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**Fibre or micro concrete tiles—
Requirements**

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Contents	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Raw materials	3
4.1 General	3
4.2 Cement	3
4.3 Sand and aggregate	3
4.4 Water	4
4.5 Admixtures	4
4.6 Pigments	4
4.7 Fibres	5
5 Manufacturing	5
6 Tolerances on dimensions	5
7 Materials for fixing	5
8 Fixing devices	6
8.1 General	6
8.2 Nailing	6
8.3 Nib	6
8.4 Lugs	6
8.5 Fixing wires	7
9 Freedom from defects	7
10 Fittings	7
11 Physical requirements	7
11.1 Breaking strength	7
11.2 Permeability	8
11.3 Water absorption	8
12 Marking	8
13 Sampling	8
Annex A (normative) Permeability test	10
A.1 Test specimen	10
A.2 Apparatus	10
A.3 Procedure	10
Annex B (informative) Common fittings	11
Annex C (informative) Common fixing devices	12

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 545 was prepared by Technical Committee RSB/TC 9, *Civil engineering and building materials*.

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

Standard Guidelines, Fibre or Micro Concrete Tiles. SKAT and ILO. Swiss Center for Appropriate Technology International Labour Office, 1992.

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

Committee membership

The following organizations were represented on the Technical Committee on *Civil engineering and building materials* (RSB/TC 9) in the preparation of this standard.

A+Construction Group Ltd

Africeramics Ltd

Consultants Engineers Group (CEG) Ltd

D&D Resources Ltd

Dutureheza Ltd

Enabel Rwanda

Greenpack Africa Ltd

Integrated Polytechnic Regional Centre (IPRC) - Musanze

Mass Design Group

NP Construction Construction Company (NPCC) Ltd

Road Transport Development Agency (RTDA)

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Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA)

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SKAT Consult

St Joseph Engineering Company (SJEC) Ltd

Standards for Sustainability (SfS)

Stonecraft Industries Ltd

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Fibre or micro concrete tiles — Requirements

1 Scope

This Draft Rwanda Standard specifies the minimum requirements for the raw materials, manufacture, dimensions and other physical properties of Fibre Concrete Roofing (FCR) tiles and Micro Concrete Roofing (MCR) tiles, semi sheets and fittings.

Guidelines for laying clay roofing tiles are covered in RS ARS 1301.

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.

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

RS 373, Aggregates for concrete — Specification

RS ISO 19596, Admixtures for concrete

RS ARS 1301, Guidelines for laying clay roofing tiles

RS ISO 10545-1, Ceramic tiles — Part 1: Sampling and basis for acceptance

RS ISO 10545-4, Ceramic tiles — Part 4: Determination of modulus of rupture and breaking strength

3 Terms and definitions

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

3.1

admixtures for concrete

material added during the mixing process of concrete in a quantity not more than 5 % by mass of the cement content of the concrete, to modify the properties of the mix in the fresh and/or hardened state

3.2

acceptable

meeting stakeholder expectations that can be shown reasonable or merited

3.3

defective

tile that fails in one or more respects to comply with the appropriate requirements of the Standard.

3.4

stated length/width

length / width that is the manufacturer's equivalent specified to be the appropriate length / width.

3.5

face of the tile

exterior part of the tile when fixed on the roof

3.6

back of the tile

underneath part of the tile when fixed on the roof

3.8

batch

tiles made using the same mixture of cement, sand and fibres

Any quantity of tiles or one size and same material type, pattern and dimensions from one manufacture, submitted at any one time for inspection and testing

3.9

fittings

components with particular shapes which are fitted to tiles or semi sheets to complete the roofing at the verge, ridge and eaves.

3.10

pitch

distance between two adjacent crests of a tile or semi sheet.

3.11

product

tile, sheet or fitting that complies with this standard.

4 Raw materials

4.1 General

The raw materials to be used for manufacturing FCR or MCR tiles products shall be free from deleterious materials liable to cause ultimate deterioration in the quality of the products.

