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Zemeljska dela - 3. del: Postopki zemeljskih del

Earthworks - Part 3: Construction procedures

Erdarbeiten - Teil 3: Ausführung von Erdarbeiten

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Earthworks - Part 3: Construction procedures

Erdarbeiten - Teil 3: Ausführung von Erdarbeiten

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 16907-3:2015) has been prepared by Technical Committee CEN/TC 396 "Earthworks", the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

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

— *Part 1: Organization, design and control of earthworks;*

— *Part 2: Classification of materials;*

— *Part 3: Construction procedures* (This document)*;*

— *Part 4: Soil treatment with hydraulic binders;*

— *Part 5: Quality control;*

— *Part 6: Dredging and land reclamation;*

— *Part 7: Hydraulic placement of mineral waste.*

1 Scope

This European Standard presents execution procedures for excavating, transporting and placing soils and rocks for the construction of earth-structures. It includes excavation and placement of rock materials underwater.

Dredging of soils and the associated hydraulic placement of fills are covered by Part 6 of this standard.

Execution of earthworks follows the conclusions of the earthworks design and optimization phase (Part 1), which should anticipate soil and rock specificities and their suitability. In case some events could not be foreseen, additional design is performed during the execution of works.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

For the normative references refer to part 1 of this standard.

3 Terms, definitions and symbols

For the purposes of this document, the following terms and definitions apply.

3.1 Definitions

3.1.1
earthworks
civil engineering process to modify the geometry of ground surface, by creating stable and durable earth-structures (cuttings, embankments or engineered fills)

3.1.2
earth-structure
civil engineering structure, made of soils, rocks, by-products or recycled materials, resulting from earthworks

3.1.3
design of earthworks
defining the construction process to produce a specified earth-structure

3.1.4
materials
all soils, rocks, by-products and recycled materials handled during earthworks

Note 1 to entry; Materials do not include binders, geosynthetics and other materials, which are designated by their own name.

3.1.5
embankment
any earth-structure formed by the placement of engineered fill (including the infilling of large excavations, and earth-structures formed by dredging)

3.1.6
embankment zone
subdivision of embankments, such as the base, the core, the shoulders and the upper zone

3.1.7
superstructure
any type of civil engineering construction placed on top of an embankment (road, rail track, building, etc.)

3.1.8
capping layer
specific transition layer, part of the upper zone, placed below the superstructure

3.1.9
trafficability
ability of a material surface to support the passage of earthworks equipment (Niall to be completed)

3.1.10
degree of saturation
ratio of the pore water volume to the volume of voids

3.1.11
air void content
ratio of the volume of air to the total volume of the soil (solids, water and air). The air void content of a compacted layer can be determined by measuring the dry unit weight, water content in the field and the unit weight of the solid particles

3.1.12
water content
ratio of the weight of water contained in a particular sample to the weight of the dry ground

3.1.13
dry density
mass of the solid particles divided by the total volume of a sample

3.1.14
maximum dry density
maximum value of the dry density obtained in the reference compaction test (Standard or Modified Proctor, Vibrating Hammer Compaction or any other compaction test). This value is related to a water contentcontent that is also known as the optimum water content

3.1.15
optimum water content
water content at which a specified compactive force can compact a soil mass to its maximum dry density

3.1.16
fine soil
soil with at least 15 % fines content (materials that passes through the sieve of 63 micrometers), depending on national practices

3.1.17
fine active soil
fine soil which exhibits specific shrinking/swelling properties to be taken into consideration for earthworks

3.1.18
granular soil
for the purpose of the part 3 of this standard, the term granular soil encompasses very coarse, coarse and composite coarse soil of the classification presented in part 2. A material with a maximum fines content (defined as 63 μm depending on national practices) of 15 % (again depending on national practice). Such material exhibits usually low or no water sensitivity, except when containing active clayey particle

3.1.19
weak rock
rock that is degraded (i.e. produces a wide variety of particle sizes and fines) during earthworks or evolves during the life of the earth-structure. It encompasses weaker rocks and intermediate rocks of the part 2 classification

3.1.20
strong rock
rock for which degradation is insignificant during earthworks or in the long term

3.1.21
non-structural fill
fill that is not going to support any infrastructure (like roads, railways, car parks, walls, structures or buildings), and for which settlements are thus not an important subject to study

3.2 Symbols

Symbols are presented in the table below. Test results (Parameters) are differentiate from tests.

