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भारतीय मानक

व्यापक पट्टिका पद्धति का उपभोग करते हुए बहिर्वेधित पालिमर भू-ग्रिड के तनन गुणधर्म का निर्धारण — परीक्षण पद्धति

Indian Standard

DETERMINATION OF TENSILE PROPERTIES OF EXTRUDED POLYMER GEOGRIDS USING THE WIDE STRIP — TEST METHOD

UDC 624·13 [677·06] : 620·17

BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Price Group 3

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Geosynthetics Sectional Committee had been approved by the Civil Engineering Division Council.

Use of Geosynthetics in the form of geotextiles, geogrid, geomembrane and geocomposites, etc, are becoming popular in civil engineering applications mainly to improve or modify soil/rock behaviour.

With a view to encourage the use of geosynthetic in the civil engineering problems, a number of Indian Standards are under preparation, based on the limited experience gained so far. This standard is one of this series.

In the formulation of this standard, assistance has been derived from the following:

BS 1610 : 1985 Material testing machines and force verification equipments: Part 1 Specification for the grading of the forces applied by materials testing machines. British Standards Institution.

ASTM D 76 : 1990 Specification for tensile testing machine for textiles. American Society for Testing and Materials.

ASTM D 4595 : 1986 Standard test method for tensile properties of geotextiles by wide-width strip method. American Society for Testing and materials.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

DETERMINATION OF TENSILE PROPERTIES OF EXTRUDED POLYMER GEOGRIDS USING THE WIDE STRIP — TEST METHOD

1 SCOPE

1.1 This standard covers the test method for the measurement of tensile properties of extruded polymer geogrids using a wide strip specimen.

1.1.1 Measurement of load and elongation characteristics and procedures for calculations of secant modulus; maximum load, breaking load, elastic limit, strain at maximum load and strain at breaking load are also covered in the test method prescribed.

2 REFERENCES

2.1 IS 13321 (Part 1) : 1992 'Glossary of terms for geosynthetics: Part 1 Terms used in materials and properties' is the necessary adjunct to this standard.

3 TERMINOLOGY

3.1 The terms defined in IS 13321 (Part 1) : 1992 shall apply.

4 PRINCIPLE OF WIDE STRIP TEST METHOD

4.1 A test specimen is held across the entire width in the jaws of a tensile testing machine which operates at a specified constant rate of extension and which applied a longitudinal force to the test specimen until the specimen ruptures. The tensile properties of the test specimen are calculated from machine scale, dials, autographic recording charts or an interfaced computer.

5 APPARATUS AND REAGENTS

5.1 Tensile Testing Machine

A constant rate of extension tensile testing machine which produces a rate of increase of specimen length that is uniform with time. While using the constant rate of extension type tensile tester, recorder must have adequate pen response to properly record the force elongation curve as specified.

5.2 Jaws

Jaws shall be sufficiently wide to hold the entire width of the specimen and shall have appropriate means to prevent slippage damage. Each jaw shall have face measuring at least the width of the specimen, 200 mm, or greater (Fig. 1).

5.3 Jig Plates

For conducting the index tensile strength test it is required to hold the geogrids between the clamps. For this it is necessary to cement upper and lower ribs of geogrid specimen metal strips with the help of a binder before their placement in the clamps. In order to ensure that the metal strips are perfectly parallel to one another special jig plates are required and should be fabricated for a particular geogrid. In this the geogrids are placed between the aluminium (Fig. 2) strips (200 × 30 × 6 mm) coated with epoxy resin and curved for 24 hours under a dead load of 20 kg. This is found to provide support proper bond between the strip and the geogrid.

