

भारतीय मानक

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Indian Standard

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की मापन पद्धति
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(दूसरा पुनरीक्षण)

**Method of Measurement of Building
and Civil Engineering Works
Part 27 Earth Work Done by Mechanical
Appliances
(Second Revision)**

ICS 17.020; 91.040.01; 93.010

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FOREWORD

This Indian Standard (Part 27) (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Method of Measurement of Works of Civil Engineering (Excluding Water Resources Development) Sectional Committee had been approved by the Civil Engineering Division Council.

Measurement occupies a very important place in the planning and execution of any civil engineering work from the time of first estimates to the final completion and settlement of payments in the project. Methods followed for measurement are not uniform and considerable difference exists in practices followed by different construction agency and the State Government departments. While it is recognized that each system of measurement has to be specifically related to administrative and financial organizations within the department responsible for the work unification of the various systems at technical level has been accepted as very desirable specially as it permits a wider range of operation civil engineering contractors and eliminates ambiguities arising out of inadequate understanding of various systems followed.

Measurement of earth work basically related to the manual method of excavation, carriage and filling is covered in Part 1 of this standard. With the advent of machinery for this operation, many lacunae in the methodology for the measurement have become apparent and thus necessity has been felt to formulate a separate standard for measurement of earth work by mechanical appliances. Accordingly, this standard was first published in 1992 and revised in 2013.

This previous revision of the standard had modified the provisions on types of machines employed for earthwork, clarified [2.7\(g\)](#), included a new clause on special plumbing and its measurement, revised the provision on classification of soil and hard rock, etc.

In this revision, the following significant modifications are being made:

- a) The procedure for measurement of linear dimensions in excavation activity has been modified;
- b) Theodolite and total station have been included in the list of equipment to be used for levelling;
- c) The girth of vegetation has been specified;
- d) The provision for separate measurement of work done where underground utilities exist has been included;
- e) The names of rocks classified as hard rocks have been mentioned;
- f) The provision for excavating hard rocks wherever blasting may not be feasible has been incorporated;
- g) The provision for measurement of excavated materials in tunnels have also been included;
- h) Consideration of working space while excavating has been included;
- j) Excavation in different combinations of soil and rock have been considered; and
- k) Provision for carriage by manual labour and by animal/mechanical transport have been incorporated.

For standards on method of measurement of river valley projects, the Indian Standards formulated by the Measurement and Cost Analysis of Works for River Valley Projects Sectional Committee, WRD 23 under the Water Resources Division Council of BIS may be referred.

This standard contributes to the Sustainable Development Goal 9 'Build resilient infrastructure, promote sustainable industrialization and foster innovation'.

(Continued on third cover)

*Indian Standard***METHOD OF MEASUREMENT OF BUILDING AND CIVIL
ENGINEERING WORKS****PART 27 EARTH WORK DONE BY MECHANICAL APPLIANCES***(Second Revision)***1 SCOPE**

1.1 This standard (Part 27) covers the method of measurement of earthwork carried out by mechanical means in building and civil engineering works.

1.2 The machines employed for earthwork may be excavators, tractors, dozers, scrapers, graders, shovel loaders, drag lines dumpers, rollers, compactors and the like.

2 GENERAL RULES**2.1 Clubbing of Items**

Items may be clubbed together provided the individual items of the clubbed items are based on the detailed description of items stated in this standard.

2.2 Booking of Dimensions

In booking of dimensions, the order shall be consistent and generally in the sequence of length, breadth or width and height or depth or thickness.

2.3 Measurement

All works shall be measured net in decimal system as fixed in position as given below:

- a) The length and breadth of excavation or filling shall be measured to the nearest 0.01 m. The depth of cutting or height of filling shall be measured, correct to 0.005 m. Where any dimension is more than 25 m, it shall be measured nearest to 0.1 m;
- b) Areas shall be worked out to the nearest 0.01 m²; and
- c) Cubical contents shall be worked out to the nearest 0.01 m³.

2.4 Work executed in the following conditions shall be measured separately:

- a) Work in or under water;
- b) Work in or under foul conditions;

- c) Work under tides;
- d) Work under snow; and
- e) Work where underground utilities exist.

2.5 The bill of quantities shall fully describe the material workmanship and accurately represent the work to be executed.

