

**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).

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Material Description

Cement-based tiles (hereafter referred to simply as 'tiles') are well suited for reclamation. They are strong and durable materials that are made from coloured cement and sand, moulded and shaped by pressing without firing. Some include stony aggregates incorporated into the mass or in the form of a surface wear layer. They owe their strength to the hardening of the cement. Their high mechanical resistance to compression, shocks and bending, as well as the possibility of ensuring satisfactory flatness thanks to narrow joints have favoured their use in functional buildings – in particular for equipment requiring the passage of machinery on casters. By their composition, they are on the other hand porous, frost-sensitive and sensitive to acids and stains (unless treated with a pore filler).



Produced in abundance in Europe since the end of the 19th century, cement tiles can be found quite easily from professional suppliers of reclaimed materials. They should not be confused with other types of tiles such as porcelain stoneware or resin-based re-composed stone tiles, both less porous and more resistant, or slip-based tiles ('encaustic tiles') very popular in the United Kingdom, or concrete slabs. An erroneous trade name sometimes refers to 'cement tiles' to actually designate tiles with traditional patterns.

There are two main types of cement tiles, depending on the composition of the visible layer:

1. Cement tiles

They can be:

- Single-layer: consisting of white or grey cement, stone powder and colouring pigments.
- Two-layer: composed of a wear layer (visible face) whose composition is similar to that of single-layer tiles, and an underlay (sole) based on sand, grey cement and fine gravel for strength. The wear layer is thin (approx. 4 mm) compared to the total thickness of the tile (> 15 mm).



Two-layer 'cement' tile



Single-layer 'cement' tile - Front Side



Single-layer 'cement' tile - Back Side

2. Terrazzo tiles

They can be:

- Single-layer: composed of dust, grains and fragments of a suitable aggregate, coated with a paste of white or grey cement and colouring pigments.
- Two-layer: composed of a wear layer (visible face) whose composition is similar to that of single-layer tiles, and an underlay (sole) based on sand, grey cement and fine gravel for strength.



Two-layer 'terrazzo' tile - Edge



Two-layer 'terrazzo' tile - Front side



Two-layer 'terrazzo' tile - Back side



Cement based tile

The aggregates used in the manufacture of terrazzo tiles can constitute up to 80% of the finished product, and can be siliceous in nature (quartz, quartzite, granite, porphyry, sand, etc.), or limestone (marble, limestone, dolostone, etc.). The dimensions of the aggregates vary according to the desired rendering. The resistance of the wear layer strongly depends on the degree of hardness of the aggregate used. These aggregates are generally by-products of stone extraction, the glass industry or even ceramic tile fragments, which thereby find interesting outlets.



Terrazzo tile whose aggregate is made up of offcuts of porcelain stoneware tiles

→ **Formats:** most tiles are square or hexagonal. Their nominal dimensions are generally in the order of 20 × 20 cm, 25 × 25 cm, 30 × 30 cm, 40 × 40 cm. The thickness is variable according to the models and generally between 15 and 40 mm. Small models of 'cement' tiles (10 × 10 cm, 10 mm thick) are occasionally found and look like unglazed porcelain stoneware tiles. They are sometimes accompanied by straight, capped and high heel skirting boards.

→ **Finish:** the visible face can have a wide range of finishes: polished, softened, brushed, shot-peened, bush-hammered, sandblasted or scratched. Cement tiles are unglazed/engobed as they are not fired. Most cement tiles are impregnated with a water/oil repellent layer before being used.

→ **Texture:** mostly smooth and uniform for the upper surface. The edges are usually straight but due to their delicacy, slight chipping is common when reclaimed. The underside (not visible) is generally provided with a slight relief to improve adhesion to the substrate. In most cases, the acronym or the name of the manufacturer appears on the underside.

→ **Colours:** the colours are varied, generally solid, two-tone (speckled, flamed) or polychrome (patterned) for 'cement' tiles. The design of the patterns with respect to porcelain stoneware tiles is generally less clearly defined (this is also a clue to recognising them). The colours of 'terrazzo' tiles are defined by the colour, size and abundance of aggregates as well as by the pigments added to the cement.



Design tip

To increase the chances of meeting the offer available on the reclamation market, the designer/specifier can choose to split large surface areas into smaller quantity batches (for example, by providing different patterns in each room).



Tiles before reuse



Material reclamation

Cement-based tiles are often found as flooring in existing buildings. Their recovery is not always easy but can nevertheless represent a great opportunity for reuse, either on-site or via the professional channels of material resellers.



