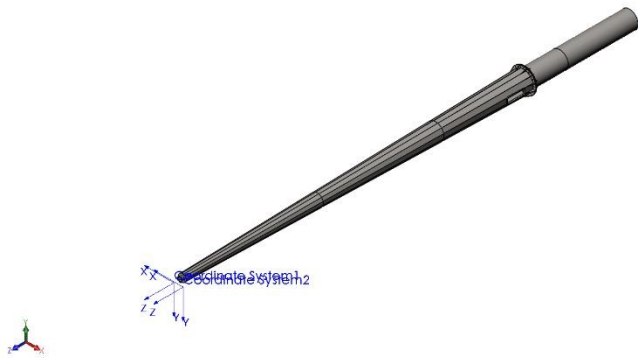




Omschrijving

Statische berekening van een 20 meter toren voor een BESTwind 10Kw MKII windturbine

Simulatie van Toren 20mtr REV2 Assemblage

Datum: Vrijdag 4 September

Studie naam: Static 1

Type Analyse: Statisch

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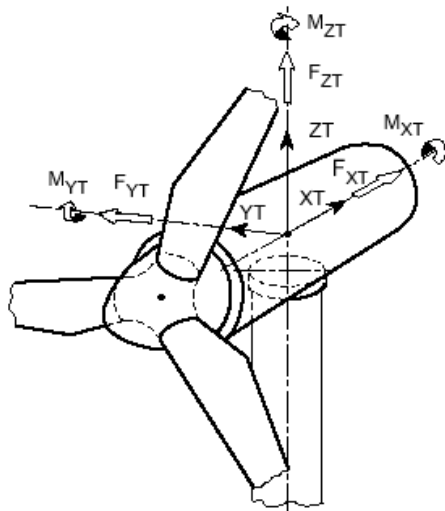


Technische gegevens

Type turbine:	Bestwatt 10Kw MKII
Vermogensregeling:	Overtrek
Nominaal vermogen:	10Kw
Maximaal vermogen:	15Kw
Aantal wieken:	3
Nominaal toerental:	Variabel 70-85 RPM
Maximaal toerental:	95 RPM
Rem:	Aerodynamische tipremmen hydraulisch bediend.
Over toeren beveiliging:	Dubbel uitgevoerd toeren opnemers
Startwindsnelheid:	2,5 m/s
Windsnelheid vollast:	9 m/s
Uitschakel windsnelheid:	25 m/s
Temperatuurbereik:	-20° C ... +30° C
Ontwerp voor IEC windklasse 2:	
- Naafhoogte:	20 m
- Gewicht gondel:	965kg (inclusief wieken)
- Eigen frequentie Gondel:	
o 1p bij nominaal toeren:	1,16 - 1,41Hz
o 3p bij nominaal toeren:	3,48 - 4,25Hz
- Hart afstand naaf tot bovenzijde mast:	312 mm
- Totale hoogte mast:	19688 mm
- Fundering:	Buisfundering; lengte op basis van sondering.

Toren berekening

De richting van de krachten word hieronder weergegeven volgens het Turbine Coordinate system torentoplasten.



As X word aangeduid als de hartlijn vanuit de naaf. Dit coördinaat vertegenwoordigt de kracht die optreed in horizontale richting.

As Y word aangeduid als de horizontale lijn haaks op de rotor as. Dit coördinaat vertegenwoordigt de kracht die optreed in zijdelingse richting.

As Z word aangeduid als de hartlijn van de toren. Dit coördinaat vertegenwoordigt de kracht die optreed in verticale richting.

My word aangeduid als het koppel wat optreed om as Y, dit is het kiepmoment van de gondel.

Mx word aangeduid als het koppel wat optreed om as X, dit is het aandrijfmoment van de gondel.

Uitgangspunten

De toren van de turbine is berekend volgens de torentoplasten uit onderstaand rapport. De toren is hier berekend in het belastinggeval Extreem parkeren bij een windsnelheid op ashoogte van $V_{e50} = 59,5$ m/s (IEC klasse 2). De rotor volgt de wind, het frontaal oppervlak van de rotor geeft dan de maximale bijdrage aan het voermoment.

Voor het simuleren van de optredende krachten in de torentop is gekozen voor het gebruik van de resultante:

