LIGNACITE
Sustainable Masonry

DESIGN GUIDE

7.0 MORTAR

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Mortar - An Introduction

This Guidance is applicable to all block types from the Lignacite range. The selection of mortar for an application is very important and should take into consideration structural requirements, the type of construction, position in the building and degree of exposure.

Guidance

Guidance for the specification of mortar for durability can be assessed in accordance with Published Document PD 6697. This provides recommendations for the quality of masonry units and mortar designations for various conditions of use, such as work below or above the external ground level.

Mortars can be specified as design mixes (Strength Performance) or prescribed mixes (Recipe). Mortars can be either factory made or mixed on site. Traditionally, prescribed mixes have been used in the UK and have a proven durability. Design mixes are likely to be increasingly used as a result of designing masonry to the Eurocode.

Where coloured mortars are specified, to avoid inconsistencies, it is advisable to use dry silo mortar or alternatively, retarded ready-to-use mortars.

Eurocode 6 categorises the exposure class by the use of MX numbers. In most cases in the UK the most severe exposure "S" relates to class MX 3.2 - exposure to severe wetting and freeze thaw cycles, but not exposed to external sources or significant levels of sulphates or aggressive chemicals.

Generally the stronger the mortar, the more durable it is. Conversely the weaker the mortar, the greater is its ability to accommodate movement. For the majority of applications a general-purposes mortar will be specified and is defined as a mortar with a thickness greater than 3mm, although 10mm is commonplace. Such mortars are produced using normal-weight aggregates. Mortars should be specified according to their compressive strength. An M4 mortar is 4N/mm^2 mortar based on a mean compressive strength at 28 days. Prescribed mortars (described by their constituent materials) are in common use e.g. a 1:1:5 cement: lime: sand mix, and do not have a corresponding 'M' value although they will have strength properties. A comparison of mortar designations from BS 5628 can be compared in compressive strength terms with those described in Eurocode 6, as shown in Table 7.1.

In the selection of mortars, as a general guide, cement:lime:sand mortars give a stronger bond than plasticised mortars of a similar compressive strength. Incorporating lime into the mix is also beneficial in terms of the mortar's ability to accommodate movement.

Table 7.1 - Equivalent mortar mixes - BS 5628 and BS EN 1996

Mortar designation - BS 5628	Compressive BS EN 1996
(i)	M12
(ii)	M6
(iii)	M4
(iv)	M2

Details of the relevant mortar designations are provided in the Table 7.2.

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Table 7.2 - Masonry mortars

	Mortar designation - BS 5628	Mortar strength class	Prescribed mortars (proportion or materials by volume) (see notes a and b)				Compressive strength (N/mm^2)
			Cement[c] lime: sand with or without air entrainment	Cement[c:] sand with or without air entrainment	Masonry cement[d] sand	Masonry cement[e] sand	
Increasing ability to accommodate movement, e.g. due to settlement, temperature and moisture changes ↓	(i)	M12	1:0 to ¼:3	1:3	Not suitable	Not suitable	12
	(ii)	M6	1:½:4 to 4½	1:3 to 4	1:2½ to 3½	1:3	6
	(iii)	M4	1:1:5 to 6	1:5 to 6	1:4 to 5	1:3½ to 4	4
	(iv)	M2	1:2:8 to 9	1:7 to 8	1:5½ to 6½	1:4½	2

Notes

a) All proportions are by volume. Proportioning by mass is permissible and will give more accurate batching than assessing by volume, provided that the bulk densities of the materials are checked on site.

b) When the sand proportion is given as a range, for example 5 to 6, the lower figure should be used with sands containing a higher proportion of fines whilst the higher figure should be used with sands containing a lower proportion of fines.

c) Table 7.2 is based on data from the UK National Annex to BS EN 1996-1-1.

When selecting the mortar strength Class/Designation, the following guidance may assist designers:

Above ground - Loadbearing and non-loadbearing walls (of moderate compressive strength).	Compressive strength class M4 - BS EN 1996
Above ground - High strength blockwork >10.4N/mm^2.	In most cases a mortar strength Class M4 will be sufficient. Although the maximum permissible stresses in a wall will be gained using a stronger mortar this will need to be balanced with a decreasing ability of the wall to accommodate movement. Loadbearing walls are rarely loaded to their ultimate safe working limit, therefore only in exceptional cases will it be necessary to use a stronger mortar.
Below ground - Blockwork used with a high risk of saturation with freezing.	A mortar strength Class M6 will normally be specified.
Reinforced blockwork e.g. Hollow blockwork with vertical reinforcement.	A mortar strength Class M12 or M6 will normally be specified.

Further information on the use of mortar may be found in the following publications:

- Published Document PD 6697 'Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2'.
- BS EN 1996-2 Eurocode 6. Design of masonry structures. Design considerations, selection of materials and execution of masonry.
- BS EN 1996-2 Eurocode 6. Design of masonry structures. Design considerations, selection of materials and execution of masonry.