4.2 Cement

4.2.1 The cement used in the manufacture of the tiles shall comply with the requirements specified in RS EAS 18-1.

4.2.2 Any other cementitious materials may be used that will produce a product complying with the requirements of this standard.

NOTE In some cases the use of pozzolanic binders may be taken into consideration.

4.3 Sand and aggregate

4.3.1 For FCR tile production only sand is used. If the tiles are produced without fibre (MCR) a special defined content of fine aggregate is added.

4.3.2 The clay and silt content may not exceed 4 %.

4.3.3 Sand and aggregate shall be clean, free from organic material.

4.3.4 Sand and aggregate for FCR shall be graded in accordance with Table 1.

Table 1— Grading of sand and aggregates for FCR tiles

Maximum grain size	2-3mm
Component above 2mm	0-10%
Component 0.5-2mm	35-75%
Component below 0.5mm	25-55%

4.3.5 Sand and aggregate for MCR shall be graded in accordance with

Table 2.

Table 2—Grading of sand and aggregates for MCR tiles

Prod. Thickness	6mm	8mm	10mm
Max. grain size	5.5mm	7mm	-
Comp. above 2mm	25-45%	30-50%	35-55%
Comp 0.5-2mm	15-40%	15-40%	20-50%
Comp. below 0.5mm	15-45%	15-40%	15-40%

4.3.6 Particles of aggregate shall not be bigger than the product thickness minus 1 mm.

4.3.7 Aggregates shall be clean and of silicious or similar characteristics. The grading of aggregate shall comply with the requirements of fine aggregate specified in RS 373.

4.4 Water

Water shall be clean and be free from matter harmful to the cement reactions and concrete

4.5 Admixtures

4.5.1 concrete additives such as accelerators, water proofers and plasticisers may be used as required.

4.5.2 Admixtures used in the manufacturing of FCR and MCR tiles shall comply with ISO 19596.

4.5.3 Any chemical admixtures used in the concrete shall not have adverse effects on the quality and appearance of the tiles produced

4.6 Pigments

4.6.1 Pigments used in the manufacturing of FCR and MCR tiles shall comply with ISO 19596.

4.6.2 Pigments applied shall not contain material that is deleterious to the product and shall not contain any toxic material.

4.6.3 Pigments may be added to the mix during production or applied as paint.

4.6.4 Pigments used shall be mineral based such as silicates and shall not be synthetic

NOTE Synthetic pigments such as plastic, latex, etc are not acceptable.

4.7 Fibres

4.7.1 Fibres shall be clean, free from loose particles, soft pith, not release matters harmful to the cement reactions, and shall be well separated.

4.7.2 Average length of individual fibres shall not exceed 20 mm.

NOTE Example of fibres include coir, kenaf, polypropylene, sisal, coconut husk and jute fibre.

5 Manufacturing

FCR and MCR tiles shall be manufactured in a system that ensures consistency in quality. The system shall put in place measures to ensure the quality of raw materials, production and post-production management. The system shall be documented.

6 Tolerances on dimensions

When tested in accordance with RS ISO 10545-2, dimensions shall meet tolerances given in Table 3.

Table 3: Tolerances on dimensions of tiles

Dimensions	Tolerance
length	±3mm
width	±3mm
profile	±3mm
thickness	±0.5mm
squareness	± 3mm

7 Materials for fixing

7.1 Materials used for fixing tiles shall be flexible enough to be twisted by hand without breaking and strong enough to carry loads of at least 300 Newton (N).

7.2 No organic strings of jute, hemp and the like shall be accepted.

7.3 The following materials shall be used for fixing tiles:

- a) galvanised steel wire of at least 0.9 mm diameter;
- b) copper wire (or other non-ferrous wire of a metal that is compatible with concrete) of at least 1.22 mm diameter;
- c) stainless steel wire of diameter at least 0.9 mm; and
- d) string of a material that does not rot (nylon, etc.)

8 Fixing devices

8.1 General

8.1.1 The tiles shall be fixed to the battens by a nib with a wire loop or tie wire.

8.1.2 Normal tiles are fixed at one point only; special tiles may have more fixing points.

NOTE Examples of special tiles include tiles at verge, ridge and eaves.