Fxy:	24,12kN
Fz:	9,9kN
Mxy:	14.81kNm

Extreme Loads Calculation Tower

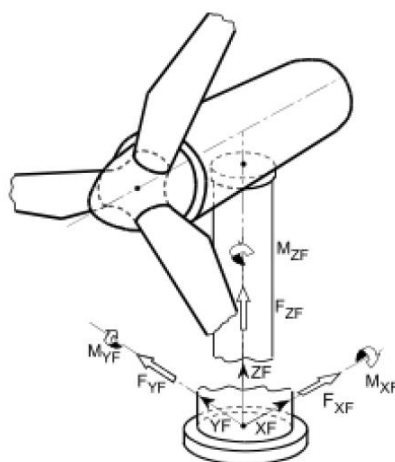
General inputs

```

Wind turbine      BW 10/15 15m tower
Load case         Extreme tower bending moment
Filename:         T20m-BW10.xls
Consequence of failure 1.00
Load factor wind gFa 1.35 (NVN/IEC)
Load factor gravity 1.35 force 0.9 moment (IEC)
Material factor gM 1.00 (IEC/NVN)
Re_16            355 MPa S235J2G3
Re_40            355 MPa S235J2G3
dH_torent        0.614
Inputs for extreme loads calculation
14.81 24.12 FXYaHtemp 6.19 MYGHtemp
V_Hub 59.5 m/s A_hub+nac 0.6 m2 (0.87m diam.)
H_hub 15.1 m Cd_hub+nac 1.2 -
FXYa_H 24.12 kN G_nac 4.2 kN (pos)
FZR_H 9.9 kN L_nac 0.42 m
MXYa_H 14.81 kNm G_rot 5.75 kN (pos)
H_high 14.460 m L_rot 0.77 m
H_low 0.000 m MYg_H 6.19 kNm
D_high 0.400 m A_blades 7.02 m2
D_low 0.775 m CD_blades 1.45 -
M0 0.026 m/m CD_tower 1.2 -
M1 0.026 m/m rho_Fe 8500 kg/m3
M2 0.026 m/m z_0 0.03 m
step 0.201 m
Extreme loads calculation (stresses include load factor but no material factor)
Date: 15-04-20
Wind regime 61400-2(ed1.0) Safety
small wind turbines.p 1
2nd mode Maak alle CD's 0 7.96E-08
routine Maak MYGH 0 1.26E+07
Maak FXYH 0
Maak MYXH = .001 (1 N)
Maak uflex 0 met solver op FXYa
dan is K_2nd = 1/alfa_fix (waarde plakken)
maak grafiek van alfa en u over de hoogte
m_generat/ 440
helpt rotor helpt nac
tower top moment 23.16 [kNm] 14.5 [m]
tower half moment 227.15 [kNm] 7.2 [m]
tower foot moment 497.64 [kNm] 0.0 [m]
Polynom const1: 0.636
Polynom const2: -42.01
Polynom const3: 498
15 m voetdiameter
schaalf: 25.83 775
Minimum SRF
X is hori/
Y is hoog/ 1.46

```

Het moment op de voet van de toren is in onderstaande tabel weergegeven, voor het berekenen van de funderingsbuis hanteert fa. Fubo consult de onderstaande tabel met het daarbij horende Coordinate system torenvoet.



XF horizontal
ZF vertically upwards in direction of the tower axis
YF horizontally sideways, so that XF, YF, ZF rotate clockwise

Fig. 4.A.6 Tower bottom coordinate system

	Ashoogte 15m			Ashoogte 20 m			Ashoogte 25m		
Windklasse	Fx kN	Fz kN	My kNm	Fx kN	Fz kN	My kNm	Fx kN	Fz kN	My kNm
IEC class 2	41.7	-27.9	498.0	51.07	-29.7	741.0	58.9	-43	1026.0
IEC class 3	32.5	-27.9	389.0	39.8	-29.7	579.0	45.8	-43	515.0
IEC class 4	20.8	-27.9	252.0	25.5	-29.7	374.0	29.3	-43	515.0

Model Informatie



Model name: Mast 20mtr REV2 Assembly
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Funderingsbuis	Solid Body	Mass: 2.074,44 kg Volume: 0,265953 m ³ Density: 7.800 kg/m ³ Weight: 20.329,5 N	C:\Users\mk\Documents\B ESTwind\Tekeningen Solidworks\Berekening 20Mtr REV3\Berekening mast 20mtr Assembly\Funderingsbuis L=6000mm.SLDPRT Sep 2 08:29:35 2020

Ondermast	Solid Body	Mass:1.592,5 kg Volume:0,204166 m³ Density:7.800 kg/m³ Weight:15.606,5 N	C:\Users\mk\Documents\B ESTwind\Tekeningen Solidworks\Berekening 20Mtr REV3\Berekening mast 20mtr Assembly\Ondermast.SLD PRT Aug 26 10:48:50 2020
Topmast	Solid Body	Mass:552,458 kg Volume:0,0708279 m³ Density:7.800 kg/m³ Weight:5.414,08 N	C:\Users\mk\Documents\B ESTwind\Tekeningen Solidworks\Berekening 20Mtr REV3\Berekening mast 20mtr Assembly\Topmast.SLDPR T Aug 26 10:53:16 2020
Tussenmast	Solid Body	Mass:909,705 kg Volume:0,116629 m³ Density:7.800 kg/m³ Weight:8.915,1 N	C:\Users\mk\Documents\B ESTwind\Tekeningen Solidworks\Berekening 20Mtr REV3\Berekening mast 20mtr Assembly\Tussenmast.SLD PRT Aug 26 15:01:52 2020

Studie Eigenschappen

Study name	Static 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	25 Celsius
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (C:\Users\mk\Documents\BESTwind\Tekeningen Solidworks\Berekening 20Mtr REV3\Berekening mast 20mtr Assembly)

Eenheden

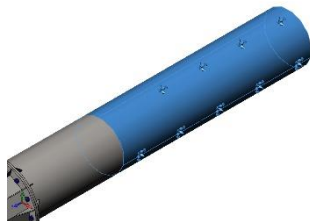
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Celsius
Angular velocity	Hertz
Pressure/Stress	N/mm ² (MPa)

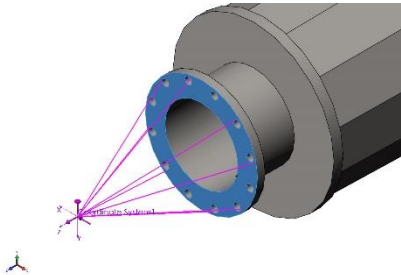
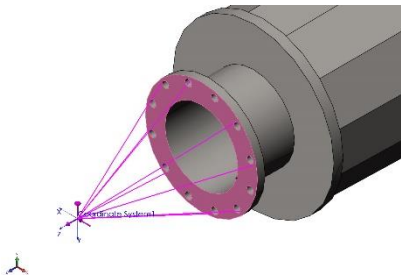


