Marshalls
Bricks & Masonry

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Brick Technical Bulletin - Mortars for Concrete Masonry Products

BTB 4

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

BS EN 998-1 - Specification for Mortar: Part 1 - Rendering and Plastering Mortar
BS EN 998-2 - Specification for Mortar: Part 2 - Masonry Mortar

These Standards should be read in conjunction with BS 5628: Part 3, PD 6697, BS 8000-3 and all other relevant Standards.

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.

- Site mixing: Mortar should 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 Darlstone Walling, tend to have low-medium suction rates and the mortar should be adjusted accordingly.

- 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 leaving any retarded mortars for 24 hours to dry out slightly before use.

- 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 3oC and falling.

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NUMBER OF COURSES PER DAY

BS 8000-3: 2001 - 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, ie. equivalent to 20 courses"

This should be 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.

TYPES OF MORTAR

- **Cement:Lime:Sand**
  These mortars give good workability, water retention and adhesion. They may be site mixed or pre-batched.

- **Ready Mixed Mortars**
  These are produced either in a dry form in silos or as wet mix, retarded mortars. 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.

- **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 made to Table 12 and 13A BS 5628; Part 3; 2005 and PD 6697)
- Designed mortars are selected by the producer to achieve particular compressive strengths
- Prescribed mortars are made in pre-determined proportions as required

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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 197-1
5. The European Standard BS EN 998-2 - 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.

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PRESCRIBED MORTARS (BY VOLUME)							
Increasing Ability to Accommodate Movement	Mortar Designation	Compressive Strength Class	Strength N/mm2 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
	<0.20	0.15	<0.20	0.29	<0.40	<0.40	<0.40

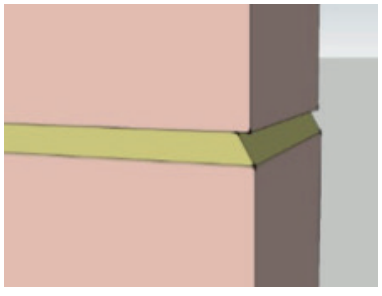
MORTAR JOINT PROFILES

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.

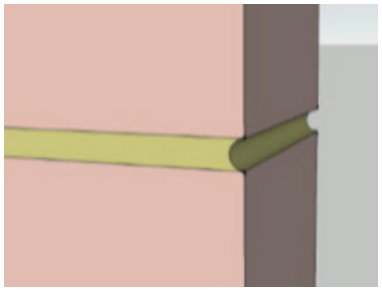
Bricks should be laid on a full bed of mortar and perpend joints fully filled. The majority of Marshalls facing products have a low-medium absorption rate and during prevailing rainfall will tend to shed water towards the joints which, if not fully filled and tooled, will allow excessive moisture into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

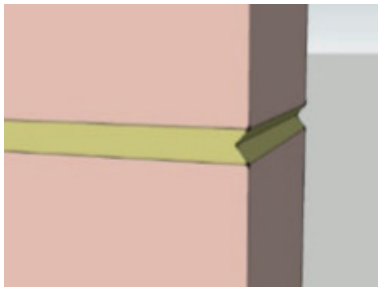
On major projects the construction of a sample panel or panels gives the ideal opportunity to test and review the best type of joint to satisfy the aesthetic and durability parameters that are required.



Weathered Joint –
joint has a downward sloping edge



Concave/Bucket Handle Joint



Vee Joint –
inverted V profile

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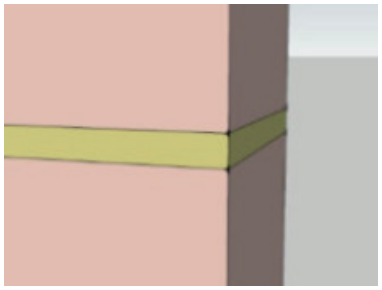
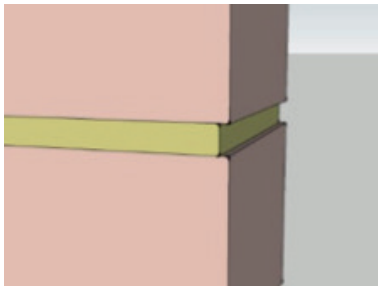
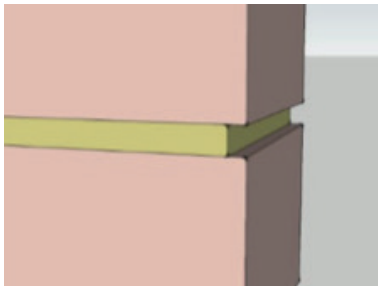


Flush Joint Stripped Joint –
a medium



Stripped Joint –
a medium recessed joint not recommended for exposed areas



Raked or Recessed Joint –
not recommended for exposed areas

APPLICATION AND CHOICE OF MORTAR

Application	Recommended Marshalls Masonry Unit	Recommended Mortar Class	Masonry Unit Strength (N/mm2)
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	iii/M4	22
Unrendered External Walls both above and below dpc	Dense Common Brick or Facing Brick	iii/M4	22
Rendered External Walls	Dense Common Brick	iii/M4	22
Cappings, Copings and Cills	Facing Brick or Engineering Quality Brick	ii/M6	35
Earth Retaining Walls	Facing Brick or Engineering Quality Brick	i or ii/M12-M6	35
Manholes and Inspection Chambers – Surface Water	Dense Common Brick	iii/M4	22
Manholes and Inspection Chambers – Foul Drainage	Engineering Quality Brick	i or ii/M12-M6	50
Class 1 Sulphate Conditions	Dense Common Brick	iii/M4	30
Class 2 Sulphate Conditions	Engineering Quality Brick	ii or iii/M6-M4	50
Class 3 Sulphate Conditions	Engineering Quality Brick	ii/M6 in SRPC	50
Areas of High Exposure	Facing Brick or Engineering Quality Brick	ii/M6	35