



The Brick Guide

Harworth

South Yorkshire

Contents

- 03 Introduction
- 04 Manufacturing process
- 07 Manufacturing standards
- 08 Properties & performance
- 09 The brick range
- 19 Site practices
- 24 Cleaning/repairs
- 25 FAQs

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MILLION BRICKS
IN FIRST YEAR OF
PRODUCTION

MILLION BRICKS
PER YEAR
PRODUCTION
CAPABILITIES

MILLION (£)
INVESTMENT

OF CURRENT
GROUP
REQUIREMENTS
FULFILLED



Introducing Brickworks

The Brick Guide has been produced by the team at Brickworks to help technical and planning professionals in the design, specification and application of the bricks for all aspects of Persimmon Group buildings and construction. It also serves as a guide for sales teams to assist them in their understanding of the manufacturing process and the inherent quality of the product.

Brickworks is the first of its kind producing concrete bricks, entirely focused on supplying the Persimmon Group's housebuilding operations. It has the accolade of being the most technologically-advanced concrete brick producing plant in the Country.

The manufacturing hub in Harworth, near Doncaster commenced production of concrete bricks in November 2017 and started supplying the Group's operating businesses in January 2018.

Built on a brownfield site and a former glassworks, Brickworks is in an ideal location to make the most of the Trent Valley's local raw materials. It also benefits from superb links to the M1 and A1.

The plant has the capacity to produce c. 80 million bricks each year, potentially satisfying approximately two thirds of the Group's current requirements. The equipment was supplied from Germany by Rekers and their block machine is capable of producing 72 bricks in a 17-second cycle, giving an annual capacity of approximately 80 million bricks.

The Brick Guide covers all aspects including manufacturing through to end delivery and cleaning. We hope it's informative and useful - please get in touch if you have any further questions.



Manufacturing process



The principle raw materials used during manufacture are sand, limestone and cement together with a combination of different pigments which are added to produce the colours for the various brick types. The aggregates were selected from specific ISO9001 accredited quarries in order to ensure their product meets EN12620, following various trials run to produce a mix design containing an appropriate profile of particle sizes and chemical composition. This enables the final product to exceed the requirements of BS EN771, the standard that all bricks are manufactured to within the UK.

The batching process

The batching process uses machinery from the world's leading manufacturers of equipment for the concrete, construction and environmental industries. The plant is fully-automated with 3D technology monitoring the mixing process at each stage. A pre-set batch quantity is programmed, and each individual raw material is weighed to a specific weight and the moisture content of each is calculated by the equipment using digital microwave technology, giving a digital output direct to the batching programme. Measurements are taken 25 times per second as the material passes over the face of the probe, allowing for rapid detection of any moisture changes and enabling real-time adjustments to maintain the optimal aggregate to water ratio.

Cement, pigment & plasticiser

Cement and pigment is supplied by leading manufacturers operating recognised standards of EN197 and EN12878, respectively. The delivery of these elements to the mixer is linked to and controlled by the batching system, with integrated weighing vessels providing the exact quantity requested. The final component is a chemical plasticiser which is held in liquid form and added along with the water to maintain the consistency of the mix and improve the dispersion characteristics of the pigment. The plasticiser effectively reduces the permeability of the concrete bricks, leading to a reduction in the occurrence of efflorescence.

The raw materials are blended together by eight mixing tools connected to three arms which form the star mixing action, guaranteeing a constant supply of high quality, fully homogenised semi-dry concrete to the brick machine. The now-coloured concrete is held in three hoppers and delivered to the brick machine on continuous rubber belting. A combination of the different colours in the hoppers and adjusting the feed speed and volume drawn from each hopper enables the different coloured bricks to be manufactured.

The brick machine

The brick machine was supplied and installed by Rekers, the world leader in concrete equipment with over 60 years of innovation and industry experience. The equipment includes a fully integrated visualisation control screen that manages all aspects of the process with the Programmable Logic Controller (PLC) control system monitoring every step of the process. Reker's Vario-Servo vibration system enables the concrete to be drawn into the mould cavities at a pre-determined rate and, combined with the tamper head, controls the compaction of the concrete. Constant monitoring of all the machine components ensures any deviation from the digital parameters is quickly identified and the technical logic built into the machine will alert when any individual component of the machine is working outside of the pre-set limits. The machine measures each compaction cycle to determine the size of the bricks produced and intervenes to stop the equipment if the size measured is outside the required dimensional tolerance. This provides the confidence that the bricks manufactured will be of a consistent size and quality every cycle.