Materiaal Eigenschappen

Model Reference	Properties	Components
	Name: 1.0545 (S355N) Model type: Linear Elastic Isotropic Default failure criterion: Unknown Yield strength: 275 N/mm ² Tensile strength: 450 N/mm ² Elastic modulus: 210.000 N/mm ² Poisson's ratio: 0,28 Mass density: 7,8 g/cm ³ Shear modulus: 79.000 N/mm ² Thermal expansion coefficient: 1,1e-05 /Kelvin	SolidBody 1(Split Line1)(Mast 20Mtr REV3-1/Funderingsbuis L=6000mm-1), SolidBody 1(CirPattern1)(Mast 20Mtr REV3-1/Ondermast-1), SolidBody 1(Cut-Extrude1)(Mast 20Mtr REV3-1/Topmast-1), SolidBody 1(Loft-Thin1)(Mast 20Mtr REV3-1/Tussenmast-2)
Curve Data:N/A		

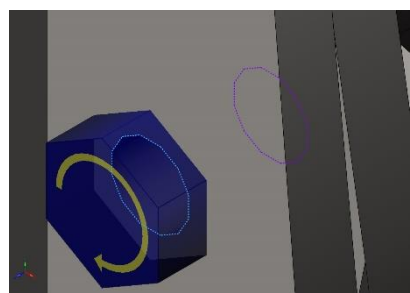
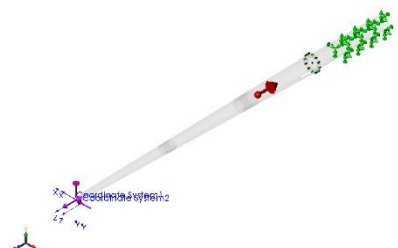
Lasten en Bevestiging

Fixture name		Fixture Image		Fixture Details	
Fixed-1				Entities: 1 face(s) Type: Fixed Geometry	
Resultant Forces					
Components		X	Y	Z	Resultant
Reaction force(N)		24.120,1	-0,00950834	40.417,4	47.067,5
Reaction Moment(N.m)		0	0	0	0

Load name	Load Image	Load Details
Remote Load (Distributed connection)-1		Entities: 1 face(s) Connection Type: Distributed Weighting Factor: Default (Constant) Coordinate System: Coordinate System1 Translational Components: 24.120 N;---;9.900 N Rotational Components: ---;14.810 N.m;--- Reference coordinates: 0 0 0 mm
Gravity-1		Reference: Face< 1 > Values: 0 0 9,81 Units: m/s^2

Connector Definitives

Pin/Bolt/Bearing Connector

Model Reference	Connector Details	Strength Details						
 Counterbore with Nut-1	Entities: 2 edge(s) Type: Bolt(Head/Nut diameter)(Count erbore) Head diameter: 65 mm Nut diameter: 65 mm Nominal shank diameter: 42 mm Preload (Torque): 3.200 Young's modulus: 2,1e+11 Poisson's ratio: 0,28 Preload units: N.m	<table><tr><td>Bolt Check:</td><td>OK</td></tr><tr><td>Calculated FOS:</td><td>1,56585</td></tr><tr><td>Desired FOS:</td><td>1,35</td></tr></table> 	Bolt Check:	OK	Calculated FOS:	1,56585	Desired FOS:	1,35
Bolt Check:	OK							
Calculated FOS:	1,56585							
Desired FOS:	1,35							

Connector Forces

Type	X-Component	Y-Component	Z-Component	Resultant
Axial Force (N)	0	-1,1181e-07	4,4777e+05	4,4777e+05
Shear Force (N)	3.954,6	-69,055	0	3.955,2
Bending moment (N.m)	-2,5288	-47,136	-1,177e-11	47,204

Counterbore with Nut-2

Entities: 2 edge(s)
Type: Bolt(Head/Nut diameter)(Count
erbore)

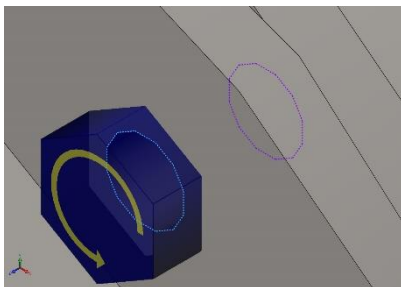
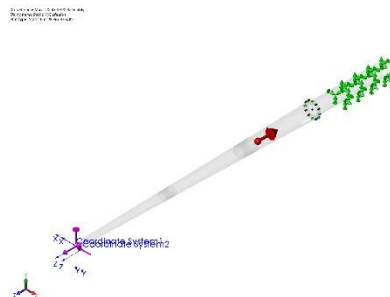
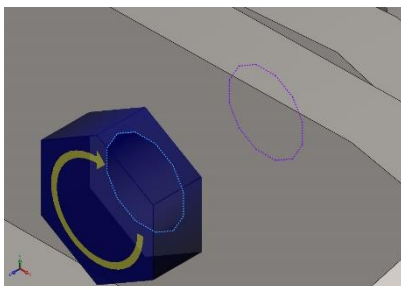
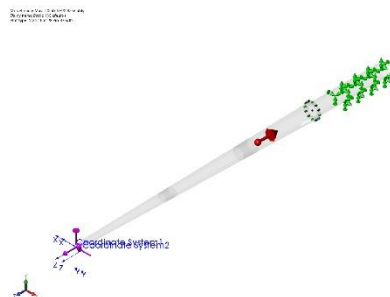
Head diameter: 65 mm
Nut diameter: 65 mm
Nominal shank diameter: 42 mm
Preload (Torque): 3.200
Young's modulus: 2,1e+11
Poisson's ratio: 0,28
Preload units: N.m

