Nineteenth-Century Tiles. Industrial Mass Production and Construction Methods of Interior Tile Schemes in the Nineteenth and Early Twentieth Centuries

Lesley Durbin

One of the purposes of the nineteenth century floor tile was to provide a cheap but elegant substitute for polished stone or marble flooring for use, in the first instance in high status municipal, ecclesiastical and government buildings and, as time went on, in middle class domestic interiors, notably the newly emergent Victorian sub-urban villa. Eventually tiles were produced for walls, floors and ceilings as a colourful, hygienic, and cheap covering for almost any interior.

Manufacturers were not shy of educating their clients in the best ways to use this most practical and decorative of materials. Most manufacturers employed both in-house and freelance designers and published their catalogue of suggested designs for interior tile schemes for domestic or less prestigious interiors. Builders, sometimes with the help of their clients, would simply choose a design from the catalogue and reproduce it. For prestigious municipal, civic or commercial buildings manufacturers would produce designs in-house specific to that interior.

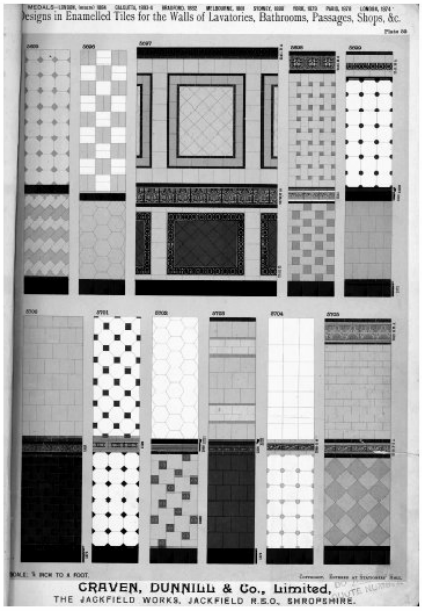

Figure 1. Wall tile schemes displayed in the 19c Craven Dunnill catalogue.
(Ironbridge Gorge Museum Trust.)

Manufacturers also found a ready ecclesiastical market during the nineteenth century flurry of church building and restoration. Floor patterns, both on individual tiles and as design configurations, were actively modelled on actual or perceived medieval designs and many churches large and small were the willing recipients of gifts of tiles from pious manufacturers, most notably Herbert Minton of Stoke on Trent. Thus the manufacturers themselves were more often than not the source of the flagrant use of flamboyant colour and pattern which typifies much of Victorian tile design and use.

Figure 2. The chancel floor at St Mary Magdalen, Battlefield, Shrewsbury by Minton's of Stoke on Trent.

The advent of the mass production tile industry in the mid nineteenth century also saw the emergence of the architect designed tile interior in national and provincial municipal buildings. Probably the first Victorian to initiate and put into practice the idea of a complete design concept is Augustus Welby Northmore Pugin (1812-52). Pugin was not only influential in his advocacy of medieval gothic style and architecture, he also advanced the idea applying a high standard of design to modern, mass produced materials in order to build complete interiors. The Palace of Westminster was completed in 1860 and although its architect was Sir Charles Barry, much of the interior decoration is attributed to Pugin who engaged Henry Minton expressly to make wall and floor tiles to his own design at great expense and much trial and error. Minton's continued to advertise for sale Pugin's House of Commons designs for at least another twenty years after completion. It was Pugin who encouraged Minton to develop the technique for mass producing block printed wall tiles, the forerunners of our modern tile, for the Stranger's Smoking Room.

Other architects followed the precedent set by Pugin of using tiles as an integral part of the interior design of their buildings. George Edmund Street (1824-81) architect to the Royal Courts of Justice on the Strand, London was involved with every detailed aspect of his buildings including the tile designs, favouring Godwin's of Hereford as manufacturers.

Towards the close of the nineteenth century many architects readily used tiles to perform a particular role to enhance the colour or graphic form of their interior designs. Alfred Waterhouse used Burmantoft's of Leeds to provide a glazed interior for his Pearl Assurance Building, St John's Lane, Liverpool and more notably the interior of the National Liberal Club in London.

As the late Victorian and art nouveau styles gave way to the art deco style of the 1930s tile manufacturers still had a ready market for instant catalogue designs particularly for bathrooms, kitchens and fireplaces. Many architects were also still favouring tiles as a medium to express the simplicity of geometrical form and function. Carter's of Poole took a leading role in the market providing tiles for architect designed art-deco inspired interiors. Sir Owen William was architect and engineer of some of the most celebrated art-deco buildings in England, his tiled interior of Boots' D6 Building in Beeston, Nottinghamshire (1930-2) manufactured by Carters still retains a modern elegance today.

