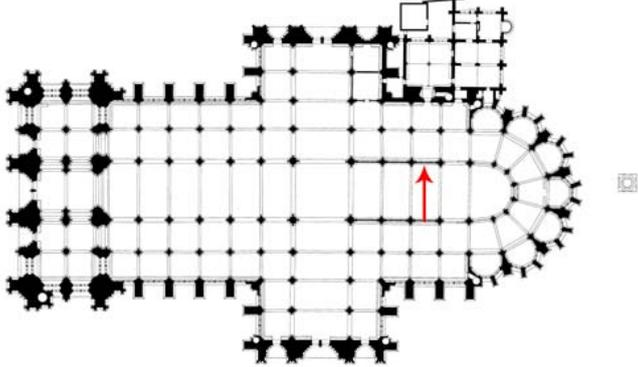


	CONSTGLASS	
	Data-sheet for pilot objects Cologne N VI Ormocer®	

Object: Cologne Cathedral, NVI Ormocer®	Date: 20. 02. 2009
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OBJECT IDENTIFICATION	
Site	Cologne (Germany)
Building	Cologne Cathedral
Location and orientation of the window Plan of the building	North side, clerestory of the choir Cycle of Kings, N VI 
Description of the window opening (dimensions, number of lights, test panel marked)	 <p> 4 lancet window with tracery total height: ca. 16 m total width: ca. 5,50 m height per lancet: ca. 11 m width per lancet: ca. 1.20 m </p>



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Data-sheet for pilot objects
Cologne N VI Ormocer®



		<p>N VI panel 4bL</p>
Date	Around 1300	
Short description of the window (identification of subject, artist, workshop)	The window N VI is part of a monumental window cycle in the choir clerestory, dated around 1300. The lower third of each window depicts four kings, alternating younger and older persons, standing in richly ornamented architectural tabernacles. The consoles are decorated with coats-of-arms. Above the figures ornamental lancets with complicated interlacing patterns raise up.	
Owner	Metropolitankapitel der Hohen Domkirche Köln	
Person(s) in charge	Stained Glass Studio of Cologne Cathedral Works Department	
Investigated panel (inventory number CVMA number, size)	N VI, 4bL	



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Data-sheet for pilot objects
Cologne N VI Ormocer®



Manufacturing technique	unpainted glazing		<input type="checkbox"/>
	painting glazing		<input checked="" type="checkbox"/>
		oxide paint / grisaille paint inside	<input checked="" type="checkbox"/>
		oxide paint / grisaille paint outside	<input checked="" type="checkbox"/>
		Silver stain inside	<input type="checkbox"/>
		Silver stain outside	<input type="checkbox"/>
		transparent enamel inside	<input type="checkbox"/>
		transparent enamel outside	<input type="checkbox"/>
		<input type="checkbox"/>
		<input type="checkbox"/>
<i>Further information:</i> The ornamental parts and the background of the figures are <u>not</u> painted.			

ENVIRONMENT IN SITU / IN STORAGE			
Protective glazing	no protective glazing		<input type="checkbox"/>
	protective glazing		<input checked="" type="checkbox"/>
		installed in the original position of the ancient panels	<input type="checkbox"/>
		mounted to the outside (ancient panels stay in their original position)	<input checked="" type="checkbox"/>
		no ventilation	<input type="checkbox"/>
		internal ventilation	<input checked="" type="checkbox"/>
		external ventilation	<input type="checkbox"/>

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	Data-sheet for pilot objects Cologne N VI Ormocer®	

		size of interspace between ancient panel and protective glazing	ca. 7 cm
		ventilation slot at the top (size)	ca. 9 cm
		ventilation slot at the bottom (size)	ca. 3 cm
		date of installation	2003
	<i>Further information:</i> The choir clerestory window NVI was unprotected exposed to weathering until 1992, when a first protective glazing was installed. This was declaredly an interim solution, made with panels of acrylic glass (“Makrolon”). The test panel, however, was already removed in 1989 and changed place to the south side of the choir clerestory. In 2003 a newly constructed protective glazing was installed, mounted from the exterior and ventilated from the interior. At the same time the panel 4bL was re-installed in its original position in window N VI, from now on being protected from weathering.		