2.6 The description of items shall include loading and unloading.

2.7 The following work shall not be measured separately and allowance for the same shall be deemed to have been made in the description of item:

- a) Setting out of work, profiles, etc;
- b) Site clearance, such as, clearing of grass and vegetation of girth up to 30 cm measured at height of 1 m above the natural ground level;
- c) Unauthorized battering or benching of excavation;
- d) Excavation for insertion of planking or strutting;
- e) Unless otherwise specified, removing slips or falls in excavation;
- f) Bailing out or pumping out water from excavations, due to rains; and
- g) Bailing out or pumping out water accumulated in excavated pits due to seepage of subsoil water.

2.8 Special pumping other than what is required for conditions given in [2.4\(a\)](#) when resorted to, shall each be measured separately for all stages of pumping including intermediate stages, unless otherwise stated, in stages against separate specific provisions made for this purpose.

3 CLASSIFICATION OF SOILS

3.1 The earth work shall be classified under the following categories and measured separately for each category.

3.1.1 Soil

It includes various types of soils, mud concrete, shingle and river or *Nallah* bed boulders, soling of road, paths and hard core, macadam surface of any description, lime concrete, stone masonry, soft conglomerate and laterite when the stone can be detached from the matrix with picks and shovel.

3.1.2 Mud

A mixture of soil and water in fluid or weak solid state.

3.1.3 Foul Condition

Means a mixture of soil and sewage or night soil.

3.1.4 Ordinary/Soft Rock

This may be quarried and split with mechanical implements and includes lime stone, sand stone, cement concrete (plain reinforced and prestressed) below the ground level.

If required, light blasting may be resorted to for loosening the materials but this will not in any way entitle the material to be classified as ‘hard rock’.

3.1.5 Hard Rock

3.1.5.1 Hard rock can be excavated by machines and requires blasting, chiselling in, edging or any other agreed method and includes quartzite, granite, basalt, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like. Once hard rock is blasted, it can be considered as ordinary rock. Hard rock requiring controlled blasting, chiseling and shaping shall be measured separately.

3.1.5.2 Hard rock requiring blasting as described under [3.1.5.1](#) but where the blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging, plasma blasting, use of rock hammers and cutters or by any other agreed method.

4 METHOD OF MEASUREMENT

4.1 The measurement of earthwork shall be done as per actual, limited to the approved excavation drawing having appropriate working space.

4.1.1 In case of open footings up to the depth of 1.5 m, all-round excavation of 30 cm beyond the outer dimension of footing shall be measured for payment to make allowances for centering and shuttering. Any additional excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment.

4.1.2 In case of open footings/rafts at a depth of more than 1.5 m, all-round excavation of 75 cm shall be measured for payment to make allowance for centering and shuttering. Additional excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment.

4.2 The measurement to be taken with the appropriate equipment such as staff, dumpy level, theodolite, total station, etc. The level shall be recorded correct to 5 mm and depth of cuttings and heights of levels calculated correct to 5 mm. Cubical contents shall be done to the nearest place of decimals in cubic metres.

Where soil and ordinary or hard rock are mixed, the measurement of the excavation shall be recorded for the entire excavation. Excavated material of ordinary rock shall be stacked, separately measured and reduced by 50 percent to allow for voids to arrive at quantity payable under ordinary rock. The difference between the entire excavation and the quantity above (under ordinary rock) shall be payable as excavation in soil.

Where ordinary rock and hard rock are mixed, the measurement of the excavation shall be recorded for the entire excavation. The two kinds of rock shall be stacked separately and measured in stacks. The net quantity of the two kinds of rocks shall be arrived at by applying deduction of 50 percent to allow for voids in stacks. If the sum of net quantity of two kinds of rocks exceeds the total quantity of the excavated material, then the quantity for each type of rock shall be worked out from the total quantity in the ratio of net quantities in stack measurements of the two types of rocks. Where soil, ordinary rock and hard rock are mixed, the measurement of the excavation shall be recorded for the entire excavation. Excavated materials comprising hard rock and ordinary rock shall be stacked separately, measured, and each reduced by 50 percent to allow for voids to arrive at the quantity payable under hard rock and ordinary rock. The difference between the entire excavation and the sum of the quantities payable under hard rock and ordinary rock shall be paid for as excavation in soil.

4.3 Where it is not possible or convenient to take measurements from borrow pits or cuttings, volume of work done shall be worked out from filling. The actual measurement of the fill shall be calculated after taking the levels of the original grounds before start of the work, after site clearance and after compaction of fill at the optimum moisture content which shall be specified in advance.

