5 The Clay Life Cycle - Demolition and Recycling

The last phase in a product's life cycle can become the first, if demolition is followed by recycling and re-use. Despite the potential long life of clay brick buildings (well in excess of a 100 years), they are sometimes demolished well before the end of their useful life. The text below examines the options for re-using ceramic building materials.

A research project carried out by TBE in the late 1990s concluded that the following are possible uses for recycled clay building materials:

- Reclaim as bricks and tiles
- Filling and stabilizing material for infrastructure works
- Aggregates for in-situ and precast concrete and mortars
- Aggregates for calcium silicate bricks
- Tennis sand
- Plant substrates
- Other options

Building & demolition waste is used extensively throughout Europe for roadworks and for use as aggregate. This is facilitated by fast developing recycling technology that allows precise extraction of various materials from mixed demolition waste. Separating out ceramic matter provides an opportunity to recycle and re-use a very sustainable building material.

5.1 A longer life for buildings

Where sustainability is important, demolition should be the last resort but if unavoidable, other options can be considered. Because bricks and tiles are highly durable materials, they can be re-used after a building has been demolished. Buildings should be designed with as long a life as possible. This constitutes a more efficient use of buildings and materials and reduces the amount of demolition waste. Buildings should also offer flexibility, so that after they have come to the end of their original purpose, they can be refurbished for other uses without having to resort to demolition.

5.2 Demolition of buildings

When the only option is to demolish, ways must be found to re-use as much as possible of the building fabric.

Extracting roof tiles and storing them for re-use is not difficult. And when bricks are left over from building projects, they too can be diverted to other uses. But utilising bricks from demolition sites is more difficult, as they may be contaminated with concrete, mortar, plaster and other materials.

5.2.1 Volume of masonry waste material

The amount of brick demolition waste that is re-used varies across Europe. In several countries, more than half of all demolition waste is re-used in some form, although at present this is often for low-grade applications. Difficulties may however occur when separating-out materials, particularly where composite elements have been used. This is why ease of separation and compatibility of certain combinations of materials should be in the minds of designers and specifiers. In some countries, studies have been conducted to highlight methods of re-using bricks from demolition sites.

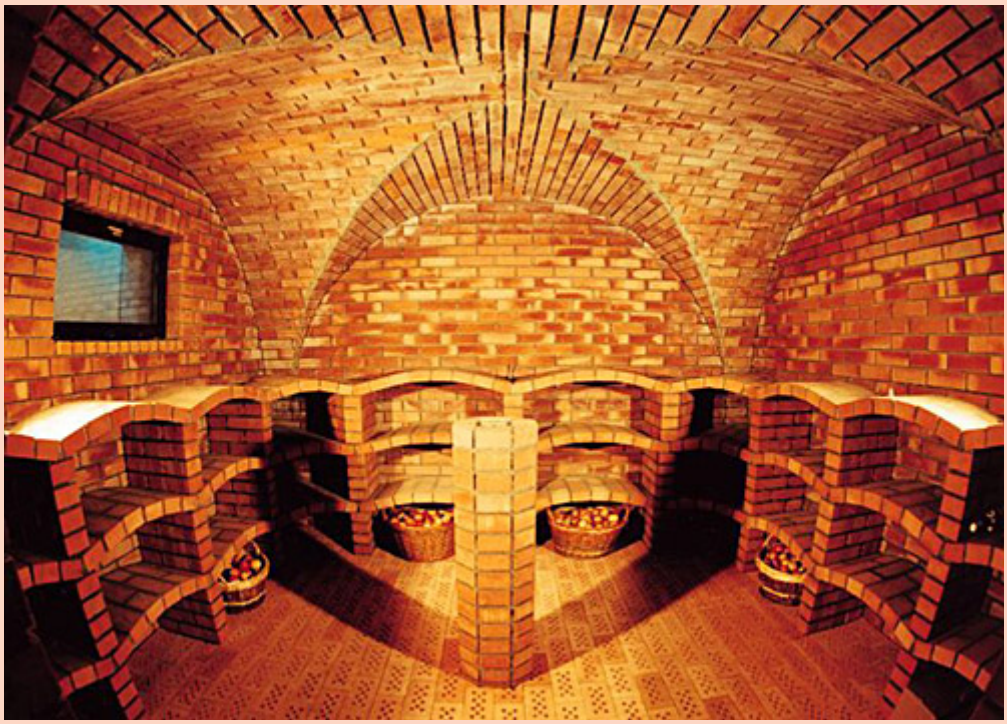
recycling facility

But it seems certain that economic and legislative pressures will have a profound effect on the process of recycling building materials.

