Knablhof, Mareit (Italy)

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Retrofit of a box-type window by exchanging the inner glass and inserting a sealant

Windows

What is the solution?

This method can only be used for constructions with several window layers (one behind the other), such as coupled or box-type windows. The historic window construction including window frame and outer glazing is conserved and restored. The solution foresees to replace the historical inner usually single glass panes with insulating glass or vacuum glazing. In order to fit insulating glazing, the rabbet and/or frame of the inner window often has to be enlarged on the outer side with a wood lath. This medium impact solution is combined with 1B. The Ug-value can be improved significantly and the historical appearance from outside can be preserved. It must be ensured that the existing hinges can bear the additional weight of the new glazing. In the case of the windows of the Knablhof, the historic window construction consisted of box-type windows from 1930/34. Airtightness of the windows was improved by milling a groove and integrating a seal on the inner side of the window frame. To reduce transmission heat losses, the single glazing of the inner window sashes was substituted by a double-glazing. So that the historical narrow frame can hold the thicker glazing pane, it was reinforced on the outside by a wooden strip (see drawing). The insulating glazing was fixed again on the outside with

putty (of linseed oil). The window frames were restored on-site by renewing the paint with linseed oil. The outer window sashes are painted with linseed oil paint in ochre according to the specifications of the monument office, while the inner window sashes are not painted with linseed oil paint as there is a risk that the linseed oil could damage the butyl of the insulating glass. Damaged outer panes were repaired with intact historical inner panes. Thus, all exterior windows have exclusively historical glazing.

Why does the solution work?

Conservation: The retrofit solution corresponds to the requirements of the heritage authority preserving the historic window construction and respecting all other criteria on color and proportions. Visual changes were foreseen only on the inner view on the window: the replacement of the historic single glazing in the inner window sashes into the thicker double-glazing with better energy performance required the enlarging of the inner window frames with a wooden strip. Besides that, the float double-glazing has another optic than the historic glazing. The integrated seal on the inner side of the window frame is only visible when the inner window sashes are open. Thus, the window appearance and proportions didn't change at all from the outside and only slightly on the inside. Moisture safety: The window construction after retrofit is generally moisture safe. Through the double-glazing in the inner window sashes, we have higher surface temperatures on the pane and thus less condensation risk. Surface temperatures in the angle between window frame and reveal are already higher in case of a box-type window. In case of the Knablhof interior insulation in the window reveal, avoids additionally condensation all around the window frame. The window manufacturer used special seals and a special manufacturing of the grooves which make it possible to make even slightly warped window frames completely airtight. Thus, no vapor can penetrate into the intermediate space between the two-window layer and condensate on the inner surface of the outer glazing. Energy improvement: Ventilation heat losses through leaky windows were decreased by improving the airtightness through a seal on the inner side of the window frame and between the two inner window sashes. Transmission heat losses were decreases by the exchange of the inner glazing into a double-glazing (Ug = 1,10 W/(m^{2}K) after; Ug = 5,75 W/(m^{2}K) before); the overall Uw-value was thus improved from 2,36 W/(m^{2}K) to 1,26 W/(m^{2}K).

Description of the context:

The Knablhof is a residential house located in Mareit in South Tyrol (North Italy) on a sea level of about 1.000 m. The building is very characteristic for the village. Built in 1819 it is one of the oldest buildings of the village in the village center. It was built as former chandlers' house with a connected barn and stable. Before the renovation, the house was uninhabited for 40 years. The heritage preservation office has formulated clear requirements for the building, which is under monument protection, which were taken into account during the retrofit. Conservation requirements with regard the windows: "Preservation of the historic window construction, (an energetic upgrading is possible): wooden windows with sash bars and slender window frame dimensions, drip sill (Wetterschenkel) on the below side of the frame in wood. Window colors in ochre with linseed oil paint, preservation of room layout, retention of size and frame proportions, replacement of one window into a window door is possible." Main aim of the retrofit was the improvement of energy efficiency, the improvement of airtightness and to make the building habitable again.