The forming of the bricks

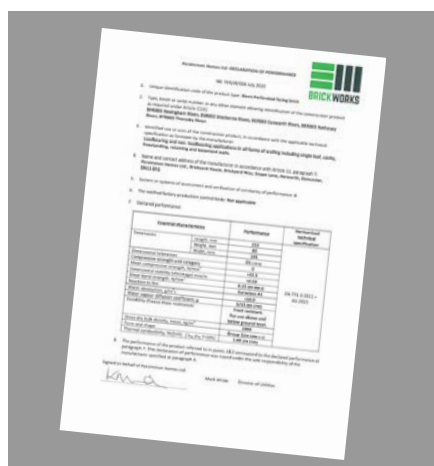
Bricks are formed beneath the brick machine on a board in a rectangular mould comprised of 72 cells with retractable steel bars passing through them. These moulds are manufactured using the latest CNC equipment from high-grade steels and are subjected to a CSI Diamond heat-treatment process.

Pressure and vibration are applied to the cells by the block machine control system, the core bars are retracted, and finally, the mould is lifted, leaving a board of 72 cored bricks which then moves along the conveyor to be replaced by the next empty board. Before entering the curing chamber, the brick faces are sprayed with a clear acrylic which forms a water-resistant protective barrier, enhances the colour and reduces efflorescence. The chamber is fully automated and communicates via the PLC with the remaining equipment within the factory. It is kept at a pre-determined temperature and humidity to maintain the optimum atmosphere for curing the concrete bricks, ensuring the cementitious reaction is constant and controlled. The bricks are automatically collected after 18hrs and delivered to the handling equipment where the bricks are formed into cubes for storage.

Peace of mind monitoring

Throughout the manufacturing process controls are in place to record the quality standards expected from each process. Every batch produced by the batching plant is recorded to ensure any deviation from the desired mixing process is highlighted. Bricks are measured on a regular basis using calibrated verniers to ensure there is minimal variation of size across all 72 bricks made during each cycle. Continuous inspection of all bricks is done at the handling line, with all bricks that don't meet the standard of colour, size and texture being removed before these are built into the packs. Every pack has a batch code printed onto the cover, which allows for full traceability of the product to a specific shift.

Manufacturing standards



Standards & approvals

Our bricks have been approved for use on NHBC, LABC and Premier sites. They are declared to exceed the warranty providers' required compressive strength of 22.5N/mm² as confirmed by the annual type tests carried out by Lucideon, an external UKAS accredited testing facility. The type test comprises five separate tests which are conducted according to specific standards. On dimensional tolerances to BSEN 772-16 & BSEN 772-20, density to BSEN 772-13, compressive strength to BSEN 772-1, water absorption to BSEN 772-11 and moisture movement to BSEN 772-14.

Daily in-house testing is also carried out on a sample from each batch by our Quality Technician to record the compressive strength, density, weight & dimensions at 14, 21 and 28 days. The in-house equipment used in our tests is calibrated by the machine supplier at regular intervals throughout the year. Routine samples are also sent to Lucideon for independent testing to give a comparative test result.

No bricks are sent out to sites until they are a minimum of 28 days old and have passed the required strength threshold.

The brick design

The Brickworks brick is a unique design with two tear-shaped holes which help to ensure they're laid the correct way round with the tear-drop point pointing towards the cavity. This improves buildability and productivity.

Brick dimensions

Persimmon bricks are shipped in hooded packs of 396 and contain a void layer to allow the hood to be pierced and moved using forks. These packs are vertically and horizontally strapped and plans are in place to apply additional cross strapping to increase the durability of the binding. In normal circumstances, these packs are handled and loaded at the factory using a grab, so they should arrive at site undamaged and with the hood still fully intact. Care should be taken when unloading to avoid damage to the packs moving them around site.

Brick dimensions: 215x102.5x65mm

Average dry brick weight: 2.800 kg (max 3.0 kg)

Pack dimensions: 860x860x820 l x w x h

Average pack weight: 1,150 kg (max 1,170 kg)

Properties & performance



Durability & weather resistance

As part of the design, testing and approval process, the bricks have been tested by an independent testing body to prove their long-term durability. The bricks are classified as being F2 suitable for use in severe exposure conditions.

Careful consideration should be given to specifying the use of the bricks if subjected to particularly severe exposure conditions such as retaining walls and exposure to de-icing salts as some damage to the face may occur to the product in such locations.

Use below DPC

The Brickworks bricks have been designed and tested as being suitable for use in up to DS-3 ground sulphate conditions and can be used below DPC in such conditions.

