Building Research
Design Guides
Version 1 – 2003

Installing windows in brick and concrete walls

523.702E
Part I

0 General

01 Contents

This Design Guide describes the installation of various types of windows in brick, poured concrete and concrete block walls.

The Design Guide shows how the windows should be positioned in the wall, how they should be installed and fastened and how you should insulate and seal the gap between the window frame and the wall.

02 References

The Planning and Building Act (PBA)
Technical regulations (TEK) Pursuant to the PBA with guidelines
Standards:
NS 3420 Specification texts for building, construction and installations
Building Research Design Guides:
520.406 Using elastic sealant to seal joints
520.415 Weather-protective flashings
523.231 Cavity walls with leaves made of brick and blockwork
523.242 Walls made of lightweight aggregate building blocks
523.621 Joints in concrete block facades
523.701 Installing windows in framework walls
542.301 Brick facings. Parts I and II
542.303 Render on insulation
573.102 Sealing materials for joints. Groups and terminology
573.104 Sealants. Properties, choice of materials
573.107 Single-component polyurethane foam. Properties, areas of use
573.121 Materials for air and moisture tightening
Group 533 concerning windows
Building administration:
723.638 Replacing windows

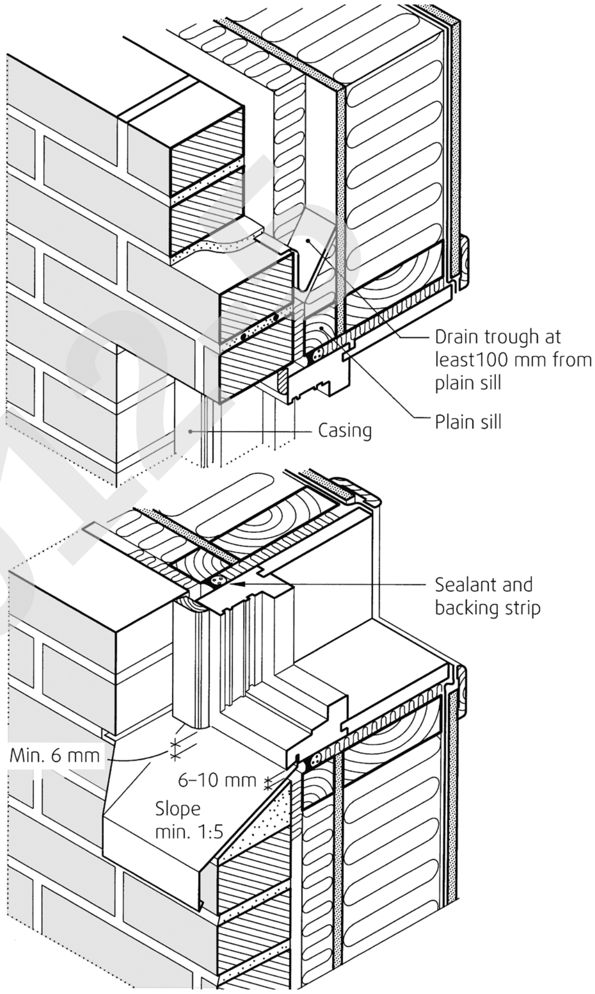


Fig. 25
Installing windows in frame walls with brick facing

1 Requirements and recommendations

11 Technical regulations (pursuant to the PBA)

TEK sets out a number of requirements relating to the properties of windows. Depending on where they are to be used, there are regulations relating to stability, fire safety, health and the environment, safety of use, sound insulation and thermal insulation. TEK also requires these properties to be adequately documented; see Section 14. Windows and other parts of the building must be fastened securely, to ensure that they do not fall out and cause personal injuries.

12 Functional requirements

Windows must be securely fastened, not just to avoid the window falling out or blowing in, but also to ensure that the window functions as intended during many years of opening and closing.

The external casings, mouldings and sealing must prevent rain and wind from penetrating through the wall via the joint between window and wall. It must also be possible for the window and joint to dry out, so that materials that become damp can quickly dry out again. The joint must be sufficiently air-tight on both the cold and warm sides to prevent through-going air leaks and convection within the joint insulation.

13 Other requirements

It is particularly important that windows classified in a specific fire and sound insulation class should be installed in accordance with the manufacturer's instructions. The installation instructions should always be available at the construction site. Installation of windows is described in NS 3420-R5.

14 Documentation of product properties

TEK stipulates that product properties affecting the fundamental requirements relating to structures should be documented before the product is marketed and used. The documentation is generally produced in accordance with the Norwegian Standard or equivalent technical specifications. Relevant documentation may include type approval from the Norwegian Door and Window Control, Technical Approval or Product Certification from SINTEF Certification, including any product-specific installation instructions.

2 Positioning and installation details

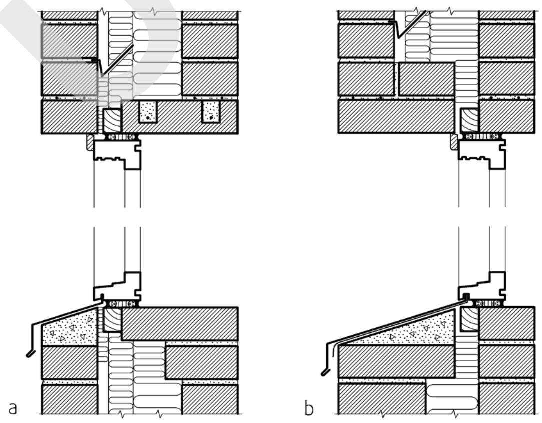
21 General

211 *Positioning options.*

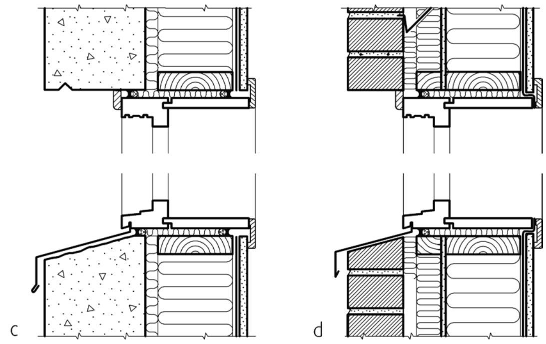
Positioning of the window (far out or deep in respectively) relative to the wall affects a number of issues and should be considered carefully. You must bear in mind aspects relating to moisture, thermal insulation and architectural design. See Sections 214 and 215. Brick and concrete walls are generally thicker than frame walls, leaving you with more choices as to where you position the window in the opening.

