

**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, nwu-europe.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.

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Material Description

Clay roof tiles are obtained by firing moistened, mixed, degassed clays (or loam); shaped by pressing or extrusion, moulded or preformed; dried and finally fired at a temperature of 1000 to 1100 °C for 12 to 48 hours. It is a ceramic material manufactured by hand or industrially, the technical properties of which depend essentially on the composition of the mixture, the firing temperature, the technical skill used in the manufacture and the surface finish. Under normal conditions, they ensure the waterproofing of roof covering or exterior cladding structures. Clay tiles have very good durability (lifespan up to 100 years). However, during their use, they will be subjected to a series of factors likely to affect their integrity and their properties (for example: the slope of the roof and the drainage capacity, the meteorological and climatic factors, the orientation of the slope, the behaviour of the finish layer, the frequency of roof maintenance, etc.)



Produced in abundance in Europe since the 19th century, clay tiles are readily found on the reclamation market. They should not be confused with their concrete counterparts, which are more porous and have an estimated lifespan of 50 years.

→ **Formats:** there is a very wide variety of models and formats, generally associated with a producer and/or a region of origin as well as with the climatic and installation conditions (roof slope, necessary waterproofing, surrounding vegetation, orientation slope, wind resistance, loads on the frame, etc.). A distinction is made between overlapping tiles (flat tiles, barrel tiles, purlin tiles, etc.) and interlocking tiles (single, double or triple; head and/or lateral interlocking). Depending on the type and model, between 10 and 20

tiles/m² are required for interlocking models, and up to 65 tiles/m² for overlapping models.

→ **Accessories:** several accessory parts, associated with specific models, are found in smaller quantities on the reclamation market. For example: ridge/hip tiles, butt tiles, edge tiles, vented tiles, half tiles, etc.

→ **Finished and Colors:**

- **Untreated:** the tiles have a red colour (uniform tile), determined by the type of clay used and the iron oxide content. Their appearance is mainly matte and slightly rough.
- **Engobed:** After the drying process, a thin layer of clay is applied to the tile to which mineral oxides or pigments have been added. During firing, this layer merges with the underlying tile. The result is a dark red, brown or black tile with a shiny or satin appearance.
- **Glazed:** a glaze suspension is applied to the unfired tile. During firing, this layer vitrifies and makes it possible to obtain red, brown and black, matte or shiny tiles, in different shades. Glazed tiles are generally smooth, have very low porosity and are more resistant to dirt, moss and algae.
- **Dark tile:** Using manganese pigmented clays, the tiles are completely black, throughout their thickness; superficial damage is therefore little or not visible.
- **Braised:** the tiles are fired in a reduction atmosphere, which gives them a blue/grey appearance.
- **Preservation treatments:** some reclaimed tiles may show traces of a water-repellent preservation treatment or of a coat of paint applied during use.





Material reclamation

The recovery of tiles must always be done in compliance with the safety rules applicable to roofing work. If the tiles do not find a new use directly on site, they can be sent to professional reclaimed channels. There are in fact operators likely to recover batches of tiles. Their interest will depend essentially on the model of tile, the quantities and the general condition of the batch.

→ **Dismantling** test (or expert opinion): in practice it 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 photos or information on the back of the tiles, or by an on-site visit. The focal points will be among others:

- the general condition of the batch and the method of installing the elements (free, nailed, screwed, fixed to the battens by clip hooks, sealed with mortar, etc.);
- commercial interest (depending on the tile model, quantity, resale potential, regional specificities, etc.);
- safety provisions (condition of the frame, roof slope, building configuration, etc.);
- logistics arrangements (deadline, working time, handling, transport, etc.).

→ **Removal**: careful dismantling should aim to ensure the integrity of the tiles and a certain uniformity of the batches. The tiles will be sorted by models, quality, possible deterioration, colours, dimensions, degree of soiling and accessory parts. Tiles showing breaks, cracks, significant damage to the surface layer, crumbling or traces of lead will be downgraded. The tiles recovered will preferably be stored on their edge in order to limit the risks of breakage and prevent the accumulation of water which can aid the development of algae and mould and which can deteriorate the porosity and the technical properties of the tiles.

Hearing test!

To check if a tile is intact, you can probe it by tapping lightly with a hard object. A 'dull' sound indicates an internal fracture, a 'clear' sound means that the tile is unaltered.



→ **Treatment**: apart from a qualitative sorting, reclaimed tiles generally do not undergo any treatment. Please note that high pressure cleaning can severely damage the surface layer and affect the impermeability. If necessary, the tiles can be cleaned with a soft brush to remove moss, algae and other dirt.

→ **Storage**: the tiles are ideally stored on box pallets, taking the necessary precautions to limit the risk of breakage (packaging on their edge, separation of layers, etc.) or transported in bulk to the storage place and stacked vertically several rows in height.

