Tanzania Standard

Concrete roofing tiles and fittings - Specification
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- Building Research Unit
- National Construction Council
- Ministry of Education
- National Housing Corporation
- Faculty of Engineering (UDSM)
- National Estates and Designing Corporation
- Mwananchi Engineering and Contracting Corporation
- Institution of Engineers (Tanzania)
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- Ardh Institute
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- Aluminium Africa Limited
- National Examination Council
- Ministry of Labour and Manpower Development

Tanzania Bureau of Standards
P.O Box 9524
Dar es Salaam
Cable: 'STANDARDS'
Fax: 450959

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0 FOREWORD

This Tanzania Standard specifies the quality of the tiles as a unit from the point of view of strength, impermeability and durability. The design of the tile in relation to the exclusion of rain depends also upon the pitch of the roof, the lap of the tiles, the use of felt or boarding, and the locality and exposure.

The standard allows for any surface texture or colour desired by the purchaser, while ensuring that the physical and mechanical properties of the tiles are satisfactory.

It should be noted that all sizes given are typical and that this Tanzania Standard does not inhibit the manufacture of other sizes.

In reporting the results of a test made in accordance with this Tanzania Standard, if the final value observed or calculated, is to be rounded off, it shall be done in accordance with TZS 4:1979 (see clause 2).

In the preparation of this Tanzania Standard assistance was derived from BS 473,550:1990 - Concrete roofing tiles and fittings.

1 SCOPE

This Tanzania Standard specifies requirements for concrete roofing tiles and fittings.

For the purposes of this Tanzania Standard, concrete roofing tiles and concrete 'slates' have been divided into two groups:

a) Group A: Double - lap (non-interlocking) concrete tiles and concrete slates.

b) Group B: Single-lap (interlocking) concrete tiles and concrete slates.

2 REFERENCES

For the purposes of this Tanzania Standard, the following references shall apply:

a) TZS 177:1983, Portland cement - Ordinary and rapid hardening - Specification
c) TZS 58 (Part 3):1980, Aggregates - Sampling and test methods
d) TZS 4:1979, Rounding off numerical values.
3 GENERAL REQUIREMENTS

3.1 Cement

The cement used in the manufacture of the products shall comply in all respects with the requirements of TZS 177:1983 (see clause 2). Coloured portland cement may be used provided that it complies with the physical requirements of TZS 177:1983 (see clause 2).

3.2 Aggregate

The aggregate shall be clean and shall be of siliceous sand crushed ballast hard's tone (excluding metalliferous mine tailings) or other materials with similar characteristics. The grading of aggregate shall comply with the requirements for fine aggregates specified in TZS 58 (Part 2):1980 (see clause 2).

3.3 Pigments

The pigments used shall be such that they do not impair other requirements specified in this standard.

3.4 Colour

The colour and texture of exposed surfaces and the colour, if appropriate of concrete roofing tiles or slates ordered in accordance with this standard shall be as agreed between the purchaser and supplier at the time of placing the order.

3.5 Freedom from defects

Products shall be true to shape and shall be free from all objectionable excrescences and depressions, and on fracture, the interior of the product shall show a uniform structure.

3.6 Surface coatings

Where granules are applied, the process of manufacture shall include the removal of granules which are not adequately bonded to the surface of the product in the course of manufacture (see note).

NOTE — This does not preclude the loosening of granules during transport or during the normal life of the roof.

3.7 Nail holes

The shank of the nail specified for fixing the tile shall be capable of passing through the nail hole without damage to the tile or nail.

The nail hole shall be positioned such that the nail can enter the batten at an edge distance appropriate to the batten material specified and not less than 25 mm from the edge of the tile.

4 CHARACTERISTICS

4.1 Transverse strength

4.1.1 For all tiles, other than plain tiles (i.e. double lap tiles 267 mm x 165 mm) when tested in the manner described in annex A, the average breaking load (obtained from six tiles selected from the batch to be tested) applied along the width of the tile midway between the supports on a clear span of two thirds of the overall length of the tile shall be not less than the values calculated by means of the formula given below.
The average breaking load in newtons (N) shall be equivalent to

(1) for double-lap tiles 305 mm wide and above, not less than 2.1 times the effective width and
(2) for single-lap tiles of all sizes, not less than 3.2 times the effective width.