Associated with symbols, abbreviation may be different in different languages.

Table 1

Nature	Name	Abbreviation*	Symbol	Unit
Soil description				
Parameter	Porosity	No	n	Dimensionless
Parameter	Natural water content	No	w_n	Dimensionless
Parameter	Water content	No	w	Dimensionless
Parameter	Natural water content	No	w_n	Dimensionless
Parameter	Degree of saturation	No	S_r	Dimensionless
Parameter	Air void	No	a_v	Dimensionless
Parameter	Air void content = air volume/total volume	No	n_a	Dimensionless
Parameter	Maximum allowable air void content	No	n_a (GER)	dimensionless %
Parameter	Air void ratio = air volume/void volume	No	$S_{ra} = 1\text{-}S_r$	Dimensionless
Parameter	Bulk density	No	γh	kN/m³
Parameter	Weight density	No	γ	kN/m³

Parameter	(Mass) density	No	ρ	t/m³
Parameter	(Relative) density = $\gamma/\gamma_w = \rho/\rho_w$	No	G	Dimensionless
Parameter	Dry weight density	No	γ_d	kN/m³
Parameter	Dry (mass) density It seems better to keep "mass"	No	ρ_d	t/m³
Parameter	*In situ* dry density Could be "natural dry density"	No	ρ_{dn}	t/m³
Parameter	*In situ* dry weight density	No	γ_{dn}	kN/m³
Words	Particle size distribution	PSD		
Parameter	Maximum dimension of the largest elements contained in the soil	No	Dmax	(mm)
Parameter	Particle size at which x % are finer D_{10}, D_{30}, D_{60}, D_{95}	No	D_x	(mm)
Parameter	Coefficient of uniformity	No	C_U	Dimensionless
Parameter	Coefficient of curvature	No	C_C	Dimensionless
Parameter	Content of particles finer than x (mm) $C_{2\ \mu m}$, $C_{63\ \mu m}$, $C_{80\ \mu m}$, $C_{2\ mm}$, …	No	C_x	dimensionless %
Parameter	Plastic limit	No	w_P	dimensionless %
Parameter	Liquid limit	No	w_L	dimensionless %
Mechanical properties of soils				
Parameter	Plasticity index	No	I_P	dimensionless %
Parameter	Consistency index	No	I_c	dimensionless
Test	Methylene blue test	MBT		
Parameter	Methylene blue value (fraction 0/50 mm)	No	V_{BS}	g/100g
Parameter	Organic matter content	No	C_{OM}	dimensionless %
Parameter	Soluble salts content	No	C_{salt}	dimensionless %
Parameter	SO_4 content	No	C_{SO4}	dimensionless %
			□	
Parameter	Unconfined compressive strength	UCS		
Parameter	Effective cohesion	No	c'	KPa
Parameter	Angle of internal friction	No	φ'	Degree
Parameter	Compressive or tensile strength	No	R	MPa
Parameter	Compressive or tensile strength after immersion in water	No	R_i	MPa
Parameter	Strength after immersion ratio (R_i/R)	No	I_r	dimensionless
Parameter	Compressive strength	No	R_c	MPa
Parameter	Tensile strength	No	R_t	MPa

