Natural stone sill

Disclaimer

This sheet is intended for designers, specifiers and other members of construction project teams wishing to reuse this building material or product. It is part of a collection of sheets aimed at bringing together the available information to date that is likely to facilitate the reuse of building materials and products.

This sheet has been produced by Rotor vzw/asbl within the framework of the Interreg FCRBE project - Facilitating the Circulation of Reclaimed Building Elements, supported by the entire project partnership. Sources of information include the experience of reclamation dealers and involved project partners, lessons learned from exemplary projects, available technical documentation, etc.

The sheets have been produced between 2019 and 2021. As the reclamation sector is evolving, some information, notably regarding pricing and availability, may change over the time. When the text refers to European standards, it is up to the project team to refer, if necessary, to their national implementations and local specificities.

It is important to note that the information presented here is not exhaustive or intended to replace the expertise of professionals. Specific questions are always project related and should be treated as such.

The complete collection of sheets (including the introductory sheet) is freely available from different reference websites (a.o. opalis.eu, nweurope.eu/fcrbe, futureuse.co.uk).

Non-exhaustive directories of dealers in reclaimed building materials are available on www.opalis.eu and www.salvoweb.com.

Interreg FCRBE partnership: Bellastock (FR), the Belgian Building Research Institute / BBRI (BE) , Brussels Environment (BE), the Scientific and Technical Center of Building / CSTB (FR), Confederation of Construction (BE), Rotor (BE), Salvo (UK) and University of Brighton (UK).

The information contained in this document does not necessarily reflect the position of all the FCRBE project partners nor that of the funding authorities.

Material description

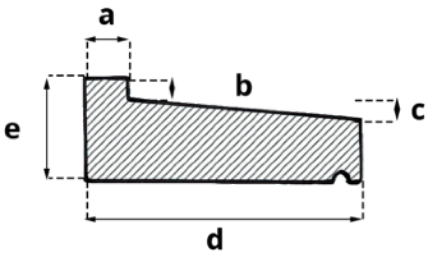
By definition, natural stone sills (or thresholds) are construction elements that form the lower part of the openings in order to facilitate the flow of water, prevent infiltration and limit the clogging of masonry.

Like other natural stone materials, stone sills are good candidates for reclamation and reuse: they are resistant, have beautiful finishes and lend themselves well to various transformations. They are commonly found on the reclamation market, in a multitude of variants often reflecting regional specificities (blue stone in Belgium, Burgundy stone in central France, various kinds of sandstone in the United Kingdom, etc.).

This sheet focuses on the use of natural stone as door thresholds or windowsills. In practice, windowsills are reclaimed more often than door thresholds. The latter are sometimes more complicated to disassemble and may show more marked signs of wear.

The shape of the sills is the result of a set of constraints:

- **To ensure watertightness and allow water to flow**. The protrusion from the façade, the presence of a drip groove, the drop from the upper surface or the presence of a rise (horn, flashing), possibly extended laterally (stool) are some of many devices to prevent infiltration (*Figure 1*).
- **To ensure the solidity of the structure**. The sills are generally placed on a bed of mortar. To prevent them from tipping over, they are embedded laterally in the masonry to a depth of at least 5 cm.



a. *Horn width*
b. *Horn height*
c. *Bevel height*
d. *Sill width*
e. *Sill thickness*

