

Guide to the specification of masonry mortar

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Foreword

This Published Document has been prepared under the direction of Subcommittee B/519/2. It supersedes PD 6472:1974, which is withdrawn.

Changes in mortar standardization in the United Kingdom occurred with the introduction of the European specification for mortar for masonry, BS EN 998. It covers factory made mortar, however, it does not give guidance on site made mortar.

This Published Document gives some guidance on the specification of factory made masonry mortar conforming to BS EN 998-2 but is mainly aimed at providing guidance on the specification of site made masonry mortar.

This guidance on the specification of site made masonry mortar takes into account the requirements of BS EN 998-2 and takes information from the withdrawn PD 6472, a guide to specifying the quality of building mortars.

This Published Document also takes into account the guidance given in the code of practice for use of masonry, BS 5628.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

This Published Document is not to be regarded as a British Standard.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 27 and a back cover.

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Introduction

Traditionally in the United Kingdom mortar has been primarily specified in terms of volume or mass proportions, the “prescriptive” or “recipe” approach, so called because it gives a prescription for the mix proportions. This method is used in the code of practice for use of masonry BS 5628, and was used in the specification for ready-mixed building mortar BS 4721 and in the specification for prepacked mortar mixes BS 5838-2.

The alternative method of specifying mortars, based on measured parameters such as minimum compressive strength, is known as the “design” or “performance” approach. For example, BS 4721 required that a minimum compressive strength was achieved. The performance approach is specified in BS 5628-3.

BS EN 998 is the new British Standard for the specification of mortar for masonry, including the specification of constituent materials. It specifies requirements for designed mortars and, to a lesser extent, prescriptive mortars. Its publication has brought about a need to withdraw or update existing British Standards. Therefore, BS 4721:1981 and BS 5838-2:1980 have been superseded by both BS EN 998-1:2003 and BS EN 998-2:2003.

1 Scope

This Published Document gives guidance on the specification of prescribed and designed:

- a) factory made masonry mortar conforming to BS EN 998-2; and
- b) site made masonry mortar.

This Published Document is intended to be used in conjunction with the code of practice for masonry, BS 5628 and the specification for masonry mortar, BS EN 998-2.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 3177, *Method for determining the permeability to water vapour of flexible sheet materials used for packaging*.

BS 5628-1:2005, *Code of practice for the use of masonry — Part 1: Structural use of unreinforced masonry*.

BS 5628-2:2005, *Code of practice for the use of masonry — Part 2: Structural use of reinforced and prestressed masonry*.

BS 5628-3:2005, *Code of practice for the use of masonry — Part 3: Materials and components, design and workmanship*.

BS 8500-2:2002, *Concrete — Complimentary British Standard to BS EN 206-1 — Part 2: Specification for constituent materials and concrete*.

BS 6100 (all parts), *Glossary of building and civil engineering terms*.

BS EN 459-1, *Building lime — Part 1: Definitions, specifications and conformity criteria*.

BS EN 934-3, *Admixtures for concrete, mortar and grout — Part 3: Admixtures for masonry mortar — Definitions, requirements, conformity, marking and labelling*.

BS EN 998-2:2003, *Specification for mortar for masonry — Part 2: Masonry mortar*.

BS EN 1008, *Mixing water for concrete — Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete*.

BS EN 1015-1, *Methods of test for mortar for masonry — Part 1: Determination of particle size distribution (by sieve analysis)*.

BS EN 1015-2, *Methods of test for mortar for masonry — Part 2: Bulk sampling of mortars and preparation of test mortars*.

BS EN 1015-3, *Methods of test for mortar for masonry — Part 3: Determination of consistence of fresh mortar (by flow table)*.

BS EN 1015-4, *Methods of test for mortar for masonry — Part 4: Determination of consistence of fresh mortar (by plunger penetration)*.

BS EN 1015-6, *Methods of test for mortar for masonry — Part 6: Determination of bulk density of fresh mortar*.

BS EN 1015-7, *Methods of test for mortar for masonry — Part 7: Determination of air content of fresh mortar*.

BS EN 1015-9, *Methods of test for mortar for masonry — Part 9: Determination of workable life and correction time of fresh mortar*.

BS EN 1015-10, *Methods of test for mortar for masonry — Part 10: Determination of dry bulk density of hardened mortar*.

