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# Earthworks

Part 3: Construction procedures

# National foreword

This British Standard is the UK implementation of EN 16907-3:2018.

The UK participation in its preparation was entrusted to Technical Committee B/526/-/1, Earthworks.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.


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# Earthworks - Part 3: Construction procedures

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## European foreword

This document (EN 16907-3:2018) 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of an identical text or by endorsement, at the latest by June 2019, and conflicting national standards shall be withdrawn at the latest by June 2019.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;*

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

— *Part 4: Soil treatment with lime and/or hydraulic binders;*

— *Part 5: Quality control;*

— *Part 6: Land reclamation earthworks with dredged hydraulic fill;*

— *Part 7: Hydraulic placement of waste.*

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

# 1 Scope

This European Standard provides execution procedures for excavating, transporting and placing soils and rocks for the construction of earth-structures and guidance for the work. Additionally, it includes excavation and placement of rock materials underwater.

Dredging of soils and the associated hydraulic placement of fills are covered by EN 16907-6 and EN 16907-7.

Execution of earthworks follows the conclusions of the earthworks design and optimization phase (EN 16907-1), 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 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 16907-1, *Earthworks - Part 1: Principles and general rules*

EN 16907-2, *Earthworks - Part 2: Classification of materials*

EN 16907-6, *Earthworks - Part 6: Land reclamation earthworks with dredged hydraulic fill*

# 3 Terms and definitions

For the purposes of this document, the terms, definitions and symbols given in EN 16907-1 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**
**trafficability**
ability of a material surface to support the passage of earthworks

**3.2**
**compaction**
process of removing air from a soil normally by mechanical means

**3.3**
**compactive effort**
energy applied to achieve compaction

**3.4**
**over compaction**
condition that arises during compaction when sufficient air has been expelled from a fill such that further compactive effort results in elevated pore water pressures causing the fill surface to become unstable as the material “mattresses”

Note 1 to entry: Over compaction of granular soils can also result in the crushing of individual particles thereby modifying the particle size distribution.

**3.5**
**density index**
density state of a granular soil (natural or compacted) determined by comparing its void ratio (e) with the minimum ($e_{min}$) and maximum ($e_{max}$) attainable for the particular material

Note 1 to entry: The minimum and maximum void ratios correspond to the densest state ($I_D$ = 100 %) and loosest state ($I_D$ = 0 %) respectively (=[$e_{max}$ – e/ $e_{max}$ - $e_{min}$] × 100 %).

**3.6**
**fine soil**
soil with at least 15 % fines content, depending on national practices

**3.7**
**fine active soil**
water-sensitive fine soil which exhibits specific shrinking/swelling properties to be taken into consideration for earthworks

# 4 General considerations

## 4.1 Prerequisites to execution of earthworks

Before the beginning of construction, all geotechnical design issues should 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 of the earthworks shall have been completed, including the assessment of the available materials and their suitability (see EN 16907-1 and EN 16907-2).

## 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.

During periods of rainfall, consideration should be given to suspending earthworks operations in wet sensitive materials. When necessary, the earth surfaces should be sealed to prevent the ingress of water.

In dry climatic conditions, consideration should be given to preventing evaporative losses by covering the exposed earth surfaces with non-sensitive materials.

NOTE Seasonal climatic considerations will vary depending on different regions. For example, a frozen ground surface may provide a temporary working platform that can enhance the excavation of soft soil.

## 4.3 Environmental factors

All earthworks should comply with the relevant environmental legislation.

Earthworks have the potential to harm the natural and built environment and therefore they should be planned in such a manner so as to minimize the potential for harm.

The environmental factors to be considered during earthworks construction commonly include the following:

**Noise** – European and national regulations should be considered. It is applying for receptors, e.g. domestic dwellings which are affected by the increase of noise beyond legal limits. Assessments should be made of the noise emissions of the various types of earthwork machinery and background noise level readings taken prior to commencement of the earthwork operations.

Consideration should be given to restricted working hours and to the construction of temporary noise barriers utilizing earth bunds or fencing.

**Contamination** – if there are areas of contamination within an excavation, the activities should be controlled so as to prevent further contamination of the surrounding soil. Contaminated materials should be handled separately and if they are to be stockpiled, the surface upon which they are to be placed should be sealed and shaped to prevent the potential run-off of contaminated water. The potential effect on workers should also be considered and appropriate protective equipment provided.

Appropriate equipment should be selected, to deal with the contaminated material.

**Dust** – Earthwork operations have the potential to cause dust, particularly in fine graded soils in dry weather conditions.

Dust should be controlled by spraying water onto the exposed surfaces. The potential for dust generation is limited if the exposed surfaces are covered with topsoil and seeded as works progress.

**Water courses protection** – The most likely cause of pollution from earthworks is the siltation of surface water by uncontrolled silt laden run-off. Consideration shall therefore be given when planning the earthwork operation to the proposed dewatering system. Control measures can include the establishment of settlement ponds and the use of silt fences.

**Vibration** shall be considered especially sensitivity of existing structures, or building or utilities to vibrations and sound shock waves.

Normal earthwork operations are unlikely to cause harmful vibration levels, however blasting operations can cause considerable vibration and therefore have the potential to damage either the works or adjoining properties. In cases where vibration caused by blasting is likely to cause damage, blasting should be prohibited and replaced by ripping and/or hydraulic breaking.

### 4.4 Use of secondary manufactured materials and recycled materials

For reasons of economy and environmental sustainability, the Earthworks Practitioner should consider the use of recycled materials and industrial by-products. These will typically include demolition arisings (crushed concrete, etc.) and industrial by-products such as pulverized fuel ash, burnt colliery shale, biomass ashes, slag, foundry sand and cement kiln dust, as well as quarrying processing by-products.

The use of by-products and recycled materials presents special considerations for the Earthworks Practitioner. These considerations fall into two principle categories: legislative and geotechnical.

Legislative considerations concern the environmental and waste licensing legislation that governs the use of such recycled materials and by-products. In order to prevent environmental harm, strict national legislative controls are normally applied to the use of such products. It should be noted that such materials are often considered as a “waste” and legislation governing such materials is often complex. The use of such materials should be carefully evaluated because of their potential to cause environmental harm during both the construction phase and the operation phase of the earthwork. Such harm is often associated with the creation of airborne pollution by dust and ground/surface water pollution by leachate.

Geotechnical concerns relate to the unique characteristics of the recycled material and secondary manufactured products. These materials will often behave in a different manner to natural materials and due consideration shall be taken of this in their specification and use. Particular consideration should be given to the long-term durability of the materials in both the physical and chemical context as, particularly in the case of industrial secondary manufactured products, they may be susceptible to gradual chemical deterioration which can lead to failure of the earthwork. Testing regimes should be established to identify the nature of the material and to validate its consistency during use.