Mortar remains on edges and back side

→ **Dismantling tests:** dismantling tests make it possible to verify the feasibility and profitability of the removal. The type of laying (cement mortar on a stabilised sand bed, in fresh screed or adhesive mortar on dry screed) and the characteristics of the joints and tiles (thickness, composition) strongly affect the dismantling of the material.



Tile reclamation

→ **Removal:** careful dismantling should aim to ensure the integrity of the tiles and a certain uniformity of the batches. To minimise the risk of deterioration during dismantling, it is advisable to weaken the tensions within the tiles by first freeing 2 sides (perpendicular) of the tiles to be detached. This usually involves breaking non-free edge lines. The tiles will be sorted by quality, colour, size and degree of cleaning. They are stored on their edge thereby minimising the risk of abrasion. 'Face to face' storage will be preferred. Particular attention will be paid to batches characterised by a defined pattern and for which certain pieces must be recovered intact (e.g.: patterned carpet with frieze and corner pieces). Very often, reused cement tiles adhere strongly to the setting mortar. The cleaning of mortar remains is rarely carried out on-site and requires specific tools.



Mechanical cleaning

→ **Treatment:** the main treatment offered by the suppliers of reclaimed cement-based tiles is the mechanical cleaning of the remains of mortar on the underside and on the edges. This manual step is generally carried out using suitable tools (pneumatic chisel, plunge-cut saw, grinder, etc.) and requires systematic downstream sorting. Tiles with significant chips and knocks are downgraded. The cleaning of mortar remains on the sides is rarely carried out, which implies special arrangements at the time of laying (ask a professional tiler for advice). The cleaning service is a weighty operation resulting in a big difference in price between the cleaned tiles and the uncleaned tiles.

→ **Storage:** the tiles are stored in bulk on pallets or repackaged in bundles, taking the necessary precautions to minimise wear on the visible side (packaging in vertical position, layers separated by a plastic or 'Unalit' type sheet, stored face to face, etc.). The tiles must be stored away from frost and bad weather.

→ **Transport and delivery:** the necessary precautions must be taken during transport and delivery in order to minimise breakage (strapped, shrink wrapped pallet, etc.). It should be noted that the pre-packaged tiles facilitate installation.

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



Few mortar remains after removal (hybrid mortar)



Reclaimed tiles

Think reversible!

The use of a hybrid mortar (lime-cement) or light cement mortar and cement-based joints without resin facilitates future dismantling. However, these laying methods have lower adhesion performance and will not be recommended for uses involving significant temperature variations and/or subjected to significant moving loads. Think about it when choosing the laying technique, it will increase the possibility of future reuse.



Applications and laying

Reclaimed cement-based tiles are generally used as interior floor covering for applications subject to moderate stress (private accommodation) or more intense stress (entrance hall, retail space). As they are not too thick (less than 16 mm), they can also be used for wall application (tiles in this format are generally of more recent production). Porous in nature, *they are not recommended for outdoor use* and are moderately suitable for uses involving excess humidity (sanitary facilities) or staining and aggressive products (community kitchens, laboratories). If necessary, and with adequate maintenance, the surface of the tiles can be subjected to a water/oil repellent treatment, and special waterproofing precautions can be taken for the substrate.

As a general rule, the choice of tiles must take into account the expected stresses (*see § 'characteristics and fitness for use'*). In all cases, reference should be made to the European and national standards relating to the product (EN 13748-1 for terrazzo tiles) and to the rules of practice in force (or implementation standards).

As long as they are completely cleaned, the reinstatement of reclaimed tiles does not differ from that of equivalent new tiles. However, the presence of residual mortar may require special precautions. The cleaned, reclaimed tiles lend themselves to the same variety of laying methods, patterns and fittings. They raise the same points of attention, in particular: properties and condition of the substrate, products and techniques for laying and grouting, drying times and laying times, costs, expansion joints, finishing joints, flatness, separation layer, underlying insulation, underfloor heating, grinding after laying for terrazzo tiles, application of a pore filler, crystallisation, specific maintenance, etc.

The presence of residual mortar on the sides is not recommended (but is common!). Not only will this affect the nominal size of the joints, but it can also influence their colour and composition. As a rule, patterned tiles are laid with a thin seam to emphasise the junction points of the composition. These thin joints also improve transit comfort and limit the appearance of breakage.

Due to the wear characteristics of cement tiles, it is recommended that an effective mat is provided for heavy traffic applications.

