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Mortar for masonry — Specification

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Contents

Page

Foreword	<u>iv</u>
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Materials	<u>67</u>
4.1 General	<u>67</u>
4.2 Water	<u>67</u>
4.3 Aggregates	<u>67</u>
4.4 Cementitious Materials	7
4.5 Cement	7
4.5.1 Lime	<u>78</u>
5 Requirements for Mortar	<u>78</u>
5.1 General	<u>78</u>
5.2 Properties of fresh mortar	<u>78</u>
5.2.1 Workable life	<u>78</u>
5.2.2 Workability	8
5.2.3 Chloride content	<u>89</u>
5.2.4 Air content	<u>89</u>
5.3 Proportion of constituents	<u>89</u>
5.4 Properties of hardened mortar	9
5.4.1 Compressive strength of mortar for bedding masonry units	9
5.4.2 Compressive strength of rendering/plastering mortar	10
5.4.3 Bond strength	<u>1142</u>
5.4.4 Water absorption	<u>1142</u>
5.4.5 Density (dry hardened mortar)	<u>1142</u>
5.5 Mixing of mortar	12
5.5.1 Machine mixing	12
5.5.2 Hand mixing	<u>1243</u>
6 Designation of masonry mortar manufactured in a plant	<u>1243</u>
7 Marking	13
8 Evaluation of conformity	<u>1344</u>
8.1 General	<u>1344</u>
8.2 Plant production control	<u>1344</u>
8.2.1 General	<u>1344</u>
8.2.2 Process control	<u>1344</u>
8.2.3 Finished product test	14
8.2.4 Traceability	<u>1445</u>

Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 108 was prepared by Technical Committee RSB/TC 09 Civil Engineering and Building Materials.

In the preparation of this standard, reference was made to the following standards:

- 1) BS EN 998-1, *Specification for mortar for masonry, Part 1: Rendering/plastering mortar*
- 2) BS EN 998-2, *Specification for mortar for masonry Part 2: Masonry mortar*
- 3) ASTM C 270. 8242-1, *Standard specification for mortar for unit masonry*
- 4) BS 5628-1, *Code of practice for the use of masonry, Part 1 Structural use of unreinforced masonry*

The assistance derived from the above source is hereby acknowledged with thanks.

This second edition cancels and replaces the first edition (RS 108: 2010), which has been technically revised.

Committee membership

The following organizations were represented on the Technical Committee on Civil Engineering and Building Materials (RSB/TC 09) in the preparation of this standard.

University of Rwanda – College of Science and Technology (UR-CST)

City of Kigali

Green Effect Engineering

Integrated Polytechnic Regional Centre –Kigali (IPRC)

TECOS Ltd

NPD

REAL Contractors Ltd

Rwanda Housing Authority (RHA)

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Mortar for masonry — Specifications

1 Scope

This Draft Rwanda Standard specifies requirements for masonry mortars for bedding, jointing and pointing in masonry walls, columns and partitions (facing and rendered masonry, load bearing or non-load bearing masonry structures for building and civil engineering).

This standard specifies requirements for rendering and plastering mortar used on walls, ceilings, columns and partitions.

It defines the performance related to workable life for fresh mortars. For hardened mortars it defines performances related to compressive strength, bond strength and density and provides the evaluation of conformity of the product based on tests.

It applies to mortars mixed in a plant or on site.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references,

RS EAS 18-1, *Cement — Part 1: Composition, specification and conformity criteria for common cement*

CD ASTM C141 *Standard Specification for Hydrated Hydraulic Lime for Structural Purposes*

RS 211-2, *Mortar for masonry — Part 2: Bulk sampling of mortars and Preparation of test mortars*

RS 211-3, *Mortar for masonry — Part 3: Determination of consistence of fresh mortar (by flow table)*

RS 211-4, *Mortar for masonry — Part 4: Determination of consistence of fresh mortar (by plunger penetration)*

RS 211-7, *Mortar for masonry — Part 7: Determination of water absorption coefficient due to capillary action of hardened mortar.*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

masonry mortar

mix of one or more inorganic binders, aggregates, water, and sometimes additions and/or admixtures for bedding, jointing and pointing of masonry

3.2

fresh masonry mortar

mortar completely mixed and ready for use

3.3

designed masonry mortar

mortar whose composition and manufacturing method is chosen by the producer in order to achieve specified properties (performance concept)

3.4

prescribed masonry mortar

mortar made in predetermined proportions, the properties of which are assumed from the stated proportion of the constituents (recipe concept)