Bolt Check:	OK
Calculated FOS:	1,51901
Desired FOS:	1,35

Simulation - 1.00

Connector Forces

Type	X-Component	Y-Component	Z-Component	Resultant
Axial Force (N)	0	0	4,4041e+05	4,4041e+05
Shear Force (N)	392,61	6.265,7	0	6.277,9
Bending moment (N.m)	175,81	49,499	0	182,65

 Counterbore with Nut-3	Entities: 2 edge(s) Type: Bolt(Head/Nut diameter)(Count erbore) Head diameter: 65 mm Nut diameter: 65 mm Nominal shank diameter: 42 mm Preload (Torque): 3.200 Young's modulus: 2,1e+11 Poisson's ratio: 0,28 Preload units: N.m	<table><tr><td>Bolt Check:</td><td>OK</td></tr><tr><td>Calculated FOS:</td><td>1,50612</td></tr><tr><td>Desired FOS:</td><td>1,35</td></tr></table> 	Bolt Check:	OK	Calculated FOS:	1,50612	Desired FOS:	1,35														
Bolt Check:	OK																					
Calculated FOS:	1,50612																					
Desired FOS:	1,35																					
Connector Forces																						
<table><tr><th>Type</th><th>X-Component</th><th>Y-Component</th><th>Z-Component</th><th>Resultant</th></tr><tr><td>Axial Force (N)</td><td>0</td><td>0</td><td>4,3071e+05</td><td>4,3071e+05</td></tr><tr><td>Shear Force (N)</td><td>-5.559,1</td><td>6.374</td><td>0</td><td>8.457,7</td></tr><tr><td>Bending moment (N.m)</td><td>187,13</td><td>193,82</td><td>0</td><td>269,41</td></tr></table>	Type	X-Component	Y-Component	Z-Component	Resultant	Axial Force (N)	0	0	4,3071e+05	4,3071e+05	Shear Force (N)	-5.559,1	6.374	0	8.457,7	Bending moment (N.m)	187,13	193,82	0	269,41		
Type	X-Component	Y-Component	Z-Component	Resultant																		
Axial Force (N)	0	0	4,3071e+05	4,3071e+05																		
Shear Force (N)	-5.559,1	6.374	0	8.457,7																		
Bending moment (N.m)	187,13	193,82	0	269,41																		
 Counterbore with Nut-4	Entities: 2 edge(s) Type: Bolt(Head/Nut diameter)(Count erbore) Head diameter: 65 mm Nut diameter: 65 mm Nominal shank diameter: 42 mm Preload (Torque): 3.200 Young's modulus: 2,1e+11 Poisson's ratio: 0,28 Preload units: N.m	<table><tr><td>Bolt Check:</td><td>OK</td></tr><tr><td>Calculated FOS:</td><td>1,44686</td></tr><tr><td>Desired FOS:</td><td>1,35</td></tr></table> 	Bolt Check:	OK	Calculated FOS:	1,44686	Desired FOS:	1,35														
Bolt Check:	OK																					
Calculated FOS:	1,44686																					
Desired FOS:	1,35																					
Connector Forces																						
<table><tr><th>Type</th><th>X-Component</th><th>Y-Component</th><th>Z-Component</th><th>Resultant</th></tr><tr><td>Axial Force (N)</td><td>-3,1448e-07</td><td>0</td><td>4,4623e+05</td><td>4,4623e+05</td></tr><tr><td>Shear Force (N)</td><td>-8.845,9</td><td>308,09</td><td>-6,2282e-09</td><td>8.851,2</td></tr><tr><td>Bending moment (N.m)</td><td>-3,9251</td><td>293,88</td><td>-2,7662e-12</td><td>293,91</td></tr></table>	Type	X-Component	Y-Component	Z-Component	Resultant	Axial Force (N)	-3,1448e-07	0	4,4623e+05	4,4623e+05	Shear Force (N)	-8.845,9	308,09	-6,2282e-09	8.851,2	Bending moment (N.m)	-3,9251	293,88	-2,7662e-12	293,91		
Type	X-Component	Y-Component	Z-Component	Resultant																		
Axial Force (N)	-3,1448e-07	0	4,4623e+05	4,4623e+05																		
Shear Force (N)	-8.845,9	308,09	-6,2282e-09	8.851,2																		
Bending moment (N.m)	-3,9251	293,88	-2,7662e-12	293,91																		

Counterbore with Nut-5

Entities:	2 edge(s)
Type:	Bolt(Head/Nut diameter)(Count erbore)
Head diameter:	65 mm
Nut diameter:	65 mm
Nominal shank diameter:	42 mm
Preload (Torque):	3.200
Young's modulus:	2,1e+11
Poisson's ratio:	0,28
Preload units:	N.m

Bolt Check:	OK
Calculated FOS:	1,50202
Desired FOS:	1,35

12/11/2019 10:10:10 AM
12/11/2019 10:10:10 AM
12/11/2019 10:10:10 AM

Connector Forces

Type	X-Component	Y-Component	Z-Component	Resultant
Axial Force (N)	0	0	4,2717e+05	4,2717e+05
Shear Force (N)	-5.978,2	-6.426	0	8.776,9
Bending moment (N.m)	-217,43	206,73	0	300,02

Counterbore with Nut-6

Entities:	2 edge(s)
Type:	Bolt(Head/Nut diameter)(Count erbore)
Head diameter:	65 mm
Nut diameter:	65 mm
Nominal shank diameter:	42 mm
Preload (Torque):	3.200
Young's modulus:	2,1e+11
Poisson's ratio:	0,28
Preload units:	N.m

Bolt Check:	OK
Calculated FOS:	1,49696
Desired FOS:	1,35

3D model of a bolt assembly with a nut, showing a red arrow indicating the direction of the force.