→ **Transport and delivery**: the necessary precautions must be taken during transport and delivery in order to minimise breakage (strapped, shrink wrapped pallet, etc.).

It is advisable to involve specialised professionals to ensure the smooth running of these operations.

For batches of old tiles, the percentage of loss at the time of removal can reach 40%. It is therefore often necessary to adapt the project or to supplement with other reclaimed tiles or new tiles in the event of on-site fitting.





Applications and laying

Reclaimed clay tiles are mainly used as roof coverings or exterior cladding. As a general rule, the choice of tiles must take into account the expected stresses (see § 'Characteristics and fitness for use') and urban planning regulations. In all cases, reference should be made to the European and national standards relating to the product (EN 1304:2013) and to the rules of practice in force (or implementation standards).

The reuse of a complete batch of reclaimed clay tiles in good condition is no different from that of new tiles. They lend themselves to the same variety of installation methods. They raise the same points for consideration, in particular: properties and condition of the frame and sub-roof, climatic and meteorological factors, minimum slope, fastening system, anchoring points and safety hooks, connection works, waterproofing underlay, ventilation system, drainage and rainwater collection, installation costs and times, specific maintenance, etc.

To facilitate installation, the designer/specifier will take care to use batches with a certain degree of uniformity in terms of the following characteristics:

→ **Batch composition:** the batch must consist entirely of the same model of clay tiles. The supplied accessories must be compatible.

→ **Completeness of the batch:** before purchasing a batch or opting for reuse on site, it is necessary to ensure the availability of the necessary accessories (new or reclaimed) and compatibility with the restoration of a roof covering in reclaimed tiles. Depending on the project, these accessories may concern: clip hooks, ridge/hip tiles, half-tiles, edge tiles, vent tiles, end tiles, etc.). Reclaimed tiles generally do not have installation guides, so it is advisable to hire a professional roofer to assist with your project.

→ **Dimensions:** the dimensions of the tiles must be uniform. Variations are however possible for old, handmade tiles. The dimensional tolerance will be determined by the designer/specifier according to the installation constraints.

→ **Colour:** variations in colour and appearance are possible. In the case of reclaimed clay tiles, these variations may be due to the production method, the original exposure, previously applied treatments, etc. It is advisable to mix the tiles when installing.

→ **Condition:** reclaimed tiles may show minor alterations such as:

- traces of surface wear, splits or crazing cracks in the glaze/engobe ;
- slightly chipped or cut edges ;
- slight damage to the protrusions/hooks and the fixing holes ;
- damage to the assembly grooves and/or flow rims ;
- stains, traces of mould, swellings, etc.

These deteriorations can influence the technical and aesthetic performances of the tiles, as well as their reinstatement, but do not constitute a major obstacle for reuse (see § 'Characteristics and fitness for use'). 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.

→ **Quantity:** some suppliers may include a 5% surplus when the product is delivered if they are not able to guarantee the absolute uniformity of the characteristics mentioned above. This surplus can also be applied in the case of an on-site salvage scenario.

Most professional suppliers are able to ensure that delivered batches meet these requirements. Most of the reclaimed building materials are sold as is. The conditions of sale may however contain specific guarantees specific to the material. Some suppliers are able to indicate the origin of the material and/or provide documentation on the product purchased (for more information, see introductory sheet).

Tip!

Clay tiles from stables, which are subjected to strong nitrogen and sulphur fumes, tend to crumble easily. Depending on their condition, it is not always advisable to reuse them.



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Characteristics and fitness for use

The harmonised European standard EN 1304:2013 establishes the relevant characteristics (depending on the context) in order to determine the fitness for use of clay tiles. Although detailed for new materials, these characteristics may prove useful in considering the specific case of reclaimed clay tiles.

