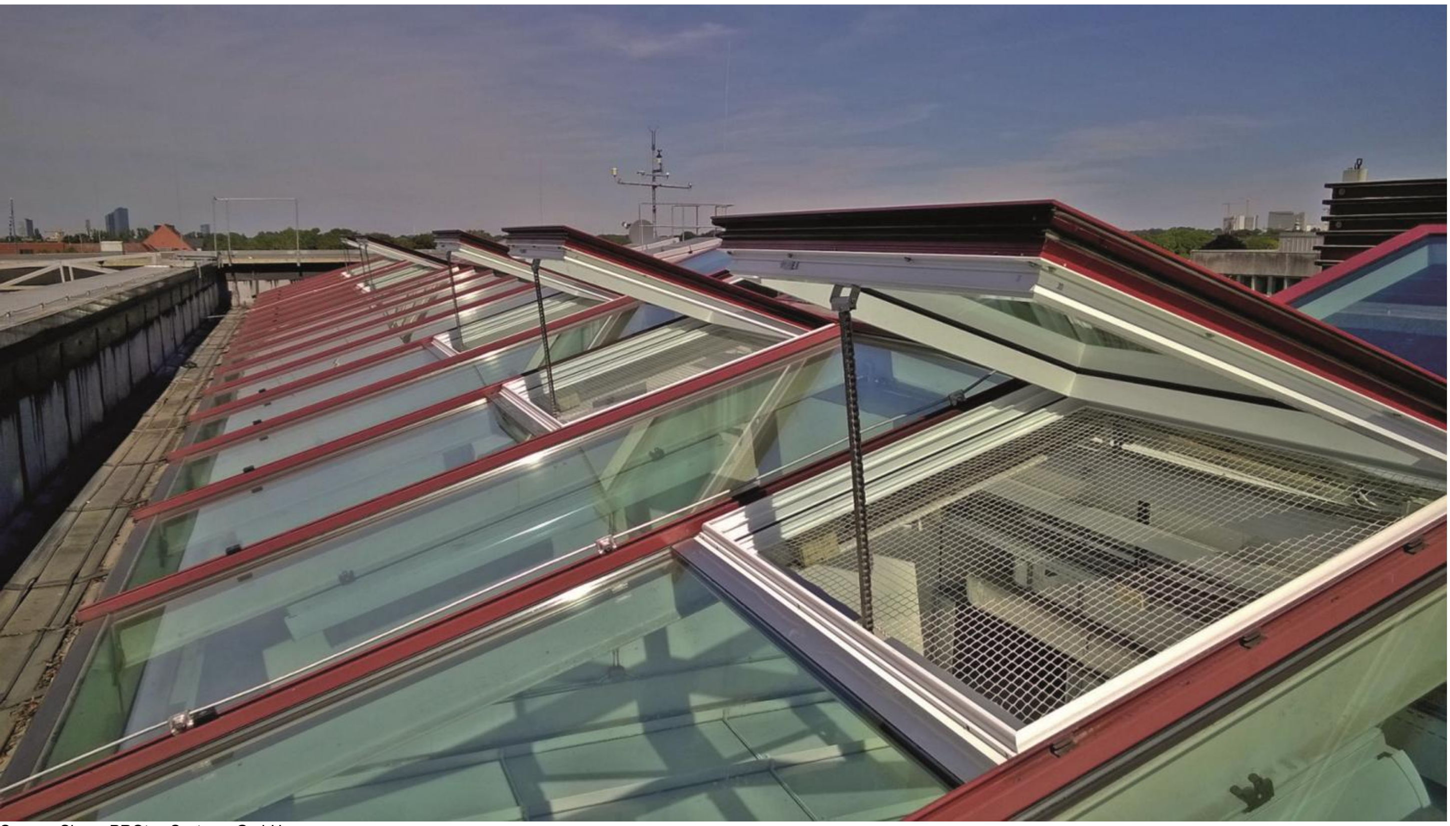

Source: Simon PROtec Systems GmbH

Openings for smoke exhaust

Information on calculating opening areas

Information sheet 33027:2025-09

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1 Introduction

The term "opening for smoke exhaust" used in building regulations has almost completely replaced the previously common term "geometric free area" in recent years, even in tenders.