MPA Mortar, part of the Mineral Products Association, provide a range of informative resources, including Data Sheets on mortar mixes and applications. See https://www.mortar.org.uk/

MORTAR

Bedding and jointing

Solid, cellular or hollow units should be laid on a full bed of mortar. Cellular units should be laid with the closed end uppermost to allow for a full bed of mortar to be applied. All perpend joints should be solidly filled with mortar to maintain the built strength, weather resistance and airtightness of the structure.

Correctly filled and tooled joints enhance the masonry's appearance and has a considerable effect upon the durability and weather resistance of the blockwork. Tooling of the joints involves forming a suitable joint profile e.g. concave joint, using a jointing tool while the mortar is still green. In addition to improving the durability of the mortar joint, tooling will improve the walls' resistance to air and sound leakage. The joint profile should be specified, taking into account the appearance required and the degree of exposure. Tooled and non-recessed joints provide the greatest resistance to rain penetration. Recessed joints should not generally be specified to exposed walls.

Flush jointing is not normally recommended for fair face blockwork, as a quality finish is difficult to achieve, especially with textured blocks and can result in mortar smears to the block face.

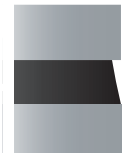
Mortar joints should be of uniform thickness and it is generally accepted that a nominal 10 mm joint be used in order to ensure optimum performance. After placing the blocks on a bed of mortar, the optimum length of time should be established between laying the units and finishing the joints - for example, until such time as the mortar has stiffened to the point of resisting an 'easy thumbprint'. If joints are tooled too soon or too late, bond strength may be compromised and the subsequent appearance made more variable.

Concave (bucket handle)

This joint usually provides an improved appearance over a flush joint. It is comparatively easy to achieve and is recommended for both internal and external fair face blockwork. Owing to the compressing of the joint and the improved bond, it has good weather resistance and is suitable for all grades of exposure.

Struck or weathered

Weathered bed joints produce an interplay of light and shadow on the blockwork. Such joints when correctly made have excellent strength and weather resistance.



Square recessed

This joint when used with durable masonry units, can produce a very pleasing effect, but its weather resistance and strength will be considerably less than struck, flush or curved recess joints. Recommended in sheltered exposure conditions. The recess should not exceed 3-4mm and is not recommended with full fill cavity insulation.

Flush or bagged joint

This finish can provide the greatest loadbearing area. However flush jointing is not normally recommended for fair face work as a good quality finish is difficult to achieve and can often result in mortar smears to the block face.

Using mortar and blocks in cold weather

During the winter months all stocks of blocks should be covered to provide protection against rain, frost and snow. Blocks that become saturated should not be used until they have dried out.

Mortar should be protected during very cold weather. If mortar freezes during storage any frozen material must be rejected. Similarly, the mortar should not be laid on frozen surfaces.

As mortar hardens and develops strength more slowly in cold weather, freshly built walls should be covered and protected from the elements. Best practice is to use two layers - thermal protection such as hessian or some form of quilting and a waterproof sheet to stop the under layer getting wet.

Protective covers should not be in contact with the face of the wall to avoid 'sweating' and consequent staining. The covers should be secure and kept in place until the mortar hardens.

As a guide no block laying should be carried out when the air temperature is at or below 3°C unless it is at least 1°C and rising. Conditions should be regularly monitored, and the wind chill factor taken into account.

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Glossary

Dry ready to use mortar	Factory produced mortar delivered to site in silos or bags, and only require the addition of water.
Factory produced mortars	These are manufactured in a factory and delivered in a wet or dry state to site ready to use
Mortar	Mortar is typically a mix of cement (or lime), sand, and water, used as an adhesive to bind building blocks or similar together. It fills the gaps between the units, and distributes loading evenly to create solid masonry structures. It's applied wet and hardens as it cures, creating a strong bond, sealing against moisture, and allowing for slight flexibility in walls.
Mortar strength class	This is derived from Eurocode 6 (EC6), where mortar strength is classified by its 28-day compressive strength in N/mm^2, using designations like M2, M4, M6, and M12, with the number representing the strength (e.g., M6 is 6 N/mm^2). These strength classes are used in masonry design calculations.
Pre-mixed lime and sand	The lime and sand are batched and mixed in a factory and supplied to the building site where cement and water are added to produce mortar
Prebatched mortar	Mortar composed of constituents batched in a factory, supplied to the building site and mixed there in accordance with the manufacturer's instructions e.g. twin compartment silo and lime:sand. This type of mortar is available as a wet mix and includes a retarded admixture. Dry mixes have a longer shelf-life and require the addition of water to produce the mortar
Prescribed Mortars	Prescribed mortars for masonry are pre-mixed mortars with fixed proportions of cement, lime, and sand (e.g., 1:1:5). They are defined by their constituent materials rather than a target strength, with their properties assumed from these proportions. Prescribed mortars are still widely used but increasingly, when designing to European masonry standards, specifying mortar by its compressive strength has become common place.
Silo mortar	Material whose constituents are mixed in a factory and delivered to the building site for use in a transportable silo and mixed there according to the producers' instructions. Silo mortars are common to see on large construction sites.
Wet ready to use	Factory produced mortar and delivered to site, requiring no further mixing and stored in containers.