5.3.1 An assembly diagram is shown in Fig. 3.

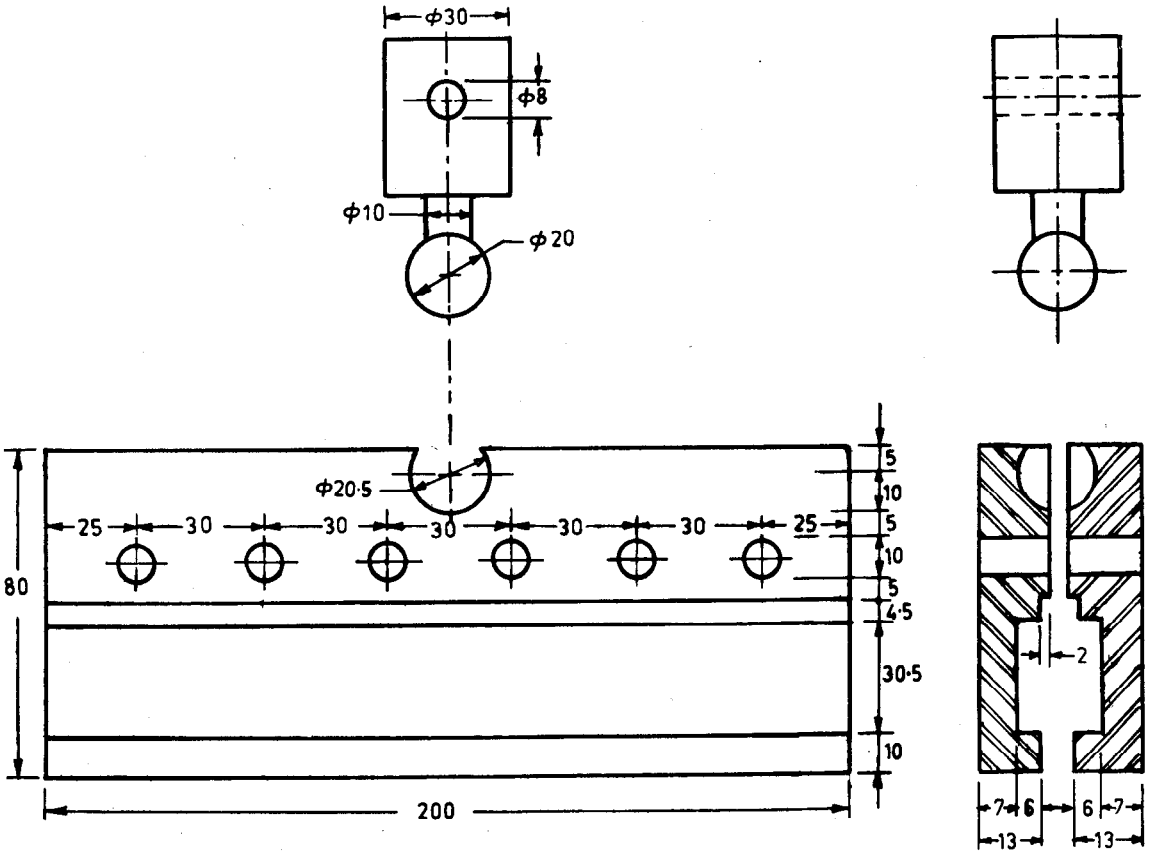
6 TEST SPECIMENS

6.1 Number of Test Specimens

At least five test specimens in both the machine direction and the cross machine direction are required.

6.2 Selection of Test Specimens

Specimens shall be selected at random from the laboratory samples. Choose those for the measurement of the machine-direction tensile properties from different positions across the width of the sample and those for the measurement of the cross-machine-direction tensile strength from different positions along the length of the sample, unless otherwise agreed. No specimen shall be taken nearer than 100 mm from the selvedge or edge of the sample.



All dimensions in millimetres.

FIG. 1 TYPICAL WIDE-WIDTH JAWS

6.3 For extruded geogrids, prepare specimen atleast 200 mm wide and sufficiently long to ensure a gauge length of at least 100 mm, measuring within ± 3 mm.

NOTE — The gauge length of geogrids is the distance between the centre-line of the elements to be contained within the jaws.

6.4 The test specimen shall contain at least five complete tensile elements within the width of the test specimen and atleast one row of nodes or cross-members, excluding the nodes or cross-members by which the test specimen is held in the jaws. Cut all ribs at least 10 mm away from any node.