**Examples**

Large double-lap slate: 457 mm x 330 mm; transverse strength wet equals 693 N (2.1 x 330).

Interlocking tile: 381 mm x 229 mm; transverse strength wet equals 653N (3.2 x 204, i.e. width of tile less side lock).

Double Roman tile: 413 mm x 330 mm; transverse strength wet equals 976 N (3.2 x 305, i.e. width of tile less side lock).

Large single-lap slate: 430 mm x 380 mm; transverse strength wet equals 1136N (3.2 x 355, i.e. width of slate less side lock).

4.1.2 For plain tiles 267 mm x 165 mm the average breaking load, applied along the width of the tile midway between the supports, on a clear span of 190 mm shall be not less than 490 N.

4.1.3 If the average breaking load in the test does not reach the value stated above, a second test shall be carried out on a further six tiles selected from the same batch.

If the average of the two tests complies with the limit stated above, the batch shall be considered to have passed the test.

4.2 Permeability

4.2.1 The average permeability of the tiles when determined by the method described in annex B, using a cap covering an area of not less than 25% of the surface area of group A products (double-lap tiles) or an area of not less than two thirds of the length and three quarters of the effective width of group B products (single-lap tiles), shall be such that, at the end of 24h the amount of water flowing into or through the tiles when the pressure head is 200 mm shall not exceed, in the case of group A products, 20ml/m²/minute. The results shall be recorded to the nearest 0.1ml.

For the purpose of calculation, the effective area of the tile exposed to width water pressure shall be considered to be the plane area of the base of the water-filled space under cap.

4.2.2 The height of the centre at the capillary pipette shall be 200 mm above the mean calculated height of the surface in contact with the water plus the free height h at which water will stand in the capillary pipette due to capillary attraction. A calibrated capillary pipette with a bore of 1 mm to 2 mm shall be used.

The rate of flow of water through the tile average for the three tiles tested, shall not exceed that stated above for the relevant group to which the tiles belong.

4.2.3 Should the batch fail to comply with the appropriate limit stated above a further three tiles shall be selected from the same batch and the test repeated. If the average of the two batches complies with the limit stated, the batch shall be considered to have passed the test.

4.3 Compliance

If the tiles fail to satisfy the test requirements, the whole of the batch from which they were selected shall be deemed not to comply with this standard.
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4.4 Fittings

Fittings shall be of similar quality too and shall match the tiles with which they are to be laid. Fittings shall- comply with 3.1 to 3.7 together with the following additional requirements.

Ridge, hip and valley tiles shall not be less than 16 mm thick or of the same thickness as the tiles with which they are bounded. All other fittings shall be of the same general thickness as the tiles with which they are designed to be used.

4.5 Manufacturer's certificate

The manufacturer shall satisfy himself that the products comply with the requirements of this standard, and shall provide a certificate to this effect if requested by the purchaser.

5 SAMPLING

The purchaser or his representative may select from every batch of 10 000 tiles or part thereof, delivered or about to be delivered, 18 tiles for the purposes of carrying out the tests.

6 GROUP A PRODUCTS

6.1 Nibs

6.1.1 If the tile has two nubs, these shall be not less than 19 mm wide and 12.5 mm thick at the base.

6.1.2 If the tile has one nib, this shall be not less than 75 mm wide and 12.5 mm thick at the base.

6.1.3 The depth of the nib or nibs, measured from the underside of the tile shall be not less than 9.5 mm and not more than 12.5mm. Where tiles are manufactured for use in vertical tilling, the hanging side of the nibs shall be such that the tile will support itself.

NOTE — Certain patterns in this group are fixed by nailing only and are not provided with nibs.