The principles behind the positioning of windows in various types of walls are shown in Figs 212 a to g.

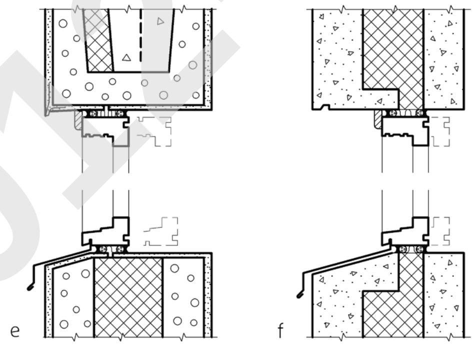
212 *Positioning of the window* (far out or deep in respectively) relative to the wall affects a number of issues and should be considered carefully. You must bear in mind aspects relating to moisture, thermal insulation and architectural design. See Sections 214 and 215. Brick and concrete walls are generally thicker than frame walls, leaving you



Figs 212 a and b
Principles behind the correct/alternative positioning of windows in cavity walls
a. In the outer part of the wall
b. Towards the warm side of the wall



Figs 212 c and d
Principles behind the correct positioning of windows
c. Concrete wall insulated on the inside
d. Wall framework with brick facing



Figs 212 e and f
Principles behind the correct positioning of windows. Dotted lines show alternative positioning.
e. Wall made of lightweight aggregate building blocks (sandwich blocks)
f. Wall made of concrete sandwich elements

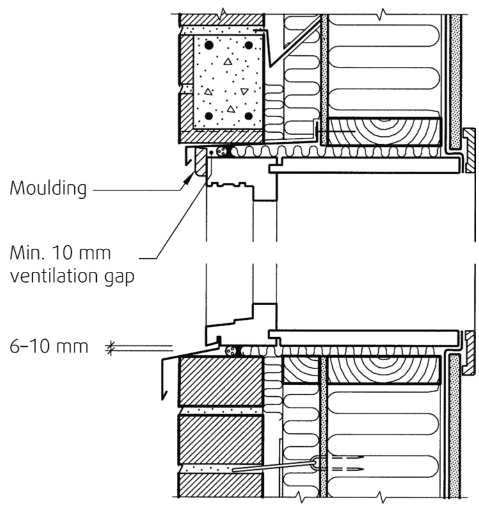


Fig. 212 g
Principles behind the positioning of windows close to the outer surface of frame walls with brick facing. The window must be fastened to the framework using brackets.
This system is not recommended for high buildings with large relative movements between the rear wall and the facing, e.g. concrete buildings that are more than two storeys high.

with more choices as to where you position the window in the opening.

The principles behind the positioning of windows in various types of walls are shown in Figs 212 a to g.

213 *Recommended positioning*. In order to avoid thermal bridges, and thereby eliminate unnecessary heat loss, the window should be positioned in line with the layer of thermal insulation. As a general rule, the window should be placed so that the turned-up edge of the windowsill flashing is just outside the insulation layer; see Fig. 212 a. Positioning the window here minimises heat loss, makes it easier to seal against rain and minimises the risk of damage due to moisture. A good seal against rain is particularly important in areas exposed to large amounts of driving rain.

214 *In cold inland regions* with little driving rain, the window can be positioned towards the warm side of the wall in order to reduce the risk of condensation on the inside; see Fig. 212 a. If the window is positioned so far in that the turned-up edge of the windowsill flashing enters the insulation layer, it is very important to ensure that the flashing and the seal around the window are completely rain tight in order to prevent leaks and damage to the wall due to moisture. See Fig. 65 b in Part II.

215 *Positioning the window in the outer part of the wall* will:
- facilitate sealing against rain and minimise the risk of moisture in the wall below the window, as driving rain penetrating past the exterior casing can easily drain down outside the insulation
- maximise the solar heat gain as the window opening doesn't shade the window to any large extent
- maximise drainage and ventilation behind the exterior casing and increases the rate at which the window dries out after driving rain
- increase the risk of rain falling on the frame head. This means that good drainage above the window is of great importance.
- increase wear and maintenance requirements

216 *Positioning towards the warm side of the wall* will:
- Reduce the risk of condensation on the inside of the window to a certain extent, as the internal surfaces of the window will stay warmer Without deep window niches, the window will more easily be warmed by heat sources below the window and from the general warm air circulation in the room. Positioning the window further in will also reduce the risk of cold draughts from the window.
- reduce the risk of condensation on the outside of the window, as the external surface of the window will stay warmer. This is due to the window recess providing partial protection from the effects of a clear (cloudless) sky.
- increase the lifetime and reduce the need for maintenance, particularly of wooden windows. This is because the window will be exposed to less rain, and also because the frame and the sash will be warmer, reducing their average moisture content.
- reduce solar heating. This is an advantage for buildings that produce excessive heat and need cooling.

22 Cavity walls

It is normal to position the window as an extension of the wall's thermal insulation layer and in such a way that it can be fastened to a plain sill that is installed between the inner and outer leaves, see Figs 212 a and b. In the event of driving rain, some water will always penetrate the outer leaf. In order to protect the window against water running down the back of the outer leaf, you must install a channel above the window that directs the water sideways, past the sill and out to the outer jamb. In this type of wall it is particularly important that the gap between the window and the wall on the inside is sealed against both air and moisture. On account of relative movements between the inner and outer leaves, the window must never be fastened to the outer leaf. It is also bad practice to fasten it to the outer leaf as this will increase heat loss and reduce the temperature of the frame and sash.

Design Guide 523.231 specifies how a cavity wall is constructed in greater detail.

