



Bricks & Masonry Technical Manual

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Acknowledgements

A huge thank you to Robert Dorrington for his incredible contribution to the second edition of this manual. With over 36 years in the pre-cast, cast stone, and brick industry, and a background as a Civil Engineer, his expertise has been invaluable.

Rob played a pivotal role on the NHBC task group for concrete brick, keeping their standards current. His input has been crucial in ensuring that our manual is not only up-to-date but accurate.

Rob has made significant contributions to the team at Marshalls Bricks and Masonry, in a technical capacity and has played an integral part in achieving significant advancements in product development. Thanks to his efforts modern-day Marshall's bricks are not only aesthetically appealing, but technically sound and can be seen on buildings throughout the UK.

Introduction

Assisting industry professionals.

This manual, produced by a team of technical experts at Marshalls, draws on over 60 years of knowledge and experience in the manufacture of concrete bricks, walling and masonry products and is intended to assist industry professionals in the design, specification and application of these products for all aspects of buildings and construction.

The manual has been designed in a way to allow easy access to each section covering the products manufactured by Marshalls Bricks & Masonry. Starting with their specifications, characteristics and standards, through functional performance and design, ending with practical site guidance.

More comprehensive technical information on each section is referenced throughout the manual and summarised in the Appendices.

This manual, together with the supporting material on our website, is designed to be the reference point for advice and guidance on bricks and masonry products manufactured and supplied by Marshalls.

Please note, not all concrete products are manufactured in the same way, therefore this manual may not be relevant to products offered by other concrete manufacturers.

The information and guidance contained in this manual is reviewed regularly by the technical team at Marshalls Bricks & Masonry.

Updates and amendments can be made without notice and the company cannot accept liability for any error or omissions.

Data and information is based on the current standards and codes applicable at the time of publication. The content of this document and the referenced data sheets and bulletins, including tables, diagrams and images, are subject to copyright.

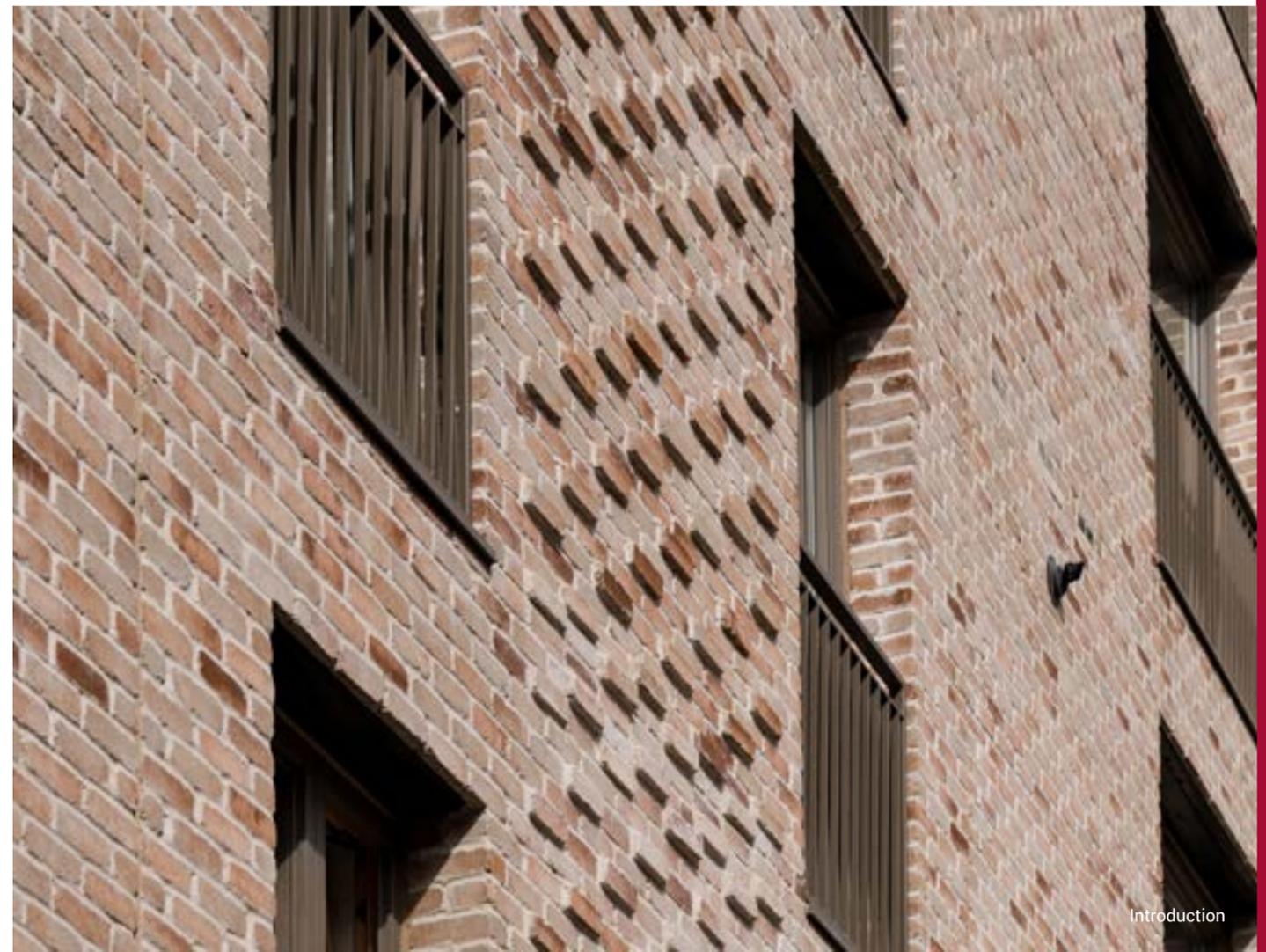
This manual was produced in consultation with and input from various developers, architects and construction companies together with organisations with specific technical expertise such as The Concrete Society, LABC and NHBC.

Further information:

For further information on any aspect of this guide, please contact us on:

☎ 01633 600 806

✉ bricksbm@marshalls.co.uk



How to use this guide

Navigation, symbols and abbreviations.

Symbols

Use the icons and terms below to help you navigate through this guide.

British Manufacturing Standards

All of our bricks and masonry products are manufactured to harmonised British standards.



UKCA/CE Marking Information

Under the Construction Products Regulation (2015) all of our products sold within mainland Britain are required to carry the UKCA Mark and for Northern Ireland and European export, the CE mark.



Made in Britain

All our concrete bricks are made in the UK and hold the Made in Britain mark.



Click the link below to see our full range of bricks or search 'Bricks and walling' at marshalls.co.uk.

marshalls.co.uk

Abbreviations

Throughout this manual we have used abbreviations to save space and time and to avoid repetition of long words and phrases. These are listed below for your understanding.

BTDS Brick Technical Data Sheets

BTB Brick Technical Bulletin

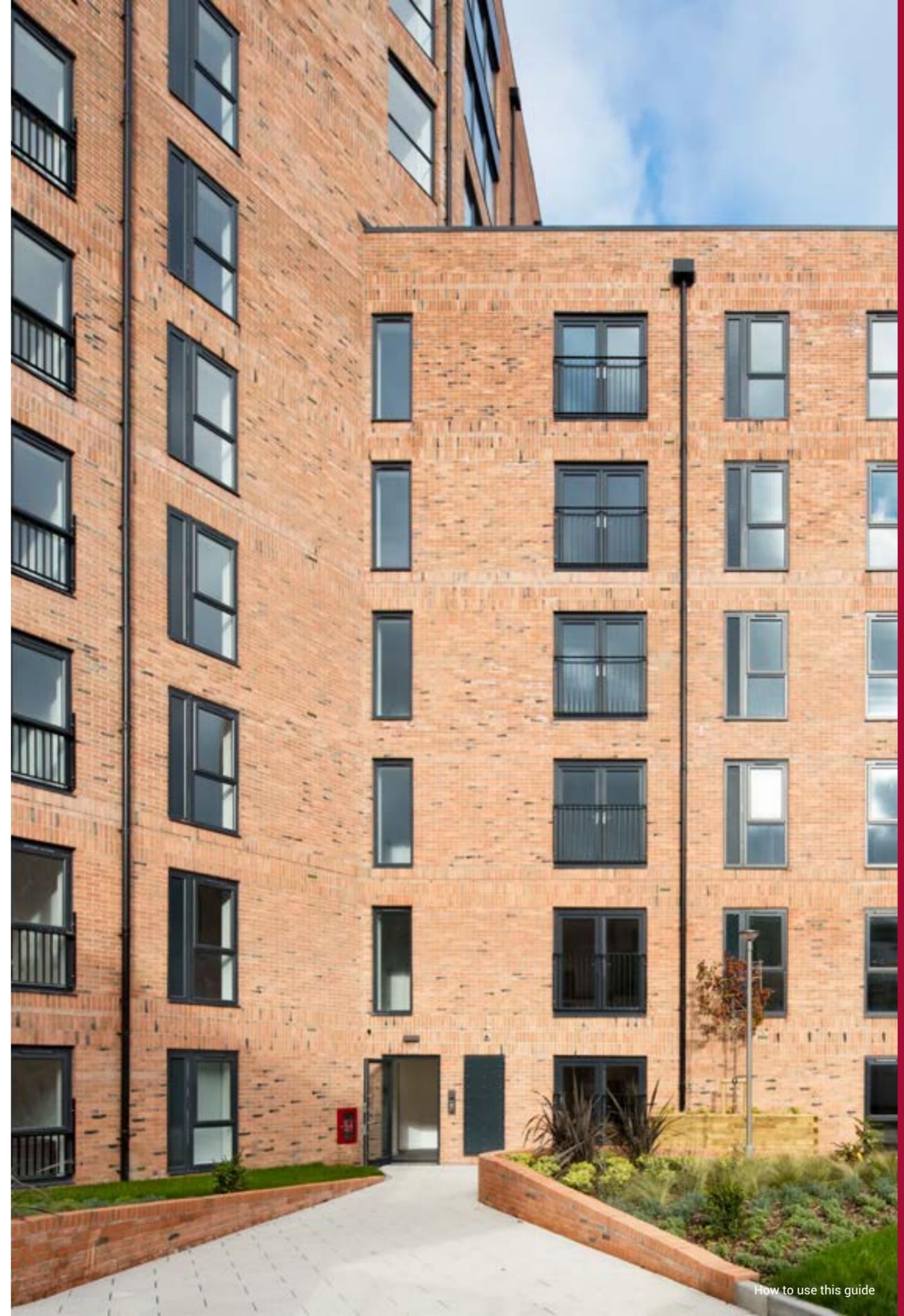
HSDS Health & Safety Data Sheets

References

Watch out for references to appendices and further information marked throughout this guide as shown below.

Please refer to:

 **BTDS 2:**
Engineering quality
concrete bricks
Page 34



About Marshalls

We're Marshalls. With you we create better places.

Marshalls is a leading UK manufacturer and has been involved in the production of concrete products since the 1950s.

The business has flourished through a combination of product development and technical innovation that has provided a range of products that meet the needs - and surpasses the expectations - of both specifiers and users of concrete building products in the market.

In 2018, the Marshalls portfolio was extended through the acquisition of the concrete brick manufacturer Edenhall. This acquisition brought together experts in their respective fields who are passionate about pushing innovation forward to be able to offer our customers the best product available.

Marshalls now offers an unrivalled range of bricks and masonry products, in a large choice of textures and finishes, combined with an extensive palette of colours.

The acquisition of Edenhall means Marshalls are leading the way in the development of concrete facing bricks made in Britain by a British company. Marshalls Bricks & Masonry continue to break down barriers and provide practical solutions that have changed the perceptions of those that use brick, converting them to the strong, durable, aesthetically attractive and technically sound product that is concrete, resulting in a national market for our product that is acknowledged and accepted by specifiers, planners, local authorities, warranty providers, developers and contractors throughout the UK.

Marshalls delivers quality products and professional service to customers whilst setting the highest standards for health, safety and welfare of stakeholders, together whilst minimising any environmental impact of its activities.

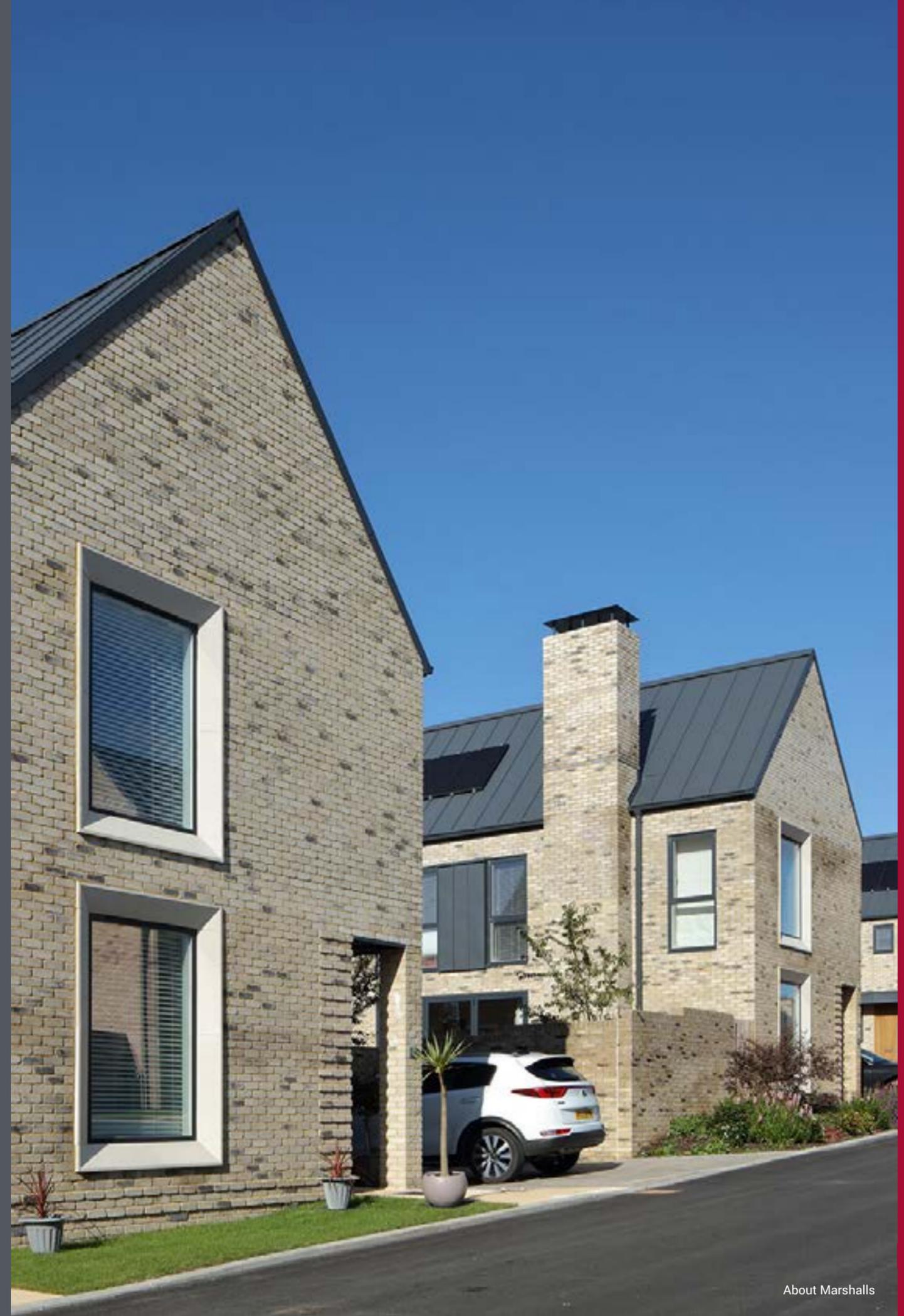
You can have confidence in Marshalls both as a business and your supplier of bricks.

We offer an unrivalled range of bricks and masonry products, in a large choice of textures and finishes combined with an extensive palette of colours.

 For more information visit: marshalls.co.uk



All our concrete bricks are made in the UK and hold the Made in Britain mark.



About our bricks

A flexible and efficient manufacturing process.

How our bricks are made

Our brick manufacturing process is efficient and flexible allowing adjustments to production plans to be made quickly and easily in response to market demands.

Production involves the compaction of a semi-dry mix of graded aggregates, binders (both cementitious and SCMs) and water, along with specialist additives and admixtures as required.

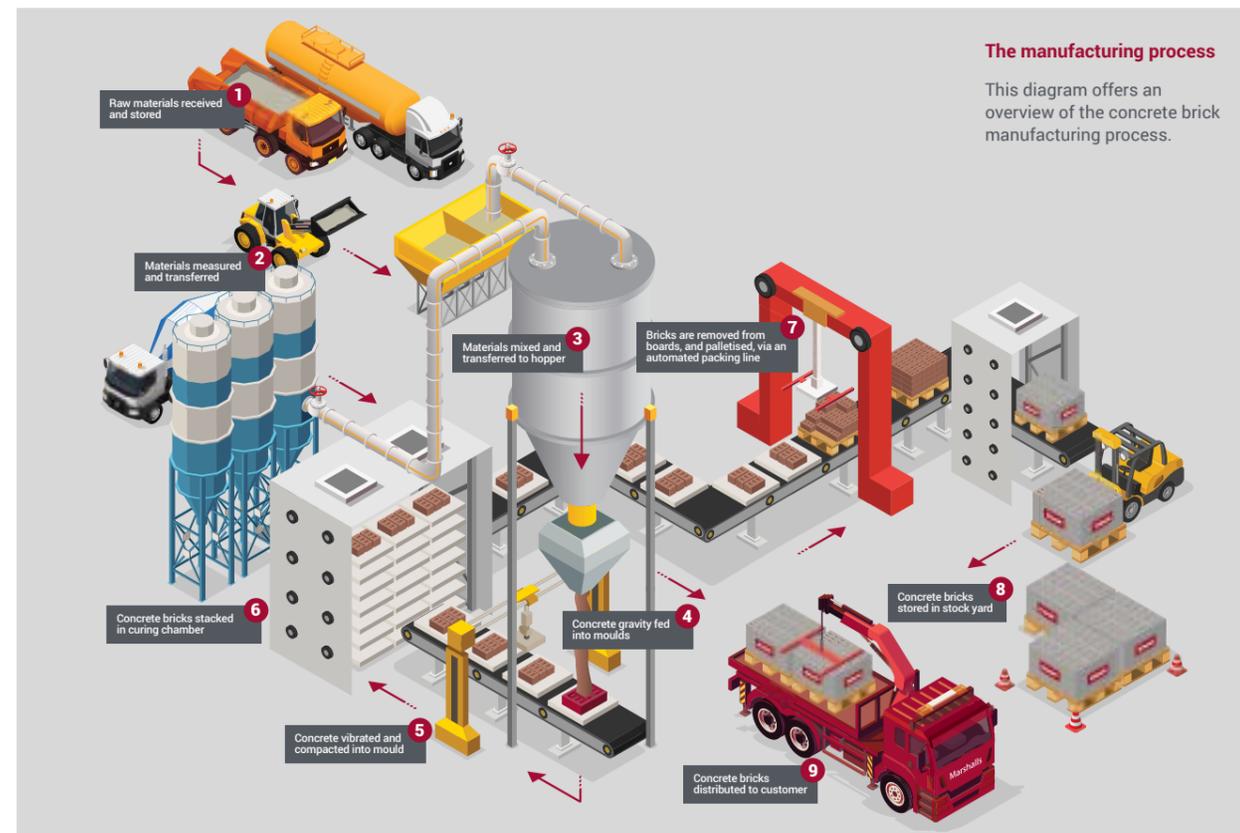
During the mixing process, various combinations of colour fast oxide pigments can be introduced depending on the particular brick required.

The whole process is computer controlled to ensure that replication of the recipe can be maintained for future requirements.

Secondary treatments for texture and colour can be applied to the brick as and when required.

The bricks are transferred to the curing chambers for the initial hydration reaction. This exothermic reaction naturally increases the temperature and humidity within the chamber, minimising the need for additional heat or energy, which ultimately provides a more sustainable solution.

Once initial curing is complete, the bricks are packaged and transferred to the stock yard for a minimum period prior to dispatch.



Manufacturing control

Marshalls operates a comprehensive internal quality control programme, which is supplemented by regular independent tests carried out by recognised test houses.

Based on the requirements of **BS EN 771-3:2011 +A1 2015**, bricks are declared as:

Category I products.

Composition

Bricks are produced using two different materials depending on brick type.

Facing, common, engineering and dense coursing bricks are all produced using combinations of crushed dense aggregates.

Light/medium weight coursing bricks include specific lightweight aggregates. These bricks have a similar density, strength and thermal conductivity properties as that of a lightweight/medium density aggregate concrete blocks. These bricks aren't considered to be frost resistant.

Our brick manufacturing process is efficient and flexible, allowing adjustments to be made quickly and easily in response to market demands.



Reasons to trust our Bricks & Masonry product ranges

Our products are manufactured and tested to market-leading standards to guarantee we meet the high standards we set ourselves - and the highest expectations of our customers.



Sustainability

- No kilns required during the curing process, keeping our carbon footprint lower.
- Raw materials are sourced as locally to each manufacturing site as possible.
- Where possible, cements are supplemented with environmentally beneficial replacements.
- Minimal water used in production.
- Low embodied and emitted carbon content.
- Net absorber of carbon.
- Responsibly sourced packaging.
- Strategic distribution from UK manufacturing sites to minimise carbon footprint.
- Independently assessed to recognised environmental standards.
- Can be crushed and recycled at the end of their life cycle.



Longevity

- Continue to age harden throughout their life cycle.



Fire resistant

- The composition of the bricks means they are fire resistant and are A+ rated.



Consistency

- Manufacturing process ensures product is accurate in size.
- The mix design of the product ensures minimal risk of efflorescence and low levels of shrinkage and moisture movement.



Choice

- A wide range of colours available.
- A wide range of texture finishes available.
- Bespoke colours on request.
- Available in a number of forms: perforated, frogged or solid.
- Special bricks on request.



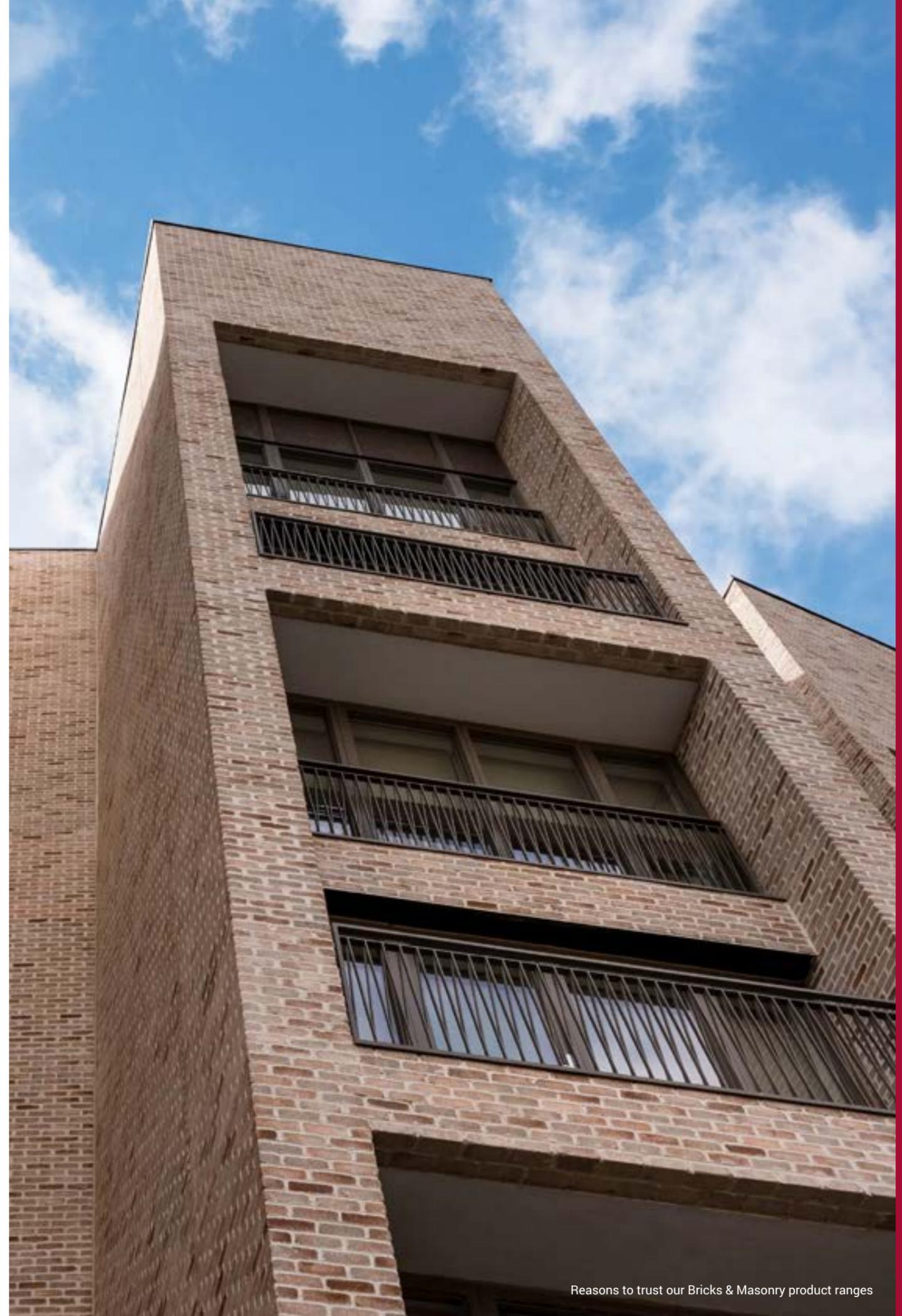
Frost resistant

- All facing bricks can be classed as equivalent to F2/S2 rating for clay bricks.



Fast availability

- Once cured and released from holding stock, the bricks can be available and on site within a matter of days.
- Network of owned and third party hauliers enable prompt delivery.



Brick types

Helping you choose the right brick for your project.

Choosing your brick type

Our bricks are divided into two categories, Facing bricks and Utility bricks.

Facing bricks

Designed for the aesthetics of outer walls on domestic and commercial buildings, our facing bricks are available in perforated, frogged and solid formats, as well as a number of different textures and over 90 colours.

Formats

Perforated



Frogged



Solid



Textures

Sandfaced



Textured



Smooth



Tumbled



Creased



Utility bricks

Made up of Common bricks, Coursing bricks, Engineering bricks, Slip bricks and Block. We are also able to offer Special bricks when needed on specific projects.

Common bricks

Formats

Solid



Frogged



Coursing bricks

Formats

Lightweight



Dense



Engineering bricks

Formats

Perforated



Special bricks

We are able, upon request, to offer a range of special bricks. These would either be 'cut and bond' or 'purpose made'.



See our full range of bricks

We offer an unrivalled range of concrete bricks and masonry products, in a large choice of textures and finishes, combined with an extensive palette of colours.

Click the link below to see our full range of bricks or search 'Bricks and walling' at [marshalls.co.uk](https://www.marshalls.co.uk)

Facing bricks

Designed for the aesthetics of outer walls on domestic and commercial buildings, our Facing bricks are available in perforated, frogged and solid formats, as well as a number of different textures and over 90 colours.

We specialise in producing a wide variety of different colours, blends and finishes. From the traditional reds and oranges through to yellows and creams, as well as more contemporary colours such as blues, greys and whites.

We can also offer a number of different finishes, as outlined here.

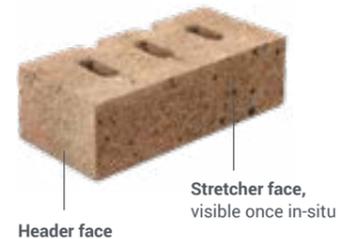
Anatomy of a brick

All bricks have a stretcher face and a header face. The stretcher face is typically the main part of the brick that is visible once in situ.

Our sandfaced, creased* and textured* bricks are classed as single stretcher, double header (SHH) in terms of finished face.

Our smooth and tumbled bricks can be classed as double stretcher, double header (2S2H) for finished faces.

* Textured and creased bricks are only textured or creased to the stretcher face.



Sand faced

Our sand faced bricks offer a smoother finish to the stretcher and header face of the brick.



Creased faced

The creased brick offers an innovative creased texture to the stretcher face of the brick. Headers do not offer a creased finish.



Textured faced

The deep rusticated texture is an ideal finish for anyone looking to step away from traditional smooth brick faces. Supplied with one textured face and a percentage of single headers. Double or extra headers can be supplied to special order.



Smooth faced

The innovative colour and water flash finish added to the stretcher of this brick helps create the smooth feel of this product.



Tumbled finish

Tumbled creating a rounder, vintage, distressed finish. In-built the rumbled texture creates a very attractive appearance, giving an aged patina. Although the bricks are given a distressed appearance the regular properties of dimensional accuracy for ease of building are maintained.

Utility bricks

Made up of common bricks, coursing bricks, engineering bricks, slip bricks and block. We are also able to offer Special bricks when needed on specific projects.

Common bricks

Our common bricks are designed to be used for most types of construction above and below damp proof course level, independently or in conjunction with dense aggregate blocks.

Common bricks are available in either a solid or frogged format.

They are also available in two heights, 65mm and 73mm.

Common bricks are classed as frost resistant.

They are intended for use in locations where the appearance and colour is of secondary importance.

Available formats

Solid



Frogged



Dimensions

Available heights:
65mm and 73mm

Features



Please refer to:

➤ BTDS 4:
Dense concrete
common bricks
Page 36

Coursing bricks

Our coursing bricks are designed to be used in conjunction with dense or or light/medium weight aggregate blocks.

Coursing bricks are available as dense or light/medium weight and in two widths, 100mm and 140mm.

They are available in 40mm slips for use in building up courses in beam and block floors as well as 65mm high.

They are also available as 40mm high slips for use in building up courses in beam and block floors.

Dense and light/medium weight bricks should not be used in conjunction with aerated autoclaved blocks.

Available formats

Dense



Lightweight



Dimensions

Available widths:
100mm and 140mm

Available heights:
40mm and 65mm

Features



Please refer to:

➤ BTDS 3:
Dense and lightweight
coursing bricks
Page 35

➤ BTB 10:
Coursing brick
applications
Page 71

Engineering bricks

Engineering bricks are durable, high strength bricks, specially manufactured to accommodate high loads and cope with exposure to aggressive ground conditions.

Durable, high strength, perforated bricks, specially manufactured to cope with exposure to aggressive conditions.