Reclaimed cement-based tiles are relatively thick and therefore more difficult to lay over an existing floor.

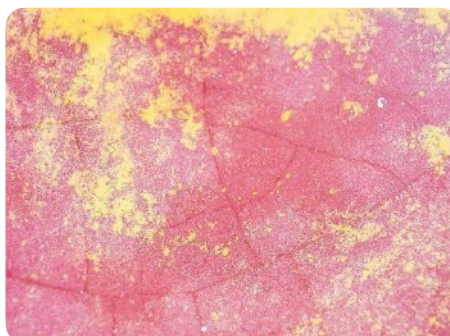
To facilitate installation, the designer/specifier will take care to use batches with a certain degree of uniformity in terms of the following characteristics:

→ **Batch composition:** the batch must consist entirely of cement-based tiles.

→ **Dimensions:** the dimensions of the tiles must be uniform, including the thickness. Variations in thickness of 1 to 2 mm are however possible for hand-crafted tiles from the same batch. In the case of tiles whose edges have not been cleaned of the remains of mortar, it is important to take this into account. The dimensional tolerance will be determined by the designer/specifier according to the equipment, the thickness of the joints and the laying technique.

→ **Colour:** slight variations in colour are possible (even for new products). In the case of reclaimed cement-based tiles, these variations may be due to the original exposure. It is advisable to mix the tiles when laying. The designer can also opt expressly for a pattern including tiles of very different colours. This is one way to take advantage of a greater variety of reclaimed tiles that can lead to architecturally interesting results.

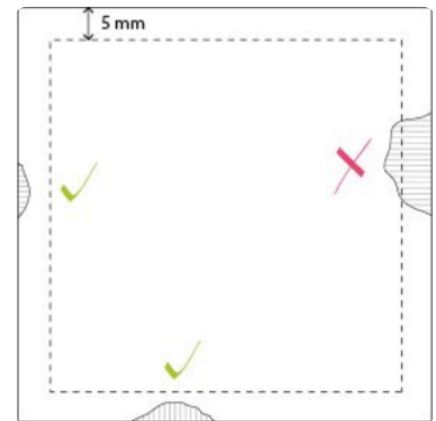
Crazing or cracking of cement tiles is a set of capillary cracks affecting the visible face of the tile and arranged in a network of small meshes. This phenomenon is probably generated by alternate shrinkage and tension between the constituent layers of the tile. This phenomenon does not affect the durability of the tiles, but can influence their aesthetic appearance if the cracks become dirty. It is therefore important to provide for the application of a water-repellent/oil-repellent protective layer if the use of tiles involves the presence of liquid and potentially staining substances (kitchens, bathrooms, etc.).



Presence of a light clouding and crazing cracks. These cracks do not alter the technical characteristics of the tile.

→ **Condition:** Reclaimed tiles may show signs of alterations such as signs of surface wear, chipped or cut edges, crazing cracks, etc. Some tiles may have swelling on their visible face. These are generally due to capillary rise occurring during their first use, and which causes lime hydrate deposits in the form of a cloud on the surface of the tiles. These swellings do not affect the longevity of the tiles. They can be removed by a specific abrasive treatment. *The use of aggressive detergents and acidic or alkaline products should however be avoided.*

It is up to the designer/specifier to define the degree of imperfection tolerated, according to the defined use, by specifying the maximum dimensions of the defects (for example, crazing: accepted, breaks and chipping < 25 mm?). This principle can be described in visual form to facilitate the examination of the tiles. Example:



→ **Quantity:** some suppliers automatically 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 the introductory sheet*).



Characteristics and fitness for use

The harmonised European standard EN 13748-1 establishes the relevant characteristics (depending on the context) in order to determine the fitness for use of terrazzo tiles. Although detailed for new materials, these characteristics may prove useful in considering the specific case of reclaimed cement-based tiles.

In case of specific and demanding applications, parameters related to characteristics such as wear resistance, slip, modulus of rupture, etc., will have to be measured and quantified using tests carried out by approved laboratories.