23 Concrete walls insulated on the outside

In concrete walls insulated on the outside it is normal to fasten the window to the insulated portion. The installation method for walls with cladding fixed to battens is in principle the same as for windows in wooden framework buildings; see Design Guide 523.701. An

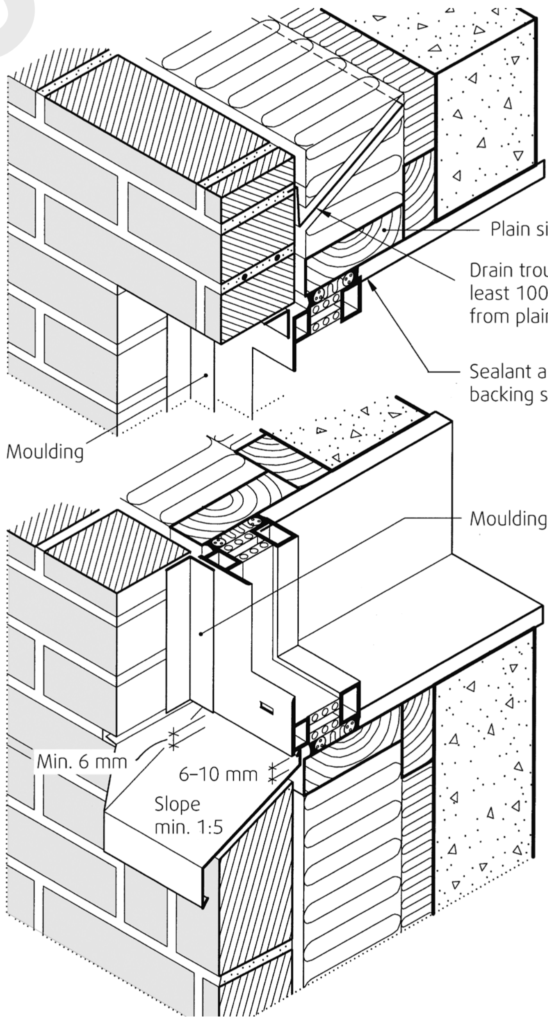


Fig. 23
Installing a metal window in an externally insulated concrete wall with brick facing

example of a window being installed in a brick-faced concrete wall is shown in Fig. 23. Design Guide 542.303 sets out how to install windows in walls with render on external insulation.

24 Concrete wall insulated on the inside

In concrete walls insulated on the inside it is normal to position and fasten the window to the framework, see Fig. 212 c.

25 Framework walls with brick facing

Windows in framework walls with brick facing should be positioned in such a way that the rear edge of the windowsill flashing is outside the insulation layer; see Fig. 25 (vignette on Page 1). The window is fastened to the framework. See Design Guide 523.701.

26 Walls made of lightweight aggregate (LWA) building blocks

In walls made of lightweight aggregate (LWA) building blocks with a foam insulation core, the window should be positioned as an extension of the insulation layer; see Figs 212 e and 26. Before fitting the windows, the blockwork walls must be wind proofed in the window openings by the application of render. In order to prevent moisture from being sucked in through the render in the window opening, and to break the thermal bridge, the render must not go right through, but must stop at the core of the insulation where the window will stand; see Fig. 26. It is important that the render has a drip edge above the window.

In walls made of hollow lightweight aggregate building blocks, windows have traditionally been positioned roughly in the middle of the wall. If additional insulation is to be added to such walls, the window should be positioned in accordance with the guidelines in Sections 23 and 24.

For large operable windows, it may be necessary to reinforce the window niche using U-blocks. Design Guide 523.242 describes walls made of lightweight aggregate building blocks in greater detail.

27 Concrete sandwich elements

Concrete sandwich elements are available with and without a plain sill. The window should be positioned as an extension of the integral thermal insulation and be fastened to the sill, or to the inner concrete leaf, see Figs 212 f and 27. Design Guide 523.621 deals with joints in facades made of concrete elements

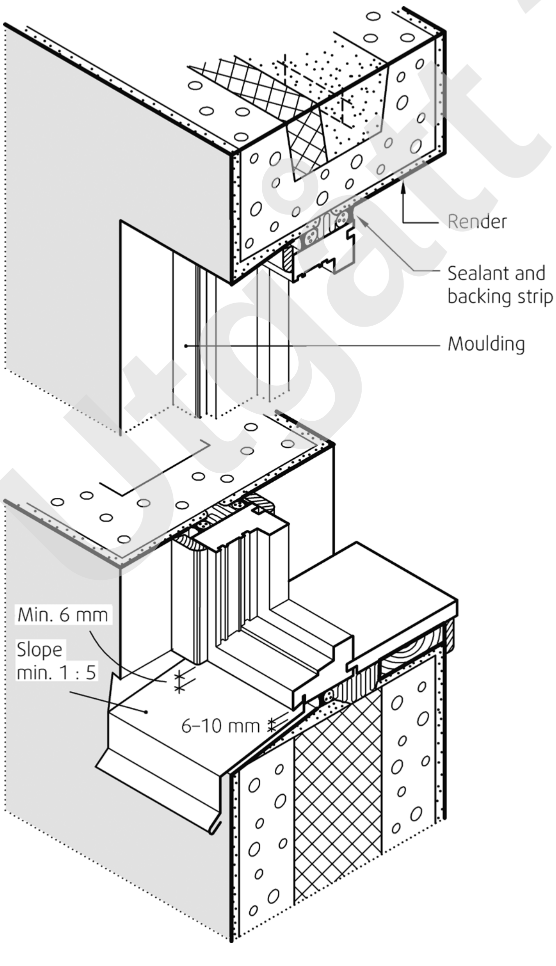


Fig. 26
Installing a wooden window in a wall made of lightweight concrete blocks with foam insulation cores

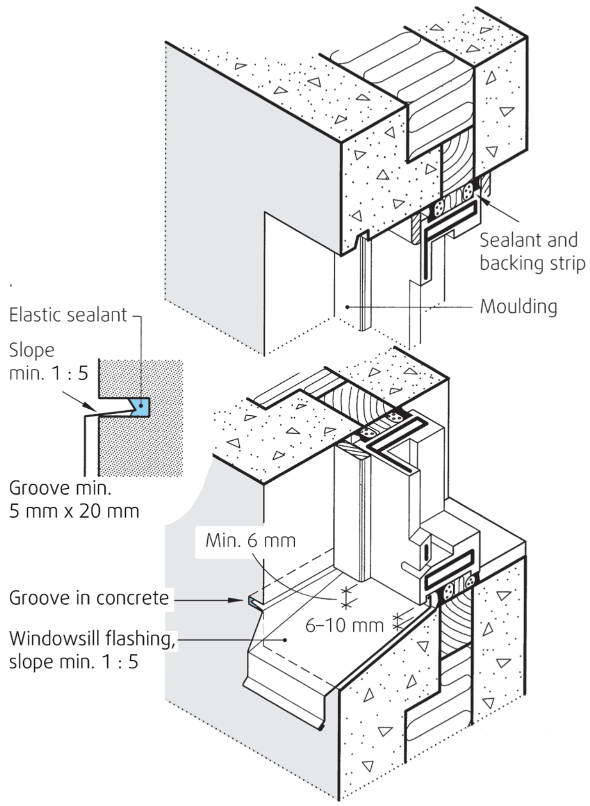


Fig. 27
Installing a plastic window in a wall made of concrete sandwich elements

Continues in Part II

Continued from Part I

3 Installation

31 When to install

In walls with brick facings, it is normal to fasten the window to the rear wall before the wind barrier is installed and bricklaying is commenced. This makes it easier to achieve a good joint between the frame and the wall, and the window is given sufficient protection against moisture. The window must also always be covered during the building period, in order to avoid alkali attacks on glass and aluminium.