Made from selected dense aggregates and cement blends that can resist sulphate attack, the bricks exhibit low absorption and high dimensional accuracy.

Fully frost resistant and suitable for use below ground level and in locations where natural sulphates, up to and including Class 3 levels, are present.

They are manufactured and tested in accordance with the relevant Standard and meet the criteria for strength, durability and sulphate resistance given in all construction and mandatory Standards. They perform to the same performance standards and applications as clay Class B engineering bricks.

Available formats

Perforated



Dimensions

Available heights:
65mm

Features



Please refer to:

↗ **BTDS 2:**
Engineering quality
concrete bricks
Page 34

↗ **BTB 11:**
Concrete engineering
quality bricks
Page 73



Special bricks

Ideal when wanting to incorporate fine detail and finishing touches to enhance your build.

Special bricks can either be produced to the dimensions and shapes detailed in the **BS 4729:2005** or purpose made to suit the structure without compromise.

To achieve these profiles we can provide our special bricks by 'cut and bond' from our full range of facing bricks, or, for instance a purpose hand-made component manufactured from the same base materials can be provided.

In addition to the range of special shapes, brick slips can be provided from our full range of facing bricks in a number of standard or bespoke thicknesses to suit various off-site prefabricated or fixed in-situ applications.

Available formats

We offer a range of special shapes including pistol stretchers and headers, angles and cants, cill bricks, plinth bricks, gable cuts and both bullnose and double bullnose bricks.

Get in touch

Please consult our sales office for any assistance regarding our special bricks

Telephone: 01633 600 806

Dimensions

Various

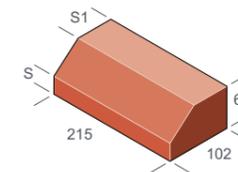
Features



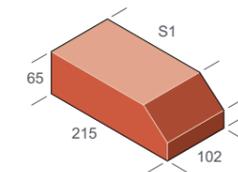
Please refer to:

↗ **BTDS 5:**
Special bricks
Page 38

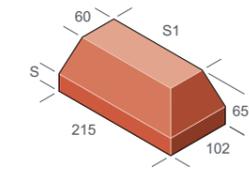
PL3 Plinth Stretcher



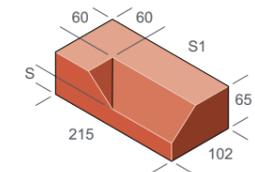
PL2 Plinth Header



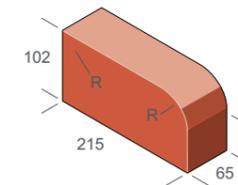
PL7 Plinth External Return



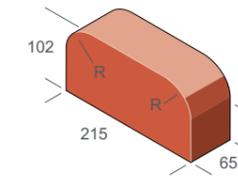
PL4 Plinth Internal Return



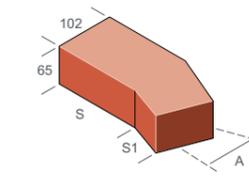
BN1 Single Bullnose



BN2 Double Bullnose



AN3 Internal Dogleg



Brick matching and design service

Do you have a specific colour or texture in mind to co-ordinate with your project?

We can make it for you!

Our technical expertise and flexible production process allows us to offer a brick matching or design service with the ultimate 'design your own brick' facility. Although we have an extensive core range, bespoke requirements can often be accommodated.

Our production process also allows the introduction of secondary or tertiary colour effects such as 'flashing', 'hearting' or 'flecking', all of which contribute to the unique visual appearance of the finished brick.



Above
Darton Red bespoke brick,
with a flecking effect

Standards & specifications

Meeting industry standards

Standards

Our bricks are produced in accordance with **BS EN 771-3: 2011 +A1 2015: 'Specification for Masonry Units. Aggregate Concrete Masonry Units'**.

Units within this Standard are described as:

- Facing masonry units intended for use with one or more faces left visible and which may or may not be exposed to external climatic conditions.
- Masonry units exposed to external climatic conditions without render or other equivalent protection.
- Common units are defined as masonry units intended for use with no faces left visible.

The above Standards are purely manufacturing Standards and do not contain any information on use or application of the product. These are covered by the following Standards with which all Marshalls bricks comply.

- BS 5628, Parts 1, 2 and 3: 2005:** 'Code of Practice for the Use of Masonry'.
- PD 6697: 2019:** 'Recommendations for the Design of Masonry Structures to BS EN 1996-1-1 and BS EN 1996-2'.
- BS 8000-3: 2001:** 'Code of Practice for Masonry. Workmanship on Building Sites'.
- BS EN 752: 2008:** 'Drain and Sewage Systems outside Buildings'.
- WAA Civil Engineering:** 'Specification for the Water Industry'.
- Water Services Association Guide:** 'Sewers for Adoption'.
- Highways Agency:** 'Specification for Highway Works'.
- National House Builders Council (NHBC Standards).



UKCA Marking Information

Our bricks are manufactured to harmonised Standard **BS EN 771-3: 2011 +A1 2015: 'Specification for Masonry Units'** and therefore under The Construction Products (EU Exit) Regulations 2020 are required to carry a UKCA Mark and have an accompanying Declaration of Performance (DoP).

In addition, for Northern Ireland and exports to the European Union these products will also carry the European CE mark.

Marshalls has systems in place to ensure products comply with this certification, details of which can be found on the website where they are available as printable downloads.

Properties and performance

The following are generic properties which cover all Marshalls brick products:

Tolerances	Category D1
Resistance to fire	Euroclass A1
Water vapour permeability	5/15 μ (Tabulated from EN 1745)
Specific heat capacity	840-880 J/kg oC
Green guide rating	A+
Bond strength	0.15N/mm ² (Tabulated from EN 998-2: 2003, Annex C)
Flexural bond strength	No performance declared as not mandatory in the UK
Characteristic flexural strength (FKx)	0.53 parallel and perpendicular to bed joints
Dangerous substances	No performance declared
Air permeability	As required under Part L (Conservation of Fuel and Power) the assumed values for dense bricks is 0.15m ³ /hr/m ²
Built wall weights (100mm wide)	Dense bricks@175-215kg/m ²

Manufacturing Standards

Marshalls bricks are produced in accordance with:

BS EN 771-3: 2011 +A1 2015: 'Specification for Masonry Units. Aggregate Concrete Masonry Units'.

Further information:

- All Marshalls brick products are compliant with The Construction Products (EU Exit) Regulations 2020.

[Click to download our Declaration of Performance.](#)

Brick specification summary chart

The following table summarises, in brief terms, the properties and performance of Marshalls bricks.

Further information:

- Individual product performance is available from specific Brick Technical Data Sheets, available for download from our website.

[Click to access our Technical Data Sheets online.](#)

BRICK TYPE	FACING BRICKS	ENGINEERING BRICKS	COMMON BRICKS	COURSING BRICKS
Dimensions	215 x 100 x 65mm 215 x 100 x 73mm (solid only)	215 x 100 x 65mm	215 x 100 x 65mm 215 x 100 x 73mm	215 x 100 x 65mm 215 x 140 x 65mm 215 x 100 x 40mm
Configuration (depending on brick type)	Perforated Frogged Solid	Perforated	Solid Frogged	Solid
Composition	Dense aggregate and cement	Dense aggregate and sulphate resisting binders	Dense aggregate and cement	Dense aggregate Lightweight aggregate
Dry density	2050 \pm 50kg/m ³	2200 \pm 50kg/m ³	2050 \pm 50kg/m ³	2050 +/- 50kg/m ³ 1750 +/- 50kg/m ³
Dry weight	2.3 – 3.2kg	2.6-2.8kg	2.3–3.1kg	1.9-3.1kg Lightweight/ Dense 100mm 2.7-4.1kg Lightweight/ Dense 140mm
Mean compressive strength	>22.5N/mm ²	>50N/mm ²	>22.5N/mm ²	>10N/mm ² - Lightweight >22.5N/mm ² - Dense
Moisture movement	Approx 0.60	Approx 0.60 mm/m	Approx 0.60 mm/m	Approx 0.90mm/m - Lightweight Approx 0.60 mm/m - Dense
Water absorption by capillarity	<85g/m ² /s0.5	<45g/m ² /s0.5	< 85g/m ² /s0.5	50-150g/m ² /s0.5
Typical water absorption by weight	5-9%	<7%	6-10%	8-16%
Thermal conductivity: dry	1.11 W/mK	1.24 W/mK	1.11 W/mK	0.42 W/mK - Lightweight 1.11 W/mK - Dense
Thermal conductivity: @ 3%	1.24 W/mK	1.39 W/mK	1.24 W/mK	0.47 W/mK - Lightweight 1.24 W/mK - Dense
Thermal conductivity: @ 5%	1.33 W/mK	1.49 W/mK	1.33 W/mK	0.50 W/mK - Lightweight 1.33 W/mK - Dense
Frost resistance	Frost resistant	Frost resistant	Frost resistant	Lightweight - not frost resistant Dense - frost resistant

Procurement and ordering

At order stage please provide the following information to help us to process your requirements efficiently:

- Full product name.
- Customer contact details (including site).
- Full order quantity.
- Quantify and identify any brick specials, if required.
- Call off schedule.
- Delivery method/vehicle type required (e.g. crane off-load/flat bed).
- Any site restrictions that may impact on delivery.
- Start date; number of plots; rate of build (plots/week); estimated finish date.
- Any other special information/instructions.

As the product is made from natural materials with their inherent variations, the following good practice and simple practical steps will help deliver a quality finish to the brickwork:

- Orders should be placed in full rather than individual loads, together with call off delivery schedules to assist stock availability and supplies from complementary batches.
- A reference panel should be built on site, prior to commencement of the build, to fairly represent the product standards and finish expected on the project.
- Although facing bricks are pre-blended in their packs, it is recommended that bricklayers work from 2-3 packs at a time and that a balance of a previous load is kept prior to another arriving so that a seamless blend is maintained throughout the brickwork.

Depending on the type and supplying works, products may be supplied either strapped in voided packs or wrapped onto disposable pallets or skids.

- Facing bricks are supplied on a pallet with a stretch hood.
- Utility Bricks are supplied as facing bricks or in a void format depending on site of manufacture.
- Engineering bricks are supplied on a pallet with a stretch hood.

Marshalls does not accept responsibility for the collection or return of pallets and it is the site's responsibility to dispose of or recycle them. All packaging materials are recyclable.

The carriage of bricks is not subject to hazardous substance conveyance regulations and vehicle labelling is not required.

Please refer to:

➤ BTDS 1:
Facing bricks
Page 33

➤ BTB 1:
Good site practice guide
Page 41

➤ HSDS 2:
Safe loading, transit
and off-loading of products
Page 82

➤ BTB13:
Fire resistance
Page 77



Performance, design and site practice

Performance overview

Durability

All Marshalls dense bricks are classed as frost resistant and exhibit excellent freeze thaw characteristics. This has been confirmed by independent testing.

Facing bricks: although not directly comparable can be considered to be at least equivalent to a clay F2/S2 grade brick.

Engineering bricks: can be considered to be at least equivalent to a clay F2/S2 grade brick and can be used for facing brick applications.

Common bricks and dense coursing bricks: are typically used in conjunction with secondary finishes or in limited exposure conditions. Consult the relevant brick datasheet for F-rating on the website. They are rated equivalent to S2 throughout.

Lightweight coursing bricks: are only recommended for use in internal walls above dpc.

Efflorescence and colour integrity

The majority of Marshalls Bricks & Masonry products are manufactured using crushed aggregates and stable synthetic pigments, all of which are predominantly insoluble, therefore the amount of soluble salts is minimal. There is no requirement within the British Standard to declare soluble salt content and therefore our products can be classed as having nil- minimum efflorescence.

Sulphate resistance

Marshalls dense bricks and walling, due to their cement content, density and low absorption, are suitable for use up to design sulphate conditions DS2. Higher sulphate conditions than this may necessitate a modification to the mix design. Higher sulphate conditions will require a greater performing brick,

Engineering bricks are made for these applications and are suitable for at least Class DS3 levels as well as use in sewerage conditions.

Water absorption and weathering resistance

The standard for concrete masonry indicates a moisture absorption by capillary test and results for individual brick types are given in Section 6.4. This test has superseded the more traditional 24 hour water absorption test, the results of which are also shown in the individual Technical Data Sheets.

The water absorption test approach is different for concrete bricks compared with that of clay bricks for example, but the requirements are there for different reasons. For clay bricks the test is primarily related to mortar adhesion and frost resistance, the former being important in case of excessive suction of the water from the mortar before it has had chance to cure, and the latter to ensure that the correct choice of brick is used in exposed conditions. A high absorption clay brick may be more susceptible to frost attack.

With concrete bricks a low/medium absorption is important to inhibit the absorption of surface dirt whilst at the same time giving sufficient suction to allow the mortar bond to develop properly. Marshalls bricks are unique in that although some may contain an element of internal additives, others have a material applied to the face which contributes to maintaining the continuous appearance of the bricks. In addition the continuous ageing means the absorption reduces over the years whilst the bricks continue to develop in strength.

Please refer to:

 **BTB6:**
Durability
Page 62

 **BTB4:** Mortars for concrete masonry products
Page 50

 **BTB7:**
Efflorescence & colour integrity
Page 64



Frost resistant

All our dense bricks are classed as frost resistant and exhibit excellent freeze-thaw characteristics.

Resistance to rain penetration

Marshalls Bricks & Masonry products have been independently tested in built wall conditions which showed that properly constructed walls adequately resist rain penetration. It should be noted that no bricks or walling of any type will resist rain penetration in single leaf walls in prevailing conditions.

Environmental performance

Bricks and walling produced by Marshalls have excellent 'green' credentials as summarised below.

- are a net absorber of CO₂ over their lifecycle
- are 100% recyclable
- utilise aggregates which may be otherwise classed as secondary products from primary clean graded aggregate
- contain raw materials that are sourced locally using home based cements
- can contain supplementary/ replacement cementitious materials
- introduced Carbon Cure technology whereby industry waste captured CO₂ is injected into the fresh mix and subsequently permanently encased within the brick
- create minimal waste during production
- require minimal additional heat to cure the product hence CO₂ emissions are very low
- have packaging which is responsibly sourced, includes recycled content and is itself recyclable
- ensure minimum transport distances to sites by a wide spread of factory locations
- have a BRE A+ rating for built walls
- have an Embodied Carbon footprint which is significantly less than clay bricks.

Fire resistance

Concrete masonry is a non-combustible material possessing excellent fire resisting properties. Bricks and walling are produced from Class 1 aggregates and are classed as non-combustible with a zero spread of flame. Typical resistance values (in hours) are as follows:

- 100mm, single leaf load bearing wall with finish = 3 hours
- 100mm, non load bearing single leaf wall with finish = 3 hours
- 100mm, load bearing cavity wall = 6 hours
- 100mm, non load bearing cavity wall = 6 hours

Sound insulation

Marshalls masonry offer excellent sound insulating properties which can be particularly important in preventing flanking wall transmission or in lightweight structures.

The average built wall weights and their Sound Reduction Indices for lightweight plastered single leaf and cavity walls are as follows:

- Solid dense masonry brick, 100mm thick wall @ 214kg/m² = 46dB
- Solid dense masonry brick, 215mm thick wall @ 458kg/m² = 50dB

Thermal insulation

Dense bricks can be considered to be similar to dense aggregate concrete blocks in terms of density and thermal conductivity whilst lightweight coursing bricks have similar properties to that of medium weight aggregate blocks. The following thermal conductivity values are typical:

THERMAL CONDUCTIVITY	DENSE BRICKS	LIGHTWEIGHT BRICKS
Dry	1.11 W/mK	0.42 W/mK
@3%	1.24 W/mK	0.47 W/mK
@5%	1.33 W/mK	0.50 W/mK

Please refer to:

 **BTB9:**
Resistance to rain penetration
Page 69

 **BTB13:**
Fire resistance
Page 77

 **BTB3:**
Environmental characteristics
Page 48

 **BTB14:**
Sound insulation
Page 78

 **BTB15:**
Thermal insulation and u-values
Page 79

Air permeability

Although no declared values are quoted, similar products achieve values of 0.15m³/hr/m².

Movement

There is no requirement within the British Standard to declare the drying shrinkage or moisture movement values of concrete masonry products but typical values for individual Marshalls products can be found in the specific Brick Technical Data sheets. However, a summary of typical results is given below. Designers should take into account these values when comparing against other concrete masonry products such as aerated blocks.

The composition and manufacturing procedures for bricks ensure that Marshalls offers some of the lowest shrinkage and moisture movement values of cement-based masonry used today.

- Low cement and mix water contents with high aggregate ratios give low moisture changes after curing.
- Low water absorption of the brick leads to reduced moisture changes in use and hence reduced movement in a structure.
- Inherent high strength of the brick for relatively low cement content produces 'stiffer' units, which can resist internal stresses.

The information below is an abbreviated version of more comprehensive information on Movement Control, which is detailed in 'Brick Technical Bulletin BTB 5' and outlines the key points in considering the accommodation of movement when using Concrete Facing Bricks. Note that not all concrete masonry is the same, and the data provided in this manual refers to use of Marshalls bricks only.

Movement control best practice

- Ensure that bricks are kept as dry as possible whilst storing and stacking out. Bricks should not be wetted before laying and incomplete brickwork should be protected from rain and snow.
- Ensure the correct grade of mortar is specified and used. An M4 Class mortar is generally most appropriate but be aware that stronger mixes which utilise a CEM I rather than a CEM II cement may not accommodate movement as well.
- Ensure to use a suitable consistency of mortar, as a rule of thumb, the consistency of mortar should be as used for other dense aggregate concrete units, such as block or reconstituted walling
- In most cases movement joint centres of between 7.5-9 metres in two storey and above type dwellings should be adequate, but shorter distances may be needed for single storey buildings. The length/height ratios of brickwork panels should not typically exceed 3:1.
- Particular care should be taken with openings greater than 1.2 metres, especially if they are placed vertically adjacent each other, e.g. the panel profile between a ground floor opening and a first floor window may be less than 3:1 but they are relatively slender and can be subject to stresses from larger areas of brickwork adjacent to the openings. In these cases lattice or similar structural type bed joint reinforcement should be introduced above the ground floor opening and below the first floor window. Note that whilst bed joint reinforcement will assist in the prevention of potential cracking, it is not a complete alternative to the provision of movement joints which should be installed in the appropriate locations.
- For openings where there are only a few courses of bricks above or below the openings then crack inducers, in the form of raked joints which have been filled with mastic, should be considered at the ends of the openings.

Please refer to:

 BTB5: Movement control
Page 53

References:

* Dissimilar materials would also include products of significantly different density, as well as directly dissimilar materials.

- A large proportion of movement joints when using concrete bricks can be simple contraction joints, but south facing elevations, particularly those built with dark coloured bricks, may require full compressible joints to accommodate thermal movement.
- In elevations which consist of block and render and concrete bricks then any movement joints should follow through both materials.
- Movement joints at short returns can frequently be installed as butt joints incorporated into the internal corner, with the longer leg abutting the shorter return.
- Placing vertical movement joints in locations where lateral support from party walls or internal load bearing partitions exist will assist in the stability and resistance to wind loading.
- Avoid mixing dissimilar materials* that have different levels and types of movement characteristics, eg. concrete (shrinkage) v. clay (expansion). Bricks made using limestone aggregates, such as those produced by Marshalls, will generally have lower moisture movement values than bricks made with gravel/sand type aggregates.
- Shrinkage cracks tend to be mainly cosmetic and do not normally affect the integrity of a structure.

Product comparisons

There are fundamentally three types of facing brick that have been used, or are used, in the UK over many years. Of these brick types, clay and concrete bricks are the most prevalent, although a certain number of calcium silicate or sand/lime bricks have been used in the past. The latter are now no longer produced in this country, but Marshalls range of Sandfaced bricks can offer a reasonable match if extensions or replacements are required.

Although clay and concrete bricks are produced to different manufacturing standards their performance in use and application are covered by similar standards such as **PD 6697: 2019**. This and other standards detail the appropriate brick specification for various locations. A comparison of the concrete and clay standards is shown on the table below.

Please refer to:

 BTB2: Product comparison
Page 45

CONCRETE BRICKS	CLAY BRICKS
British Standards	
BS EN 771-3: Aggregate Concrete Masonry Units	BS EN 771-1: Clay Masonry Units
<i>Note: Both of the above Standards are manufacturing Standards only and as such make no reference to use or application.</i>	
Compressive Strength	
From 22.5N/mm ² up to and exceeding 50N/mm ² dependent on brick type	Depends on brick type and manufacturer
<i>Note: Both BS 5628: Part 3 and the new PD 6697 :2019 give recommendations for which brick properties are required for various applications and locations.</i>	
Dimensions	
D1: +3-5mm in all dimensions D2: +1-3mm in all dimensions; ±2mm in height D3: +1-3mm in all dimensions; ±1.5mm in height	T1: +1-6mm if the bricks are between 209-221 mm in length T2: +1-4 mm if the bricks are between 211-219mm in length T1: +1-6mm if the bricks are between 59-71 mm in height T2: +1-4mm if the bricks are between 61-69 mm in height
Water Absorption	
Generally 5-9% by weight	Depends on brick type and manufacturer
Composition	
Produced from naturally occurring aggregates, Portland cement, SCM's, various admixtures and synthetic iron oxide pigments. Bricks are through coloured.	Produced from naturally dug materials, frequently blended with other materials. Certain bricks may only have applied faces.
Durability	
Fully frost resistant and with minimal soluble salts	May contain metallic salts such as sodium, potassium and magnesium, and consequently are categorised as either S0 (no requirement), S1 or S2. Under BS EN 771-1 the original FL grade is categorised as F2/S2.
<i>Note: Although produced to a different standard, Marshalls bricks are equivalent to clay class F2/S2</i>	
Acoustic & Thermal Performance	
Highly resistant to sound transmission Moderate rate of thermal conductivity	Depends on brick density and mass
Green Credentials	
Produced using low cement content Minimal heat required during curing Minimal water content used in manufacture CO ₂ emissions are minimal Bricks are 100% recyclable 100% Made in Britain Flexibility in production factories Embodied CO ₂ is low at 145kg/CO ₂ /Tonne	Bricks are dried out prior to firing Kiln temperatures between 700-1100o° and very energy intensive large amounts of CO ₂ are emitted during firing process Frequent imports to subsidise stocks bricks types tend to be unique to specific factories Embodied CO ₂ is high at 213kg/CO ₂ /Tonne

Mortar

A 1:1:6 (mortar designation iii/ compressive strength class M4) is adequate for most facing brick locations. Lime enhanced mortars have more capacity to absorb small degrees of movement and are recommended. This mortar designation allows the location of movement joint centres to be at 7.5 – 9.0 metres or greater depending on openings and other factors.

Higher strength mortars i.e 1:½:4-4½ (mortar designation ii, strength class M6) can be used in conjunction with facing bricks, where exposure and conditions dictate.

Higher strength mortars are more typically used for higher strength specification, such as with engineering brick applications.

This may also require sulphate resisting properties for ground sulphate conditions.

Workability/consistency of the mortars should be adjusted to accommodate the density and absorption of the bricks. Ready to use tubbed or silo based mortars should be used in accordance with the suppliers' recommendations whenever possible.

Use below DPC

All facing bricks, engineering bricks, dense coursing bricks and most common bricks* are suitable for use below and within 150mm of damp courses as well as in superstructures. Lightweight coursing bricks should not be used in these locations.

Brick bonds

Although normal stretcher bond is the most common, alternative bond patterns are also available if a more decorative appearance is required. Some of these bonds demand the more prevalent use of headers and it is recommended that the designer discusses this with the Marshalls sales staff prior to specification. Bonding patterns should be maintained at openings - broken bonds increase the risk of cracking.

Cavity insulation

The *BRE Good Building Guide, GBG44, Part 2, Table 3* details the maximum recommended exposure zones for various types of insulated walls. For facing masonry walls, eg. facing bricks with tooled flush joints, the maximum recommended exposure zone for built in cavity fill is Zone 3. For exposure zones greater than this then full cavity fill is not recommended.

Site guidance

Detailed guidance on the practical use of Marshalls concrete bricks is provided in BTB1 'Good Site Practice Guide'.

Please refer to:

↗ BTB4:
Mortars for concrete masonry products
Page 50

↗ BTB1:
Good site practice guide
Page 41

References:

* Refer to relevant datasheet for suitability of common brick types



The information and guidance contained in our Technical Bulletins, Technical Data Sheets and Technical Manual are regularly reviewed as part of Marshalls Bricks & Masonry's continuous development and improvement programme. Updates and amendments can be made without notice and the Company cannot accept liability for any errors or omissions. The content of this document and the referenced data sheets and bulletins, including tables, diagrams and images, are subject to copyright.

Appendices.

Supporting information

↘ Select a link below to jump to any section or page.

Appendix 1: Brick Technical Data Sheets

- BTDS 1: Facing bricks
- BTDS 2: Engineering quality concrete bricks
- BTDS 3: Dense & lightweight coursing bricks
- BTDS 4: Dense concrete common bricks
- BTDS 5: Special bricks

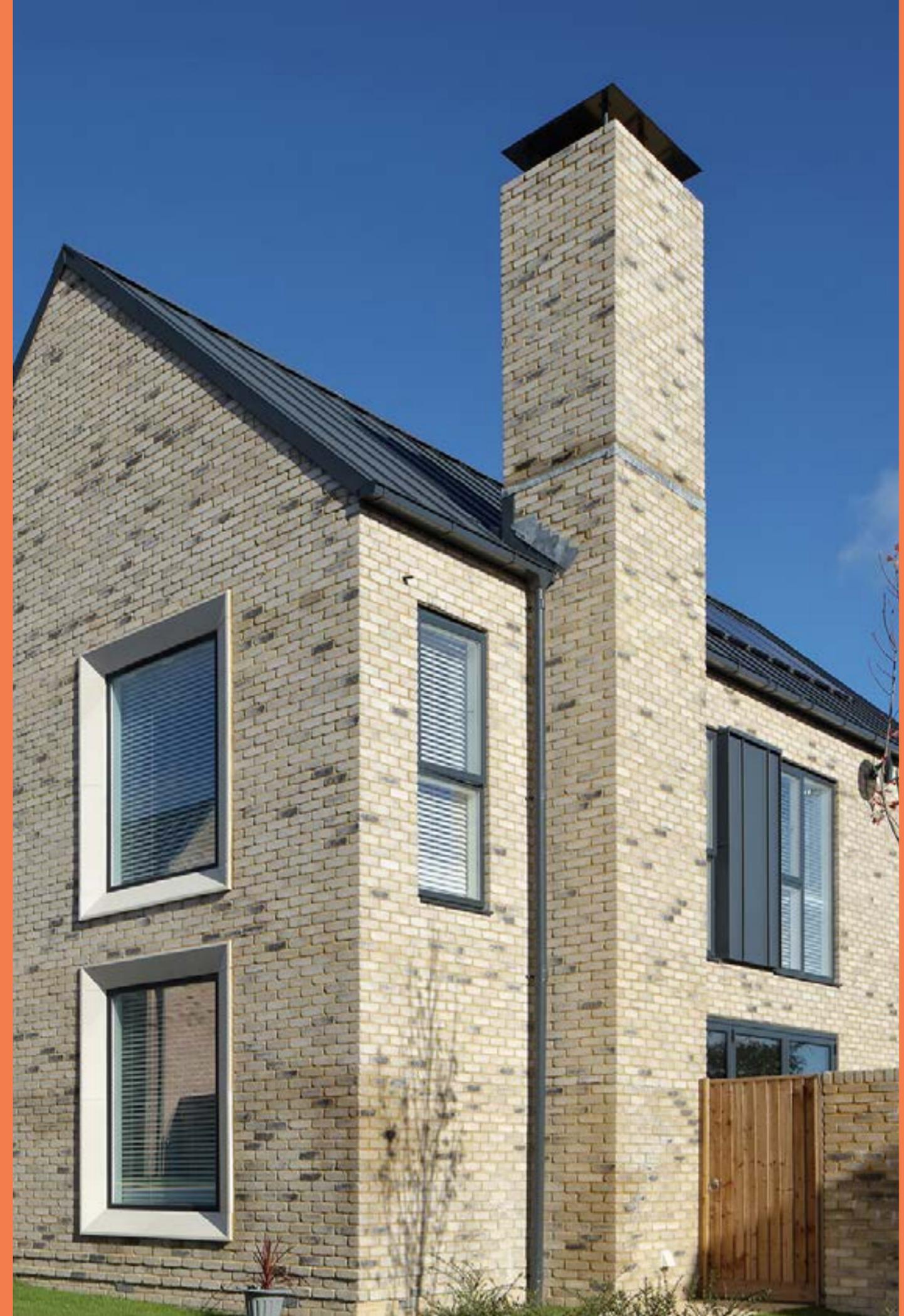
Appendix 2: Brick Technical Bulletins

- BTB 1: Good site practice guide
- BTB 2: Product comparison
- BTB 3: Environmental characteristics
- BTB 4: Mortars for concrete masonry products
- BTB 5: Movement control
- BTB 6: Durability
- BTB 7: Efflorescence and colour integrity
- BTB 8: Cleaning, maintenance and repair
- BTB 9: Resistance to rain penetration
- BTB 10: Coursing brick applications
- BTB 11: Concrete engineering quality bricks
- BTB 12: Using Marshalls bricks with dissimilar materials
- BTB 13: Fire resistance
- BTB 14: Sound insulation

BTB 15: Thermal insulation

Appendix 3: Health & Safety Data Sheets

- HSDS 1: Product hazards
- HSDS 2: Safe loading, transit & off-loading of products
- HSDS 3: Product data COSHH sheet



Appendix 1.

Brick Technical Data Sheets

BTDS 1

FACING BRICKS

Marshalls facing bricks provide an attractive appearance and may be used for the majority of forms of external and internal construction.

They are available in a wide range of mono and multi colours, from white to blue, and in a variety of different textures including Sandfaced, Textured, Stock, Shotblasted, Vintage Stock and Creased and Vintage Creased.

Facing bricks are manufactured by blending selected dense aggregates and colourfast iron oxide pigments with Portland cements. Their low porosity, frost resistance and age hardening properties make them eminently suitable for use below dpc in foundations, boundary walls and externally above ground level, regardless of the severity of exposure.

Manufacturing Standards

The bricks, which may be perforated, frogged or solid are manufactured and tested in accordance with the requirements of:

BS EN 771-3:2011+A1:2015
Specification for Masonry Units:
Aggregate Concrete Masonry Units.