3.5

general purpose masonry mortar

masonry mortar without special characteristics

3.6

thin layer masonry mortar

designed masonry mortar with a maximum aggregate size less than or equal to a prescribed figure (see 4.2)

3.7

lightweight masonry mortar

designed masonry mortar with a dry hardened density below a prescribed figure (see 5.4.5)

3.8

plant made masonry mortar

mortar batched and mixed in a plant which is supplied ready for use

3.9

prebatched masonry mortar

mortar whose constituents are wholly batched in a plant supplied to the building site and mixed there according to the manufacturer's specification and conditions

3.10

premixed lime-sand- masonry mortar

mortar whose constituents are wholly batched and mixed in a plant, supplied to the building site where further constituents specified or provided by the plant are added (e.g. cement)

3.11

site-made masonry mortar

mortar composed of individual constituents batched and mixed on the building site

3.12

binder

material used to hold solid particles together in a coherent mass, e.g. cement, building lime

3.13

aggregate

granular material that does not contribute to the hardening reaction of the mortar

3.14

admixture

material added in small quantities to produce specified modifications to the properties

3.15

addition

finely divided inorganic material (which is not an aggregate or binder) that may be added to mortar in order to improve or achieve special properties

3.16

bond strength

adhesion perpendicular to the bed between the masonry mortar and the masonry unit

3.17

declared value

value that a manufacturer is confident in achieving, bearing in mind the precision of test and variability of process

3.18

masonry subjected to severe exposure

masonry or elements of masonry which are subjected to saturation with water (driving rain, ground water) combined with frequent freeze/thaw-cycling due to climatic conditions, and absence of protective features

3.19

masonry subjected to moderate exposure

masonry or elements of masonry which are exposed to moisture and freeze/thaw-cycling, excluding constructions subjected to severe exposure

3.20

masonry subjected to passive exposure

masonry or elements of masonry which are not intended to be exposed to moisture and freezing conditions

3.21

rendering/plastering mortar

mix of one or more inorganic binders, aggregates, water and sometimes admixtures and/or additions, used as external renders or internal plasters

3.22

fresh rendering/plastering mortar

mortar completely mixed and ready for use

3.23

designed rendering/plastering mortar

mortar whose composition and manufacturing method is chosen by the producer in order to achieve specified properties (performance concept)

3.24

prescribed rendering/plastering mortar

mortar made in pre-determined proportions, the properties of which are assumed from the stated proportion of the constituents (recipe concept)

3.25

plant-made rendering/plastering mortar

mortar batched and mixed in a plant. It may be 'dry mortar' which is ready mixed only requiring the addition of water, or 'wet mortar' which is supplied ready for use

3.26

prebatched rendering/plastering mortar

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

3.27

premixed lime-sand rendering/plastering mortar

mortar whose constituents are wholly batched and mixed in a plant, supplied to the building site where further constituents specified or provided by the factory are added (e.g. cement)

3.28

site-made rendering/plastering mortar

mortar composed of individual constituents batched and mixed on the building site

3.29**general purpose rendering/plastering mortar**

rendering/plastering mortar without special characteristics. It can be prescribed or designed

3.30**lightweight rendering/plastering mortar**

designed rendering/plastering mortar with a dry hardened density below a prescribed figure.

3.31**coloured rendering mortar**

designed rendering/plastering mortar specially coloured

NOTE The colour is achieved with pigments or coloured aggregates.

3.32**one coat rendering mortar for external use**

designed rendering mortar applied in one coat which fulfils all the functions of a multicoat system used externally and which is usually specifically coloured. One coat mortars for external use may be manufactured using normal and/or lightweight aggregates

3.33**renovation mortar**

designed rendering/plastering mortar used on moist masonry walls containing water soluble salts. These mortars have a high porosity and vapour permeability and reduced capillary action

3.34**render/plaster**

materials used externally are referred to as render/rendering and materials used internally as plaster/plastering

3.35**rendering/plastering system**

sequence of coats to be applied to a background which can be used in conjunction with the possible use of a support and/or reinforcement and/or a pre-treatment

NOTE In some cases the pre-treatment may be regarded as a separate coat in addition to the specified system.

3.36**render/plaster coat**

layer applied in one or more operations or passes with the same mix, with the previous pass not being allowed to set before the next one is made (i.e. fresh on fresh)

3.37

undercoat

lower coat or coats of a system

3.38

final coat

last coat, decorative or not, of a multicoated rendering or plastering system

4 Materials

4.1 General

4.1.1 Raw materials shall have characteristics permitting the finished product to conform to the requirements of this standard.

