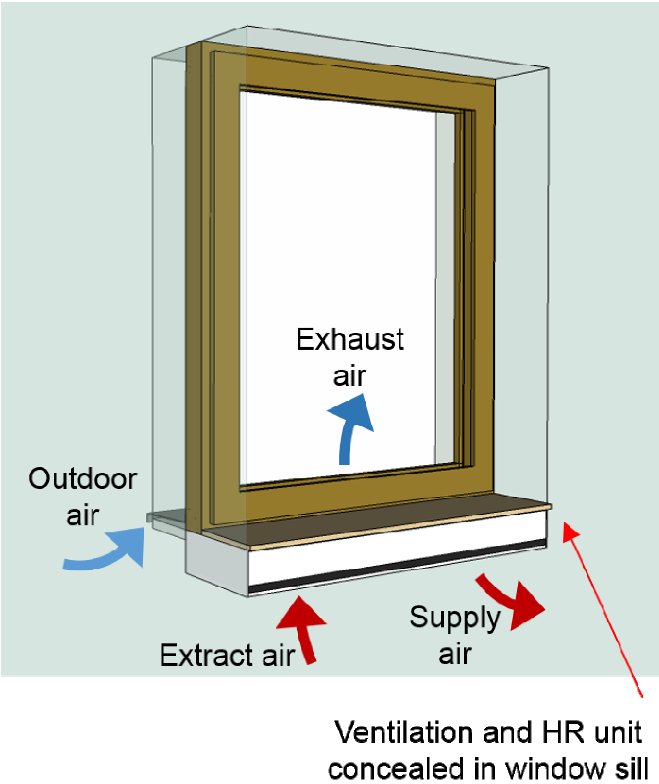
D5.1.8_Window_integrated_ventilation



INTELLIGENT ENERGY – EUROPE II

Energy efficiency and renewable energy in buildings

IEE/12/070

EuroPHit

[Improving the energy performance of step-by-step refurbishment and integration of renewable energies]

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Abstract

This document is a guideline for the ventilation industry interested in developing new products for the Passive House standard. Although this is focused on the needs of step-by-step renovation, the identified areas for product development are mostly valid also for 1-step renovations or new buildings.

The product briefs discuss in more detail the demands of these new products. Similar products and products in development are given as examples to make the case as clear as possible.

It is now up to the manufacturer to gain market advantages through innovations.

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1 Window – Integration

- Placement: Façade/Windows
- Type of building: Residential small and large, Office
- Climatic conditions: Cold, cool temperate, warm temperate, warm

1.1 Description

When exchanging windows, the resulting opening can also be used to integrate a ventilation system in addition to the new window. Enlarging the opening below, on one side, or in case of existing shutter boxes, above the existing window is possible without interfering with the structural integrity of the building. In the case of exchanging the shading devices, a new shading concept should consider the ventilation solution (the old shutter box, for example, can be used for the installation of the ventilation device).

Thinking of window integration in the context of step-by-step refurbishment, there might be three options:

1. The ventilation system is already integrated in the new window. Exchanging the window therewith means reducing transmission heat losses and ventilation heat losses at once while increasing the thermal comfort.
2. The ventilation system will be installed in a second step, when the new window is already installed. For this case however good window solutions will be required in order to simplify the ventilation-installation afterwards.
3. Shutter box: the ventilation system might be integrated in the space of the old shutter box. The approximate dimensions of old shutter boxes are 200 x 200 mm (length according to the window measures). The available space is quite limited, but might be sufficient for small room wise ventilation systems for residential use.

1.2 Demands

Additional to the requirements for façade integration, the following specific requirements for window integration must be considered.

The impact of the thermal bridges on the heating demand, inner surface temperatures and whole energy efficiency of the combined system needs to be determined and considered, to ensure the absence of damage, to achieve the requirements of an energy efficient construction, and to fulfil the demand for comfort. Therefore, requirements in terms of hygiene, energy efficiency and comfort have been already defined and can be adapted to integrated ventilation concepts.