Facing masonry units intended for use with one or more faces left visible and which may or may not be exposed to external climatic conditions.

Masonry units exposed to external climatic conditions without render or other equivalent protection.

	PERFORATED FACING	FROGGED FACING	SOLID FACING
Appearance	Sandfaced, Creased, Tumbled, Textured	Smooth, Tumbled	Smooth, Textured
Dimensions	215 x 100 x 65mm		
Tolerances	Category D1 (+3-5mm in all directions)		
Configuration	3 vertical perforations	Frogged, one bed face	Solid Facing
Gross dry density	1950kg/m ³ average	2000kg/m ³ average	2200kg/m ³ average
Dry weight	2.3kg – 2.6kg	2.5kg – 2.7kg	2.8 - 3.1kg
Compressive strength	>22.5N/mm ² mean. Air dry		
Thermal conductivity	1.11 W/mK (dry); 1.24 W/mK (@3%); 1.33 W/mK (@5%)		
Durability	Based on tabulated values from PD 6697:2019 facing bricks are classed as frost resistant with minimal salts		
Water absorption by capillarity	<85g/m ² /s0.5		
Water absorption by weight	5-9% after 24 hours		
Moisture movement	<0.6mm/m		
Water vapour	5/15μ (Tabulated from EN 1745)		
Reaction to fire	Euroclass A1		
Shear bond strength	0.15N/mm ² (Tabulated from EN 998-2: 2003, Annex C)		
Built wall weight (100mm wide)	175kg/m ² unplastered single leaf wall	189kg/m ² unplastered single leaf wall	215kg/m ² unplastered single leaf wall
Green guide rating	A+		
Presentation	Self-contained packs, stretch hooded bagged to non-returnable pallets. Pack size determined by brick type and manufacturing site		

Note: As many of these products are made to order for specific markets, please obtain further details on specification, product availability, pack sizes and weights from the Bricks & Masonry sales team on 01633 600 806.

BTDS 2

ENGINEERING QUALITY CONCRETE BRICKS

Marshall's Engineering Concrete Bricks are durable and high strength, specially manufactured to accommodate high loads and cope with exposure to aggressive ground conditions.

Made from selected dense aggregates and a choice of cements, the bricks, which exhibit low porosity and high dimensional accuracy, are completely frost resistant and suitable for use below ground where natural sulphates, up to and exceeding Class 3 levels, are present.

Engineering bricks are available in solid and perforated formatP

Please refer to:

BTB 11:
Concrete engineering bricks
Page 73

Manufacturing Standards

Tested in accordance with the requirements of:

BS EN 771-3:2011+A1:2015 Specification for Masonry Units: Aggregate Concrete Masonry Units and meet the criteria for strength, durability and sulphate resistance as detailed in **BS 5628-3:2005** and **PD 6697:2019** and other Standards.

Application	Can be used: below d.p.c; for inspection chambers; manholes; catch pits containing surface water or foul drainage and for earth retaining walls.
Appearance	Red or Blue – close texture. Colour consistency not guaranteed.
Dimensions	215mm x 100mm x 65mm Tolerances Category D1 (+3-5mm in all directions).
Configuration	Solid or perforated.
Composition	Dense aggregate and blended cements, with a minimum cement content of 360kg/m ³ . Both types of engineering bricks have been surface carbonated in accordance with BRE Special Digest 1:2005, Concrete in Aggressive Ground Conditions: Part F5.
Dry density	Average 2200kg/m ³
Dry weight	Solid: 3.1kg - 3.3kg approximately. Perforated 2.6kg - 2.9kg approximately.
Compressive strength	>50N/mm ² mean. Air dry.

Note: Under the standards BS EN 771-1:2011: Clay Bricks and BS EN 771-3:2011+A1:2015: Concrete Masonry Unit, the test method for measuring compressive strength has been amended. This results in higher strengths being achieved but with no inherent alteration in the fundamental properties of the product. Engineering Concrete Bricks harden with age and a standard 50N/mm² brick will perform in a similar manner as regards durability to a Clay Class B.

Thermal conductivity	1.24 W/mK (Dry); 1.24 W/mK (@ 3%); 1.33 W/mK (@ 5%)
Durability	Engineering Concrete Bricks comply in all respects to the standards required by BS 5628: 2005, the NHBC, the Highways Agency, the Water Research Council and the Department of Transport. They are suitable for use in sulphate soil conditions up to and including DS-1, DS-2 and DS-3. The engineering brick may be suitable up to DS-4 conditions subject to satisfying the other criteria laid down in the relevant BRE Special Digest. Neither engineering brick is suitable for use as an actual damp proof course. Neither engineering brick, nor the mortar, is resistant where high levels of acid are present and degradation will occur to varying degrees dependant on the pH levels as shown below: *pH 6.5-5.5 - slight degradation *pH 5.5-4.5 - severe degradation *pH < 4.5 - very severe degradation.
Water absorption by capillarity	<45g/m ² /s0.5. Average water absorption <7%. Engineering bricks are required to have a water absorption of less than 7%. This traditional test method is measured by a different test to that of water absorption by capillarity.
Moisture movement	<0.6mm/m
Water vapour permeability	5/15μ (Tabulated from EN 1745)
Reaction to fire	Euroclass A1
Shear bond strength	0.15N/mm ² (Tabulated from EN 998-2: 2003, Annex C)
Green guide rating	A+
Presentation	Self-contained packs, shrink-wrapped in most instances to non-returnable pallets.

BTDS 3

DENSE AND LIGHTWEIGHT COURSING BRICKS

Marshall's coursing bricks are designed to be used in all types of construction in conjunction with dense aggregate or lightweight aggregate concrete blocks.

The 140mm width units are particularly suitable for use in the inner leaf of three storey buildings and party walls (Ref, Parts A and E of the Building Regulations) in addition to the requirements of **BS 8103-1:2011**, 'Structural Design of Low Rise Buildings'.

For lightweight bricks the specially selected aggregates used in the manufacturing process provide density, strength and thermal conductivity values that are comparable with the majority of lightweight aggregate blocks having a density range of 1000-1500kg/m³. Lightweight bricks should not be used in conjunction with autoclaved aerated blocks.

Good quality coursing bricks age harden and dense coursing bricks, with an average compressive strength of 22.5N/mm², will resist freeze-thaw cycles. Lightweight bricks should only be used on inner leaves and should be protected from prolonged frost or snow.

Manufacturing Standards

The bricks, which are solid, are manufactured and tested in accordance with:

BS EN 771-3:2011+A1:2015: Specification for Masonry Units: Aggregate Concrete Masonry Units.

	DENSE BRICKS	LIGHTWEIGHT BRICKS
Appearance	Greyish colour with variable texture. The colour may vary depending upon the supplying works. No guarantee can be given in respect of colour or texture consistency	
Dimensions	215mm x 100mm x 65mm / 215mm x 140mm x 65mm 380mm x 100mm x 45mm / 215mm x 100mm x 40mm	215mm x 100mm x 65mm / 215mm x 140mm x 65mm
Tolerances	Category D1 (+3-5mm in all directions)	
Configuration	Solid (no frogs/perforations) Bricks can be supplied with a textured face for render situations as required by the NHBC Standards (Chapter 6.1 – D15(d))	
Composition	Selected dense aggregates and Portland cements. A certain amount of recycled aggregate may also be included in the mix	Selected lightweight aggregates and Portland cements. A certain amount of recycled aggregate may also be included in the mix
Dry density	Average 2100kg/m ³	Average <1500kg/m ³
Dry weight	100mm: 3.1kg / 140mm: 4.1kg	100mm: 2.0kg / 140mm: 2.8kg
Compressive strength	Average 22.5N/mm ² mean	Average 10N/mm ² mean
Thermal conductivity	Protected: 1.24 W/mK / Exposed: 1.33 W/mK	Protected: 0.39 W/mK / Exposed: N/A
Durability	Based on tabulated values from BS 5628-3 and PD 6697 dense coursing bricks are classed as frost resistant. Lightweight bricks should only be used on internal walls and the inner leaves of cavity walls above dpc level where there is no risk of freezing	
Water absorption by capillarity	50-150g/m ² /s0.5	
Water absorption by weight	8-16%	
Moisture movement	<0.45mm/m	<0.90mm/m
Water vapour permeability	5/15μ (Tabulated from EN 1745)	
Reaction to fire	Euroclass A1	
Shear bond strength	0.15N/mm ² (Tabulated from EN 998-2: 2003, Annex C)	
Built wall weight (100mm wide)	200kg/m ² Unplastered Single Leaf Wall	150kg/m ² Unplastered Single Leaf Wall
Green guide rating	A+	
Presentation	Self contained packs, shrinkwrapped in most instances to non-returnable pallets in packs of 384, 448 and 512 No. bricks.*	
Applications	Making up courses in blockwork As reveals, jambs and window heads To eliminate cutting on site	As padstones on top of hollow blocks As kicker units to bring blockwork to wall height

* Pack size is dictated by product/manufacturing site

BTDS 4

DENSE CONCRETE COMMON BRICKS

Marshalls dense concrete common bricks are designed to be used for all types of construction above and below dpc level, independently or in conjunction with dense aggregate concrete blocks.

The specially selected dense aggregates used in the manufacturing process provide density, strength and thermal conductivity values, which are compatible with the majority of dense concrete blocks.

In addition to their ability to withstand repeated cycles of attack from rain and frost, good quality dense concrete bricks age harden, and throughout independently controlled laboratory experiments, the bricks passed the most rigorous freeze-thaw tests designed to establish the durability classification for masonry.

The bricks, which may be solid, frogged, or perforated, are manufactured and tested in accordance with **BS EN 771-3:2011+A1:2015 Specification for Masonry Units: Aggregate Concrete Masonry Units**.

As stated in this Standard they can be defined as common masonry units normally intended for use with no faces left visible.

Manufacturing Standards

Tested in accordance with:

BS EN 771-3:2011+A1:2015 Specification for Masonry Units: Aggregate Concrete Masonry Units. As stated in this Standard they can be defined as common masonry units normally intended for use with no faces left visible.

	SOLID COMMON	FROGGED COMMON	PERFORATED COMMON
Appearance	Colour and finish may vary depending on the supplying works. No guarantee can be given in respect of colour or texture		
Dimensions	215 x 100 x 65mm	215 x 100 x 65mm / 215 x 100 x 73mm	215 x 100x 65mm
Tolerances	Category D1 (+3-5mm in all directions)		
Configuration	Solid, no voids or frogs	Frogged, one bed face	3 vertical perforations
Composition	Dense aggregates and Portland Cements may include recycled material		
Dry density	2000kg/m ³ – 2150kg/m ³	1850kg/m ³ – 2000kg/m ³	1850kg/m ³ – 2000kg/m ³
Dry weight	2.9kg – 3.1kg	2.4kg – 2.7kg	2.4kg – 2.7kg
Compressive strength	>22.5N/mm ² mean. Air dry		
Thermal conductivity	1.24 W/mK @ 3% / 1.33 W/mK @ 5%		
Durability	Based on Table 15 of PD 6697:2019 common bricks are classed as frost resistant and suitable for use below or near external ground level with a high risk of saturation and freezing		
Water absorption by capillarity	<85g/m ² /s ^{0.5}		
Water absorption by weight	6-9% after 24 hours		
Moisture movement	<0.60mm/m		
Water vapour	5/15μ (Tabulated from EN 1745)		
Reaction to fire	Euroclass A1		
Shear bond strength	0.15N/mm ² (Tabulated from EN 998-2: 2003, Annex C)		
Built wall weight (100mm)	190kg/m ² unplastered single leaf wall	180kg/m ² unplastered single leaf wall	175kg/m ² unplastered single leaf wall
Green guide rating	A+		
Presentation	Self contained packs, shrinkwrapped in most instances to non-returnable pallets, or void packed and shrinkwrapped, depending on supplying works		

Note: All products are manufactured and supplied in accordance with the relevant standard with the exception of Regrade/Mixed Commons that carry no warranty on their performance or suitability.



BTDS 5

SPECIAL BRICKS

The Marshalls range of facing bricks is supported by a range of standard matching specials produced to the profiles demonstrated in **BS 4729:2005** (bricks of special shapes and sizes) This Technical Data Sheet is only intended to show some of the most popular sizes and shapes. Many other complementary and striking shapes can be manufactured to meet bespoke requirements.

Please note that certain specials are only available in a Smooth finish, whilst others are produced in both Smooth, Textured, Creased and Sandfaced finish. Please consult your local Marshalls Sales Office for details.

Due to the particular method of production of special bricks it is important that adequate notice is given before delivery can commence. Your local Marshalls Sales Office can quote delivery times.

Special bricks can be provided by either cut and bond, cut and reface, or handmade bespoke bricks.

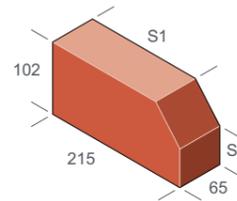
The drawings show some of the basic shapes of the units and their principal dimensions. Where sizes or angles have to be specified, please contact your local Marshalls Sales Office for details of availability.

Note:

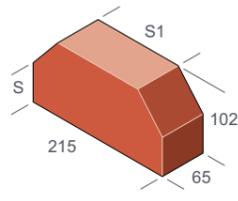
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- S1: Specify Dimension
- R: Specify Radius
- A: Specify Angle

Some of the basic shapes we manufacture and their principal dimensions

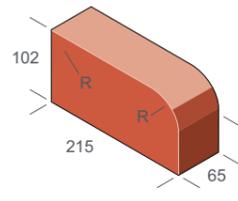
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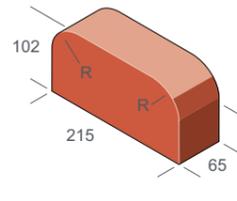
AN6 Double Cant



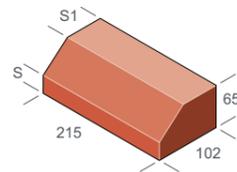
BN1 Single Bullnose



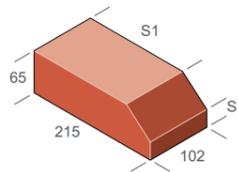
BN2 Double Bullnose



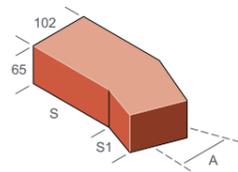
PL3 Plinth Stretcher



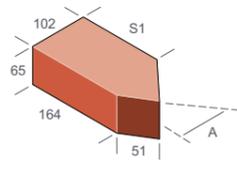
PL2 Plinth Header



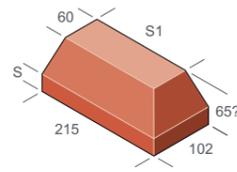
AN3 Internal Dogleg



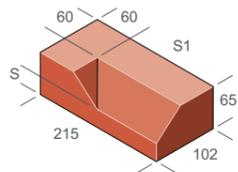
AN1 Squint



PL7 Plinth External Return



PL4 Plinth Internal Return



BTDS 5

SPECIAL BRICKS

As well as a range of 'standard' shapes Marshalls can also offer bespoke units that in addition to aesthetic appeal offer efficiencies in installation (see images below) demonstrating a modular cill unit including 'dummy' joints to maintain the final desired appearance once pointed.





Appendix 2. Brick Technical Bulletins

BTB 1

GOOD SITE PRACTICE GUIDE

Delivery

Marshalls sales offices can advise on load and pack sizes, weights and delivery methods. Please advise the sales offices of any special delivery requirements, site restrictions or delivery time windows at the time of ordering and before deliveries commence.

Storage and handling

Bricks should be stored on sound, level ground and raised clear of wet and muddy areas to prevent contamination and staining. Storage areas should be sited close to the points of work to reduce unnecessary handling and minimise damage and waste.

In each instance, assessments of the ground should be made for the suitability of stacking packs on top of each other. As a guide, unless on solid hard standing, such as solid concrete floors, packs should not be stacked more than three high. On soft or undulating ground, packs should likely be stacked individually, but in any case no more than two packs high.

Whilst on site, and during construction, bricks should be protected from the weather, including the covering of completed but uncapped brickwork. Waterproof coverings should allow circulation of air. These precautions will reduce the likelihood of subsequent lime bloom, shrinkage and movement. Materials used in conjunction with concrete facing bricks should also be stored under protection. Damage and wastage will be minimised by mechanical methods of distribution to the points of work. Facing bricks should be lifted and placed – not thrown and tipped. Selection of bricks should be made by combining from three packs if possible and mixing loads where practical. Bricks should be kept as dry as possible with opened packs and bricks that are stacked out on site fully protected from the weather.

Sample panels

The construction of a sample panel for major projects is good practice and strongly recommended by Marshalls. Ideally, a sample reference panel should be constructed on site using the delivered product, laid in the normal way, and not using specially selected product. It should be recognised that facing bricks and walling products are defined as having an acceptable colour, finish and texture, but like a large proportion of building materials they can suffer from a certain degree of variation and damage through the build process.

Laying, bedding and jointing

Building with Marshalls bricks should pose no more problem than using any other masonry material. The accurate dimensions and regularity of size will help with the laying out and maintenance of brick courses. Bricks should be dealt with in the same way as dense concrete blocks, reconstructed or natural stone. The number of courses achievable per day should be between 16 and 20, provided dry bricks are used and mortar consistency is adjusted to suit brick suction. In accordance with BS 8000-3 the height of lifts should not exceed 1.5 metres or 20 courses per day.

Frogged bricks should be laid frog up. Marshalls bricks should NOT be wetted before laying. The workability/consistency of the mortar should be adjusted to take into account the weight and suction of the bricks. Marshalls bricks have a low to medium absorption and tend to shed water towards the mortar joints. Failure to fill the perpendicular joints in particular can lead to excessive water ingress into the cavity.

The specified joint profile should be formed after leaving the mortar to harden slightly. Tooling is recommended to compact the joints, improve weather resistance and reduce shrinkage in the mortar. Recessed or flush pointing is not recommended in areas of high exposure.

Do not lay bricks when the temperature is at or below 3°C or when freezing may occur after the mortar has hardened. Wall ties should be placed at normal locations, except around movement joints where additional ties may be necessary. Ties should be positioned within 225mm either side of the opening or joint and at vertical centres not exceeding 300mm. Alternatively flat ties may be inserted across the joint provided one end of the tie is unbonded.

Bed joint reinforcement

Bed joint reinforcement (BJR) may be used to control stresses within the brickwork and in certain instances can be used to extend the distances between movement joints.

We would suggest a structural purpose reinforcement, however, consultation with an approved engineer is recommended.

Bonding

Bonding patterns should be maintained at openings. Broken bonds increase the risk of cracking. Where special details are required at openings Marshalls can supply a full range of standard or bespoke special bricks to suit each design.

Note:

In part, these notes are extracts of more comprehensive details demonstrated from our Brick Technical Bulletins that follow and are also available on our website.



Cavities

Both leaves of a cavity wall construction should rise simultaneously. Cavities must be kept clean to reduce the risk of cold bridging or water reaching the inner leaf. Cavity trays over openings should incorporate stop ends to prevent water over-run during severe weather.

Weep holes

Weep holes should be provided wherever there is extensive bridging of the cavity, eg. at lintels, cavity trays and floor slabs. Weep holes are recommended at the rate of every third perpend (675mm centers).

Wall ties

The selection of wall ties should be made in accordance with **PD 6697: 2019, Section 6.2**. Tables 9 to 12 give guidance on the selection of ties for normal use and refer to exposure zone, cavity width and type of structure. Wall ties should be simultaneously incorporated into both leaves as the work progresses and be embedded not less than 50mm into each leaf. The ties should have the drip located centrally within the cavity and facing downwards. Ties should fall towards the outer leaf to prevent any tracking of moisture towards any partial cavity insulation or the inner leaf.

The density of ties (number of ties per square metre) should be in accordance with **BS EN 1996-1-1: 2005** and they should be evenly distributed except around openings where, at vertical edges (for example movement joints), additional ties should be used at a rate of one tie per 300mm height. These should be placed not greater than 225mm from the edge.

Damp proof courses

Materials should conform to the relevant British Standard referenced in **Table 1 of PD 6697: 2019**. Damp proof material must be of the correct width so that it fully covers the leaf thickness. Damp courses should be fully bedded in mortar and have an overlap of at least 150mm.

In certain instances where a slip plane is required, two layers of joint material may be laid on top of each other, but the effectiveness of this depends on the type of material used and the loads imposed upon it. Reputable manufacturers can give further advice. If a slip plane is to be provided, then other means of maintaining structural stability, such as extra wall ties, should be installed.

Mortar

An M4 or equivalent mortar is adequate for most locations. Further details for specific locations are given in **Table 15 of PD 6697: 2019** or by reference to Marshalls.

Lime enhanced mortars have more capacity to absorb small degrees of movement and are recommended. This mortar category allows the location of movement joints to be at 7.5-9 metre centres depending on window openings and other factors. Workability should be adjusted to suit the density and absorption of the brick. Approved admixtures may be used to improve the workability. Retarded or silo based mortars should be used in accordance with the suppliers' recommendations.

Cutting and chasing

Cutting can be done by bolster, mechanical saw or hydraulic guillotine. On facing work mechanical means should be adopted to preserve a true arris. Wet cutting will help to maintain the appearance of the bricks, but if this method is used the bricks should be hosed down immediately after cutting and dried prior to laying. Chases generally should not exceed one-third of the thickness of the wall in vertical chasing and not be deeper than one-sixth of the wall in horizontal chasing. Timber laths should be used as guides when using mechanical means. Goggles and dust masks should always be used when chasing concrete bricks.

Brick finishes

The choice of brick with their different finishes can have an effect on the final brickwork appearance and the following comments should be considered.

Sandfaced (smooth) bricks have one finished stretcher and two finished header ends.

The non-faced stretcher to the creased, sandfaced and textured brick is marked and care should be taken to lay the brick in the correct orientation.

These back marks can either be in the form of rebates or scratches.

Sandstock and Vintage Sandstock bricks, which are frogged, have finished faces on four sides.

Final brickwork appearance is a matter of agreement between the specifier or user and the supplier and may vary depending on the use to which the bricks are to be put.

Sample panels are recommended to be built between 1 to 1.5 square metres in size. Viewing of these panels should be made from a distance of at least 3 metres.

The brickwork should be examined as a whole rather than just viewing individual bricks. Some degree of damage may be inevitable on an individual brick, depending on the brick type and subsequent site handling, but generally speaking bricks are required to be reasonably free from deep or extensive cracks and damage to edges and corners. However, it is generally accepted that all facing bricks may have some form of chipping and the industry accepted standard is that no individual chip should be greater than 15mm.

An added benefit of Marshalls bricks is that they are through coloured and hence any chips may be less apparent than an applied face brick.

Please refer to:

 **BTB 4:**
Mortars for
concrete masonry
products
Page 50

Completed brickwork review

As with any bricks there is a risk of chipping when handled on site. Appendix D of **BS 5628-3:2005**, requires facing bricks to be reasonably free from deep or extensive cracks and damage to the edges and corners.

The accepted industry standard is that no individual chip should be greater than 15mm in diameter and that the whole wall panel should be viewed from a distance of not less than three metres.

The range of Marshalls bricks, with their different finishes, can have an effect on the final brickwork appearance.

Movement control

For general movement control, measures should have been catered for by the designer and if not indicated on drawings it is advisable to raise this omission with the designers prior to work commencing. Marshalls recommendations, derived from those given in **BS 5628-3:2005** and **PD 6697:2019**, together with the experience of the technical and performance characteristics of the product, are detailed as follows. This guidance is endorsed for Marshalls bricks by warranty schemes including NHBC, Local Authority Building Control (LABC) and Checkmate.

- Ensure that bricks are kept as dry as possible whilst storing and stacking out. Bricks should not be wetted before laying and incomplete brickwork should be protected from rain and snow.
- Ensure the correct grade of mortar is specified and used. An M4 Class mortar is generally most appropriate but be aware that stronger mixes which utilise a CEM I rather than a CEM II cement may not accommodate movement as well.
- In most cases movement joint centres of between 7.5 to 9 metres in two storey and above type dwellings should be adequate, but shorter distances may be needed for single storey buildings. The length/height ratios of brickwork panels should not exceed 3:1.
- Particular care should be taken with openings greater than 1.2 metres, especially if they are placed directly above each other, eg. the panel profile between a ground floor opening and a first floor window may be less than 3:1 but they are relatively slender and can be subject to stresses from larger areas of brickwork adjacent to the openings. In these cases bed joint reinforcement should be introduced above the ground floor opening and below the first floor window. Note, whilst bed joint reinforcement will assist in the prevention of potential cracking, it is not a complete alternative to the provision of movement joints which should be installed in the appropriate locations.
- For openings where there are only a few courses of bricks above or below the openings then crack inducers, in the form of raked joints which have been filled with mastic, should be considered at the ends of the openings.
- A large proportion of movement joints when using concrete bricks can be simple contraction joints, but south facing elevations, particularly those built with dark coloured bricks, may require full compressible joints to accommodate thermal movement.
- In elevations which consist of block and render and concrete bricks then any movement joints should follow through both materials.
- Movement joints at short returns can frequently be installed as butt joints incorporated into the corner, with the longer leg abutting the shorter return.
- Placing vertical movement joints in locations where lateral support from party walls or internal load bearing partitions exist will assist in the stability and resistance to wind loading.
- Avoid mixing dissimilar materials that have different levels and types of movement characteristics, eg. concrete (shrinkage) v. clay (expansion). Bricks made using limestone aggregates, such as those produced by Marshalls, will generally have lower moisture movement values than bricks made with gravel/sand type aggregates.
- Shrinkage cracks tend to be mainly cosmetic and do not normally affect the integrity of a structure.

Please refer to:

 **BTB 5:**
Movement control
Page 53

BTB 1

GOOD SITE PRACTICE GUIDE

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Prevention of efflorescence

The phenomenon of efflorescence or lime bloom in all concrete products is derived from the leaching of free calcium ions which are present in solution during the hydration of the cement matrix within the bricks. As the calcium ions migrate to the surface of the brick they crystallise on the surface and are exhibited as a milky white deposit. However, due to the above potential problems, Marshalls has developed systems which involve the incorporation of advanced additives both within and on the surface of the brick. The amount of efflorescence emanating from Marshalls bricks can thus be classed as minimal.

Although the bricks can be classed as having minimal efflorescence this can still occur if good site practice and laying procedures are not followed.

The most common causes are:

- Poor building practice, such as partially built walls being left exposed to rain.
- Poor storage of bricks on site, both once packs have been delivered and also once packs have been broken down and bricks have been stacked out ready for building. Marshalls bricks need to be kept dry.
- Poorly designed or missing copings and flashings.
- Failure to protect incomplete brickwork at the end of the working day. It must be remembered that mortar is rich in cement and whilst in its uncured state it is extremely susceptible to water leaching out the lime within it.

Plastering and rendering

Any areas of concrete common brickwork that are to be rendered or plastered should have raked joints to form a key for the specified finish. For optimum adhesion a plaster bonding coat or similar should be applied. A spatterdash coat may be necessary for good adhesion and if so this should be 1:2:3 parts cement:sand, applied before the undercoat. On concrete masonry the render coat should be 1:1:6 (this is referring to 3 elements not 2 as above) or equivalent, using clean sand. In all cases of two or three coat rendering the final coat should be a weaker mix than the undercoat or the same mix but thinner.

Painting

Smooth faced bricks are suitable for painting with emulsion or alkali resisting paint, especially plastic emulsions. Brickwork should be dry and free from dust, lime bloom, grease and other detritus. Oil based paints should be avoided.

Cleaning down

Concrete facing bricks can be described as a 'low maintenance' building material. However, there are simple precautions that should be taken to ensure the long term attractiveness and ability to perform the required function. These involve:

- Ensuring the masonry remains weatherproof.
- Ensuring adequate design and detailing of protruding elements.
- Prevention of the possibility of mortar smears and efflorescence by good site practice.

Given the above is carried out, then the amount of cleaning down should be minimal.

Repairs

One of the many advantages of Marshalls bricks is their through colour which enables any repairs on chips or damage to be carried out in a reasonably discrete manner.

Winter working

Marshalls bricks are supplied in stretch hood/shrink wrapped packs which should remain sealed until such time as they are required. Once opened packs should be kept protected, as should incomplete or fresh brickwork. Stacked out bricks on scaffolding should also be fully protected. Overnight, or whenever rain interrupts bricklaying, the top of newly laid walls should be protected. Bricklaying should cease when the temperature is below 3°C and falling or when frost is imminent. Brickwork and mortar dry out more slowly when cold and mortar takes more time to cure, hence it is important that adequate protection is given to the wall until the mortar has developed enough strength to resist frost attack.

Waste disposal

Marshalls bricks are completely inert and may be crushed and recycled as aggregate or inert fill. All packaging, which may consist of polythene covers, plastic strapping and wooden pallets or skids, is recyclable. If burnt, however, they may release smoke and fumes, which if inhaled in sufficient quantities can be injurious to health.

Please refer to:

➤ **BTB 7:**
Efflorescence and colour integrity
Page 64

➤ **BTB 8:**
Cleaning, maintenance and repair
Page 66

BTB 2

PRODUCT COMPARISON

Page 1 of 3

This Technical Bulletin details the comparison between Marshalls concrete bricks and clay bricks. Historically there was also a third type of brick used in the British Isles, namely the Calcium Silicate or Sand Lime brick, but as these are no longer produced in this country they have been ignored for comparison purposes.

British Standards

Concrete bricks are produced to **BS EN 771-3: 2011+A1 2015 Aggregate Concrete Masonry Units**. This replaced **BS 6073-1:1981** and **BS 6073-2:2008**. Clay bricks are produced to **BS EN 771-1: 2011+A1 2015 Clay Masonry Units**. This replaced **BS 3921**.

Both standards for concrete masonry and clay units specify the characteristics and performance requirements for both products but do not give any reference to their use or application. This is covered generally by **BS 5628-1:2005: Code of Practice for Walling**, now replaced by a new Standard **PD 6697:2019** and other Codes and Standards.

Compressive strength

Marshalls bricks have a minimum compressive average strength of 22.5N/mm², increasing where required to 50N/mm². Concrete bricks continue to gain strength with age.

Clay bricks vary in strength, depending on type, with a typical strength range of 15-90N/mm². There is no strength gain with clay bricks.

Strength and cement content are indicative of durability in Marshalls bricks, whereas in clay bricks strength is a function of the constituent raw material and firing technique. For example, in **PD 6697:2019** the minimum strength requirement for use in a typical external wall above and below dpc requires a concrete brick of 22.5N/mm², whereas a clay brick has to be selected from one with the preferred frost resistance and soluble salts content.