4.1.2 Mortar is a combination of water, aggregate, and cementitious materials. Each ingredient serves an important purpose in the mix.

4.2 Water

Water assists the mixing of the aggregate and cementitious materials. Adequate water is essential for hydration, workability and chemical process that gives mortar its strength. Potable water shall be used in mortar because water that is safe to drink generally does not contain contaminants that may adversely affect mortar properties.

4.3 Aggregates

Aggregate used in mortar is usually sand and resists shrinkage of the cement in the mortar mix. For workability and strength, each particle of aggregate shall be coated with a combination of cementitious material and water. If sand particles of uniform size (large or small) are used in the mortar, the total volume of voids between particles is greater and more of the cementitious material is required in the mix than if sand particles of varying sizes are used.

Well-graded sand, containing hard particles of varying sizes from dust up to about 2 mm shall be desirable because the required proportion of cementitious materials to aggregate is decreased, as is the total volume of water used in the mix. Lower proportions of cement and water or water-cement ratio mean less shrinkage.

Less shrinkage means less tendency of the mortar to crack. The sand shall be free from grass, leaves, roots, and other harmful ingredients.

The manufacturer of mortar shall keep records of how suitability of materials is established.

4.4 Cementitious Materials

Cementitious materials have adhesive and cohesive properties both when in a plastic state and when hardened. There are two categories of cementitious materials: cement and lime, and mortar shall include one of them or a combination of the two.

4.5 Cement

Common cements shall be used and shall comply with RS EAS 18-1 and shall be kept in dry stores. If there are hard lumps in the cement that cannot be crumbled by hand, it is not fresh and should not be used.

4.5.1 Lime

Building lime complying with CD ASTM C141M shall be used.

Lime should be used if the sand lacks fine material or is single sized, as such sands tend to produce mortar with poor workability unless lime is included in the mix.

Lime also helps the fresh mortar to retain water when it is placed against dry cement bricks or blocks and helps to prevent cracking of the hardened mortar.

5 Requirements for Mortar

5.1 General

The requirements and properties specified in this standard shall be defined by the test methods and other procedures referred to in this standard. For production evaluation, the manufacturer shall define the conformity criteria in the production control documentation.

5.2 Properties of fresh mortar

5.2.1 Workable life

In respect of fresh properties, the manufacturer is required to declare the workable life.

The workable life shall be declared by the manufacturer. When the masonry mortar is sampled from a consignment in accordance with RS 211-2, working life will depend upon working characteristics.

Once the initial set has started the mortar shall not be reconstituted in a mechanical mixer or by any other method. Setting of cement is affected by weather and will proceed more slowly when it is colder. This factor is taken into account when the mortars are manufactured but subsequent significant reductions in temperature may increase the retardation period and extend the working life and will have no adverse effect on the masonry.

The mortar shall be spread easily and remain workable to enable the accurate laying to line and level of the masonry units. It shall retain water so that it does not dry out and stiffen too quickly, especially when using absorbent masonry units.

It shall then harden in a reasonable time to prevent it deforming or squeezing out under the weight of the units laid above.

5.2.2 Workability

5.2.2.1 Workability may be defined as the behaviour of a mix in respect of all the properties required during application, subsequent working and finishing. The operative's opinion of workability is greatly influenced by the flow properties of the mix, its cohesiveness and its retention of moisture against the suction of the substrate.

5.2.2.2 A mortar with good workability shall have the following properties:

- a) ease of use, i.e. the way it adheres or slides on the trowel;
- b) ease of spread on the masonry unit;
- c) ease of extrusion between courses without excessive dropping or smearing; and
- d) ease of positioning of the masonry unit without movement due to its own weight and the weight of additional courses.

5.2.2.2 If a mortar is 'harsh', that is of poor workability, the output of craftsmen will be reduced. Picking up and spreading will be slower and difficulty will be experienced in placing the cross or perpendicular joints and in obtaining a good finish.

5.2.2.3 To assess the working properties of the mortar the consistence is first determined in accordance with RS 211-3 or RS 211-4.

5.2.3 Chloride content

When relevant, the chloride content of the mortar as delivered shall be declared by the manufacturer.

The chloride content should not exceed 0.1 % Cl of the mortar by dry mass.

5.2.4 Air content

When relevant for the use for which the masonry mortar is placed on the market the range in which the air content will fall shall be declared by the manufacturer.