Figure 3. A detail of the architectural scheme designed by Sir Owen Williams in the Boot's D6 Building in Nottingham.

MANUFACTURE

Industrial mass production of nineteenth century floor tiles

It is clear from the outset that once Samuel Wright of Shelton, Stoke on Trent, had taken out a patent for making inlaid tiles in 1830 and established a method for mass production of tiles, that the leading lights of the tile industry, Herbert Minton, George and Arthur Maw, Henry Godwin and Jesse Carter were equal and serious in their intent to use science as a basis for manufacturing a product which was materially consistent, quick to produce for an affordable cost. W. J. Furnival (1904) lists the desirable qualities to be provided as elements in the manufacture of good geometric tiled floors as follows;

> uniform durability, evenness of colour, distinctness of colour, regularity of size, good foothold, level surface, tolerable fineness of grain, insusceptibility to permanent discolouration, facility in cleansing, frost resistance, strength, adhesion to cements.

They eschewed the haphazard nature of previous technologies which were based on hand crafting rather than machine production. Samuel Wright's patent for inlaid tiles included the method for impressing tiles by means of a plaster of Paris mould, which had been previously cut with a pattern, set in a metal frame with screw studs attached to two sides. The mould was filled with clay and the metal die, which configured the makers mark and aerating holes in the reverse of the tile, was placed on top and secured to the screw studs, the whole thing was then pressed, giving an exact same depth and position for the imprint on every tile.

Herbert Minton bought Wright's patent in 1835, but it took a further five years of experimentation in clay mixes, firing temperatures and shrinkage rates before he or his former partner Walter Chamberlain could confidently market a product which could be relied upon to be consistent in production, indeed all of the main manufacturers gave up their early production years to the development of clay sources, mixes and colours, the recipes of which mostly remained secrets within the companies.

Up until the development of Richard Prossers's patent for 'dust pressed tiles' in 1840, which by 1860 was in widespread use, all floor tiles were made with wet, or 'plastic' clay. Early efforts made by Chamberlain's and Godwin's dating between 1830 to 1850 using plastic clay resulted in tiles up to three centimetres thick in an effort to prevent warping, both Minton's and Maw's used Wright's patent to develop a method of sandwiching the plastic clay which improved stability. A layer of course, cheap clay about one centimetre thick was sandwiched between two layers of matching fine clay, each about three millimetres thick, the top layer containing the imprinted, or 'encaustic', as they became known, design. The two layers of fine clay encouraged an equal amount of shrinkage to prevent warping, and the course clay middle section provided a cheaper bulk of clay. Encaustic

pattern making remained essentially a hand crafted operation, patterns were impressed into the wet clay with the use of machine presses, but pouring the colour 'slip' (slip is the term given to wet clay mixed to the consistency of cream) into the impressions was a hand skilled job, which after two or three days drying, would be scraped flat by hand, revealing the pattern with sharp clear edges. The tile was then left to continue to dry slowly, as speeding up the drying time too much could also result in warping. Drying time for plastic clay was up to three weeks before firing, resulting in a slow production time.

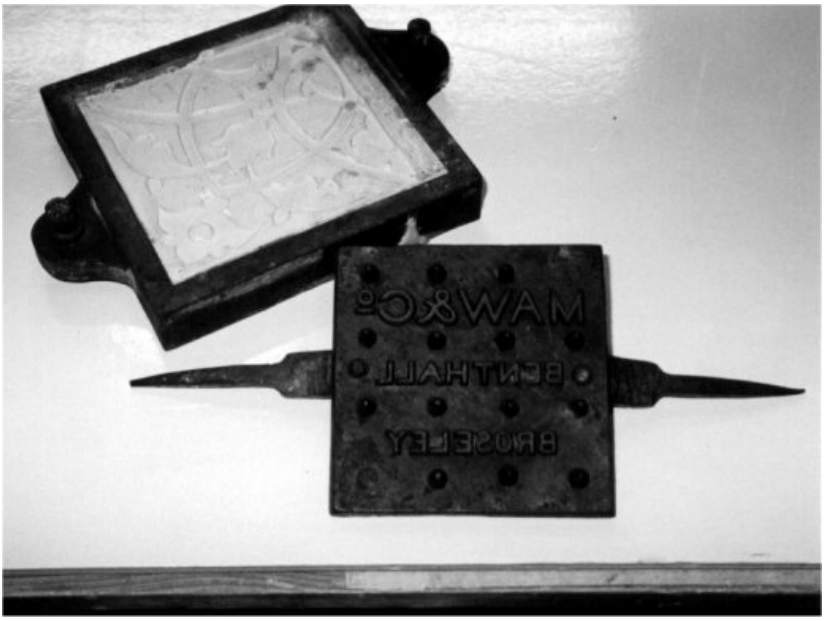

Figure 4. Above is a plaster mould for an encaustic tile fixed into a former, below is a hand operated back stamp used for wet clay tilemaking, the two wooden handles are missing. The stamp, reading Maw & Co was simply pushed into the wet clay.

