



SCHOTT
glass made of ideas

The Cologne Cathedral

Project report

Glass protects glass at the Cologne Cathedral

New anti-reflective exterior protective glazing is preserving historical stained glass at the Cologne Cathedral and not just from the harmful effects of the environment and weather. The customized optical interference coating from SCHOTT AMIRAN® Heritage Protect, also minimizes reflections and gives an almost authentic view even from unfavorable angles.

Background

The Cologne Cathedral is a World Cultural Heritage Site with windows from seven centuries. It has one of the largest collections of historical stained glass ever with the oldest dating back to the 13th and 14th centuries. Such works of art made of glass not only have decorative and narrative purposes but also let light in, form a barrier to the outside world, and protect interiors from the weather.



The challenge

Stained glass is perpetually in peril. This begins with their glass surfaces that react sensitively to water and aqueous solutions. The same is true for modern glass, but much more so for medieval glass which is high in calcium and potassium that further reduces its stability and resistance to weather. This is made worse by aggressive pollutants from the ambient air, especially sulfur dioxide. As a result, deposits are formed that can dull or even fully darken medieval glass.

The solution

The most important protective measure for historical stained glass is exterior protective glazing. It is installed in the groove of the window reveal in place of the original window and functions structurally as a climatic barrier. The stained glass is mounted a few centimeters before the protective glazing to guarantee the required air circulation. This is a major architectural intervention especially in a Gothic building such as the Cologne Cathedral, but installing exterior protective glazing is the only effective measure to preserve historical stained glass and to protect it from further substantial degradation. It also preserves costly restoration work for longer and prolongs the durability of materials such as adhesives. Furthermore, the glazing protects against mechanical stresses from wind, sound and pressure waves during concerts, as well as against vandalism and fireworks.



The Cologne Cathedral received its first protective glazing in 1980, a solution using monolithic panes. However, the laminated safety float glass used has the disadvantage of constant reflection. Since 2003, an anti-reflective glass has been used as protective glazing for the medieval choir windows. Reflections from the sky and neighboring buildings as well as shadows from the buttresses, which vary according to the position of the sun, needed to be reduced as much as possible.

A solution was also required for a specific problem: the upper choir windows stand 17 meters (55.8 ft.) tall and positioned at a height of 27 meters (88.6 ft.) thereby

requiring an extremely steep viewing angle from below. In all standard anti-reflective glass, steep viewing angles result in stark, colored residual reflections – of blue, green or bronze, depending on the manufacturer. The anti-reflective layer needs to be as color neutral as possible and is vital for aesthetic reasons. This was therefore a major concern of the cathedral's chief building engineer and stonemason team.

Glass experts from SCHOTT in Grünenplan specialized in producing architectural glass with special anti-reflective coatings, have developed a customized optical interference coating.

It uses a complex system of multiple anti-reflective coating layers of different thicknesses and refractive indices. Such anti-reflective systems are normally designed for 90 degree viewing angles to the glass surface. These systems reduce the degree of visual reflection to only about 1 percent, optimize reflected colors and have many applications such as shop windows, displays, picture glazing and showcases. However, viewing angles for protective glazing in historical buildings often deviate significantly from 90 degrees. Viewing windows at angles of around 45 degrees from the Roncalliplatz



square at the Cologne Cathedral using glass samples with anti-reflective and optical interference properties from various manufacturers, had noticeably high degrees of reflection and intense color reflection. The anti-reflective system from SCHOTT minimizes these reflections and allows an almost unadulterated view of the original glazing.

In the spring of 2018, the first upper choir windows in the Cologne Cathedral were fitted with the new SCHOTT AMIRAN® Heritage Protect glazing. More windows are to follow.



SCHOTT AMIRAN® Heritage Protect



Float glass

THE MATERIAL

- AMIRAN® Heritage Protect, 6.76 mm thickness
- Extremely high transmission – minimal visible reflection (1%, instead of 8% for float glass)
- Reduction in the level of reflection and colors from unfavorable viewing angles
- Laminated glass with protection against weathering, UV radiation and mechanical stresses

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