In solid brick and concrete walls, windows should be installed after the wall is finished.

32 Shims

321 *General*. Load-bearing shims are intended to transfer the weight of the window to the wall beneath. The shims must therefore be positioned directly under the load-bearing elements of the window frame.

322 *Operable windows*. Before positioning the window in the opening, place two shims towards the corners of the opening, directly beneath the side jambs, see Figs 322 a and b. The thickness of the shims must be exactly right, so that the sill is completely level and at the same height as all other windows in the wall.

For windows with a mullion, an extra shim must be placed under the mullion if one of the sashes is hinged to the mullion. Windows with mechanisms that transfer some of the sash's weight to the mullion should also have an extra shim.

It is important that the shim under the mullion is no higher than the shims under the side jambs. Otherwise the window sill will be pushed upwards, resulting in too little clearance between sash and frame. All of the shims must be short enough to avoid interfering with the air seal around the window.

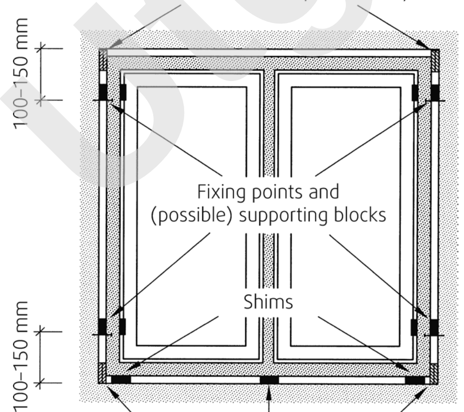


Fig. 322 a
Operable window with mullion. Positioning of shims, temporary wedges and fixing points

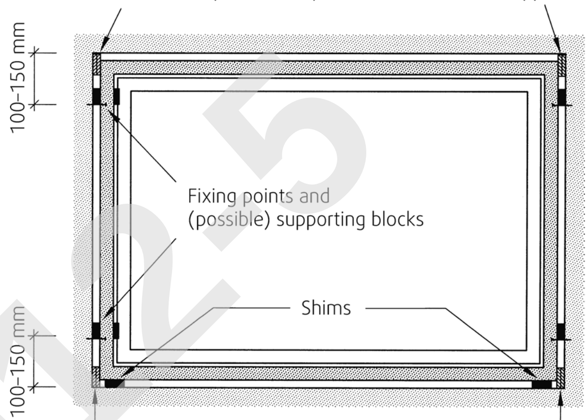


Fig. 322 b
Window with wide, side-hinged sash. Positioning of shims, temporary wedges and fixing points

323 *For fixed frame windows*, a shim must be placed directly under each of the two glazing support blocks upon which each pane rests in the sash. A space of approx. 100 mm is usually left between the edge of the pane and the edge of the glazing support block. There must therefore be a gap of approx. 150 mm between the edge of the opening in the wall and the edge of the shim, see Fig. 323.

33 Adjustment and wedging

When the window has been correctly positioned in the opening, fasten the frame temporarily by inserting wedges into the vertical joints between the extension of the frame head and the wall. Next insert temporary wedges between the extension of the sill and the wall. When installing high windows and windows with a window transom, it may also be necessary to insert temporary wedges, for instance next to the transom. With the window still closed, adjust the wedges until the window is straight and vertical. Then open the window sashes to check that the clearance between the sash and

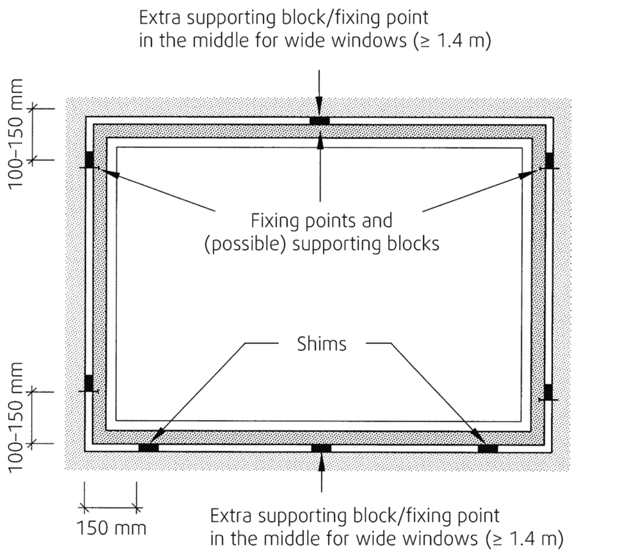


Fig. 323
Positioning of shims below the window, fixing points and (possible) supporting blocks on either side of large fixed frame windows

the window is correct. No part of the sash should touch the frame when opening or closing the window. Also check that the sash fits snugly against the bead stop and weather strips around the whole window. For windows with wide, side-hinged sashes, it is important that there is adequate clearance between the sash and sill on the closing side, so that there is room for adjustment if the sash drops over time, e.g. due to the hinges becoming worn.

You must not place any shims or permanent wedges in the upper horizontal joint between frame head and wall. See Section 343. That could result in the frame head being pushed downwards. When you have finished fastening the window, remove the temporary wedges (but not the extra supporting blocks), see Section 34.

34 General installation advice

341 *Strength*. It is important to fasten the windows securely to the wall, both to prevent them from blowing in and to prevent them from falling out when they are opened. Double, and particularly triple, glazed units are heavy, and impose a substantial load on hinges and fixing points when fully opened. The forces exerted on the fixing points increase with the size of the window, as do the requirements relating to their specification. If the window is not properly supported, or if the frame is not fastened securely to the wall, the window may move out of position, resulting in leaks and problems with opening and closing the sashes.