Unlike smoke and heat exhaust ventilators in accordance with EN 12101-2, which are measured in a wind tunnel, the area of openings for smoke exhaust must be determined geometrically. This can be done on site at the opening or based on drawings (taking into consideration the installation).

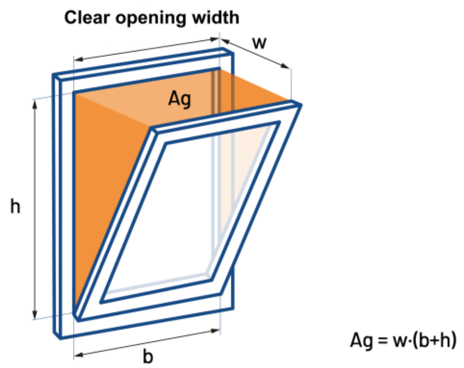
This information sheet helps you to calculate the free geometric cross-sections.

2 Opening width and free geometric cross-section for facade openings (windows and louvre windows)

2.1 Windows in the facade

To determine the geometric free area, the "clear opening width b," the "clear opening height h," and the "clear opening width w" are decisive, for example, in the case of a tilt-and-turn sash (Figure 1).

Single window:



Ag = geometric free area

a = Distance between the windows

b = Clear opening width

h = Clear opening height

w = Clear opening width

$$Ag = w \cdot (b + h)$$

Illustration 1

Two windows with distance $a \leq \frac{1}{2} b$:

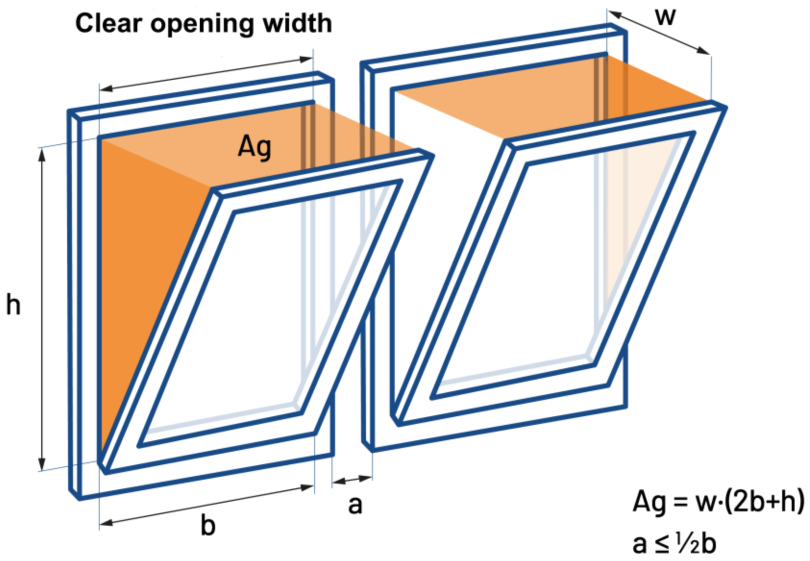


Illustration 2

Two windows with a gap $a > \frac{1}{2} b$:

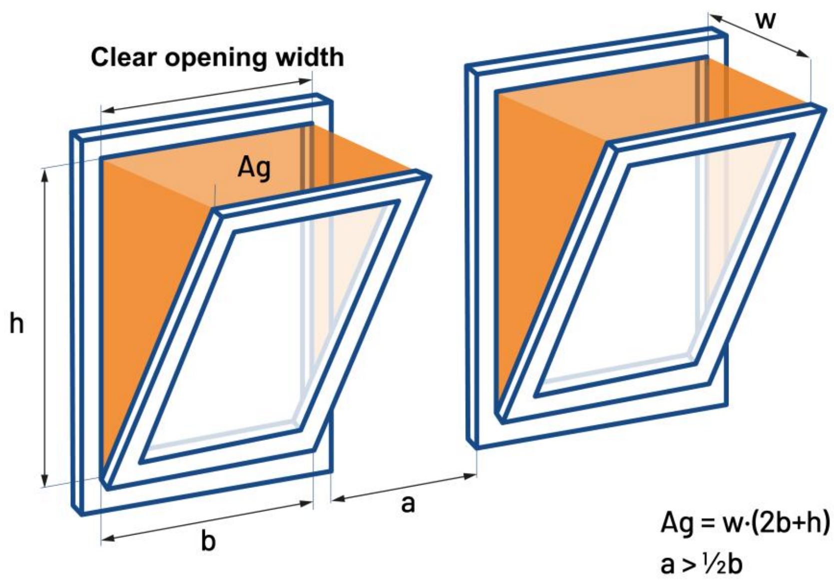


Illustration 3

$Ag = w \cdot (2b + h)$ applies if $a \leq \frac{1}{2} b$ - otherwise, the rules for a single window apply, i.e., for two windows: $Ag = 2 \cdot w \cdot (b + h)$

Any number (n) of windows with spacing $a \leq \frac{1}{2}b$:

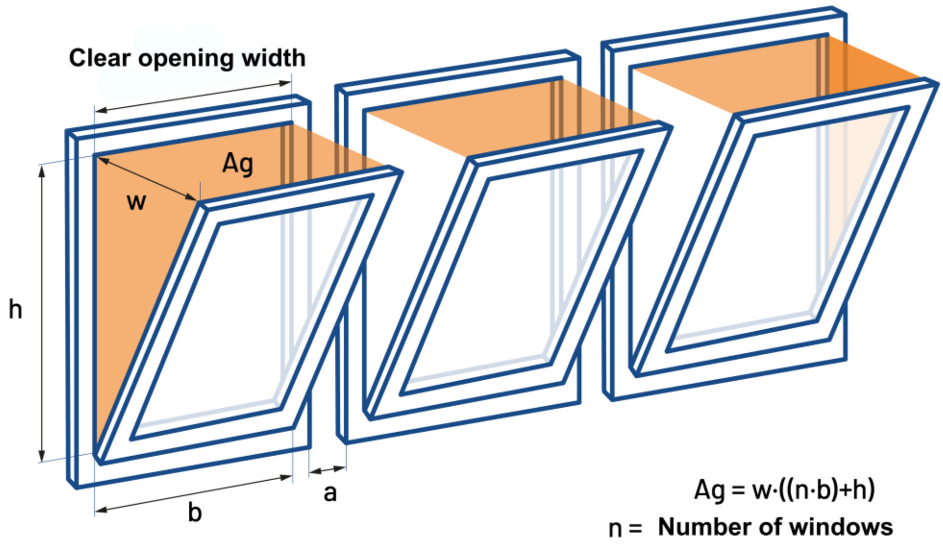


Illustration 4

Please note that, regardless of the installation examples above, the geometric free area cannot be larger than the clear building opening. Equivalently, the rules established here for tilt windows can also be applied to other window types (e.g., swing windows). In individual cases, it must be checked whether components such as insect screens or photovoltaic systems need to be considered when calculating the geometric free area.

3 Examples

The following calculation examples illustrate the relationships:

3.1 Single window (Figure 1)

Assumptions:
h= 1.5 m
b= 1.25 m
w = 0.3 m

Calculation:

$$Ag = w \cdot (b + h) = 0.3m \cdot\ (1.25m + 1.5m) = 0.825m^2$$

3.2 Two identical windows with a distance of $a\ \leq\ \frac{1}{2}b$ (Figure 2)

Assumptions:
a=0.3m
h=1.5 m
b=1.25 m
w=0.3m

a is therefore$< \frac{1}{2}b$, since $a = 0.3m$ and $\frac{1}{2}b = 0,.25m$

$$Ag = w \cdot (2b + h) = 0.3m \cdot (2 \cdot 1.25m + 1.5m) = 1.2m^2$$

3.3 Two identical windows with a distance between them $a > \frac{1}{2}b$ (Figure 3)

Assumptions:
a=0.8 m
h=1.5 m
b=1.25 m
w=0.3 m

a is therefore $> \frac{1}{2}b$, since $a = 0.8m$ and $\frac{1}{2}b = 0.625m$

$$Ag = 2 \cdot w \cdot (b + h) = 2 \cdot 0.3m \cdot (1.25m + 1.5m) = 1.65m^2$$

$a > \frac{1}{2}b$, the calculation formula for a single window applies, i.e., the geometric free area Ag doubles for two identical windows.