Connector Forces

Type	X-Component	Y-Component	Z-Component	Resultant
Axial Force (N)	0	0	4,3568e+05	4,3568e+05
Shear Force (N)	1.980,2	-7.074,2	0	7.346,1
Bending moment (N.m)	-249,25	-59,803	0	256,32

Counterbore with Nut-7

Entities:	2 edge(s)
Type:	Bolt(Head/Nut diameter)(Count erbore)
Head diameter:	65 mm
Nut diameter:	65 mm
Nominal shank diameter:	42 mm
Preload (Torque):	3.200
Young's modulus:	2,1e+11
Poisson's ratio:	0,28
Preload units:	N.m

3D Model of a Bolt Assembly

Bolt Check:	OK
Calculated FOS:	1,52156
Desired FOS:	1,35

Connector Forces

Type	X-Component	Y-Component	Z-Component	Resultant
Axial Force (N)	0	-3,9067e-07	4,3294e+05	4,3294e+05
Shear Force (N)	6.033,3	133,83	1,1642e-10	6.034,8
Bending moment (N.m)	6,4559	-224,85	-2,0289e-10	224,94

Counterbore with Nut-8

Entities:	2 edge(s)
Type:	Bolt(Head/Nut diameter)(Count erbre)
Head diameter:	65 mm
Nut diameter:	65 mm
Nominal shank diameter:	42 mm
Preload (Torque):	3.200
Young's modulus:	2,1e+11
Poisson's ratio:	0,28
Preload units:	N.m

Bolt Check:	OK
Calculated FOS:	1,49406
Desired FOS:	1,35

3D model of a bolt assembly

Connector Forces

Type	X-Component	Y-Component	Z-Component	Resultant
Axial Force (N)	0	0	4,3675e+05	4,3675e+05
Shear Force (N)	2.668,1	6.307,5	0	6.848,6
Bending moment (N.m)	241,11	-84,273	0	255,42

Counterbore with Nut-9

Entities: 2 edge(s)
Type: Bolt(Head/Nut diameter)(Count erbores)

Head diameter: 65 mm
Nut diameter: 65 mm
Nominal shank diameter: 42 mm
Preload (Torque): 3.200
Young's modulus: 2,1e+11
Poisson's ratio: 0,28
Preload units: N.m

12/11/2014 10:10:10 AM
12/11/2014 10:10:10 AM
12/11/2014 10:10:10 AM

Bolt Check:	OK
Calculated FOS:	1,4588
Desired FOS:	1,35

Connector Forces

Type	X-Component	Y-Component	Z-Component	Resultant
Axial Force (N)	0	0	4,3895e+05	4,3895e+05
Shear Force (N)	-5.882,8	6.145,8	0	8.507,6
Bending moment (N.m)	235,42	208,51	0	314,48

Counterbore with Nut-10

Entities: 2 edge(s)
Type: Bolt(Head/Nut diameter)(Count erbores)

Head diameter: 65 mm

Nut diameter: 65 mm

Nominal shank diameter: 42 mm

Preload (Torque): 3.200

Young's modulus: 2,1e+11

Poisson's ratio: 0,28

Preload units: N.m

Bolt Check:	OK
Calculated FOS:	1,47363
Desired FOS:	1,35

3D model of a mast assembly with a red arrow indicating a force or moment.

Connector Forces

Type	X-Component	Y-Component	Z-Component	Resultant
Axial Force (N)	5,1806e-09	0	4,4134e+05	4,4134e+05
Shear Force (N)	-8.174,6	-419,99	1,1642e-10	8.185,4
Bending moment (N.m)	-12,803	267,92	1,5028e-13	268,23

Counterbore with Nut-11

Entities: 2 edge(s)
Type: Bolt(Head/Nut diameter)(Counterbore)

Head diameter: 65 mm
Nut diameter: 65 mm
Nominal shank diameter: 42 mm
Preload (Torque): 3.200
Young's modulus: 2,1e+11
Poisson's ratio: 0,28
Preload units: N.m

Result of the Bolt Check: OK
Desired FOS: 1,35
Calculated FOS: 1,47767

Connector Forces

Type	X-Component	Y-Component	Z-Component	Resultant
Axial Force (N)	0	0	4,4374e+05	4,4374e+05
Shear Force (N)	-4.852,5	-5.313,2	0	7.195,6
Bending moment (N.m)	-149,4	193,72	0	244,64

Counterbore with Nut-12

Entities: 2 edge(s)
Type: Bolt(Head/Nut diameter)(Counterbore)

Head diameter: 65 mm
Nut diameter: 65 mm
Nominal shank diameter: 42 mm
Preload (Torque): 3.200
Young's modulus: 2,1e+11
Poisson's ratio: 0,28
Preload units: N.m

Bolt Check:	OK
Calculated FOS:	1,51419
Desired FOS:	1,35

Simulation Results

Connector Forces

Type	X-Component	Y-Component	Z-Component	Resultant
Axial Force (N)	0	0	4,4114e+05	4,4114e+05
Shear Force (N)	144,35	-6.232,5	0	6.234,1
Bending moment (N.m)	-159,53	98,451	0	187,47

Contact Informatie

Contact	Contact Image	Contact Properties		
Contact Set-1		Type: Bonded contact pair Entities: 24 face(s)		
Contact/Friction force				
Components	X	Y	Z	Resultant
Contact Force(N)	-8,1498E+07	2.611,6	2,2256E+06	8,1528E+07
Contact Set-2		Type: Bonded contact pair Entities: 24 face(s)		
Contact/Friction force				
Components	X	Y	Z	Resultant
Contact Force(N)	1,0709E+08	-21.533	-2,9116E+06	1,0713E+08
Global Contact		Type: No penetration (Surface to surface) Components: 1 component(s)		