342 *Post-installation adjustments*. If the window's supporting blocks or fastenings fail, or if the opening in the wall is distorted, it may be necessary to make adjustments to the window.

Using screws with sleeves during installation makes it easier to perform any such subsequent adjustments. Provided the window is firmly supported and the walls are stable, alternative fastening methods which limit the ability to make post-installation adjustments may be used. See Sections 353–355.

343 *Positioning of fixing points*. Normal sized windows only need fastening through the side jambs, approx. 100–150 mm from the top and bottom. Side-hinged windows should be fastened close to the hinges, so that the forces that are transferred from the sash via the hinges are transferred directly into the wall. Windows that are more than approx. 1.4 m wide must for safety reasons also be fastened through the frame head and sill. Windows that are higher than approx. 1.4 m should have at least three fixing points on each side.

Possible fixing points in the sill of metal or plastic windows must never be located in such a way that they perforate channels that are designed to drain away water. The fixing points should always be on the inside of the weather strip between the sash and the frame, or on the inside of the pane of fixed frame windows. If fixing points are positioned so that they make holes in the flange of windows that open outwards, it may easily cause water to leak into the wall. When the window has been properly fastened, the holes in the frame should be covered with a plastic plug or bung that is glued in place.

344 *Supporting blocks*. If the window is to be fastened with nails or ordinary, thin wood screws, the frame needs to be made more rigid by means of supporting blocks at the fixing points on either side of the window. Supporting blocks or double wedges should be placed in the gap between the frame and the wall at the fixing points. They also prevent the frame from being pressed outwards during nailing or screwing. This is particularly important when installing wooden windows, in order to prevent damage to the corner joints. Provided you use the sleeves correctly, or use thick, rigid screws (thicker than approx. 7 mm) supporting blocks are unnecessary at the fixing points, see Sections 351 and 353.

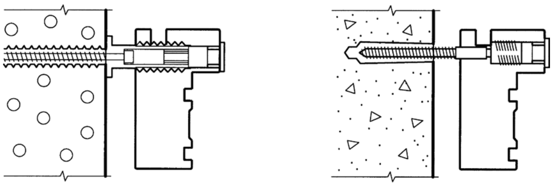
Windows with wide, side-hinged sashes should have extra lateral support at the bottom on the hinge side and at the top on the closing side, in order to prevent the frame distorting and the sash sagging. Such windows should therefore have extra supporting blocks at the extension of the frame head and window sill,; see Fig. 322 b. All of the supporting blocks must be short enough to avoid interference with the sealing of the window.

35 Installing wooden windows

351 *Fixing and adjustment sleeves*. There are several types of fixing and adjustment sleeves that can be installed in pre-drilled holes in the side jambs. There are special drill sets designed for the various systems, in case the frames are not pre-drilled. If using sleeves, you will not need supporting blocks between the side jambs and the wall for normal sized windows.

One type of sleeve can be screwed out towards the uprights and be fastened with its own screw when the window is in the right position, see Fig. 351 a.

Sleeves with a wide base provide the most rigid fixing, but require the surface of the opening to be parallel to the frame, to prevent the frame from being twisted when the sleeve is screwed into place. When adjusting the window after installation, loosen the screw at the bottom of the sleeve before screwing the sleeve round so that the frame is moved sideways. Another system involves a thick screw with an externally threaded sleeve that is kept in place by the head of the screw, but in such a way that the sleeve can be turned independently of the screw. See Fig. 351 b. The screw and sleeve are screwed into pre-drilled holes in the frame using a special key. The whole of the sleeve is set into the frame and it does not touch the upright. As the screw is relatively thick, approx. 7 mm, this provides a sufficiently rigid fixing for normal sized windows without the need for supporting blocks on either side of the frame.



a b

Figs 351 a and b
Example of fixing and adjustment sleeves used to fasten wooden windows
a. Fixing and adjustment sleeve that is screwed to the brick wall
b. Screw with a sleeve that is held in place by the head of the screw, but in such a way that the sleeve can turn independently of the screw

352 *Special screws*. Special screws are available that make it possible to adjust the window after installation. One type involves a deeply grooved sleeve that is held in place below the head of the screw, but in such a way that the screw can be turned independently of the sleeve. As the screw is screwed into the wall, the grooved sleeve is pulled into the pre-drilled hole in the frame. The large diameter and deep grooves ensures that this becomes securely fastened to the frame. See Fig. 352. The position of the frame can be adjusted sideways slightly as the frame will be held by the grooves in the sleeve and be drawn along when the screw is unscrewed again.

Other screws have grooves instead of threads nearest their head, but being thinner, they do not fasten the window as firmly to the frame. If the screw is thinner than approx. 7 mm, you must use supporting blocks or double wedges that are exactly the same thickness as the width of the space at each fixing point.

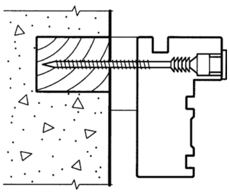


Fig. 352
Fastening with special screws
Each fixing point must always be supported by a block or double wedges.

353 *Coarse fully-threaded screws*. Wooden windows can be fastened to woodwork using coarse, fully-threaded screws (thicker than approx. 7 mm); see Fig. 353. Such screws require you to pre-drill into the uprights, but the coarse screw will hold the window in place without the need for supporting blocks at the fixing points. If you want to make any post-installation adjustments you will need to unscrew the screw, adjust the position of the window and screw it back in again, pre-drilling again if necessary.

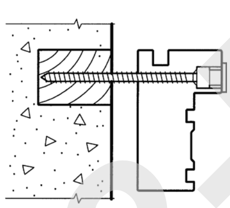


Fig. 353
Fastening with thick, threaded special screws
Temporary wedges are removed after the window has been screwed in place. Supporting blocks are not required on either side of the frame.

354 *Normal thin wood screws* can provide a good and stable fastening provided that you insert supporting blocks or double wedges between the side jambs and wall at all of the fixing points. If you subsequently want to adjust the window, you will need to adjust the supporting blocks as well.

355 *Nailing* is one of the traditional ways of fastening wooden windows, but it is hard to make any subsequent adjustments without sawing through the nails. We do not, therefore, recommend using nails. If you nevertheless choose to use nails, you must use accurately made supporting blocks, or double wedges, made of wood or plastic. They can be inserted in the space between the frame and the wall, above the nail to ensure that they do not fall down if they become loose. The nails should be countersunk into the side jambs using a punch.