Figure 2. Cross-section of a window sill in natural stone

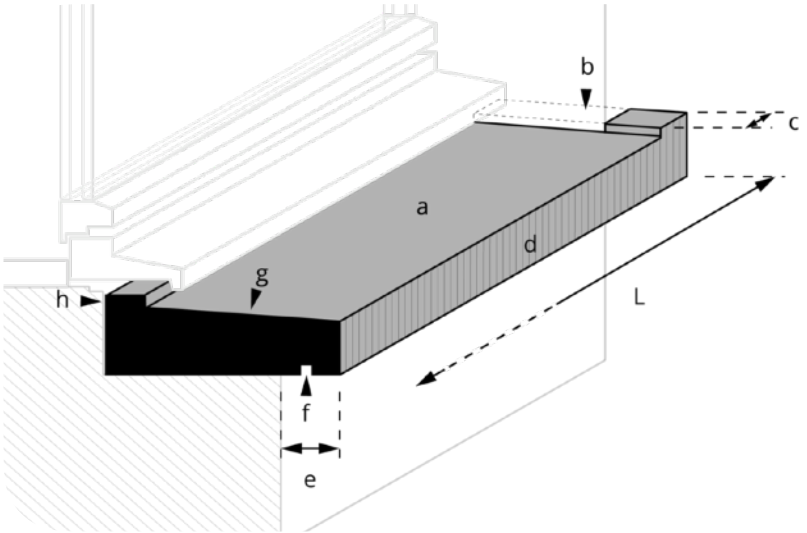
The reclamation market has a wide variety of sills models. Several criteria make it possible to distinguish them:

→ *Geological nature.* Many types of rocks were used in the manufacture of sills. Among the most common on the reclamation market, we find granites, sandstones and limestone (blue stone or white stone), in all their local variations.

→ *Dimensions*. Usually the reclaimed sills have widths between 20 and 40 cm, thicknesses between 4 and 20 cm and variable lengths. Unlike current new sills, which are often divided into two parts when over 155 cm in length, there are reclaimed sills of up to 2 m (*Figure 2*).

Blue stone door threshold (limestone)

Blue stone windowsill (limestone)



a. *Upper face (ground, bush hammered, softened, etc.)*
b. *Stool (glued)*
c. *Embedding depth*
d. *Front face (chiselled, ground, ...)*
e. *Overhang of the façade plane*
f. *Drip groove or anti-drip device*
g. *Drain slope*
h. *Horn or window flashing*

Figure 1. Geometry of a window sill in natural stone.

→ *Profiles*. Different sills profiles can meet (*see figure 3*). Sills that are not at the same level as the ground generally have a drop to facilitate drainage. To do this, they can have a sloping profile (*figures 3b, 3d and 3e*) or be placed at an incline (*figures 3a, 3c and 3f*).

→ *Appearance*. The diversity of rocks is reflected in a wide range of colours, including within the same family: grey, beige, ochre, brown, pink, bronze, etc. A specific vocabulary is used to designate the stone inlays: veins, grains, strata, flames, stains, etc.

In addition to the original appearance of the rock, the sills can bear the marks of their cutting method (cleavage, sawing) and of their original finish (grinding, sanding, softening, chiselling, bush hammering, flaming, etc.). Over time, their appearance also varies according to the stresses of use: softening, polishing of the visible face, traces of paint, mortar, development of organisms (mosses, lichens), etc.

When a re-machining of the reclaimed sills is envisaged (sawing, squaring, milling, etc.), this will generally modify the appearance of the visible faces.

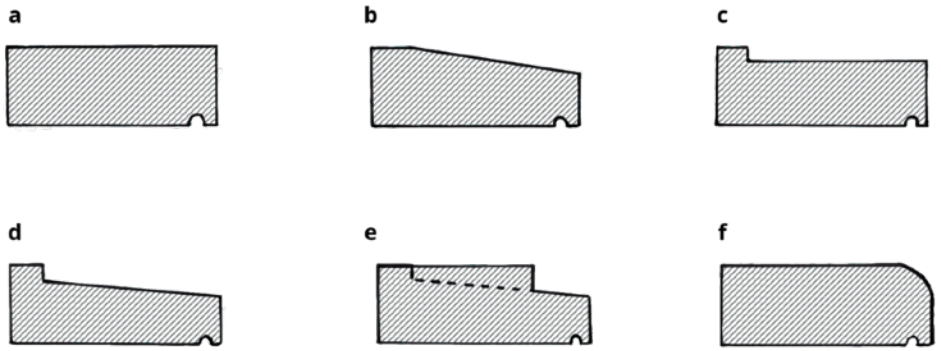


Figure 3 : *a. Classic flat sill with drip groove (inclined installation)*
b. Sill with continuous slope and drip moulding and flat at the rear of the sill
c. Sill cut flat with drip groove and horn (inclined installation)
d. Bevelled threshold with drip groove and horn
e. Bevelled sill with drip groove and horn and side seating
f. Flat threshold with bullnose (inclined installation)

