MicroShade™ provides daylight and view out in the new Confederation of Danish Industry' building in Copenhagen

The Confederation of Danish Industries' main HQ has been rebuilt and extended over the past two years. An important element of the new building is a large atrium right at the center of the building – glazed with MicroShade™ to provide a great view out, comfortable daylight and a well balanced indoor climate.

HELLE FOLDBJERG RASMUSSEN
PhotoSolar A/S. E-mail: hfr@photosolar.dk

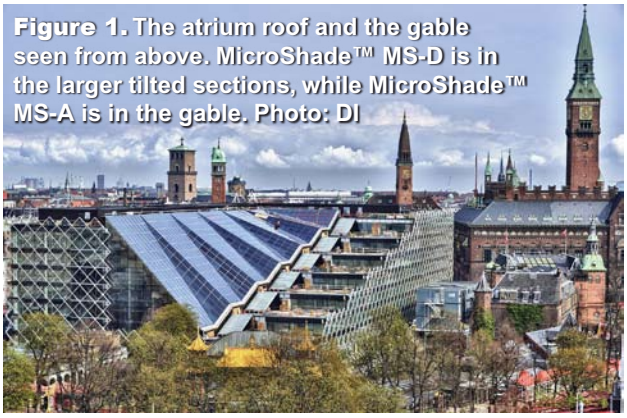


Figure 1. The atrium roof and the gable seen from above. MicroShade™ MS-D is in the larger tilted sections, while MicroShade™ MS-A is in the gable. Photo: DI

The Headquarters of the Confederation of Danish Industries ("DI") is situated right in the center of Copenhagen at the Town Hall Square, and overlooking the famous Tivoli Gardens at the rear. The building dates back to 1979 and over the past two years it has been completely rebuilt, modernised and extended.

A prominent feature of the new building is a large glazed atrium in the center. It rises to the 7th floor level, and contains a conference facility, spacious lobby and bridges which inter-connect the offices placed in the two wings of the building.

The function of the atrium

The main function of the atrium is to provide daylight to the core of the building and at the same time provide a well balanced indoor climate in order for the atrium to be used for conferences and meetings. The allowed temperature variation of the atrium in the summer is in the range from 22 to 27°C, and in the winter between 22 and 25°C. Temperatures above 26°C are accepted for 100 hours yearly, and temperatures above 27°C must be limited to 25 hours yearly. In addition, it was important to the client that the building was designed to be as energy effective as possible, and that this was reflected in the choice of materials and technologies used in the building.

The facade area of the atrium is 1 700 m² of which 1 500 m² constitute the roof and the remaining 200 m² the southwest gable. The roof is facing southeast and features 7 segments that tilt between 0 and 46°. Because of the orientation and tilt of the roof, heat gain from the direct sun is a major issue in the summer period. Controlling solar heat gain in the atrium without compromising daylight levels therefore became an important challenge. It was soon recognized that a very efficient solar shading had to be implemented for the atrium roof and gable.

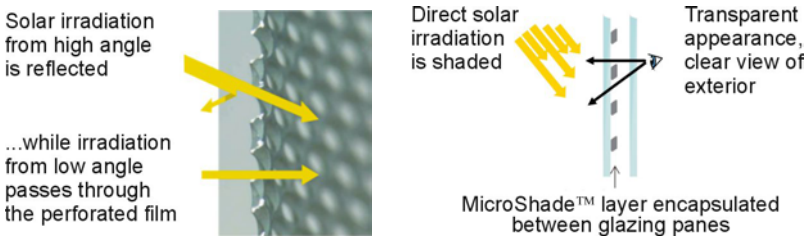
Figure 2 shows a model of the atrium. Most of the triangular surfaces of the glazed roof (No. 3, 5, 7, 9 and 11) were to be fitted with semi-transparent photovoltaics embedded in glazing. However, the light transmission on these surfaces was reduced by 94%. On the remainding surfaces No. 1, 2, 4, 6, 8, 10, 12 and the gable No. 13 a solution had to be found which would provide the required level of daylight combined with high performance solar protection.