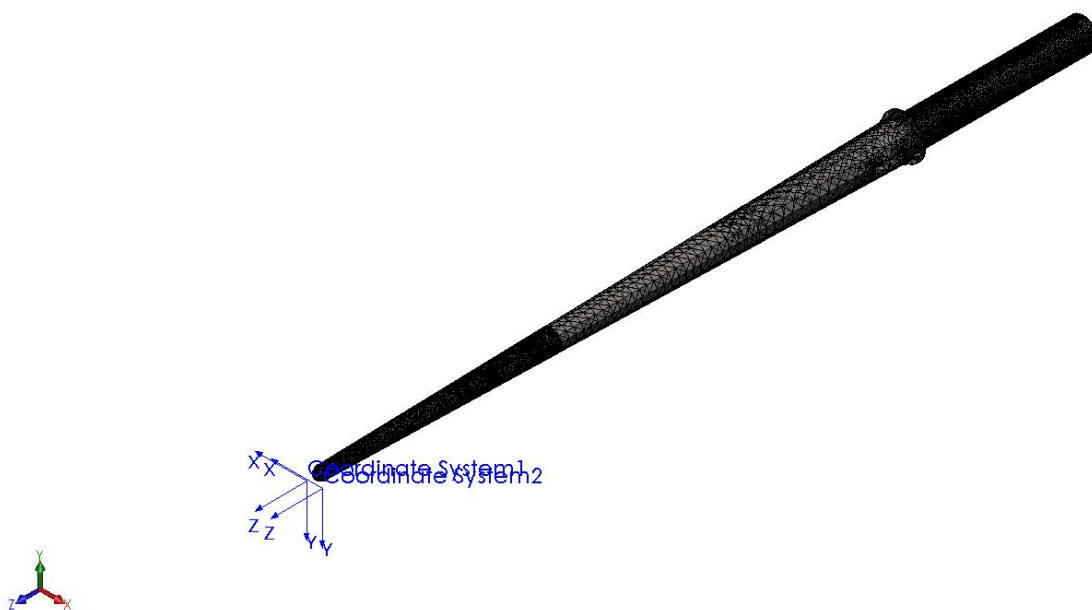
Mesh informatie

Mesh type	Solid Mesh
Mesher Used:	Curvature-based mesh
Jacobian points	4 Points
Maximum element size	281,051 mm
Minimum element size	56,2101 mm
Mesh Quality Plot	High
Remesh failed parts with incompatible mesh	Off

Mesh informatie details

Total Nodes	133810
Total Elements	66369
Maximum Aspect Ratio	112,62
% of elements with Aspect Ratio < 3	6,28
% of elements with Aspect Ratio > 10	37,9
% of distorted elements(Jacobian)	0
Time to complete mesh(hh:mm:ss):	00:00:12
Computer name:	BETTINK-NB33

Model name: Mast 20mtr REV2 Assembly
 Study name: Static 1(-Default-)
 Mesh type: Solid Mesh



Mesh Control Information:

Mesh Control Name	Mesh Control Image	Mesh Control Details
Control-1	 Mesh: Mast 20mtr REV2 Assembly Control-1: 1 Solid Body (s) Units: mm Size: 67,2078 Ratio: 67,2078	Entities: 1 Solid Body (s) Units: mm Size: 67,2078 Ratio: 67,2078
Control-2	 Mesh: Mast 20mtr REV2 Assembly Control-2: 1 Solid Body (s) Units: mm Size: 71,7901 Ratio: 71,7901	Entities: 1 Solid Body (s) Units: mm Size: 71,7901 Ratio: 71,7901

Resultante Krachten

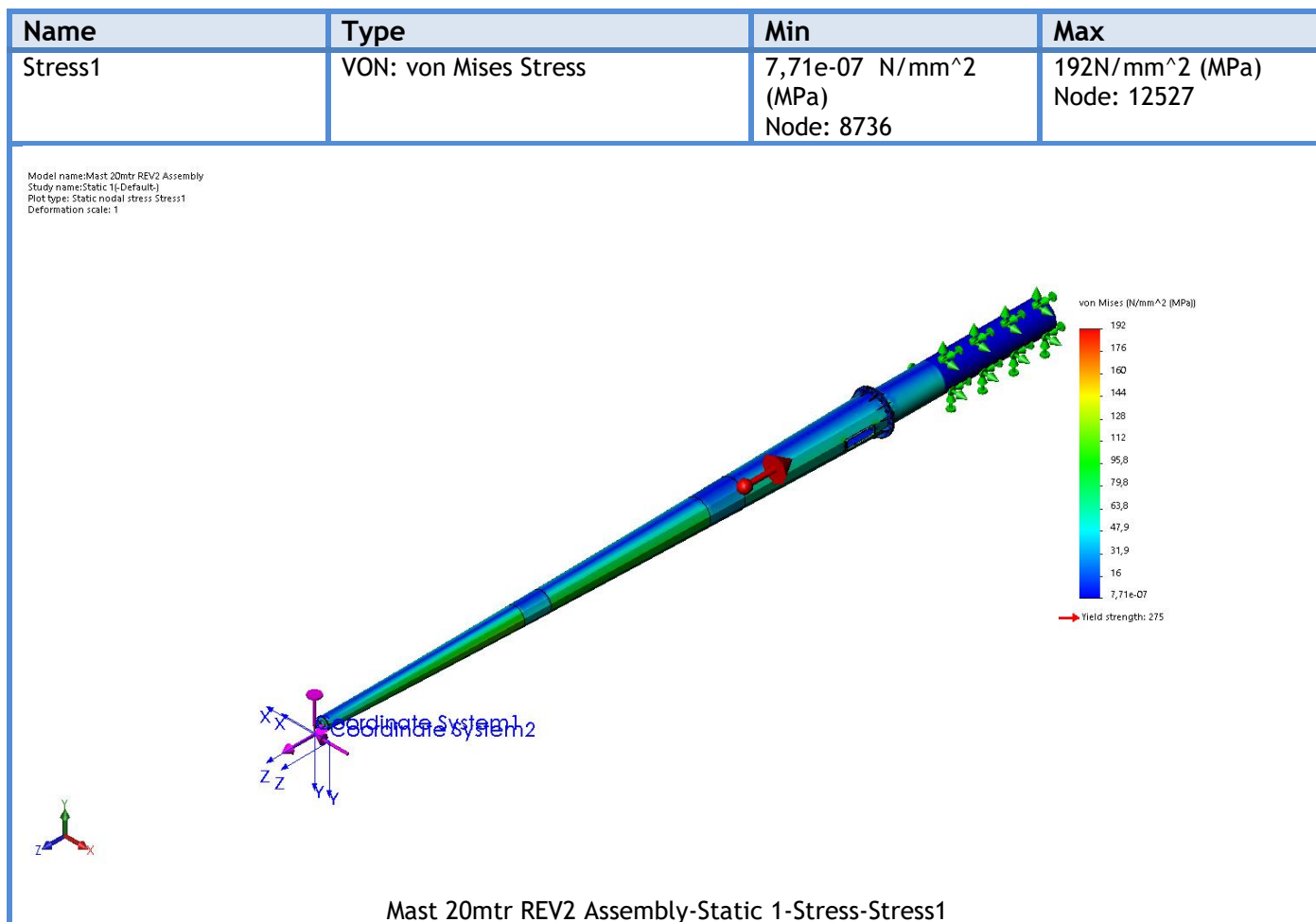
Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	24.120,1	-0,00950834	40.417,4	47.067,5