Granite window sill
© Stone of New England

Sandstone window sill
© Cawarden Reclaim

Flat threshold in blue stone
© Het arduinen hoekje

Remains of white painting
© valleyreclamation.co.uk

Development of living organisms (mosses, lichens)
© valleyreclamation.co.uk

Traces of remaining mortar
© valleyreclamation.co.uk

Natural stone sill

Material reclamation

Natural stone sills are a good candidate for reuse, either on-site or through the professional channels of material resellers. They can also ensure the supply of batches of sills ready for installation. They are able to ensure the smooth running of the following operations:

→ *Disassembly test* (or expert opinion). Makes it possible to ensure the feasibility and profitability of a removal. An "expert eye" generally makes it possible to estimate the interest of a batch based on plans, photos, historical documents or by an on-site visit. The focal points for sills will be among others:

- the general condition of the batch and the laying method: condition of the stone, formats and dimensions, nature of the laying bed, characteristics of the joints, etc.
- commercial interest, depending on the period, style, stone, condition, quantity in place, etc.
- logistics arrangements: especially in terms of deadline, working time, handling, transport, etc.

In order to more confidently determine the salvage potential of sills, a dismantling and cleaning test is usually performed on a sample.

→ *Removal*. The careful dismantling of sills must ensure the safety of the workers and the integrity of the recovered elements. Once the frame or door has been removed, the sills are first detached from the masonry using suitable tools (jackhammer, pneumatic chisel, etc.) before being pushed out of their notch. The sills can be heavy due to their size and the density of the stone (> 2.5 t/m³). They can also be fragile, especially if there are white grooves or veins on the surface of the stone. In the event of cracking or breakage, they lose a lot of their value. It is therefore advisable to equip oneself with suitable means or to call in a professional. Removal may also involve making the necessary arrangements for working at height.

→ *Sorting and cleaning*. The salvaged sills will then be sorted by qualities, colours and dimensions. Cleaning with a brush and water allows removal of laying residues, jointing products and other elements which could adhere to them. Scraping with a suitable blade removes mortar residues and sealant joints. There are products to repair small cracks and breaks (e.g. mineral mortar, stone grafts, etc.). These can be considered to restore damaged sills.

→ *Operations*. Some sills can be reused as they are after a rough cleaning. Others may require additional operations such as:

- *Sawing*: to obtain flat and vertical side faces or to make the dimensions of the sills uniform.
- *Cutting and machining*: to regain and correct the profile of the sills and ridges.
- *Finish*: in order to homogenize the appearance of the stone or give it a rough appearance on the visible parts. Several techniques are possible depending on the nature of the stone and the expected performance: grinding, sanding, softening, chiselling, bush hammering, flaming etc. A specific vocabulary determines the type of finish depending on the type of rock.

These various operations can be carried out by specialized resellers within their facilities. They can also be considered on site, provided that the site logistics allow it.

→ *Storage and packaging*. Sills are generally stored outside, packaged and strapped on pallets. They are arranged horizontally. Ideally, they are separated by wedging elements in order to limit the risk of damage. The wedges/separation wood must not be treated, be very dry and not contain tannins which could stain the stones. Metal straps should be avoided as there is a risk of staining the stone (rust). The packaging must take into account the large mass of the elements. Appropriate means of transport and lifting are also required.

Reclaimed natural stone sills are generally sold by batch or by piece. Most suppliers are able to provide indications on their main characteristics: type of rock, nominal dimensions and tolerances, finish, intended applications, in certain cases, their origin.

Detachment of the top, side and bottom of the sills
© CDR Construction

Stacked pallet storage
© valleyreclamation.co.uk

Storage on strapped pallet

Applications and installation

Reclaimed sills can be reused in their original function or be reused for other applications such as exterior flooring, stair treads, street or exterior furniture, etc.

Most of the considerations related to the implementation of reclaimed stone sills in an identical use are similar to those of new sills - in particular, and non-exhaustively: nature and dimensions of the sills, nature of the bedding, type of jointing, sill profile and difference in level, dimension of the horn, presence of drip groove, construction details, thermal insulation, etc.

