भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG, NEW DELHI 110002

व्यापक परिचालन मसौदा

हमारा संदर्भः सीईडी 48/टी-25 **25 नवंबर 2024**
तकनीकी समिति: रॉक मैकेनिक्स विषय समिति, सीईडी 48

प्राप्तकर्ता :

क) सिविल इंजीनियरी विभाग परिषद्, सीईडीसी के सभी सदस्य
ख) सीईडी 48 के सभी सदस्य
ग) रूचि रखने वाले अन्य निकाय

प्रिय महोदय/महोदया,

निम्नलिखित भारतीय मानक का मसौदा संलग्न है:

प्रलेख संख्या	शीर्षक
सीईडी 48 (26978)WC	**शिला जोड़ – प्रत्यक्ष श्रपरूपण सामर्थ्य प्रयोगशाला — निर्धारण की विधि का भारतीय मानक मसौदा** [IS 12634 का *पहला पुनरीक्षण*] ICS 93.120

कृपया इस मानक के मसौदे का अवलोकन करें और अपनी सम्मतियॉ यह बताते हुए भेजे कि यदि यह मानक के रूप में प्रकाशित हो तो इस पर अमल करने में आपके व्यवसाय अथवा कारोबार में क्या कठिनाइयाँ आ सकती हैं ।

सम्मतियाँ भेजने की अंतिम तिथि : **26 दिसंबर 2024**

सम्मति यदि कोई हो तो कृपया अधोहस्ताक्षरी को उपरिलिखित पते पर संलग्न फोर्मेट में भेजें या manoj@bis.gov.in पर ईमेल कर दें ।

यदि कोई सम्मति प्राप्त नही होती है अथवा सम्मति में केवल भाषा सम्बन्धी त्रुटि हुई तो उपरोक्त प्रलेख को यथावत अंतिम रूप दिया जाएगा। यदि सम्मित तकनीकी प्रकृति की हुई विषय समिति के अध्यक्ष के परामर्श से अथवा उनकी इच्छा पर आगे की कार्यवाही के लिए विषय समिति को भेजे जाने के बाद प्रलेख को अंतिम रूप दे दिया जाएगा ।

यह प्रलेख भारतीय मानक ब्यूरो की वैबसाइट www.bis.gov.in पर भी उपलब्ध हैं।

धन्यवाद ।

भवदीय,

(द्वैपायन भद्र)
प्रमुख (सिविल इंजीनियरी)

संलग्नक : उपरिलिखित

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG, NEW DELHI 110002

DRAFT IN WIDE CIRCULATION

Ref: CED 48/T-25 **25 December 2024**

TECHNICAL COMMITTEE: Rock Mechanics Sectional Committee, CED 48

ADDRESSED TO:

a) All Members of Civil Engineering Division Council, CEDC
b) All Members of CED 48
c) All others interests.

Dear Sir/Madam,

Please find enclosed the following document:

Doc No.	Title
CED 48 (26978)WC	**Draft Indian Standard** **Rock Joints – Direct Shear Strength Laboratory — Method of Determination** (*First Revision* of IS 12634) ICS 93.120

Kindly examine the draft standard and forward your views stating any difficulties, which you are likely to experience in your business or profession, if this is finally adopted as National Standard.

Last Date for comments**: 26 December 2024**

Comments if any, may please be made in the attached format and mailed to the undersigned at the above address or preferably through e-mail to manoj@bis.gov.in.

In case no comments are received or comments received are of editorial nature, you may kindly permit us to presume your approval for the above document as finalized. However, in case of comments of technical in nature are received then it may be finalized either in consultation with the Chairman, Sectional Committee or referred to the Sectional Committee for further necessary action if so desired by the Chairman, Sectional Committee.

The document is also hosted on BIS website **www.bis.gov.in.**

Thanking you,

Yours faithfully,

(**Dwaipayan Bhadra**)
Head (Civil Engineering)

Encl: As above

FORMAT FOR SENDING COMMENTS ON BIS DOCUMENTS

(Please use A-4 size sheet of paper only and type within fields indicated. Comments on each clause/sub-clause/table/fig etc. be started on a fresh box. Information in column 3 should include reasons for the comments and suggestions for modified working of the clauses when the existing text is found not acceptable. Adherence to this format facilitates Secretariat's work) (Please e-mail your comments to manoj@bis.gov.in)

Doc. No.: CED 48 (26978)WC

Title: Draft Indian Standard Rock Joints – Direct Shear Strength Laboratory — Method of Determination
(*First Revision* of IS 12634) ICS 93.120