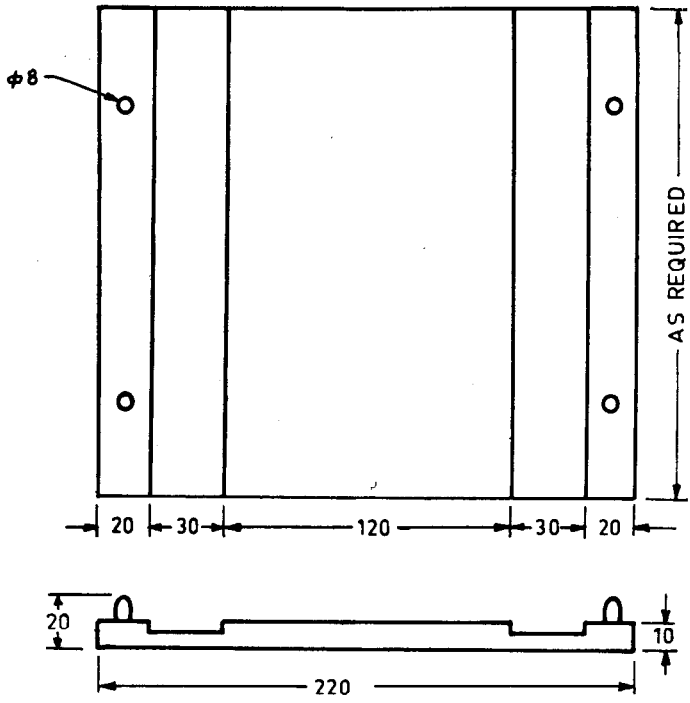
7 PROCEDURE

7.1 Setting up of Tensile Testing Machine

Adjust the distance between the jaws/clamps at the start of the test to give a gauge length of 100+/−3 mm or as appropriate for geogrids. Select the force range of the tensile testing machine such that the break occurs between 10 percent and 90 percent of full-scale force. Set the machine to a strain rate of 7 percent per minute to 13 percent per minute.

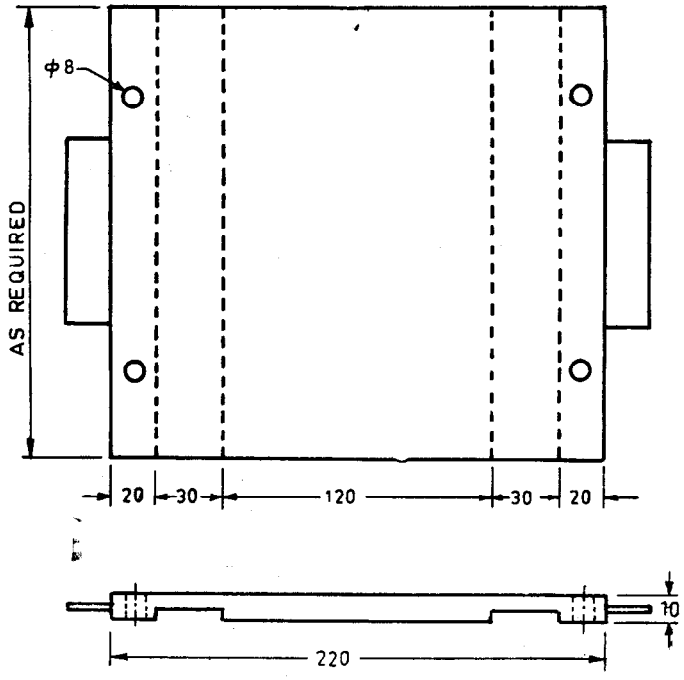
7.2 Insertion of Test Specimen in Jaws/Clamps

Mount the test specimen centrally in the jaws with approximately the same length of test specimen extending beyond the jaws at each end, ensuring that the specimen length in the machine and cross-machine direction tests is paralled to the direction of applied force. This shall be done by having the two lines, which are previously drawn at 100 +/−3 mm apart across the width of the specimen positioned adjacent to the inner edges of upper and lower jaws.



All dimensions in millimetres.

FIG. 2A TYPICAL JIG PLATE-BOTTOM



All dimensions in millimetres.