Reaction Moments

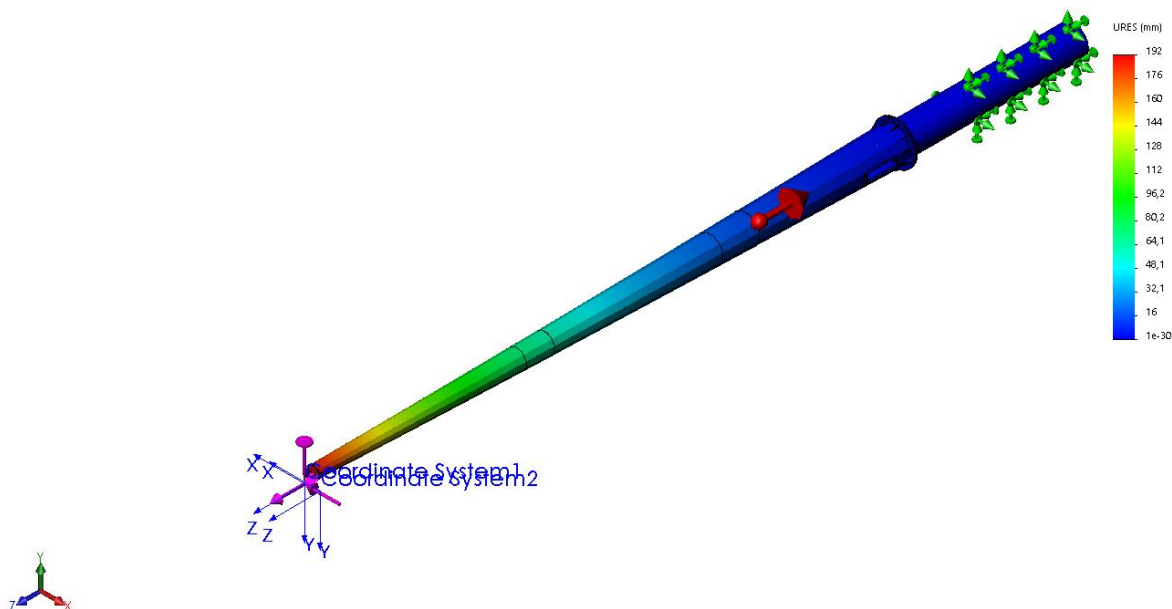
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

Studie Resultaten



Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0mm Node: 1	192mm Node: 92210

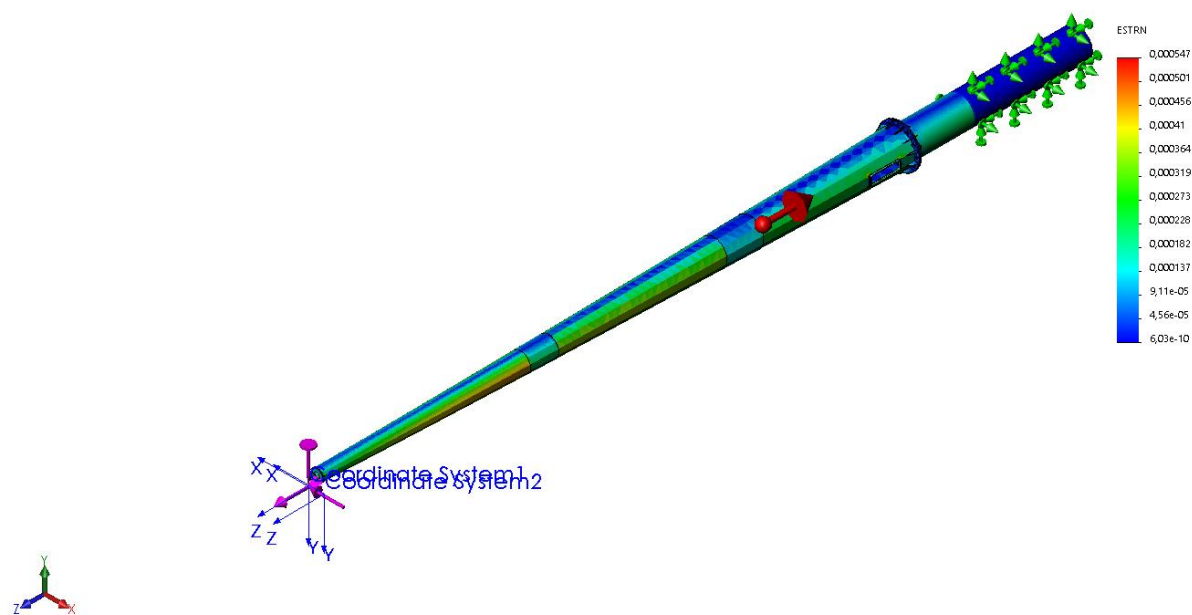
Model name: Mast 20mtr REV2 Assembly
 Study name: Static 1(-Default-)
 Plot type: Static displacement Displacement1
 Deformation scale: 1