36 Installing metal or plastic windows

Metal or plastic windows can be fastened to the wall using screws or sleeves that go directly through pre-drilled holes in the side jambs. The holes must always be elongated in order to allow the sections to move slightly in response to temperature changes. The windows can also be fastened using brackets or anchors that are threaded into grooves in the sections; see Fig. 36. This means that you can avoid drilling holes into the frame sections, and temperature changes can be absorbed without the window being pushed out of position in the wall.

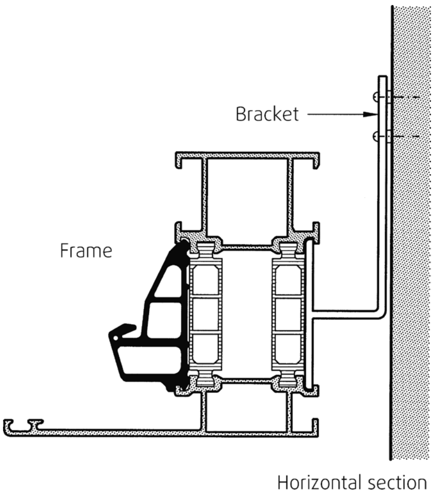


Fig. 36
Example of metal or plastic windows fastened with brackets

4 Principles for external sealing

Failure to properly seal the gap between the window frame and the wall can often cause air and rainwater to leak in, thus causing damage to the window itself and the wall around it. The wall below the window is particularly vulnerable. Good and reliable rain tightness is most easily achieved by using the principle of two-stage sealing with separate rain and air tightening.

The outside of the gap is covered by a rain shield, usually a moulding or flashing, that stops the rain. Mouldings and flashings are described in greater detail in Section 6. Between this rain shield and the external air seal (wind barrier), there must be a ventilated space that should be at least 10 mm deep. The external air seal covering the gap between side jamb and wall, must be designed in such a way that any water that does manage to penetrate through to the air tightening runs down to the weatherboard flashing and is diverted away from the wall.

5 External air sealing

51 Sealing materials

External air sealing is accomplished using elastic or foam sealant.

52 Elastic sealant

Elastic sealant applied against a backing strip is considered the most appropriate sealant for the space between the frame and the wall, see Figs 643 a and b.

The strip of sealant must be continuous and should be of even depth around the whole window. Ideally the cross-section of the sealant strip should have a width to depth ratio of approx. 2:1. When using elastic sealant, the gap between the frame and the wall must be even and not too wide - preferably no wider than 15 mm. The elastic sealant can be injected against a round backing strip that has previously been pushed into the right position in the joint. The backing strips should be made of a plastic material with closed pores to which the sealant cannot adhere. The backing strip must be 20–25 % thicker than the joint, so that it provides adequate resistance when it is pressed into the joint. The sealant must bond well to the materials used for the opening and window frame. Any cleaning and priming of the sides of the joint must be done prior to sealing and in accordance with the manufacturer's instructions. The sealant must be able to absorb the movements that can occur and should withstand being stretched or compressed up to at least 20 % of the width of the joint. The sealant must have a long lifespan and withstand temperature variations without cracking or loosening. See also Design Guide 520.406 on how to execute a seal and 573.104 on types of sealants and their properties. In concrete or brick walls, you can normally inject the sealant straight against the surfaces in the window opening after they have been brushed clean of dust or other loose particles and cleaned of any form-release lubricant. In walls made of lightweight aggregate building blocks, the window opening must be rendered, so that you have a solid, airtight surface against which to apply the sealant.

53 Polyurethane foam

Single-component polyurethane foam sealant is an alternative choice for sealing around wooden windows. Although the foam has a certain amount of strength, the window must nevertheless be fastened mechanically to the wall. Foam sealant is particularly suitable if the surface of the window opening is uneven and if the width of the space between the wall and the frame varies. The foam hardens by absorbing moisture from the air or surrounding materials after it has been injected into the joint. In order to speed up the hardening process, you can moisten the materials around the joint before injecting, but the materials must not be wet. The speed at which it hardens is also highly dependent on the temperature, which should be over 5 °C. You must follow the manufacturer's instructions.

Until the foam has completely hardened, it may be necessary to brace the frame to prevent it from being pressed inwards against the sash. Bracing is especially necessary at low temperatures or if there is a deep layer of foam sealant.

Foam sealant cannot be used as the only seal between the wall and windows made of aluminium or plastic, as the foam may crack due to temperature movements in the window. Foam sealant has the disadvantage of making it impossible to adjust the window frame after the foam has hardened. If you use polyurethane foam to seal the gap, you must follow the manufacturer's instructions and the safety regulations of the Norwegian Labour Inspection Authority (*Arbeidstilsynet*).

Design Guide 573.107 describes how to seal joints using polyurethane foam.

54 Other types of seal

Special plastic «socks» filled with mineral wool are available that can be pressed into the space between the frame and the wall. This requires both sides of the joint to be smooth and the work must be executed very carefully in order to achieve a good seal.

6 Rain shield and windowsill flashing

61 General

In order to achieve a two-stage seal, external mouldings and flashings must be fitted in such a way that together they create a rain barrier that prevents rainwater reaching the air seal; see Section 4. The mouldings and flashings should also protect the sealing compound against deterioration due to sunlight. The joints above and below the window are particularly vulnerable on account of the water that runs down from the wall/ window pane above them.

62 Rain shield

You can use wooden, metal, plastic or fibre-cement mouldings for the rain barrier. The mouldings are either fastened to the window or to the wall, and should be finished 6 mm above the windowsill flashing; see Section 64. At the bottom of the window the turned-up edge of the windowsill flashing acts as a rain shield. Rendering-in of windows is not recommended, as this may lead to moisture coming into direct contact with the frame for extended periods of time. In areas exposed to little driving rain you can, however, apply render up to the mouldings.

63 Joints without a rain shield

Exposed joints without a rain shield (one-stage seal) are quite widely used, but do not provide a good solution as the elastic sealant then has to act both as rain shield and wind tightening. For this to be effective, the climate must be mild. If you nevertheless do choose to use a one-stage seal, you must use a sealing compound that is stabilised to withstand sunlight and rain.

You can paint over acrylic sealant, which protects it against UV radiation. However, you must bear in mind that acrylic sealant is a plastic material with a limited ability to absorb joint movements (max. 12–13 % of stretching/shrinkage). It is important to follow the manufacturer's instructions in order to achieve the best possible durable bond.