It is up to the designers to rely on the regulations in force, the rules of practice and the national and European standards relating to natural stone products. Furthermore, adequate installation requirements must be specified to cover the wide variety of possible applications of reclaimed sills.

In general, finding a batch with very specific characteristics can be complicated. It is often preferable to identify a batch of raw reclaimed sills and to consider additional processing operations. The expertise of professionals can be invaluable in this regard.

The following characteristics can be described and specified when drafting the technical requirements related to the delivery of a batch of reclaimed sills:

→ *Batch composition*. The batch consists of reclaimed stone sills of the same type (same profile), same geological nature (sandstone, granite, limestone, blue stone, white limestone) or even from the same origin of use (geographical area regularly subject to frost , etc.). However, the project developer can choose to combine different batches of stone (formats, type of stone, origins of use, etc.) and distribute them in an organized way in the building (for example, by providing a homogeneous batch of sills per façade).

→ *Dimensions*. The identified batch must correspond to the project constraints. In general, the dimensions must be uniform in width and thickness. To limit costs and facilitate the identification of a batch, it is preferable to be flexible enough on the dimensions by defining only the intervals of width, length and thickness that satisfy the project constraints (width allowing an overhang, interval of thickness, etc.). It is also possible to constitute a long sill from similar elements of a smaller size. If necessary, it is also possible to insist on more precise dimensional characteristics (as well as tighter dimensional tolerances). This may result in a heavier transformation of the material (sawing, re-machining).

→ *Profile*. Ditto. If necessary, specify the expected profile (*see figure 3*), the shape of the edges (straight sawn, chamfered, rounded, etc.), the degree of inclination and the dimensions of the drip groove. These characteristics may be given approximately (for example, horn height> 10 mm, height difference> 5%, etc.) or defined more precisely.

→ *Texture and finish*. Depending on the requirements (functional and aesthetic) and the type of rock, it may be useful to specify the appearance of the upper faces (sawn, ground, honed, bush hammered, flamed, etc.) and of the seen faces (sanded, honed, ground, chiselled).

→ *Hue*. By nature, natural stones have a wide variety of colours and appearances. Depending on usage requirements (for example, in the context of heritage renovation), it is possible to specify this characteristic by referring to a general hue or to a specific colour.

→ *Condition*. In addition to traces of mortar, paint and bitumen residues, reclaimed sills may show minor alterations such as signs of surface wear, chips, light cracks, craters, light flaking, stains, leftover moss, etc. These deteriorations can influence the technical and aesthetic performance of the sills, as well as their re-installation, but do not constitute a major obstacle to reclamation (*see § "Characteristics and fitness for use"*). Depending on the nature of the rock, other aspects can be considered as major imperfections. For example, certain limestone rocks (i.e. blue stone) may have stylolithic joints liable to weaken the stone. To a large extent, the existing technical documentation makes it possible to assess these various aspects on a case-by-case basis. Professionals can also be consulted. It is up to the designer/specifier to define the degree of imperfection tolerated, according to the defined use and the installation conditions, by specifying the degree of acceptable alterations (for example: chips, cracks and flaking < x cm² tolerated on visible sides, broken corners and edges tolerated on invisible parts, etc.).

Stylolythic joints

Most of the reclaimed building materials are sold as is. The conditions of sale may however contain special guarantees specific to the material. Some suppliers are able to indicate the origin of the material and/or provide documentation on the product purchased (f*or more information, see the Introductory sheet*).

Did you know?

Some providers of reclaimed stone items also offer new product lines, some of which are artificially aged to give them the appearance of a used product. If in doubt, find out where the materials are coming from, in order to be sure of their reused origin.

Design tip!

In the event of reuse on site, the following points should be checked:

- *some sills will probably be broken during dismantling. Sills on the reclamation market may possibly supplement the batch on site.*
- *during a renovation, in the event of insulation of the outside, the existing sills may no longer be wide enough and therefore not be able to be reused in the same place.*

Characteristics and fitness for use

By knowing the family or the type of stone present, it is generally possible to find its general characteristics (depending on the context). These indications are invaluable for studying the compatibility of the reclaimed stone for the intended use.