Dimensions

The tolerances on concrete bricks are broken down into three categories:

- **D1:** +3-5mm in all dimensions
- **D2:** +1-3mm in all dimensions; ±2mm in height
- **D3:** +1-3mm in all dimensions; ±1.5mm in height
- Clay brick tolerances are:
 - **T1:** +1-6mm if the bricks are between 209-221mm in length
 - **T2:** +1-4mm if the bricks are between 211-219mm in length
 - **T1:** +1-6mm if the bricks are between 59-71mm in height
 - **T2:** +1-4mm if the bricks are between 61-69mm in height

Fundamentally concrete bricks, because of their manufacturing method, tend to be produced to finer tolerances than clay bricks. Marshalls bricks are produced and certified to D1 category.

Durability

Durability in the form of frost resistance and soluble salts content in concrete bricks is a function of the compressive strength and mix design. Independent tests that have been carried out by the Building Research Establishment and other approved Testing Laboratories have confirmed that concrete bricks are frost resistant (equivalent to clay F2 category) in most locations. They may not however be resistant to de-icing salts or certain situations experiencing high wear or high acid environments.

Further tests show Marshalls bricks to have a minimal soluble salts content and the admixtures used both within the mix and on the surface of certain facing bricks ensure that bricks have minimal efflorescence.

By contrast clay bricks may contain metallic salts such as sodium, potassium and magnesium, and consequently are categorised as either S0, S1 or S2. These define the maximum level of soluble salts.

Under the more recent **BS EN 771-1: 2011+A1 2015** the old original FL grade is now categorised as F2/S2. There is no such requirement for concrete bricks and they can be classified as being equivalent to F2/S2.

Manufacturing Standards

Concrete bricks are produced to:
BS EN 771-3: 2011+A1 2015: Aggregate Concrete Masonry Units.
This replaced:
BS 6073-1:1981 and BS 6073-2:2008

Clay bricks are produced to:
BS EN 771-1: 2011+A1 2015: Clay Masonry Units.

This replaced BS 3921.

Composition

Marshalls bricks' are manufactured by compacting under a combination of high pressure and vibration a semi-dry mix of naturally occurring aggregates, portland cements, SCMs, various admixtures, and synthetic iron oxide pigments. The bricks are through coloured. This gives the major advantage that any small chips or damage will be predominantly the same colour as the main face of the brick.

Clay bricks are also produced using naturally dug materials, frequently blended with other materials and they are then fired in kilns. Certain bricks may only have applied faces and the body of the brick may be different from that of the applied face.

Water absorption and weathering resistance

The standard for concrete bricks requires a moisture absorption by capillarity test, and results are given in the relevant Product Data Sheets. This test has superseded the more traditional 24 hour water absorption test, the results of which are also shown in the individual Product Data Sheets.

The water absorption test approach is different for concrete bricks compared with that, for example, of clay bricks, but the requirements are there for different reasons. For clay bricks the test is primarily related to mortar adhesion and frost resistance, the former being important in cases of minimal or excessive suction from the mortar before it has had a chance to cure, and the latter to ensure that the correct type of brick is used in exposed conditions. A high absorption brick of low strength may be susceptible to frost attack.

With concrete bricks a low-medium absorption is important to inhibit the absorption of surface dirt whilst at the same time giving sufficient suction to allow the mortar bond to develop properly. Marshalls bricks are unique in that they contain certain specialist additives which not only maintain the overall appearance but also inhibit any potential efflorescence. At the same time the continuous ageing of Marshalls bricks means the absorption reduces over time whilst the bricks still increase in strength, resulting in excellent durability characteristics.

Acoustic and thermal properties

Concrete bricks tend to have a higher density than clay and hence have a higher sound reduction index. This can lead to better degrees of sound attenuation in flanking walls, which may be critical in those properties of lightweight construction.

Conversely, concrete bricks will have a higher value of thermal conductivity than clay bricks. In real terms this will have minimal effect on the U-value of a wall construction due to the degree of secondary thermal insulation necessary to meet Building Regulations.

Green credentials

Marshalls bricks have 'green' credentials, including the following:

- The bricks are manufactured using low cement content, with raw materials sourced generally within 50 miles of the manufacturing works.
- Minimal additional heat is used in the production of the bricks. The natural exothermic reaction of the process provides most of the heat required to cure the product.
- Bricks from the core range of the same colour and texture can be replicated at different works. The core range allows manufacture in a number of locations thus minimising delivery distances and subsequent CO₂ emissions.
- Concrete by its very composition is a CO₂ absorber.
- Water consumption and usage during the whole manufacturing process is minimal.
- CO₂ emissions in the whole manufacturing process are minimal. There is no pre-drying of materials or any firing process.
- Marshalls bricks are recyclable with no deleterious materials present when crushed.
- Marshalls does not need to import bricks to sustain demand.

Clay bricks use a process that starts with materials which have to be extracted, aged, milled and mixed. The bricks are then dried before being fired. Firing temperatures in kilns are between 700-1100°C and the process is very energy intensive. Large amounts of CO₂ are emitted during the firing process and the burning technique can be difficult to control.

Capital costs of introducing extra capacity by the opening of new factories are significantly more than that of an equivalent output factory for concrete bricks.

Clay manufacturers frequently need to import stocks to maintain supply levels.

Comparison table

CONCRETE BRICKS	CLAY BRICKS
British Standards	
BS EN 771-3: +A1: 2015 Aggregate Concrete Masonry Units	BS EN 771-1: +A1: 2015 Clay Masonry Units
<i>Note: Both of the above Standards are manufacturing Standards only and as such make no reference to use or application.</i>	
Compressive Strength	
>22.5N/mm ² available up to 50N/mm ² to special order	Depends on brick type and manufacturer
<i>Note: Both BS 5628 -3: 2005 and the new PD 6697:2019 give recommendations for which brick properties are required in various locations. For example, a minimum strength of 22.5N/mm² is recommended for a concrete brick used above and below dpc.</i>	
Dimensions	
D1: +3-5mm in all dimensions D2: +1-3mm in all dimensions; ±2mm in height D3: +1-3mm in all dimensions; ±1.5mm in height	T1: +1-6mm if the bricks are between 209-221 mm in length T2: +1-4 mm if the bricks are between 211-219mm in length T1: +1-6mm if the bricks are between 59-71 mm in height T2: +1-4mm if the bricks are between 61-69 mm in height
Water Absorption	
Generally 5-9% by weight	Generally 5-9% by weight
Composition	
Produced from naturally occurring aggregates, Portland cement, various admixtures and synthetic iron oxide pigments. Bricks are through coloured	Produced from naturally dug materials, frequently blended with other materials. Certain bricks may only have applied faces
Durability	
Fully frost resistant and with minimal soluble salts	May contain metallic salts such as sodium, potassium and magnesium, and consequently are categorised as either SO (no requirement), S1 or S2 Under BS EN 771-1 +A1: 2015 the original FL grade is categorised as F2/S2
<i>Although produced to a different standard, Marshalls bricks are equivalent to the old clay FL Grade.</i>	
Acoustic & Thermal Performance	
Highly resistant to sound transmission. Moderate rate of thermal conductivity.	Depends on brick density and mass.
Green Credentials	
Produced using low cement content. Limited heat required during curing. Minimal water content used in manufacture. CO ₂ emissions are minimal during manufacture. Bricks are recyclable. No imports. Flexibility in production factories. Concrete bricks sequester carbon dioxide throughout their lifecycle.	Bricks are dried out prior to firing. Kiln temperatures between 700-1100°C and very energy intensive. Large amounts of CO ₂ are emitted during firing process. Frequent imports to subsidise stocks. Brick types tend to be unique to specific factories. Embodied CO ₂ is high at 220kg/CO ₂ /Tonne.

Environmental performance summary

- Marshalls bricks can be considered as a net absorber of CO₂ due to the continuous carbonation of concrete, or to give it a more accurate name, recarbonation, which is the reaction between carbon dioxide gas (CO₂) in the atmosphere, weak atmospheric acid, and calcium oxide. Calcium oxide is an alkaline product of cement which reacts with CO₂ to reform calcium carbonate (CaCO₃) as concrete ages.
- Concrete Bricks are 100% recyclable and suitable for, and indeed are reused as crushed aggregates.
- The aggregates used in the manufacturing process utilise materials that are often classed as a secondary product of quarrying, being a by-product of manufacturing primary clean graded aggregates.
- Most aggregates used are from sources local to Marshalls plants and brick delivery points are typically within 120 miles, therefore reducing the environmental impact and associated carbon footprint.
- Marshalls bricks are manufactured at a number of locations throughout the UK and have reduced environmental impacts compared with imported products.
- The high energy firing of kilns in clay production processes is not required for the curing of Marshalls bricks. We simply use the natural exothermic reaction of the cement with little additional energy input. This means minimal additional natural resources are consumed and overall emissions are reduced.
- Cements used in the production of Marshalls bricks are supplemented by replacement materials such as blast furnace slag. Additionally Marshalls supports UK cement production facilities rather than the high carbon footprint associated with overseas and imported products.

Carbon footprint of Marshalls bricks

Marshalls Bricks & Masonry have produced an Environmental Product Declaration (EPD), offering cradle to gate data for our facing bricks. A copy of the EPD is available to download from the Marshalls website

The embodied CO₂ of dense concrete masonry products is estimated as 84kg/CO₂/Tonne.* This is assumed to be an 'ex works' figure which takes into account the manufacture of the product itself, but not the transportation to site.

On a typical return journey of 160 miles a 44 tonne vehicle carrying 28 tonnes will produce about 8kg/CO₂/Tonne.** Hence the average total embodied carbon content of Marshalls bricks is estimated at 92kg/CO₂/Tonne manufactured and delivered to site.

By comparison clay bricks have an embodied carbon content of 244kg/CO₂/Tonne from quarry to site.***

Taking into account a typical end of terrace house of 31m² floor area using 3840 bricks and assuming 20% openings, the embodied carbon of a clay brick is 2202kg/CO₂/Tonne which over a design life of 100 years equates to 22kg/CO₂ per year.

The equivalent figure for a concrete brick is 1095kg/CO₂/Tonne or 11kg/CO₂ per year over the same design life. Therefore a Marshalls brick has 50% of the embodied carbon content of a clay brick thus halving the overall impact.

The recarbonation or CO₂ absorption characteristics of Marshalls bricks, as described above, can also offset any embodied carbon over the life of a building.

In addition, the slightly heavier mass of a concrete brick can contribute to improved sound reduction from external sources and can also add to the thermal mass of a building.

Finally, with their low cement content, locally sourced aggregates, use of cement replacements and natural exothermic curing regimes, along with local production factories which minimise haulage distances to site, Marshalls bricks are particularly environmentally friendly.

Energy consumption to produce Marshalls bricks

Apart from power used by production equipment, little additional energy is required to manufacture and cure the bricks. Although limited additional heat is utilized, the exothermic reaction of the cement is generally sufficient to cure the bricks to a condition where they can be handled and after that natural curing takes place to age harden the product, a process which continues to take place over the life of the brick.

Downloads:

Available to download from our website:

An Environmental Product Declaration (EPD), offering cradle to gate data for our facing bricks.

An Environmental Policy, CPS4 and Sustainable Development Policy, CPS6.



References:

* Data derived from British Precast Fact Sheet - 'Generic Carbon Footprint of Aggregate Blocks'. (Note: Aggregate blocks and concrete bricks have similar densities and cement contents).

** Data derived from Road Haulage Association Document - 'Carbon Footprint Explained'.

*** Data derived from Brick Development Association Document - 'Sustainability'.

Recyclable materials

All packaging materials, which are mainly in the form of plastic banding, shrink wrapping and/or timber pallets or skids, are responsibly sourced, contain recycled material and are suitable for recycling.

Environmental assessment

As well as having a full set of policies which include; Health and Safety, Quality, Environmental, Equal Opportunities, Sustainable Development, Anti Bribery, Ethical Trading and Corporate and Social Responsibilities, Marshalls is also independently assessed against recognised environmental standards equivalent to ISO 14001.

Environmental issues

The key aspects pertaining to both environmental and sustainability issues are outlined below:

- Concrete brick is 100% recyclable and would be suitable for use as a crushed aggregate. It contains no deleterious salts or materials which could affect their future use. Marshalls recycles almost all in process material wastage during manufacture.
- The key materials used in the production of our bricks are generally from suppliers who are ISO 14001 compliant, demonstrating our commitment to the responsible sourcing of materials.
- Generally our source of raw materials is within the locality of our works and our delivery points are on average within 120 miles of a factory, thus minimising the impact, and associated carbon footprint, of transportation.

- The geographical locations of our factories enable us to supply a similar product from any works to any location within the country with the minimum of haulage. Concrete bricks are not imported.
- Concrete is an inherent CO₂ absorber and a recent article published by the Concrete Centre demonstrates that concrete based homes take advantage of their inherent thermal mass to save a significant amount of energy over their lifetime compared with a lightweight construction.
- Excellent thermal capacity and insulation properties. The mass of concrete adds to the potential for solar gain which evens out variations in temperature within a building. In addition the 'U' values of a typical wall construction using concrete bricks compared to clay is similar (ref. CBA 'U' Value calculations where concrete brick can be substituted for dense aggregate block).

Mortar performance

Mortars must be carefully gauged to the proportions given in the specification. Too strong a mix may lead to cracking through the masonry unit itself, too weak a mix will adversely affect the strength and durability of the mortar. If the sand is dry or saturated the specified volume should be used. If it is damp, it may be necessary to increase the volume to allow for the effects of bulking. In both instances care must be taken to ensure the correct volumes of cement.

- Mortar is provided by either ready mixed mortars or mixed on site from raw materials.
- **Ready mixed mortars:** These are produced either in a dry form in silos or as ready-to-use, retarded mortars supplied and replenished in tubs. Both types are factory batched and hence have guaranteed mix proportions, thus eliminating site mix variations.
- Mortar workability should be adjusted to suit the suction and absorption of the unit.
- The Mortar Industry Association recommends that for silo based mortars the workability should be adjusted on site within the mortar designation. For premixed retarded mortars, which are supplied in tubs, it is important to specify to the supplier that the workability needs to suit masonry units with a low-medium absorption. The correct workability should be specified rather than leaving any retarded mortars for additional time over the retardation value to dry out slightly before use.
- Silo and ready to use tubbed mortar offer higher levels of consistency, however, if site mixing, mortar can be mixed by hand or machine until it has a uniform colour throughout. Note: Shovel mixing of mortars can cause apparent colour changes in the finished masonry, particularly if pigments are included. Shovel mixing often results in weaker mortar than the designed strength due to the difference in the angle of repose of sand and cement.
- **Adhesion:** Good adhesion results from good workability. Sand:Cement mortars tend to be harsh to work and require additional water to achieve workability and this in turn can compromise mortar strength. The addition of lime or proprietary admixtures can improve workability without the addition of extra water.

- Concrete masonry units, including bricks and reconstituted walling tend to have low-medium suction rates and the mortar should be adjusted accordingly.
- **Admixtures:** Waterproofing agents, air extracting agents and pigments may be added to mortars. However their use should be closely controlled as over-dosing can have a negative effect. Washing up liquids and calcium chloride based admixtures should be avoided.

Lime mortars

Lime mortars offer significant benefits in terms of workability, water retention, elasticity, ultimate strength and durability. However, care should be taken, as with all mortars, to protect uncured brickwork from the weather, in particular from the downward percolations of water through the finished masonry. This can lead to calcium carbonate leaching out of both the lime and cement, resulting in unsightly efflorescence staining around the joints which is difficult to remove once cured.

Cold and wet weather working

Laying of masonry products should not be carried out when the temperature is below 3°C and falling.

Number of courses per day

BS 8000-3: 2020 - Workmanship of Building Sites recommends:

'The consistency of the mortar should be adjusted to suit the suction rate of the bricks'; 'All frogged bricks should be laid frog uppermost and the frogs filled with mortar'; and 'The height of lifts should be limited to 1.5m in one day, i.e. equivalent to 20 courses'.

This is readily achievable provided the bricks have been kept dry and the mortar workability is adjusted to suit the suction of the unit and the prevailing conditions.

Manufacturing Standards

To achieve maximum benefit, mortars for use with Marshalls bricks should comply with the following Standards:

BS EN 998-1: 2016 - Specification for Mortar: Part 1 - Rendering and Plastering Mortar.

BS EN 998-2: 2016 - Specification for Mortar: Part 2 - Masonry

These Standards should be read in conjunction with:

BS 5628-3: 2005, PD 6697: 2019, BS 8000-3: 2020 and all other relevant Standards.

Types of mortar

- **Cement: Lime: Sand:** These mortars give good workability, water retention and adhesion. They may be site mixed or pre-batched.
- **Masonry Cement: Sand:** This mortar type is pre-bagged OPC with a fine mineral filler and air entrained plasticiser. Masonry cements, in which a fine filler is lime in a 1:1 ratio, can be used to produce cement:lime and sand mortars.
- **Air-entrained Cement: Sand:** Specialised air-entraining admixtures are introduced to the mix as an alternative to lime to give improved working characteristics. Care should be taken not to overdose on site or to use cheap alternatives such as washing up liquid.

Mortar selection

Mortar should be selected by considering the following:

- Characteristics of the masonry unit.
- Degree of exposure.
- Type of locations of the masonry.
- Structural requirements (Reference should be made to **Table 12 and 13A BS 5628-3: 2005 and PD 6697: 2019**).
- Designed mortars are selected by the producer to achieve particular compressive strengths.
- Prescribed mortars are made in pre-determined proportions as required.

PRESCRIBED MORTARS (BY VOLUME)							
Increasing ability to accommodate movement	Mortar designation	Compressive strength class	Strength N/mm ² at 28 Days	Cement: Lime:Sand with or without air entrainment	Cement: Sand with or without air entrainment	Masonry: Cement: Sand (4)	Masonry: Cement: Sand (3)
	i	M12	12	1:0:1/4-3	-	-	-
	ii	M6	6	1:½:4-4½	1:3-4	1:2½-3½	1:3
	iii	M4	4	1:1:5-6	1:5-6	1:4-5	1:3½-4
↓	iv	M2	2	1:2:8-9	1:7-8	1:5½ -6½	1:4½

Notes:

1. Proportioning by mass will give more accurate batching than by volume, provided bulk densities of materials are checked on site.
2. When the sand proportion is given as, for example, 5 to 6 the lower figure should be used with sands containing a higher proportion of fines.
3. Masonry cement (lime) complies with BS EN 197-1.
4. Masonry cement inorganic filler (other than lime) complies with BS EN 1977-1:2011.
5. BS EN 998-2:2016 - Specification for Mortar: Part 2 - Masonry Mortar has been written using the performance concept, ie. prescribed by minimum strength category. This is a departure from the traditional UK practice which has been primarily based on a prescription (recipe) approach, eg. mix ratio of 1:1:6 by volume.

The recipe approach is based on the producer of the mortar batching the required proportions of materials by volume, whereas the performance concept requires the producer of the mortar to achieve the stated performance, eg. minimum strength, and allows the producer freedom to select the mix proportions and cement types to achieve this.

The impact of this change of specification method with regard to its use with concrete masonry is that the actual performance of the mortar may show different characteristics depending on the local mix design used to achieve the strength grade. For example, a nominal M4 mortar, which is equivalent to the previous prescribed mix ratio of 1:1:6, may have a cement element included which has been made from a CEM I cement, whilst another mix may utilise a CEM II cement which in itself may incorporate either a limestone, PFA or slag filler. Consequently the performance of what is essentially the same grade mortar may be different from site to site or from producer to producer.

The recommendation for the appropriate grade of mortar to use with Marshalls bricks is detailed in this Technical Bulletin but customers should be aware of the possible differences in performance, particularly in its consequent ability to accommodate movement due to the change in specification method detailed above.

The main influence of the changes is that when a stronger mortar strength is achieved it is less accommodating to movement which may result in an increased occurrence of shrinkage/movement cracking than

historically would have been the case. This may, where strengths are considerably higher than those achieved under the recipe approach, be evident in cracking through the brick units rather than around the edges between the brick and mortar interface. Whichever is evident, they will in most situations be what are defined as micro cracks that do not impact on the structural integrity of the brickwork and can, if particularly required, be retrospectively 'filled' by specialist cosmetic companies that have the ability and skill to minimise the aesthetic impact of this action.

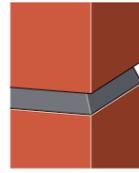
Mortar joint profiles

Joint profiles in brickwork constitute nearly 17% of the overall wall area and different bond joint profiles can affect both the final appearance and weathering properties of the wall. The quality of workmanship is important in ensuring that the wall achieves its structural, aesthetic and weathering requirements.

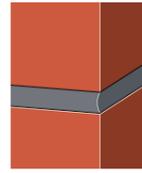
Bricks should be laid on a full bed of mortar and perpend joints fully filled. The majority of Marshalls facing products have a low-medium absorption rate and during prevailing rainfall will tend to shed water towards the joints which, if not fully filled and tooled, will allow excessive moisture into the wall cavity.

The different choice of faces available with Marshalls bricks allows various options of mortar joint to be chosen for any particular set of circumstances. For example, a rumbled face Vintage Sandstock brick may look better with one particular type of joint when compared with the precisely engineered and clean arrises of a traditional smooth faced brick.

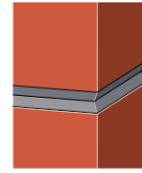
On major projects the construction of a sample panel or panels gives the ideal opportunity to test and review the best type of joint to satisfy the aesthetic and durability parameters that are required.



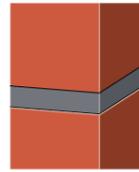
Weathered joint
joint has a downward sloping edge



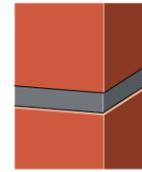
Concave/bucket handle joint



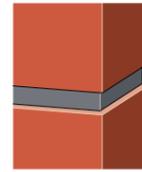
Vee joint
inverted v profile



Flush joint



Stepped joint
a medium recessed joint not recommended for exposed areas



Raked or recessed joint
not recommended for exposed areas

Application and choice of mortar

(Derived from Table 12 and Table 13 of BS 5628-3: 2005)

APPLICATION	RECOMMENDED MARSHALLS MASONRY UNIT	RECOMMENDED MORTAR CLASS	MASONRY UNIT STRENGTH (N/MM ²)
Internal walls above dpc	Lightweight coursing brick	iv/M2	10
	Dense common brick	iii or iv/M4-M2	15
Internal walls below dpc	Dense common brick or facing brick	iii/M4	22
Rendered external walls	Dense common brick	iii/M4	22
Cappings, copings and cills	High strength facing brick or engineering brick	ii/M6	35
Earth retaining walls	Facing brick or engineering brick	i or ii/M12 - M6 *	22/35 *
Manholes and inspection chambers - surface water	Dense common brick	iii/M4	22
Manholes and inspection chambers - foul drainage	Engineering brick	i or ii/M12-M6	50
Class 1 sulphate conditions	Dense common brick	iii/M4	30
Class 2 sulphate conditions	Facing brick or engineering brick	ii or iii/M6-M4	22/50
Class 3 sulphate conditions	Engineering brick	ii/M6 in SRPC	50
Areas of high saturation or wear **	High strength facing brick or engineering brick	ii/M6	35

References:

* Dependent on whether the retaining face is waterproofed.

** Special care should be taken in the choice of facing brick if used in areas of high exposure, saturation or wear such as steps, kerbs or certain types of retaining walls. Standard strength facing bricks are not suitable for use in these environments. Facing bricks are not resistant to de-icing salts.

This Technical Bulletin outlines in brief terms the mechanism behind the performance of Marshalls bricks, particularly in regard to movement, and offers some comments and suggestions as to how that should be considered when designing to accommodate that movement in buildings.

It should be stressed however that the frequency and location of movement joints is not a precise science and are influenced by many factors including those detailed in the Design Considerations section and consequently this Bulletin can only offer general advice.

Introduction

All building materials move in one way or another, either from drying shrinkage, moisture movement (absorption and drying out), thermal effects or structural movement. Concrete bricks are not unique in this respect.

People's perceptions of drying shrinkage and hence cracking in concrete can stem from their experiences with traditional poured concrete. The mechanism of shrinkage in concrete commences with the drying out of excess mix water within the matrix. Other factors such as the final water absorption; type of curing; cement content; aggregate type; density; and compressive strength can all affect the amount of movement. Marshalls bricks specifically can claim:

- Low cement and mix water contents with a high aggregate ratio giving low volume changes within the brick matrix
- Low water absorption of the cured brick leading to reduced moisture changes thus minimal moisture movement changes
- Inherent high strength of the brick for relatively low cement content producing 'stiffer' units which can resist internal stresses.

Marshalls bricks with the above characteristics therefore offer some of the lowest shrinkage and moisture movement values of cement-based masonry units used today.

Movement in a structure can either be controlled or localised in order to minimise internal stresses in the brickwork. It is these internal stresses that may cause cracking. The provision of movement or control joints offers an opportunity to localise that movement into a preferred position where it can be best accommodated. Alternatively the introduction of bed joint reinforcement at the appropriate locations can dissipate any stresses and/or allow an increase in spacing between joints.

It is widely accepted that the degree of movement is extremely difficult to predict. For example, Marshalls bricks, which have a natural tendency to shrink when drying, will also expand when subject to moisture or thermal effects. These differential movements, which occur in different directions, can in many instances nullify each other.

Although it is theoretically possible to just quote an arbitrary figure of 7 1/2 to 9 metres for spacing between vertical joints, in practice the designer should take into account other factors such as orientation of the wall in relation to the sun; number and position of openings; the shape and size of the wall, the number, position and proximity of each of the openings, shape and slenderness of the panels; moisture content of the bricks; past experience; and utilise Marshalls extensive knowledge of the product we supply.

The National House Building Council (NHBC) initially made general recommendations of maximum spacing of 6 metres for vertical joints using concrete masonry products. This advice was acceptable for the generic group of cement based masonry but it was recognised that concrete masonry encapsulates a wide variation of product groups ranging from Autoclaved Aerated Blocks with a low strength and high drying shrinkage through to a Dense Masonry Brick of high strength and low shrinkage. The NHBC had adopted the lowest performance characteristics of any product within the concrete products group as a guide for the spacing of joints without consideration of

the individual product characteristics. In simple terms these characteristics influence the degree of movement and hence joint spacing. For Marshalls bricks these can be summarised as high density; low drying shrinkage; high strength; high modulus of elasticity; and low water/cement ratio.

In a communication from NHBC in April 2014 they accepted that the 6 metre rule for joint spacing for concrete bricks could be waived and that the recommendations given in BS 5628-3: 2005 and its subsequent supporting document PD 6697: 2019 should be utilised. This states that joint spacing of between 6-9 metres may be acceptable but that designers should consult the manufacturer (eg. Marshalls) over the use of their specific products given the manufacturer's past experience and knowledge. As the leading concrete brick manufacturer in Europe, Marshalls has a wealth of experience in all aspects of the use of concrete bricks.

Consequently Marshalls recommendations are that movement control measures are incorporated at 7.5-9 metres subject to panel profile, position and size of openings, and site practice.

These spacings have also been recognised by insurance agencies such as Checkmate.

Concrete technology

When concrete dries out it contracts and shrinks. When it is extracted from the mould in its uncured state it is as large as it is ever going to be but as it cures it shrinks but expands again when wetted. That expansion does not occur to the same extent as the shrinkage.

These volume changes due to variations in moisture content are an inherent characteristic of hydraulic cement based concretes. The volume and type of aggregate and cement content have a significant effect on the magnitude of these volume changes. Since Marshalls bricks are produced with a relatively low cement content and use low shrinkage aggregates the volume changes are low.

The requirement within BS EN 771-3, 'Specification for Concrete Masonry Units', sets no limits for shrinkage or moisture movement and the values for Marshalls bricks can be found with the individual CE and DoP documents. Designers should take into account these values when comparing against other concrete masonry materials. However independent tests carried out on Marshalls bricks show a typical facing brick to have the following values:

Drying shrinkage:	0.04 - 0.16 mean	0.12mm/linear metre
Moisture movement:	0.14 - 0.26 mean	0.19mm/linear metre
Total movement coefficient:		0.31mm/linear metre

Note: The test method measures the moisture expansion between the bricks at initial ambient condition and after soaking in water for four days and then the shrinkage between that saturated value and after drying for 21 days @ 33°C. The sum of these gives the total movement coefficient. These are extreme conditions - in effect measuring from absolute saturation to complete oven dry - a condition unlikely to occur in practice on site. Indeed research in Canada estimates that actual shrinkage and moisture movement is probably only half that compared with a standard test. It should also be noted that the effects of shrinkage due to drying may be compensated for by the thermal expansion due to solar effects.

Design considerations

Types of movement

Movement in a structure can arise from the effects of:

- Thermal influences
- Shrinkage and moisture movement characteristics of the external masonry
- Changes in the orientation or shape of a building
- Site practice
- Type and grade of mortar.

The tendency for all concrete products is to shrink slightly over time and when drying out, although they may revert back to near their original size when subject to moisture. Like all materials they are also subject to thermal movement. Consequently the location of movement joints is to define the most appropriate position to accommodate this movement whilst considering the aesthetic, practical and structural factors.

Mortar choice

The recommended movement joint spacing of between 7.5-9 metres assumes the use of a Type iii (compressive strength M4) mortar, ie. 1:1:6 or equivalent. It should be noted that mortars designated by strength may be stronger than those batched by volume due to the statistical requirement to achieve the minimum strength.

Stronger mortars, such as M6, which have higher shrinkage values, may necessitate the reduction in spacing of joints down towards the lower limit (i.e. 7.5m or less). Lime-based mortar which have a higher degree of flexibility to accommodate movement, offer better characteristics than pure sand/cement based mortars.

Site protection

Since bricks shrink slightly as they dry out it is important that they are kept as dry as possible before laying. Opened packs should be covered up, as should bricks after they have been stacked up around the site. Incomplete brickwork should be protected as this will minimise the risk of shrinkage and efflorescence leaching from around the mortar joints. As mentioned if the bricks are allowed to become wet or saturated whilst stored or in build then there would be a tendency for the brick to expand and on subsequent drying the magnitude for shrinkage would be greater.

Thermal movement

South facing walls, particularly those built of dark coloured bricks, are more susceptible to thermal movement than other elevations. Whereas a simple contraction joint may suffice in more sheltered elevations, joints for southern facing elevations should have movement joints which are capable of responding to both expansion and

Please refer to:

- BTB 4: Mortars for concrete masonry products Page 50

contraction. If movement joints are not practical in these elevations then the use of bed joint reinforcement should be considered above and below large openings.

