

SOLAR ENERGY IN ARCHITECTURE AND URBAN PLANNING

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Berlin Germany 26-29 March 1996

FOURTH EUROPEAN CONFERENCE

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A PASSIVE SYSTEM FOR REHABILITATION AND PRESERVATION OF ANCIENT STAINED GLASS WINDOWS: THE CASE STUDY OF THE SUPERIOR CHURCH OF ASSISI ST. FRANCIS BASILICA

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The main purpose of this work is the passive protection and preservation of ancient stained glass windows together with the rehabilitation of window functions and preservation of its original aspect and visual perception. The methodology of work has been to consider the "window system" as an unitary system constituted by ancient window, interspace and new counterwindow. The counterwindow is designed to obtain the best conditions for protection, preservation and aesthetic revisement of the ancient glasses and "grisalles", without any active system or device. This aim is obtained in a passive manner through its own capacity of mediating between external aggressive climatic agents and internal ones due to large masses of visitors.

Keywords: Passive climate system, Facade integration, Integrated lighting control, Ventilated cavity window.

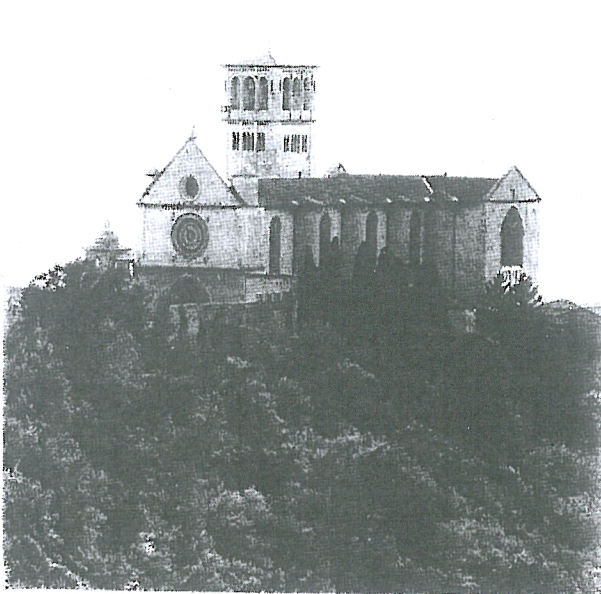


Figure 1: Assisi St. Francis' Basilica [2]

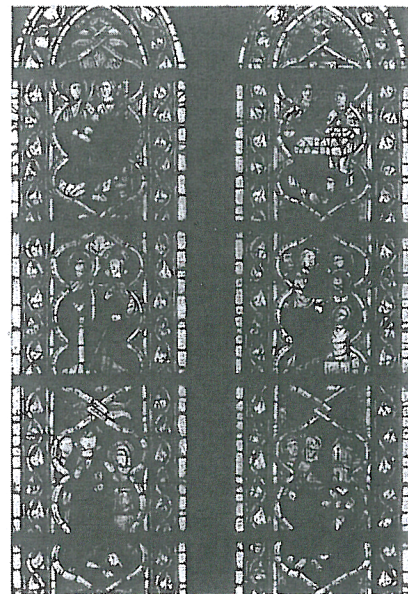


Figure 2: St. Francis' Basilica "Corpus Vitrearum", an ancient stained window [1]

1. INTRODUCTION:

Requalification and conservation of ancient stained glasses and "grisalles" is often a hard theme to deal with. Restoration design involves complex problems and many different aspects, which are more or less linked each other.

In one hand we have to requalify the window for what concern requirements connected with its window-function. In the other hand to get the possibility of favouring the ancient window in its originally aspects without modifying its aesthetic features and quality vision.

The way chosen in order to reach these purposes, must in any case act to create the ideal microclimate-conditions for glass conservation.

Case study window selected for this work is very interesting and significant [1].

St. Francis' Basilica in Assisi (Italy) was built up in two different epoques, in order to keep St. Francis' mortal remains. The Inferior Church, which is at present partially underground, dates of XIII century and the Superior one, dates of beginning XIV century. In the Superior church we can find a magnificent *Corpus Vitrearum* which is one of the oldest in the world. Most of original glass decorations is of the same period [2].