See for example: www.febenat.be ; www.stonenaturelle.fr ; www.pierreetsol.com ; www.cstc.be ; etc.

As an indication, the following table (*Table 1*) shows some of the known performances of some types of rock constituting sills which are frequently reclaimed. It is important to point out that each stone has its own characteristics and that two batches of sills of the same rock can however have quite different performances.

There is no harmonized standard specific to stone sills, but several standards and test methods make it possible to determine the properties relating to natural stones (EN 12407 - Petrographic examination, EN 1936 - Determination of real density and apparent density, and of total and open porosity, EN 12371 - Determination of frost resistance, etc.). Although they relate to new materials, these documents can be useful in determining the relevant characteristics (depending on the project) related to the reclamation of natural stone sills (*Table 2*).

Table 1 : Technical characteristics of the most common stones used in the manufacture of stone sills

	Bulk density (kg/m³)	**Porosity**	**Wear resistance**
Sandstone	2000 - 2700	little porous (0.5 to 10%)	good to very good
Soft limestone (e.g.white stone)	< 2500	porous (5 to 50%)	good
Compact limestone (e.g. belgian blue stone)	> 2500	little porous (0.2 to 5%)	good
Granite	2500 - 3000	very little porous (0.2 to 2%)	very good

Table 2 : Characteristics to be evaluated in order to determine the fitness for use of reclaimed natural stone sills

Characteristics	**Comments**
Geological origin and petrographic description	The reclaimed sills come from works that may have been made from batches of multiple origins. If it is possible to visually characterize the type of rock present, it is however more difficult to affirm with certainty that their geological origin is identical, unless there are records that allow it to be attested (for example: a certificate of origin, archival documents, etc.). This is all the more true for the batches made up of sills of various origins.
Geographical origin	As with the geological provenance, information on the original geographic provenance of a batch of reclaimed sills is difficult to certify with any certainty. On the other hand, we can deduce certain characteristics if we know where the sills were removed. For example, intact and dismantled sills in an area subject to strong freeze/thaw cycles are likely to show good frost resistance. Thus, in the absence of information on the original quarry, it may be useful to have information on the original use or the area where the sills come from.
Geometric characteristics	These characteristics can be found out by taking simple measurements. They are closely linked to the degree of sorting and cleaning of the reclaimed sills as well as to the transformation operations undertaken on the material. In the case of sills intended to be re-machined or re-cut, it is advisable to define with the supplier the dimensional tolerances applicable to each of the dimensions (width, thickness, length, etc.) the type of stone and the functionality of the works. The requirements in terms of flatness, straightness, dimensions of the drip groove and the desired degree of slope should also be detailed.
Bulk density and open porosity	These characteristics are specific to each stone. The density [kg/m³] gives an indication of the degree of compactness of the stone. In general, the more compact a rock, the less porous it is. The open porosity of a stone [% by volume] corresponds to the proportion of pores connected to each other and accessible to water. This characteristic influences in particular the degree of resistance to stains and soiling. It does not directly affect its freezing (it is rather its capacity to return the absorbed water that matters at this level). This information can be estimated based on technical documentation relating to natural stones (*see Table 1*). If necessary, these characteristics can be measured more precisely by an identity test as defined by the test EN 1936.