Dissimilar materials

In certain instances different masonry materials may be combined within the same elevations. In the case of clay bricks, which have expansive properties, and concrete bricks, which may shrink slightly, it is important to make provision for this differential movement.

Where for example a clay brick is used up to dpc level and a Marshalls brick built as the superstructure, then the dpc itself may act as a slip plane and allow the differential movement to occur. This can be dependent on the dead load on the dpc and an Engineer's advice should be sought as to whether a single dpc is adequate or whether two layers would be required. In all cases provision should be made to ensure structural stability.

If two dissimilar materials are mixed on one elevation then slip planes should be introduced or bed joint reinforcement incorporated to dissipate the areas of tensile stress. Again, provision must be made to ensure that structural stability is not compromised.

Length/height ratio and panel shape

The relevant Standards, BS 5628-3: 2005 and PD 6697: 2019, recommend that the length/height ratio of panels should not exceed 3:1. Shape is as crucial as arbitrary length. For example, a long garden wall of single leaf construction which is unloaded will have a greater tendency for movement (and hence cracking) than a two storey box type dwelling. With a 1 meter high garden wall, movement joint spacing of 9 metres would be excessive as this well exceeds the 3:1 ratio, whereas a two storey elevation averaging 5.5 metres in height could accommodate a movement joint at 9 metres.

The superstructure should be viewed as a series of panels. For example, in elevations where window openings are long in comparison to their height, or where those types of openings are stacked above each other, this may result in the brick panels in between the windows being less than 7.5-9 metres but exceeding the 3:1 ratio. In these instances vertical joints in line with the jambs may need to be considered, or more realistically bed joint reinforcement introduced to dissipate the stresses within the panel.

The example shown in **Figure 2** may be suitable for those openings where brick soldier courses are used as cills and heads, but if Artstone or precast cills and heads are used then the designer should consider the practical difficulties of installing movement joints which follows around the bed joint and at the end of those components.

Particular care should be taken where there are large openings above each other, e.g. 1.2 metres plus, but with only low panels of brickwork above or below them. In these instances it is prudent to incorporate bed joint reinforcement above and below the openings. See **Figures 3**. This is particularly important where the panel between the openings is long in relation to its height and there are large areas of brickwork either side of that panel. By contrast a small, narrow window within a gable may not require the introduction of any specific control measures if it is surrounded on all four sides by large areas of brickwork.

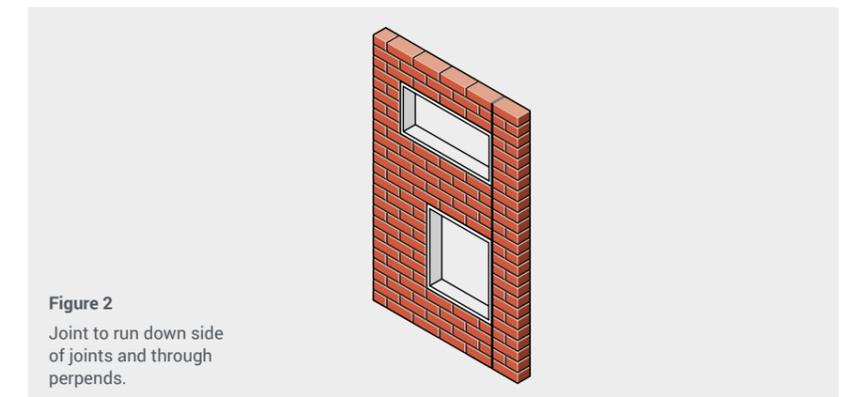


Figure 2
Joint to run down side of joints and through perpend.

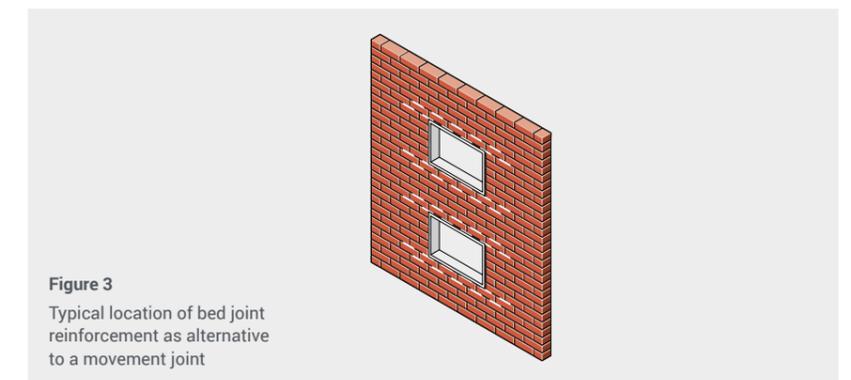


Figure 3
Typical location of bed joint reinforcement as alternative to a movement joint

Location of movement joints

Movement joints should be introduced in areas of potential stress such as detailed in **Figures 5, 6 and 7** below. If joints are placed near adjacent structural members, e.g. columns and beams, they should incorporate a flexible compressible filler between the brickwork and member to allow for the absorption of movement and flexure under load, as well as providing a fire stop.

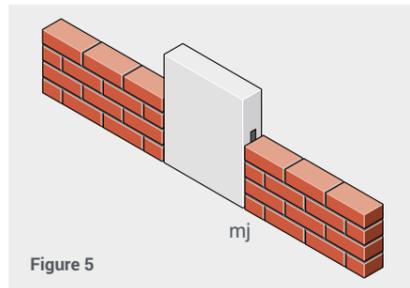


Figure 5

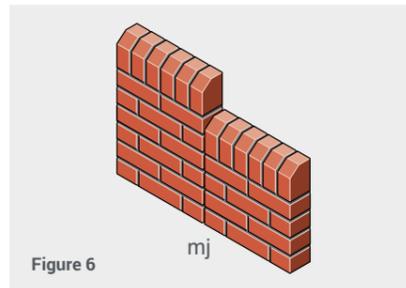


Figure 6

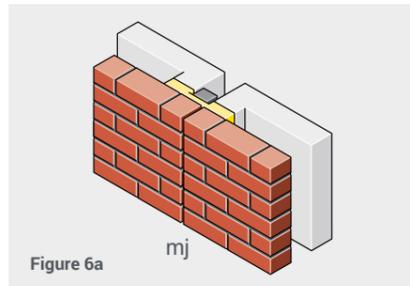


Figure 6a

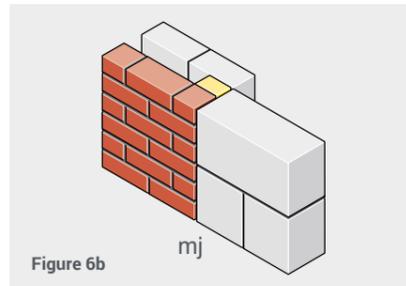


Figure 6b

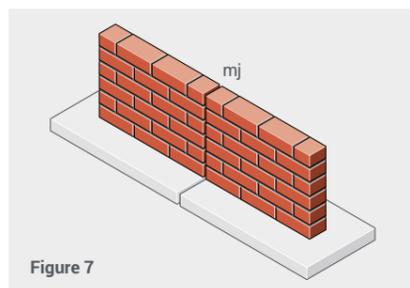


Figure 7

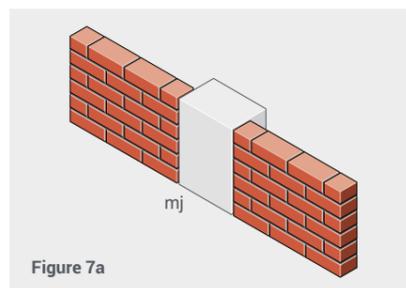


Figure 7a

Where possible break up the elevations into discrete panels as demonstrated in **Figure 8**.

Use bed joint reinforcement as an alternative or supplement to the movement joints at areas of the greatest tensile stresses. Joint reinforcement can be used in elevations where the division of the wall into panels is impractical. **See Figure 9**.

The use of bed joint reinforcement should be especially considered if the openings are greater than 1.2 metres.

Bed joint reinforcement cannot fully replace the necessity for movement joints but it can allow an elimination or enhance the spacing of joints, in instance, by up to 50%.

Areas of weakness also occur when the openings are wide in relation to their height or where large openings are positioned vertically above each other. In these instances

vertical joints should be considered adjacent to the jambs or bed joint reinforcement introduced. **See Figure 10**.

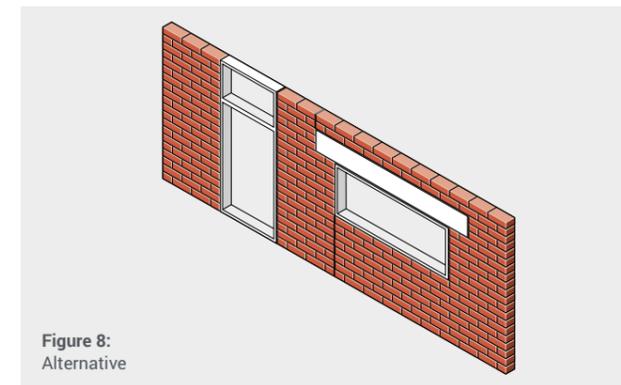


Figure 8: Alternative

Note: The window detail example shown frequently occurs on upstairs windows below the wall plate where only one or two courses of brickwork exist above the lintel. In these instances a contraction joint, which acts as a crack inducer, can be installed running vertically up the line of the jambs or ends of the lintels (see **Figure 14**). This can be filled with mastic and will have the effect of localising any potential cracking.

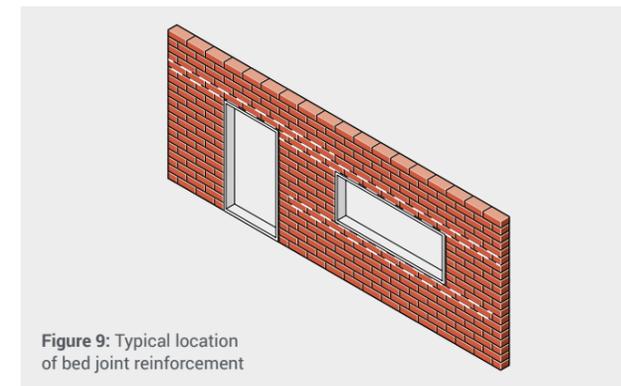


Figure 9: Typical location of bed joint reinforcement

Note: Full details on the use and application of bed joint reinforcement is available from the manufacturers.

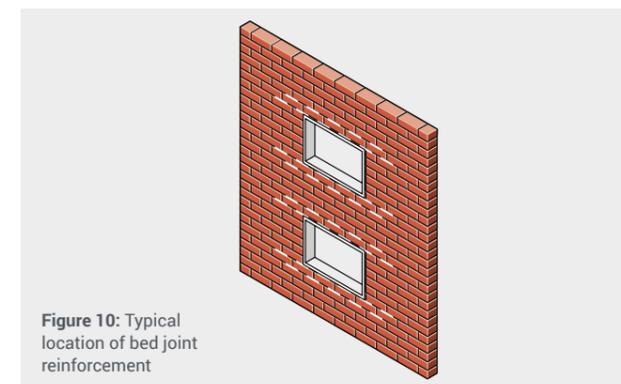


Figure 10: Typical location of bed joint reinforcement

BTB 5

MOVEMENT CONTROL

Horizontal movement (vertical movement joint)

Marshall's experience in the supply of Facing Bricks, which can be demonstrated by numerous sites across the country, shows that as a general rule vertical movement joints may only need to be incorporated at 7.5-9 metre centres. Certain shapes of buildings, for example cube shaped two storey buildings with elevations of between 6-9 metres in length, may not require joints at all depending on the frequency, size and location of openings. A typical two storey semi-detached block may only require joints at the party wall junctions provided the correct mortar has been used and the bricks have been built when dry. See **Figures 11, 11a, 11b, 11c and 11d**.

Figure 11 is practical if the joint can run vertically upwards from the end of the lintel and downwards from the line of the jamb.

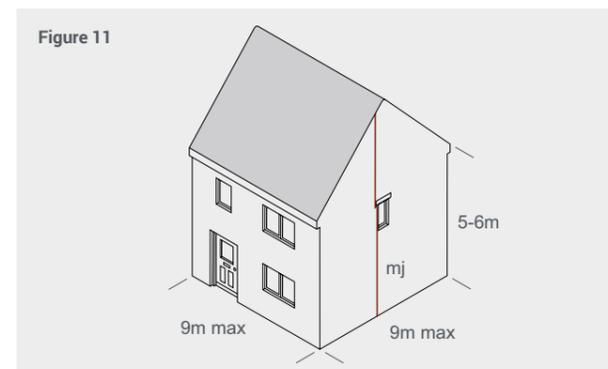
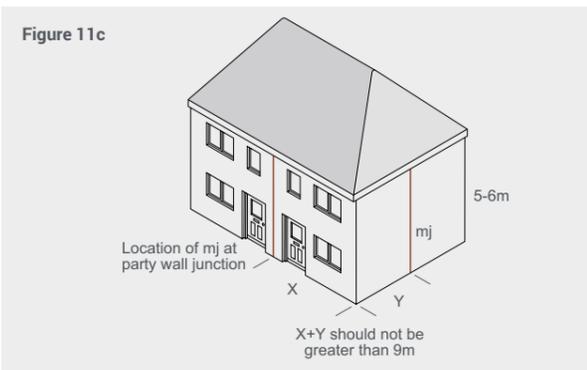
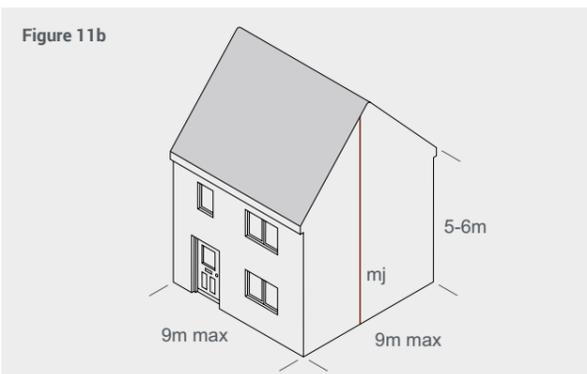
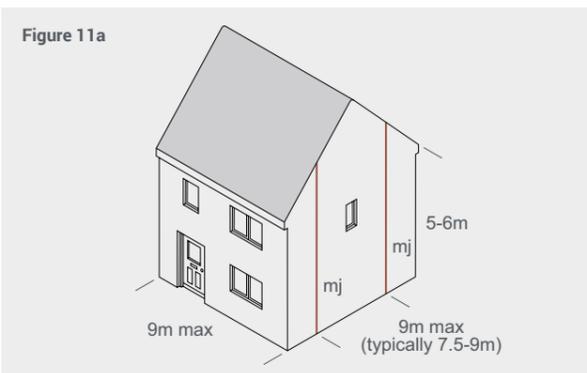
Figure 11a may be suitable where there are soldier courses of cills and lintels, or where normal brick bonding exists. Alternative courses of half brick will be needed either side of the joint.

Figure 11b. It is difficult to form an effective joint around the perimeter of projecting artstone or precast cills or lintels and this joint location is not recommended.

Figure 11c shows typical locations for semi detached properties. The requirement for a joint in the gable or end wall is dependent on the elevation dimensions.

Figure 11d shows suggested locations in typical linked properties. The longer elevation should butt up to the shorter return. See **Figure 12a**.

Note: The long/low shape of the panel between the windows may require the introduction of bed joint reinforcement. If the gable end is south facing consideration should be given to incorporating a movement joint in the centre.



BTB 5

MOVEMENT CONTROL

The length of a panel can also include a return provided the overall panel length is within the allowed parameters. See **Figures 12 and 12a**. The longer leg should butt up to the shorter return.

Vertical movement (horizontal joint)

Vertical movement can be considered to be of the same magnitude as horizontal movement.

However, consideration should be given to the potential of differential movement between the inner and outer leaf construction. For buildings less than 4 storeys or 12 meters can be uninterrupted for the full height. For buildings over 4 storeys or 12 meters joints should be generally positioned at every second storey.

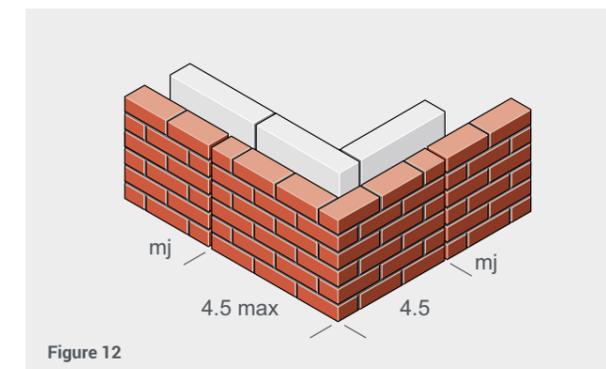
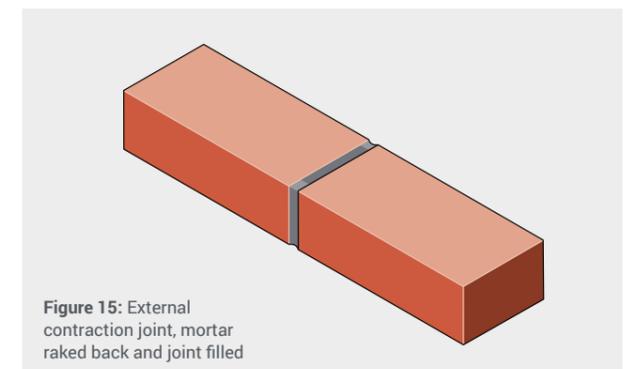
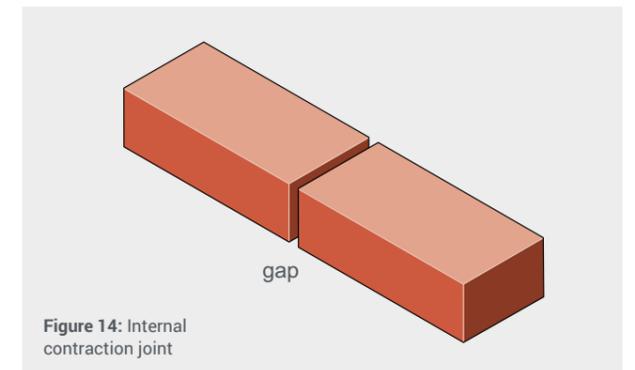
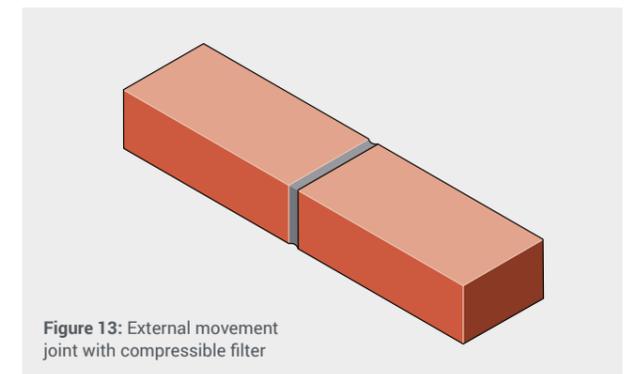
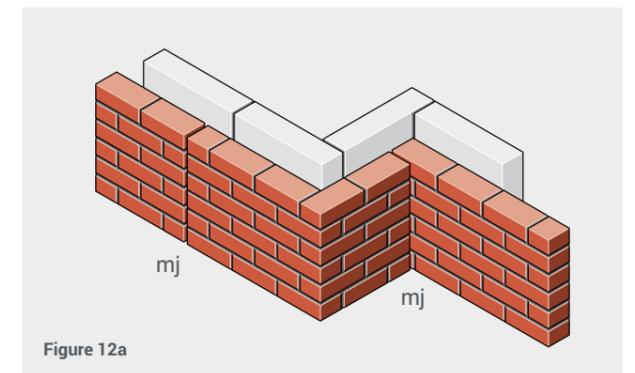
Consideration should also be given to the movement in timber frame buildings and the necessary provisions made to accommodate shrinkage of the frame.

Types of joint

In a large percentage of cases movement joints for Marshall's bricks can be installed as contraction joints apart from those elevations that may be subject to excessive thermal movement thus requiring joints which are compressible as well as allowing for contraction. In these instances the filling material in the joints should be easily compressible. Flexible materials such as polyurethane, polyethylene or foam rubber are suitable.

For contraction joints fibre board or similar materials are suitable but care should be taken that the backing material does not dislodge after any contraction of the brickwork has taken place. Joints should be sealed to resist any water ingress. **BS 6213: 2000** gives further details. Joints for Marshall's bricks should normally be 10mm wide.

Typical joint types are shown in **Figures 13, 14 and 15**.



Contraction joints would also be used on internal walls where there is unlikely to be any significant expansion. In these instances a simple raking out of vertical joints between the units may be sufficient to localise any potential cracking. In other locations the choice of flexible filler and sealant should be adequate for the anticipated movement. Care should be taken that adequate stability is provided across the joint by the incorporation of extra ties in a cavity wall or by the installation of horizontal flat ties across the joint. *See Figures 16 and 17.*

Joints below dpc

NHBC Standards, Clause 6.1, D3 (g) says 'Any movement joints provided in the substructure must be carried up into the superstructure. Movement joints may be needed in the superstructure where none are required in the substructure – however suitable allowance should be made for relative movement.'

In the case of Marshalls bricks below dpc the element of shrinkage is minimal, but in accordance with the NHBC Guidance the following should be taken into consideration:

- Where the dpc is less than 600mm above ground level, movement joints do not generally need to extend below the dpc.
- Where the dpc is more than 600mm above ground level, consideration should be given to continuing the joint through the masonry below the dpc.
- Where the movement joint is provided for differential ground movement, for example (a) at major changes in foundation level or (b) between foundations of different designs or at variations in the height of buildings, the movement joints should continue through the brickwork below the dpc.

Wall ties and sleeved ties

According to document *PD 6697: 2019, Clause 6.2.2.2.*, the density, i.e. wall ties per square metre, should be in accordance with *BS EN 1996-1-1:2005* where the ties are distributed evenly except around openings and movement joints where they should be installed at vertical heights of 300mm, not more than 225mm from the edge of the joint. Alternatively the incorporation of flat wall ties, one end of which is de-bonded, will allow relative movement whilst still maintaining stability.

Bonding to the inner leaf

Where external joints are to be coincidental to any internal blockwork joints then those joints should be staggered vertically by a minimum of 450mm. *See Figure 18.*

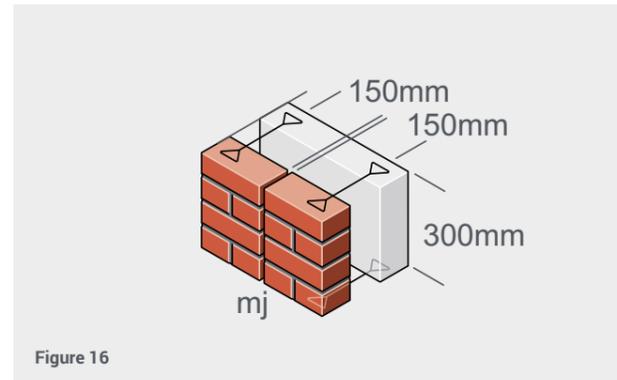


Figure 16

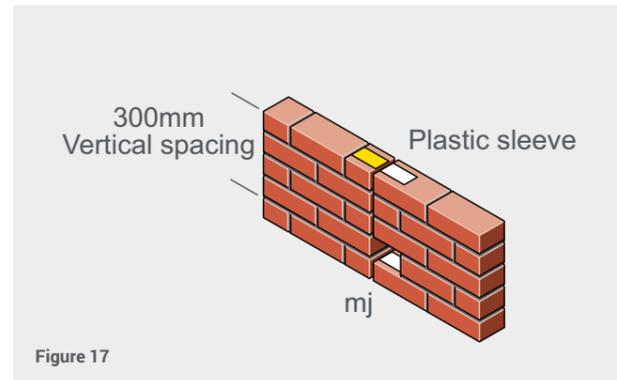


Figure 17

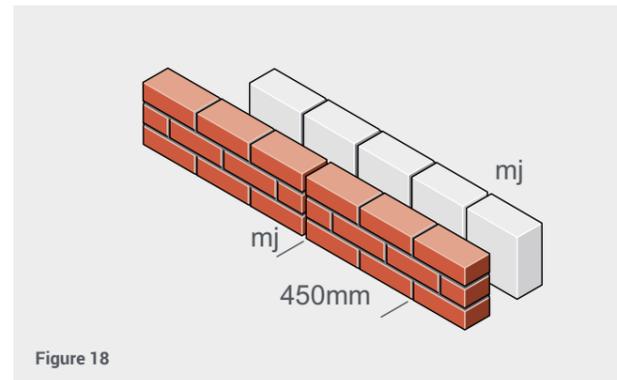


Figure 18

Bed joint reinforcement

The introduction of bed joint reinforcement can be used to distribute stress around openings or as an alternative to a vertical movement joint if that joint location is either not practical or aesthetically acceptable. Typical locations would be the front elevations of a property. Bed joint reinforcement should not be used as a substitute for movement joints but can be used to enhance the spacing of the joints if required.

There is evidence from manufactures/ suppliers that spacing of joints can be increased by up to 50% depending on the circumstances, with the inclusion of bed joint reinforcement.

Bed joint reinforcement must not extend past the movement joint and should be installed in accordance with the manufacturer's recommendations.

The reinforcement should be certified for structural use as opposed to the expanded mesh version. *See Figure 19.*

The nominal extra cost of incorporating bed joint reinforcement is generally outweighed by the benefits accruing from its installation.

Retrospective installation of movement joints

Although the inclusion of movement joints in the appropriate locations should have been provided for during design and construction, there are instances where they may have been omitted.

It is possible to retrospectively install joints into a building by cutting vertical contraction

joints into the brickwork at the designated positions. These joints, which will be contraction joints, act as crack inducers and localise any shrinkage movement. They can be formed by cutting vertical joints, 10mm wide, down the face of the brickwork to a minimum depth of 75mm. In order to maintain the lateral stability of the wall, horizontal flat ties, one end of which is de-bonded, should be installed into the bed joints at 450mm centres. The bed joints can then be mortared up as normal. The vertical joints can either be filled with a flexible strip or weak mortar which is then faced with normal joint mastic.

Movement joint placement

- Joints can be incorporated at internal junctions if required. *See Figure 12a.*
- Utilise down pipes and soil pipes to hide joints where practical.
- If jambs of openings are directly above each other then a joint along the jambs can follow through vertically. If the jambs are staggered then bed joint reinforcement may be required.
- Introduce slip planes under any precast or art stone lintel if the joint is running up the side of a reveal and around the lintel.
- Joints should ideally be at least 300mm away from any reveal.
- Placing vertical joints at locations, where lateral support from party walls or load bearing internal walls exists, will assist in the stability and resistance to wind loading. *See Figure 20.*
- It is essential to keep bricks as dry as possible before and during construction.
- Use of bed joint reinforcement should be considered for all openings greater than 1.2 metres.

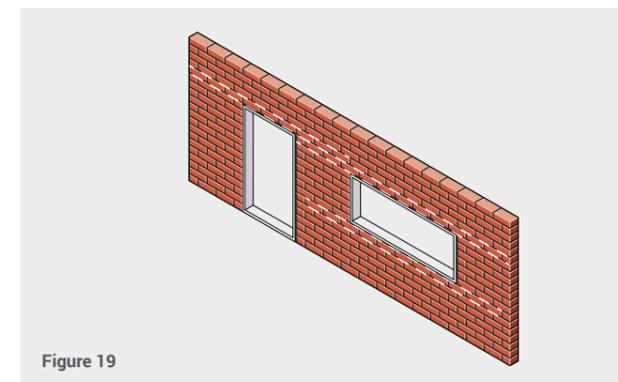


Figure 19

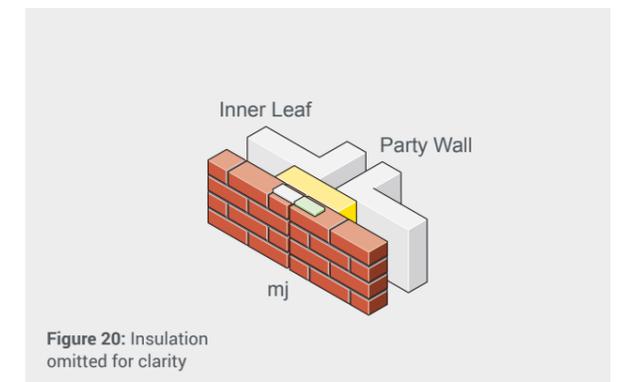


Figure 20: Insulation omitted for clarity

BTB 6

DURABILITY

Concrete bricks have a direct relationship between strength and durability, including freeze/thaw resistance. Most concrete bricks have a strength of 22N/mm² and are durable in most situations and are said to be equivalent to frost resistance class F2 for clay bricks. For copings and sills, concrete bricks with a compressive strength of 35N/mm² should be used.

There are no known instances of failure of correctly manufactured concrete bricks used in masonry walls due to frost action.

Marshalls, in conjunction with the Building Research Establishment Scottish Laboratory, commissioned accelerated freeze/thaw testing of a variety of concrete bricks in the 1990s, which recorded no frost damage and concluded that the bricks have durability at least equivalent to the old clay brick 'F' classification.

More recently Marshalls has commissioned further product testing with accredited laboratories to confirm the durability classification. Marshalls has adopted the BSI document for testing clay masonry units because there is no test method specified in *BS EN 771-3:2011+A1:2015*. This enables Marshalls to meet the requirements needed to state the exposure classification of its bricks.

Sample bricks are tested for determination of freeze/thaw resistance in accordance with the British Standard Technical Specification method of testing clay masonry units *DD CEN/TS 772-22: 2006*.

This involves subjecting a panel of brickwork to repeated freeze/ thaw cycles designed to simulate naturally occurring weather conditions.

From the test results the manufacturer gives the bricks a declared freeze/thaw resistance classification by reference to its applicability or intended usage and whether it is subjected to passive, moderate or severe conditions.