LAST DATE OF COMMENT: **26/12/2024**

NAME OF THE COMMENTATOR/ORGANIZATION: _____

Sl. No.	Clause/Para/Table/ Figure No. Commented	Comments/Modified Wordings	Justification of the Proposed Change

BUREAU OF INDIAN STANDARDS

DRAFT FOR COMMENTS ONLY
(*Not to be reproduced without the permission of BIS or used as an Indian Standard*)

Draft Indian Standard

ROCK JOINTS – DIRECT SHEAR STRENGTH LABORATORY — METHOD OF DETERMINATION

(*First Revision* of IS 12634)
ICS 93.120

Rock Mechanics
Sectional Committee, CED 48

Last date of Comments:
26 December 2024

FOREWORD

(*Formal clauses will be added later*)

The direct shear strength measured in the laboratory can be used to realistically assess the strength of rock joints. This test measures the peak and residual direct shear strength of rock joint samples as a function of stress normal to the shearing plane. The results of this test can be used directly in the stability analysis only if the type and size of roughness irregularities of the tested plane are similar to those obtained in the field on a larger scale. If this is not the case, then the laboratory value of peak strength should be suitably modified. IS 11315 (Part 4) : 1987 'Method for the quantitative descriptions of discontinuities in rock masses: Part 4 Roughness' may be referred for non-linear shear strength criteria of joints.

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 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft Indian Standard

ROCK JOINTS – DIRECT SHEAR STRENGTH – LEBORATORY METHOD OF DETERMINATION

(First Revision)

1 SCOPE

This standard covers a laboratory method for determination of direct shear strength of rock joints.

2 REFERENCE

The Indian Standards given below contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
IS 11315 (Part 4) : 1987	Method for the quantitative description of discontinuities in rock masses: Part 4 Roughness (*first revision*)
IS 11358 : 1987	Glossary of terms and symbols relating to rock mechanics

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 11358 shall apply.

4 APPARATUS

4.1 Suitable materials to protect the specimen from mechanical damage and to maintain the water content both during cutting and transit to the laboratory, such as, protective packing and wax, or other similar water proofing materials. Suitable materials are also required for holding the specimen together, such as, binding wire or metal band.

4.2 Equipment for specimen preparation should include core drills, percussive drills of suitable diameter, rock saws, chisels and hammers for cutting the specimen and the equipment for measuring the dip, direction, roughness and other discontinuities in rock characteristics of the test horizon.

4.3 Equipment for mounting the specimen should include specimen carriers forming a dismountable part of the test equipment, mixing utensils along with strong encapsulating material, such as, cement, plaster or resin.

4.4 Test Equipment

Along with the shear box (*see* Fig. 1), the test system should comprise the following:

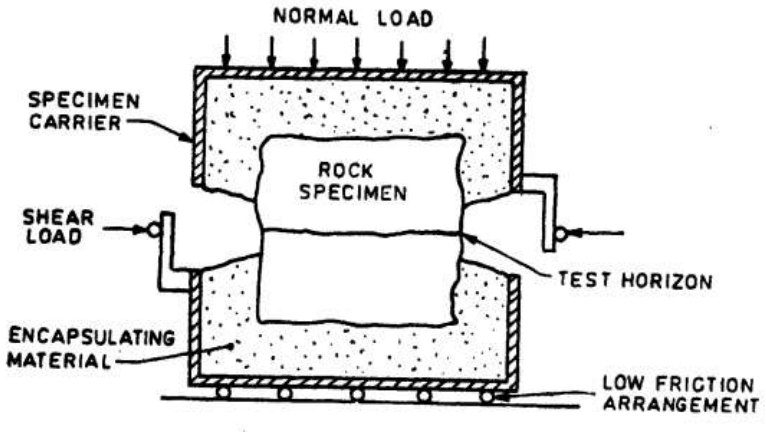

FIG. 1 ARRANGEMENT FOR THE LABORATORY DIRECT SHEAR TEST ON ROCKS

4.4.1 *A Suitable Hydraulic, Pneumatic or Mechanical System*

It shall be capable of applying normal loads on the shear plane of the specimen in such a manner that the load is uniformly distributed over the plane to be tested. The normal load should pass through the center of the shearing area. The system should be capable of maintaining the normal loads consistent to within ± 2 percent of the desired load.