5.3 Proportion of constituents

For prescribed mortars the mix proportions by volume or by weight of all the constituents shall be declared by the manufacturer. The following is the mix proportion by volume:

- a) cement, 15 %
- b) lime, 10 %

c) aggregates, 75 %

5.4 Properties of hardened mortar

5.4.1 Compressive strength of mortar for bedding masonry units

For designed mortars, the compressive strength of masonry mortar shall be declared by the manufacturer.

Adequate mortar strength is essential, but the final strength of a mortar should not exceed that of the bricks or blocks used.

The manufacturer may declare the compressive strength class in accordance with Table 1, where the compressive strength class is designated by (I), (II), (III), (IV).

5.4.1.1 Class I

Reinforced and unreinforced masonry where higher flexural strengths are required.

5.4.1.2 Class II

Masonry in contact with earth like normal load bearing applications, as well as parapets, balustrades, retaining structures, and freestanding and garden walls, and other walls exposed to possible severe dampness.

5.4.1.3 Class III

Lightly stressed non-structural walls.

5.4.1.4 Class IV

Non-load bearing application.

Table 1 — Guide for the selection of mortar

Location	Building segment	Mortar designation	Prescribed mortar (proportion of material by volume)		Compressive strength at 28 days (N/mm ²)
			Cement: Lime: sand	Cement: sand	
Exterior above grade	Highly stressed masonry incorporating high-strength structural units which may be used in multi-storey load bearing buildings and seismic loading	(I)	1:0 to 1/4: 3	1:3 to 4	12

Exterior at or below grade	Foundation retaining walls, walls, manholes, sewers, pavement, walks	(II)	1:0 to 1/2: 4	1:5 to 6	6
Interior	Lightly stressed non-structural walls	(III)	1:1:5 to 6	1:6	4
Interior or Exterior	Non-bearing partitions, repointing	(IV)	1:2:8 to 9	1:7	2

5.4.2 Compressive strength of rendering/plastering mortar

5.4.2.1 The principles for specifying rendering mortars are similar to those for specifying mortars for bedding masonry units. The specification of rendering system requires consideration of a number of parameters:

- The nature and condition of the background (its strength and absorptivity); and
- The nature and conditions of exposure, the functional requirement, the type of render, the type of finish/appearance (textured/smooth).

5.4.2.2 Different fields of use and exposure conditions require mortars with different properties and performance levels. For this purpose, compressive strength shall be classified according to Table 2. The properties relevant to the intended use and/or type of product shall be declared according to Table 2.

Rendering is normally subjected to environmental exposure (frost, wind, sun and rain).

Table 2 — Classification for hardened rendering/plastering mortar

Intended use of mortar	categories	Mix proportion of materials by volume		Range of compressive strength at 28 days
		Cement: sand: lime	Cement: sand (using plasticizer)	
Severe exposure	CS I	1: 1/4: 3	—	≥ 6 N/mm ²
Moderate exposure	CS II	1: 1/2 4 to 4 1/2	1: 3 to 4	3.5 to 7.5 N/mm ²
Moderately low exposure	CS III	1:1:5 to 6	1:5 to 6	1.5 to 5.0 N/mm ²
Passive / sheltered exposure	CS IV	1:2: 8 to 9	1:7 to 8	0.4 to 2.5 N/mm ²

Note It is important to consider the mix proportions of mortars with care.

5.4.2.3 The location of the structure to which the rendering has been applied also affects the ability of the rendering to withstand the environmental actions applied to it.

5.4.2.4 The categories of exposure based on driving rain can be described as follows:

- Passive/sheltered exposure:** these are classified as areas of moderately low rainfall in which walls are protected from the weather by overhanging eaves and the close proximity of other buildings.

- b) **Moderate exposure:** this classification applies to walls partially protected from the weather by overhanging eaves and by adjacent building of similar height.
- c) **Severe exposure:** this classification applies to walls which are exposed to the full force of wind and rain.

Examples of this classification would be buildings on hill sites, near the coast and those projecting above surrounding buildings.

5.4.2.5 The compressive strength class in descending order for hardened rendering/ plastering mortar is designated by **CS I, CS II, CS III, and CS IV.**

5.4.2.6 The mix proportions are intended as a guide but may need altering slightly to suit local conditions such as the types of brick or block. or the sand being used.

5.4.3 Bond strength

Good bond is essential to minimise ingress of water and moisture. The interface of the masonry unit and the mortar is usually the most vulnerable part of the masonry construction to the ingress of rain. Bond strength is required to withstand tensile forces due to wind structural and other applied forces. Movement of the masonry units and temperature changes.

It should also be emphasized that workmanship is a key factor in affecting bond. The time lapse between spreading mortar and placing shall be kept to a minimum. Once the masonry unit is in place and aligned it shall not be subsequently moved.