The installation of window-frames causes a thermal bridge, due to geometrical thermal bridge effects and the different heat transfer coefficient of the regular wall system and the component itself. In addition to that, interconnection effects may occur caused by joints, the mounting of the window and the interconnection of materials with higher conductivity, e.g. the aluminium facing shell of the frame in combination with concrete or other highly conductive materials. Therefore, it is necessary to determine the thermal bridge coefficient of the installed component to connecting components and to determine its impact on the heating demand and the energy balance of the building. Punctual executions may require a 3D FEM simulation. The thermal transmittance coefficients and the thermal bridge coefficients of transparent components are determined on the base of DIN EN ISO 10077, EN 673 and DIN EN 12631.

The installation ψ-value must be calculated for the specified details. Verification of the hygiene criterion is provided using 2-dimensional heat flow calculations of the standard cross-sections. The most unfavourable temperature factor shall be applicable.

In order to achieve the requirements of comfort, the following quotation is applicable. This formula includes the thermal bridge effects of the installation. In contrast with the average operative indoor temperature, the minimum surface temperature may deviate by a maximum of 4.2 K. A bigger difference may lead to unpleasant cold air descent and perceptible radiant heat deprivation.

$$U_{transparent,installed} \leq \frac{4,2K}{(-0,03 \cdot \cos\beta + 0,13)\ m^2K/W \cdot (\theta_{op}K - \theta_a K)}$$

In addition to that, the requirements of hygiene should be met. The requirement restricts the minimum temperature at the window surface for health reasons. Mould growth may occur if water activity exceeds 0.80. Such conditions should therefore be avoided. The $f_{Rsi=0,25}$ temperature factors should not exceed 0.70 for cool temperate climates.

1.3 Advantages

- New windows require a forced air exchange due to higher air tightness, window
- Integrated ventilation can provide both: improved air tightness and controlled ventilation
- Decentralized solution with a potential of minimized ducting
- RES integration possible on facade/window/shading
- Integration possible without structural impact on the building
- In case of shading boxes, airtightness and thermal bridge free construction can be achieved at the same time.

1.4 Risks

- Maintenance (filter accessibility)
- Noise from ventilators
- Traditional overflow concept not working
- Frost protection and condensation
- Costs

1.5 New products

- Window sill integrated ventilation unit (designed for up to 100 m3/h)
- Window side integrated ventilation unit (designed for up to 100 m3/h)
- Window top integrated ventilation unit with integrated shading box (designed for up to 100 m3/h)
- Window frame integrated ventilation unit (designed for 20-40m3/h)

1.6 Similar solutions

There are several products (ventilation device integrated in the window frame) already available on the market promising ventilation and a good heat recovery at the same time. But a closer look at the different systems show that the required heat recovery of at least 75% (basic requirement for certification as passive house component according to [PHI 09]) simply can’t be fulfilled with most of the products because the units providing only cross flow heat exchanger or no heat recovery at all.

Following is the description of a positive example one for residential and one for non-residential use.

1.6.1 Paul Wärmerückgewinnung Premivent

This device was designed to be installed under a window frame in the facade and there with using the space that is already lost for other use. The ventilation performance of about 60 m³/h is suitable to ventilate single rooms. A further development of this product in direction of a slightly higher air flow rate and optional second room connection is desirable in order to be able to use this device even in small flats with 3 rooms.

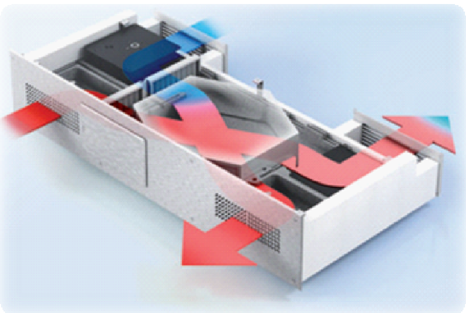

Figure 1: Facade integrated ventilation device designed to be installed under the window frame [Source: Paul Wärmerückgewinnung]