

DIN EN 16907-1:2019-04 (E)

Earthworks - Part 1: Principles and general rules

Contents	Page
European foreword	7
1 Scope	8
2 Normative references	9
3 Terms and definitions	9
3.1 Definitions	9
3.2 Abbreviations and symbols	14
4 Principles of earthworks design and execution	17
4.1 General	17
4.2 Stages of earthworks projects	17
4.3 Instructions for the execution of works	18
4.4 Relationship between earthworks and earth-structure design	19
4.5 Sustainable development and environmental considerations for earthworks	20
4.6 Risk management	21
4.7 Types of earthwork processes	22
5 Specific site and material investigations	22
5.1 Information needed for earthworks design	22
5.2 Coordination of ground investigations	23
5.2.1 General	23
5.2.2 Site investigations for geotechnical design	23
5.2.3 Specific ground investigations for earthworks	23
5.2.4 Geotechnical reporting	24
5.3 Use of classification systems	24
6 Design of earthworks for fills	25
6.1 Introduction	25
6.2 Design procedure	26
6.2.1 General	26
6.2.2 Fill zones	27
6.3 Selection of the fill material properties and compaction process	32
6.3.1 General	32
6.3.2 Characterization of materials	33
6.3.3 Criteria for assessing the compacted fill material	34
6.3.4 Compaction behaviour of fill materials	35
6.3.5 Relationship testing to assess fill performance	37
6.3.6 Link between construction method and earthworks fill design	38
6.3.7 Use of full-scale tests to assess a compaction process for a given fill material	38
6.3.8 Design of fill cross-section	39
6.4 Details of specific parts, materials and earth structures	39
6.4.1 Introduction	39
6.4.2 Capping layers	39
6.4.3 Transition zones	40
6.4.4 Fills on slopes	42
6.4.5 Specific materials	42
6.4.6 High fills	43
6.4.7 Fills on soft soils or areas prone to flooding	44
6.4.8 Fills built above cavities	44
6.4.9 Surplus materials	45

7	Design of earthworks for cuttings	45
7.1	General	45
7.2	Materials involved	45
7.3	Geometry	46
7.4	Drainage	46
7.5	Overall stability	46
7.6	Relevant properties of the cutting base (subgrade)	46
8	Design of earthworks formed by dredging and hydraulic placement of fills	47
9	Design of earthworks for hydraulic placement of wastes	47
10	Earthworks Drainage	48
10.1	Drainage for collecting water	48
10.2	Protection of slopes against erosion	51
11	Optimization of earthworks project design	51
12	Technical Specifications for earthworks	52
12.1	General	52
12.2	End product Specification	54
12.3	Method Specification	54
12.4	Performance Specification	55
13	Monitoring earthworks and checking earth-structures performance	55
13.1	Introduction	55
13.2	Needs and techniques for monitoring and checking earthworks	56
13.3	Checking earth-structure performance	57
14	Use of national experience and non-conflicting rules	57
14.1	General	57
14.2	Informative examples of experience-based national practices	57
	Annex A (informative) Geometry definitions for earthworks and earth-structures	59
	Annex B (informative) Summary of national practice - Austria	62
B.1	Introduction	62
B.2	Soil and Rock Classification	63
B.2.1	Soil classification according to ÖNORM B 4400-1	63
B.2.2	Soil and rock classification according to ÖNORM B 2205	63
B.3	Execution of earthworks	63
B.3.1	General	63
B.3.2	Soil and rock excavation	64
B.3.3	Preparation of formation level of subsoil (embankment foundations)	64
B.4	Construction of embankments and fills	65
B.4.1	Construction materials	65
B.4.2	Placement and compaction	66
B.4.3	Construction of formation level of sub-base	68
B.4.4	Construction of embankments and cut slopes	68
B.4.5	Backfilling and filling of structures	69
B.4.6	Filling of line trenches and covering of lines (pipes, cables)	73
B.4.7	Measures aimed at improving subsoil and fills	74
B.5	Quality Control (Tests)	76
B.5.1	General	76
B.5.2	Test types	76
B.5.3	Test procedures	77
B.6	Literature	80
	Annex C (informative) Summary of national practice - France	83