BS EN 1015-11, *Methods of test for mortar for masonry — Part 11: Determination of flexural and compressive strength of hardened mortar*.

BS EN 1015-17, *Methods of test for mortar for masonry — Part 17: Determination of water-soluble chloride content of fresh mortars*.

BS EN 1015-18, *Methods of test for mortar for masonry — Part 18: Determination of water absorption coefficient due to capillary action of hardened mortar*.

BS EN 13055-1, *Lightweight aggregates — Part 1: Lightweight aggregates for concrete, mortar and grout*.

BS EN 13139, *Aggregates for mortar*.

3 Terms and definitions

For the purposes of this Published Document, the terms and definitions given in BS EN 998-2, BS 6100 and the following apply.

3.1

addition

finely divided material used in mortar in order to improve certain properties or to achieve special properties

3.2

binder

material used to hold solid particles together in a coherent mass

NOTE Examples of binders include cement and building lime.

3.3

CE marking

mark signifying that a product conforms to the essential requirements of the relevant European Directive(s) and that the product has been subject to the appropriate conformity assessment procedure(s)

NOTE Harmonized European Standards are standards that include essential requirements from relevant European Directives. The level of attestation of conformity for CE marking purposes applicable to a particular product is decided by the European Commission and is included within the appropriate harmonized European product standard. There are six levels of attestation of conformity, some requiring third party involvement.

3.4

combination

restricted range of Portland cements and additions, which have been combined in the mortar mixer

3.5

designed masonry mortar

mortar with a composition and method of manufacture that is chosen by the producer in order to achieve specified properties

[BS EN 998-2, definition 3.2.1]

3.6

factory made masonry mortar

mortar batched and mixed in a factory

NOTE Factory made mortar can be either “dry” mortar which is ready-mixed and requires only the addition of water or “wet” mortar which is supplied ready for use.

[BS EN 998-2, definition 3.4.1]

3.7**factory production control**

system consisting of procedures for the internal control of production, which has the objective of ensuring that products placed on the market conform to standard requirements and the declared values

3.8**fresh masonry mortar**

plastic masonry mortar

mortar completely mixed and ready for use

NOTE The term plastic masonry mortar is sometimes used instead of fresh masonry mortar, particularly for mixes containing a cement set retarder.

3.9**initial type testing**

testing undertaken prior to placing a product on the market and when changes occur, either in the basic materials or manufacturing procedures, which could affect the characteristics of the product

3.10**manufacturer**

person who makes mortar either in a factory or on site

NOTE Traditionally the term associated with site made mortar production has been producer rather than manufacturer.

3.11**prebatched semi finished factory made masonry mortar**

mortar with constituents wholly batched in a factory, supplied to the building site and mixed there according to the manufacturer's specification and conditions

[BS EN 998-2, definition 3.4.2.1]

3.12**premixed lime:sand**

semi finished factory made masonry mortar with constituents wholly batched and mixed in a factory, supplied to the building site where further constituents specified or provided by the factory are added

[technically equivalent to BS EN 998-2, definition 3.4.2.2]

NOTE Historically this material has sometimes been known as ready-mixed lime:sand.

3.13**site mixed lime:sand**

semi finished site made masonry mortar with constituents wholly batched and mixed on a building site where further constituents are added

NOTE Historically this material has sometimes been known as coarse stuff, a term which is now deprecated.

3.14**prescribed masonry mortar**

mortar made in predetermined proportions, the properties of which are assumed from the stated proportions of the constituents

[BS EN 998-2, definition 3.2.2]

3.15**reference panel**

panel of masonry erected and retained on a building site, used to establish the visual acceptability of materials and workmanship to be maintained during construction work

[BS 5628-3, definition 3.48]

3.16**workable life**

time from the end of manufacture or final mixing of the masonry mortar until the mortar reaches a defined limit of resistance to penetration of a rod forced into it

NOTE The workable life of mortar is determined in accordance with BS EN 1015-9.

4 General

The relationship between fresh (plastic) mortar and hardened mortar is complex. The properties of fresh (plastic) mortar affect the properties of the hardened mortar and the two cannot be considered in isolation.