64 Window-sill flashing

641 *General*. The gap between the window-sill and the wall is particularly exposed to the weather. Below the window you must therefore install a flashing or metal Guide to protect the wall below the window against water ingress. If the window is exposed to driving rain, it is absolutely essential to install window-sill flashing.

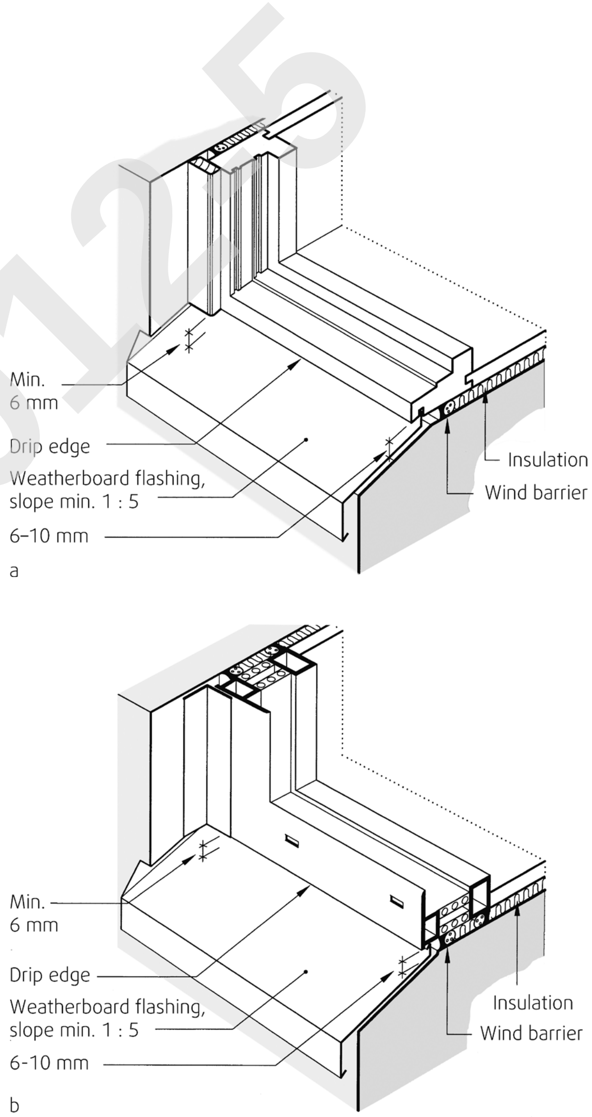
642 *Materials*. Flashing can, for example, be made of copper, aluminium or coated-steel Guides,. When choosing flashing, you must also bear in mind other metals used in the facade, so as to avoid potential corrosion. Copper flashing may produce green stripes on the wall where water runs down from the flashing.

643 *Gradient and distance to windowsill*. The window-sill should have a gradient of at least 1:5.

The flashing or metal Guide must never be flush with the bottom of the frame, but there must be a gap of 6–10 mm in order to prevent drops of water attaching themselves to both surfaces of the joint and staying there for a long time without running out, see Figs 643 a and b.

In walls where relative movements between the outer and inner leaves is likely, the distance should be increased to at least 15 mm.

This clearance is particularly critical for wooden windows, where a narrow gap may lead to the bottom of the window sill becoming damp and being damaged. A narrow gap can also lead to capillary suction of water in through the wall below the window.



Figs 643 a and b
Window with windowsill flashing entering into a groove/section beneath the window sill
The air seal is accomplished by means of sealing compound.
a. Wooden window
b. Aluminium window

644 *Design*. The metal flashing must have a turned-up edge at the back, so that it can be inserted into the groove at the bottom of the windowsill. The top edge of the flashing and the joint between the frame and the flashing will then be well protected against splashing rain. The window-sill flashing must have a turned-up edge

at both ends, or end pieces, in order to prevent rain from running sideways into the wall, see Figs 644 a, b and c. The turned-up edge is particularly important in areas that receive a lot of driving rain. If the window is positioned far into the wall, the turned-up edge of the flashing must be particularly high, and it is also essential that the corners are completely watertight.

Using sealing compound in the corner after the flashing has been installed will not produce an adequate long-term seal. With thin flashing made of steel, zinc or copper you can fold the corners as shown in Fig. 644 a.

Folding the corners is a simple way of ensuring a perfect seal in the corners. For zinc, aluminium, copper and hot galvanised steel flashing, you can also solder, glue or weld the corners. In order to increase protection against water penetrating under flashing that goes inside the wall's wind barrier, or above it's insulation layer, you should also install a watertight membrane, see Fig. 65 b. Windowsill flashings must never be jointed lengthwise.

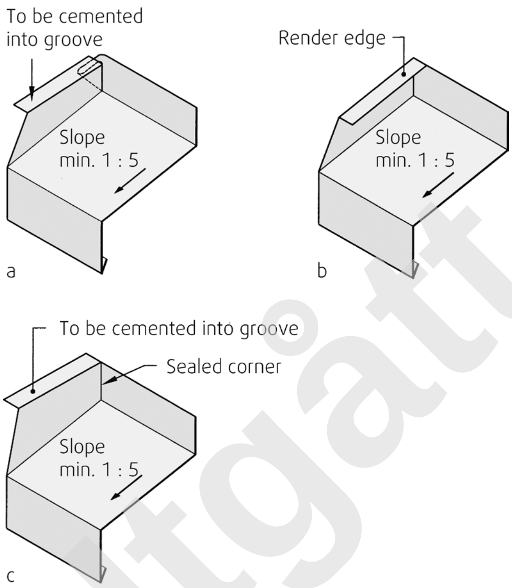


Fig. 644 a–c
Windowsill flashing for brick wall
a. Folded corner
b. Flashing for rendered wall
c. Flashing for insertion in joint or groove

645 *Long window-sills*. Joints in long lengths of continuous windowsill flashing must be flanged, so that temperature movements can be absorbed without the flashing being deformed, see Fig. 645. The joints must always be located between windows. Using a sealing compound to seal an overlap joint will produce an inadequate long-term seal. Butt joints formed by soldering, or overlap jointing where component parts are locked together by pop rivets or screws, have little ability to take up temperature movements without damaging the flashing, thus causing leaks.