Characteristics	Comments
Dimensions (length, width)	This characteristic is closely related to the degree of sorting and cleaning of reclaimed tiles. A visual or detailed examination of the batch is often sufficient to estimate it.
Thickness	The standard for new products indicates a requirement of 4 mm minimum thickness for the surface layer of double-layered terrazzo tiles not intended to be ground and 8 mm for those which will be ground after laying.
Thickness	A tolerance of ± 2 mm is acceptable for new tiles with a thickness of < 40 mm
Geometry (straightness of edges, angularity, flatness of the surface)	For hand-made tiles, the lower face is not necessarily parallel to the upper face, however this irregularity can be easily remedied by means of adequate laying.
Surface and edge quality	This characteristic is closely related to the degree of sorting and cleaning of reclaimed tiles. A visual or detailed examination of the batch is often sufficient to estimate it. It should be mentioned that the edges of cement-based tiles are very fragile.
Water absorption	Porous in nature, cement tiles are susceptible to absorbing liquids. This characteristic concerns 1) <i>the lower face</i> , by which a rise in humidity promotes the appearance of swelling at the level of the visible surface, 2) <i>the edges</i> , for which it is not recommended to use a coloured jointing product, 3) <i>the upper face</i> for which it is advisable to apply a water/oil repellent coating product.
Breaking strength/breaking load	Mainly dependant upon the thickness and porosity of the tile. Older reclaimed cement-based tiles are generally quite thick (≥ 20 mm) to meet this requirement. Contemporary production techniques have made it possible to bring thinner tiles to the market. The in-depth evaluation of this performance is relevant in case of high static and/or dynamic loads.
Surface abrasion resistance (wear)	/
Slippage	The usually smooth character of the surface can cause slippage. Smooth tiles will probably not be suitable for outdoor uses that are uncovered and/or regularly flooded (e.g.: Italian shower). Their performance should be particularly evaluated for intensive use and/or sloping ground.
Reaction to fire	In accordance with European Commission Decision 96/603/EC, terrazzo tile flooring is classified as non-combustible material and belongs to European reaction-to-fire class A1FL without prior testing.
Stain resistance	Given the porous nature of cement-based tiles, it is advisable to provide for the application of a water/oil-repellent protective layer (pore filler) to prevent stains.
Resistance to low and high concentrations of acids and base products	Untreated cement-based tiles are very sensitive to acids and base products.
Thermal conductivity	To be assessed if the tiles should contribute to the thermal performance of an element.
VOC emissions	Cement-based materials are considered to be low emitters of Volatile Organic Compounds. However, the laying and protection products can potentially emit VOCs.



Availability

Cement-based reclaimed tiles are relatively common in the salvage market. However, availability depends on the quantities required. As an example:

Frequent	Batch from 1 to 50 m ²
Occasional	Batch from 50 to 100 m ²
Rare	Batch > 100 m ²

Dismantling

Dismantling efficiency: ~ 15 m² of tiles in good condition person/day

This rate includes laying, logistics and percentage of breakage. It varies according to the size of the tiles, the degree of adhesion of the mortar, the configuration of the building, etc.

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:

Supply: depending on size, pattern, general condition, etc. (excluding antiques)

→ *Uncleaned reclaimed tiles:* 25 - 50 €/m²

→ *Cleaned reclaimed tiles:* 55 - 125 €/m²

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

	kg CO ₂ eq./m ²	kg CO ₂ eq./kg
DNV – Life Cycle assessment on floor coverings *	9.6	0.21
ICE database (UK) *	5.3	0.12

* Indicative values for terrazzo tiles with an average thickness of 10 mm and estimated density of 2300 kg/m³



Reusing 100 m² of tiles prevents the production of ~ 530 to ~ 960 kg of CO₂ equivalent related to the manufacture of new tiles (production phase only). This corresponds to a journey of ~ 3,200 to ~ 5,700 km in a small diesel car.

Tips for distinguishing cement-based tiles from ceramic tiles

→ *By eye:* the pattern of a ceramic tile appears to have been drawn with a pencil, and that of a cement-based tile with a thicker felt tip pen. The colours of the cement-based tile are more 'washed out', but once dampened, the colours become much more vivid. This contrast is less pronounced on ceramic tiles.

→ *By ear:* two ceramic tiles that are knocked together sound like glass, which is not the case for cement-based tiles. The cleaning potential of reclaimed cement tiles can reach around 10 to 20 m²/person per day with proper installation.

→ *By touch:* exposed to the sun, a ceramic tile is warmer to the touch than a cement-based tile.



Reused tiles (BE) @ Antony Nocera (Ceramica Concept)

Did you know?

Contemporary cement tiles are generally produced in Morocco. Each worker is able to manually manufacture about 4 m²/day. The resale price of new tiles on the NWE market varies between 60 and 150 euros/m².

The cleaning potential of reclaimed cement tiles can reach around 10 to 20 m²/person per day with proper installation.

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