Parameter	Indirect tensile strength	No	Rtb	Mpa
Parameter	Modulus of elasticity	No	E	MPa
Parameter	Modulus of elasticity in compression	No	E_c	MPa
Parameter	Modulus of elasticity in direct tension	No	E_t	MPa
Parameter	Modulus of elasticity in indirect tension	No	E_{it}	MPa
Parameter	Poisson's ratio	No	ν	dimensionless
Tests specific to earthworks				
Test	Standard Proctor Test	SPT		
Test	Modified Proctor test	MPT		
Parameter	Optimum water content	OMC	wOPN	Dimensionless
Parameter	Optimum dry density	ODD		Dimensionless
Parameter	Maximum dry weight density (OPN)	No	$\gamma_{dmaxOPN}$	kN/m³
Parameter	Maximum dry mass density (OPN)	No	$\rho_{dmaxOPN}$	t/m³
Parameter	Maximum dry weight density (OPM)	No	$\gamma_{dmaxOPM}$	kN/m³
Parameter	Maximum dry mass density (OPM)	No	$\rho_{dmaxOPM}$	t/m³
Parameter	Water content at Optimum Proctor Normal / Standard	OMC	wOPN	dimensionless
Parameter	Water content at Optimum Proctor Modified	OMC	wOPM	dimensionless
Tests specific to earthworks				
Parameter	Fraction x % of the maximum dry density on the reference Proctor curve	No	x % $\rho_{dmaxOPN}$	t/m³
Parameter	Degree of compaction = γ_d/γ_{dmax}	No	D_{Pr}	dimensionless %
Words	California bearing ratio	CBR		
Test	CBR test (soaked or unsoaked)	CBR		
Parameter	CBR index		I_{CBR}	dimensionless %
Parameter	Soaked CBR index		I_{CBRi}	dimensionless %
Words	Immediate bearing index	IPI		
Test	IPI test	IPI		
Parameter	IPI index		I_{IPI}	dimensionless
Test	Los Angeles test	LA		
Parameter	Los Angeles coefficient		CLA	dimensionless
Test	Micro-Deval test	MDE		
Parameter	Micro-Deval coefficient in presence of water		CMDE	Dimensionless
Test	Fragmentability test	FR		
Parameter	Coefficient of fragmentability		I_{FR}	Dimensionless
Parameter	Coefficient of friability for fine		I_{FS}	Dimensionless

	aggregate			
Test	Degradability test	DG		
Tests specific to earthworks				
Parameter	Coefficient of degradability		I_{DG}	
Parameter	Linear swelling strain in CBR mould		ε_{sw} or ε_g	dimensionless
	Volumetric swelling strain in CBR mould		ε_{vsw} or ε_{vg}	dimensionless %
Parameter	Collapse settlement (oedometer) ESP		□	
Parameter	Linear expansion (oedometer) ESP		□	
	Moisture condition value	MCV		
Words	Continuous compaction control	CCC		
Other tests				
Test	Static cone penetrometer test	CPT		
Test	Dynamic cone penetration test	DPT		
Test	Standard penetration test	SPT		
Parameter	Plate load test modulus E_{V1}		E_{V1} (M1)	MPa
Parameter	Plate load test modulus E_{V2}		E_{V2} (M2)	MPa
Parameter	Compression wave velocity		V_p	m/s
Parameter	Shear wave velocity		V_s	m/s
Parameter	Point load index		I_{s50}	MPa
Others…				
Parameter	Pulverization		P	%
Parameter	Thornwaithe index		I_m	

4 General considerations

4.1 Prerequisites to execution of earthworks

Before the beginning of construction, all geotechnical design issues shall be solved, including temporary and permanent stability, erosion and settlements. All unresolved issues during design shall be identified to all parties and highlighted before the commencement of construction. In this case the responsibility for closing out shall be made clear.

Before the commencement of each part of works, the design of each part earthworks shall have been completed, including the assessment of the available materials and their suitability (See Part 1 and Part 2 of this standard).

4.2 Climatic conditions

Before commencing earthworks, the prevailing climatic conditions at the construction site shall be considered. Seasonal climatic variations can impose limiting factors on earthworks.