3.4 Three identical windows with a respective distance of $a \leq \frac{1}{2}b$ (Figure 4)

Assumptions:
a=0.3 m
h=1.5 m
b=1.25 m
w=0.3 m
a is therefore$\leq \frac{1}{2}b$, since$a = 0.3m$, and $\frac{1}{2}b = 0.625$

$$Ag = w \cdot \left((n \cdot b) + h\right) = 0.3 \cdot \left((3 \cdot 1.25m) + 1.5m\right) = 1.575m^2$$

3.5 Three identical windows with respective distances $a > \frac{1}{2}b$

Assumptions:
a=0.8 m
h=1.5m
b=1.25 m
w=0.3 m

a is therefore$> \frac{1}{2}b$, since a=0.8 m and $\frac{1}{2}b = 0.625m$

$$Ag = n \cdot w \cdot (b + h) = 3 \cdot 0.3m \cdot (1.25m + 1.5m) = 2.475m^2$$

The following must also be considered in the calculations:

Depending on the design and installation situation of the window/flap, the clear opening width may vary. For example, it is reduced if the opening is directly adjacent to a ceiling. It should also be noted that deep reveals reduce the geometric free area accordingly, as the usable height (h_{red}) is reduced by the reveal depth (see Figure 5 on the right).

If, for example, the distance to the interfering contour (e.g., ceiling) "s" is less than or equal to the clear opening width "w," then "w" must be replaced by "s" in the above calculation formulas (Figure 5, left and centre).

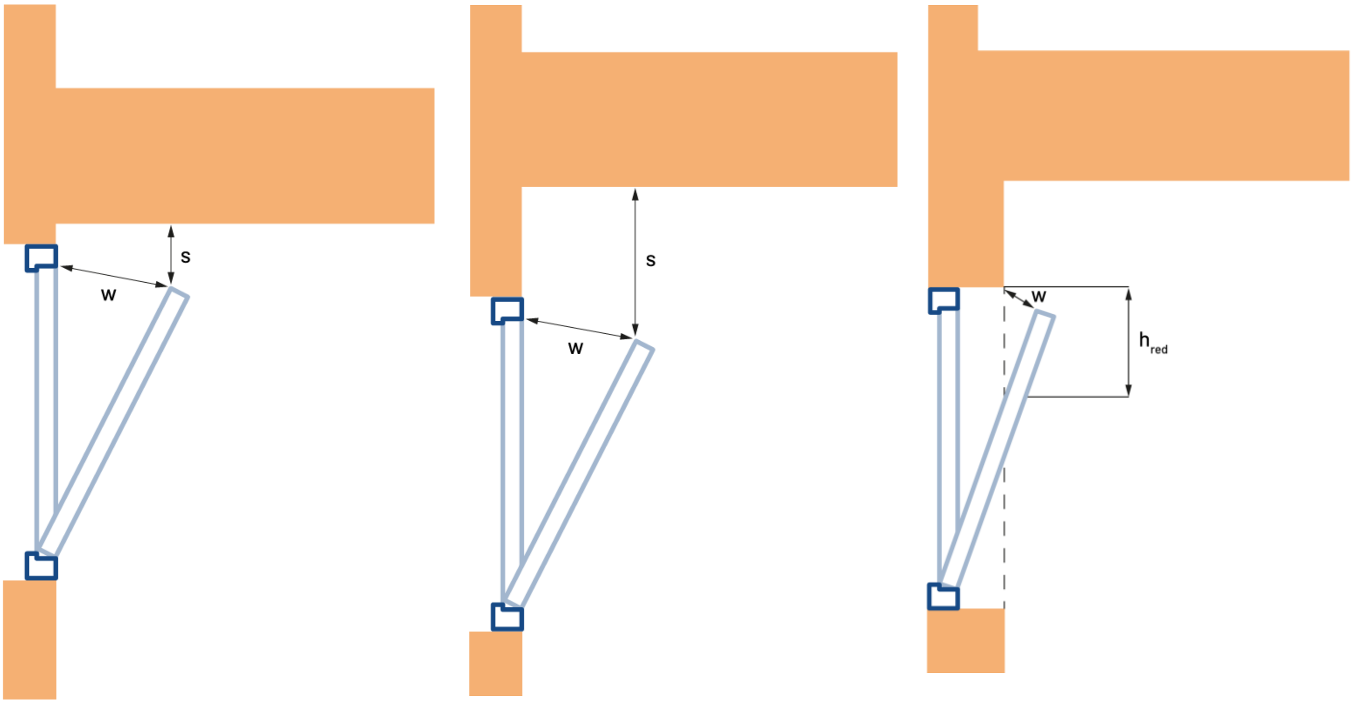
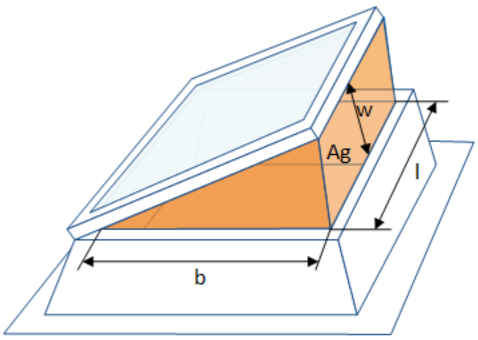