The brick classifications are:

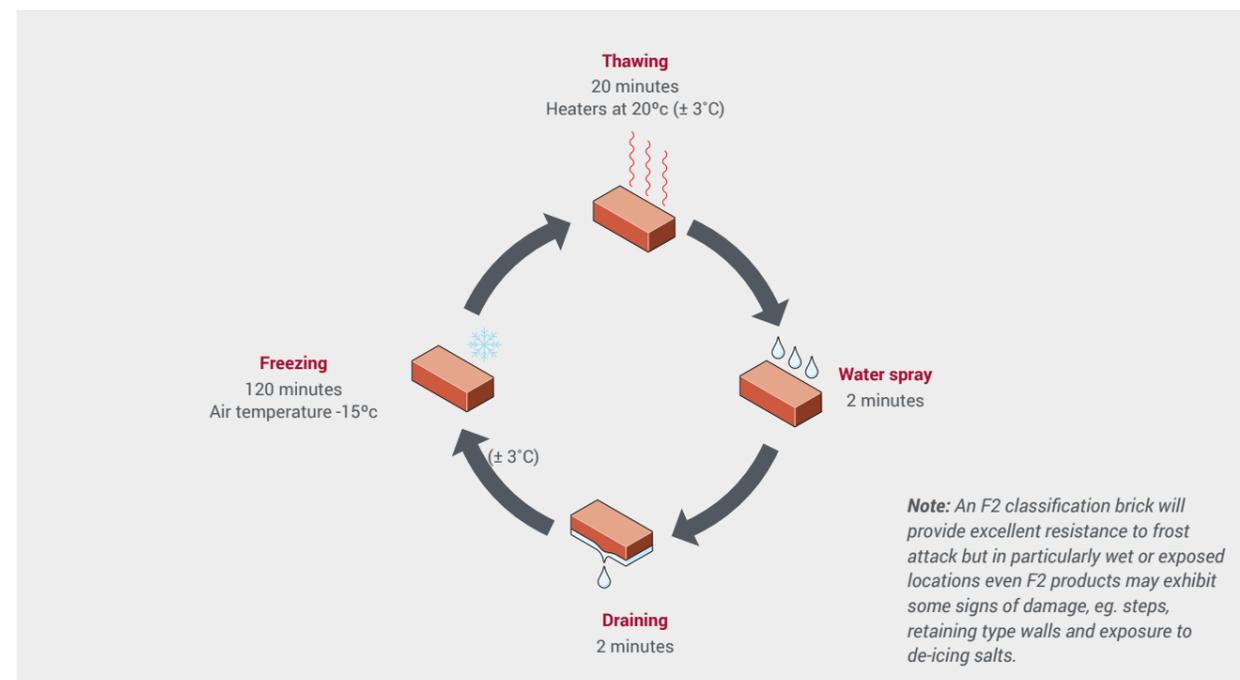
F2: Severe Exposure

F1: Moderate Exposure

F0: Passive Exposure

The panel of brickwork tested is subjected to 100 cycles, each cycle consisting of a flood coat of water, a drain period, a freezing period, and a thawing period, with a cycle time of circa four hours. After each cycle the panel is visually examined for damage with every tenth cycle including a physical 'soundness' test and a final examination of each brick after the 100 cycles are complete.

The freeze/thaw cycle diagram



BTB 6

DURABILITY

Durability of concrete bricks

Bricks should always be specified to be of the appropriate durability to meet design intention. The class of brick used will affect the specification of the mortar. Bricks with greater durability should be used where there is a higher potential for saturation or severe exposure to wind driven rain.

Minimum strength required to achieve durability class

(Minimum strengths in accordance with *PD6697:2019, Table 15*)

CONCRETE BRICKS TO EN 771-3			CLAY BRICKS TO EN 771-1	COMMENTS
Strength designation	Mean strength (M/mm ²)	Active soluble salt content	Freeze/thaw resistance clay equivalent	
C48	48.0	N/A	Frost resistance F2	Freeze/thaw resistant durable in all uses *
C35	35.0	N/A	Frost resistance F2	
C22	22.0	N/A	Frost resistance F2	
C18	18.0	N/A	Frost resistance F1	Moderate freeze/thaw resistant durable except when saturated and subject to repeated freezing and thawing
C16	16.5	N/A	Frost resistance F1	
C7	7.3	N/A	Frost resistance F0	Not freeze/thaw resistant. Bricks liable to be damaged by repeating freezing and thawing. For internal construction or masonry protected by impervious cladding only

Notes:

Marshalls does not offer bricks to all strength classes, but does offer a higher strength class suitable for more applications. All of Marshalls standard range of facing bricks are 22.5N/mm².

Concrete bricks contain no soluble salts. C48 is equivalent to clay Class B engineering bricks.

References:

* C48, C33, C22 designation bricks offer superior resistance to frost damage and can be used for construction that is in part exposed to substantial wetting and freezing temperature. However, this masonry should include design that will minimise both the extent of severe wetting and the long term build up of saturated conditions.

BTB 7

EFFLORESCENCE AND COLOUR INTEGRITY

Page 1 of 2

Over a number of decades Marshalls has been at the forefront of improvements into the performance of concrete masonry bricks and through research and development the products now exhibit superiority in both performance and appearance.

To explain the mechanism whereby efflorescence is minimised and colour-fastness secured it is important to understand the principles which caused certain concrete bricks built in previous years to look somewhat pastel in shade.

Colour integrity

In the early days of concrete brick production in the UK there was a tendency to use liquid or carbon based pigments. Ultimately these tended to leach out due to natural weathering to leave just the base colour of the aggregate brick. Hence there are examples of concrete brick buildings from the 1960s and 1970s which appear 'washed out' or 'faded'.

Since the early 1990s however, Marshalls bricks have been produced using synthetic iron oxide pigments from the major industrial, multi-national chemical companies. These pigments are high quality powders which are colour fast and retain their colour under all circumstances. All pigments used by Marshalls are 100% Synthetic Iron Oxide and are, by definition, lightfast. Additionally, all pigments are manufactured to the latest BS EN 12878: 2014 standard and this allows each of the products to carry the CE/UKCA mark. Within this standard there are various tests, including weathering trials, to which each pigment has to be subjected and therefore, if the pigment is CE/UKCA marked then the pigment has been determined as being resistant to weathering and is lightfast. However, even products made with these colour fast pigments may appear to fade, not due to colour loss of the pigment, but likely due to lime bloom (efflorescence) appearing on the surface of the brick which may mask the true colour. This can appear to be more prevalent on darker colours.

Efflorescence

The phenomenon of efflorescence or lime bloom on all cementitious products is derived from the leaching of the free calcium ions which are present in solution during the hydration of the cement matrix. If the brick or mortar becomes saturated (from the presence of water) these calcium ions can migrate towards the surface using the water as a vehicle. If this calcium rich solution migrates to the surface of the brick then the calcium crystallises will form on the surface and exhibit as a milky white deposit once the water in the solution has evaporated. The calcium ions will react with CO₂ in the air forming calcium carbonate. In time this deposit will weather off due to environmental effects but it could return on an on-going basis, albeit less and less over the years.

Unless an inhibitor is incorporated into the face or within the matrix of the brick then it could appear to lose its intensity of colour due to lime bloom, although this would eventually weather off by the acidity of rainfall.

Due to these issues, Marshalls, in conjunction with specialised chemical companies, have derived a number of systems and treatments to inhibit efflorescence forming from the brick.

The longevity of these treatments is tried, tested and evidenced on buildings constructed for many decades. However, the main effect of inhibiting efflorescence is best demonstrated at the primary stages of a brick's life, because as the brick gets older the amount of free calcium ions reduces due to the continued hydration of the cement. Additional carbonation of the brick surface reduces the permeability and any likelihood of efflorescence. Hence Marshalls facings bricks look good from initial construction through the life of the building.

However, it is important that good practice, in terms of design and protection during construction, is followed to minimise the risk of efflorescence, not only from the bricks but also from the mortar where unsightly staining can occur if adequate measures are not taken to protect uncompleted brickwork.

The term efflorescence is given to a white powdery deposit that forms on the surfaces of porous building materials such as masonry units, mortar and concrete. The temporary appearance of efflorescence or lime bloom is not unusual on new masonry. For efflorescence to occur, three conditions must be present:

1. There must be soluble salts present;
2. There must be water entering the masonry; and
3. The masonry must be able to dry out.

The absence of any of the previous three conditions will prevent efflorescence. Any situation which allows water to enter the wall is likely to promote efflorescence. The most common causes are:

- Poor building practice such as partially built walls left uncovered during rain. Delays in installation of window cills and downpipes can exacerbate this problem, allowing rainwater to enter block cavities and leach free lime to the surface
- Poor storage of masonry units on site. Before units are placed in the wall they can absorb ground salts and excessive water in the stockpiled masonry and can mobilise latent salts. It is desirable to store masonry off the ground and loosely cover with a waterproof membrane during rain
- Poorly designed or missing copings and flashings
- Excessively deep raked joints which allow water to enter the bed face of the masonry (ironed joints are recommended); and
- The use of inappropriate additives, such as washing up liquid, in the mortar which makes the mortar act like a sponge.

Good laying practice and site procedures are necessary for controlling efflorescence to a reasonable level. Care should also be taken to ensure that excessive lime is not used in mortar.

Detailing to avoid efflorescence

The following measures should be taken to minimise the occurrence of efflorescence in masonry walls:

Tops of walls and parapets

Walls and parapets should have protection such as flashings or capping to the top surface. A common source of staining of masonry is water entering walls and cavities at this point via the exposed horizontal surface.

BTB 7

EFFLORESCENCE AND COLOUR INTEGRITY

Page 2 of 2

Window cills

Window cills with an inadequate projection provide a source of water entry to the walls and will promote staining. The incorrect installation of window flashings will exacerbate this problem.

Flashings

Flashings should protrude to the outside face of the brickwork. If the flashing is stopped short of the weep holes in the external leaf, any moisture entering the wall will be channelled into the units, permeating the mortar, dissolving calcium hydroxide and eventually passing to the outside, precipitating as efflorescence.

Masonry units

Marshalls concrete masonry units have efflorescence potential of nil or slight due to the inclusion of additives and surface treatments on the face of bricks, thus minimising the risk.

Mortar designation

Class 4: For general applications (except as listed for M4):

Preferred: 1 part cement, 5 parts sand plus plasticiser.

Alternative: 1 part cement, 1 part lime, 6 parts sand.

Class 6: For applications subject to saline wetting and drying, in aggressive soils, in severe marine environments, in saline or contaminated water including tidal splash zones and within 1km of an industry producing chemical pollutants:

Preferred: 1 part Type cement, 4 parts sand plus plasticiser.

Alternative: 1 part Type cement, ½ part lime, 4½ parts sand.

Movement joints

Walls should include well positioned movement joints to prevent indiscriminate cracking of the walls that would permit ingress of moisture. Movement joints should be correctly sealed.

Weep holes

Cavity walls should include numerous well positioned weep holes to allow any moisture in the cavity to escape. Cavities should be free of mortar droppings. This is crucial to reduce lime leaching onto the face of the masonry.

Removal of mortar smears

The external face of the masonry should be kept clear of mortar smears.

Concrete masonry, in the form of Facing Bricks and Reconstituted Walling can generally be described as a 'low maintenance' building material. However, there are some important, simple precautions, based on standard best practice, that should be taken to ensure its long term attractiveness and its ability to perform the required structural function.

These involve:

- Ensuring that masonry remains weatherproof
- Repairing any cracks or deterioration of joints
- Cleaning off any efflorescence, staining or mould and if necessary sealing the surface.

Construction considerations

Mortar deposits

Mortar extruded from masonry joints during laying should be cut off with an upward stroke of the trowel. In this way a clean cut can be made without smearing the face of the unit.

On completion of laying and tooling, any mortar smears which may be on the face of the work should be removed, firstly with dry brushing and secondly, if necessary, by wet brushing. Do not allow mortar smears and snots to set on the face of the masonry. If these mortar deposits are allowed to set on face masonry, careful use of high pressure water jets, or in extreme cases diluted acid solution, might be needed to remove mortar stains. (Note: See 'Cleaning Concrete Masonry' before testing either water jets or acid solutions). Acid cleaning should be avoided if possible as this could affect the appearance and cause discolouration.

Scaffolding

Scaffolding planks should be placed with a clearance of at least 150mm to the wall. This gap allows mortar droppings to fall clear of the plank instead of splattering on the plank and building, disfiguring the wall. At the end of each day's work or when rain interrupts work, the plank nearest the wall should be propped on edge to prevent mortar from being splattered onto the wall by overnight rain.

Concrete droppings

Masonry that supports reinforced concrete slabs and beams is frequently disfigured by residue from a concrete pour. If such deposits are allowed to set it is sometimes impossible to rectify the damage. Protection is best achieved by covering the walls with plastic sheeting. Where this is not done, any concrete on the wall must be thoroughly cleaned off before it sets.

Rain Interruption

Overnight, on completion of a 'lift', or when rain interrupts bricklaying, the top of newly laid walls should be protected with plastic sheeting or similar. This is essential with face brickwork. When newly laid masonry becomes saturated by rain, lime is placed into solution either from Portland cement, or from saline (unwashed) sands or hydrated lime in the mortar. This solution absorbs carbon dioxide in from the atmosphere and precipitates as calcium carbonate along the line of the joints. This whitish stain may be very disfiguring. Frequently, new masonry is marred by bands of calcium carbonate stain to three or four courses of masonry – the result of rain saturating freshly laid brick work.

Cleaning concrete masonry

Good building practice

Brick layers must take care when laying concrete masonry to minimise mortar staining and in particular must:

- Keep facing bricks as clean as possible while laying and tooling
- Keep unused pallets of bricks and the tops of unfinished walls covered during rain to prevent water penetration and excessive efflorescence
- Clean any snots and mortar smears before they set hard

Remaining stains could be removed following the procedures set out below.

Removal of mortar stains with hand tools

After using a bucket and brush, remove any remaining mortar snots and smears by rubbing the surface with a piece of 'like coloured' brick or a piece of wood. Careful use of a paint scraper, wide bladed chisel or wire brush can be helpful in removing mortar build-up, however care must be taken not to scratch or damage the masonry surface.

Pressure water cleaning

This cleaning method is not a substitute for good building practice and hand cleaning methods and should only be used after these procedures have been carried out if further cleaning is required.

Pressure water cleaning may be carried out with the pressure not exceeding 7MPa (1000psi), the volume not exceeding 20 litres/ minute and a fan jet of a minimum 40 degree width, held not closer than 500mm from the wall. Cleaning should be continuous and even. The pressure jet should never be

stationary and should not 'needle' or zero in on mortar stains as surface erosion will almost certainly occur.

Note: *If this method is not totally successful, further hand cleaning and scraping should be carried out prior to further pressure water cleaning.*

Caution

High pressure water blasting can cause personal injury and damage the masonry. Mortar joints can be blown out and face brickwork marked or eroded.

Zero degree or needle jets, narrow fan jets and turbo jets should not be used on brickwork because all will concentrate the water pressure on too small an area which will cause damage.

Minimal pressure should be used to avoid mortar blowouts and/or damage to the face of units.

Experienced operators should carry out pressure water cleaning in accordance with the above recommendations only after appropriate trials have taken place.

Essential preliminaries

Thoroughly remove mortar smears and snots back to a flat surface with hand tools as outlined above. Hand cleaning must not leave any thickness of mortar otherwise pressure water cleaning will damage the masonry face and mortar joints before removing the thickness of mortar.

Allow the bedding mortar to harden for a minimum of seven days prior to pressure water cleaning.

Carry out a pressure water cleaning trial on a typical but inconspicuous area and allow it to dry to determine:

- The effectiveness of this cleaning method; and
- That marking, damage or erosion of the surface has not been caused before proceeding with the general cleaning.
- Pressure water cleaning can promote the formation of efflorescence on the surface (*see BTB 7*)

Caution: *Excessive pressure will lead to damage of masonry units.*

Note: *If there is no inconspicuous area, a small wall could be constructed for this purpose.*

Acid treatments

Only if hand cleaning and pressure water cleaning methods have failed to fully remove mortar stains should acid treatments be considered for cleaning of concrete brickwork.

Important note: Acids react with and dissolve cement, lime and oxide pigments in concrete masonry units and mortar joints and are thus capable of etching, fading and streaking the masonry finish. When acid is applied to dry brickwork without pre-wetting it is drawn below the surface it is intended to clean. Salts may reappear when the masonry dries out.

If it is considered necessary to use an acid for general cleaning it should only be used after trialing in an inconspicuous area, as outlined under 'Essential Preliminaries' and strictly in accordance with the following procedures.

Hydrochloric Acid based cleaners can be tested at a strength of 1 part acid to 20 parts water. A less aggressive alternative is powdered Citric Acid which can be used at strengths up to 1 part acid to 10 parts water (by volume).

Procedures for acid cleaning

1. Remove mortar snots and smears as described under 'Removal of Mortar Stains with Hand Tools'.
2. Working from the top of the wall down in vertical 'runs', thoroughly pre-wet (SOAK) an area of brickwork of approximately 2m² at a time.
3. Apply diluted acid to the water-soaked area using a brush or broom with a horizontal (sideways) action to prevent runs and streaks.
4. Within 2 to 3 minutes rinse this area from top to bottom under tap pressure only. Pressure clean this area thoroughly, gently and evenly, as outlined previously. Repeat steps 1 to 4 as necessary to achieve the best compromise between cleaning and damage caused by excessive treatment.

Safety precautions and warnings

- When using chemicals, care must be taken to avoid damage to adjacent materials and finished surfaces. Masking and plastic sheeting may be necessary.
- To avoid personal injury, wear suitable personal protective equipment (PPE), paying particular attention if working in confined spaces. If in doubt, always wear PPE as recommended by the chemical manufacturer.
- NEVER mix chemicals that you are unfamiliar with, particularly chlorine and acid as this will emit deadly chlorine gas. Always follow the chemical manufacturer's recommendations.

- Dilute acid by adding the acid to water. Never add water to the acid. Ideally use a pre-diluted proprietary cleaner.
- Harsh acidic chemicals should never be used for the cleaning of brickwork.
- Chemical waste must not be allowed to run down drains and storm water outlets in accordance with Environmental Agency Regulations.

Efflorescence

In conjunction with dry brushing, the cleaning methods outlined previously will usually remove most 'normal' levels of efflorescence. Dry brush, then wet brush and wash down. It is important to remove as much efflorescence as possible with DRY brushing because powder efflorescence is water soluble. Wet brushing can dissolve the powder and the dry unit can re-absorb it. If high levels of efflorescence are present on walls exposed to continual wetting from rain or other sources of dampness over an extended period, calcification or hardening of the lime tends to take place. The powdery lime gradually becomes a very hard film of calcium carbonate. If this occurs it will almost certainly require professional advice and specialised cleaning methods for its removal.

Wall sealers also help to prevent future efflorescence, mould growth and general staining by reducing water absorption from rain.

Most cement based masonry products can be prone to efflorescence and allowances must be made by the purchaser for this occurring. Marshalls products include inhibitors both within and on the surface to minimise this effect.

Other stains

Timber

These can usually be removed by the application of a chlorine solution, preferably Sodium Hypochlorite (household bleach), onto the dry surface. Reapply as necessary to achieve the desired result.

Clay or loam stains

If not too severe and intransigent, these stains may be removed with a solution of 50ml household detergent and 500 grams of oxalic acid dissolved in 4 litres of warm water. Lightly pre-wet the surface then apply the above solution with a nylon brush.

Rinse off and repeat as necessary. Pressure water cleaning as outlined previously may be of assistance.

Mosses, moulds and lichens

These commonly appear as a green to black area, often with a hair like growth, around damp areas such as taps, gutter overflows, south facing walls, etc.

1. Scrape off any thickness of moss mould/lichen.
2. Pre-wet the mouldy area.
3. Apply a chlorine solution, preferably Sodium Hydrochlorite (household bleach), at sufficient strength to kill mould within approximately 1 hour.
4. Scrubbing with a stiff brush or broom will normally assist.
5. Thoroughly flush the surface. If mould remains, repeat steps 1 to 3 as necessary to kill and remove the mould.
6. Pressure water cleaning, as outlined previously, may assist.

Repairs

Repairs to Marshalls bricks and masonry may be required to remedy any minor chips or cracks, both of which are relatively easy to carry out depending on the severity of the damage. In certain instances, where for example only one unit is involved, it may be more acceptable to leave the damaged unit where it is rather than replace it with something which may be more obvious. In all cases a full risk assessment should be carried out and all appropriate PPE equipment used where necessary.

Chips

As Marshalls bricks and masonry are through coloured (although some may have supplementary faces applied) any minor chips can be repaired using an appropriately coloured fine mortar or repair mix. The chipped area should be free of loose material and be pre-treated with a pva solution. To avoid overspill the surrounding area should be masked with adhesive tape. The repair material should be mixed to a workable consistency that allows it to be pressed into the chip without slumping. Any excess should be struck off but leave some material slightly proud. After curing the excess material may be sanded down or textured to match the adjacent faces. If required the whole brick face can then be tinted or stained to match the remainder of the wall.

CLEANING, MAINTENANCE AND REPAIR

Cracks

There may be two types of crack which need to be remedied; one which is relatively minor and can be classed as a minor or micro crack, ie. less than 0.1mm in width; and another which is relatively wide and more obvious. In the latter case the crack may appear to have continued right through the unit. This is typical of cracks resulting from shrinkage of the unit or structural movement.

In the case of the micro crack, which appears to be on the surface of the unit, the crack may appear more obvious as it attracts dirt. In many instances this crack may heal itself by the process known as autogenous healing whereby a combination of moisture and absorbed carbon dioxide from the atmosphere reacts with unhydrated cement within the brick matrix. Any residual dirt around the crack can be cleaned off as outlined in the above sections.

Larger cracks, possibly resulting from drying shrinkage or structural movement, may be treated in a number of ways.

- If no further movement or expansion of the crack is anticipated then the crack can be raked out as deep as possible, but maintaining as thin as width as is viable. All residual dust should be blown out and the crack filled in the same way as detailed above for repairing chipped areas. If necessary a very fine, light coloured sand may be rubbed into the joint to help match the brick texture. An alternative to repair mix is to use a mastic gun containing material similar to that used in any movement joints. Again, fine sand can be incorporated into the surface of the repair. As an alternative the cracked brick can be replaced if more desirable.

- Wider or more obvious cracks, or those which may have a tendency to reappear because of movement within the structure, may require the introduction of bed joint reinforcement above and below the cracked areas in order to stabilise the movement prior to any repairs to the unit itself. In certain instances the customer may wish to cut out and replace any cracked bricks, although care should be taken to match up the mortar to the surrounding areas. There are a number of specialist contractors and suppliers skilled in the installation of brick stitching systems and reference should be made to these if required. Marshalls will be pleased to assist with this information. Should the bed joint reinforcement be installed with the existing bricks in place then a traditional repair such as detailed above may be carried out. As an alternative the cracked brick can be replaced if more desirable.

RESISTANCE TO RAIN PENETRATION

Independent research has shown that walls built from Marshalls bricks perform well. The testing was carried out in accordance with **BS 4315: Part 2: 1970** and comprised intermittent spraying of water at a length of wall for one minute, at half hour intervals, over a 48 hour period, under a maintained positive air pressure.

The area of dampness was then monitored. Tests carried out on various types of concrete brick indicated very low levels of rain penetration occurred, thus clearly showing that there was no correlation between rain penetration and the product readings for strength, density or water absorption of the various types of brick.

The notes below give general guidance for walls built using either concrete or clay bricks, and further reference should be made to the following Standards:

- **PD 6697: 2019:** Recommendations for the design of masonry structures.
- **BS 8104: 1992:** Code of practice for assessing exposure of walls to wind driven rain.
- **BRE Report 262:** Thermal Insulation; avoiding risks.

Neither the outer leaf of cavity walls nor single leaf walls are impervious to driven rain. During periods of high or prolonged exposure some moisture will penetrate the outer leaf. Initially this penetration will be through the joints and more specifically the interface between the brick and mortar (typically the most vulnerable point to rain penetration) but then ultimately through the brick itself.

The performance of the wall in resisting water crossing over the cavity is affected by the workmanship, degree of exposure and the quality of design and specification. Poor design or practice is more likely to lead to moisture transmission to the inner leaf.

In general Marshalls facing bricks can be classed as having a low-medium rate of absorption and thus tend to initially shed rainfall towards the joints. It is important therefore that full bedding and complete filling of the perpendicular joints is carried out during construction.

Performance of walls

Single leaf walls

The degree of resistance to penetration of moisture to a single leaf wall would be determined by either the wall thickness or whether the wall is protected by a secondary finish or coating. In summary:

1. **Unprotected:** Walls of this type will not remain dry internally in all conditions. The thicker the wall, the greater the resistance to penetration but over time and persistent wetting, moisture will eventually penetrate the wall. Where necessary the performance can be improved by the application of a proprietary external water proofer with a high solids content.
2. **Solid masonry walls:** Internally insulated walls should be at least 328mm thick and have a notional cavity between the masonry and the insulation.
3. **Protected by tile hanging or cladding:** These will be watertight in all locations provided the recommendations of the manufacturers have been followed.
4. **Protected by external rendering:** Providing render of the correct specification has been applied then walls may be reasonably watertight but some damp may percolate through to the inside given high degrees of exposure.

Cavity walls

Moisture may penetrate the outer leaf of a cavity wall but should not cause dampness on the inner leaf provided the appropriate design and construction, type of insulation, cavity widths and workmanship have been carried out as suggested below.

1. Use the correct grade of mortar and mortar joint.
2. Take all necessary precautions to minimise the effects of movement and in particular the risk of cracking by the incorporation of the appropriate movement joints.
3. Provide weep holes in the outer leaf immediately above any damp proof course or tray. They should be installed at not more than 900mm centres. Provide means of restricting the entry of wind driven rain in areas of high or very high exposure.
4. Ensure clear cavities with a minimum width of 50mm are maintained throughout the wall and that cavities are not bridged by mortar debris or incorrectly fixed insulation.
5. Do not adjust the position of bricks once they have been bedded. This can break the brick/mortar bond, leaving fine cracks for rain penetration.

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RESISTANCE TO RAIN PENETRATION

Determination of exposure

BS 8104: 1992 gives recommendations for two methods of assessing exposure ratings of walls to wind driven rain, namely the local spell index and the local annual index. The former should be used when assessing the resistance of a wall to rain penetration whilst the latter is intended for use when assessing durability, the weathering appearance and the potential growth of mould or mosses.

The exposure categories in terms of wall spell indices are given in the table below using the local spell index. They should not be regarded as exact as local circumstances or experience may require adjustments to be made. Where an assessment produces an intermediate index then the designer should utilise local knowledge, topography and experience to decide the most appropriate exposure index.

The full scale map detailed in the Standards, listed above, indicate the approximate zones within the United Kingdom but more accurate data can be derived from large scale maps and the correction factors given in **BS 8104:1992**. Adjustment may need to be made for local conditions.

Maximum recommended exposure zone for facing masonry in cavity walls with cavity wall insulation

More permutations of cavity type and widths are given in BRE Document.

Thickness of single leaf walls (outer leaf of a cavity wall or solid wall)

The resistance to rain penetration is dependent on its thickness for single leaf walls. The table below gives the recommended thicknesses for various categories of exposure using Marshalls bricks as a single leaf wall.

MINIMUM THICKNESS (MM)	UNRENDERED/FAIR FACED	RENDERED	EXTERNALLY INSULATED	IMPERVIOUS CLADDING
100	Not recommended	Zone 1	Zone 3	Zone 4
215	Not recommended	Zone 2	Zone 3	Zone 4
250	Zone 1	Zone 3	Zone 3	Zone 4

INSULATION METHOD	CLEAR CAVITY WIDTH (MM)	MORTAR JOINT PROFILE	
		TOOLED FLUSH JOINTS	RECESSED MORTAR JOINTS
Built in full fill	50	Zone 2	Zone 1
	75	Zone 3	Zone 1
	100	Zone 3	Zone 1
	125	Zone 3	Zone 1
Injected fill not UF foam	50	Zone 2	Zone 1
	75	Zone 3	Zone 1
	100	Zone 3	Zone 1
	125	Zone 3	Zone 1
Partial fill	Residual 50mm cavity	Zone 3	Zone 1
	Residual 75mm cavity	Zone 4	Zone 1
	Residual 100mm cavity	Zone 4	Zone 2
	Internal insulation		
Clear cavity	Clear 50mm cavity	Zone 3	Zone 1
	Clear 100mm cavity	Zone 4	Zone 2
	Fully filled cavity 50mm	Zone 2	Zone 1
	Fully filled cavity 100mm	Zone 3	Zone 1

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COURSING BRICK APPLICATIONS

This Marshalls Technical Bulletin is intended to clarify the type of concrete bricks that should be used as coursing units when combined with blockwork.

A number of issues have been raised, predominantly by housebuilders and inspectors from the National House Builders Council (NHBC), on the use of concrete common bricks in conjunction with other masonry materials, e.g. blocks, when combined together in a wall.

The NHBC Standards reference 6.1.11 states:

'Clay bricks and concrete bricks should not be mixed. Where a different size of masonry unit is needed to ensure correct coursing, small units of the same material should be used to reduce cracking and problems due to different thermal insulation properties.'

The NHBC note is intended to prevent problems created by mixing clay products (which expand) with concrete materials, (which contract) within the same wall, and where thermal bridging may be a problem, to prevent the mixing of aggregate and aerated concrete products.

The table below can be used as an indicative guide to the acceptability of coursing bricks with different block backgrounds.

Block background	Coursing brick
Dense concrete blocks	Solid concrete brick, textured for rendering if required
Medium density blocks	Lightweight/medium density coursing bricks

Dense concrete blockwork

Definition: Aggregate blocks with a solid density range of 1850 - 2300kg/m³ which meet the Robust Details Specification.

Solid concrete bricks

Definition: Solid bricks, not frogged or perforated, with a density range of 1900 - 2200kg/m³.

Solid dense concrete bricks are recommended for use as coursing units in conjunction with dense aggregate blocks. The densities of blocks and concrete bricks are compatible, as are their drying shrinkage, thermal conductivity and water absorption. Dense coursing bricks are available to suit 100mm and 140mm widths at 65mm and 73mm high.

Lightweight/medium density blockwork

Definition: Medium density blocks with a density range of 1300 - 1550kg/m³.

Lightweight/medium density coursing bricks

Definition: Solid bricks with an average density of <1550kg/m³.

In this application bricks of medium/lightweight density should be used. These are available in both 100mm and 140mm widths at 65mm high.

Note: By virtue of their production method, frogged and perforated concrete common bricks tend to have smoother faces and may not offer the same degree of adhesion as a textured solid coursing brick. They are, however, suitable for use in general construction, but care should be taken that they are laid frog up, and the frog filled with mortar. Frogged bricks are NOT recommended for use either as soldier courses or as padstones, regardless of whether the frog is filled with mortar.