Efflorescence & colour integrity

The bricks are made using a blend of crushed aggregates and synthetic pigments and therefore have a low potential for efflorescence. An acrylic coating is applied to the outer face of the brick during the manufacturing process which seals the face and maintains the colour integrity of the brick. Any damage to the face/acrylic coating during laying and cleaning could have a detrimental effect on the long-term appearance of the brick.

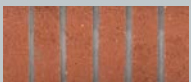
Mortar specification

The bricks can be laid with a general 1:1:6 Class 4 mortar or equivalent mortar. Should a development be subject to severe exposure conditions, Table 15 of PD 6697:2010 and Warranty Providers requirements should be consulted. Stronger mortar requirements may need amendments to movement joint and brickwork reinforcement designs. We recommend the use of Tarmac Y2 coloured mortar.

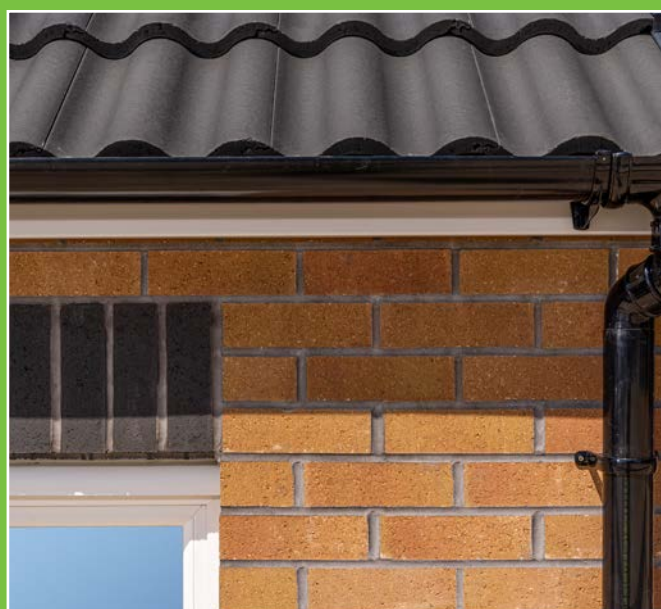


The brick range

The 2020 Brick Range has been developed to provide an enhanced range of colours and surface finishes to provide an aesthetic solution to most brick-built homes across the country. The 2020 Brick Range consists of five core colours/blends and with smooth and riven surface finishes available, providing a real alternative to other concrete and clay brick products. The 2020 Brick Range provides suitable contrasting detail bricks to compliment main facing bricks to further aesthetically enhance our homes.

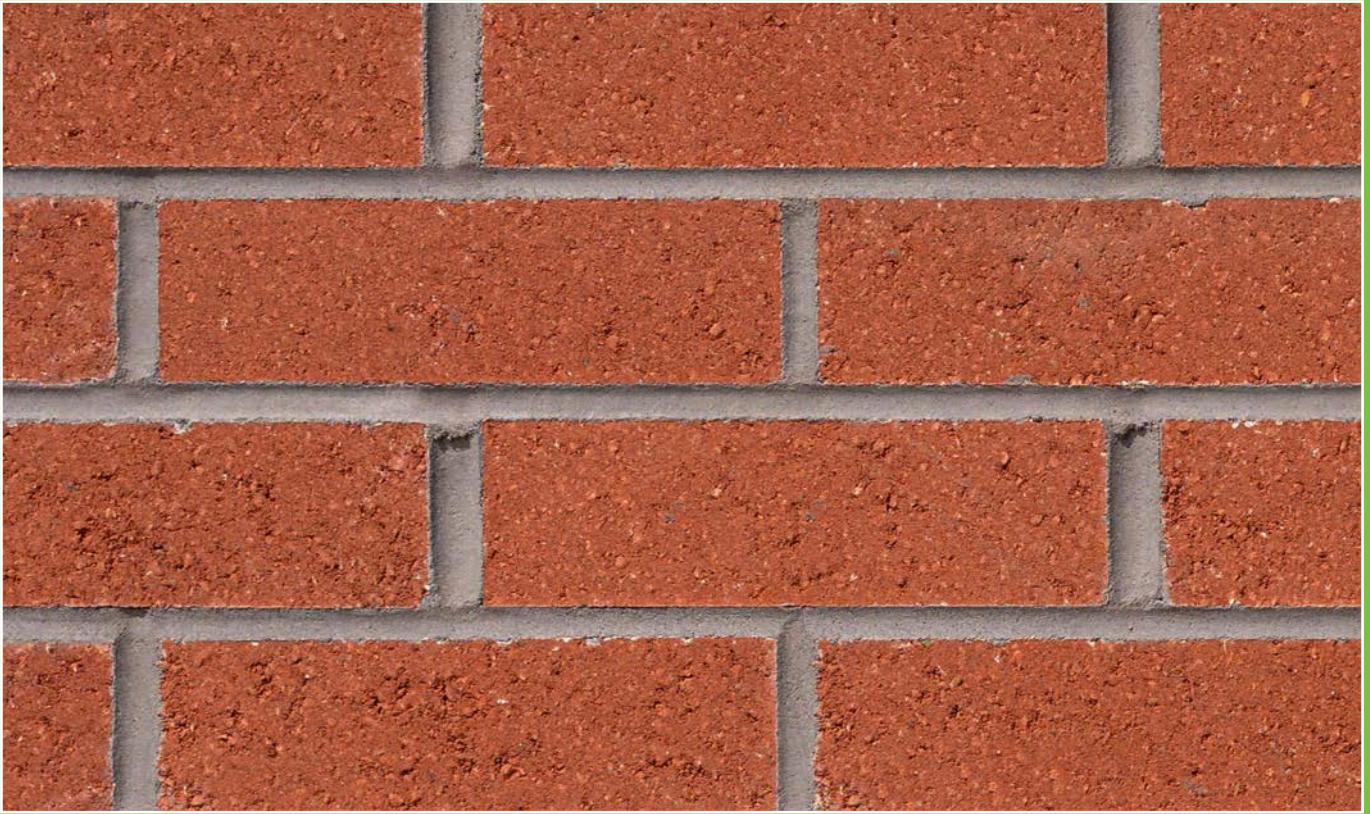
	Main brick	Suggested detail brick
Smooth	 Rothesay	 Hovingham or  Cusworth
	 Hovingham	 Cusworth or  Rothesay
	 Cusworth	 Hovingham or  Rothesay
	 Sherborne	 Rothesay or  Hovingham
Riven	 Hovingham Riven	 Cusworth or  Rothesay
	 Rothesay Riven	 Hovingham or  Cusworth
	 Cusworth Riven	 Hovingham or  Rothesay
	 Sherborne Riven	 Hovingham or  Rothesay
	 Thoresby Riven	 Cusworth or  Rothesay