Freshly laid masonry should be protected from extremes of wind and sun to avoid drying of the mortar before hydration of the cement is complete.

For designed masonry mortars intended to be used in elements subjected to structural requirements the bond strength of the mortar in combination with a masonry unit shall be declared in terms of the characteristic initial shear strength.

NOTE Bond strength depends on the mortar the masonry unit its moisture content and the workmanship.

5.4.4 Water absorption

For masonry mortars intended to be used in external elements and exposed directly to the weather, the water absorption shall be declared by the manufacturer. When sampled from a consignment in accordance with RS 211-2 and tested in accordance with RS 211-7, the water absorption shall not be higher than the declared value.

5.4.5 Density (dry hardened mortar)

When relevant for the use for which the masonry mortar is placed on the market the range in which the density of dry hardened mortar will fall shall be declared by the manufacturer.

For lightweight masonry mortars the density shall be equal to or less than 1300 kg/m³.

5.5 Mixing of mortar

5.5.1 General

Batching of mortar shall be done by either volume or weight. The manufacturer shall ensure that equipment used is calibrated to maintain accuracy in measurements.

Where high precision is required, measurement by weight is recommended, and by volume otherwise.

5.5.2 Machine mixing

Machine mixing refers to mixing large quantities of mortar in a drum-type mixer. All dry ingredients shall be placed in the mixer first before adding the water slowly. The mortar shall be mixed until a completely uniform mixture is obtained.

5.5.3 Hand mixing

Hand mixing involves mixing small amounts of mortar by hand in a mortar box or wheelbarrow. Care shall be taken to mix all ingredients thoroughly to obtain a uniform mixture. As in machine mixing all dry materials shall be mixed together first before adding water slowly. A steel drum of water shall be kept close at hand to use as the water supply. All masonry tools free of hardened mortar mix and dirt shall be kept by immersing them in water when not in use.

If certain types of mortar need specific site mixing equipment procedures or times these shall be specified by the manufacturer. Mixing time is measured from the time when all constituents have been added.

6 Designation of masonry mortar manufactured in a plant

The designation shall include the following as relevant:

- a) name of manufacturer;
- b) a code for or the date of production;
- c) workable life;
- d) chloride content;
- e) air content;
- f) proportion of constituents (for prescribed mortars) and relationship to compressive strength or compressive strength class;
- g) compressive strength or compressive strength class (for designed mortars);
- h) bond strength;

- i) water absorption; and
- j) density.

NOTE In the designation for a product information about special qualities may be included when the mortar is intended for use in special construction.

7 Marking

The designation shall be marked on the packaging the delivery ticket or the manufacturer's data sheet or other information accompanying the product.

8 Evaluation of conformity

8.1 General

The manufacturer (or his agent) shall demonstrate compliance for his product with the requirements of this Rwanda Standard by carrying out relevant laboratory testing of the mortar.

8.2 Plant production control

8.2.1 General

8.2.1.1 A plant production control scheme shall be established and documented in a manual. The plant production control system shall consist of procedures for internal control of the production to ensure that such products placed on the market conform to this standard.

8.2.1.2 The internal control shall consist of one or both of the following:

- a) regular inspections, checks and tests and the utilization of the results to control equipment, raw or incoming materials and the production process; and
- b) regular inspections, checks and tests on the finished product.

8.2.1.3 Records shall be maintained of the dates of tests and inspections identification of the products tested and the results of the tests or inspections as indicated in the quality manual.

8.2.2 Process control

8.2.2.1 Incoming materials: as appropriate, the manufacturer shall define the acceptance criteria of incoming materials and the procedures that he operates to ensure that these are met.

8.2.2.2 Production process: as appropriate the relevant features of the plant and production process shall be defined giving the frequency of the inspections checks and tests together with the values or criteria required both on equipment and on work in progress. The action to be taken when control values or criteria are not achieved shall be given. Weighing and measuring equipment shall be calibrated. The frequency of calibration shall be indicated.

8.2.3 Finished product test

8.2.3.1 For testing the finished product. The plant production control system shall incorporate the sampling plan and testing frequency of the finished product. The results of sampling and testing shall be recorded.

8.2.3.2 Test equipment having a bearing on test results shall be calibrated. The calibration criteria and inspection procedures shall be given in the quality manual.

8.2.4 Traceability

As appropriate, systems of traceability and control of incoming materials and the use of materials shall be given in the quality documents. The stock control system of manufactured products shall be given in the quality documents. This should include the method of treating non-conforming products.

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