After the drying period, tiles were fired once only to fuse the clays together and produce a good standard of vitrification, temperatures had to reach 900 - 1000 degrees centigrade or above, but the exact temperatures needed to produce a floor tile hard enough and of consistent colour to be a good product were a matter of much trial and error, and personal judgment, by the fireman. Two and three colour tiles needed the correct combination of clays and temperatures in order to fuse the inlays, but not burn the colours or cause them to shrink away from the imprint. In the early years of production, Minton's, Chamberlain's and Godwin's all favoured glazing their tiles, with either clear glazes, yellow enamels or green glazes in an attempt to replicate the medieval style, but those finishes fell out of favour fairly quickly, and encaustics were marketed unglazed but with a hard vitrified surface.

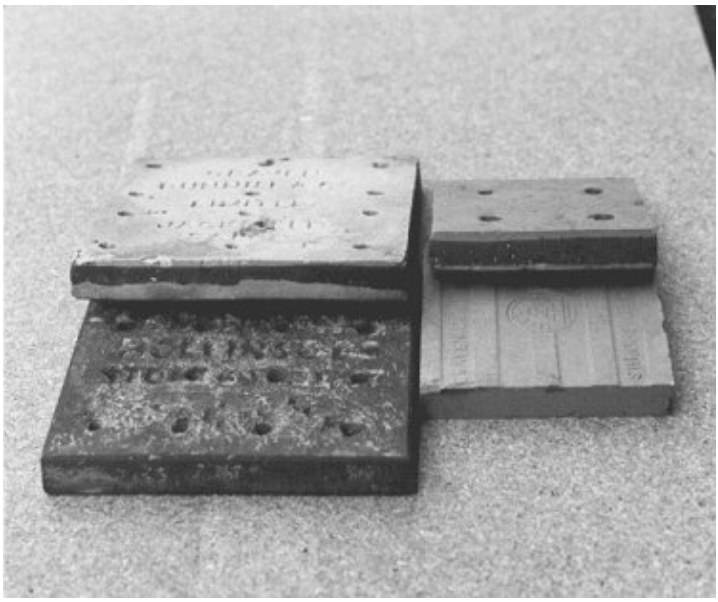

Figure 5. The edges and reverse of these tiles indicate if a tile was wet clay pressed, as the Minton tile in the bottom left or dust pressed, as the Craven Dunnill tile on the bottom right. The other two tiles are examples of the sandwich method of wet clay pressing.

Production times, however, were revolutionised by the introduction of Prosser's dust pressing technique. Prepared clay was dried and ground up to a fine powder, retaining a small moisture content of between five and eight percent, which, when subjected to extreme pressure between steel dies, forced the clay into a compressed state forming a slab or tile about one centimetre thick, the design could also be imprinted at the same time using a patterned die stamp. In this way not only was pressing time cut down, but the all important drying stages were reduced to days instead of weeks. In addition to those advantages tiles could be made thinner with a reduced shrinkage rate and less propensity to warping. Dust pressing, as a technique, created the opportunity for floor tile production on a huge scale. Coloured geometric and encaustic floor tile designs were part of every tile manufacturer's mainstay of production. Each company had their own range of colours and designs in a variety of geometric sizes and shapes. Many of the ranges were so similar that it is difficult to identify a specific company's wares without detailed knowledge of company catalogues, back stamps or sales archive.

Choosing, preparing and mixing the clays were the most important preliminary exercises in nineteenth century tile production. The quality of the tile depended directly on the quality of the clay and method of preparation. Cheap tiles were made from local clays, sometimes a mix of more than one. Each component clay and ingredient was pulverised, measured, and mixed. The mix was 'pugged' (i.e. continuously turned and folded in a wet state), then dried, it was passed through a

series of sieves and left to mellow in bins before use. More expensive tiles had more complex clay and mineral ingredients sometimes including colour stains, which were mixed, put into tanks with double their volume of water and left in order to fatten, after several hours the mix was 'blunged' (i.e. mixed with a paddle like action to a slip clay of creamy consistency). The slip was passed through a series of sieves and then poured onto drying floors, where it remained until the clay was completely dry. The dry clay was stored in bins where it was allowed to mellow before use. A typical recipe for a red floor tile was:

10 cwts of mixed red marls or clays, carefully selected and weathered
12 lbs of finely levigated common ironstone
14 lbs of Cornish china clay.