4.4.2 *A Suitable Hydraulic Jack or a Mechanical Gear Drive System*

This system is for applying shear loads uniformly along the half-face of the specimen with the resultant acting in the plane of shearing. It should have rollers, cables or other low friction device to ensure that the resistance of the equipment to shear displacement is within 1 percent of the maximum shear force applied during a test.

4.4.3 *Equipment for Measuring the Normal and Shear Forces Independently*

The accuracy shall be ± 1 percent of the maximum values of these forces during a test. This equipment should be calibrated before the test and the relevant charts/tables should be supplied with the report.

4.4.4 *Suitable Devices for Measuring the Normal and Shear Displacements during the Test*

These may include micrometer dial gauges, displacement transducers, etc. The shear displacement measuring system should have a travel greater than 10 percent of the specimen length and with an accuracy of 0.1 mm. The normal and lateral displacement measuring system should have a travel more than 20 mm and an accuracy of 0.05 mm. In the case of displacement transducers, the relevant calibration data should be included
in the report.

5 SPECIMEN PREPARATION

5.1 A suitable test horizon should be selected and its relevant geological characteristics, such as, dip, dip direction, etc, are recorded. Block or core specimens are then collected from the said test horizon in such a manner that the specimen is subjected to least disturbances and its location within the test horizon should be such as to allow mounting without any further trimming in the laboratory and with sufficient clearance for adequate encapsulation. The test plane should be square as far as possible and with a minimum area of 2 500 mm^2. It should be smooth and flat in comparison with the size of the specimen. The mechanical ideality of the specimen should be preserved by binding tightly with wire or tape, which is to be kept in position until the commencement of the test.

5.2 Specimens, which are not encapsulated immediately for testing should be given a waterproof coating, labelled and packed to avoid possible damage in transit to the laboratory. Special care should be taken while transporting, fragile specimens.

5.3 After the specimen is taken to the laboratory, its protective packing is removed and the block supported in one of the carriers so that the horizon to be tested is secured in proper position and orientation. The encapsulating material is then poured and allowed to set. The other half of the specimen is also similarly encapsulated. A clear zone of about 5 mm on either side of the shear plane should be free from the encapsulation. For rock joints, plaster of Paris may be used as the encapsulating material.

6 TEST PROCEDURE

6.1 Consolidation

6.1.1 Before the actual commencement of the test, the specimen is allowed to consolidate under full normal load for dissipation of pore water pressure in the rock material and the filling material adjacent to the shear plane.

NOTE – The sample should be saturated before test for finding values in saturated condition.

6.1.2 After mounting the specimen in the shear box, all gauges are checked and a preliminary set of load-displacement readings are taken.

6.1.3 Normal load is then gradually increased to the specific value. The normal displacement (consolidation) of the specimen is recorded as a function of applied loads and time as shown in Fig. 2.

6.1.4 The consolidation of the specimen is considered complete when the rate of change of normal displacement is Jess than 0.05 mm in 10 min.

6.2 Shearing

6.2.1 The object of shearing is to establish the peak and residual values of direct shear strength of the test horison.

6.2.2 The shear force should be applied either in increments or continuously in such a way as to control the rate of shear displacement.

6.2.3 The rate or shear displacement should be less than 0.1 mm/min in the 10 min period just prior to taking readings. This rate may be increased to not more than 0.5 mm/min between consecutive sets of reading provided that the peak strength is properly recorded. When testing clay filled discontinuation, or in a drained test, the total time to reach the peak strength should exceed 6 times t 100 as determined from the consolidation curve in Fig. 2. If required, the rate of shear can be reduced or the application of subsequent shear force increments delayed so to meet this requirement. Approximately, 10 sets of readings should be taken before the peak strength is reached.