8.2 Nailing

8.2.1 Direct nailing through holes in the tile or in the nib shall not be permitted to prevent damage.

8.2.2 Nail holes shall be of an acceptable diameter and shall be so positioned that the distance between their centres and a line joining the bases of the batten lugs is not less than 10 mm and not more than 16 mm.

8.2.3 Plain tiles shall have two nail holes, the centre of each being not less than 25 mm and not more than 45 mm from the adjacent side of the tile.

8.2.4 Interlocking-type tiles shall have at least one nail hole positioned approximately on the longitudinal centreline of the tile.

8.3 Nib

The minimum dimensions of a nib shall be in accordance with Table 4.

Table 4: Minimum dimensions of a nib

Length	25mm
Width	15mm
Height	15mm

8.4 Lugs

Lugs shall be of one of the following types:

- a) a concrete lug (on the underside of the tile, having a hole of at least 3 mm diameter through the lug. The distance between the other surface of the lug and the adjacent periphery of the hole shall be at least 6 mm;
- b) a non-ferrous metal lug which is compatible with concrete, firmly cast into the underside of the tile, and having a hole of at least 3 mm diameter through the lug. The distance between the outer edge of the lug and the periphery of the hole shall be at least 3 mm.

8.5 Fixing wires

Fixing-wires shall be firmly cast into the bottom of the nib and shall have sufficient length for:

- a) wire loop to allow nail fixing to the batten; and
- b) tie wires to allow tie around a 50x50 mm batten.

9 Freedom from defects

9.1 The products shall be free from visible defects which may impair the appearance or serviceability of the products. The surfaces of the products shall be of uniform texture and smooth on the side intended to be exposed to weather.

9.2 The product shall not have any holes and no visible cracks longer than 5 mm.

9.3 The surface shall not have any pores deeper than 2 mm or larger in diameter than 5 mm.

10 Fittings

Fittings shall be of similar quality, color and texture to the tiles with which they are laid.

11 Physical requirements

11.1 Breaking strength

11.1.1 A nominal 250 mm x 500 mm tile shall bear the following loads (when tiles are dry):

- a) A 6 mm thick product should bear 30 kg weight.
- b) A 8 mm thick product should bear 50 kg weight.
- c) A 10 mm thick product should bear 80 kg weight

11.1.2 When tested in accordance with RS ISO 10545-4 breaking load shall not be less than:

- a) for 6 mm thick tile 250 N

- b) for 8 mm thick tile 400 N
- c) for 10 mm thick tile 650 N

11.2 Permeability

When tested in accordance with Annex A, the underside of the product shall be free from water drips. Eventual signs of damp shall not cover more than 50 % of the total area covered with water.

11.3 Water absorption

When the tiles are tested in accordance with RS ISO 10545-3, the average percentage of water absorption shall be not more than 10 %.

12 Marking

12.1 The product shall be legibly and indelibly marked with the following information:

- a) the manufacturer's name or registered trade mark, or other means of identification
- b) batch number

12.2 In addition to the information in 12.1, and the following shall be legibly and indelibly marked on the bulk packaging:

- a) nominal dimensions;
- b) address of the manufacturer;
- c) country of manufacture;
- d) net weight; and number of tiles per square metre;
- e) the date of production; and
- f) reference to this Standard.

NOTE If requested, a certificate that the products comply with the requirements of this standard should be supplied.

13 Sampling

Sampling shall be performed in accordance with RS ISO 10545-1.

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Annex A (normative)

Permeability test

A.1 Test specimen

Ten tiles shall be randomly selected to form the sample and used for this test.

A.2 Apparatus

The test shall be conducted in a rectangular trough (see Figure 6) which is open at the bottom, the dimensions at the bottom being equal to the size of the tile.

A.3 Procedure

A.3.1 The test shall be conducted at a temperature of $27\text{ °C} \pm 2\text{ °C}$ and relative humidity of $65\% \pm 5\%$.