The final colour of the tile also dictated its position in the oven, which was subject to considerable variation in temperature at the bottom, middle and top, for example, black tiles were best placed in the middle of the kiln at the hottest part. Different positions in the kiln could produce different variations within a single colour according to temperature, and much was left to the fine judgement of the fireman. However the Victorian bottle kiln was much more efficient in reaching sustained high temperatures than any which preceded it and the result was a much harder semi-vitrified tile with low porosity.

The British tile making industry reached its peak of production between 1870 and 1900 techniques in floor tile manufacture did not change substantially until the 1960s when improved refining of raw materials and the advent of gas fired tunnel kilns not only increased production but ensured a more consistent product.

Industrial mass production of nineteenth century glazed wall tiles

Glazed wall tiles with white dust pressed bodies began to be developed alongside the floor tile industry, though in general they took a longer time to gain in popularity. In 1850 Minton produced a range of wall tiles decorated with enamel glazes and designed by Augustus W N Pugin. Examples are to be found in the Strangers Smoking Room at the Palace of Westminster. They also produced a range of embossed tiles glazed with a range of opaque glazes derived from lead and tin oxides, these were first shown at the 1851 Great Exhibition and then later installed in Refreshment Room of the South Kensington Museum. Opaque tin glazes gave way to translucent colour lead glazes or art enamels, though the major developmental problem to be solved was the correct marrying up of the body clay and the glaze mix, without which the finished tile would quickly have a propensity to surface crazing with possible loss of glaze. Given the limitless combinations of clay body mixes, glaze mixes and firing temperatures, the producers of glazed wall tiles often failed to prevent crazing, which they considered to be a fault, not only disfiguring but also negated the hygienic qualities of the glazed tile.

The best manufacturers each developed their own sound clay tile body in the first instance, and thereafter developed their dies, glazes and firing temperatures to suit shrinkage rates and adhesion respectively. Body clay recipes were complex, stains or additives were introduced to offer alternatives to the white body. Some nineteenth century tiles achieve very beautiful hues by combining a coloured clay body overlaid with a different colour glaze, for example a yellow body coated with a blue glaze. A typical recipe for a white dust pressed tile body was:

5 cwt best ball clay, dry
6 cwts best china clay, dry
8 cwts ground calcined flint
2 cwts ground Cornish china stone

In developing new lines for mass production it was not uncommon for manufacturers to alter body formula, vary the ingredients, alter the size of dies or moulds, burn the tiles in a different part of the oven, or even burn the whole oven differently. However, despite the incalculable opportunity for variation, most manufacturers developed their own distinctive ranges of colours and designs which are very often identifiable as a house style.

The vast majority of both plain and embossed tiles were dust pressed, though 'specials' and larger faience pieces were cast in plastic clay. Tiles were decorated in many different ways, the most common forms being, embossed, impressed, transfer printed, and tube lined. Heavily embossed tiles allowed the glaze to run and form deep pools in the recesses of the embossing, creating a two tone effect from one glaze colour. Tube lining was a method of separating different glaze colours using trails of clay slip applied directly on to the biscuit tile. The slip was applied by hand, following a pre determined design, forming the separating barrier Tiles were also hand painted with under glaze colours straight onto the biscuit, then coated with a clear glaze to protect the colours during firing. Under glaze colours were made from a variety of metal oxides with mineral additives.

By the turn of the century the tile industry was moving away from lead glazes in response to the unacceptable levels of lead poisoning cases amongst pottery workers. The industry, admitting the poisonous nature of lead glazes for both worker and consumer, turned to the use of alkali-lime glazes, though at the same time bemoaning the loss of the deep gloss finish peculiar to lead, along with the deep ruby reds and French pinks which were impossible to replicate without its inclusion. Glazes composed with a high proportion of oxide of lead produced easily managed glazes which gave darker, richer hues with a glassy quality, their failing was that they were prone to crazing. Alkaline glazes were difficult to manage, arguably lacking in gloss, but they were thinner, less likely to craze and their colours had a brilliance not present in lead glazes. Their non poisonous base made them the way forward.