6.2 Dimensions

The sizes of tiles are typically as detailed in table 1.

TABLE 1 — Group A double-lap (non-interlocking) concrete tiles and concrete slates.

<table>
<thead>
<tr>
<th>Maximum limit of manufacturing size</th>
<th>Minimum limit of manufacturing size</th>
<th>Overall work size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length mm</td>
<td>Width mm</td>
<td>Length mm</td>
</tr>
<tr>
<td>270</td>
<td>168</td>
<td>264</td>
</tr>
<tr>
<td>462</td>
<td>335</td>
<td>452</td>
</tr>
</tbody>
</table>

6.2.1 The deviation in tiles manufactured to agreed sizes, not shown in table 1, shall not exceed ± 5.0 mm for tiles above 300 mm x 200 mm or ± 3 mm for tiles below 300 mm x 200 mm of the size specified by the manufacturer of that type of tile.

The thickness of the body of the tile shall be not less than 9.5 mm at any cross section.
6.2.2 If there is a surface cross-camber it shall not exceed 3.2 mm.

6.2.3 The plus deviation in the thickness at any one section at right-angles to the log axis shall not exceed 3.2 mm.

6.3 Longitudinal camber

The camber if present or its equivalent, shall be not less than 4.5 mm and not more than 8 mm.

7 GROUP B PRODUCTS

7.1 Nibs and fit

7.1.1 If the tile has two nibs, these shall be not less than 32 mm wide and 6 mm thick at the base.

7.1.2 If the tile has one nib, this shall be not less than 75 mm wide and 12.5 mm thick at the base.

7.1.3 The depth of the nib or nibs, measured from the underside of the tile shall be not less than 12.5 mm.

7.1.4 The lower edge of each tile shall be designed to fit closely the profile of the tile immediately below.

7.2 Dimensions

7.2.1 The overall sizes of tiles are typically as given in table 2.

TABLE 2 — Group B single-lap (interlocking) concrete tiles and concrete slates.

<table>
<thead>
<tr>
<th>Maximum limit of manufacturing size</th>
<th>Minimum limit of manufacturing size</th>
<th>Overall work size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length mm</td>
<td>Width mm</td>
<td>Length mm</td>
</tr>
<tr>
<td>425</td>
<td>355</td>
<td>415</td>
</tr>
</tbody>
</table>

7.2.2 The deviation in tiles manufactured to other sizes as agreed, shall be ± 5.0 mm of the sizes specified by the manufacturers for that type of tile.

7.2.3 The body of the tile shall be not less than 9.5 mm thick except in the interlocking portion which shall be not less than 6.3 mm thick.

The side lap shall be not less than 25.0 mm.

8 MARKING

8.1 Each tile shall be legibly and indelibly marked with the name of the manufacturer or his trade mark, the marking shall not cover more than 5% of the area of the specimen and shall not hamper the properties of the tile.

8.2 Each roofing tile may also be marked with the TBS Certification Mark.

NOTE — The TBS Certification Mark may be used by manufacturers only under licence from TBS. Particulars of conditions under which the licence may be granted may be obtained from TBS.
ANNEX A

METHOD OF CARRYING OUT TRANSVERSE STRENGTH TEST

A-1 Immerse six tiles selected in the manner described in 4 in water at a temperature of 27 ± 2°C for 24 ± 1/2h. Immediately upon removal from the water test them wet in the following manner.

A-2 Evenly support the tile which is to be tested with the top surface uppermost on the bottom two bearers of a flexural testing machine. The distance between the centres of these bearers being two thirds of the length of the tile for all tiles except plain tiles (i.e. double-lap tiles 257mm x 155 mm).

For these tiles the distance between the centres of the bearers is 190 mm. Apply the load centrally through a third bearer to a uniform rate not exceeding 6500 N/min. Any one of the lower bearer and the top bearer shall be self-aligning and the width of the bearers shall exceed the width of the widest tile which is to be tested. The bearers shall be 38 mm in diameter.