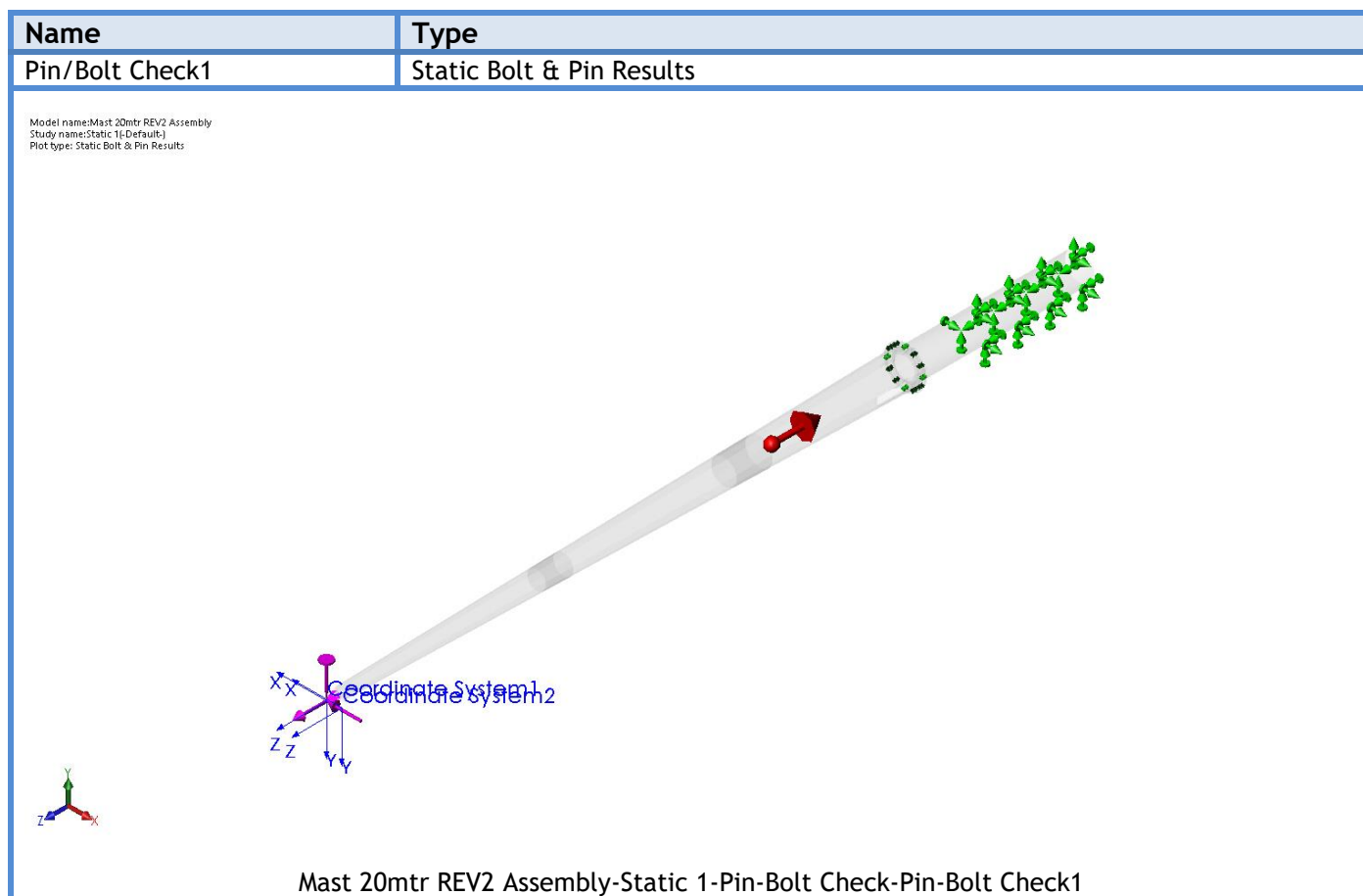
Mast 20mtr REV2 Assembly-Static 1-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	6,03e-10 Element: 10223	0,000547 Element: 16268

Model name: Mast 20mtr REV2 Assembly
 Study name: Static 1(-Default-)
 Plot type: Static strain Strain1
 Deformation scale: 1



Mast 20mtr REV2 Assembly-Static 1-Strain-Strain1



Conclusie

De spanningsreserve is gelijk aan de rekgrens / ($gF \cdot \sigma$) = $275 / (1.35 \cdot 192) = 1,06$.
Deze is groter dan 1 dus de toren is statisch goedgekeurd