Figure 6. Part of a tube lined panel.

Figure 7. An embossed ceramic pillar.

Figure 8. Transfer printed fireplace tiles

Construction methods in the nineteenth and early twentieth century

The nineteenth century tile manufacturers possessed what was essentially a new, mass produced product which they wished to be used in the best possible ways both functionally and decoratively. Tiles produced by different manufacturers could differ quite dramatically in terms of quality and precision, which in turn affected the quality and precision of the setting. Geometric floor tile setting was a new technology in the early years of mass production with no established conventions concerning joints or finishing. Forward thinking manufacturers published advice on the recommended methods for setting their tiles, however much of the information given was fairly loosely specified, leaving much room for error or manoeuvre on the part of the tile setter, again to suit his skills, available materials and location. It is not far from the truth to say that no two schemes were fixed alike because the available skills and the conditions in which those skills were applied to a variety of materials and locations will rarely be replicated. It is not until after the late 1950s that we begin to see uniform and precise methods of tile setting which match, and are appropriate to, the uniformity in production quality which is the hallmark of modern tile manufacture.

The steady rise of Victorian tile manufacture began in 1840 and reached it's zenith between 1880 and 1900. At the same time, though probably linked more closely to the expansion of the brick making industry than tile manufacture, the first modern Portland cement was manufactured in 1845 and was in widespread use by about 1880. Victorian buildings decorated with tiles prior to 1860 can

be typically found to have either lime plaster or lime mortar used as the adhesive layer. Post 1870 the tile industry moved wholesale into the use of Portland cement as a medium for fixing and grouting tiles, and it is unusual to find any other medium used, but during the intervening decade either types of mortar can be found.

The tile manufacturers were not slow to recognise the positive attributes of Portland cement as a fixative. It did not stain as readily as traditional lime mortar, an advantage when setting polychromatic tile schemes, and was a hard, robust, durable adhesive which gave a faster, more reliable set than traditional lime mortars. The new geometric floor tiles were manufactured in much smaller size units than old style quarry tiles, making them more likely to become unseated easily if the adhesive mortar was insufficiently hard.

The 1870 recommendations from 'Directions for Laying the Pavements,' Maw & Co. Catalogue, includes the use of lime in the cement which is to be used as the adhesive layer.

> A cement composed of a mixture of Lias and Portland is specially manufactured for our tile work, and can be supplied in casks or sacks, but either Lias, Portland or roman cement of good quality may be used. Either of the above cements may be mixed with about one third of its bulk of good sharp sand. No cement that is very quick setting is suitable, as it does not afford sufficient time for the proper adjustment of the tiles. Sand employed for the mixing of cement should be sharp and free from loam

The depth of the cement adhesive required is set out specifically thus;

> Preparation of the Foundation. If the foundation is not sufficiently solid, lay, as evenly as possible, a bed of concrete, composed of one part finely riddled quick lime, and three of gravel, and bring it to a perfectly level surface with a thin coat of cement allowing three eighths of an inch more than the thickness of the tiles for the cement to be used for bedding them. In tiles of half an inch substance, the level surface of foundation should be brought to with three fourths to seven eights of an inch of the intended surface of the pavement, and for tiles of an inch substance, to within one and a quarter inches of the intended surface

Maw & Company specified ‘finely riddled quick lime’ because lime was not always pre-slaked for long periods to form lime putty before use, a common technique was to place the amount of raw burnt lime, still in lump form, which was estimated for use the following day on to the ground and surround it with a ring of sand. A small amount of water was sprinkled onto the lime causing it to react, breaking down the lumps into powder form. Whilst the reaction was still taking place the lime was covered with a layer of sand and left until the next day when further sand, aggregate and water would be added to the mix to make a wet mortar. This technique often resulted in lumps of

inadequately slaked lime to be left within the mortar which could continue to react long after the mortar had been laid as substrate. It was this possibility which the tile manufacturers regarded as a less than satisfactory.