Characteristics	Comments
Resistance to freezing/thawing (and de-icing salts)	For an exterior application, the natural stone elements must be able to withstand freezing/thawing without their appearance or their mechanical characteristics being affected. The source and condition of a batch of reclaimed sills can provide a useful guide to determining their resistance to freezing/thawing. Many old sills are in fact likely to have withstood, during their first use, more freeze/thaw cycles than what is recommended by the test standard which allows this performance to be assessed (EN 12371). It is therefore important to find out about the geographical origin of the batch to ensure the original climatic conditions (for example, a batch coming from a continental climate in northern Europe will probably be suitable for an application in the Mediterranean climate of the South of France). Generally, less resistant sills that have suffered frost damage will probably have been discarded during the sorting and cleaning steps.
Reaction to fire	In accordance with Commission Decision 96/603/EC, natural stones are considered to belong to class A1 of reaction to fire (see EN 12 058 for exceptions). However, be careful with the use of filler sealants, which can affect this performance.
Susceptibility to staining	To assess this characteristic, we differentiate between internal staining caused by the reaction of certain constituents of the stone (metallic minerals or organic materials present in the stone), from accidental staining caused by contact with a potentially staining product for stone. Internal staining is above all a concern for the aesthetics of the material and it is therefore appropriate for the designer/specifier to define the acceptable characteristics with regard to the intended use. The sensitivity to staining is also directly related to the porosity value of the stone. The higher the porosity, the more easily the stone absorbs liquids (and therefore pollution) and the more sensitive it is to staining. A porosity of less than 4% is generally satisfactory in order to limit the risks of soiling. It is also possible to visually identify the degree of soiling of the reclaimed sills by observing the visible face of the unprocessed (sawn) elements. Specific surface treatments can also be recommended to improve this performance.

Reuse Inspiration. *Sliding sash sill consisting of two old window sills cut to the right size and cut to provide ventilation of the cellar (hole in the centre) © Sophie Boone*

Natural stone sill

Availability

Professional suppliers of reclaimed stone materials usually have stone sills. The quantities found are often relatively small (<10 elements) and are therefore mainly suitable for small projects. For larger quantities, it will be necessary to check the stocks with the suppliers sufficiently in advance. Being generally well equipped to work with stone, they can also offer to make stone sills based on other reclaimed elements (wall cover, lintel, step, etc.). Certain elements and certain stones are highly sought after and thus circulate beyond their area of origin. For example, Belgian blue stone is very popular in the Netherlands and Burgundy stone is also found on the Belgian and English markets.

Indicative prices (Excl. tax)

A non-exhaustive sampling of the reclamation market in North West Europe (Belgium, France, Great Britain and the Netherlands) made it possible to extract some indicative prices. These vary depending on the availability of the size and type of stone, as well as the degree of sorting and cleaning requested.

- Sills of conventional dimensions (between 1m and 1.5m): ~ 40 - 70 €/linear meter
- Long sills: (>1.5m) : ~ 75 - 120 €/linear meter
- Cutting: ~ 40 €/h for cutting the stone

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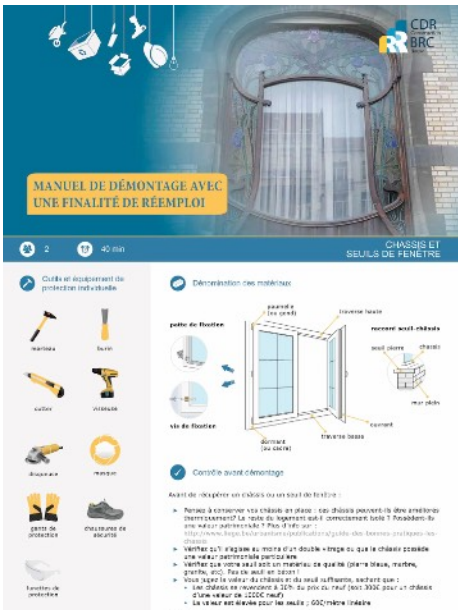
Embodied carbon (Cradle to gate - production A1-A3)	kg CO_2 eq./linear meter
INIES database (FR) – Generic data– Natural stone sills *	51.7

** Indicative value to ensure the function of 1 linear metre of natural stone sill for a reference lifespan of 100 years.*

According to the sources and types of stone, reusing 10 linear metres of reclaimed natural sill prevents the production of ~ 517 kg of CO_2 equivalent related to the manufacture of new sills (production phase only). This corresponds to a journey of ~ 3100 km in a small diesel car.

On-site reuse of bluestone sills, reconversion of the former Belle-Vue breweries, Brussels, (BE)
© François Lichtlé, L'Escaut Architectures. https://opalis.eu/fr/projets/reconversion-des-anciennes-brasseries-belle-vue



Illustrated manual for dismantling window frames and sills for reclamation: https://reuse.brussels/pdf/chassis-et-seuils-de-fenetre.pdf