Illustration 5

3.6 Opening width and free geometric cross-section for roof openings (skylights, flaps in skylight strips, flat roof windows, and louvre ventilators)

Sample calculation Ag for skylights and flat roof windows

To determine the geometric free area for a skylight dome or flat roof window, the clear opening width (b), clear opening length (l), and clear opening width (w) are decisive (Figure 7).



Ag = Free geometric cross-section

b = Clear opening width

l = Clear opening length

w = Clear aperture width

$$Ag = w \cdot (b + l)$$

Illustration 7

Please note that the geometric free area cannot be larger than the geometric exit area of the flashing ($b \cdot l$). In individual cases, it must be checked how fixtures such as fall protection or insect screens are to be considered when calculating the geometric free cross-section.

Continuous rooftop flaps in skylights

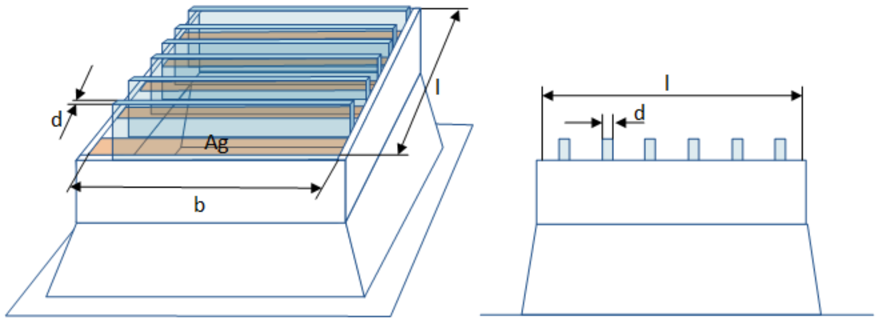
The calculation instructions in 2.1 apply equally to continuous rooftop flaps installed in skylights or glass roofs.

Calculation of the required opening width (w)

$$w = Ag/(l + b)$$

After determining the mathematically required opening width, it must be ensured that there is sufficient swivel range for the selected opening unit (electric motor or pneumatic cylinder).

Calculation of Ag for a louvre ventilator (Figure 8)



Ag = geometric free area

b = Clear opening width

l = Clear opening length

d = Material thickness of the blade

n = Number of louvres

$$Ag = b \cdot (l - (d \cdot n))$$

Illustration 8

4 Terms / Explanations

Smoke extraction opening
Smoke extraction openings are openings in the building envelope that are closed by a closure and can be opened by a device for opening the closure if necessary.

Devices for opening
Device for opening the closure of a smoke extraction opening when necessary.

Closures for smoke extraction openings
Cover for a smoke extraction opening to protect against the weather and reduce energy loss. The closure of a smoke extraction opening must be activated manually and automatically by a fire detection system and an opening device in the event of a fire.
In this context, the requirements of the building regulations of the federal states and any requirements in the special building regulations or guidelines of the federal states must be considered.

Interfering contour
Building or construction elements that have a negative impact on the clear cross-section.

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