On the walls under the windows, in the inside part, there is the famous whole of 28 Giotto frescoes representing St. Francis' life.

Apart of damage caused by wars and incursions glasses conservation did not cause any real problem along the centuries. Today we remark that in the last decades deterioration has gone further with more intensity and we



Figure 3: Section and lateral view [2]

really have the necessity to operate to slacken this tendency. Deterioration is due mostly to atmospheric pollution and large masses of visitors, typically modern pollution factors, that change the original microclimate suitable to glasses and "grisalles" increasing mostly range of temperature and humidity.

On 1979 a first counterwindow, made of glass and iron, was installed, supported by an external net to prevent the possible danger caused by counterwindow glass breakage. Expectation were not satisfied because the only purpose was to cut off the window from the outside without any control of the microclimate in the interspace. Moreover, existing counterwindow was not able to control air and watertightness; water infiltrating into the interspace between the ancient window and the counterwindow could not evacuate and vacancy of range temperature control caused condensation on the ancient stained glasses, in the winter.

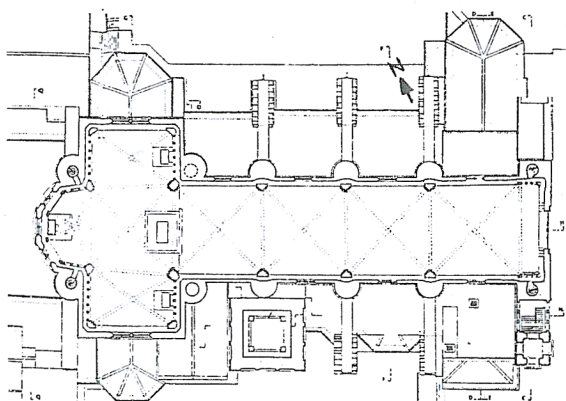


Figure 4: Plant of the Superior church [2]

2. AIM OF THE WORK:

The aim of the work is, first of all, to define a methodology which guide the sequence of design steps, in order to reach a design method for rehabilitation and preservation of ancient glass windows. This means to

organize climatic and non climatic actions, to analyze the requirements for functional, technical and aesthetical rehabilitation, to choose a specific intervention technique and at last to test devices' performance.

The define methodology has been verified with success for the selected case study.

Because of all the raising problems connected with the first counterwindow, we have planned to study again the situation. The methodology of work has been to consider the "window system" as an unitary system constituted by ancient window, interspace and new counterwindow. The counterwindow is designed to obtain the best conditions for protection, preservation and aesthetic revision of the ancient glasses without any active system or device. This aim is obtained in a passive manner through its own capacity of mediating between external aggressive climatic agents and internal ones due to large masses of visitors.

3. METHODOLOGY OF APPROACH:

The rehabilitation of the window functions imply the satisfaction of three groups of requirements:

- window function requirements;
- conservation requirements;
- aesthetical and visual perception requirements.

First of all the "window system" has to satisfy its proper window-function requirements as light transmission, airtightness and watertightness (also to protect the above Giotto's frescoes).

For what concern conservation requirements, the purpose is to preserve ancient stained glasses. This means principally to protect the window against external climatic factors as temperature, humidity, U.V. radiations, to protect against pollution factors, dusts and mechanical actions and to control surface temperature on glasses and "grisalles" in order to reduce thermal stress and to eliminate condensation.

By the way, not less important than conservation, it is the possibility of enjoying the ancient window in its originally aspects. The mystical atmosphere we have in the Basilica depends on the shadow-light effect due to the sunshine getting through stained windows. The contrast between dark walls and coloured glasses is high. This means that in any case the chosen device must not interfere with this

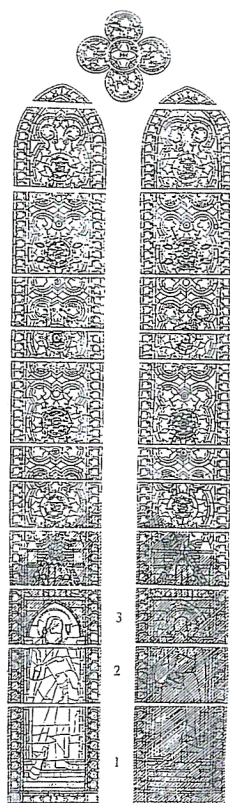


Figure 5: Window number XI [1]

effect, and must be as much invisible as possible. To reach this purpose is necessary to eliminate the net, not to reduce the amount and the quality of daylight, not to modify light colours and not to shade any part of the ancient window.