4.4 For measurement of excavated materials in tunnels where the quantity is to be measured by the carrying capacity in cubic metres of the haulage

trucks/tippers, due consideration of moisture content and void ratio shall be taken.

4.5 Embankment

4.5.1 Forming embankments and filling shall be measured, in cubic metres, and shall include formation of slope. When the material is to be deposited in layers this shall be described stating thickness of such layer. The method of compaction shall be described. The measurement shall be taken in successive stages of 1.5 m stating commencing level.

4.5.2 Backfilling done by mechanical means shall be calculated by deducting the volume of structure below the underground from the original measured volume of excavation done.

4.6 Lead

4.6.1 The lead for filling and removal shall be measured over the specified route or over the shortest practicable route to be traversed.

Carriage by manual labour shall be reckoned in units of 50 m or part thereof.

Carriage by animal and mechanical transport shall be reckoned in 1 km unit. Distances of 0.5 km or more shall be taken as 1 km and distance of less than 0.5 km shall be ignored. However, when the total lead is less than 0.5 km, it will not be ignored but paid for separately in successive stages of 50 m subject to the condition that the rate worked on this basis does not exceed the rate for initial lead of 1 km by mechanical/animal transport.

4.6.2 Travelling distance by reasonable path from geometrical centre of the excavated pond to the geometrical centre of the dumping ground, prior to commencement of work, shall be taken as lead.

4.7 Soil heap when it has become consolidated due to passage of time or otherwise shall be so stated and measured separately.

4.8 Excavation in Trenches for Foundations and Drains and for Pipes, Cables, etc

4.8.1 The authorized quantities (calculated on the basis of authorized width) or those excavated, whichever are less, shall be measured in case of excavation for pipes, cables, etc. For the purpose of calculating the contents, cross-sections shall be taken at suitable intervals. The authorized width shall be specified in each case (relevant Indian Standards, if any, may be consulted for guidance).

4.8.2 Excavation Trenches for Foundations and Drains

For depth exceeding 1 m, an allowance of 50 mm/m depth for each side of trench shall be added to the specified width.

4.9 Earth work in excavation (including authorized working space) for pile caps shall be shown as a separate entity depending on actual site conditions in view of intricacies involved. No deduction shall be made in the measurement of earth work for the volume of piles and empty bore holes.

4.10 Lifts

In earth work done by mechanical means, lift shall not be measured separately.

4.11 The planking and strutting required to uphold the face of excavated earth shall be measured in square metre of face supported. The description shall include use and wastage of all works including waste struts, boards inclusive of fixing and removal. Planking and strutting required to be left permanently in position shall be measured separately.

4.12 Removing Trees

Trees exceeding 300 mm in girth measured at 1 m above natural ground level shall be pre-measured by numbers and shall deem to include removal and transportation within 50 m.

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

Method of Measurement of Works of Civil Engineering Construction (Excluding Water Resources Development) Sectional committee, CED 44

<i>Organization</i>	<i>Representative(s)</i>
In Personal Capacity (<i>Flat No.-370 Asiad Village Complex Siri Fort, New Delhi - 110049</i>)	SHRI SARVAGYA KUMAR SRIVASTAVA (<i>Chairperson</i>)
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Border Roads Organization, New Delhi	SHRI R. SRINIVASA RAO
Central Public Works Department, New Delhi	SHRI PREM MOHAN SHRI DINESH K. UJJAINIA (<i>Alternate</i>)
Central Water Commission, New Delhi	SHRI AJAY SHIVLAL BANODE SHRI KIRAN PRAMANIK (<i>Alternate</i>)
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Hindustan Construction Company Limited, Mumbai	SHRI HARISH M. P.
Institute of Valuers, New Delhi	COL (RETD) B. B. SHARMA SHRI AJIT FAUZDAR (<i>Alternate</i>)
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BIS Directorate General	SHRI DWAIPAYAN BHADRA, SCIENTIST 'E'/DIRECTOR AND HEAD (CIVIL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (<i>Ex-officio</i>)]

Member Secretary
SHRIMATI DIVYA S.
SCIENTIST 'D'/JOINT DIRECTOR
(CIVIL ENGINEERING), BIS

(Continued from second cover)

The composition of the Committee responsible for formulation of this standard is given in [Annex A](#).

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 measurement 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.

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