CLIVE THOROGOOD
BUILDING SURVEYING LIMITED

## Technical Note 2: TERRACOTTA AND OTHER FIRED EARTH MATERIALS

### Background

Terracotta is 'fired earth' material, much as a roof tile or a clay brick, albeit it is formed in a different way. It has been used for centuries, the earliest known examples being in Babylonia dating from around 1400 BC. It was first used on buildings in this country for a short period of about 15 years from around 1520, including on Hampton Court Palace.

The second phase in the use of terracotta and the one where it fully-developed as an architectural building material in England, was during the mid-late Victorian period.

Prior to this, the more expensive stone and decorative brickwork had primarily been used for façades. Around this time, the value in terracotta had been recognized for its ability to be built by mass production to create ornamentation and fine masonry. Casting of terracotta blocks from 1 original single mould offered a new approach to style and decoration, which also suited the Victorians more flamboyant architectural tastes.

Terracotta is produced as either a slab, or a block and is used in both a structural and semi-structural context. For the blocks, fine clay is hand pressed into the mould of Plaster of Paris to create hollow blocks. The blocks would have been either dowelled, cramped or anchored to a lower-quality brick substrate by means of iron or steel fixings. Voids to the rear of the blocks were filled, usually with concrete, which enclosed the metal fixing camps.

The clay used to make terracotta needs to be able to carry fine detail and then be fired to a high temperature without distortion or excessive shrinkage; therefore, selection of the suitable clay base material was essential. The raw materials for terracotta varied, but generally included a blend of clays selected to achieve these desired effects.

This blended clay was mixed with water to create a smooth texture and plasticity. Terracotta clays will also have been mixed with ground glass, pottery and, in some cases, sand was added to restrict the amount of shrinkage in the fired product. There was still some shrinkage of approximately 10% and this was factored-into the sizing of the mould.

Terracotta blocks varied in size between different manufacturing regions and depending on the nature of the proposed installation. Where used as a structural block, however, they were typically (in metric terms), approximately 300-450mm long, 150-375mm high and 100-250mm wide. The thickness of the shell was typically 25-50mm.

The natural surface of terracotta is a fired skin, which is a hard, thin, vitreous unglazed skin formed on the surface upon firing after the clay has been hand-smoothed or finished. Glazing

was often used to change the colour and texture and was sometimes used to imitate other (more expensive) types of stone.

Terracotta could, therefore, adopt any one of several colours, depending on the glaze used, the kiln type, amount of heat it has experienced during firing and also depending on the quality and type of clay used. Most terracotta tended to be in the colour range between buff or red.

For a particular clay, different tints of the fired block indicate the varying quality of the firing. Harrods department store, for example (1911) is fully clad with well-fired rich yellow terracotta produced by Doulton.

Terracotta had qualities of being relatively lightweight and, therefore, easily transported and also stronger in compression than, say, Portland Limestone. It is also cheaper than stone. However, its development was largely due to the low cost and speed with which detailed architectural features could be replicated from a single mould and the majority of buildings where terracotta has been used to display a replicating architectural feature of some sort.

Also, its fine fired surface was thought to be resilient to soiling, which was an important factor in the dirty atmosphere of industrial cities at the time. This proved to not be the case, however and many terracotta facades show the effects of harsh industrial environments, as well as later poor attempts to clean them.

Following the 1851 Great Exhibition, a purpose-built building was required to display many of the exhibits that have been shown at the exhibition. The Victoria and Albert Museum was, therefore, built for this purpose between 1859 and 1872, with extensive use of terracotta used in its construction.

Other buff terracotta was widely used in the other buildings at South Kensington during the 1860s as seen on the Royal Albert Hall. This building shows the ease with which intricate architectural detail could be replicated, this being with considerably lower cost and at much greater speed than working with stone carving.

## Faience

Faience is a large, solid masonry slab or tile, which was fixed as a cladding to a building over the concrete, brick or breeze blocks. Essentially, it was a glazed terracotta block, typically around 25mm-thick. It became widely used from the 1890s and developed from experimentation in the production of terracotta. The term terracotta usually refers to the material used in the same colour as the clay from which it is made, whilst faience refers to fired units which have the glaze applied, as above.

The most usual colour for faience was white or cream, but poly-chromy was also used and inspired Art Nouveau and Art Deco architecture. Many such uses include the cinemas of the early 20$^{th}$ century, entrances of some of the London Underground stations and some high-profile earlier public buildings, such as the Natural History Museum in Kensington.

Natural History Museum front entrance

## Causes of failure in terracotta and faience

Terracotta fails because of its delicate nature and the early ignorance believing that the blocks did not need flashings, weepholes or drips and it was some time before it was realised that the material is not as hardy as first thought.

Poor pressing of the clay into the mould could produce air pockets and, therefore, surface delamination during firing, which left the block prone to frost attack. Once the external fired surface was broken, the relatively soft underbody was exposed and this quickly deteriorated.

Under-firing was another problem. This resulted in the pores of the fired skin not bonding properly. This can lead to their early failure.

Terracotta also became a victim of its own success and popularity. High demand meant that quality dropped, with inadequate firing resulting in distortion in some of the blocks; this required wider joints, which often created routes for water to ingress into the block.

More common failure relates to corrosion of the iron cramps, which hold the blocks onto their masonry substrate. This is often a result of the water ingress discussed above, with the fired skin trapping water in the block. Only being able to penetrate further inwards, this water eventually reached the cramps and the corrosion damage began. Corroding iron expands to many times the size of the original and this causes significant expansive forces upon the block around it. These can be physically forced outwards, which open the joints even more, allows more water to penetrate and the downward spiral of failure continues.

## Poor glaze

The protective glazes on terracotta and faience can become pitted and powdery as they weather. Lead glazes of the 19$^{th}$ century were fired at relatively low temperatures and tended to deteriorate quickly in the harsh industrial atmospheres of the major cities.

Another cause of failure is the differential expansion between the clay and its glaze after firing, as the clay absorbs atmospheric moisture. This would lead to tension cracks in the surface of the glaze, which would create a route for water to ingress the block. Also, water

entering these fine cracks cannot be removed without further damage to the glaze and further moisture is drawn into the block through the cracks by capillary action. The above cycle of corrosion and aggravated failure then continues.

## Coade Stone

Coade is another fired product, first produced in 1768; it is not a stone, but a blend of clay, terracotta, silicates, and glass, which was fired for around four days at a time at very high temperatures in kilns. This produced a hard-wearing, smooth and easily-carved material, which closely-resembled stone, or smooth concrete. The exact blend was one of those commercial secrets, which originally disappeared with the death of the creator, Eleanor Coade and it stopped being produced in the 1830's. This was only after it enjoyed popular use on buildings for e.g. George III on Buckingham Palace and Windsor Castle, Kew Gardens and the Imperial War Museum.

One famous example includes the Coade lion standing on the south end of Westminster Bridge in London. There are many other examples remaining on the front of public buildings and as ornaments in formal gardens.

Later analysis of the constituents of Coade identified a mix of around 60% clay, 10% each of flint, quartz and glass plus 10% grog (ground-up fired clay). As with terracotta, the firing was the key to longevity and failure of some Coade is due to weak resistance to weathering caused by under-firing.

Coade was never used as a structural material, more a decorative one to create dressings and other features. It did have the benefit of being able to create some large and detailed 'statues', as well as the more common ornate garden ornaments, such as urns.

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