Traditionally the craftsman has been left to adjust the proportions of the constituents to produce a mortar which can be handled easily and in the experience of the craftsman would be adequate. However, requirements for strength or other important properties cannot be satisfied by this approach, as it can unduly consider the short term properties of the fresh mortar at the expense of the properties of the hardened mortar. While it is important for a mortar to be of suitable consistence for the craftsman to use, this requirement should not conflict excessively with the desired hardened properties.

It is seen therefore that whilst the craftsman can clearly be permitted to exercise choice with respect to the fresh (plastic) properties, some of the hardened properties should also be considered. This means that specifications for mortar need to state limiting values for mix proportions which should not be reduced or exceeded.

It is fortunate that some properties of mortar are relatively insensitive to normal performance or prescriptive requirements. For example, the thermal properties of a mortar are not greatly affected by the strength or the relative proportions of the materials, but are affected significantly by the choice of the density of the aggregate and to a much more limited extent by any air entrainment.

5 Methods of specifying masonry mortar

5.1 General

BS 5628 gives guidance on the design of masonry structures, including the design of masonry mortar.

The type of masonry mortar recommended for use differs for various conditions of design and exposure. This means that differing structural requirements give rise to the need for different mortar types. Similarly the durability environment will also impose requirements on the mortar type. These two influences mean that a mortar should be specified to take each need into account, without prejudicing the other.

An overview of the methods by which mortar can be specified is given in 5.2, 5.3 and 5.4.

5.2 Prescribed mortars

A “prescriptive” or “recipe” approach to mortar production involves detailing all of the constituent materials for the mortar and the recipes used to combine them.

BS 5628 describes a prescriptive approach to mortar production that is in line with the British Standard for masonry mortar, BS EN 998-2.

BS EN 998-2 allows for the specification of prescribed factory made mortars, with a requirement that the manufacturer declares the mix proportions by volume or by weight of all the constituents.

A prescribed mortar specification should be drafted so that the quality of the mortar is controlled by stated compositional requirements. Where prescribed mortar is produced, the manufacturer will verify conformity of the mortar to the specification by referring to any production records and delivery documentation.

CE marking of a prescribed factory made mortar signifies that the product conforms to the essential requirements of the European Commission’s Construction Products Directive (CPD) [1] unlike site made mortar, to which CE marking does not apply. Producing prescribed factory made mortar in accordance with BS EN 998-2 ensures that the mortar conforms to the CPD and can therefore be CE marked.

Conformity evaluation methods for both factory and site made masonry mortar can range from examination of production records to testing and comparison of the results with tabulated values for known compositions. Historically the assessment of conformity to a prescribed specification could only be achieved by the use of chemical analysis to BS 4551. An alternative now is to infer the mix proportions of the mortar from compressive strength. BS EN 998-2 states the relationship between compressive strength and mix proportions for a limited range of strengths and mortar compositions.

5.3 Designed mortars

A “design” or “performance” approach to mortar production involves specifying the final performance to be achieved by the mortar.

BS 5628 describes a design approach to mortar production that is in line with the British Standard for masonry mortar, BS EN 998-2, which specifies requirements for designed factory made mortars.

All the BS EN 998-2 requirements for properties that are considered relevant for the factory or site made mortar should be included in a designed mortar specification. The manufacturer is responsible for the evaluation and certification of conformity to the stated requirements.

CE marking of a designed factory made mortar signifies that the product conforms to the essential requirements of the European Commission’s Construction Products Directive (CPD) [1] unlike site made mortar, to which CE marking does not apply. Producing designed factory made mortar in accordance with BS EN 998-2 ensures that the mortar conforms to the CPD and can therefore be CE marked.

Where designed mortars are manufactured on site, and not within a factory control system, the mortar specification should state how conformity is to be assessed. This can range from infrequent but regular testing of samples to visual inspection and random testing of samples with statistical analysis of results.

5.4 Factory made and site made mortar

The prescriptive and design approach to specifying mortar can be used to specify both factory made mortar and site made mortar.

The prescriptive and design approach to factory made masonry mortar is covered by BS EN 998-2.

There is no standard for site made mortars. However, the scope of BS EN 998-2 permits the use of national codes of practice or specifications for site made mortars. Therefore, specific guidance on the specification of site made masonry mortar is given in Clause 8. This guidance is based on BS 5628 and the principles and requirements of BS EN 998-2. It is intended that this guidance is used by manufacturers of site made mortar in the United Kingdom.