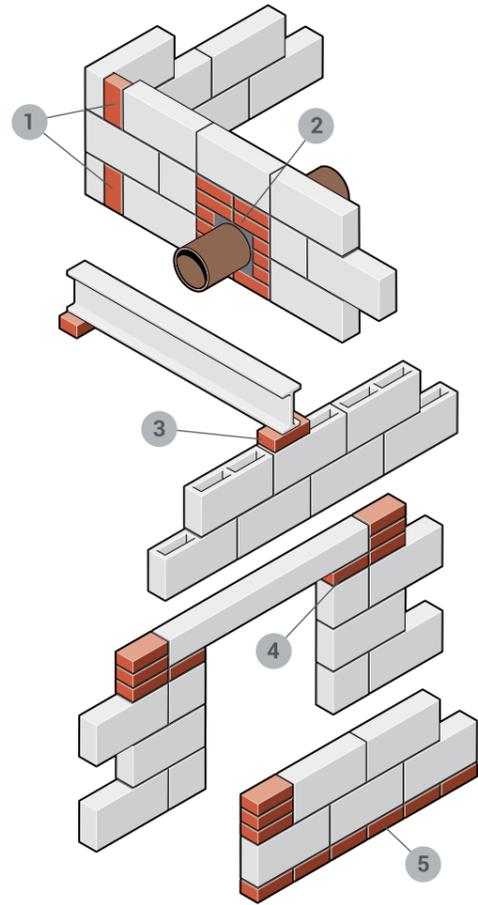
Clay bricks **should not** be used in conjunction with aggregate based or aerated blocks due to their potential differential movement but dense or lightweight coursing bricks may be combined with the appropriate aggregate blockwork.

Marshalls coursing bricks are **not** suitable for use in conjunction with autoclaved aerated blocks.

The use of bespoke coursing bricks offers the advantages of:

- Manufactured by the same basic material as dense and lightweight aggregate blocks.
- Similar performance characteristics in relation to density, drying shrinkage, thermal properties and water absorption.
- Available in different widths to accommodate 100mm to 140mm block widths.
- Eliminates the need for cutting blocks on site.
- Approved by the NHBC
- Available, if required with a specific keyed face to assist adhesion.

Concrete coursing bricks are available from most Builders Merchants. They should be specifically ordered as coursing bricks, either lightweight or dense, depending on their compatibility with the block background.



- 1 Coursing bricks of both sizes and densities can be used to bond in block walls.
- 2 They are easily used to fill the voids in walls formed by such items as pipes, etc. where cutting of blocks may be difficult.
- 3 With the increasing use of hollow blocks due to weight restrictions, coursing bricks can be used to form padstones to cover the voids within the block and to spread any load.
- 4 The most popular use is in the makeup of courses in and around window and door openings. Because both the dense and lightweight coursing bricks have similar properties to that of the base blockwork, the overall wall construction can be assumed to be a homogenous mass.
- 5 Standard storey heights within floor levels frequently co-ordinate to sizes which are less than multiples of full-height blocks. The coursing bricks are ideal for making up courses either as kicker units or by closing off at roof level. Similarly coursing bricks can be used to make up half-length modules instead of the expense of cutting blocks to size.

Note: Although the illustration shows the use of 140mm bed width coursing bricks, the standard 100mm size can be used in similar applications.

Properties

	DENSE	LIGHTWEIGHT
Form	Solid	Solid
Sizes	215mm x 100mm x 65mm 215mm x 140mm x 65mm 215mm x 100mm x 73mm (Frogged)	215mm x 100mm x 65mm 215mm x 140mm x 65mm
Composition	Dense Aggregate and Portland Cement	Blended Lightweight Aggregate and Portland Cement
Density	<2100 ±50 kg/m ³	Average <1550 ±50 kg/m ³
Strength	22.5N/mm ² min	10N/mm ² min
Drying shrinkage	<0.45mm/m	<0.9mm/m
Thermal conductivity	Protected: 1.24W/mK Exposed: 1.33W/mK	Protected: 0.47W/mK Exposed: N/A

Introduction

Concrete engineering bricks produced by Marshalls satisfy the majority of criteria in terms of technical performance, but more importantly they are produced at a number of strategically placed factories across the country and are generally available on an ex stock basis. They were introduced over 30 years ago following the result of an extensive independent research and development programme and have been widely used in all forms of civil and general construction since then.

Produced in a solid form, a format in which the clay brick manufacturers may have limited volumes, and perforated format, the Marshalls Engineering brick offers a cost competitive solution for ground works and utility constructions.

History

The engineering brick was developed originally by Marshalls in the mid 1980s and its concept was adopted nationally by other concrete brick producers who existed at that time. The background was that there was a shortage of Clay Class Bs and a suitable alternative was required.

The original Standards for concrete bricks of **BS 6073** and prior to that **BS 1180**, included a category for the production of 'Special Purpose' bricks which had a minimum cement content of 350kg/m³ but with no recommendation as to where they could be used.

Research by Marshalls showed that although there were significant examples of other precast concrete units being used in underground and aggressive locations. eg. concrete pipes, rings, precast concrete manholes etc., there were no examples of performance of concrete bricks in these locations. A typical concrete brick in those days tended to be limited to a strength of 20N/mm² which restricted its use to above and below dpc.

The Building Research Establishment had carried out work in 1970 with concrete buried in sulphate bearing soils and had concluded that the criteria for suitability under these conditions was a low absorption, sulphate resistant unit. BRE Digest 250, which was really concerned with in-situ concrete, did allow precast units as long as they were made with some form of sulphate resisting cement for up to Class 3 sulphate levels.

Marshalls then embarked on a programme of testing which resulted in the production of a brick with a minimum cement content of 350kg/m³ and made from a cement mixture of either sulphate resisting cement (SRPC) or Ordinary Portland Cement and cement

replacements such as Ground Granulated Blast Furnace Slag (GGBS) or Pulverised Fuel Ash (PFA). These blends gave the same degree of sulphate resistance as bricks made with SRPC.

To carry out a performance comparison of concrete and clay Class B bricks Marshalls commissioned the Laing Design and Development Centre to institute a six month programme. The test involved the construction of three walls of a simulated blocked manhole using three different types of concrete bricks (limestone, basalt, and limestone aggregates at 40, 40, and 20 N/mm² respectively). The fourth was built using a Clay Class B brick. The chamber was filled with a simulated acidic effluent, the pH of which was maintained throughout the six month experiment. Laing's subsequent report gave conclusions as follows:

'The evidence produced shows that any of the three types of concrete brick is suitable for manhole construction, but if there is a preference it is for the 40N/mm² limestone one.'

'All three types performed extremely well and only lost fractions of a millimetre at their exposed surfaces in an acid effluent for 6 months and only then from the three month interval.'

'Under practical conditions of use, a lifetime of many decades can be predicted for any of the bricks provided good workmanship is followed and the conditions of exposure lie within the ranges tabulated.'

Following these test results Marshalls applied for an Agrément Certificate which was granted in 1986. This Agrément Certificate has not been replaced as the collated data from it formed part of the updated concrete masonry **Standard BS 6073-2:2008** and subsequently **BS EN 771-3:2011+A1:201**.

Typical applications

Marshalls engineering bricks are particularly suitable above and below ground level where aggressive conditions occur and/or where natural sulphate levels up to and including Class 3 are present. They are especially suitable in chimney stacks, manholes, drainage inspection chambers, retaining walls, copings and caps and other constructions subject to aggressive conditions.

Approvals

Engineering Quality bricks are approved under the following Standard and by the following authorities:

1. Engineering bricks comply with **BS EN 771-3: 2011**
2. Bricks produced to the engineering specification comply with Table 12 'Durability of Masonry in Finished Construction' **BS 5628-3: 2005** and in the subsequent **Standard PD 6697:2019**
3. Freeze-thaw tests carried out the BRE in Scotland concluded that engineering bricks could be classed as frost resistant and equivalent to the old Category 'F' for clay bricks. They have minimal soluble salts.
4. As engineering bricks comply with **BS EN 771-3:2011+A1:2015** and **BS 5628-3:2005** and in addition are suitable for use up to and including Class 3 sulphate levels, the bricks are approved by the National House Building Council.
5. **BS 8301: 1985: Clause 5.73** (now replaced by **BS EN 752:2017**) states that a 40N/mm² concrete brick with a minimum cement of 350kg/m³ should be used in four situations. Consequently this Standard is referred to under the Building Regulations.
6. Engineering bricks can be used for inspection chambers, manholes and catch pits which are to be adopted by a Local Authority. In particular they are approved in:
 - WAA 'Civil Engineering Specification for the Water Industry'
 - Water Services Association's Guide 'Sewers for Adoption'
 - Highways Agency 'Specification for Highway Works'.

Performance

Under **BS 5628-3:2005** and **PD 6697:2019** the required strength requirement for use in foul situations requires the strength of concrete bricks to be 48N/mm². Marshalls engineering are produced to a compressive strength of 50N/mm². In addition they are produced using a cement mix which is suitable up to Class 3 sulphate conditions.

Note: It should be noted that the requirement for a Clay Class B brick in the same location is now 75N/mm². **This is purely because the test method for preparing and testing the compressive strength of clay bricks has changed.**

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Perforated engineering brick



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Appearance

Marshalls engineering bricks are produced in either a fully solid format or perforated format and are available in a red or a blue colour. The colours are primarily due to cosmetic perceptions of what an engineering brick looks like. Marshalls engineering bricks are not classed as facing bricks, although in certain locations their appearance may be aesthetically acceptable.

They are a brick, produced to extremely tight tolerances with a smooth, consistent colour appearance.

Brick comparison

Concrete EQs compared to Clay Class Bs

Clay Engineering bricks are categorised into two types:

- **Class 'A'** with a compressive strength of 125N/mm²; and
- **Class 'B'** with a compressive strength of 75N/mm².

Following on from the introduction of the new Standard for clay bricks, BS 771-1, the strength categories of these bricks were increased purely due to a change in the preparations of the sample prior to compressive testing. The basic composition of the bricks has not changed.

The use of Clay Class B and Concrete Engineering bricks are covered in both **BS 5628-3:2005** and **PD 6697:2019**

The requirement for long term durability should not be confused with the different compressive strengths exhibited by different materials. Only a few specialised structural situations require bricks with strengths in excess of 35N/mm². In the majority of situations, where durability is the prime requirement, concrete engineering bricks perform in the same way as Clay Class B bricks.

Limitations of use

Engineering bricks should not be used in excessively strong acid environments. However, it should be noted that in these particular locations, if built with any brick, then the mortar joints may be subject to attack and consideration should be given to using an alternative form of construction.

They are also not suitable for use as dpc.

Advantages of concrete engineering bricks

- Marshalls perforated engineering brick offer the same performance as the solid engineering brick and are available from stock.
- Marshalls solid engineering bricks are a custom made unit manufactured on a regional basis with competitive prices, consistent availability and realistic delivery periods.
- Concrete hardens with age. A brick which is 50N/mm² strength at its early stage will keep increasing in strength and resistance to moisture.
- Marshalls engineering bricks are a custom made unit manufactured on a regional basis with competitive prices, consistent availability and realistic delivery periods.

Summary

The development of the concrete engineering brick, which has been in existence now for over 30 years, has led to its increased use as a cost effective, readily available masonry unit. Produced on a regional basis throughout the UK it is generally available from stock and can be delivered either direct to site or via the extensive network of Builders Merchants supplied by Marshalls.

USING MARSHALLS BRICKS WITH DISSIMILAR MATERIALS

It is recognised that a large proportion of building materials, especially masonry walling products, can have different characteristics stemming from their basic raw materials, manufacturing methods, properties and performance, and although these products all fulfil the functions required of them, the designer and end user should be aware of the differing properties and the effect on the final building.

A prime example is that of concrete and clay bricks. Both products expand and contract in response to thermal movement but clay bricks suffer an irreversible expansion after manufacture due to adsorption of moisture from the atmosphere. That expansion can vary depending on the type of clay and the firing method.

By contrast, concrete has a tendency to shrink during drying and expand back to its original size when wetted. It should be noted that the drying shrinkage and moisture movement of concrete masonry can vary from the extremes of aerated concrete @ 0.09% to that of Marshalls bricks @ 0.02-0.03%. These values themselves can influence the frequency and position of movement joints.

However, there are instances where Marshalls bricks and clay bricks are to be used together and in these cases it is important that steps are taken to accommodate the differential movement that may occur.

1. If either type of brick is used below dpc and another type built off it, e.g. Marshalls bricks below dpc and clay bricks above it, then the dpc may act as a slip plane and allow some amount of lateral movement between the two products. Below dpc, because the Marshalls brick is likely to be in a semi-damp location, then it may not be necessary to incorporate movement joints at the recommended intervals as the likelihood of shrinkage and hence the risk of differential movement is small.
2. If the clay brick is used below dpc and the Marshalls brick built off it then normal incorporation of movement joints in the superstructure should be sufficient to accommodate the differential movement.

3. **Feature Panels:** These may be located where either clay or concrete bricks are incorporated as feature bricks surrounded by an alternative product. In these instances provision should be made in the form of horizontal dpcs to act as slip planes both above and below the panels. Vertical joints should be installed at the edges. In all cases the number and position of wall ties should be adjusted to ensure structural stability. An Engineer's opinion should be sought to verify the design.
4. **Splash Courses:** These can be examples where bricks are built up off the dpc for a number of metres or even up to the height of the wall head at ground floor level. Again, slip courses may be introduced to allow for differential movement between any different materials. If the Marshalls bricks are built at the base level then it is likely that the dead weight and superimposed load of the masonry above those brick courses may be sufficient to restrain the brickwork to the extent that it may be possible to minimise the frequency and distance that movement joints are required. This depends on the type of masonry unit that is built on top of the brickwork.
5. Should rendered aggregate concrete blockwork be built on top of concrete facing work then any movement joints incorporated into the blockwork should be followed through the brickwork courses below.
6. Where there is an element of doubt or suitability regarding the efficiency of a slip plane then an alternative action of incorporating bed-joint reinforcement into the structure should be considered. This will have the effect of dissipating internal stresses and controlling the differential movement.

FIRE RESISTANCE

Concrete masonry in the form of a Marshalls brick is a non-combustible construction material possessing excellent fire resisting properties. The resistance to fire within a structure utilising concrete masonry products is a function of:

1. The thickness of the units involved
2. The function of the wall, i.e. whether or not it is load-bearing
3. Wall construction, ie. whether it is single leaf or cavity construction
4. The applied wall finish, whether plastered or otherwise
5. Finally, the type of aggregate used to produce the masonry units.

Marshalls products are all produced from Class 1 aggregates, are classed as non-combustible with a zero spread of flame, and are further classed as Category A1 in accordance with **BS EN 13501-1:2018**.

The table below indicates the nominal fire resistance periods for Marshalls various types of masonry, i.e. common and facing bricks.

They are based on: Table 14 of BS 5628-3:200.

WALL THICKNESS MADE FROM BRICK	FIRE RESISTANCE IN HOURS	
	No finish	VG finish
	Load bearing single leaf wall	
100mm	2	3
140mm	4	6
215mm	6	6
	Non load bearing single leaf wall	
100mm	2	3
140mm	3	6
215mm	6	6

WALL THICKNESS MADE FROM BRICK	FIRE RESISTANCE IN HOURS	
	No finish	VG finish
	Load bearing cavity wall	
100mm	6	-
140mm	6	-
215mm	6	-
	Non load bearing cavity wall	
100mm	6	-
140mm	6	-
215mm	6	-

Notes:

- Marshalls bricks are produced in a minimum thickness of 100mm.
- Finishes should be not less than 13mm plaster on each face of a single leaf wall and the exposed faces of a cavity wall. VG is Vermiculite: gypsum plaster.
- The thicknesses quoted are in millimetres and represent the work size of the unit or, where applicable for solid walls, the sum of the work sizes for two units including the joint between them.

BTB 14

SOUND INSULATION

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The ability of a material to reduce the transmission of sound or noise (noise being unwanted sound) through a panel or wall is primarily based on the mass of that material, although it is also affected by air paths. Consequently the sound reduction of a panel or wall is directly linked to its total mass, including any mortar joints or finishes.

The 'Mass Law' establishes a relationship between Mass and the Sound Reduction Index (SRI) when measured over a range of frequencies.

The average built wall weights for Marshalls bricks, assuming a coat of lightweight plaster on one leaf of the 100mm wall and two coats of lightweight plaster on the 215mm thick wall, are as follows:

Solid dense brick of approximately 3.1kg in weight:

100mm thick wall
@ 214kg/m²

Solid dense brick of approximately 3.1kg in weight:

215mm thick wall
@ 458kg/m² Frogged/Perforated Dense brick of approximately 2.5kg in weight:

100mm thick wall
@ 189kg/m² Frogged/Perforated Dense brick of approximately 2.5kg in weight:

215mm thick wall
@ 405kg/m²

Based on the above figures the estimated Sound Reduction Index for each wall type, when measured over a frequency range of 100-3150Hz, is as follows:

Solid Dense Brick:

100mm wall
@ 46dB

Solid Dense Brick:

215mm wall
@ 50dB Frogged/Perforated Dense Brick:
100mm wall @ 45dB Frogged/Perforated

Dense Brick:

215mm wall
@ 48dB

The Building Regulations Approved Document E details the requirements for satisfying the criteria for Party and Separating Walls in dwellings. Alternatively, a system of Robust Details may be used, which if followed avoids the need for pre-completion testing.

For those details shown in the Building Regulations, the use of solid dense bricks in both a 215mm thick wall and in a wall constructed of two leaves of 100mm brick with a 50mm cavity would exceed the 415kg/m² requirement.

By utilising Marshalls dense bricks, particularly those in a solid form, these could be considered to be similar in performance to that of dense aggregate blocks which are acceptable under the following Robust Details Notations.

Two leaves of dense solid bricks with a 75mm cavity and 13mm plaster.

RD Notation: E-WM-1

Two leaves of dense solid bricks with 8mm parging and drylining:

RD Notation: E-WM-3

Two leaves of dense solid brick with a 100mm cavity and 13mm plaster.

RD Notation: E-WM-18 215mm

Solid wall (on Raft Foundations only), 15mm dense plaster and drylining:

RD Notation: E-WM-9

Refer to the Robust Details Handbook for full details of the above, including specification of flanking elements.

Notes: Good practice points must be followed in all elements of separating wall construction, including:

- Direct air paths must be avoided, hence the necessity for wet plaster or parging.
- Careful detailing at junctions with flanking walls, ceilings and floor slabs.
- No services should pass through the walls and any chasing, especially back to back, should be avoided.

It should be noted that changes to Part L1A in the Building Regulations for England and Wales state that cavity separating walls can lose a significant amount of heat by convection via the cavity. Consequently, edge sealing to prevent convection is a requirement in order to achieve U-values of 0.02W/m²K or 0.0W/m²K if the cavity is sealed and filled with the appropriate insulation. Full details are given in the Robust Details information.

The density of Marshalls bricks can give an advantage in external use, particularly in flanking walls with lightweight structures such as timber framed constructions, as the bricks offer higher resistance to sound transmission.

BTB 15

THERMAL INSULATION

Page 1 of 1

Marshalls bricks will generally be used in a number of locations during the construction process with the following effect on the thermal performance of the building.

Facing bricks/Dense Concrete Common bricks/Utility bricks/Dense Coursing bricks

The products can be considered similar to dense aggregate blocks in terms of density and thermal conductivity. They would normally be used in external walls or below ground level, although solid common bricks will offer particularly good values of sound insulation in separating walls.

Thermal conductivity (dry)	Thermal conductivity @ 3% m/c	Thermal conductivity @ 5% m/c
1.11 W/mK	1.24 W/mK	1.33 W/mK

Lightweight coursing bricks

Lightweight coursing bricks have similar properties to medium weight aggregate blocks with a density range of <1550kg/m³. Coursing bricks are available in both 100mm and 140mm widths.

Thermal conductivity (dry)	Thermal conductivity @ 3% m/c	Thermal conductivity @ 5% m/c
0.42 W/mK	0.47 W/mK	0.50 W/mK

Engineering bricks

Engineering Bricks have a slightly higher density than normal dense bricks with thermal conductivity values as follows:

Thermal conductivity (dry)	Thermal conductivity @ 3% m/c	Thermal conductivity @ 5% m/c
1.24 W/mK	1.39 W/mK	1.47 W/mK

Air permeability

Although no declared values are quoted, similar products achieve air permeability values of 0.15m³/hr/m².

Specific heat capacity

Assume values of 840-880J/kg °C.

U-Value

Currently, to achieve the maximum U-values allowed in UK Building Regulations, a value for external walls of 0.18W/m²K is set, although lower values may be specified. Other aspects such as air permeability, edge sealing etc. have to be taken into account.

Due to the amount of additional insulation incorporated either into the cavity or on the inner leaf, the thermal properties of an external facing brick have no real significance on the overall performance of the wall. Consequently, Marshalls facing brick can be deemed to produce similar results to that of a rendered dense aggregate block or reconstructed stone unit. Due to the infinite numbers of permutations in achieving the required U-value using internal and cavity insulation systems and inner leaves it is impractical to demonstrate methods of achieving the required thermal requirements in this particular Bulletin.

Note: When calculating U-values the effect of mortar joints when using Marshalls bricks can be ignored. For precise calculations the conductivity data given above should be used in individual cases.

Coursing bricks

Marshalls coursing bricks are produced in two widths, 100mm and 140mm, to suit the most popular block sizes. Both types are 65mm high and are available either as dense coursing units to be compatible with dense aggregate blocks, or as lightweight/medium aggregate bricks to complement medium/lightweight aggregate blocks. They are not suitable for use with autoclaved aerated blocks.

Appendix 3. Health & Safety Data Sheets

HSDS 1

PRODUCT HAZARDS

This Data Sheet is a formal notification as required by Section 6 of the Health & Safety at Work Act, as amended by the Consumer Protection Act 1987. This legislation requires us to provide customers with certain information pertaining to the properties and safe use of our products. It is important that this information is distributed to all relevant personnel and/or sub-contractors or other parties employed by yourselves in the handling and use of these materials.

Products

Precast concrete and masonry products manufactured and marketed by Marshalls comprise of bricks, blocks and reconstituted stone walling items. Architectural Cast Stone Dressings and Structural and Bespoke Precast items.

They are produced from the normal constituents of concrete, and when presented in their normal form and manner are unlikely to give rise to any significant risk to health. The normal constituents are:

- Natural and Artificial Aggregates
- Cementing Agents
- Additional Binders
- Non-Toxic Iron Oxide Pigments.

Physical and chemical characteristics

Precast and masonry concrete products are manufactured to fine tolerances by the compaction and/or vibration of a hydrated mix of constituent materials which subsequently undergo a curing process. Concrete of this nature can be considered to be inert and therefore presents no major chemical hazard.

Main hazards

The handling of concrete products may cause abrasive damage to the hands. Excessive handling may cause dermatitis or drying of unprotected skin.

Manual handling should only take place where the weight of the unit(s) permits, otherwise injury may occur. Weights of products are available from the supplying works.

Cutting, drilling, grinding or similar treatment of the products will give rise to respirable dust. Such dust, if inhaled in excessive quantities over extended periods, can constitute a long-term health hazard. Cutting, unless adequately controlled, can project particles at high velocity, with consequent risk of impact damage. Steel reinforcement, which may be integrated into some precast units, may constitute a fire hazard from the

resultant sparks if the units are to be cut. Wet cutting processes minimise the dust exposure, however the product appearance may be affected. Dry cutting processes will require appropriate and adequate dust extraction and protective equipment.

For further/additional information see Product Data COSHH Sheet, Appendix 3.

Cleaning and maintenance

Periodic cleaning may be carried out by washing with water and mild detergents, using soft brushes. For more assertive cleaning refer to specialist concrete cleaning agencies.

Aggressive cleaning with high pressure washers and/or diluted acids will/may leave units with a coarser texture which will/may change the apparent colour and appearance.

Precautions

During cutting or similar surface treatment, inhalation of dust should be avoided and eyes protected. When working with heavy, dense, cementitious building products, personal protective equipment (PPE) such as gloves, masks and protective footwear should be worn.

Care should be taken when handling heavy components, and mechanical lifting equipment should be used in accordance with the Manual Handling Regulations.

Care is also required when cutting and disposing of any packaging materials so as to avoid injury (for example, banding straps used to restrain the product will be under tension with the potential risk of springing out when cut). Relevant PPE should be worn.

Transportation and storage

The carriage of concrete products is not subject to hazardous substance conveyance regulations and vehicle labelling is not required.

Particular care should be taken in the handling and stacking of units or packs of units, taking into account the weight, method of handling, condition of the ground, and stability of the packs.

For further/additional information see Product Data COSHH Sheet, Appendix 3.

Waste disposal

Hardened concrete is inert but should be disposed of in accordance with local regulations.

Products may be delivered in packaging that comprises of polythene covers, steel and plastic strapping and wooden pallets. All types of packaging require careful site disposal after use. In particular the haphazard burning of polythene covers and wooden pallets will, in themselves, release smoke and fumes which can be inhaled in sufficient quantities to be injurious to health.

Note: Although Marshalls does its best to ensure that any advice, recommendation or information it may give is accurate, no liability of any kind (including liability for negligence) is accepted in this respect by the Company, its servants or agents.

HSDS 2

SAFE LOADING, TRANSIT AND OFF-LOADING OF PRODUCTS

The notes detailed below are offered as guidance on the safe loading, transit and off-loading of our products. For the purposes of clarity, references to sites will also apply to storage and merchants yards, and the term contractors also applies to all who are in receipt of our products, including, but not limited to builders merchants and private individuals.

Application

This data sheet applies to:

- All factories manufacturing or distributing products made by Marshalls Bricks & Masonry
- Any company-owned, franchised or contracted delivery vehicle
- All customer vehicles whilst collecting from Marshalls Bricks & Masonry factories
- Any indirectly owned customer vehicles which collect or deliver from any Marshalls Bricks & Masonry factory.

Legal responsibilities

- It is the duty of Marshalls to ensure that all its activities, including delivery and collections of its products, are done in a manner which does not prejudice the health, safety or welfare of its employees, sub-contractors, customers or members of the public.
- It is the duty of every delivery driver, whether directly or indirectly sub-contracted to Marshalls, to ensure that his own safety and that of all others is protected.
- Marshalls must ensure that all delivery drivers who collect or deliver on its behalf have demonstrated they have the necessary training, competency and knowledge to comply with all legal and Health & Safety requirements.
- Marshalls must also ensure, as far as is practical, that its products are loaded, conveyed and off-loaded in such a way as to protect the health and safety of our customers, sub-contractors and members of the public.

Marshalls loading responsibilities

- Marshalls will carry out and document adequate risk assessments on the loading and transit of its products.
- Marshalls will ensure that the relevant safe systems of work (SSW) are provided and operated where necessary to minimise hazards.
- The SSW require an appropriate and adequate method of restraint to be used on loads in order to minimise movement or loss in transit.

- The SSW will include measures necessary to ensure the safety of drivers, loaders and all other yard personnel or pedestrians when vehicles are on our premises.
- Marshalls will ensure that all drivers of loading machines have sufficient training to carry out their duties in a safe manner. Assessment of the competency of loader drivers and all other yard personnel will be carried out at regular intervals.

Marshalls and third party hauliers' responsibilities

- The haulier must carry out an adequate risk assessment on the safety and integrity of the load prior to off-loading so that all relevant hazards are identified and Health & Safety procedures are followed.
- The haulier's SSW must ensure that adequate and appropriate restraints are used on the load.
- The haulier must ensure that all drivers have sufficient training to carry out their duties in a safe and legal manner and that Hiab- type cranes are only operated by suitably trained personnel whose training records are available for inspection. This requirement also applies to any vehicles with detachable off-road fork trucks.
- Delivery drivers have a duty to familiarise themselves with all relevant risk assessments, SSWs and specific site procedures from any Marshalls factory or delivery site, if necessary, prior to any unloading.
- The SSW should address the issue of reversing safely, which includes the requirement for a designated banksman being present to control operations.
- Access to sites by the haulier should only be carried out with the express permission of the contractor or, in his absence, his agent and must at all times comply with all relevant site specific rules.
- The haulier shall ensure at all times that his personal protection equipment is maintained and is utilised as required by both Marshalls and any contractor on site.
- No loading or unloading operations are to take place from vehicle platforms unless suitable methods of prevention of falls from vehicles are in place.
- Access to unload materials, sheet/unsheet/fix/unfix load securing straps, or other restraints should only take place using secured access systems.
- Any accidents, near misses or incidents should be reported to the relevant site personnel and the relevant report completed and signed.

Customer responsibilities

- Customers have a legal responsibility to perform their own risk assessment of operations on their sites.
- Customers should ensure that their risk assessment controls and SSW are made known to delivery drivers arriving on their site, and satisfy themselves that the delivery driver can perform his duties in a safe manner and with due regard to site rules.
- It is the customer's responsibility to ensure that materials are off-loaded and stored in a safe and neat manner, and protected from the elements where required.
- If customers off-load materials themselves, then they must satisfy themselves that the competency and training of their own personnel satisfies their own SSW.

Unsafe conduct

- Where an unacceptable safety risk is known to exist on site, the haulier should draw this to the customer's attention, and ask for rectification within a reasonable timescale. Marshalls and the haulier reserve the right to withdraw deliveries until the safety risk has been removed.
- Should the customer detect any unsafe conduct by the delivery driver, then deliveries may cease until a safe, alternative method of delivery can be agreed. Should the customer be unable to resolve the incident with the haulier, then it should be reported to Marshalls who will attempt to resolve any issues.

Approved hauliers

- Regular hauliers who consistently operate from any Marshalls factory, and who deliver materials on its behalf, are obliged to comply with the requirements of this Health & Safety Data Sheet. Marshalls will also ensure that, where practical, any customer-owned, franchised or indirectly employed vehicle also conform to these requirements.

Note: Although Marshalls does its best to ensure that any advice, recommendation or information it may give is accurate, no liability of any kind (including liability for negligence) is accepted in this respect by the Company, its servants or agents.