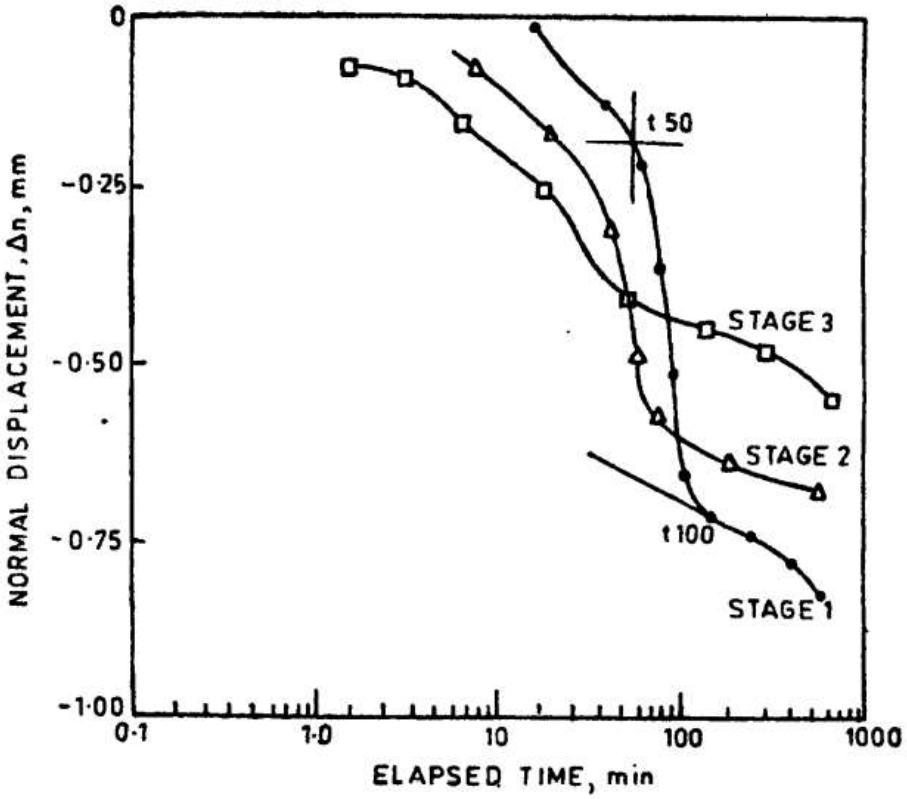

FIG. 2 CONSOLIDATION CURVES FOR DIRECT SHEAR TEST SHOWING ESTIMATION OF t 100

6.2.4 Once the peak strength is reached, the readiness should be taken at increments of 0.5 mm shear displacements as required to adequately shear displacements as required to adequately define the force-displacement curve shown in Fig. 3. The rate of shear displacement should be 0.02 mm/min to 0.2 mm/min in the 10 min period just before a set of readings is taken and may be increased to not more than 1 mm/min between sets of readings.

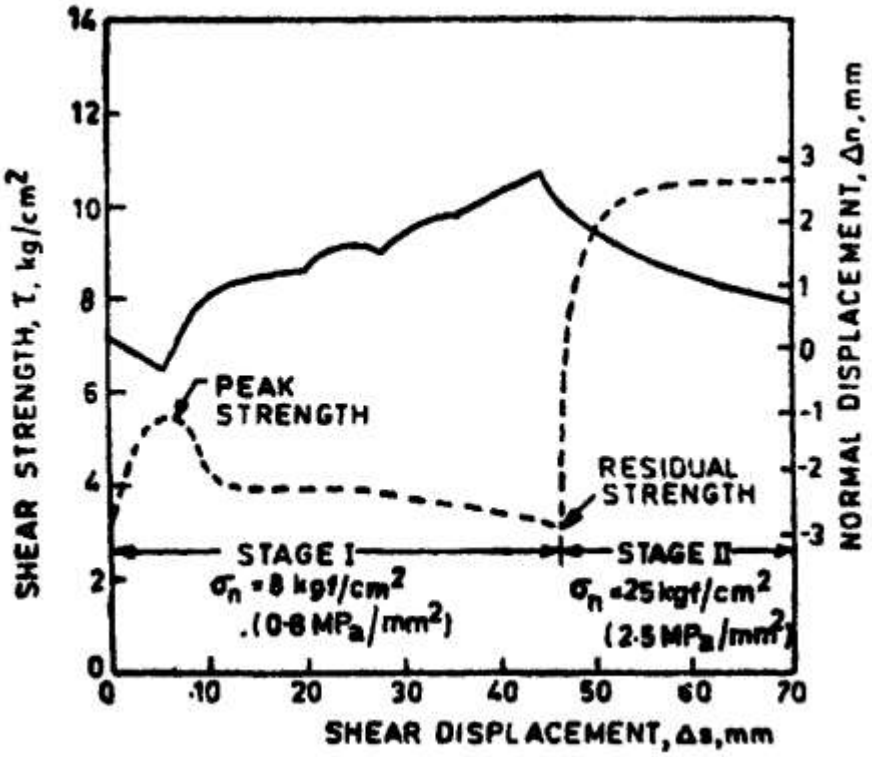

FIG. 3 SHEAR STRENGTH – DISPLACEMENT GRAPH

6.2.5 The residual shear strength value can be established when the sample is sheared at a constant normal stress and a sufficient number offsets of reading show Jess than 5 percent variation in shear stress over a shear displacement of 10 mm.