The centre of rotation of the self-aligning bearers shall be as near to the testing face as possible and, in any case, within the thickness of the bearer.

A-3 Essentials of apparatus for transverse test are illustrated in figure 1. Calculate the average of breaking load of the six tiles.

ANNEX B - METHOD OF CARRYING OUT PERMEABILITY TEST

B-1 Test in the following manner, three tiles selected as described in annex A. Each tile shall be dried at room temperature for a minimum period of 48 h before testing.

B-2 Place a rigid metal or plastic cap, which may be transparent, over the tile to form a watertight void above the surface of the tile. A male cap similar to figure 2a or 2c, or alternatively female cap (figure 2b) shall be used. The area of the void shall be the minimum described in 3.2 and the seal between the cap and the tile shall be made watertight as follows:

B-2.1 A male cap made in accordance with figure 2a shall be attached to the surface of the tile by a coating of Faraday wax* in order to ensure good adhesion, the tile may be warmed. The surface of the tile remaining exposed shall also be coated with Faraday wax. Any nail holes shall be stopped with wax.

B-2.2 A male cap made in accordance with figure 2c shall be fitted with a suitable rubber or plastic gasket, shaped to the perimeter of the cap, so that when located between the cap and the surface of the tile it shall make a water tight seal. The cap shall be secured to the surface of the tile with 'G' clamps. To improve the seal, grease should be used. The surface of the tile remaining exposed shall be coated with quick drying paint, i.e. clear cellulose varnish. Any nail hole shall be stopped with a suitable sealing compound.

B-2.3 A female cap made in accordance with figure 2b shall fit each particular product. The inner surfaces of the cap where it seats upon the tile shall be coated with Faraday wax* to make a water-tight seal. Any nail holes shall be stopped with wax.

NOTE — It is permissible to remove the 'topping' around the perimeter of a male type tile cap in order further to improve the seal between the cap and the tile.

B-3 Place the tile horizontally face uppermost on a three-pointed stand incorporating levelling means as shown in figures 2a and 2c.

*Faraday wax is a mixture of resin, beeswax and red oxide, and can be obtained from the suppliers of chemical stores.
The metal or plastic cap A (see figures 2a, 2b and 2c) is provided with an aircock B, tube connections C₁ and C₂ and an aperture to accommodate a partial immersion thermometer. A suitable thermometer for use in this apparatus is one calibrated for a small immersed length (the minimum available is 38 mm but this depth will not be attained in this present application), a scale range between 20°C and graduated at each 0.05°C. During the actual reading of the flow rate do not allow the temperature of the water in the cap to vary by more than 0.05°C.

B-4 Connect the space enclosed by the cap A and the upper surface of the tile through C₁ to an open reservoir of water D and through C₂ to a capillary pipette E.

It is important that only freshly boiled water is used for this test. Boil the water for at least 1/2 h and allow it to cool to room temperature in stoppered bottle before use.

B-5 On commencing the test, open taps F and B to admit water to cap A. When this is fully charged with water, close tap B. Then allow the water to pass into the tile for 24 h, during which time maintain the level of water in reservoir D at the correct level, if necessary by adding boiled water. After 24 h open tap B to allow water to fill the capillary pipette E.

Then close tap F and deduce the rate of flow of water into or through the tile from the rate at which water travels along the calibrated capillary pipette E a stopwatch being used to measure the time. Calculate the average for the three tiles tested.

B-6 It is essential that, before the actual reading is taken at the end of the 24 h period, any entrapped air in the system is removed. It has been found helpful to use transparent plastics tubing and tube clamps in place of glass taps when setting up the apparatus as described. This facilitates the removal of air from the system and allows observation to ensure that all air bubbles have been removed.
FIGURE 1 — Essentials of apparatus for transverse test

FIGURE 2 (a) — Details of male metal or plastic cap A and method of attachment to tile with Faraday wax
FIGURE 2 (b) — Details of female metal cap

FIGURE 2 (c) — Apparatus for permeability test with male cap and gasket secured by G clamps