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Aggregates for concrete — Specification



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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 gazetted as Rwanda Standards.

DRS 373 was prepared by Technical Committee RSB/TC 009, Building Materials and Civil Engineering.

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

- 1) ASTM C33/C33M – 13 ,Standard Specification for Concrete Aggregates
- 2) BS EN 12620:2013 Aggregates for concrete

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

Committee membership

The following organizations were represented on the Technical Committee on RSB/TC 009, Building Materials and Civil Engineering in the preparation of this standard.

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INES RUHENGERI

Ruliba Clays

Rwanda Housing Authority

Standards for Sustainability

University of Rwanda

RSB(Secretariat)

Aggregates for concrete — Specification

1 Scope

This standard specifies the properties of fine aggregate, coarse aggregate and filler aggregates obtained by processing natural, manufactured or recycled materials and mixtures of these aggregates for use in concrete. It covers aggregates having an oven dried particle density greater than 2 000 kg/m³ for all concrete, including for structures cast in situ, precast structures, and structural precast products for buildings and civil engineering structures and concrete used in roads and other pavements and for use in precast concrete products.

It also covers recycled aggregate with densities between 1 500 kg/m³ and 2 000 kg/m³.

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.

RS 96-2, *Methods of test for aggregates — Part 2: Guide to sampling and testing aggregate*

RS 96-3, *Methods of testing aggregates — Part 3: Method for sampling*

RS 96-4, *Methods of test for aggregates — Part 4: Methods for determination of particle size distribution — sieve tests*

RS 96-5, *Methods of test for aggregates — Part 5: Determination of particle shape – Flakiness index*

RS 96-6, *Methods of testing aggregates — Part 6: Determination of shell content in coarse aggregate*

RS 96-7, *Methods of test for aggregates — Part 7: Determination of moisture content*

RS 96-8, *Methods of test for aggregates — Part 8: Determination of ten per cent fines value*

RS 96-9, *Methods of test for aggregates — Part 9: Determination of aggregate impact value (AIV)*

RS 96-10, *Methods of test for aggregates — Part 10: Determination of acid-soluble material in fine aggregates*

RS 96-11, *Methods of test for aggregates — Part 11: Methods for testing and classifying the drying shrinkage of aggregates in concrete*

ASTM C 127, *Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate*

ASTM C 88, *Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate*

ASTM D 5821, *Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine*

ASTM C 131/C 131 M, *Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine*

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

3 Terms and definitions

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

3.1

aggregate

granular material used in construction, such as sand, gravel, crushed stone, used with a cementing medium to form hydraulic-cement concrete or mortar

3.2

natural aggregate

aggregate resulting from the natural disintegration of rock and which has been deposited by streams or glacial agencies

3.3

fine aggregate

aggregate entirely passing the 4.75 mm sieve and predominantly retained on the 75 µm sieve

3.4

course aggregate

aggregate predominantly retained on the 4.75 mm sieve

3.5

all-in aggregate

aggregate consisting of a mixture of coarse and fine aggregates

3.6 manufactured aggregate

aggregate of mineral origin resulting from an industrial process involving thermal or other modification

3.7

recycled aggregate

aggregate resulting from the processing of inorganic material previously used in construction

3.8

filler aggregate

aggregate, most of which passes a 0.063 mm sieve, which can be added to construction materials to provide certain properties

3.9

grading

particle size distribution expressed as the percentages by mass passing a specified set of sieves

3.10

fines

particle size fraction of an aggregate which passes the 0.063 mm sieve

4 Geometrical requirements

4.1 General

The geometrical properties of aggregates shall be determined with consideration of the application conditions and origin of the aggregates, and in accordance with the test methods specified in this standard.

Coarse aggregate shall consist of gravel, crushed gravel, crushed stone, or crushed hydraulic-cement concrete or a combination thereof.

Fine aggregate shall consist of natural sand, manufactured sand, or a combination thereof.

4.2 Grading

The grading of the aggregate shall be determined by sieving in accordance with RS 96-4.

4.2.1 Coarse aggregate

The grading of coarse aggregates shall be within the appropriate limits given in Table 1.

Table 1— Grading of coarse aggregates

Sieve	Percentage by mass passing test sieves (%)
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size (mm)	Nominal size of graded aggregates (mm)			Nominal size of single-sized aggregate (mm)				
	40 to 5	20 to 5	14 to 5	40	20	14	10	5
50	100	-	-	100	-	-	-	-
37.5	90-100	100	-	85-100	100	-	-	-
20	35-70	90-100	100	0-25	85-100	100	-	-
14	25-55	40-80	90-100	-	0-70	85-100	100	-
10	10-40	30-60	50-85	0-5	0-25	0-50	85-100	100
5	0-5	0-10	0-10	-	0-5	0-10	0-25	45-100
2.36	-	-	-	-	-	-	0-5	0-30

Note For coarse recycled 20 mm and 10 mm single-sized aggregates, the percentage by mass passing 4 mm test sieve shall not exceed 5%.

4.2.2 Fine aggregate

The grading (i.e. Grading zone I, Grading zone II, Grading zone III as defined in table 2 below) of fine aggregates shall be declared and documented by the aggregate producer or supplier. This grading shall comply with both the overall limits and the limits for the declared grading given in Table 2. In addition, not more than one in ten consecutive samples shall have a grading outside the limits for the declared grading.