FIG. 2B TYPICAL JIG PLATE-TOP

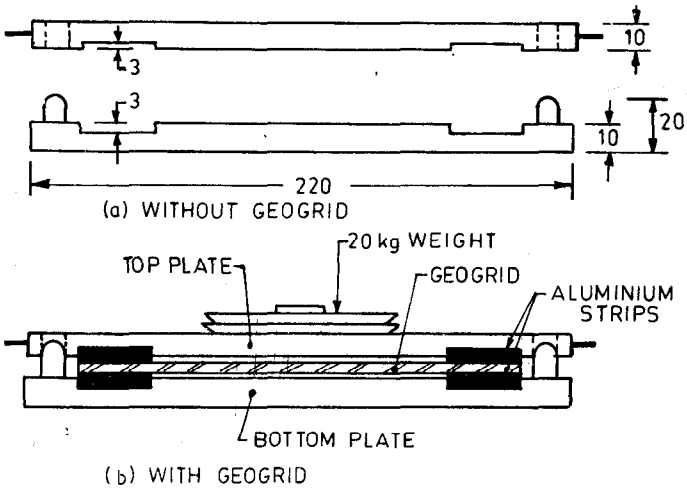


FIG. 3 TYPICAL ASSEMBLY OF JIG PLATES

7.3 Measurement of Tensile Strength

7.3.1 Start the tensile testing machine and the area measuring device, if used. Continue running test to rupture. Stop the machine and reset the initial gauge position. Record the load to the nearest 0·1 kN/m and the strain to the nearest 0·1 percent.

7.3.2 For fixed clamping systems such as compressive or profiled jaw, or where specimens are set in epoxy resin or metal, determine the strain from the transverse head movement.

7.3.3 For frictional clamping systems, measure the strain by extensometer and adjust the transverse head movement to give a strain rate of 7 percent per minute to 13 percent per minute.

7.3.4 If the test specimen slips at the edge of/or in the jaws, for any reason attributed to faulty operation, the result falls markedly below average for the set of specimens, discard the result and test another specimen. Continue until the required number of acceptable break have been obtained. Do not discard any other break unless the test is known to be faulty.

7.3.5 If a test specimen slips in the jaws or if more than one-quarter of the specimens break at a point within 5 mm of the edge of the jaw, then it is permissible for the jaws to be padded; the test specimen to be coated under the jaw face area; or the jaw face to be modified. If any of these modifications are used, state the method of modifications in the test report.

7.4 Measurement of Strain

7.4.1 Measure the strain at any stated force by means of a suitable autographic recording device, at the same time as the breaking load is determined, unless otherwise agreed upon. Measure the increase in length to an accuracy of 0·1 percent.

7.4.2 A measured strain within the specimen can be obtained from jaw to jaw measurement by gauging along the central axis between the jaws across the central 76 mm of the specimen. These measurements can be made using a scaled rule taped on a line on the upper end of the specimen, in the gauge area, and recording the change in length as measured from a line spaced 76 mm below the upper line. In addition, the centre portion of the specimen can be gauged using Linearly Variable Differential Transducers (LVDT) or mechanical gauges. By comparing it can be determined if slippage is occurring in the clamps.

8 CALCULATION

8.1 Maximum Load

Calculate the maximum load per unit width α_f expressed in kN/m directly from the information obtained from the tensile testing machine using the following equation:

$$\alpha_f = F_f \times C$$

where

F_f is the observed maximum load in kN.

C is a constant obtained as:

$$C = (N_m/N_s)$$

where

N_m is the number of tensile elements within 1 m width of the product being tested.

N_s is the number of tensile elements within the test specimen.

8.2 Breaking Load

Calculate the breaking load per unit width α_b expressed in kN/m directly from the information obtained from the tensile testing machine using the following equation:

$$\alpha_b = F_b \times C$$

where

F_b is the observed breaking load in kN, as at point G in Fig. 4.

C is a constant obtained as in **8.1**.

8.3 Elastic Limit

Record the elastic limit in kN/m and the strain in percent at the elastic limit.

8.4 Offset strain

Calculate the offset strain in percent (*see* Fig. 4).

8.5 Strain at Maximum Load

Record the strain in percent at the maximum load (*see* Fig. 4).

8.6 Strain at Breaking Load

Calculate the offset strain in percent (*see* Fig. 4).

8.7 Offset Modulus

For geosynthetics with a linear load-strain relationship [*see* Fig. 4(a)]. Extrapolate the linear region (CD) to the zero load axis (B). Calculate the offset modulus from the following equation:

$$J = \frac{F}{e \times W} \times 100 \text{ percent}$$

where

J is the offset modulus (in kN/m) at strain e.

