

## Glass and Aluminium - An Example of Innovative Façade Design

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### Summary

Modern facades have developed from the traditional single-layered framed window glazing to load carrying, high performance glass structures. Besides their protective functions, the primary aims are visual design intent and performance. The dominating materials used for the façades of the new AUDI Terminal buildings are glass and aluminium. They illustrate an innovative design to the combination of glass and perforated aluminium. A new and worldwide corporate identity design was developed for the AUDI sale centres. Especially the façade elements are part of the corporate identity design. The cladding consists of perforated and folded aluminium panels and is visually broken up by transparent double glazing units. For the glazed parts different façade options were developed which are a standardised curtain walling system with mullions and transoms or a full-height glazing with vertical glass fins. The so called "AUDI Terminals" were designed by the Munich based Architects Allmann, Sattler, Wappner. The AUDI Terminal in Munich is the worldwide largest centre so far and has an overall exhibition area of 2250m<sup>2</sup>. Space and light are optimised and by restricting the materials to concrete, aluminium and glass the architects achieved a unified look. This paper outlines the design of the Terminal buildings and describes the detailing and the structural design of the façade in Munich. Furthermore special design requirements are explained.

**Keywords:** glass, aluminium, architectural aspects, design requirements

### Introduction and Design Concept

A new and worldwide corporate identity design was developed for the AUDI sale centres. Especially the façade elements are part of the corporate identity design. The cladding consists of perforated and folded aluminium panels and is visually broken up by transparent double glazing units. For the glazed parts there different façade options were developed: Type 1: standardised curtain walling system with mullions and transoms, Type 2: standardised curtain walling system with mullions and transoms and glazed corners, Type 3: floor to floor glazing with vertical glass fins. Furthermore the glass width and the height are variable. The width is to be either 2.5m or alternatively 1.55m and the height is to be 2.9m or 5.8m. The cladding consists of perforated and folded aluminium panels 2500mm wide and 750mm high. Along the short edges the panels are fixed to angle sections which are mounted to the main concrete structure. The horizontal span between the angle sections is to be 1250mm. Steel-sandwich panels are used for the thermal isolation of the wall.

## Construction and Design

The 2250m<sup>2</sup> Terminal is organised on two levels with an overall height of 16m above ground level (Fig. 5, Fig. 6). The floor plan has a rectangular shape having a size of approximately 26m x 55m.

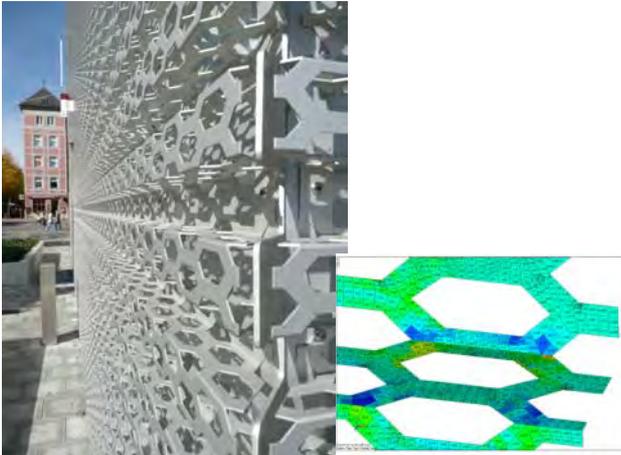


Fig. 1 Detail of the aluminium cladding



Fig. 2 View from eastern direction

There are two entrances one on the southern face and the main entrance on the eastern face of the building. From the open ground floor an escalator takes visitors up to the main gallery on the first floor. In the whole 40 cars can be displayed.

The standardised curtain walling system with mullions and transoms and glazed corners (facade type 2) was chosen for the Terminal building in Munich. The size of the double glazing units measure 2.5m x 2.9m (width x height) and is linear supported along its edges. The glass set-up was calculated as follows: 8mm fully toughened glass / 16mm Spacing:/ laminated safety glass consisting of 2 x 6mm annealed glass, 0.76mm PVB film. The mullions and transoms consist of Schueco FW 60 profiles with additional steel stiffeners. According to the design concept the 2500mm wide and 750mm high aluminium panels are fixed to angle sections which are mounted to the main concrete structure.

## Loading and Special Design Requirements

Besides the dead and wind loads for the aluminium panels additionally snow and ice loads had to be taken into consideration. Due to the exposed geometry of the panels an ice coating of 10mm had to be assumed. Furthermore the "AUDI" letters and the logo should be fixed directly to the panels. Therefore it was likely that local stress peaks could occur due to the perforation and a finite element analysis had to be carried out. Special requirements had also to be fulfilled for the glazing which spans floor to floor. As the cars are parked close to the windows and people can step in front of them the glazing has to resist human and vehicle impact. To simulate the impact of a vehicle a horizontal uniformly distributed line load of 2 kN/m was considered to act at bumper height (0.5m). The verification against human impact was carried out according to the requirements of TRAV.

### 1. Conclusion

A new and worldwide corporate identity design was developed for the facades of the AUDI Terminal buildings. The cladding consists of perforated and folded aluminium panels and is visually broken up by transparent double glazing units. For the glazed parts different façade options were developed which are a standardised curtain walling system with mullions and transoms or a floor to floor glazing with vertical glass fins. Using perforated aluminium, which is not a standard product, detailed verification analyses and studies were necessary. Additionally due to the complex geometry of the connection elements between cladding and main structure numerous structural calculations had to be carried out. Furthermore special load cases like ice coating and vehicle impact had to be considered.

**References: See full paper**