
Zemeljska dela - 2. del: Klasifikacija materialov

Earthworks - Part 2: Classification of materials

Erdarbeiten - Teil 2: Materialklassifizierung

Terrassements - Partie 2: Classification des matériaux

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Earthworks - Part 2: Classification of materials

Terrassements - Partie 2: Classification des matériaux

Erdarbeiten - Teil 2: Materialklassifizierung

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 16907-2:2018) has been prepared by Technical Committee CEN/TC 396 “Earthworks”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2019, and conflicting national standards shall be withdrawn at the latest by June 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document is one of the European Standards within the framework series of EN 16907 on *Earthworks*, as follows:

- *Part 1: Principles and general rules,*
- *Part 2: Classification of materials (this document),*
- *Part 3: Construction procedures,*
- *Part 4: Soil treatment with lime and/or hydraulic binders,*
- *Part 5: Quality control,*
- *Part 6: Land reclamation earthworks using dredged hydraulic fill,*
- *Part 7: Hydraulic placement of extractive waste.*

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EN 16907-2:2018 (E)**Introduction**

This European Standard is part of a European Standard on Earthworks. It was decided by CEN/TC 396 to establish a stand-alone standard part on the classification of materials used in earthworks.

The different regional situations in geology and climate result in national differences in the earthwork procedures which do not allow a single classification of materials throughout Europe at present. Therefore, this standard identifies the principles and systems for classification considering national practices. Furthermore the test procedures suitable for earthworks are identified.

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1 Scope

This document defines a common basis for description and classification for use by all parties involved in the design, planning and construction of the earthworks.

This document specifies the processes and properties to be used in the description and classification of earthworks materials. It specifies soil and rock groups as a basis of material specifications for earth structure elements. This classification relates to the physical and chemical properties of the soil and rock materials.

NOTE 1 The approach to description of soil and rock set out in EN ISO 14688-1 and EN ISO 14689 respectively and the approach to classification of soil set out in EN ISO 14688-2 are applicable to earthworks, but the range and scope of classification for earthworks given here is more detailed and orientated to the specific demands of earthwork procedures and earth structure elements.

NOTE 2 Informative examples of existing national experience based classification systems and their use are presented in the annexes to EN 16907-1:2018.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 932-1, *Tests for general properties of aggregates — Part 1: Methods for sampling*

EN 1997-2, *Eurocode 7 — Geotechnical design — Part 2: Ground investigation and testing*

EN 13383-1, *Armourstone — Part 1: Specification*

EN 16907-1:2018, *Earthworks — Part 1: Principles and general rules*

EN ISO 14688-1, *Geotechnical investigation and testing — Identification and classification of soil — Part 1: Identification and description (ISO 14688-1)*

EN ISO 14689, *Geotechnical investigation and testing — Identification, description and classification of rock (ISO 14689)*

EN ISO 22475-1, *Geotechnical investigation and testing — Sampling methods and groundwater measurements — Part 1: Technical principles for execution (ISO 22475-1)*

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3 Terms, definitions, symbols and abbreviations**3.1 Terms and definitions**

For the purposes of this document, the terms and definitions given in EN 16907-1:2018 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1**description**

identification and naming of a given material and its physical and soil mechanical properties that are relevant for earthwork purposes

3.1.2**classification**

definition of material groups and classes and assigning of materials to groups and classes with similar properties for earthworks

3.1.3**classification parameters**

values of characteristics that define groups and classes

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3.1.4**characteristics**

material properties which may be relevant for a defined use

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3.1.5**properties**

physical and chemical attributes of a material

3.1.6**intrinsic properties**

properties of solids of soils and rock which do not change in the course of earthworks such as particle size distribution, particle shape, mineralogy, plasticity, organic or carbonate content

3.1.7**state properties**

properties of the soil or rock that may change during earthworks; such as density, water content, strength, consistency, relative density or stiffness

3.1.8**materials**

all soils, rocks, by-products and recycled mineral materials handled during earthworks

3.1.9**material groups**

classification of materials based on intrinsic properties

3.1.10**material class**

classification of materials based on intrinsic and state properties for use in specific aspects of earthworks

3.1.11**particle size**

dimension of a material particle defined by a representative diameter which is determined by sieving or by sedimentation analysis

3.1.12**particle fraction**

mass percentage of particles in a range of particle sizes with defined lower and upper diameters referring to the total mass of particles in a soil volume or sample

EXAMPLES Sand fraction: mass percentage of particles with particle sizes between 0,063 mm and 2,0 mm.