Characteristics	Comments
Dimensions (length, width), regularity of shape	These characteristics are closely related to the degree of sorting of the reclaimed tiles. A visual or detailed examination of the batch is often sufficient to estimate them. The irregularity of old hand-moulded tiles must be taken into account when refitting them.
Structure	Tiles showing cracks, breaks, crumbling or missing hooks are discarded. A hearing test (see above) can be set up when installing. This characteristic is therefore linked to the degree of sorting of the reclaimed tiles. A visual or detailed examination of the batch is often sufficient to estimate them.
Surface quality	Scratches, scrapes, scuff marks, swelling and crazing cracks in the glaze are not considered to be defects as long as they do not affect the physical and mechanical properties of the tiles.
Impermeability	<p>Ceramic tiles are porous in nature. Glazed, engobed or water-repellent finishes improve water tightness. It is therefore necessary to ensure the surface condition of the tiles and the finish layer. The presence of moss and algae on the tiles may indicate a deterioration of the waterproofing.</p> <p>For overlapping tiles, in the absence of drainage grooves, the water tightness of the system is not guaranteed. This involves providing a good waterproof underlay. This arrangement is also valid for overlapping tiles with signs of deterioration in the assembly grooves and/or flow rims. It is also possible to test the waterproofness of a batch in the laboratory.</p>
Flexural strength	To be taken into consideration according to the climatic zone (strong winds, snowfall, etc.) and the configuration of the roof (orientation, slope, etc.). Specific tests can be performed in the laboratory to determine the breaking strength of a batch.
Frost resistance	Reclaimed tiles have generally passed the test of time and freeze/thaw cycles. However, it is important to compare the origin of the batches and the climatic zone of installation. For old tiles that have been damaged by frost, please refer to the point on structural characteristics. Specific tests can also be performed in the laboratory.
Performance regarding an exterior fire	According to the European Commission decision 2000/553/EC, clay roof tiles belong to the B _{ROOF} class (t1) without additional testing, subject to the design and proper realisation of the roof.
Reaction to fire	In accordance with European Commission Decision 96/603/EC, clay roof tiles are classified as non-combustible materials and belong to the European reaction to fire class A1 without prior testing.
Fixings	Several fixing methods are generally accepted. It is advisable to refer to the installation rules and the condition of the fixing device to judge the conformity of the batch (in particular for cladding applications). Some implementation rules may require the presence of 2 fixing holes. It is always possible to (re)drill the tiles, but this work is tedious.
Overlapping	For overlapping tiles (flat tiles, purlin tiles, etc.), a minimum overlap distance and cross-joint installation must be observed. In the absence of specific technical documentation relating to reclaimed products, reference should be made to new equivalents or to the experience of professionals.
Toxicity	The tiles must not be contaminated with lead (visible as grey traces) from external elements. This characteristic is therefore linked to the degree of sorting of the reclaimed tiles. A visual or detailed examination of the batch is often sufficient to estimate them.

in the event of specific and demanding applications, parameters related to characteristics such as mechanical resistance, frost resistance or impermeability can be measured and quantified using tests carried out by accredited laboratories.



Availability

Clay roof tiles are present in relatively large quantities on the reclamation market, depending on the model and the geographic region. The most common batches of models easily reach a few hundred to a few thousand m². The rarer models and some decorative items are mainly sold for repairs or roof renovations. Some resellers are also suppliers of new tiles and accessories.

In Belgium, the tiles concerned are mainly Boom tiles, Burgundy tiles, Side tiles, Storm tiles, Flat tiles, etc.

The market is very important in the Netherlands. The most common rustic models are Boom tiles, Side tiles, Storm tiles, Ball tiles and Roman tiles. Contemporary engobed or glazed models are also widely available.

In France, the offer is more focused on French types of rustic tiles and half-round tiles.

Indicative prices (excl. tax)

A non-exhaustive sample of the Western European reclaim market (Belgium, France, UK, and the Netherlands) has allowed us to extract some indicative prices:

- Inexpensive and common models: from €8/m²
- Contemporary models: €15–25/m²
- Rare models: €35–40 €/m²
- Accessory parts: €15–25/piece

Hazardous substances and precautions

Lead: Some old tiles were made from engobe or lead-based glaze. Some tiles may also have been contaminated with lead or other substances from associated roofing elements.



Read more!

Diagnostic and performance evaluation methodology for the re-use of clay roof tiles - Fondation Bâtiment Énergie (FBE). December 2020 (In French). <http://www.batiment-energie.org/doc/70/FBE-ECB-enjeu-A-facade-V5.pdf>

Embodied carbon (Cradle to gate – production A1-A3)

	kg CO ₂ eq./m ²	kg CO ₂ eq./kg
INIES database (FR) – Generic data*	26.4	0.53
CTMNC – Collective Declaration – Interlocking tiles **	12.2	0.27
CTMNC – Collective declaration – Half-round tiles and flat tiles ***	18.9	0.29
ICE Database (UK) – Clay Tile	24.0	0.48

* Indicative values for a surface mass estimated at 50 kg/m²
 ** Indicative values for a surface mass estimated at 45,4 kg/m²
 *** Indicative values for a surface mass estimated at 65,8 kg/m²

 According to the sources, reusing 100 m² of reclaimed clay tiles prevents the production of ~ 1220 to ~ 2640 kg of CO₂ equivalent related to the manufacture of new tiles (production phase only). This corresponds to a trip of ~ 7 320 to ~ 15 840 km in a small diesel car.



Example of reused clay roof tiles (BE)
© AGWA



Example of reused clay roof tiles (BE)
© recupan.be



Example of reused clay roof tiles (BE)
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