By 1904, W.J. Furnival, taking direct advice from published material by the Tile Manufacturers of the United States of America, November 1900 completely rejects the use of lime in the cement used for floor tile setting;

> A good foundation is always necessary and should be both solid and perfectly level. Tiles should always be laid on a concrete foundation, prepared from the best quality Portland cement, clean sharp sand and gravel, or other hard material. Cinders should never be used as they destroy the quality of the cement. A foundation may be formed using brick or tile imbedded solidly in, and covered with cement mortar. Lime mortar should never be mixed with concreting. Concrete should be allowed to thoroughly harden before laying the floor, and should be well soaked with water before laying the tile. Concrete should consist of:
>
> 1 Portland cement
> 2 Clean sharp sand
> 2 Clean gravel
>
> thoroughly mixed with sufficient water to form a hard solid mass when well beaten down into a bed two and one half inches to three inches thick. The surface of the concrete must be level and finished to within one inch of the finished floor line, when tile one half inch thick is used, which will leave a space of one half inch for cement mortar, composed of equal parts of the very best quality Portland cement and clean sharp sand.

The formation of the substrate layers below tiles on upper floors, or ground floors above basements will largely depend on the structure of the building itself. Steel joists and concrete floor structures were becoming more common at the end of the Victorian period, but most buildings which were tiled from the middle to the end of the nineteenth century have traditional timber joist structures for upper floors. The following extract, again from Furnival, usefully describes what we may be likely to find as substrate under tiles from that period.

> Wood floors in upper stories may be readily replaced with mosaic, the foundation being prepared by nailing fillets to the joists at three inches from the upper surface, and the floor boards sawn into short lengths and fitted in between the joists upon the fillets; concrete may then be filled in flush with the upper face of the joists and faced with the coat of cement before mentioned

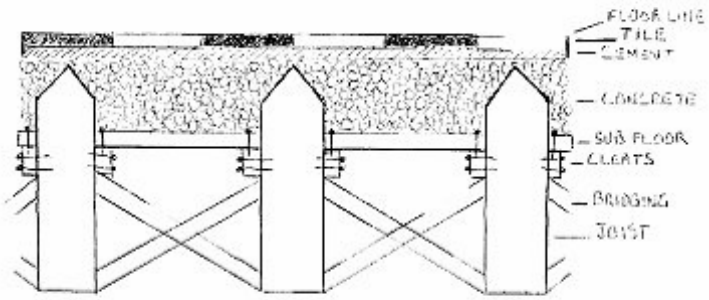

Figure 9. Diagram nineteenth century floor substrate, (Furnival.)

Pure Portland cement, with no added sand, mixed with water to a creamy consistency was recommended as a grouting medium for both wall and floor tiles. Furnival also describes, courtesy of the Tile Manufacturers of the United States of America, detailed methods for wall tile fixing, there are some slight differences in the fixing methods and the ratios of the mortar mixes to those given for floor tiles. It is advised that new brickwork should not be pointed, or if the brickwork is old then the pointing should be removed in order to create a key into the brickwork, a rough coating of cement about one half inch thick, mixed from one part Portland cement to two parts of sand, should cover the bricks and be allowed to harden for at least one day.

Fixing the wall tiles comprised of three stages, first to ensure a good bond, the rough foundation should be coated with a mix of pure cement and water. The setting coat or adhesive layer is added immediately to a further half inch depth, the ratio for the setting coat is one part Portland cement to two parts sand mixed to a stiff consistency. The advisors concede that if lime must be added to the mix it must be no more than ten percent, and point out emphatically that all tiles should be soaked in water prior to setting, to help the cement to unite with the tiles. Extra assistance towards fixing was provided by the manufacturers with the development of sometimes quite elaborate back stamps, which not only identified the manufacturer but also acted as a key into the wet cement.

The same mix of 2:1 of sand and Portland cement used for setting the tiles was also used as the grout, providing a seamless adhesive layer which not only coated the back of the tile fixing it to the floor or wall, but also fixed the edges of the tile to the edge of its neighbour, effectively bonding all surfaces except the face. The fixing methods described seemed to have been used as standard practice by builders and tile setters from the mid 1870s up until the late 1950s, with very little deviation. In the 1950s new, more user friendly, adhesive preparations began to be developed.

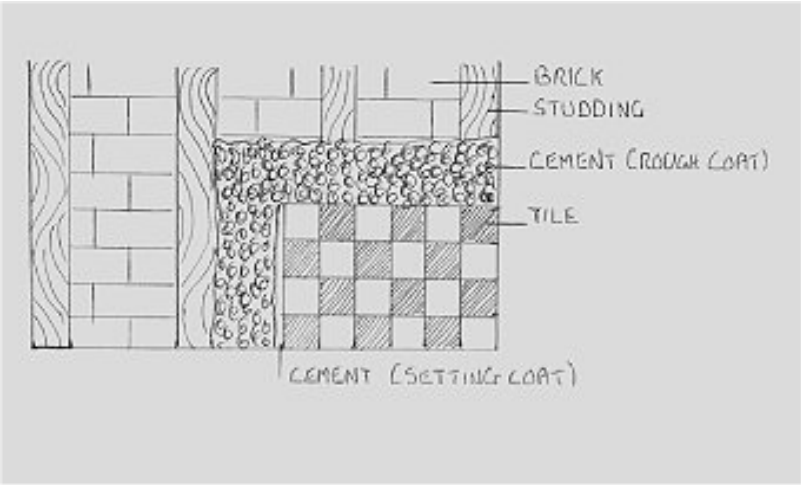

Figure. 10 Diagram nineteenth century wall substrate, (Furnival.)