3.1.13**finer**

particles with a particle size smaller than 0,063 mm

3.1.14**anthropogenic material**

natural materials processed mechanically e.g. by crushing or washing, manufactured materials including secondary manufactured materials and recycled materials

3.2 Abbreviations and symbols

For the purposes of this document the abbreviations and symbols given in EN 16907-1:2018 and the following apply. <https://standards.iteh.ai/catalog/standards/sist/245d532e-360a-4986-b9ec-4c04997b67af/sist-en-16907-2-2019>

Abbreviations for terms and tests

DG	Degradability
FR	Fragmentability
MDE	Micro-Deval Test
LA	Los Angeles Test
IDD	Intact dry density

Symbols for Quantities

C_C	Coefficient of curvature	dimensionless
C_{LA}	Los Angeles coefficient (by LA test)	dimensionless
C_{MDE}	Micro-Deval coefficient	dimensionless
C_{OM}	Organic matter content	dimensionless (%)
C_U	Coefficient of uniformity ($C_U = D_{60}/D_{10}$)	dimensionless
C_x	Mass percentage of particles smaller than x (mm) (e.g. $C_{0,063} < 5\%$: the content of fines is less than 5 % of the soil mass)	dimensionless (%)
D	Particle size (representative diameter)	mm

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D_x	Particle size at which x % are smaller (e.g. $D_{60} = 3,5$ mm: the particle size, at which 60 % of soil mass are smaller, is 3,5 mm)	mm
D_{\max}	Maximum diameter of particles in a soil mass	mm
I_{DG}	Coefficient of degradability (by DG test)	dimensionless
I_{FR}	Coefficient of fragmentability (by FR test)	dimensionless
I_P	Plasticity index ($I_P = w_L - w_P$)	dimensionless (%)
MB, MB_f	Methylene blue values, determined acc. to EN 933-9	g/1000g
V_{BS}	Methylene blue value (fraction 0/50 mm)	g/100g
V_p	Compression wave velocity	m/s
w_L	Liquid limit	dimensionless (%)
w_P	Plastic limit	dimensionless (%)
ρ_d	Dry density	Mg/m ³
ρ_{di}	Intact dry density (by IDD test)	Mg/m ³

Symbols for soil and rock groups

See Tables 3 to 9 in Clause 6.

Symbols for state parameters of rock

See Tables 10 and 11 in Clause 7.

4 Principles of classification

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Soils, rocks and other materials shall be placed into groups (based on intrinsic properties) and classes (based on state properties) which have similar behaviour for one or more earthworks procedures (excavation, transport, treatment, placement and compaction) and which will have similar engineering properties in an earth structure after completion of the earthwork procedures.

The system of classes or classification system shall be defined on the basis of experience from previous works and is influenced by the geological and climatic conditions that prevail in each country.

The classification system may represent national practices, local practices based on experiences with particular materials or project based. It may be limited to materials for which previous experience exists. Variations between countries are allowed to account for national experiences. The national regulations mentioned in the annexes to EN 16907-1:2018 may be used where appropriate.

When a new classification system is prepared or an existing system is used, experience shall refer to:

- the satisfactory behaviour of completed earth-structures made of a class of material using specific construction procedures,
- the suitability of particular construction procedures for a given class of material.

The engineering behaviour of the completed earth-structure shall be assessed according to the type of structure, see EN 16907-1:2018.

The mineralogy and particle size distribution of soils and the origin, fragmentability and degradability of rocks are important properties from the point of view of engineering behaviour. The sensitivity of fine grained soils to water has a major effect on the execution of works and the water content of fine soils shall be considered, when relevant, in the classification system.

The description of the ground mass is part of the information needed for identifying zones of homogenous character and thus in the design of earthworks. Therefore, the classification based on samples alone is not sufficient to characterize a given source of natural materials.

5 The process of description and classification

5.1 General

The ground shall be described and classified into materials of similar material properties and homogenous areas, a process which is typically supported by testing. This should involve three stages as given in Table 1:

- 1) The soil and rock materials shall be described in their *in situ* condition;
- 2) Classification into groups of similar material properties and homogenous areas based on the intrinsic properties shall be made as part of the design and planning process. Classification of the materials generally requires an adequate suite of testing;
- 3) Classification shall be made during the design, planning and construction stages, on the basis of the state properties. Classification by state properties should be used to plan, specify and control the works and to demonstrate that the product required by the design and the specification has been achieved.