Pros and cons of the solution:

Pros: (i) in case of a box-type window, the two window layers allow to intervene on the inner window layers for energy enhancement, the view from outside can be completely preserved; (ii) with this solution great parts of the window construction can be preserved (all wooden parts) and is only slightly changed. Historic glazing on the outer window layer is preserved, too; (iii) at the same time energy performance can be improved significantly (Uw-value after retrofit 1,26 W/m^2K) Cons: (i) the inner (energy efficient) window layer has to be widely airtight, the seal has to compensate also uneven or slightly curved window frames - the outer window layer has to be "untight" or well ventilated enough - both in order to avoid condensation risk on the outer window layer. Innovations: The window manufacturer Josef Moser used a system from Zoller-Prantl for the renovation. The special sealant patented by the company allow even warped window frames to be made completely airtight. Thus it can be avoided that moisture can penetrate into the interior of the box-type window and cause condensation.

Type of data available:

Information available: Photos, digital drawings after measurement (views from inside and outside, horizontal section), description, heritage value assessment (before retrofit), thermal simulation in Framesimulator, Uw-value calculation, evaluation of conservator afterwards

Additional information about the solution:

When renovating the box window with this method, care must be taken to ensure that the seal of the inner window is done in an accurate way. At the same time, the outside window must be well ventilated enough to be able to remove moisture in the space between the panes. If room air enters the window cavity, the risk of condensation is high. The window manufacturer used a system from Zoller-Prantl for the renovation. The special gaskets patented by the company enable even warped window frames to be closed completely airtight. Thus, no humidity can penetrate the interior of the box window. The window solution was documented in the FESR project PlanFenster, including detail drawings and U-value calculation.

Available pictures or puplications of the solution:

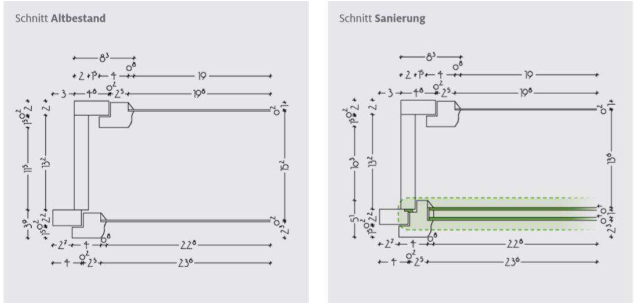
South view before retrofit, Elmar Gruber

South view after retrofit, Darius Richter

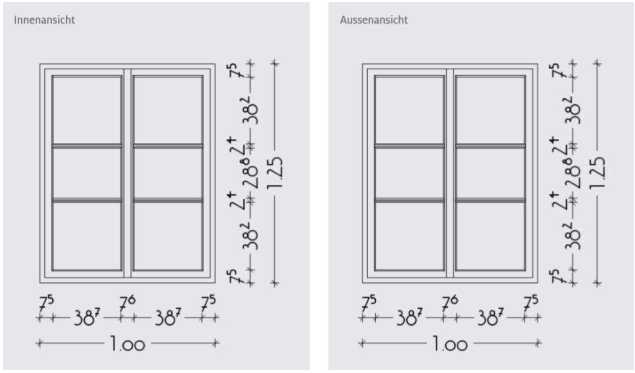
West view before retrofit, Elmar Gruber

West view after retrofit, Darius Richter

Box-type window, view from outside, Darius Richter



Horizontal section of the box-type window before and after retrofit, EURAC



View window from inside (left) and outside (right), EURAC

Thermal properties	Existing window	Refurbished window
Window type	Box-type window	Box-type window
Glazing	Inner window: single glazing Outer window: single glazing	Inner window: double glazing Outer window: single glazing
Shading	Without/window shutters	Without/window shutters
Uw		
Ug	5,0	5,0
Uf	1,4	1,4
g-value glass	0,6	0,6
Air tightness	No sealing	Zoller-Prantl sealing
Approximate installation year	1819, 1930-34	2017

Thermal properties

Box-type window, new inner glass, Darius Richter

Box-type window, view from inside, Darius Richter

Box-type window after retrofit, detail with sealant, Darius Richter

https://www.hiberatlas.com/smartedit/projects/83/03_RE_Planfenster_Knablhof_03.pdf

Link to best pracitce example:

http://www.eurac.edu/de/research/technologies/renewableenergy/projects/Pages/PLANFenster.aspx