Material protective glazing	Stainless steel construction with panes of non-reflective security glass
------------------------------------	--

Surround materials and construction related materials	The surrounding stone material is trachyte. Before the installation of a protective glazing the panels were inserted in the grooves and fixed in mortar. Today the panels are still in their original position in the grooves, but without mortar or any other sealant.
--	---

Museal exposition / Storage	Room	<input type="checkbox"/>
	Cabinet	<input type="checkbox"/>
	Store	<input type="checkbox"/>
	<i>Further information:</i>	

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Objects exposed to	partial sunlight	<input checked="" type="checkbox"/>
	daylight, but no direct sunlight	<input type="checkbox"/>
	artificial warmlight	<input type="checkbox"/>
	artificial coldlight	<input type="checkbox"/>
	mixed warm-/coldlight	<input type="checkbox"/>



Climate of the building

The interior climate in Cologne Cathedral is rather humid, in average about 70%; there is no heating.
Because of missing data for summer months (unknown technical problem), only basic graphs are presented.

The climate at the window in the time between 1.01. until 31.12.2009:

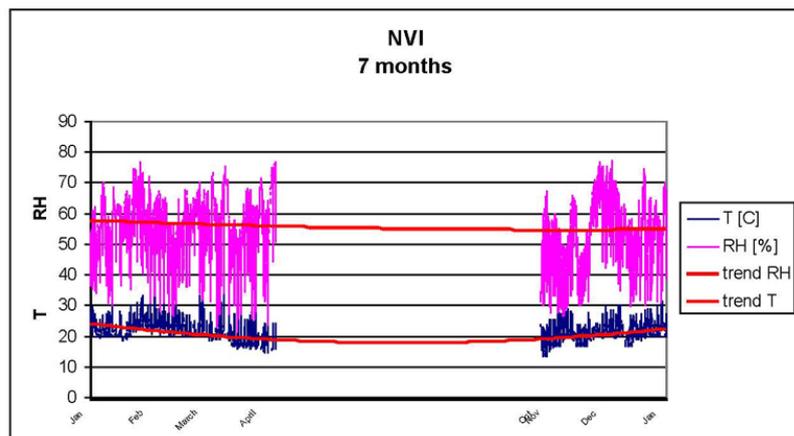


fig.1 DBV Cologne NVI climate

The climate in cold seasons shows rather stable trends with RH hardly reaching 75%. It means, that, at least not in summer one can say, that the probability of vapor condensation is low.

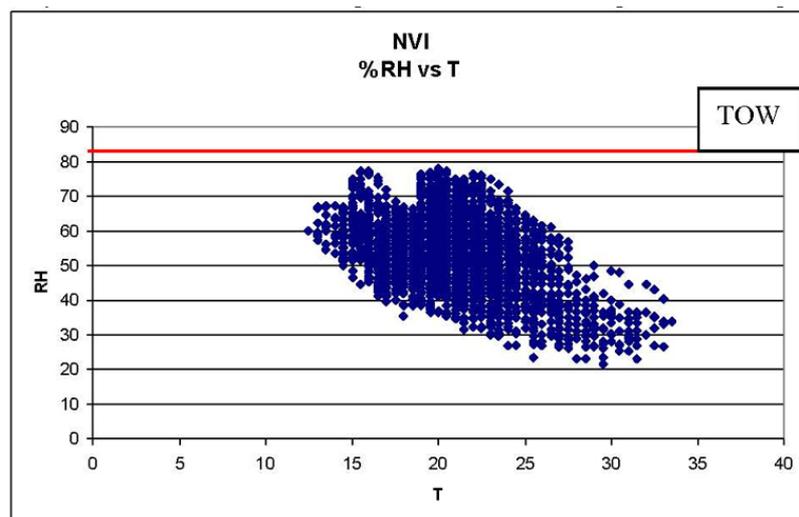


fig. 2 The 1 year climate scatter plot.