Conventional solar shading inadequate

The initial envisaged solution for the shading contained a combination of screen printed glass and movable interior screens. The exterior screen print was designed to vary between 0 and 75% density such that the surfaces with the largest tilt had the most dense print. The movable interior screens featured an aluminum coating to reflect the heat to the outside, but the optical transparency of the screen was less that 10%.

The screen print on the glass will reduce the heat flow to the building, but the specified temperatures in the atrium only could be achieved by extensive use of the

The MicroShade™ technology is a progressive solar shading technology designed to achieve a shading performance on a level with exterior shading solutions. The progressive effect of the MicroShade™ ensures that most shading is provided when most needed. MicroShade™ is a passive element which does not require any maintenance, service or operation during use.



MicroShade™ glazing provides a reduction of the solar heat gain up to 90%, while maintaining visually transparency. The light transmittance is close to 50% for 2 layer MicroShade™ glazing.

supplementary interior screens. The disadvantages of using the interior screens were the reduction in daylight below acceptable levels and blocking the view to the outside. This combined solution was therefore rejected by the design team.

New technology: MicroShade™

As an alternative to the initial solution, MicroShade™ glazing was investigated.

MicroShade™ is a new generation of modern, energy efficient facade and roof glazing for new and refurbished buildings.

MicroShade™ solar shading consists of a patented microscopic lamella structure built into the glazing. The microscopic lamellas are angled to provide a shading of the direct solar irradiation falling onto the window while allowing light from other angles through the glazing. The advantage of these microscopic lamellas is that they are invisible to the human eye even at close distance, and hence allow a free view through the glazing at typical viewing angles. The microscopic lamellas are made of metal and are built into the product during the production of the MicroShade™ glazing. As the shading device is integrated in the glazing and contains no moving parts it requires no service and is not sensitive to the exterior climate.

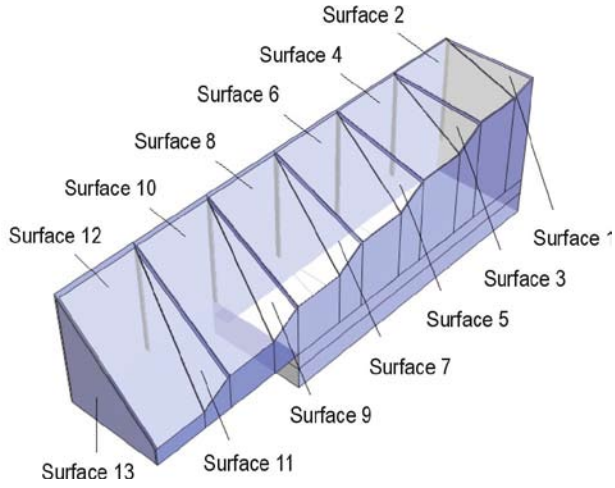


Figure 2. Model of the atrium with indication of the surfaces. Source: Rambøll

Adaptation of the MicroShade™ solution

Before the decision was taken to use MicroShade™ glazing, a series of calculations and simulations were made to compare the thermal and optical performance of different scenarios and shading solutions. Initial calculations of the solar heat gain in the atrium revealed that glazing fitted with MicroShade™ type MS-A would lead to an unacceptable heat gain on a selection of the surfaces in the atrium roof compared to the initial solution consisting of screen print in combination with interior movable screens.

As a consequence, PhotoSolar A/S, the Danish company which develops and produces MicroShade™, manufactured a new version of MicroShade™ named MS-D. The MS-D differs from the MS-A by having a steeper tilt of the microscopic lamellas. Accordingly, the shading efficiency of the MS-D is higher than that of the MS-A, and the product is better suited to the atrium roof of the DI building. The tilt of the microscopic lamellas of the MS-D was optimized to provide the same energy balance as the initial shading solution with screen print and movable screens.

Figure 3 shows a comparison of the total solar transmittance through the different solutions – screen print in combination with movable shades, MicroShade™ MS-A and MicroShade™ MS-D.