Cusworth Smooth



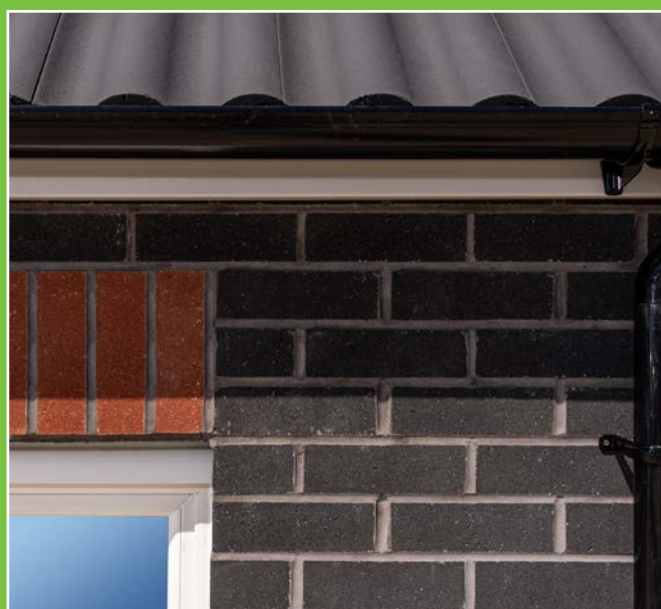
Main brick	Suggested detail brick	Suggested mortar colour
Cusworth	Rothesay (shown) or Hovingham	Tarmac Y2

Hovingham Smooth



Main brick	Suggested detail brick	Suggested mortar colour
Hovingham	Cusworth (shown) or Rothesay	Tarmac Y2

Rothesay Smooth



Main brick	Suggested detail brick	Suggested mortar colour
BRS003 Rothesay	Hovingham (shown) or Cusworth	Tarmac Y2 (shown) or Y14 (darker)

Sherborne Smooth



Main brick	Suggested detail brick	Suggested mortar colour
Sherborne	Hovingham (shown) or Rothesay	Tarmac Y2

Cusworth Riven



Main brick	Suggested detail brick	Suggested mortar colour
BCR003 Cusworth Riven	Hovingham (shown) or Rothesay	Tarmac Y2

Hovingham Riven



Main brick	Suggested detail brick	Suggested mortar colour
Hovingham Riven	Rothesay (shown) or Cusworth	Tarmac Y2