Nineteenth Century Style

AWN Pugin's early collaboration with Henry Minton in the House of Commons, produced a scheme that is colourful and has an energy and balance typical of Pugin's design work, however it is comprised solely of flat, square or rectangular tiles used in a manner differing very little from the style in which tiling had been used over the previous two centuries in continental Europe. The tiles are fixed to dado height in simple fashion, the decorative effect being derived from the placing of the ground and border designs, whilst the edging and finishing is made up with simple half round plaster mouldings and a deep timber skirting board.

As the art of tile scheme design developed the incongruity of any large expanse of wall tiling mixed with timber dado rails and skirting became apparent, an almost inevitable consequence was the need to develop moulded ceramic tiles to form a termination or framework for schemes. The development of semi-constructional mouldings to form not only skirtings and dado rails but corner beading, architrave, friezes, arches, columns and the like, moved forward until any typical large interior scheme would include a complete architectural framework for the main body of the tile wall covering, built entirely from a range of different tile mouldings, shapes, sizes and colours.

Many schemes follow a similar and recognisable format, dados are often made up of elaborately embossed tiles in panel format, the panels being surrounded by combinations of different coloured, off-set, rectangular, slip tiles, topped by moulded capping tiles which form the dado rail and finished by deeply moulded skirtings at floor level. The over dado work is often to ceiling height, usually more simply constructed of six inch by six inch tiles set in diagonal fashion, and more often

than not finished with a flourish of deeply embossed and elaborate friezes and entablatures. Victorian floor tile designs tend to follow fairly strict ruling principles; diagonal central panels surrounded by deep borders of parallel offset tiles. Certain tile measurements lend themselves to use in diagonal format to create the base measurement of a 6inch x 6inch square, they are; 4 inch, 3 inch, 2 1/8 inch, 1 inch, frequently the 4 inch tile will be patterned encaustic, or a star motif made up of small tiles.