5.5 Specifying masonry mortar using BS EN 998-2

5.5.1 *Category of use*

BS EN 998-2 classifies masonry mortar in terms of its proposed application. The three categories that have been identified are:

- a) general purpose;
- b) thin layer; and
- c) lightweight.

5.5.2 *Mode of manufacture*

BS EN 998-2 defines mortar according to three different modes of manufacture. These are:

- a) factory made;
- b) semi finished factory made; and
- c) site made.

Factory made mortars can be either dry mixed materials requiring only the addition of water at the site, or ready-to-use mixes containing a cement set retarding admixture which are delivered in tubs or bags and should be used within a stated time period. Semi finished factory made materials can be prebatched at the factory and delivered in silos only requiring the addition of water, or can be delivered in other containers and requiring the addition of other constituents, e.g. cement.

The scope of BS EN 998-2 does not include site made mortars although it is the only specification standard for masonry mortar in the United Kingdom and so the requirements of BS EN 998-2 can be used as the basis for specifying site made mortar.

Where a specifier draws up a specification for site made mortar the selection should be made from appropriate clauses from BS EN 998-2. Although the superseded UK specification for ready-mixed building mortars, BS 4721, was clearly written to cover only factory made mortars, in practice it was often invoked where mortars were made on site. It is anticipated that much of BS EN 998-2 will similarly become used for site made mortars.

If the specifier has not drafted a site made mortar specification based on the principles of BS EN 998-2 or used requirements from BS EN 998-2, the specifier should draft a detailed materials and conformity specification that conforms to BS 5628-3.

5.5.3 Prescriptive approach

Historically mortars were generally specified in terms of a prescription or recipe as, for example, in BS 5628.

The new British Standard for masonry mortar, BS EN 998-2, is a performance based standard. It recognises the prescriptive concept but gives no guidance on prescribed mortar mix proportions. BS EN 998-2:2003, **5.3** does however require that:

- a) the proportions of all prescribed mortar mixes shall be declared by the manufacturer; and
- b) the compressive strength of all prescribed mortar mixes shall be declared using publicly available references that establish relationships between mix proportions and compressive strength, e.g. Table 1 and Table 2.

Both items a) and b) apply when specifying prescribed factory made mortar in accordance with BS EN 998-2. Both items a) and b) should also apply when specifying prescribed site made mortar using the principles of BS EN 998-2.

Where specifiers require the use of site made mortars that conform to the traditional recipes (mortar designations) in BS 5628, the specifier should ensure that the mortar conforms to the mix proportions and consists of raw materials recommended in BS 5628. The specifier should specify that manufacturers are also responsible for combining and mixing the constituent materials in accordance with BS 5628 and ensuring that no extraneous materials are added to the mix.

The relationship between BS 5628 prescribed site made mortars and compressive strength is given in Table 1 and Table 2.

Compressive strength is required by BS EN 998-2 to be determined using prism specimens in accordance with BS EN 1015-11. The results obtained from this method are not directly comparable with test cube results obtained using the procedure given in BS 4551-1:1998, therefore, a conversion factor needs to be determined (or obtained from an authoritative reference) and applied where cube specimens are used to assess compressive strength.

NOTE BS 4551-1:1998 has been superseded by BS 4551:2005. The determination of the compressive strength of mortar is not given in BS 4551:2005 because this is covered by BS EN 1015-11.

5.5.4 Performance approach

A mortar specification for mortars conforming to BS EN 998-2 should contain requirements that refer to specific BS EN 998-2 clauses rather than repeating the BS EN 998-2 requirement in full. Specific reference to BS EN 998-2 clauses will also invoke many general requirements for constituent materials, production and conformity thereby negating the need to prepare an overly detailed specification.

The specification should include any special requirements for the site made mortar, e.g. for obtaining an aesthetic effect, that are not covered in BS EN 998-2.

A move to the use of performance based mortar specifications from traditional prescriptive mortar specifications simplifies the requirements of specification drafting. This is because the specifier has only to specify the performance requirements and the manufacturer takes responsibility for achieving them.

Therefore, for designed mortars it is the mortar manufacturer that selects which materials to use to ensure that the delivered product conforms to the specifier's requirements. A mortar specification should only include requirements for what constituent materials to use when special requirements exist, e.g. for obtaining an aesthetic effect, or a prescribed mortar is specified.