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**Wind energy generation systems –
Part 6: Tower and foundation design requirements**



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CONTENTS

FOREWORD.....	9
INTRODUCTION.....	11
INTRODUCTION to Amendment 1	11
1 Scope.....	12
2 Normative references	12
3 Terms and definitions	13
4 Symbols and abbreviated terms.....	18
4.1 Symbols.....	18
4.2 Abbreviated terms.....	20
5 Design basis including loading.....	25
5.1 General.....	25
5.2 Basis of design	26
5.2.1 Basic principles	26
5.2.2 Durability	26
5.2.3 Principles of limit state design	26
5.2.4 Structural analysis	27
5.2.5 Assessments by tests	27
5.3 Materials.....	27
5.4 Loads.....	28
5.4.1 Use of IEC 61400-1 or IEC 61400-2 load cases and partial safety factors for loads.....	28
5.4.2 Superseding of IEC 61400-1 or IEC 61400-2 partial safety factors for materials	28
5.4.3 Serviceability load levels	28
5.4.4 Load combinations in UL.....	29
5.4.5 Structural damping values to be used in load calculations	30
5.4.6 Definitions and methods for use of internal loads.....	30
5.4.7 Definition of required load data for fatigue analysis.....	31
5.4.8 Definition of required load data for extreme load level	31
5.4.9 Vortex induced vibration	31
5.4.10 Loads due to geometric tolerances and elastic deflections in tower verticality	32
5.5 Load data and interface reporting requirements	32
5.5.1 Purpose.....	32
5.5.2 Wind turbine specification.....	32
5.5.3 Time history data	33
5.5.4 Load origins.....	33
5.5.5 Load components	33
5.6 General structural design requirements.....	34
5.6.1 Secondary structural influence.....	34
5.6.2 Fatigue analysis	34
5.7 Delivery documentation.....	34
6 Steel towers	34
6.1 General.....	34
6.2 Basis of design	34
6.3 Materials.....	34
6.3.1 General	34

6.3.2	Structural steels	34
6.3.3	Bolts and anchors	37
6.4	Ultimate strength analysis for towers and openings	38
6.4.1	General	38
6.4.2	Partial safety factors	38
6.4.3	Verification of ultimate strength	39
6.4.4	Tower assessment	39
6.4.5	Detail assessments	39
6.5	Stability	40
6.5.1	General	40
6.5.2	Partial safety factor	40
6.5.3	Assessment	40
6.5.4	Door frames/stiffeners	41
6.6	Fatigue limit state	41
6.6.1	General	41
6.6.2	Partial safety factor for materials	42
6.6.3	Assessment	42
6.6.4	Details	42
6.7	Ring flange connections	43
6.7.1	General	43
6.7.2	Design assumptions and requirements, execution of ring flanges	43
6.7.3	Execution of ring flanges	45
6.7.4	Fatigue limit state analysis of bolted connection	45
6.7.4	Ultimate limit state analysis of flange and bolted connection	51
6.7.5	Fatigue limit state analysis of flange bolts	53
6.7.6	Fatigue limit state analysis of flange weld and fillet radius	62
6.8	Bolted connections resisting shear through friction	63
6.8.1	General requirements	63
6.8.2	Test-assisted design	64
6.8.3	Design without test	65
7	Concrete towers and foundations	66
7.1	General	66
7.2	Basis of design	66
7.2.1	Reference standard for concrete design	66
7.2.2	Partial safety factors	66
7.2.3	Basic variables	67
7.3	Materials	69
7.4	Durability	69
7.4.1	Durability requirements	69
7.4.2	Exposure classes	69
7.4.3	Concrete cover	69
7.5	Structural analysis	69
7.5.1	Finite element analysis	69
7.5.2	Foundation slabs	70
7.5.3	Regions with discontinuity in geometry or loads	70
7.5.4	Cast in anchor bolt arrangements	71
7.6	Concrete to concrete joints	71
7.7	Ultimate limit state	71
7.7.1	General	71

