DRAFT TANZANIA STANDARD

Soil test methods – Classification – Determination of shrinkage characteristics-Linear shrinkage

TANZANIA BUREAU OF STANDARDS

Second Edition 2023

This Tanzania Standard was published under the authority of the Board of Directors of Tanzania Bureau of Standards on 2023-mm-dd.

Tanzania Bureau of Standards (TBS) is the statutory national standards body for Tanzania established under the Standards Act No. 3 of 1975, repealed and replaced by the Standards Act No. 2 of 2009.

The Building and Construction Divisional Standards Committee (BCDC), under whose supervision this Tanzania Standard was prepared, consists of representatives from the following organizations:

*College of Engineering and Technology, University of Dar er Salaam
Tanzania Commission for Science and Technology (COSTECH)
Ministry of Works and Transport (MoWT)
National Housing Corporation (NHC)
Contractors Registration Board (CRB)
Ardhi University (ARU)
Jeshi la Kujenga Taifa (JKT)
*National Estates and Designing Consultancy Company Ltd (NEDCO)
Architects and Quantity Surveyors Registration Board (AQRB)
Institution of Engineers Tanzania (IET)
*National Construction Council (NCC)
Engineers Registration Board (ERB)

The organizations marked with an asterisk (*) in the above list, together with the following were directly represented on the Technical Committee entrusted with the preparation of this Tanzania Standard:

Dar es salaam Institute of Technology (DIT)
TANROADS-Central Materials Laboratory (CML)
ENGG CONSULT Consulting Engineers
Zanzibar Bureau of Standards (ZBS)

Tanzania Bureau of Standards
P O Box 9524
Dar es Salaam
Tel: +255 (22) 2450206/2450949/2450298
Fax: +255 22 2450298
E-mail: info@tbs.go.tz
Website: www.tbs.go.tz

0 National Foreword

The Tanzania Bureau of Standards is the statutory national standards body for Tanzania, established under standards Act No. 3 of 1975, amended by Act No. 2 of 2009.

This draft Tanzania Standard was prepared by BCDC 13 Foundation and Soils for civil engineering purposes technical committee under the supervision of the Building and Construction Divisional Committee (BCDC).

Testing of soil plays an important role in establishing its engineering properties. The knowledge of these properties is a pre-requisite prior to commencement of major construction works.

In the preparation of this draft Tanzania Standard, assistance was derived from: BS 1377: Part 2: 2022, Methods of test for Soils for civil engineering purposes- Part 2: Classification tests and determination of geotechnical properties.

This draft Tanzania Standard replaces TZS 654 (Part 3): 2004 *Soil test methods – Classification (Part 3) – Determination of linear shrinkage* which has technically been revised.

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

Soil test methods – Classification – Determination of shrinkage characteristics-Linear shrinkage

1 Scope

This draft Tanzania Standard specifies methods for laboratory determination of the linear shrinkage of the fraction of a soil sample from linear measurements on a bar of soil.

2 Normative references

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

TZS 653: 2017 (3rd Ed), *Soil test methods – Terms and definitions*

TZS 652: 2020(4th Ed)/ISO 11464:2006, *Soil quality – Pre-treatment of samples for physico-chemical analyses*

BCDC 13 (1864) /ISO 17892-1:2014 *Geotechnical investigation and testing — Laboratory testing of soil — Part 1: Determination of water content*

TZS 59:2010, *Water for analytical laboratory use - Specification and test method*

BCDC 13 (1863) /ISO 17892-12:2018 *Geotechnical investigation and testing - Laboratory testing of soil - Part 12: Determination of liquid and plastic limits*

TZS 4: 2009 (2nd Ed), *Rounding off numerical values*

3 Definitions

For the purpose of this draft Tanzania Standard, the terms and definitions given in TZS 653 and BCDC 13 (2045) shall apply.

4 General

COMMENTARY ON CLAUSE 3

Shrinkage due to drying is significant in clays but less so in silts and sands. These tests enable the shrinkage limit, w, of clays to be determined, i.e., the water content below which a clay ceases to shrink. They also provide ways of quantifying the amount of shrinkage likely to be experienced by clays, in terms of the shrinkage ratio, volumetric shrinkage and linear shrinkage.

These factors are also relevant to the converse condition of expansion due to wetting.

A standard test method for determining the shrinkage factors of a soil paste by immersion in water is given in ASTM D4943-18. This method determines the shrinkage limit, shrinkage ratio and volumetric shrinkage and allows the calculation of the equivalent linear shrinkage.

The standard method for the direct determination of the total linear shrinkage of a soil paste is given in Clause 7.

Alternative methods have been developed, e.g. by laser scanning (PR. N. Hobbs et al, 2014 [2]) to determine the volume/water content curve during drying.

NOTE

This method covers the determination of the linear shrinkage of the fraction of a soil specimen passing a 425 µm test sieve from linear measurements on a bar of soil.