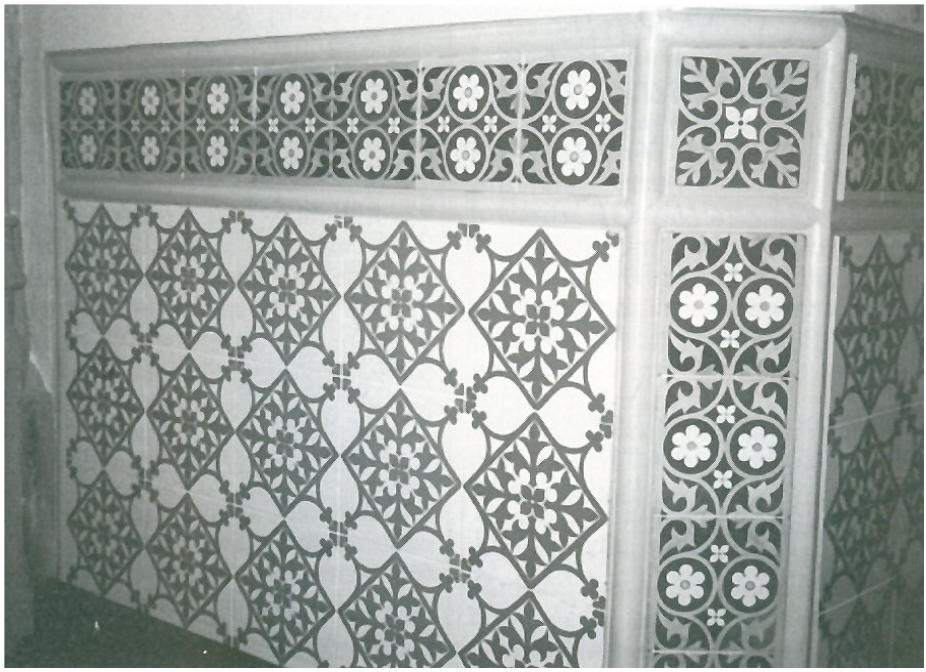

Figure 11. Early Minton wall tiles in the House of Commons designed by AWN Pugin

Hotels were often sumptuous in their decoration whilst the most flamboyant schemes found their natural homes in the richly decorated interiors of the ubiquitous 'gin palaces'. A natural home for decorative tiles was the Spa and Turkish baths and Victorian philanthropists made the most of the availability of brightly coloured nursery rhyme tile panels to brighten the interior of newly built infirmaries. It sometimes seems as though the Victorian imagination for using tiles knew no limits, from the starkly utilitarian interiors of workhouses or pumping stations, through schools, hospitals, railway stations, and shops to some of the most magnificently decorated interiors of our most important national buildings. The nineteenth century tile heritage with it's beginnings in the UK and spreading the world over is a tremendously rich one, and although a good deal of it has been lost in the latter part of the twentieth century, much of it still remains in place and in relatively good repair.

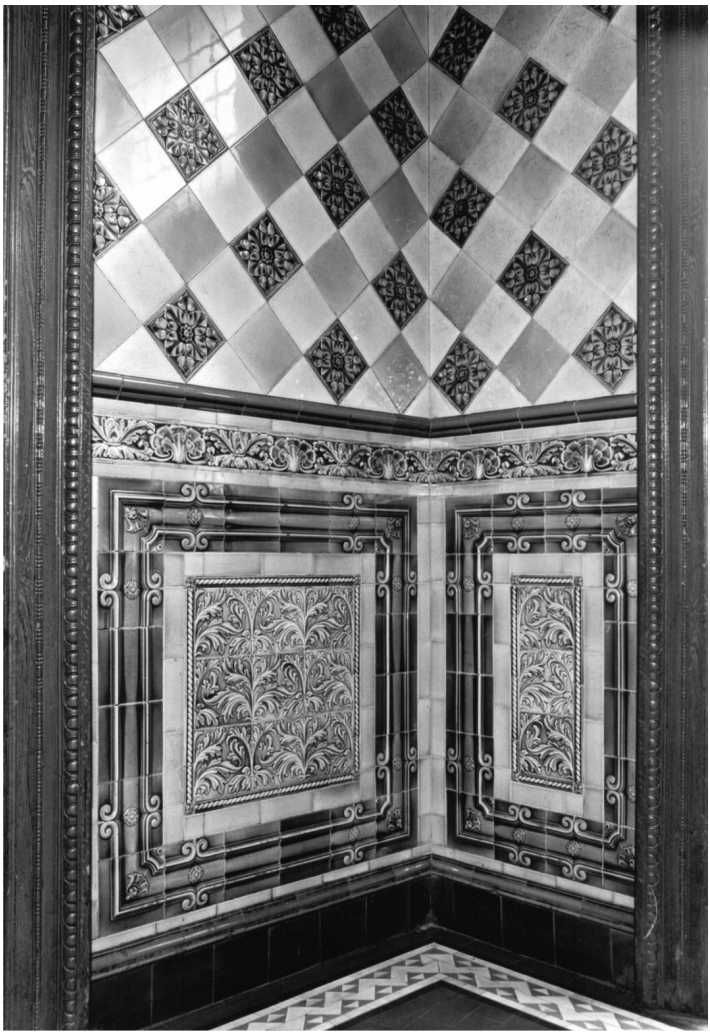

Figure. 12. Typical late nineteenth century tile scheme, Church Tavern, Birmingham.

REFERENCES

Extracts of the above text are taken from '*Architectural Tiles - Conservation and Restoration*' Durbin, L (2004) Elsevier Butterworth Heinemann

Atterbury and Wainwright (1994) *Pugin, A Gothic Passion*. Yale University Press

Beaulah, K. (1987) *Church Tiles of the Nineteenth Century*, Shire Publications.

Curl, Prof. J. S. (1999) *Dictionary of Architecture*. Oxford University Press.

Furnival W.J. (1904) *Leadless Decorative Tiles Faience and Mosaic*, Furnival

Maw & Co. (1850) *Company Catalogue,* courtesy Ironbridge Gorge Museum Trust

Irik (2002) An 1840 Letter from Augustus Welby Pugin to Herbert Minton. Glazed Expressions.

Jervis, S. (1984) *Dictionary of Design and Designers*. Penguin Books

Mintons Enamelled Tiles Catalogue c1885 Reprinted (1996) Richard Dennis Publications

Sims M. (2003) The Encaustic Tile in America, *Journal of Tile Heritage of America*, Vol. 7 No.1