7.7.2	Shear and punching shear	72
7.8	Fatigue limit state	72
7.8.1	General	72
7.8.2	Reinforcement and prestressing steel fatigue failure	72
7.8.3	Concrete fatigue failure	72
7.9	Serviceability limit state	73
7.9.1	Load dependent stiffness reduction	73
7.9.2	Stress limitation	73
7.9.3	Crack control	73
7.9.4	Deformations	74
7.10	Execution	74
7.10.1	General	74
7.10.2	Requirements	74
7.10.3	Inspection of materials and products	74
7.10.4	Falsework and formwork	74
7.10.5	Reinforcement and embedded steel	74
7.10.6	Pre-stressing	74
7.10.7	Precast concrete elements	75
7.10.8	Geometrical tolerances	75
8	Foundations – Geotechnical design	75
8.1	General	75
8.2	Basis of design	75
8.2.1	General	75
8.2.2	Geotechnical limit states	76
8.3	Geotechnical data	76
8.3.1	General	76
8.3.2	Specific considerations	78
8.4	Supervision, monitoring and maintenance of construction	79
8.5	Gravity base foundation	79
8.5.1	General	79
8.5.2	Ultimate limit state (ULS)	80
8.5.3	Serviceability limit state (SLS)	83
8.6	Piled foundations	85
8.6.1	General	85
8.6.2	Pile loads	85
8.6.3	Ultimate limit state	86
8.6.4	Serviceability limit state	87
8.7	Rock anchored foundations	88
8.7.1	General	88
8.7.2	Types of rock anchor foundation	88
8.7.3	Geotechnical data	88
8.7.4	Corrosion protection	88
8.7.5	Anchor inspection and maintenance	89
8.7.6	Post tension tolerances and losses	89
8.7.7	Ultimate limit state	89
8.7.8	Serviceability limit state	90
8.7.9	Robustness check	90
8.7.10	Rock anchor design	91
9	Operation, service and maintenance requirements	93

9.1	Operation, maintenance and monitoring	93
9.2	Periodic structural inspections	93
9.3	Embedded steel structural section inspections	94
9.4	Bolt tension maintenance	94
9.5	Structural health monitoring	94
Annex A (informative) List of suitable design codes and guidelines for the calculation basis		95
A.1	General	95
A.2	Reference documents	95
Annex B (informative) List of material for structural steel		96
B.1	General	96
B.2	Structural steel	96
Annex C (informative) Bolts		97
C.1	General	97
C.2	Reference documents	98
C.3	Use of HV bolt assemblies	98
C.4	Water immersion test	99
Annex D (informative) Z-values for structural steel		100
D.1	General	100
D.2	Definition of Z-value according to Eurocode	100
D.3	Reference documents	100
Annex E (informative) Simplified buckling verification for openings in tubular steel towers		101
Annex F (informative) Fatigue verification		104
F.1	General	104
F.2	Specific details	104
Annex G (informative) Methods for ring flange verification		105
G.1	Method for ultimate strength analysis according to Petersen/Seidel	105
G.1.1	Basics	105
G.1.2	Calculation method	105
G.1.3	Extension by Kobayashi and Ishihara	109
G.2	Method for fatigue strength analysis according to Schmidt/Neuper/Seidel	110
G.2.1 Basic		
G.2.2 Formulas for the tri-linear approximation		
G.2.1	Conditions for calculation model	112
G.2.2	Bolt force curve	113
G.2.3	Bolt moment curve	120
G.2.4	Calculation of force required to close inclination	121
G.3	Reference documents	122
Annex H (informative) Crack control – Guidance on 7.9.3		124
H.1	General	124
H.2	Crack control based on Eurocode 2	124
H.3	Crack control based on Japanese standards	124
H.4	Crack control based on ACI 318	125
H.5	Reference documents	125
Annex I (informative) Finite element analysis for concrete		126
I.1	General	126
I.2	Order and type of elements	126

I.3	Constitutive modelling	127
I.4	Solution methods	127
I.5	Implicit approach	127
I.6	Steps in conducting of a finite element analysis	128
I.7	Checking results	128
I.8	Reference documents	129
Annex J (informative)	Tower-foundation anchorage	130
J.1	General	130
J.2	Embedded anchorages	130
J.3	Bolted anchorages	131
J.4	Grout	131
J.5	Anchor bolts	131
J.6	Embedded ring	131
J.7	Anchorage load transfer	132
Annex K (informative)	Strut-and-tie section	133
K.1	General	133
K.2	Example of a rock anchor foundation	134
K.3	Reference documents	137
Annex L (informative)	Guidance on selection of soil modulus and foundation rotational stiffness	139
L.1	General	139
L.2	Soil model	139
L.3	Dynamic rotational stiffness	141
L.4	Static rotational stiffness	142
L.5	Reference documents	143
Annex M (informative)	Guidance for rock anchored foundation design	144
M.1	General	144
M.2	Corrosion protection	144
M.2.1	Standard anchors	144
M.2.2	Corrosion protection of bar anchors	145
M.3	Product approval	146
M.4	Rock anchor design	146
M.5	Grout design	146
M.6	Testing and execution	146
M.7	Suitability/performance test	147
M.8	Acceptance/proof test	147
M.9	Supplementary extended creep tests	147
M.10	Reference documents	147
Annex N (informative)	Internal loads – Explanation of internal loads	148
Annex O (informative)	Seismic load estimation for wind turbine tower and foundation	150
O.1	General	150
O.2	Vertical ground motion	150
O.3	Structure model	150
O.4	Soil amplification	151
O.5	Time domain simulation	152
O.6	Reference documents	152
Annex P (informative)	Structural damping ratio for the tower of wind turbine	153
P.1	General	153