Followed design phases have been:

- background analysis: existig cases, optimal conservation values, materials and techniques.
- Existing counterwindow: physique survay, microclimate monitoring, chemical analisys on glasses and "grisalles".
- Glasses and "grisalles" restoration.
- Requirements and performances analysis and methodology definition.
- First design hypothesis: mathematical simulation.
- Executive design.
- Results check: prototype monitoration.

4. SIGNIFICANT RESULTS:

Counterwindow's design is a concrete issue and represents the application of the studied methodology. The designed prototype was eventually installed on the XI th window of the superior church and then monitored.

The window system is designed considering the aesthetic aspects and the functional-technological ones, in order to perform requirement's guidelines.

Shape and materials chosen for its construction respect aesthetic parameters, and each part can be easily

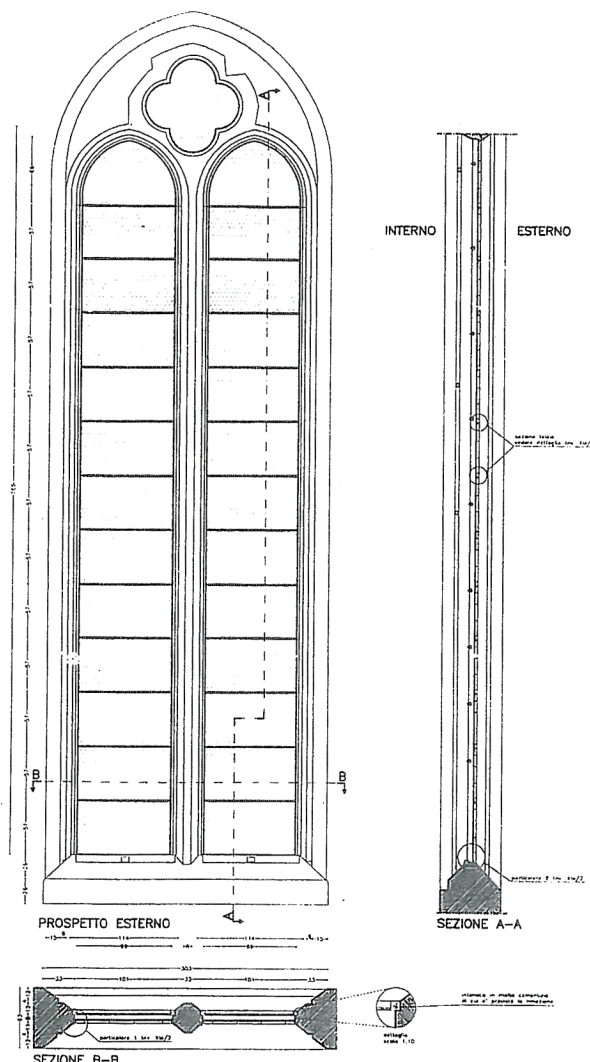
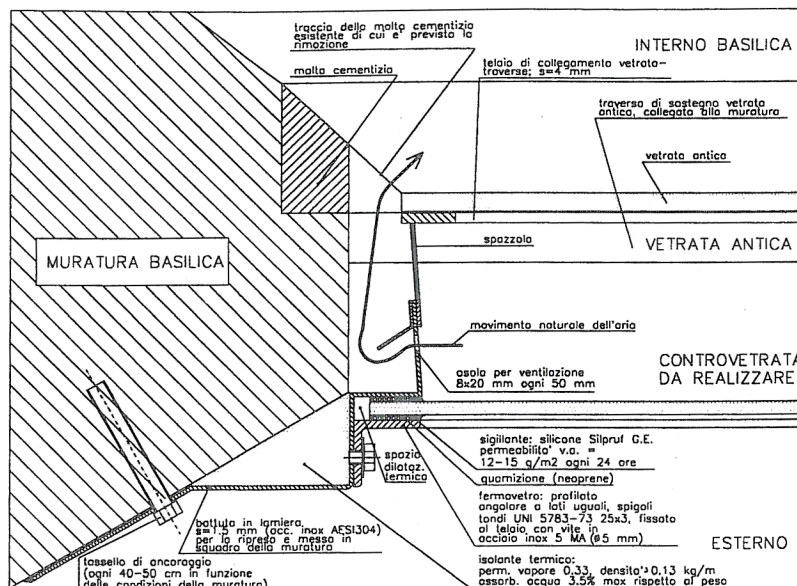