Table 2— Grading of fine aggregate

Sieve size	Percentage by mass passing for aggregate zones			
	Overall limits	Limits for declared grading		
		Grading zone I	Grading zone II	Grading zone III
10mm	100	-	-	-
4.75mm	90 to 100	-	-	-
2.36mm	60 to 100	60 to 100	65-100	80-100
1.18mm	30 to 100	30 to 90	45-100	70-100
600µm	15 to 100	15 to 54	25-80	55-100
300µm	5 to 70	5 to 40	5-48	2-70
150µm	0 to 20	-	-	-

4.3 Shape of coarse aggregate

When required, the shape of coarse aggregates shall be determined in terms of the flakiness index.

The flakiness index shall be the reference test for the determination of the shape of coarse aggregates

The flakiness index of coarse aggregates, determined in accordance with RS 96-5, shall not exceed 15%.

4.4 Shell content

When required, the shell content of coarse aggregate, determined in accordance with RS 96-6, shall not exceed 10%.

4.5 Deleterious substances

Aggregate shall not contain any harmful material, such as pyrites, coal, lignite, mica, shale or similar laminated material, clay, alkali, soft fragments and organic impurities in such quantity as to affect the strength and durability of the concrete.

The maximum quantity of deleterious substances shall not exceed 1.0 % by mass. For substances finer than 75µm, the quantity of deleterious substances shall not exceed 3.0 %

5 Physical requirements

5.1 General

The necessity for testing all properties specified in this clause shall be limited according to the particular application at end use or origin of the aggregate. When required, the tests specified in this clause shall be carried out to determine appropriate physical properties.

5.2 Particle density and water absorption

When required the particle density and water absorption shall be determined in accordance with ASTM C 127. Water absorption shall not exceed 1.5%

The minimum oven dried particle density of aggregates shall be 2 000 kg/m³.

5.3 Soundness

The aggregate, when subjected to five cycles of the soundness determined in accordance with ASTM C 88, shall not exceed the following limits for weighted loss:

- a) **For fine aggregates:** 10 % when tested with sodium sulphate (Na₂SO₄) and 15 % when tested with magnesium sulphate (MgSO₄).
- b) **For coarse aggregates:** 12 % when sodium sulphate (Na₂SO₄) is used or 18 % when magnesium sulphate (MgSO₄) is used.

5.4 Drying shrinkage

The drying shrinkage of aggregates used in structural concrete, when determined in accordance with RS 96-11, shall not exceed 0.075%.

5.5 Aggregate crushing value

The aggregate crushing value, determined in accordance with ASTM D 5821, shall not exceed 30 percent.

NOTE 1 The aggregate crushing value gives a relative measure of the resistance of coarse aggregate to crushing under a gradually applied compressive load.

NOTE 2 The aggregate crushing value test is made on aggregate passing a 12.5mm sieve and retained on a 10 mm sieve.

5.6 Ten percent fines value

The ten percent fines value shall be determined in accordance with RS 96-8.

5.7 Aggregate impact value

The aggregate impact value for coarse aggregate, when determined in accordance with RS 96-9, shall not exceed 30 percent.

NOTE The aggregate impact value gives a relative measure of the resistance of an aggregate to sudden shock or impact, which in some aggregates differs from its resistance to a slow compressive load.

5.8 Aggregate abrasion value

The aggregate abrasion value for coarse aggregate, when determined in accordance with ASTM C 131 using Los Angeles machine, shall not exceed 30 percent.

6 Chemical requirements

6.1 General

The chemical properties of aggregates shall be determined with consideration of the application conditions and origin of the aggregates, and in accordance with the test methods specified in this Standard.

6.2 Chlorides

The acid-soluble chloride ion content of aggregates for concrete shall be determined in accordance with RS 96-10.

The chloride ion contents of the combined natural aggregates shall not exceed the limits given in Table 3 for three categories of concrete.

Table 3 — Limits for chloride ion content of natural aggregates

Type and use of concrete	Chloride ion content expressed as percentage by mass of combined natural aggregates (%)
Prestressed concrete and heat-cured concrete containing embedded metal	0.01
Concrete containing embedded metal and made with cement complying with RS EAS 18-1	0.05
Other concrete	No limit

The chloride ion content of the natural aggregates and coarse recycled aggregate when combined in use shall not exceed 0.05% by mass.

The acid-soluble sulphate content of natural aggregates shall not exceed 0.8% by mass.

The acid-soluble sulphate content of coarse recycled aggregate shall not exceed 1% by mass.

The total sulphur content of natural aggregates shall not exceed 1% by mass.

When required the water-soluble chloride ion content of aggregates for concrete shall be determined in accordance with ASTM C 1524.

NOTE If the water-soluble chloride ion content of the combined aggregate is known to be 0.01 % or lower (e.g. for aggregates extracted from most inland quarries) this value can be used in the calculation of the chloride content of concrete.

7 Sampling and testing

7.1 Sampling

The guidance to sampling and method of sampling shall be in accordance with RS 96-2 and RS 96-3 respectively.

7.2 Testing

The amount of material required for each test shall be as specified in the relevant method of test given in RS 96-4 to RS 96-11 in addition to ASTM test methods quoted in this standard.

8 Supplier's certificate

The supplier shall satisfy him/herself that the material complies with the requirements of this standard and, if requested, shall supply a certificate to this effect to the purchaser.

If the purchaser requires independent tests to be made, the sample for such tests shall be taken before or immediately after delivery according to the option of the purchaser, and the tests carried out in accordance with this standard and on the written instructions of the purchaser.

The supplier shall supply free of charge the material required for tests.

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Bibliography

- [1] CS 3:2013 Construction Standard, Aggregates for Concrete
- [2] SANS 1083 , Aggregates from natural sources — Aggregates for concrete

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