A.3.2 The tile shall be fitted at the bottom of the trough and the space between the tile and the sides of the trough plugged water-tight with suitable material like wax, bitumen, etc.

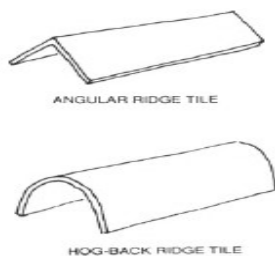
Water shall be poured into the mould so that it stands over the lowest tile surface to a height of 50 mm.

A.3.3 The water in the trough shall be allowed to stand for a period of six hours. The bottom of the tile shall then be carefully examined to see whether the water has seeped through the tile.

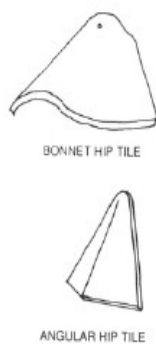
Annex B (informative)

Common fittings

The most important fitting is the ridge tile. Two types are commonly used, the angular ridge tile and the hog-back ridge tile.



For hipped roofs the Bonnet hip tile or the angular hip tile are used.



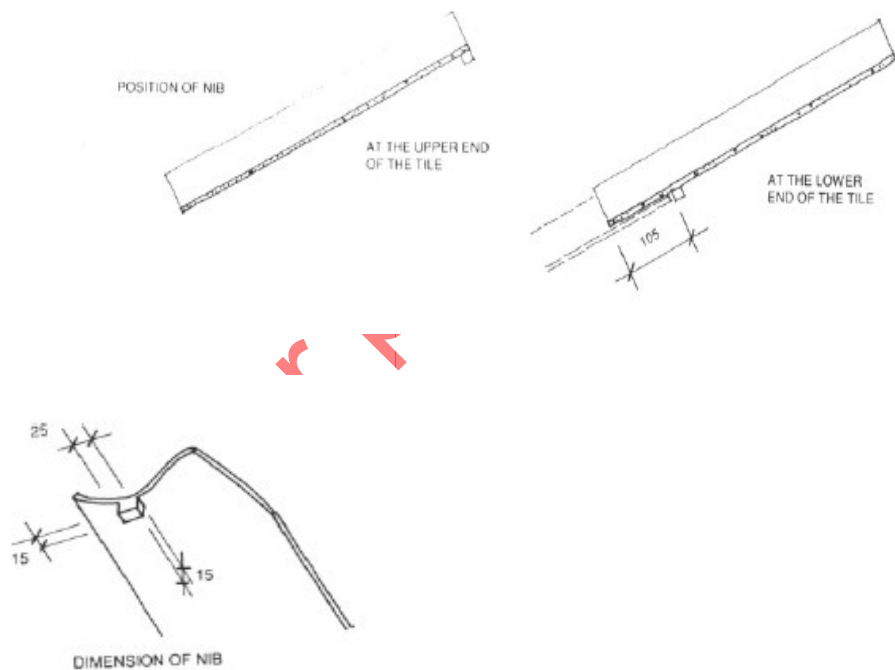
For L-shape buildings a roof with a valley may be required. Here the valley tile can be used.



Annex C (informative)

Common fixing devices

- C.1** The tiles are fixed to the battens by a nib with a wire loop or tie wire.
- C.2** Normal tiles are fixed at one point only, special tiles (eg. at verge, ridge and eaves) may have more fixing points.
- C.3** In hurrican prone areas all tiles should have two fixing points.
- C.4** Direct nailing through holes in the tile or in the nib is not recommended because there is a risk of damage in the form of hair cracks during nailing that reduces durability.



Nib dimensions length min 25 mm

- Width min 15 mm
- Height min 15 mm

Fixing wires shall be firmly cast into the bottom of the nib and shall have sufficient length

- in case of wire loop to allow nail fixing to the batten.

- in case of tie wires to allow tie around a 50 x 50 mm batten. The wire should be flexible enough to be twisted by hand without breaking.

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Bibliography

[1] ISO/IEC/IEEE 24765:2017 Systems and software engineering — Vocabulary

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