P.2	First mode structural damping ratio	153
P.3	Second mode structural damping ratio	154
P.4	Higher mode damping	154
P.5	Reference documents	155
Annex Q (informative)	Guidance on partial safety factors for geotechnical limit states	156
Q.1	General.....	156
Q.2	Equilibrium.....	156
Q.3	Bearing capacity	156
Q.4	Sliding resistance	157
Q.5	Overall stability	157
Q.6	Reference documents	158
Bibliography	159
Figure 1	– Flange notations as an example of an L-flange	36
Figure 2	– Door opening geometry	41
Figure 3	– Flange gaps k in the area of the tower wall	41
Figure 4	– Bolt force as a function of wall force	41
Figure 5	– S-N curve for detail category 36	41
Figure 8	– Bolt force F_S as a function of external force Z (including dead weight)	45
Figure 9	– Flange gaps with gap height k and gap length l at the tower wall and flange surface inclination α_S	45
Figure 10	– Illustration of parallel gaps and angular gaps	46
Figure 11	– Example for flatness measurement evaluation ($D = 6\,000$ mm)	47
Figure 12	– Clarification of flatness values for the individual flange (u_{t0l}) and resulting gap height after mating of two flanges (k)	48
Figure 13	– Schematic representation of $k_{limit,unloaded}$ and $k_{limit,loaded}$	51
Figure 14	– Schematic representation for the correct shimming of an unacceptable gap	51
Figure 15	– Total settlement $f_{Z,tot}$ as function of DFT_{sbw}	56
Figure 16	– Coating thickness reference points	57
Figure 17	– Gap shape ($L_{gap} = 2\,000$ mm / $k_{design} = 1,0$ mm)	60
Figure 18	– S-N-curve for bolts (examples M30 and M80 shown)	62
Figure 19	– Distance requirements for the flange weld in case fillet radius is not explicitly specified	63
Figure 6	– Thermal effects around tower cross-section	67
Figure 7	– Illustration of rock anchor length	93
Figure E.1	– Circumferentially edge-stiffened opening	102
Figure E.2	– Definition of W_S and t_S according to JSCE	103
Figure G.1	– Simplification of system to segment model	105
Figure G.2	– Locations of plastic hinges for different failure modes	106
Figure G.3	– Geometric parameters	107
Figure G.6	– Location of plastic hinges for T-flanges	109
Figure G.4	– Modification factor λ for different α [1]	110
Figure G.7	– Illustration of bolt force model (L- and T-flanges)	113
Figure K.1	– Example for the design of a deep beam using the strut-and-tie method	133

Figure K.2 – Simple shapes of strut-and-tie models	133
Figure K.3 – Three examples for carrying load in a deep beam	134
Figure K.4 – Strut-and-tie models for a rock-anchor foundation.....	136
Figure K.5 – Top tie reinforcement in a rock-anchor foundation.....	137
Figure L.1 – Example stress-strain relationship for soil	139
Figure L.2 – Loading and unloading behaviour of soil	140
Figure L.3 – Variation of shear modulus with soil strain.....	141
Figure L.4 – Reduction in rotational stiffness due to load eccentricity.....	142
Figure L.5 – Illustrative example of reduction in foundation rotational stiffness due to increasing load eccentricity.....	143
Figure M.1 – Section through rock and anchor	144
Figure M.2 – Typical anchor configuration with corrosion protection.....	145
Figure N.1 – Representation of internal loads	149
Figure O.1 – Structure model for response spectrum method.....	151
Figure P.1 – First mode damping ratio for the steel tower of wind turbine	154
Table 1 – Flange tolerances.....	47
Table 3 – Flange tolerances.....	47
Table 2 – Summary of geotechnical limit states	76
Table B.1 – National and regional steel standards and types	96
Table C.1 – Comparison of bolt material in ISO 898-1, JIS B1186 and ASTM A490M-12.....	97
Table C.2 – Mean preload after installation	98
Table E.1 – Coefficients for Formula (E.3)	102
Table G.1 – Data points for external forces and bolt forces for determination of polynomial coefficients.....	115
Table H.1 – Limit value of crack width based on Japanese standards [1]	125
Table P.1 – Damping coefficients	153
Table Q.1 – Minimum partial safety factors for the equilibrium limit state (European and North American practice)	156
Table Q.2 – Minimum partial safety factors on for the equilibrium limit state (JSCE)	156
Table Q.3 – Minimum partial material and resistance factors for the bearing resistance limit state, ULS	157
Table Q.4 – Minimum partial material and resistance factors for the sliding resistance limit state, ULS	157
Table Q.5 – Minimum partial material and resistance factors for the overall stability limit state, ULS	158

INTERNATIONAL ELECTROTECHNICAL COMMISSION

WIND ENERGY GENERATION SYSTEMS –

Part 6: Tower and foundation design requirements

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IEC 61400-6 edition 1.1 contains the first edition (2020-04) [documents 88/751/FDIS and 88/754/RVD], its corrigendum 1 (2020-11) and its amendment 1 (2025-06) [documents 88/1088/FDIS and 88/1096/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 61400-6 has been prepared by IEC technical committee TC 88: Wind energy generation systems.