5.2.2 Main environmental criteria for re-use

The technical criteria for re-using ceramic demolition waste are few. In most cases, demolition waste is mixed-up with other material, but needs to be free of contaminating elements such as heavy metals and PAH's. Re-using demolition waste in infrastructure projects is not normally a problem, unless it ends up in landfill.

The European Commission is working on rules to prevent the contamination of soil, groundwater or surface water caused by landfill material. But as ceramic building materials are made of natural clay, they do not pose a danger to the environment.



wine cellar made of recycled bricks

5.3 Demolition and recycling - European Policy

The European Commission is formulating a strategy for the reduction and recycling of waste. There are no barriers for the use of granulated ceramic material. But unfortunately, it is often mixed with contaminated demolition waste. If this is purely brick masonry it is not a problem when converted to landfill, as generally contact between ceramic material and ground or surface water causes no toxic side effects. After all, bricks and tiles in service are frequently exposed to ground and surface water and do not normally pose a threat.
For a more sustainable construction, ceramic building products should be incorporated into flexible buildings with long design lives in order to ward off the spectre of demolition for as long as possible. Ceramic products are certainly very durable and will stand the test of time to prove they are truly sustainable.

5.4 Options for recycled brick material

A research project carried out by TBE in the late 1990s concluded that the following are possible uses for recycled clay building materials:

5.4.1 Filling and stabilizing materials for infrastructure

Minor roads

Masonry waste and scrap bricks have for many years been used to fill and stabilise minor roads, especially in wet areas such as woods and fields. The practice is common in countries that lack adequate stone supplies such ad Denmark. The material is generally used uncrushed.

Main roads

Crushed clay bricks, roof tiles and other masonry can be used on larger road building projects, especially as unbound base material. It is used to build roads in countries that include Switzerland, Holland, UK and Denmark.

Although crushed masonry can be used for lightly trafficked roads, it is not suited to heavy traffic due to the risk of deformation.

The material replaces natural materials, such as sand and gravel, which are normally used in large amounts for this purpose. In some cases, crushed masonry can form part of a mix that may also contain concrete and natural aggregate.

In both cases, the material has to be free of non-ceramic contaminants that may be leached by water to cause pollution. Scrap bricks, roofing tiles or selectively demolished masonry do not normally pose a problem unless they are contaminated with impurities such as mineral wool and concrete.

Although energy is used in demolishing and transporting the reclaimed material to the point of re-use, the use of ceramic material can have a lower embedded energy than the use of ‘virgin’

raw materials. Indeed, using demolition waste in small roads may even result in less energy usage in forestry and agriculture equipment.

5.4.2 Aggregates for in-situ and precast concrete and mortars

Crushed clay bricks and other masonry can also be used to level and fill pipe trenches. The crushed material will replace natural materials such as sand and will therefore cause fewer disturbances to the landscape.

A fine grain size of around 0-4 mm is normally used for pipe trench material and this can mostly comprise crushed masonry material. Coarser particles can be used for other applications (e.g. aggregates in concrete and mortars).

Crushed masonry that is used for this purpose must be free of contaminants that can be leached by water to cause ground water pollution.

5.4.3 Aggregates for calcium silicate bricks

Crushed clay bricks, tiles and other masonry can also be used as aggregate in cast concrete. The crushed material replaces other raw materials such as sand and causes fewer disturbances to the landscape.

The production of crushed masonry aggregates for concrete involves crushing, sorting and cleaning the demolition waste.

The main environmental impact of this process is the production of dust during crushing and sieving. The problem can be minimised by sprinkling with water and is comparable to problems connected with the production of natural aggregates.

Several European research projects have explored the potential of using crushed masonry as aggregate for concrete. It is common practice in Austria, Switzerland, Denmark and especially Holland.

Sand for surfacing tennis courts is produced by crushing red bricks and roof tiles.

The material is produced by crushing in hammer mills to a grain size of 0-2 or 0-4 minimum. The process is most efficient when it occurs at brick or tile factories where there is an abundance of scrap material. Different bricks will give different qualities and colours of tennis sand. Clinker quality will have numerous benefits:

- Better water drainage
- Unique colour
- Greater density (less wind scatter)
- No moss problems

Dust may arise during production but the problem can be minimised by enclosing the crushing equipment and if necessary, using water sprayers.

