The Norton Priory Medieval Tile Kiln Project
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The ‘Norton Priory Medieval Tile Kiln Project’ proposes to rebuild and fire a replica medieval tile kiln in the grounds of Norton Priory, near Runcorn in Cheshire. Since no archaeological evidence exists of what medieval tile kilns looked like above the ground, this project aims to test a hypothetical design. The design is based on the remains of the medieval tile kiln, found in the grounds of Norton Priory in 1972 (Greene and Johnson 1978, 31), and it will build upon Greene and Johnson’s ‘Experimental Kiln Firing’ (1977-8), which produced some good results, but experienced problems with cold spots in the firing chamber (Greene and Johnson 1978, 38). Our overall aim in this experiment is therefore to design, construct and fire a wood-burning clay kiln, using the floor plan of the original medieval tile kiln, but with an above the ground design which is different from the 1977-8 experiment. This new experiment will, hopefully, improve our knowledge of what small tile kilns, such as the one at Norton Priory, would have been like.

Medieval tile kilns
In medieval England the production of tiles took place for the main part in the countryside. This was particularly true for the production of floor tiles and would have involved both the construction of the kiln and the firing of tiles upon the grounds of the site for which the tiles were intended, e.g. Clarendon Palace, Norton Priory and Meaux Abbey (Clarke 1984, 150). In some instances, however, the kilns were constructed as part of a commercial enterprise, as at Danbury or Penn (Clarke 1984, 150).

Glazed floor tiles do not appear in England until the late twelfth / early thirteenth centuries in royal and monastic sites and were thought to have been introduced from France (Clarke 1984, 156). At Norton Priory 80m² of floor tiles, made up from geometrically shaped mosaic tiles found in situ, have been dated to the early fourteenth century by the discovery of coins contemporary with the context (Clarke 1984, 156). It is estimated that to tile the choir, chapel, transepts, the east chapel, the first bay of the nave and the chapter house at Norton Priory 40,000 tiles would have been needed, equating to 54 firings of the Norton Priory tile kiln (Clarke 1984, 157). The remains of other tile kilns, such as a less well-preserved example from North Grange in Yorkshire, have also been found. The kiln from North Grange produced the tiles for the nearby Cistercian Meaux Abbey, and was larger than the Norton
Priory kiln.

**Meaux Abbey**
The Norton Priory tile kiln resembles in structure and purpose the Meaux Abbey kiln, as both were intended for the firing of mosaic tiles, although the kiln at Meaux is slightly larger. The Meaux kiln consists of two parallel rectangular firing chambers below ground level, fired through two parallel arches opening onto a stoke hole (Eames 1961, 139). Small parallel arches would have supported the walls inside, being flat topped, so that they could carry the oven floor (Eames 1961, 139). There is no surviving evidence for how the kiln may have been roofed. However, Eames suggests that the roof would probably have been either of fired tiles, laid across the top after the oven had been set, or domed over with clay after each setting of the kiln (1961, 139). Eames also suggests that the kiln may have had a double arched roof of fire-bars, a theory possibly supported by the presence of a type of segmented building tile, of which six examples were found at the Meaux Abbey site (1961, 163).

**Experimental kiln firings**
There have only been a few experimental firings of medieval tile kilns: in addition to the ‘Norton Priory Kiln Firing’ (1977-78), another took place at Cleeve Abbey in Somerset in 1998, a collaboration between English Heritage, Somerset county Museums Service and the Bickley Ceramics Project (Kent and Dawson 1998, 45). The Cleeve Abbey kiln, although medieval, was designed to fire square tiles, not mosaic tiles, which limits its usefulness in this particular experiment. Nonetheless, the type of kiln structure used at Cleeve Abbey was similar to the Norton Priory kiln – rectangular with two fireboxes, but it was at least half the size of that at Norton Priory, with the firing chamber measuring 800mm x 900mm (Kent and Dawson 1998, 45). The Bickley Ceramics Project, which researched types of medieval kilns using examples of modern updraft kilns from around the globe, found that no real link can be made with the design of a kiln and a particular pottery ware type (Kent and Dawson 1985, 70).

**The Norton Priory medieval tile kiln**
The medieval tile kiln at Norton Priory was found during excavations carried out by Patrick Green for Runcorn Development Corporation in 1972 (Greene and Johnson 1978, 31). The Kiln once sat within a large flat-based pit which was 0.5 metres deep, but only the lower part of the kiln survived, being rectangular in shape and measuring 1.9 metres long x 1.4 metres
wide (Greene and Johnson 1978, 31). The walls were 0.3 metres thick at the side and back, the front wall being 0.41 metres thick and incorporating two arched tunnels intended for stoking (Greene and Johnson 1978, 31). Inside the kiln there were two stoking chambers separated by a spine wall measuring 0.18 metres thick, so that each chamber measured 1.1 metres long x 0.35 metres wide on average (Greene and Johnson 1978, 31). The walls of the kiln were constructed mainly of clay with the inclusion of tile wasters and large pebbles, possibly for levelling up during construction (Greene and Johnson 1978, 31-32). Of all other tile kilns, where the dimensions are known (such as at Danbury, Essex and Naish Hill, Lacock), Norton Priory is the smallest (Greene and Johnson 1978, 31).