Figure 6: "window system"

maintained. The frame is made on painted inox steel, while the glass is of polycarbonate. Lead packing for frame and silicon packing for glasses are a guarantee for air and water thightness. Polycarbonate assures no reflection, non alteration of the sky light, U.V. protection and moreover it is unbreakable, light and easy to place. The "window system" designed is connected with the inside part of the Basilica and it is closed towards the outside. With this device we can obtain, in the interspace, the best microclimate for glass preservation by the air convective movements which allow air exchange between the counterwindow-window interspace and the inside of the building. Because of the short space available (4-7 cm) and of the important height (almost 8 m) of the interspace formed by ancient window and new counterwindow, in order to permit air mouvement, connection are located all along the height (every 5 cm). Especially the excessive temperature increasing during summer and rigorous temperature during the winter, is kept controlled in a satisfactory way.



PARTICOLARE 1 COLLEGAMENTO TELAIO-MURATURA

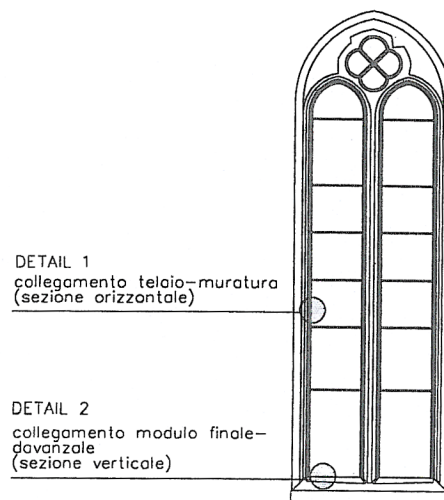
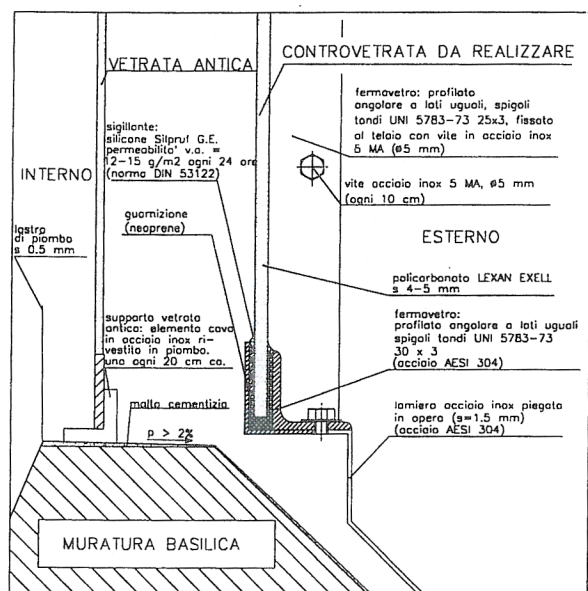


Figure 7: Technological details



PARTICOLARE 2 COLLEGAMENTO MODULO FINALE-DAVANZALE

This is done in a passive way and depends on inside-outside climate conditions.

While with the inside opening we can take advantage of natural ventilation, the external closing is a guarantee against air and water entrance.

The environmental (temperature, humidity, air speed) measures undertaken on the installed prototype, showed its overall efficiency as in winter as in summer. The counterwindow have shown no problems up to now, since the installation day (october 1994). Particularly, monitoring showed that condensation is removed on the ancient glasses during the winter, and that summer overheating in the interspace between window and counterwindow is not appreciable. Because of these positive results, window system designed for the case

study (window XI th), could be extended to all the "Corpus Vitrearum".

5. CONCLUSIONS:

The preservation of ancient stained glass windows can be achieved by means of passive components. The design of these components depends on many factors.

This research carries on existing background on ancient window protection and we believe that the studied methodology can give a design method to deal with new cases.

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