Depending on project conditions other application fields for the different classification levels may be considered.

For the use of recycled mineral materials and by-products in earthworks, the approaches in Table 1 may also be applicable. Where the material is not natural its mineralogy, properties and origin shall be stated.

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Table 1 — The stages of description and classification

Stage	Definition	Basis	Application
Description	Engineering geological description of the soil and rock to record those features of the ground that will control the ease of excavation and influence the use of the material but that may be destroyed in sampling or earthwork procedures such as layering, variability and discontinuities.	Observation in the field and laboratory. Description of material and mass characteristics.	Grouping into areas of similar characteristics; determine layers, areas or zones of similar properties or homogenous character. Stratum descriptions aid the scheduling of testing which leads to classification.
Classification (intrinsic) see Tables 2 to 9	Classification based on the intrinsic properties, those which are not changed by the effects of sampling or the earthwork procedures Assignment of soil and rock materials to soil and rock groups	Selection of appropriate tests in order to determine the mineralogy and properties such as grain size and plasticity	Classification to determine material applicability in different zones of the proposed earthwork. Available tests can be selected from those listed in Annex A.
Classification (state) See Tables 10 to 13	Characterization on the basis of the state of the ground, that is by those properties that can change by sampling or by the earthwork procedures	Selection of appropriate tests to determine properties such as water content, strength, stiffness and stability. The properties to be measured will depend on the particle size of the soil and the strength of the particles	Classification to determine classes depending on engineering properties at excavation, transport, deposition and compaction. Available tests can be selected from those listed in Annex A.

NOTE: The details given in the Column “application” are taken as examples only.

5.2 Description

The materials present at the site should be described by systematic recording of the material and mass characteristics of the soil or rock.

Description of the materials is usually related to the geological succession, which may be subdivided into subgroups depending on the variability. Geological input should be incorporated so as to ensure a full and accurate description.

The soils and rocks that may be used in the earthwork shall be described in accordance with EN ISO 14688-1 and EN ISO 14689 on the basis of visual and manual techniques in the field applied in trial pits or in samples recovered from boreholes and/or in the laboratory. Description of soils is based on particle size distribution, plasticity and organic content.

The size fractions defined in EN ISO 14688-1 shall be used, which are

- Very coarse soils (boulders and cobbles);
- Coarse soils (gravel and sand);
- Fine soils (silt and clay).

The description enables the *in situ* condition of the ground, including its ease of excavation and variability, to be assessed. Laboratory testing is not normally required within description. The mass properties include fracture spacing and weathering which are generally not amenable to testing.

The description should identify those characteristics of the soil or rock relevant to the excavation, transport, deposition and compaction of the material and its inclusion in the earthwork. Characteristics of the *in situ* soil or rock that could be of interest should include strength, structure such as layering, or the spacing of discontinuities that may affect the ease of excavation. The availability of a description of the materials may allow interpolation between test results in those areas or materials where field or laboratory testing has not been carried out.

The descriptions enable the identification of zones of homogenous character and the scheduling of appropriate field or laboratory tests for classification.

Descriptions should appear on the field reports of the investigation points (for example trial pits, boreholes); the disposition of the materials across the site should normally be displayed as plans and sections as appropriate. The requirements of field and investigation reports are detailed in EN ISO 22475-1 and EN 1997-2.

5.3 Classification

Where relevant the classification process in Table 1 shall be followed together with the reference to Tables 2 to 11 which summarize the typical classification system of materials available for the earthworks project.

Classification at a site should initially use an existing national classification system which allows a project to link into precedent experience. The classification systems adopted for the project may be amended as more information on the ground conditions at a site becomes available.

Classification should comprise definition of material groups based on intrinsic properties and definition of classes based on material groups in addition to further state properties.

The grouping of soils or rocks based on their intrinsic properties can be used as a basis for specifications of the requirements of the materials to be used in the earth structures. In combination with the state properties, this can also then help to identify appropriate earthworks construction procedures which should enable the establishment of project orientated classes. The definition of these classes should be supported by field and/or laboratory testing.

6 Classification by intrinsic parameters

6.1 General

All materials that are used for earthworks shall be classified into material groups on the basis of the intrinsic properties.

NOTE The earthworks classification into groups helps to identify which materials are suitable or potentially suitable for use in an earth structure, subject to meeting the design objectives as defined in EN 16907-1:2018.

Classification on the basis of intrinsic properties does not necessarily demonstrate suitability for re-use as earth fill as that depends on the state properties and the achievement of satisfactory compaction.