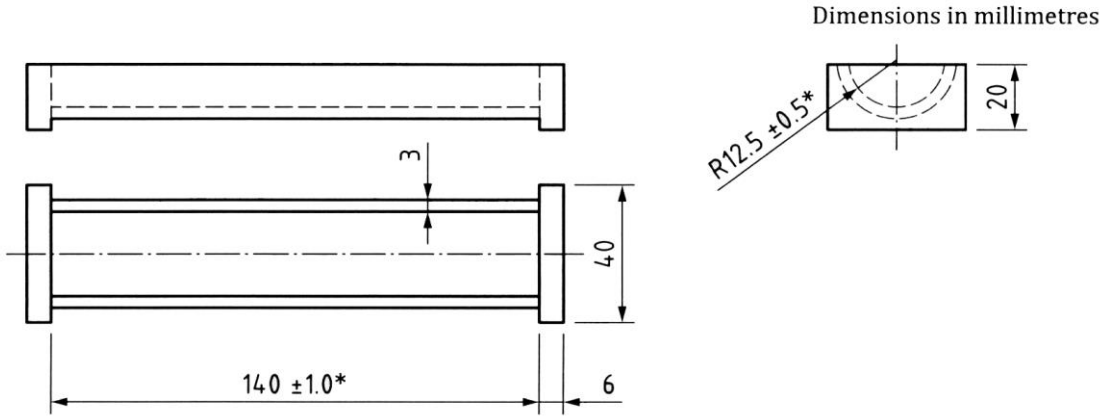
The requirements of BCDC 13 (2045), as appropriate, shall apply to this test method.

5 Apparatus

5.1 *Two palette knives or spatulas.*

Flat, glass plate, a convenient size being 10 mm thick and about 500 mm square, or *an evaporating dish* of approximately 150 mm diameter.

5.2 *Mould* made of brass or other suitable material conforming to the essential details in Figure 1.



NOTE

This design has been found satisfactory but alternative designs may be used provided that the essential requirements are fulfilled. See BCDC 13 (2045). **5.1.3.1.**

Figure 1-Mould for linear shrinkage test

5.3 *Silicone grease* or *petroleum jelly*.

Drying oven, capable of maintaining temperatures of 60 °C to 65 °C and of 105 °C to 110 °C.

5.4 *A means of measuring a length of up to 150 mm to within 0.5 mm,* such as an engineers' steel rule or vernier callipers.

Distilled or deionized water, in accordance with BCDC 13 (2045), **6.1**.

5.5 Preparation of apparatus

Clean the mould thoroughly and apply a thin film of silicone grease or petroleum jelly to its inner faces to prevent the soil adhering to the mould.

6 Procedure

6.1 Place a specimen of approximately 150 g from the material passing through the 425 µm test sieve, obtained as specified in BCDC 13 (1863) /BS EN ISO 17892-12:2018+A1:2021, **5.2**, on the flat, glass plate or in the evaporating dish.

Add distilled/deionized water if necessary and mix thoroughly using the palette knives until the mass becomes a smooth homogeneous paste with a water content at approximately the liquid limit of the soil.

NOTE

The required consistency gives a cone penetration of approximately 20 mm in the cone penetrometer liquid limit device using the 80g/30° cone or requires approximately 25 bumps of the Casagrande apparatus. This water content is not critical to within a few percent.

6.2 Place the soil/water mixture in the mould such that it is slightly proud of the sides of the mould. Gently jar the mould to remove any air pockets in the mixture.

Level the soil along the top of the mould with the palette knife and remove all soil adhering to the rim of the mould by wiping with a damp cloth.

6.3 Place the mould where the soil/water can air dry slowly in a position free from draughts until the soil has shrunk away from the walls of the mould. Complete the drying, first at a temperature not exceeding 65 °C until shrinkage has largely ceased and then at 105 °C to 110 °C to complete the drying.

Remove from the oven and place in a desiccator with dry self-indicating desiccant. When cool, measure the mean length of the soil bar. If the specimen has become curved during drying, carefully remove it from the mould and measure the lengths of the top and bottom surfaces. The mean of these two lengths shall be taken as the length of the oven dry specimen.

NOTE

If a specimen cracks badly, or breaks, such that measurement is difficult, the test should be repeated at

a slower drying rate.

7 Calculations and expression of results

Calculate the linear shrinkage of the soil as a percentage of the original length of the specimen, L_o (in mm), from the formula:

Percentage of linear shrinkage=$\left(1-\frac{L_D}{L_o}\right)100$

where:

L_D is the length of the oven-dry specimen (in mm)

8 Test report

The report shall affirm that the test was carried out in accordance with **4** and shall include the:

a) method of test used;
b) value of the linear shrinkage of the soil;
c) proportion of soil that passes the 425 µm sieve test;
d) history of the specimen, e.g. whether tested in the natural state or after wet sieving or after any other process; and
e) information required by BCDC 13 (2045), Clause 10.