Rothesay Riven



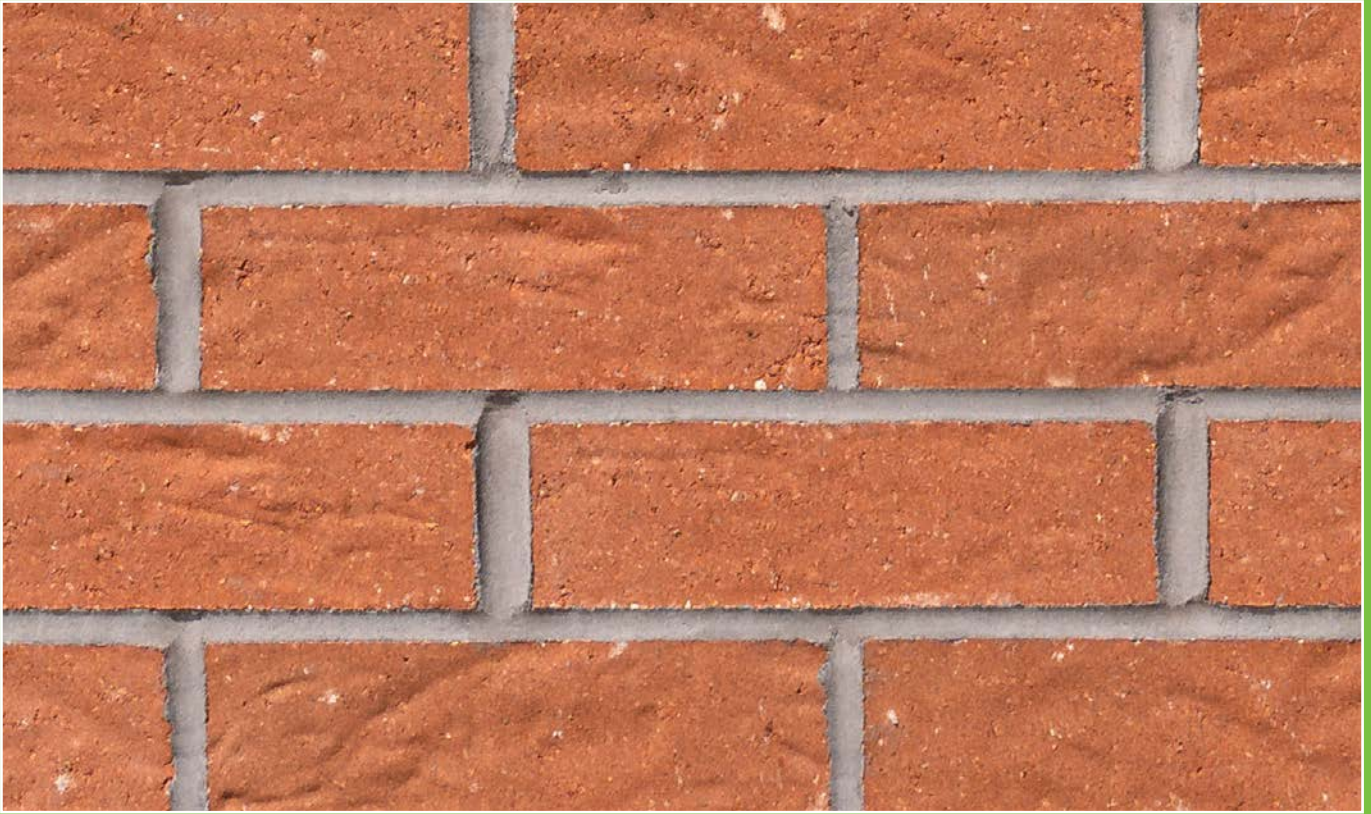
Main brick	Suggested detail brick	Suggested mortar colour
Rothesay Riven	Hovingham (shown) or Cusworth	Tarmac Y2 (shown) or Y14 (darker)

Sherborne Riven



Main brick	Suggested detail brick	Suggested mortar colour
Sherborne Riven	Rothesay (shown) or Hovingham	Tarmac Y2

Thoresby Riven



Main brick	Suggested detail brick	Suggested mortar colour
Thoresby Riven	Rothesay (shown) or Cusworth	Tarmac Y2

Site practices



Delivery

The bricks are delivered to sites by our haulage partners after a minimum of 28 days' curing. They are delivered in packs of 396, vertically and horizontally-banded and wrapped with a void to allow them to be unloaded and moved using the site forklift truck. The Brickworks can facilitate unloading if required. Each pack is clearly marked with an identification number which enables the Brickworks to identify the specific shift the pack was produced on to assist with quality control purposes.