HSDS 3

PRODUCT DATA COSHH SHEET

01 IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING	
Identification of substance	Precast concrete products.
Product description	Precast concrete paving, kerbs, channels, block paving, drainage channels, walling products & specific decorative products marketed under many different range names.
Manufacturer/supplier	Marshalls Mono Ltd., Landscape House, Premier Way, Lowfields Business Park, Elland HX5 9HT
Telephone number	(+44) 01422 312 000
Technical advisory services	0370 411 2233
02 HAZARDS IDENTIFICATION	
Handling	Care must be taken when handling precast units, especially when operating at height such as from a scaffold or tower. Risk of serious injury or death from falling objects if suitable and proper site practice is not followed and adhered to. Standard site personnel protective Equipment such as Hard Hat, Gloves, Safety footwear and safety glasses should be worn when handling or modifying the precast units.
Cutting	Dry cutting of hardened precast units will produce excessive amounts of dust that will contain respirable Quartz, this may constitute a chronic health hazard. Accordingly when possible dry cutting should be avoided. Long term prolonged exposure to high levels of respirable crystalline silica can also lead to an increased risk of developing silicosis and lung cancer. Any dry cutting or finishing can also result in particles being projected at high speed with the consequent risk of injury or damage. If products are hit with a trowel, bolster scotch etc, sharp chips and splinters may fly and damage skin or eyes.
03 COMPOSITION/INFORMATION ON INGREDIENTS	
Description of the preparation	Sand, aggregate, cementitious material, pigments, admixtures and water are combined and processed to form dense concrete products.
04 FIRST AID MEASURES	
General advice	In all cases of doubt, or when symptoms persist, seek medical attention. Never give anything by mouth to an unconscious person.
Inhalation (dust)	Remove to fresh air and seek medical attention if required
Skin contact	Minor cuts and grazing can occur on sharp edges. Wash skin thoroughly with clean soap and water use a proprietary skin cleaner and apply suitable dressings. Treat with normal antiseptic if required.
Eyes contact	Contact lenses should be removed. Irrigate copiously with clean, fresh water for at least 10 minutes, holding the eyelids apart. Obtain medical attention if irritation persists.
Ingestion	Pre cast units: Not applicable From cutting: If dust is accidentally swallowed remove from exposure and seek medical attention if required.
05 FIRE FIGHTING MEASURES	
Suitable extinguishing media	Concrete is not flammable and will not facilitate combustion with other materials
Precast Concrete Material Safety Data Sheet	www.marshalls.co.uk
06 ACCIDENTAL RELEASE MEASURES	
Personal precaution	In the event of dust release, avoid breathing in dust. Wear dust mask/respirator and goggles.
Eyes contact	No danger, but material should be disposed of in accordance with local authority guidelines
Ingestion	No special requirements. Where possible use mechanical aids to reduce the risk of manual handling injury. Avoid sweeping that creates dust and vacuum dust where practical.



Appendix 4. Frequently Asked Questions

Frequently asked questions

Below is a list of some of the more frequently asked questions relating to our brick products, together with our responses, supported by the more detailed information contained in our Technical Manual, Brick Technical Bulletins and Brick Technical Data Sheets.

Please note the information and guidance only relates to Marshalls bricks and should not be read as generic advice for any other concrete brick.

1. What is a concrete brick?

A concrete brick is a masonry unit produced by compacting a semi-dry concrete mix using a combination of selected aggregates, cement and various admixtures along with synthetic pigments to produce a brick with low water absorption and minimal efflorescence. The resultant product is a dense unit with proven durability and frost resistance. This manufacturing process is easily and accurately repeated ensuring each unit has the same properties and appearance.

2. What are the main benefits of concrete bricks?

- Concrete bricks will gain strength with age.
- Concrete bricks are extremely durable and frost resistant with minimal efflorescence.

Please refer to:

➤ **BTB 6:**
Durability
Page 62

- Concrete bricks are dimensionally accurate.
- Concrete facing bricks are through coloured.
- The superior strength and performance of a concrete brick means that facing bricks to 35N/mm² strength are suitable for use in free standing and earth retaining boundary walls, in foundations and below dpc.
- The manufacturing process requires minimal energy input, resulting in a very low environmental impact.

Please refer to:

➤ **BTB 3:**
Environmental characteristics
Page 48

- Concrete bricks absorb CO₂ throughout their lifecycle giving further positive contribution when considering product sustainability.

3. How are concrete bricks environmentally friendly?

- Concrete Bricks are an inherent CO₂ absorber.
- 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 secondary product of quarrying.
- Most aggregates used are from sources local to our plants and our delivery points are typically within 100 miles therefore reducing our impact and associated carbon footprint.
- Marshalls bricks are manufactured in the UK and have no adverse environmental impacts associated with imported products
- The high energy firing of kilns in clay production processes is not required for the curing of our Concrete Bricks. We simply use the natural exothermic reaction of the cement with little additional energy input. This means minimal natural resources are consumed and emissions are kept to a minimum.
- Concrete brick has a BRE A+ Rating for brickwork.

4. What is the difference between Marshalls concrete bricks and clay bricks?

- Fundamentally they are both small element masonry units designed to fulfil the same purpose, although they are made by different processes and have slightly different properties. The appropriate product standards specify the characteristics and performance requirements but give no detail as to where or in what conditions they can be used. These are covered by other standards such as BS 5628: 2005 and the superseded version of PD 6697: 2019. Generally speaking both clay and concrete bricks may be used for the same purposes and in the same areas of construction.

Please refer to:

➤ **BTB 2:**
Product comparison
Page 45

5. What is the difference between Marshalls concrete bricks and other concrete bricks?

- Marshalls has over 60 years' experience of manufacturing and developing concrete bricks. This wealth of knowledge ensures that Marshalls bricks are produced and tested to exacting standards giving

users the confidence that the product will comfortably last the lifetime of the building. Marshalls bricks have been tested for frost resistance over 100 cycles and are classed as fully frost resistant (similar to the 'F' classification for clay). Marshalls bricks are manufactured from carefully selected and sourced raw materials that are precisely blended for maximum performance.

- It is important to recognise that bricks are not the same as other concrete products, particularly in relation to their performance characteristics and requirements.
- Users should satisfy themselves that the product meets all the standards, practical application and performance requirements before selecting alternative brick suppliers.
- Particular areas to focus on are: durability; strength; movement characteristics and susceptibility to shrinkage cracks; and colour integrity including efflorescence control.

6. What is the lifespan of Marshalls bricks and how long are they guaranteed for?

Concrete is a building material that has been used since the days of the Romans and in the form of precast masonry units since the beginning of the last century. Marshalls bricks in the UK have been produced since the 1950s and indeed were used in the construction of the original Calder Hall nuclear complex now Sellafield, which was opened in 1956.

Since then the product has evolved and developed to a stage where it is now the preferred medium for a large number of developers and contractors. One of the prime benefits is their inherent frost resistance and durability derived from their increased strength as they age. Consequently, provided they have been used in the appropriate manner and location they should be suitable for use in excess of 60 years.

Frequently asked questions

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7. What coloured mortars can be used to match Marshalls facing bricks?

Most of the major pre-mixed mortar suppliers can supply colour swatches or samples of different coloured mortars. These are a better option than trying to select off a printed page. Site batching using pigments rarely gives satisfactory results unless it is for small quantities where one batch of mix will suffice. Reproduction of consistent coloured mixes on site is difficult due to changes in moisture content, mix time or dosage rates. Typically the advice is to choose between a complimentary or contrasting mortar, the latter tending to give a more dramatic impact but is less forgiving on the quality of the brickwork.

Please refer to:

 **BTB 4:**
Mortars for concrete masonry products
Page 50

8. What are the preferred mortar joint profiles for Marshalls bricks?

The choice of mortar and its finished profile can have a profound effect on the final appearance and performance of a finished wall. The choice of joint should be considered in respect not only of the finished appearance but also the brick type and level of exposure. For example, a heavily recessed or stripped joint may give the desired aesthetic effect but it is not recommended in areas of high exposure or where full cavity fill is used. By comparison a flush joint is hard to compact fully and should only be used in sheltered or internal locations. In all cases full bedding of the mortar bed and complete filling of the perpend is essential due to the low-medium absorption of the bricks which tends to throw water towards the joints.

Please refer to:

 **BTB 4:**
Mortars for concrete masonry products
Page 50

9. What are the differences between using silo batched or pre-mixed mortars compared with site batching and mixing?

Silo based and pre-mixed factory produced 'ready to use tubbed' mixes offer consistency and convenience of mix. The silo based mixes can have their workability adjusted on site to suit the suction of the masonry whilst the retarded tub mixes may require additional

time to stiffen before final tooling of the joint can be carried out.

Site batching and mixing on site can be suitable for smaller works but can also be variable in consistency, especially if coloured mixes are required.

In all cases it is important that the correct specification of mortar is used. Under the latest standards the old volumetric method of specifying mortars, eg. 1:1:6, has been superseded by a nominated mortar grade, eg. M4 (4N/mm² strength). Due to the safety factors in manufacturing the mortar suppliers may offer a mortar with a strength of 5-6N/mm². Strong mortars can contribute to potential cracking risk and it may be prudent for the customer to confirm the likely actual strengths whilst specifying the mortar.

Please refer to:

 **BTB 4:**
Mortars for concrete masonry products
Page 50

10. How can I best achieve a clean, even joint in the brickwork?

The key to achieving good quality brickwork is to ensure that the mortar consistency is adjusted to reflect the characteristics of the brick. As Marshalls bricks tend to have low-medium absorption characteristics they are suited by a 'stiffer' mortar similar to that required for Clay Engineering Bricks. If the mortar is too wet there is a tendency for the excess to be squeezed out and this could lead to "smearing" when striking off with a trowel. To assist in all areas of jointwork the main areas to focus on are to ensure that the bricks and brickwork are kept dry and protected and that the workability of the mortar is correctly adjusted.

Please refer to:

 **BTB 4:**
Mortars for concrete masonry products
Page 50

11. How important is mortar quality within a wall?

The grade and quality of mortar has a crucial part in the performance of a brick wall particularly in relation to its durability, weather fastness and resistance to any potential cracking. Mortar consists of over 17% of the wall area and the correct choice is crucial. Under the old Standards, mortar was specified by volume eg. 1:1:6, that is one part of cement, one part of lime and six parts of sand.

This traditionally gave a mortar strength of around 4N/mm². Mortars now are designated by strength category, e.g. M4, which in theory is equivalent to 4N/mm². In practice, because that is a minimum strength requirement, pre-mixed mortar suppliers have to take account of strength variations and hence average strengths maybe higher so to ensure that there are no results less than 4N/mm². The same analogy applies to Marshalls bricks. In order to claim a minimum strength of 22.5N/mm² the actual brick average strength may run at 28-32N/mm². The strength of mortar therefore is particularly important in relation to a risk of cracking within a wall.

As well as constituting 17% of the overall area, mortar differs from bricks in three ways:

- Mortar has a higher mix water content than bricks.
- Mortar has a higher cement content than bricks.
- Mortar is made with finer aggregate than bricks.

Consequently mortar has a higher shrinkage and moisture movement value than Marshalls bricks. The stronger the mortar the greater the risk of cracking.

Lime-based mortars are more flexible and accommodate movement better than pure sand:cement mixes. In addition they have the capacity for autogenous healing whereby any micro cracks self seal themselves over a period of time.

Experience from sites has shown therefore that if properties are built with no facility for accommodating movement in the form of joints or bed joint reinforcement in the appropriate locations and strong mortars are used then there is a risk of cracking around the openings.

12. Do I have to use any special techniques or make any allowances when building with Marshalls bricks?

Building with concrete bricks should pose no more problems than using any other masonry products. If anything the dimensions and consistency of a concrete brick can help with the laying out and maintenance of brick courses.

The product should be dealt with in the same way as if building with dense concrete blocks or reconstructed split walling stone.

The number of courses achievable per day should be between 15-20. Bricks should be kept dry and in accordance with BS 8000-3: 2020. The height of lifts should not exceed 1.5 metres or 20 courses each day.

Frequently asked questions

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13. How should movement be accommodated within the structure?

As with all other building materials Concrete bricks can and will move when subjected to thermal, moisture or structural effects.

In practical terms the shape and height:length ratio of the masonry panels is the major factor in accommodating movement. From experience we find that vertical movement control measures in the range of 7.5 - 9m in length will be adequate.

Please refer to:

 **BTB 5:**
Movement control
Page 53

14. I know that I may have to install vertical movement joints into my elevations but do I also need to incorporate horizontal joints?

The degree of horizontal movement can be classed as the same as vertical movement, although due to panels being more heavily loaded 'horizontally' the requirement is likely to be less than for vertical movement control which Marshalls recommends at 7.5 - 9m. Generally speaking horizontal joints are not required on two storey buildings, but in buildings that exceed 4 storeys or 12 metres in height they should be installed at every second storey.

Particular attention should be given to low level parapet walls at the top of a building which may be relatively lightly loaded and are long and slender. Should 'horizontal support' be under consideration then Marshalls would suggest reference to a suitably qualified engineer or specialist fixing company.

Please refer to:

 **BTB 5:**
Movement control
Page 53

15. How cost effective is bed joint reinforcement and is it really necessary?

Bed joint reinforcement (BJR) can be used to control movement and supplement any movement joints. It is not intended to fully replace movement joints but the manufacturers claim that it allows joint spacing to be increased by up to 50%. It should be of structural grade such as the lattice or ladder type (which consists of two parallel flat stainless steel bars cross-linked at intervals by wires). It should not be confused with lightweight mesh which is sometimes used to bond internal walls together. BJR is available to suit different widths of masonry and is inserted into the mortar bed and is therefore hidden.

The purpose of BJR is to increase the tensile strength of a wall and dissipate any internal stresses over a wider area, thus reducing the risk of cracking. It is mainly used above and below openings and should extend some 600mm either side of the opening.

Generally speaking we recommend it for openings greater than 1.2 metres. Normally two courses are installed in consecutive courses immediately above and/or below the opening. The use of BJR is not restricted to concrete bricks or blocks and is common practice in all masonry types.

BJR is particularly effective in examples such as front elevations where installation of a movement joint would be neither practical nor visually attractive.

The cost of BJR will vary between manufacturers but the overall cost for the inclusion within a full house can be off set against the savings in forming movement joints and the potential cost of remedying or replacing any cracked bricks. The cost should be viewed within the context of the whole build cost.

16. What key characteristics change dependent on the form (solid, frogged, perforated) of Marshalls bricks?

The main differences that the form makes relate to weight and density of the brick and brickwork.

Please refer to:

 **BTDS 1:**
Facing bricks
Page 33

 **BTDS 4:**
Dense concrete common bricks
Page 36

17. Can I use Marshalls Frogged or Perforated bricks as coursing units?

Coursing bricks are normally used in conjunction with blocks to make up course heights; fill gaps within blockwork and for use in reveals. They may be subject to being cut or drilled and although in theory the bed face mortar will make a frogged or perforated brick 'solid', this mortar typically has an average strength which is less than the blocks or bricks.

NHBC requires that infill units have to be compatible with the background block so therefore a solid brick is ideally suited to a solid block of similar performance characteristics.

Please refer to:

 **BTB 10:**
Coursing brick applications
Page 71

18. Do Marshalls coursing bricks need to have a certain texture?

Bricks with a very smooth, dense face may, in some circumstances, cause adhesion problems if plastered or rendered. NHBC recommendations are that coursing bricks should have properties similar to that of the background block, ie. dense or lightweight aggregate and in terms of density, finish, absorption etc. Block textures tend to vary depending on the particular manufacturer but generally speaking standard Marshalls commons have similar properties to aggregate blocks and are therefore acceptable as a coursing brick with blocks.

Please refer to:

 **BTB 10:**
Coursing brick applications
Page 71

Frequently asked questions

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19. What are the sound reduction properties of Marshalls bricks and is the heavier weight of the bricks an advantage or disadvantage?

Dense bricks and blocks both offer high degrees of sound reduction or attenuation where increased mass gives higher degrees of reduction. Dense facing bricks in particular are suitable for use in lightweight constructions such as timber framed housing for reducing external noise and flanking transmission.

Please refer to:

 **BTB 14:**
Sound insulation
Page 78

20. What is the maximum strength of Marshalls bricks that are available?

This depends on brick types. For example an Engineering brick has a compressive strength of 50N/mm² which is achieved by a significant increase in cement content and compaction which may not be possible in many facing bricks.

The minimum suggested strength of 22.5N/mm² covers the majority of applications where the brick would be used.

Higher strength brick requirement, for example, for use in lift shafts may require units that have to be specifically made but generally speaking a facing brick would only be available with a maximum strength of 35N/mm². It is usually only special situations/circumstances that require loading strengths > 22.5N/mm² and this characteristic also ensures the durability of the brick.

Please refer to:

 **BTB 6:**
Durability
Page 62

21. What is the correlation between water absorption and absorption by capillarity?

The traditional method of measuring the water absorption of bricks was to dry the bricks completely, then soak for 24 hours and measure the percentage increase in weight. This gives a value of the total absorption from an oven dry state to saturation but gives no indication of the rate of absorption. The alternative, current method, involves measuring the increase in weight by partial immersion in water over a ten minute period. As such it measures the rate of absorption per second per square metre.

Consequently there is no real correlation between the two sets of results. Both sets of results are therefore quoted in the relevant product Technical Data Sheets.

For concrete bricks the degree of absorption is different to that of clay bricks. Whereas in the latter case high absorption figures may indicate low levels of frost resistance, with Marshalls bricks the low-medium values allow a degree of bond with the mortar but at the same time reduce the risk of dirt absorption on the faces and ensure resistance to frost.

Please refer to:

 **BTB 9:**
Resistance to rain penetration
Page 69

22. What is the difference between Category I and Category II masonry?

The relevant standard allows for two categories of manufacturing control.

Category I, which replaced the old Special Category, covers units where the probability of the unit failing to reach its declared compressive strength is less than 5%. This normally involves independent third party assessment of the manufacturing and quality control process.

Category II involves any process not covered by Category I.

In the case of Marshalls Bricks & Masonry we are currently working towards BS EN ISO 9001:2015 registration. However in practice the actual compressive strength levels achieved tend to be in excess of the minimum standards. All Marshalls bricks are regularly checked and tested.

23. Can Marshalls bricks be used below dpc?

Yes. Marshalls bricks (with the exception of medium density lightweight coursing bricks) are eminently suitable for use above and below dpc, but not as an actual dpc. The relevant standards BS 5628: 2005 and PD 6697: 2019 recommend a minimum compressive strength of 22.5N/mm² for the majority of locations. Marshalls Bricks comply in terms of both strength and frost resistance.

Please refer to:

 **BTDS 1:**
Facing bricks
Page 33

24. Can I use Marshalls facing bricks in areas of high exposure/sensitivity?

The majority of dense facing and common bricks are suitable for use in most external and internal locations as well as below dpc. However in areas where the placement of the brick is more likely exposed, such as cills, copings and cappings or where the brick is used in close proximity to marine environments, higher strength units of at least 35N/mm² are recommended.

Provided the higher strength bricks are specified they are suitable in most situations, for example in areas such as flood protection walls.

Please refer to:

 **BTB 6:**
Durability
Page 62

25. Are Marshalls bricks resistant to sulphate attack?

Sulphates exist in certain ground conditions and can attack both concrete and clay bricks. The amount of sulphates in the ground determines the class of ground sulphate level. Due to their cement content and density Marshalls bricks are durable and suitable for use in ground sulphate levels up to and including Class 2. If conditions are Class 3 (higher sulphate levels) then the Marshalls Engineering brick is suitable for use due to its enhanced sulphate resisting properties. Any ground conditions above Class 4, eg. acid, effluent tanks, are severe and Marshalls bricks are not suitable and therefore very specialist bricks and mortar should be used.

26. What is the sulphate/soluble salts content of Marshalls bricks and how does it compare to clay bricks?

Sulphate content is present in clay bricks predominantly in the form of sodium, magnesium and potassium sulphates, all derived from the raw clay content. If they are soluble (which the soluble salts test on clay bricks is derived to establish) then they can migrate to the surface of the brick and form a hard, white deposit known as efflorescence, which can be very difficult to remove.

In Marshalls concrete bricks there are no soluble salts leaching out of the raw material. The only leaching that can occur is from free calcium ions emanating from the cement content and Marshalls controls the migration (speed and particle size) of such to minimise their impact which tends to be a milky white deposit of calcium carbonate on the surface. This can be easily removed by the careful application of a proprietary mild brick acid. Hence the amount of soluble salts in Marshalls bricks is classed as 'minimal'.

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27. What is the carbon footprint of Marshalls bricks?

The embodied CO₂ of dense concrete masonry products is estimated as 154Kg CO₂/tonne (cradle to gate). With their low cement content, use of cement replacements, natural exothermic curing regime, and ability to be recycled, Marshalls bricks are environmentally friendly. Clay bricks by comparison have an embodied carbon content of 213Kg CO₂/tonne (cradle to gate). Comparative data derived from the Brick Development Association publications.

28. Are packaging materials recyclable?

Our packaging materials, which are mainly in the form of plastic banding, shrink wrapping and stretch hoods are responsibly sourced and contain a % of recycled material. Current suitability for recycling will depend on location, however the material is recyclable.

All timber packaging such as pallets/skids, are responsibly sourced and 100% suitable for recycling.

29. How consistent is the colour on Marshalls bricks?

Concrete bricks are produced from natural aggregates and Portland cement and incorporate where applicable synthetic iron oxide pigments. The pigments are inert and colour stable.

As the aggregates are from natural sources they may vary in shade from time to time, but careful selection and batching during manufacture will minimise these variations and the base colour of aggregates is carefully selected for use with the appropriate brick type.

In accordance with good practice it is recommended that when building, bricks are taken from different packs and blended from different deliveries.

30. I've seen examples of concrete bricks where the colour has washed out – does that happen now?

Many years ago, at the start of concrete facing brick production, the pigments used were often soluble over a period of time and consequently the colours washed out of the bricks. However, in the last thirty years or so synthetic pigments have been used which are colour stable and hence retain the original colour.

At the same time significant progress has been made in the development of integral admixtures and surface coatings which have inhibited the effect of efflorescence or lime bloom which can mask the colour of concrete units.

All Marshalls facing bricks are treated to minimise efflorescence and thus maintain the original colours and finishes of the product.

31. We have some bricks that are built in and the colours don't match. How do we resolve this?

Marshalls bricks can be tinted when on the odd occasion there is colour banding. Initially the risk of banding can be reduced by working from multiple packs and good management of stocks and deliveries.

The use of permanent stains is popular when tinting. These stains react with the cement within the matrix resulting in a permanent tint. Marshalls would recommend the use of suitably referenced specialist remedial experts to carry out such work.

32. The brickwork looks different and dries out after rainfall – why?

The manufacture of all concrete masonry involves a balance between producing a unit with a reasonable level of absorption to provide a degree of suction for good mortar bond and adhesion, but also with a degree of weatherproofing to reduce the effect of pollution and ensure durability.

Differential drying rates and their visual impact tend to be purely cosmetic and although may appear unsightly will have no detrimental impact on the overall integrity or performance of the outer leaf of brickwork. Full cavity fill, by rendering the outer leaf colder and wetter, can lead to longer periods of time for drying out. Additionally as concrete hardens with age colour variations tend to reduce over time and more importantly the water absorption (and therefore water retention) on the face also reduces. This has been proven and demonstrated on Marshalls bricks by examining different aged bricks from 2 weeks to 12 months using a reactive indicator solution such as phenolphthalein. This demonstrates the rate of change from unhydrated cement in the matrix to hard, carbonated, recalcified cement over time.

If the aesthetics are deemed unacceptable there are options to tint the affected brickwork using a reputable remedial specialist and/ or applying a proprietary waterproof coating in accordance with the manufacturer's guidelines.

33. I have cracked bricks in the wall of my house – how serious is this?

Although cracked brickwork is unsightly and emotionally disturbing it is normally not a major issue unless the cracks are wide and are replicated through to the inner leaf. In these cases the problem may be structural and the opinion of a qualified structural engineer should be sought.

Most cracks involving brickwork, whether concrete or clay, tend to be caused either by moisture or thermal movement and as such can be classed as micro cracks which either run through the bricks themselves and/or the bricks and mortar. The strength of the mortar is critical in that too strong a mortar will not allow sufficient flexibility within the structure.

Action to remedy cracks can basically fall into three categories:

- If the cracks are very fine, virtually unobtrusive and are limited to a few affected bricks then it may be more practical to leave them alone as a repair may appear to be more obvious than the actual cracked bricks.
- For slightly wider cracks then repairs may be possible in-situ whereby any cracked mortar is raked out and repointed and the cracks within the bricks repaired, filled and tinted if necessary.
- If necessary, bricks and mortar can be cut out and replaced. This should be carried out by trained technician and it should be acknowledged that such repairs can appear unsightly as it is difficult to match colours of mortar.

It should be stressed that ALL building materials move in some form or other. This movement is normally accommodated for by the provision of movement joints or bed joint reinforcement in all brick faced structures.

Please refer to:

 **BTB 5:**
Movement control
Page 53

34. What is the best way to clean down my bricks?

Cleaning techniques depend on the degree and type of dirt or stain that needs to be removed. In all cases a trial area should be tested first. When undertaking cleaning all necessary health and safety measures should be implemented before commencement.

Please refer to:

 **BTB 8:**
Cleaning, maintenance and repair
Page 66

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35. I have 'scratches' on the face of my bricks – how do I get rid of them?

The majority of Marshalls bricks are produced from crushed limestone and other aggregates, the colours of which can vary from dark grey to a light buff/grey. The colours are normally pigmented all the way through and so if the bricks are broken in two or chipped then the basic colour will still show through. Any lighter coloured flecks would stem from broken aggregate. However as the largest stone within the brick is typically < 4mm then the visual impact is generally low, especially if viewed from the recommended 3 metres distance. This is unlike some clay bricks which only have a surface coated finish which when chipped or spalled can expose a totally different sub-base material colour and texture.

Scratches on the face are normally caused where bricks have been dragged across the faces of each other or where a trowel has been used excessively to strike off the mortar extrusions. Although initially unsightly, in practice we find the effect of the scratches tends to diminish as the bricks weather. Should an acceleration of the process be required then the application of an acrylic type clear matt finish may help mask the scratches, however always follow the manufacturer's guidelines and test a small, less sensitive area first.

Please refer to:

 **BTB 8:**
Cleaning, maintenance and repair
Page 66

36. I've got green staining and mould on my bricks – how do I get rid of it?

This tends to occur where bricks are kept in a particularly damp condition often not exposed to sunshine and therefore not having the chance to dry out completely. It can be removed by using an appropriate mould cleaning material or a domestic chlorine based cleaner (bleach) using all necessary safety precautions following the manufacturer's guidelines. It is common sense and good practice to test a small, less sensitive area first.

Please refer to:

 **BTB 8:**
Cleaning, maintenance and repair
Page 66

37. Can I paint Marshalls bricks?

Marshalls bricks of all types are suitable for painting. They do not contain any salts that would have a negative effect on paint finishes. Standard bricks can be painted with emulsion or alkali resistant paints. Plastic emulsions are also suitable. In most cases it is important for the moisture content of the brickwork to be low and consistent before application and it is generally advisable to seek the advice of a paint manufacturer and test a small, less sensitive area first. In all cases the brick background should be free from dust or lime bloom.

Please refer to:

 **BTB 1:**
Good site practice guide
Page 41

38. Can I render or plaster on top of Marshalls bricks?

Marshalls bricks are classed as having a low-medium water absorption. This absorption is measured through an immersion of the brick. Occasionally the durable nature of the brick face can have very low absorption levels and in these cases should a wall of facing bricks need to be plastered or rendered then the mortar joints need to be raked out and a PVA bonding agent or cement spatterdash finish applied to the face of the wall before plastering. Reference should be made to the appropriate standard (BS EN 13914-1: 2016) or the Mortar Industry Association Specifications.

Please refer to:

 **BTB 1:**
Good site practice guide
Page 41

39. How do I fix pistol bricks/brick slips to a structure?

Because of potential movement due to moisture or thermal changes, the fixing of pistol bricks or slips needs to be carried out using a flexible adhesive rather than a cement/sand mortar. There are a number of suitable, proprietary materials available and the manufacturer's advice and guidelines should be sought and followed. The suitability of bonding bricks to a substrate must comply with all current regulations.

40. Do concrete bricks 'float'?

Building with Concrete Bricks should not differ from using any other building product. However, it is important that the correct grade of mortar is used and its consistency is adjusted to allow for the density and relatively low suction rate of the bricks. This combined with keeping the brick dry will keep the risk of float to an absolute minimum. Marshalls offer a range of frogged and perforated bricks which also provide a 'mechanical key' when laying.

Please refer to:

 **BTB 4:**
Mortars for concrete masonry products
Page 50

41. My bricks on site are wet. Can I still use them?

Marshalls bricks should only be laid when dry and it is important to keep them protected prior to use. Wet or soaked bricks will be difficult to lay, may not achieve a good bond with the mortar and may ultimately shrink significantly, potentially leading to cracks in the finished brickwork.

Opened packs should be protected and fully covered, as should any stacked out bricks on the scaffold. If the bricks become wet then the packs should be opened up and the bricks spaced out to allow air to circulate and the bricks to dry out prior to use.

Please refer to:

 **BTB 1:**
Good site practice guide
Page 41

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42. The inside walls of my garage are damp after heavy rain, why is this happening?

Garages are frequently built using only a single skin of brickwork, 100mm wide. In these cases any masonry material will allow ingress of water, especially during heavy rain accompanied by winds. This is why walls are generally constructed with cavities that prevent the transfer of moisture from the external skin to internal surfaces.

For brick walls the interface of the brick to mortar is generally the position in the wall most vulnerable to rain penetration. Due to the physical nature of mortar bonding, imperfections, cracks and small capillaries, which allow easier penetration, will exist at this interface. Accordingly, single skin construction generally requires a higher standard of workmanship to offer better resistance.

To further reduce the extent and likelihood of water penetrating single skin brickwork a proprietary heavy duty masonry sealant can be applied to the exterior wall.

Please refer to:

 **BTB 9:**
Resistance to rain penetration
Page 69

43. Can I use brick on edge coping and if so how effective is it?

Brick on edge coping/capping is frequently used to finish off the top of a wall. When the brick is flush (the same width) with the wall below it will not "throw" water away from the surface, which can lead to unsightly staining and leaching from the mortar joints. Ideally the coping/capping should project from the wall and contain a drip groove to shed water more effectively. Some practical tips to follow include: capping bricks to have a minimum strength of 35N/mm²; install a high bond dpc below the coping/capping; include fixings to prevent the displacement of bricks; and use a higher grade mortar, eg. Class M6, to maximise frost resistance.

For further information please visit our website and reference our Brick Technical Manual.

Creating Better Spaces