Time of wetness (TOW) area



The light parameters are: illuminance of visible light (VIS [lux]) and irradiance of UV radiation [mW/m²]

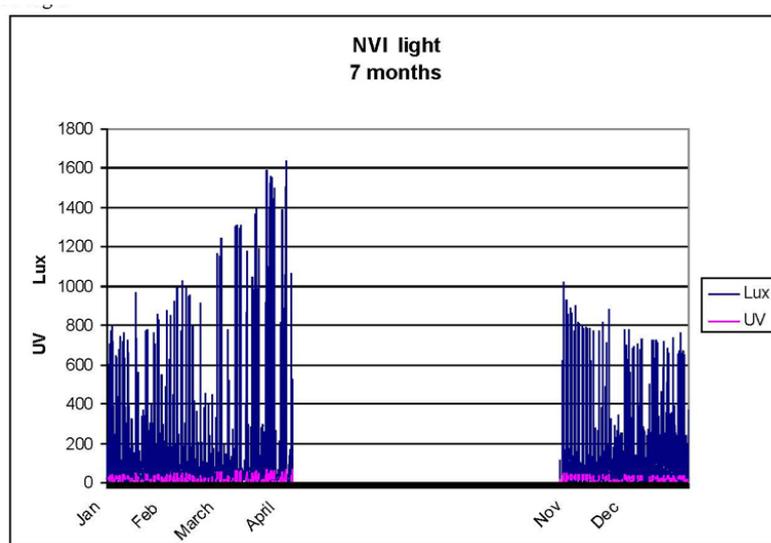


fig. 3. DBV Cologne NVI visible and UV light levels

As the data are limited only to spring and winter months we have the information for this period. The VIS light luminance was growing quickly from January till April but in winter the light was more stable.

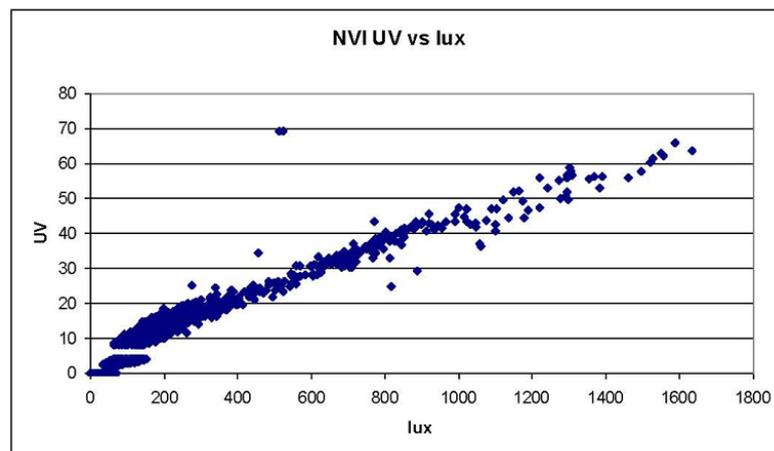


fig. 4 The UV-VIS radiation scatter plot.

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	Data-sheet for pilot objects Cologne N VI Ormocer® 

	<p>The prevailing radiation concentrates rather in their lower intensities, yet both, UV and VIS radiation appear also in the higher ones.</p> <p>Climatic data for the NVI suggest, that direct contact with outer climate is limited and the window is protected against elements. The scatter plot (fig.2) shows that a risk of wetness is vey little, if any.</p> <p>Due to missing data for summer, it is not possible to figure out if the risk of higher radiation is important, The scatter plot suggests, on the base of wide span of radiation levels, that such a possibility may exist.</p>
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INSPECTION OF THE SITE BEFORE REMOVAL (WITH PICTURES)	
Requirements for a safe removal in respect of minimal intervention	
Environmental causes for damage	
Short report of removal	
Short report of transport	<p>The panel was easy to remove. For having access to the choir clerestory windows which are mounted from the interior, we used an electric lift cage. Fixed in a case the demounted panel 4bL was transported in the studio by hand.</p>