C.1	Introduction	83
C.2	Classification of materials	83
C.3	Design of Earthworks	87
C.3.1	Introduction	87
C.3.2	Specification of the mechanical properties to be obtained	87
C.3.3	Classification of hydric state of materials and weather conditions	89
C.3.4	Fill material	90
C.3.5	Capping layer	92
C.3.6	Compaction of fill	95
C.3.7	Extraction and transportation of soil and rocks	98
C.3.8	Compaction of materials	98
C.4	Control of earthworks	99
C.4.1	Introduction	99
C.4.2	Technical processes and control methods	99
C.5	References	102
	Annex D (informative) Summary of national practice - Germany	104
D.1	Introduction	104
D.2	Classification of materials	105
D.2.1	Classification according to DIN 18196	105
D.2.2	Classification according to DIN 18300	110
D.2.3	Classification of frost susceptibility of soil groups according to ZTV E-StB	111
D.3	Execution of earthworks	112
D.3.1	General	112
D.3.2	Loosening, loading and conveying	112
D.3.3	Placing and compacting	112
D.3.4	Special construction methods in earthworks according to ZTV E-StB	115
D.4	Control of Earthworks	116
D.4.1	Types of testing	116
D.4.2	Testing methods	117
D.5	References	118
	Annex E (informative) Summary of national practice - Norway	121
E.1	Introduction	121
E.2	Classification of materials	121
E.3	Design of earthworks	122
E.3.1	Dredging	122
E.3.2	Underwater blasting	122
E.3.3	Transportation at sea	123
E.3.4	Spreading and compaction of fills	123
E.3.5	Filling under water	133
E.3.6	Replacement / displacement of soft soil	135
E.3.7	Influence of weather conditions	136
E.4	Quality control of earthworks	136
E.5	References	137
	Annex F (informative) Summary of national practice - Spain	138
F.1	Introduction	138
F.2	Classification of materials	138
F.2.1	General	138
F.2.2	Soil classes	138
F.2.3	Fill classes built with rocky materials	141
F.3	Possible use of marginal materials	141
F.3.1	General	141
F.3.2	Some marginal soils	141
F.3.3	Some marginal rocks	142
F.4	Preliminary design of earth-structure cross section	143
F.5	Types of earth-structures to be built	145
F.6	Basic construction rules	145

F.6.1	Preparation of the ground area to build the earth or rockfill	145
F.6.2	Earthfills	145
F.6.3	Rock and random fills	147
F.7	Control of earthworks	148
F.7.1	General	148
F.7.2	Earthfills	148
F.7.3	Rock and Random fills	149
F.8	Reference	150
Annex G (informative) Summary of national practice - Sweden		151
G.1	Introduction	151
G.2	Classification of materials	151
G.2.1	Introduction	151
G.2.2	Soil classification	151
G.2.3	Rock classification	153
G.3	Design of earthworks	153
G.4	Control of earthworks	153
Annex H (informative) Summary of national practice - United Kingdom		155
H.1	Introduction	155
H.2	Classification of materials	155
H.3	Design of earthworks	159
H.3.1	General	159
H.3.2	BS 6031:2009, Clause 8.2: Specification of earthworks by SHW approach	159
H.3.3	SHW required documentation within project earthworks specification	160
H.3.4	Compaction requirements (classification, design and construction aspects)	160
H.3.5	Alternative specifications	160
H.3.6	Additional requirements for deep fill areas/buildings and structures	161
H.3.7	Selection of fill material properties (earthworks fill design)	161
H.3.8	Extracts from core tables of UK Specification for Highway Works (SHW)	163
H.4	Control of earthworks during construction	168
H.5	References	168
Bibliography		170