Unfortunately, the Brickworks are unable to sell bricks direct to our purchasers or trade. This is due to the logistics of dealing with requests from potentially thousands of individual purchasers following legal completion in taking/processing and delivering small quantities of bricks. Plus, the use of the Brickworks bricks requires specific design considerations being adopted/incorporated into brickwork which, if not done correctly, may cause structural failures and unfounded concerns being raised over the quality of the product.



Handling & storage

Once delivered to sites, the bricks should ideally be placed on pallets and stacked no more than three packs high. It's important the packs are adequately spaced to allow air movement.

The bricks should ideally be stored under shelter ensuring that the bricklayer receives a dry and stable brick. The hood wrapping around the bricks should be slit to all sides in order for the air to circulate and condensation to evaporate. The packaging should be left on however, and not removed completely as it carries the batch reference number which will be required by the brickworks in the event of any quality issues.

When bricks are stacked around a plot ready for laying then the use of brick jackets are advised to ensure that the bricks are kept in a stable dry condition. However, caution must be taken to ensure that condensation and moisture is not trapped within the brick jackets as this may have an adverse effect over a long period of time. The brick jackets have proven not to be 100% waterproof and do let moisture and water in.





Pointing

Pointing of the bricks can be undertaken in the same way as other concrete products. Care and attention should be taken to fill any joints fully to prevent excessive water ingress into the cavity. Mortar used for pointing should be the same strength as the original mortar used when constructing the brickwork.

Preventing efflorescence

To prevent efflorescence forming on the surface of the bricks, an acrylic coating is applied during the manufacturing process to the outer face only of the bricks. This prevents calcium ions forming on the face of the bricks.

Efflorescence can still form on the brick face if the brick is laid 'back to front' or if good site practice and laying practices aren't followed or if the acrylic coating is damaged/removed during the cleaning of the brickwork (See Cleaning Section). The rounded end of the tear-drop should always point to the face, and the pointed end, to the cavity. Care and attention should be taken at junctions to minimise the potential for water to penetrate into the brickwork.

Protection & inclement weather

As with all building products, the bricks should be protected during periods of inclement weather. Bricks should be kept dry before laying and also protected during bad weather conditions and at the end of every day. Mortar is rich in cement and whilst uncured has the potential for lime to leach out of it during wet weather – this will cause staining to the bricks. Scaffolding boards should be installed with adequate clearance to the wall to allow any excess mortar to drop without hitting the face of the brickwork. During inclement weather or at the end of the working day when the scaffold is not being used and closed off for access, it's recommended the plank nearest the wall is turned on edge to prevent any splashback onto the brickwork.

Typical mortar mix

A typical mix should be composed based on proportion by volume as the following:

Above DPC level:

a) Severe or very severe exposure conditions – M6 mortar is recommended (designation class ii) – 1:0.5:4.5 (cement: lime: mortar) mix by volume – structural engineer to confirm.

b) Other exposure conditions/general use – M4 mortar is recommended (designation class iii) – 1:1:5 to 6 (cement: lime: mortar) mix by volume – structural engineer to confirm.

Below DPC level:

a) High durability – M6 mortar is recommended (designation class ii) – 1:0.5:4.5 (cement: lime: mortar) mix by volume – structural engineer to confirm.



Scaffold loading

Concrete bricks are heavier than equivalent clay products and therefore extra care should be taken when loading onto scaffolding. Brickworks recommends that early advice and guidance is sought from the Health & Safety Department on the appropriate number of blocks and bricks to load on the specific scaffold type being used.

Laying concrete bricks

Laying Brickworks bricks should not pose any issues, and laying should be dealt with in the same way as clay equivalents. The dimensional accuracy and regularity of size will enable coursing to be maintained. Bricks should be laid with the tear-drop pointing inwards and care should be taken not to wet the bricks before laying. Brickworks bricks have a low-medium water absorption, and if necessary, the consistency of the mortar should be adjusted to suit brick suction. Assuming our bricks are adequately protected and dry, 15-20 courses per day should be able to be laid, and in accordance with BS8000-3, lift heights should not exceed 1.5m or 20 courses. Care should be taken to ensure our bricks are fully bedded with perp joints fully filled to avoid excessive water ingress into cavities.

Brickworks bricks can be cut using a bolster or mechanical saw. Wet cutting using a mechanical saw is recommended on face work to preserve sharp and regular edges. However, bricks should be cleaned immediately after cutting and allowed to dry thoroughly before laying.

Bonding patterns should be maintained at openings as broken bonds can increase the risk of cracking.

The joint profile should be formed when the mortar has hardened using tooling to ensure adequate compaction of the joint and improve weather resistance.