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CONSERVATION MATERIAL																	
Conservation material (producer, product name, characterization, data, etc.)	<p>SH 1 (product name: “Hahnzement”, Glasbau Hahn, Frankfurt/Main, Germany, Tel: +40 (0) 69490742) is a colourless epoxy resin, developed to assemble glass cases. For our special requirements the SH 1 was darkened by the producer with a black pigment (“ebony black”). Today the resin is not available any more, because the production has been stopped.</p> <p>Ormocer® (developed by ISC-Fraunhofer Institute, Würzburg, D) is an inorganic-organic hybridpolymer, a heteropolysiloxane (synthesised by a hydrolysis and condensation process), mixed with an acrylate (Paraloid® B 72). The Ormocer® protective coating system is a composite system of individual layers, applied in the form of lacquers. To reduce the permeability of the coating, plate-like inorganic pigments in form of glass flakes are added in the protective lacquer (middle layers).</p> <p>BS 31 (Wacker Chemie, München, Germany, Tel:+49/89/627901) is a addition cross-linking two-part silicone resin (1.5 : 1) with good adhesion.</p>																
	Purpose of use	<table border="1"> <tr> <td>consolidation of paint layer and paint pigments (BS 31) [not relevant for the unpainted sample!]</td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>coating / lamination (Ormocer®)</td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>edge bonding (SH 1)</td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>stabilization of cracked and crizzled glass</td> <td><input type="checkbox"/></td> </tr> <tr> <td></td> <td><input type="checkbox"/></td> </tr> <tr> <td></td> <td><input type="checkbox"/></td> </tr> </table>	consolidation of paint layer and paint pigments (BS 31) [not relevant for the unpainted sample!]	<input checked="" type="checkbox"/>	coating / lamination (Ormocer®)	<input checked="" type="checkbox"/>	edge bonding (SH 1)	<input checked="" type="checkbox"/>	stabilization of cracked and crizzled glass	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>			
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	<input type="checkbox"/>																
Application technique	<table border="1"> <tr> <td>application with brush (Ormocer® and BS 31)</td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>application with spray</td> <td><input type="checkbox"/></td> </tr> <tr> <td>single application (BS 31)</td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>repeated application (Ormocer®)</td> <td>Yes</td> </tr> <tr> <td>concentration of Ormocer®:</td> <td>see below „Further information“</td> </tr> <tr> <td>mixing ration of Ormocer®</td> <td>see below „Further information“</td> </tr> <tr> <td>mixing ratio Hahnzement SH 1 (2 component epoxy resin)</td> <td>2 g : 3 drops</td> </tr> <tr> <td></td> <td></td> </tr> </table>	application with brush (Ormocer® and BS 31)	<input checked="" type="checkbox"/>	application with spray	<input type="checkbox"/>	single application (BS 31)	<input checked="" type="checkbox"/>	repeated application (Ormocer®)	Yes	concentration of Ormocer®:	see below „Further information“	mixing ration of Ormocer®	see below „Further information“	mixing ratio Hahnzement SH 1 (2 component epoxy resin)	2 g : 3 drops		
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repeated application (Ormocer®)	Yes																
concentration of Ormocer®:	see below „Further information“																
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Data-sheet for pilot objects Cologne N VI Ormocer®



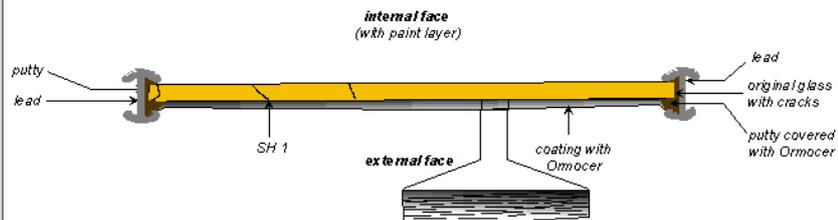
Further information:

Description of the Ormocer® treatment:

1989 practical tests with the Ormocer® protective coating system were carried out in our studio.

The treatment of the panel included following steps:

- Cleaning of the surface with brushes and fibreglass brushes to remove all corrosion products.
- Gluing the cracks with SH 1 (“Hahnzement”)
- Inserting putty (made of chalk and linseed oil) between glass and lead
- Application of the Ormocer® protective system on the external side of the panel. The coating system was applied in several different layers:
 1. base lacquer (50% Ormocer® + 50% Paraloid® B 72, solved in Ethylacetate 1:3), twice applied.
 2. protective lacquer (50% Ormocer® + 50% Paraloid® B72, solved in Etylacetate 1:10), three times applied; in each coating inorganic pigments (glass flakes) were inserted.
 3. final covering layer: Paraloid® B 72, solved in Toluene 1:9



Publications by the Fraunhofer-Institute on the subject exist. Many of them are available in our workshop.