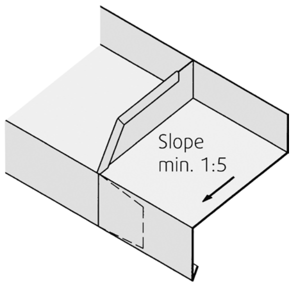


Fig. 645
Example of joint on a long section of flashing
The joints must be located between two windows.

65 Window-sills made of slate, etc.

If using a stone slab as the window-sill, the seal between the windowsill and the window frame can be combined with a small metal flashing as shown in Fig. 65 a. However, this system will be inadequate in places exposed to large quantities of driving rain.

Wherever flashing is not used, the sealing compound between the stone slab and the window should be set far back under the window sill, so that the sealant is well protected against rain and sunlight. Where the stone slab finishes against the window opening, you need to install a seal that is not protected against the rain. This joint must therefore be maintained regularly.

The simple solution of using mortar in the joint is not satisfactory over the long term. Window-sills made of natural stone with joints are particularly vulnerable to water leaks. In such cases, and in places that receive a lot of driving rain, it may be necessary to install a separate sealing layer under the slate tiles, consisting of either a flashing or a membrane, see Fig. 65 b. The sealing layer should slope down out from the wall, and the stone can, for example, be fastened with clips.

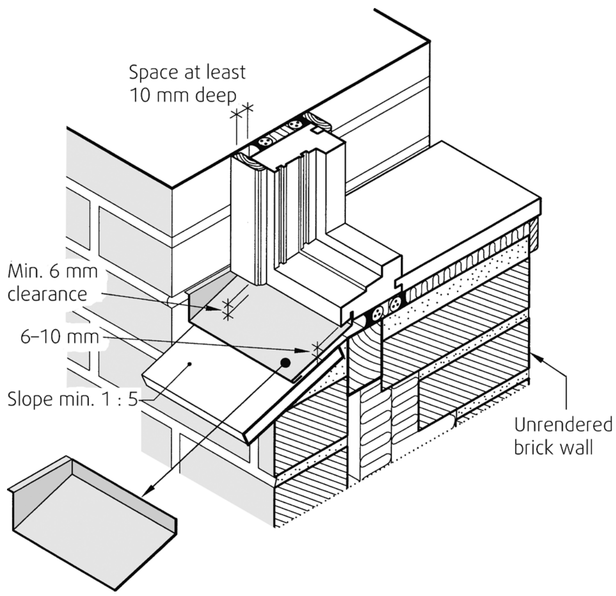


Fig. 65 a
Membrane providing an additional seal below a natural-stone widow sill

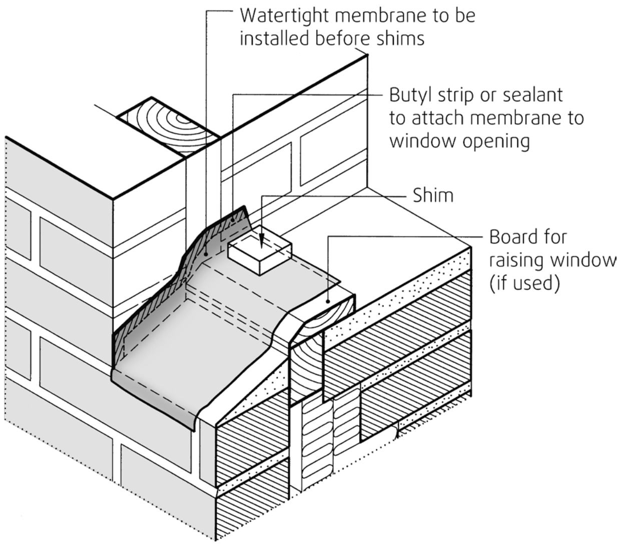


Fig. 65 b
Membrane providing an additional seal below a natural stone extension sill

66 Window-sills made of brick, etc.

If you have a windowsill made of bonded bricks without metal flashing as a rain shield, the bricks will need to be highly frost resistant. You should use a specialist mortar to bond the bricks. It is essential that there is a steep gradient away from the wall in order to avoid damage caused by moisture (min. gradient 1:1). The sealant between the windowsill and the window should be set well back below the window sill in order to protect it well against rain and sunlight.

67 Drip edge

In order to prevent water from the facade above reaching the window, a drip edge should be executed at the outside edge of the window opening above the window. The drip edge will thereby reduce the amount of moisture absorbed by the window and prevent the glass from being damaged by alkali water. See examples in Figs 212 c and e, part I.

7 Insulating the gap between window frame and wall

The gap between frame and window opening should be insulated to its full depth, for instance using strips of mineral wool or similar, which can be pushed loosely into the space from the inside. The insulation must not be pushed in so hard that the external seal is damaged or causes the frame to be bent inwards. The insulation only provides a very poor wind barrier, and cannot be used in place of other separate external and internal air seals. This is true both of mineral wool and other fibrous materials that can be used to provide thermal insulation in the space between the window frame and the wall.

8 Internal sealing

81 General

The internal seal is important, and must be executed with care. Its purpose is to provide an air seal, and prevent external draughts entering the room. It is also intended to prevent moist air from the inside penetrating through to the external seal, where it would cool down and release moisture in the form of condensation.

In practice you can only achieve an effective air seal in brick and concrete walls by using an elastic sealant.

It is not strictly speaking necessary to protect the joint on the inside, but mouldings are often used for aesthetic reasons, and they will also help to prevent mechanical damage. With walls that are insulated on the inside you can press the moisture barrier against the window trim instead of using a sealing compound.

82 Internal mouldings

Interior casing is not very common in brick and concrete walls, except against the window sill. Trim and mouldings must be chosen to fit the thickness of the wall, the width of the frame, the thickness of the frame and the thickness of the internal cladding. If the windows open inwards, the trim must be fitted in such a way on the frame that there is enough space to lift out the sash. The mouldings should be nailed to the trim, not to the wall, in order to prevent cracks at the joints. It may be necessary to support the trim at the bottom from below if it is to act as a window ledge.

9 References

91 Authors

This Design Guide has been revised by Tore Kvande and Sivert Uvsløkk.
It replaces the design guide with the same number published in 1996. The technical editor was Lars-Ivar Aarseth. Technical editing was completed in May 2003.

92 Literature

921 Kvande, T. and Lisø, K. R. *Beslag mot nedbør* (Weather-protective Flashings, in Norwegian). Guidelines 38, SINTEF Building and Infrastructure. Oslo, 2002
922 Mur-Sentret. *Murkatalogen*