The text of this standard is based on the following documents:

FDIS	Report on voting
88/751/FDIS	88/754/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This document has been developed for the design of onshore wind turbine towers and foundations that will build on and complement the IEC 61400-1 relating to design criteria and provide a complete set of technical requirements for the structural and geotechnical design. The requirements are also applicable to wind turbines covered by IEC 61400-2. It is envisaged that the proposed work will be followed by the development of another part, directed towards the design of offshore support structures, thus also complementing IEC 61400-3-1.

Civil engineering practices associated with the scope of the standard have regional variations. It is not the intention of this document to conflict with those practices but to supplement them particularly in ensuring that all important features of typical wind turbine towers and foundations are fully and correctly considered. To this end, the relevant parts in existing standards for design of steel and concrete structures and for geotechnical design have been identified for participating countries and regions.

The principles included in this document apply to the sections of the tower of an offshore fixed structure above the splash zone if the loading has been calculated according to IEC 61400-3-1.

This document will include the evaluation and calibration of partial safety factors for material strengths to be used together with the safety elements in IEC 61400-1 and IEC 61400-2 for loads and for verification of static equilibrium.

INTRODUCTION to Amendment 1

Clauses and subclauses as given in this document are replacing or amending the respective clauses and subclauses of IEC 61400-6:2020. The main part of this amendment concerns updated knowledge for the design of L-flanges and modifications required due to changes to IEC 61400-1.

The previous method of fatigue assessment using the Schmidt/Neuper trilinear bolt force curve approximation has been removed as the default method from the document. It has been replaced with a physically more accurate method.

The updated methodology for fatigue assessment of L-flanges has been calibrated so that the target failure probability defined in IEC 61400-1 is achieved. Where existing flange designs are checked with the updated method, over-utilization can be found, which in some cases can show an order of magnitude higher than nominally acceptable damage.

This does not impose an immediate risk for the turbines affected, though, due to the following factors:

- a) in most cases, such designs have significant conservatism in the fatigue loads assumed, e.g. due to the assumption of uni-directional wind combined with type class turbulence conditions,
- b) experience shows that broken bolts are almost always found and replaced before a turbine collapses.

It is not necessary to re-assess existing flange designs using the new method. In cases where broken bolts are found in operating turbines, the affected flange should be checked with the new methodology. Based on the assessment results and the root causes analysis for the failure, further measures should be defined (e.g. shorter inspection intervals).

WIND ENERGY GENERATION SYSTEMS –

Part 6: Tower and foundation design requirements

1 Scope

This part of IEC 61400 specifies requirements and general principles to be used in assessing the structural integrity of onshore wind turbine support structures (including foundations). The scope includes the geotechnical assessment of the soil for generic or site specific purposes. The strength of any flange and connection system connected to the rotor nacelle assembly (including connection to the yaw bearing) are designed and documented according to this document or according to IEC 61400-1. The scope includes all life cycle issues that may affect the structural integrity such as assembly and maintenance.

The assessment assumes that load data has been derived as defined in IEC 61400-1 or IEC 61400-2 and using the implicit reliability level and partial safety factors for loads.

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.

IEC 61400-1:2019, *Wind energy generation systems – Part 1: Design requirements*
IEC 61400-1:2019/AMD1:2024

IEC 61400-2, *Wind turbines – Part 2: Small wind turbines*

IEC 61400-3-1:2019, *Wind energy generation systems – Part 3-1: Design requirements for fixed offshore wind turbines*

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs with specified property classes – Coarse thread and fine pitch thread*

ISO 898-2, *Fasteners – Mechanical properties of fasteners made of carbon steel and alloy steel – Part 2: Nuts with specified property classes*

ISO 898-3, *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 3: Flat washers with specified property classes*

ISO 965-2, *ISO general purpose metric screw threads – Tolerances – Part 2: Limits of sizes for general purpose external and internal threads – Medium tolerance quality*

ISO 965-5, *ISO general purpose metric screw threads – Tolerances – Part 5: Limits of sizes for internal screw threads to mate with hot-dip galvanized external screw threads with maximum size of tolerance position h before galvanizing*

ISO 4759-1, *Tolerances for fasteners – Part 1: Bolts, screws, studs and nuts – Product grades A, B and C*

ISO 4759-3, *Tolerances for fasteners – Part 3: Washers for bolts, screws and nuts – Product grades A, C and F*