points from the bridge structure.

## Apron control towers

We developed, fabricated and installed a ten degree outwardly inclined, segmented curtain wall for each of the two new apron control towers at Frankfurt Airport. The Schüco (FW60+AOS) add-on steel construction was selected as the facade system.

Individual facade segments were pre-fabricated in the shop as steel-frame system. Birdcage scaffolding and several mobile cranes were needed for installation. Given that no interference with flight operations was permitted during the daytime, the steelwork and glazing were erected in night shifts. The full-depth glazing to the drum consists of outwardly inclined, trapezoidal, non-reflective, thermally insulating/solar-control glass panes. The upper sections of these panes were screenprinted with a band of dots. To provide the air-traffic controllers with



*Apron control tower with drum*

a glare-free view of the apron areas, the glazing is also fitted with outwardly inclined, trapezoidal venetian blind systems and high-grade solar film roller blinds.

## F90-fire-rated curtain wall to passageway link

The design by JSK Dipl. Ing. Architekten for the approx. 300 m passageway, which was clad in F90-fire-rated panels, allows for its possible later extension.

*(Continued on back page)*



*Lift tower (pictured centre)*



*Passageway link with fire-rated curtain wall*

# Fabrication & Installation

(Continued from page 2 of inside leaf)

Some of the welded steel columns spanning between the structural slabs were provided with bolted flange connections at suspended ceiling level. The purpose of this was to simplify any later dismantling of individual wall sections needed for a subsequent extension of the building. The fire-rated panels were carried across horizontal spans of 5.4 m and bolted to the steelwork. Schüco horizontal ribbon windows (FW50+ facade system) were incorporated in wall areas not subject to fire-safety requirements. The fire protection and sound-control requirements necessitated accurate detailing of all structural and movement joints at junctions with other building elements and parts. To ensure full compliance with the

strict fire-safety requirements, our designers undertook detailed prior consultations with the Fraport AG project team, the airport fire brigade and the local fire authority. Due to the rapid growth in air traffic at Frankfurt Airport, part of the passageway facade had to be dismantled after only one year's service to make way for a curtain wall accommodating a new apron bus drop-off point. Anders Metallbau also supplied and installed sliding door systems together with the associated security devices.

#### ■ Metall rainscreen cladding

The wall areas of the C/D pier and passageway link were clad with a metal rainscreen system. The generally adopted standard grid of 1.92 m x 0.92 m (w x h) was consistent with that of the gate area and bridge structure facades. Individual sections were



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fitted with louvres as specified by the building services engineers. The upper facade edge terminates with a continuous coping that runs over a total length of approx. 1,600 m.

#### ■ Safety and fire protection

Certain sections of the facade were fitted with laminated-safety glazing with a special screenprinted finish to shield the airport's safety-critical areas from the view

of passengers. All opening lights are monitored by concealed magnetic contacts. The openings are additionally protected by impact-resistant, powder-coated expanded metal. These opening casements function as air inlets for the natural smoke venting of the C/D pier and passageway link stairwells. In case of fire, they are activated via the central fire-alarm control panel or by the airport fire brigade.

## Facts and figures: the essentials in brief

### Employer/architect/project team:

Operator/client:	Fraport AG, Frankfurt/Main
Architect/designer:	JSK Dipl. Ing. Architekten, Frankfurt/Main
Facade consultant:	Institut für Fassadentechnik Karlotto Schott (IFFT), Frankfurt/Main
Curtain wall package:	Anders Metallbau GmbH, Fritzlar
<b>Facade component supplier for C/D pier:</b>	
Facade system/gate areas:	Schüco International KG, Bielefeld
Facade system/bridge structures:	Schüco International KG, Bielefeld
Sunshading/gate facades:	Schüco International KG, Bielefeld
Sunshading/apron control:	Warema Renkhoff SE, Marktheidenfeld
Glare protection/apron control tower:	Glasgard AG, Lollar
Glazing:	Glas Trösch GmbH, Nördlingen
Louvre windows:	Schneider + Nölke Lamellenfenster GmbH, Altenglan
<b>Facade component supplier for passageway link:</b>	
Facade system:	Schüco International KG, Bielefeld

### Glazing:

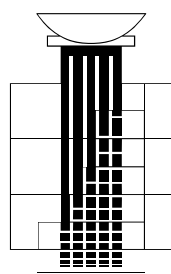
Fire-rated panels:	Glas Trösch GmbH, Nördlingen Pflaum & Söhne Bausysteme GmbH, Traun (Austria)
Louvre windows:	Schneider + Nölke Lamellenfenster GmbH, Altenglan

### Project data:

<b>Total curtain wall area:</b>	
C/D pier:	Approx. 12,800 sqm
Passageway link:	Approx. 4,220 sqm
Unitized curtain walls:	Approx. 3,700 sqm
Steel/glass curtain walls:	Approx. 1,780 sqm
Stick-system curtain walls:	Approx. 1,750 sqm
Aluminium metal rainscreen cladding:	Approx. 9,000 sqm
Sunshading as internal facade blinds:	Approx. 1,510 sqm (comprising 290 individual blinds)
F90-fire-rated curtain wall:	Approx. 5,360 sqm
Rooftop plantrooms with corrugated metal cladding:	Approx. 1,700 sqm
Structural steelwork for passageway link and lift towers:	300 t
Copings:	Approx. 1,600 m

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