Date of application

Application of the Ormocer® system: 1989

Documentation of this treatment

photographs (colour transparent and black & white, prints, digital images)	<input checked="" type="checkbox"/>
written records	<input checked="" type="checkbox"/>
Diagrams	<input type="checkbox"/>
data-files	<input type="checkbox"/>
	<input type="checkbox"/>
	<input type="checkbox"/>

Further information:

The written record is available in Cologne Cathedral’s stained glass studio



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Data-sheet for pilot objects
Cologne N VI Ormocer®



	Do you think the information is	exact	<input type="checkbox"/>
		more or less reliable	<input checked="" type="checkbox"/>
Previous restorations (data, treatments, material)	Do you think the information is	exact	<input type="checkbox"/>
		more or less reliable	<input checked="" type="checkbox"/>
		hearsay	<input type="checkbox"/>



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Data-sheet for pilot objects
Cologne N VI Ormocer®



CONDITION REPORT / DOCUMENTATION IN THE WORKSHOP

**Pictures of panel /
glass in transmitted
light**



Lighting: photoflash "Multiblitz"

[All digital photos in this data sheet were recorded with an Olympus E3 reflex camera; object lens: Vario 12–60 mm]



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Data-sheet for pilot objects
Cologne N VI Ormocer®



Pictures of panel /
glass in reflecting
and raking light,
internal and
external surface



internal face



external face

Lighting condition: artificial light

	<p style="text-align: center;">CONSTGLASS</p> 
<p>Data-sheet for pilot objects Cologne N VI Ormocer®</p>	

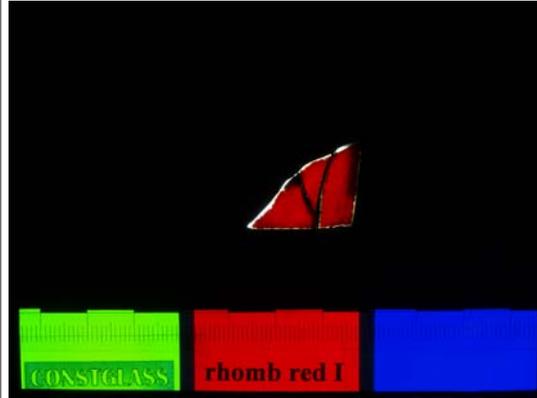
<p>Examination of the object (if possible with microscope)</p>	<p>The <u>external surface</u> is completely coated with the Ormocer® protective system and in a good condition; partly the conservation material got some bubbles and several parts of the coating (thickly applied) look somewhat milky. The putty around the glass is coated with Ormocer®</p> <p>The <u>internal surface</u> is uncoated, only some parts of the paint were covered with BS 31. <u>This does not apply for the sample which is unpainted!</u></p>
<p>Selected damages</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>internal face, reflected light</p> </div> <div style="text-align: center;">  <p>external face, reflected light</p> </div> </div>



Selection and documentation of samples to be analysed

Conservators questions

Sample: Col_Ormocer®



internal face, transmitted light



internal face, reflected light



external face, reflected light

Conservator's Questions:

- What about the today's condition of the Ormocer® protection system?
- How is the adhesion between glass and the multilayered Ormocer® application?
- Can you detect and differentiate the various layers: 1) base lacquer, 2) protective lacquer with glass flakes, 3) final coating with Paraloid?
- Can you differentiate between glass and the Ormocer® coating system?
- When peeling off, does the Ormocer® lacquer affects the glass surface?
- Is there any chance to remove the Ormocer® coating without damage for the original glass?

Selection and documentation of areas for reversibility tests or reactivation tests

The glass sample can be used for scientific tests, but must not destroyed.

The two cracks within the sample may be opened if necessary for further investigations. This must be done by Katrin Wittstadt only!

Sample Col_Ormocer was separated in July 2009 for the investigations in samples:
Col_Ormocer_separated_1
Col_Ormocer_separated_2.

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	Data-sheet for pilot objects Cologne N VI Ormocer® 

RESPONSIBLE CONSERVATORS (name, phone, e-mail)	
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