Movement control

The vast majority of materials used in the construction of homes move in some form as a result of drying, moisture absorption, changes in temperature or structural movement and the Brickworks bricks are no different in this respect. Shrinkage and cracking in traditional wet cast/pour concrete results from excess water in the mix drying out, however, due to the manufacturing process and precise control of moisture content coupled with the quality of aggregates used, the amount of shrinkage movement within the bricks is minimised as far as possible. Although movement in concrete brickwork is extremely difficult to predict as it can be affected by extremes of moisture and thermal exposure, it can be controlled by the inclusion of movement joints and the introduction of bed joint reinforcement at appropriate locations in brickwork panels. The extent of any movement can also be affected by the type and grade of mortar used and site practices. To minimise these effects the correct

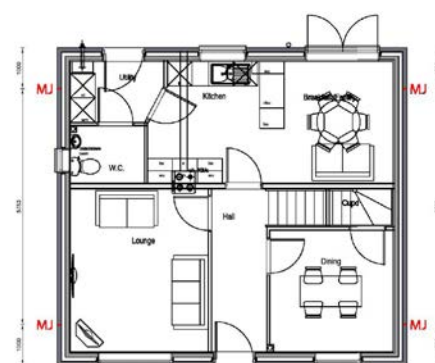
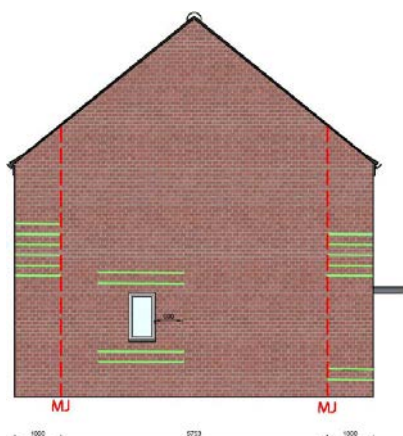
mortar should be specified and the bricks kept as dry as possible before and after laying until cured.

Each of Persimmon Homes' standard group housetypes has been assessed by a structural engineer and the location of movement joints and bed joint reinforcement indicated on working drawings and full supporting technical drawings and calculations are available if required. The position of the movement joints and bed joint reinforcement has been determined in accordance with BS5628, BS8103, BS EN 1996-2, PD6607, and NHBC and Premier Guarantee's technical manual and requirements.

The assessments and designs have been undertaken based on the group standard elevation drawings, with movement joints and bed joint reinforcement being introduced in the external brickwork leaf in areas of potential stress and where brickwork panels exceed 6m in length. Should specific elevation treatments/materials be required resulting in dissimilar materials being used in the external leaf advice should be sought from a structural engineer on the correct position of any movement joints and bed joint reinforcement required. In addition, should standard housetypes be configured into 'blocks' or 'terraces' full structural assessment of the block must be undertaken by a structural engineer to ascertain the correct position of any movement joints and bed joint reinforcement required.

Movement joints do not generally need to extend below the damp proof course (DPC) unless the DPC is more than 600mm above the adjacent ground level. In such cases a structural engineer should be consulted to ascertain if additional movement joints and bed joint reinforcement is required in the brickwork below the DPC.

Movement joints should also be considered and incorporated into any garden and retaining walls which are more susceptible to greater degrees of movement and cracking due to them being unloaded. A structural engineer should be consulted to ascertain the correct position of any movement joints and any bed joint reinforcement required.



Cleaning & repairs

To ensure the best results, care and attention during laying is key

To ensure the long-term appearance and attractiveness of the bricks is maintained, care and attention during laying is key to avoid any mortar stains/splashes accumulating on the face of the bricks. Mortar joints should be struck off in an upward motion and any mortar stains/smears removed initially by dry brushing and then wet brushing if necessary. Every effort should be made to avoid mortar stains/snots from curing on the face of the bricks.

Should cleaning of brickwork be required after curing, the use of a pressure water cleaning can be considered. This must be undertaken at a pressure less than 1000psi and volume of 20 litres/minute using a wide-fan width. Cleaning should be undertaken evenly and in a continuous movement avoiding concentration on any one particular area. This is to prevent damage to mortar joints and more importantly, the surface of the brick and acrylic coating.

Using an acid-based treatment isn't recommended and should only be considered in extreme circumstances if hand cleaning and then water pressure cleaning has not produced a satisfactory appearance. It's highly likely that the acid will damage/remove the acrylic coating from the face of the brick, which in turn will lead to degradation of the brick colour and efflorescence occurring.

Repairs

Due to the nature of the product, thermal expansion and contraction is inevitable and should good site practice not be maintained especially concerning movement joints and brickwork reinforcement, cracking of mortar joints may occur, especially on southerly facing elevations. Should any cracking occur a Technical Briefing document to assist with assessing the cause and appropriate remedial action has been developed.