The requirements for sand and other materials used in tennis courts may be laid down in standards and specifications stipulated by tennis governing bodies. The main requirements are water permeability, grain size distribution, surface shear stability and a satisfactory proctor test. The fine surface layer is laid over courser-grained layers that can comprise crushed clay brick matter.

5.4.5 Plant substrates

Crushed bricks and tiles can also be used to form substrates for growing plants. The material may be mixed with other substances used in plant production, e.g. composted organic materials. This material is especially suited for green roofs. Flat roofs are covered with a dense polymer membrane and overlaid with 10-30 cm of the crushed brick and tile material.

In research projects, this material has compared well with other materials used for the same purpose e.g. expanded clay and lava. The porosity of the material allows it to retain water that plants can draw on in dry periods. The use of a lighter coloured material can lower evaporation and thus enhance soil moisture levels.

Another possibility for crushed bricks and masonry is as fill material around tree roots where traffic would otherwise compact the soil and hinder its ability to absorb air and water.

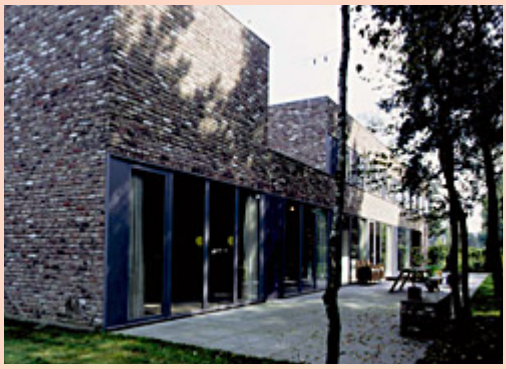
The use of recycled ceramic waste material will save on new raw materials, but it must be free from contaminants that could be leached by water and adversely affect the plants and the surrounding area.

5.4.6 Other options

The above-mentioned options for recycling clay bricks and roofing tiles are the most notable. In some countries (e.g. the Netherlands) a possible reduction of masonry waste from infrastructure works is expected to occur in a few years. This will dictate the need for new national and regional strategies.

Bricks and roof tiles have traditionally been regarded as important materials as after demolition they have often been incorporated into new buildings. In many countries, this traditional way of recycling is still used. By using old bricks and tiles, it is possible to endow buildings with a unique appearance.

applications of reused bricks



However, it should be remembered that:

- Cleaning bricks is time consuming, difficult and dusty work that, if mechanised, is rarely successful. New techniques should be applied to tackle such problems.
- Cement rich mortars are difficult to remove. In countries like Greece, where mortar from ancient constructions is a full ceramic material, it does not need to be removed.
- Excess mortar dust can inhibit the adhesion between mortar and bricks and lead to weaker masonry, depending on the mortar composition.
- Bricks from demolished buildings may vary in quality. It is therefore difficult to assess the strength and load-bearing capacity of masonry made from recycled bricks. European and national standards are very strict and it is extremely difficult to be sure that recycled bricks used in new structures will be durable.
- Due to the difficult nature and high labour costs associated with the process, the use of recycled bricks may be more expensive than the use of new bricks.

The stability and porosity of recycled brick renders it suitable for use as a fill or surfacing material in roads and trenches. Other possibilities will no doubt be found for future applications. Bricks, roofing tiles and other recycled masonry have chemical compositions that may be compatible for use with other building products fired at high temperatures. Possibilities therefore exist for combinations with materials such as cement and mineral wool.

Finely ground clay brick and roofing tile materials have a pozzolanic effect. Due to the presence of reactive silica, the material can form a binding mixture when mixed with lime or lime-containing materials, such as cement. This effect can be used in mortars and concrete. The practice was adopted by the Romans and exploited by numerous cultures ever since. Current investigations may show that this is an important use for recycling clay bricks and roof tiles.

Scientific institutes and universities are embarking on an increasing amount of research to further our knowledge in this sphere. In the Netherlands, one project studies the separation of mixed building and demolition waste materials and the re-use of each type.

After selective demolition, heat is used to remove mortar from bricks in order to allow re-use in housing. In cases where the mortar is a full ceramic material, as in Greece, separation would not be needed and would thus render re-use a lot easier.

In all other cases where bricks and mortar are separated, tests have shown that the whole brick still conforms to technical standards. This proofs that ceramic building products have enduring qualities that are suited to sustainable construction.