Although the 1977-8 experimental kiln was based upon the foundations of the original tile kiln, there was no surviving evidence to indicate how the kiln may have been constructed above the ground. For this reason Greene and Johnson built their design upon what they believed would have been necessary to produce a through draught that would adequately fire the tiles (1978, 34). During their construction Greene and Johnson used simple wooden arched frames to create the tunnels through which the kiln was stoked and the fire-bars that spanned the chambers, creating a floor for the firing chamber (1978, 34). It was believed that the optimum number of bars for this would have been five (Green and Johnson 1978, 32). The wooden frames would have been left in position to burn out upon firing. Greene and Johnson believed that the construction of the kiln above the ground would have to be sufficiently high and with narrow enough gaps to produce a chimney effect, i.e. to encourage a through draught to fire the tiles adequately (1978, 34). In order to do this, and to keep the structure stable, the walls would have to slope in gradually and the top of the kiln left open and covered with a clay slab when needed (Greene and Johnson 1978, 34). The size of the opening was 0.4 metres x 0.6 metres.

The kiln survived its first firing well; some firing cracks opened in the structure but were easily plugged with more clay (Greene and Johnson 1978, 38). On the first firing, one of the fire bars broke, but none broke in any of the further firings, leading Greene and Johnson to conclude that the kiln could have been used for many firings (1978, 38). Some modifications were made to the kiln after the second firing. The kiln was increased in height by 0.5 metres and the slope of the kiln was continued up (Greene and Johnson 1978, 38). They also built two 0.5 metre tunnels, as extensions of the stoking chambers, in the hope that this would help to reduce the number of cold spots in the firing chambers. These modifications helped raise
the temperature in the kiln to over 1000°C reaching as high as 1200°C at its top temperature, which was too high as it caused some of the tiles to over fire. Whereas the modifications did reduce the extent of the cold spots, they did not succeed in eliminating them altogether (Greene and Johnson 1978, 38). One further problem of the new design was that the narrower opening did not allow for stacking through the top of the kiln, meaning that the top of the kiln had to be removed to stack the tiles, and then replaced and sealed onto the structure with wet clay (Greene and Johnson 1978, 38).

**Norton Priory Medieval Tile Kiln Project 2008**

Our project aims to produce enough mosaic tiles to re-floor part of the priory. However, before we can do this we must first choose the design of the kiln, hopefully a design which will work as well as, if not better than, Greene and Johnson’s 1977-78 experiment. We hesitate to merely reproduce the same experiment, and as such would like to attempt a different design.

Whilst the previous Norton Priory experimental firing used a chimney effect to try to adequately fire the tiles, the Cleeve Abbey kiln merely built the firing chamber up to a height roughly equivalent to the breadth of the firing chamber (in order to achieve even distribution of heat in the firing chamber) and then capped the kiln with tile wasters (Greene and Johnson 1978, 34; Kent and Dawson 1998, 45). Our design will follow along the lines of the Cleeve Abbey kiln in terms of proportion and capping, whilst taking into account Eames’s reconstruction of the Meaux Abbey mosaic tile kiln (1961, 159), see figure 1.

We are aware that kilns require proper insulation (Lou 1998, 11) and as such believe that earth may have been built up around the sides of the kiln as a form of insulation, and possibly
turf laid onto the roof as well as is suggested in the mosaic tile illustration by Eames (1961, 159). We hope that insulation may help prevent cold spots forming when heat is drawn to other areas during firing.

The stoking of the kiln will be a major part of the project; we are aware that we need stoke only enough to make the flames observable and re-stoking need only be done when the fire dies down (Lou 1998, 49). We are aware that over stoking the fire will not increase the temperature but will probably cause the fire to choke as it will restrict the flow of air / oxygen that the fire needs to burn. The fire bars will need to be spaced wide enough apart to allow ash to fall through but not so wide as to allow unburnt material through. The wood will need to be clean and dry, and for increasing the temperature rapidly the optimum size pieces of wood will be 1 inch square for rapid combustion (Lou 1998, 49). Eames has suggested that the kiln at Meaux would have been fired gently for 48 hours before a full firing, in order to dry out the clay structure (1961, 148).

We hope to complete and fire the kiln in the spring of 2009.

Editor’s Note
The findings of this project will be published in a later issue of Diffusion.

References