F is the determined load at strain e (in kN).

e is the corresponding strain (in percent) [e is equal to BH in Fig. 4(a)].

W is the specimen width (in m).

8.8 Secant Modulus

For geosynthetics with a non-linear load-strain relationship [*see* Fig. 4(b)] determine the load for the specified strain. If not specified, determine the secant modulus at a strain of 10 percent. Calculate the secant modulus using the following equation:

$$J = \frac{F}{e \times W} \times 100 \text{ percent}$$

where

J is the secant modulus (in kN/m) at the specified strain e;

F is the determined load at strain e in kN.

e is the corresponding strain (in percent [e is equal to AN in Fig. 4(b)]; and

W is the specimen width (in m).

9 TEST REPORT

9.1 The test report shall include the following particulars:

a) the number and date of this standard;

b) identification of the sample tested and size;

c) the mean elastic limit, breaking load and maximum load in both the machine direction and cross-machine direction, expressed as in **8**;

d) the mean strain and offset strain at a specified load in both the machine direction and cross-machine direction, expressed as in **8**;

e) the mean offset modulus and/or the mean secant modulus expressed as it in **8**;

f) the condition of the test specimens, i.e. wet or dry;

g) the number of test specimens tested in each direction;

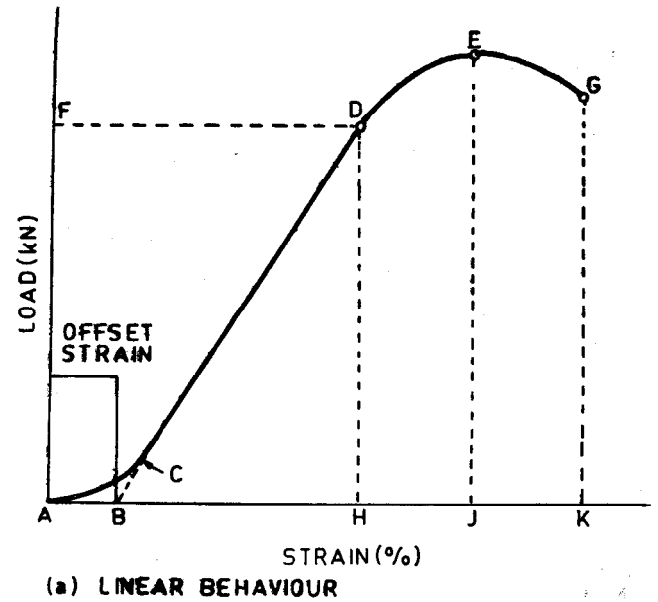
h) the make and model of tensile testing machine;

j) the type of jaw, including the dimensions of the jaws and the type of jaw faces used;

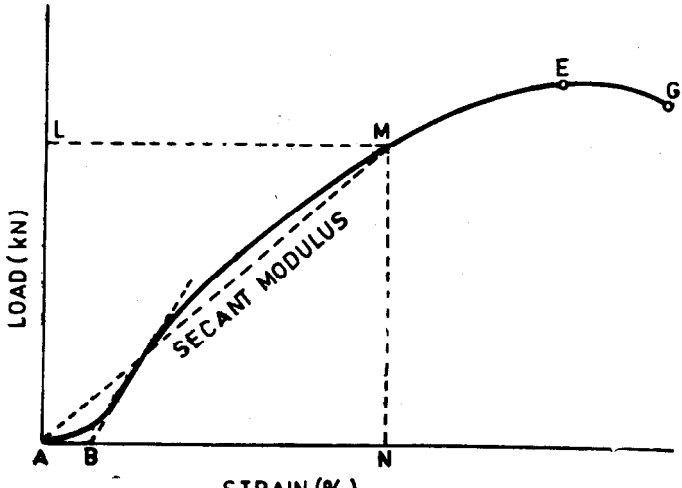
k) the standard deviation or coefficient of any of the properties determined;

m) a load-strain curve; and

n) details of any deviations from the specified procedure.



(a) LINEAR BEHAVIOUR



(b) NON-LINEAR BEHAVIOUR

FIG. 4 TYPICAL LOAD-STRAIN GRAPHS

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Bureau of Indian Standard

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