6.2.6 After establishing one value of the residual shear strength, the normal stress may be varied suitably and the specimen reconsolidated under each new normal stress and the shearing. Continued as in earlier clauses to get additional values of residual shear strength.

6.1.7 At the end of each test, the shear plane should be exposed and fully described in the report. The area of the shearing surface should be measured and photographs of the same should be taken, if required. Samples of rock, the fill material and the shear debris should be subjected to index tests.

7 CALCULATIONS

7.1 A consolidation curve as shown in Fig. 2 should be plotted for the consolidation stale of the test. The time t 100 required for complete primary consolidation is determined by constructing tangents to the curve. The time required to reach the peak strength value should be, greater than 6 times t 100 to allow complete dissipation of pore pressure.

7.2 The displacement readings are averaged to obtain mean values of normal and shear displacements. Lateral displacements are recorded only to observe the specimen behavior during the test. If these are appreciable, they should be used in calculating the correct contact area.

7.3 The normal and shear stresses are calculated as

$$\text{Normal stress } \sigma \text{ n} = \frac{\text{Normal Force } (P_\text{n})}{\text{Shearing Area } (A)}$$

$$\text{Shear stress } \tau = \frac{\text{Shear Force } (P_\text{s})}{\text{Shearing Area } (A)}$$

NOTES

1 The effect of primary weakness or joint surface in rock mass should be accounted for [*see* IS 11315 (Part 4)].
2 Effective stress should be used if the joint surface is in water.

7.4 For each test, graphs of shear stress and normal displacements vs shear displacement are plotted as shown in Fig. 3. The graphs are annotated to indicate the nominal normal stress and any changes in normal stress during shearing. The values 0 peak and residual shear strength, the normal stresses, and shear and normal displacements can be abstracted from these graphs.

7.5 From the combined results or all test specimens, graph of peak and residual shear strength *vs* normal stress are plotted to obtain the strength parameters, ϕ_a, ϕ_b, ϕ_r, c and c' as shown in Fig. 4.

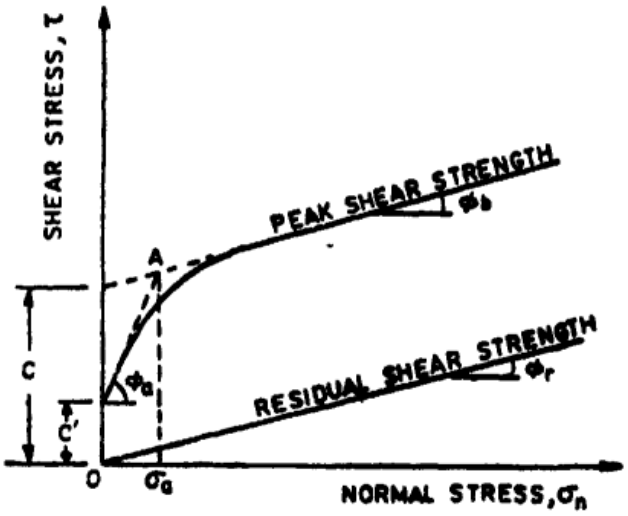

FIG. 4 SHEAR STRENGTH – NORMAL STRESS RELATIONS

8 REPORTING OF RESULTS

8.1 The report of tests should include a schematic diagram and description of the test equipment; description of the methods used for taking, packing, transporting, storing and mounting of the specimen; and the method of testing.

NOTE – The non-linear peak strength curve may be reported by correlation [*see* IS 11315 (Part 4)].

8.2 Full geological description of the intact rock mass, sheared surfaces, filling material and the debris should be given along with index tests data providing information about the roughness profiler water content, grain size distribution and Atterberg limits of the fill material.

8.2.1 Diagrams or preferably photographs showing, the sample location, dip and dip direction of the test horizon and any other features of importance.

8.2.2 For each test conducted, a set of data tables, consolidation, curve, graphs of shear stress and normal displacement *vs* shear displacement (as shown in Fig. 2 and Fig. 3) should be given.

8.2.3 Abstracted values of peak and residual shear strength should be tabulated with corresponding values of normal stress shear and normal displacement.

8.2.4 For shear strength determination as a whole, graphs of peak and residual shear strength *vs* normal stress together with the derived values of shear strength parameter (*see* Fig. 4) should also be given.