Frequently asked questions



1. Why do you use concrete bricks?

Clay brick makers struggled to meet demand from vastly reduced manufacturing bases following the last downturn, however concrete facing brick manufacturers maintained production and the manufacturing process means we can produce concrete bricks quicker to meet the increased demand of our business. Persimmon PLC made a significant investment in our own brick production plant to meet the growing demand for quality facing bricks.

Our Concrete Bricks are a masonry unit produced by compacting a semi-dry concrete mix using a combination of selected aggregates, cement and various admixtures along with pigment. This produces a brick with low water absorption and minimal efflorescence. The density of our concrete brick proved excellent durability and frost resistance. Our manufacturing process is easily and accurately repeated ensuring each brick has consistent properties and appearance.

2. What are the benefits to customers for using concrete versus clay bricks?

Concrete Bricks gain strength with age and they are extremely durable with excellent frost resistance which reduces the risk of the face spalling, and are less susceptible to efflorescence (the white salts that you may see in clay brick). Concrete Bricks are more dimensionally accurate than clay bricks and are more consistent in colour and quantity. They do not have the same issues as clay brick with imperfections through the manufacturing and kiln processes.

Concrete Facing Bricks are through coloured so any damage will expose the same colour unlike clay bricks that have a face and if damaged are more visible. The superior strength and performance of a Concrete Brick means that Facing Bricks to 35N/mm² strength are suitable for use in any conditions and are less effected by weather and the environment.



3. Are there any environmental benefits?

Yes. Concrete bricks are more energy efficient and environmentally friendly than clay bricks. The manufacturing process requires minimal energy input, resulting in a very low environmental impact when compared to clay bricks. Concrete bricks are an inherent CO₂ absorber. With regards the whole life cycle unlike clay bricks concrete bricks are 100% recyclable and are suitable for use as crushed aggregates.

The aggregates used utilise materials that in some instances are classed as a waste product of quarrying. Our aggregates used are from sources local to our plants and our bricks are manufactured in the UK therefore reducing our impact and associated carbon footprint. The high energy firing of kilns in clay production processes is not required for the curing of Concrete

Bricks. The natural exothermic reaction of the cement is used with minimal additional energy input. This means no additional natural resources are consumed and emissions are reduced. Concrete Bricks have a BRE A+ Rating for brickwork.

The embodied CO₂ of dense concrete masonry products is estimated as 84Kg CO₂/tonne. With their low cement content, natural exothermic curing regime, and ability to be recycled, Concrete bricks are environmentally friendly. Clay bricks by comparison have an embodied carbon content of 244Kg CO₂ /tonne (quarry to site), three times that of concrete. (Data from the Concrete Centre and Brick Development Association publications)



4. Why is there an expansion joint/gap running down the front and gable of the house?

All building materials are subject to movement. This movement is due to a number of reasons including:

- Thermal expansion/contraction due to temperature changes
- Moisture movement
- Creep and structural loading
- or the effects of chemical changes such as sulphate attack.

It is the first two of these which are particularly influential on masonry movement. The expansion and contraction of masonry needs to be accommodated and controlled by the inclusion of both vertical and horizontal joints within the building. If such movement is not allowed for there will be a build-up of internal stresses and a risk of cracking which is unsightly and costly to repair.

5. Why don't your competitors use concrete bricks?

Many of our competitors are using concrete facing bricks, and they now represent the fastest growing materials sector in the UK brick industry, being regularly used by national developers including Bellway, Mace, McCarthy & Stone, Keepmoat and Taylor Wimpey, as well as a wide array of regional developers.

6. Are they cheaper to buy?

We manufacture our own concrete bricks which allows us to maintain competitive prices and a consistent supply.

7. Do they last as long as clay bricks?

Concrete bricks are denser and more durable than clay bricks and conditions and are less effected by weather and the environment, both meet the NHBC requirements.

8. Will surveyors value these the same as clay bricks?

In terms of mortgage valuation reports, standard construction will normally refer to properties built in brick or stone, either with solid or cavity walls, with a tile or slate roof. Non-standard construction encompasses those buildings constructed by other means.

9. Are these concrete bricks just block paving?

No, whilst manufacturing techniques are similar, concrete bricks are of a higher quality.

10. Are these concrete bricks prone to thermal cracking?

All bricks are prone to thermal cracking. Clay brickwork will generally be subjected to long-term expansion while concrete bricks are be prone to shrinkage. This is why the correct expansion joints and bed reinforcement are built into your property to minimise the risk of thermal cracking.