After that, detailed CFD simulations of temperature and air currents in the atrium were conducted in order to ensure the solution would live up to the indoor cli-

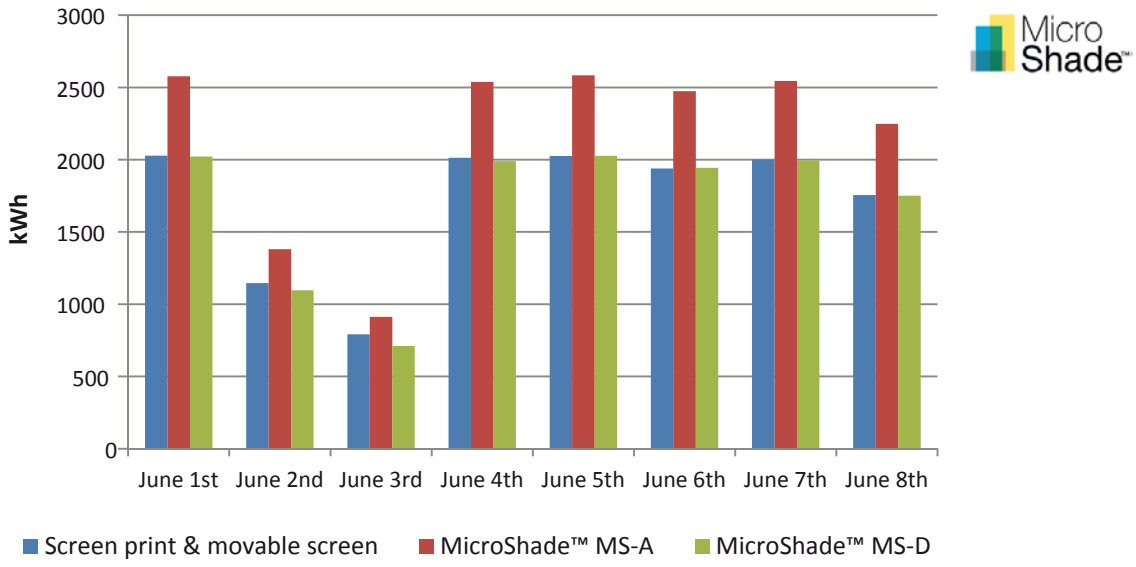


Figure 3. Total solar transmittance on selected summerdays for the original solution with screen print and movable shades, the traditional MicroShade™ MS-A and the modified MicroShade™ MS-D.

mate requirements from the tender material. The simulations showed that the modified MicroShade™ MS-D solution performed just as well as the original solution with screen print and movable shades.

View Out

A simple mock-up with a MicroShade™ glazing was made in order to test the view out through a MicroShade™ glazing. The mock-up could be adjusted to the different view angles, which exists in the atrium roof. Furthermore DI visited a MicroShade™ roof installation in Germany too see an installation of the product. In this way the client got a first-hand experience of the MicroShade™ glazing before the solution was finally decided.

There was a great satisfaction with the MicroShade™ glazing, and this together with the calculations lead to the final choise of MicroShade™ as the solar shading solution for the atrium.

The final solution

The final solution in the atrium roof became MicroShade™ MS-A Vertical in surfaced no. 1 and in the gable MicroShade™ MS-A was used. In the remaining surfaces (no. 2, 4, 6, 8, 10 and 12) the modified MicroShade™ MS-D was used.

It is not possible to tell the difference between the different types of MicroShade™ with the naked eye and thereby the entire atrium facade ended up appearing homogenous.

The MicroShade™ glazing was delivered by Glassolutions Scandinavia in the autumn of 2011 and in January 2012 the atrium roof was finished. Even though some of the interior works still remain before the building is ready for commissioning in May 2013, it already now looks very promising for the large atrium. ■

Table 1. Technical properties of MicroShade™ solar shading for four standard types.

Type	Description	Tilt of micro-lamellas	g-value [1]	Light transmittance [2]
Standard				
MS-A	For facade and roof application	16°	0.10–0.33	0.49
MS-D	For facade and roof application	23°	0.10–0.30	0.43
MS-RS	For roof application	0°	0.09–0.28	0.49
MS-RW	For roof application	40°	0.09–0.28	0.32

[1] The g-value varies with the position of the sun and depends on the glazingtype, tilt and orientation.

[2] The light transmittance normal to the surface according to EN 410. The light transmittance varies with angle of incident.