



i Calculation without errors.

ii Project information

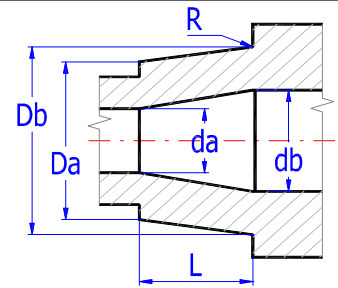
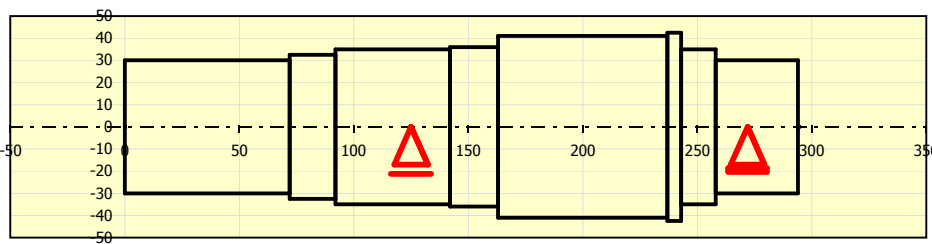
? Input section

1.0 Preliminary shaft diameter design

1.1 Calculation units	SI Units (N, mm, kW...)		1.6 Type of shaft load
1.2 Transmitted power	9.60	[kW]	C...Repeated torsion + bending
1.3 Shaft speed	116.5310732	[/min]	1.7 Material of the shaft
1.4 Torsion moment	787.02	[Nm]	B...Structural steel with increased strength (850)
1.5 Preliminary min. diameter	67.04	[mm]	

2.0 Shaft shape and dimensions

2.1 The scale of the displayed shaft diameter.  Calculation units SI Units (N, mm, kW...)



2.2 Table	1	2	3	4	5	6	7	8	9	10
Origin	0.00	72.00	92.00	142.00	163.00	237.00	243.00	258.00	294.00	294.00
L	72.000	20.000	50.000	21.000	74.000	6.000	15.000	36.000		
ø Da	60.000	65.000	70.000	72.000	82.000	85.000	70.000	60.000		
ø Db	60.000	65.000	70.000	72.000	82.000	85.000	70.000	60.000		
ø da	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
ø db	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
R	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

2.3 Total length of the shaft	294.00	[mm]	2.6 The shaft surface (Roughness Ra)
2.4 X-coordinate of the left support (bearing)	Free	125.00	○ [mm]
2.5 X-coordinate of the right support (bearing)	Fixed	272.00	● [mm]
			D...Turned (1.6)

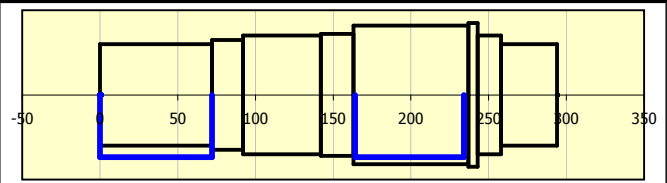
3.0 Notches and necking-down on the shaft

3.1 The ultimate tensile strength (Su, Rm) 635.0  [MPa]

3.2 Notch sensitivity factor (q) 0.45

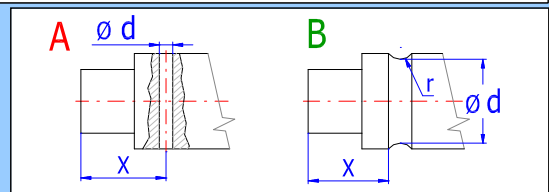
3.3 A. Transverse hole

X[mm]	d[mm]	β c	β b	β t
		1.00	1.00	1.00
		1.00	1.00	1.00



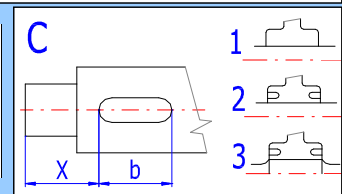
3.4 B. Necking-down

X[mm]	d[mm]	r[mm]	β c	β b	β t
			1.00	1.00	1.00
			1.00	1.00	1.00
			1.00	1.00	1.00



3.5 C. General notch

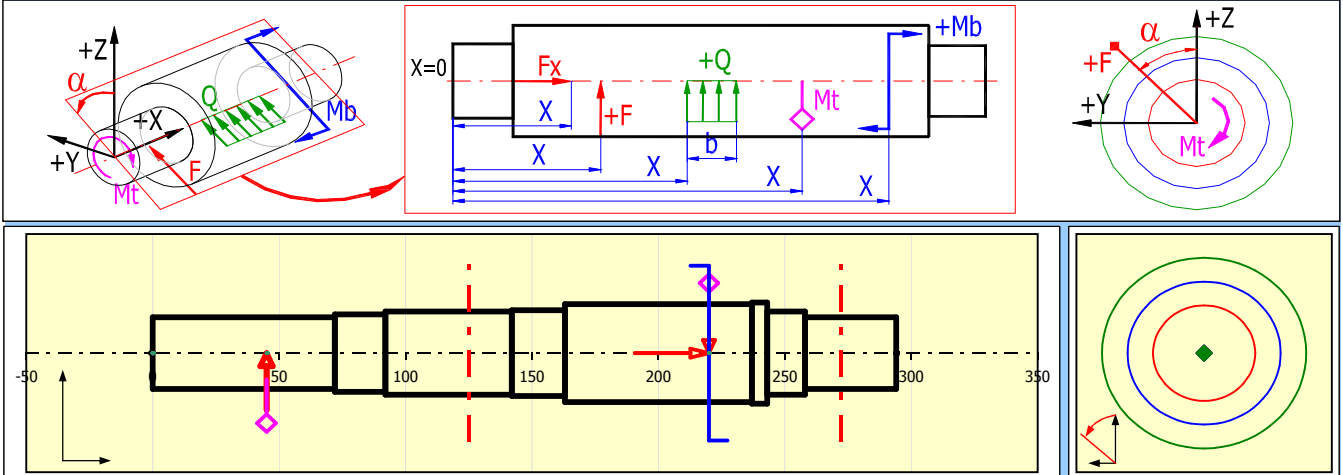
X[mm]	b[mm]	β c	β b	β t	
0.00	72.00	2.36	2.36	1.55	Straight-sided splines
164.00	70.00	2.36	2.36	1.55	Straight-sided splines
		1.00	1.00	1.00	User values
		1.00	1.00	1.00	User values
		1.00	1.00	1.00	User values



3.6 D. Rounding between cylindrical sections of the shaft

	1	2	3	4	5	6	7	8	9
β c	1.74	1.75	1.53	1.95	1.63	2.04	1.90	1.00	1.00
β b	1.66	1.67	1.45	1.83	1.57	1.89	1.78	1.00	1.00
β t	1.31	1.32	1.22	1.40	1.27	1.44	1.39	1.00	1.00

#### 4.0 Loading of the shaft



#### 4.1 Loading

	X	Fx	F	alfa	Mt	Mb	alfa	Q	b	alfa
	[mm]	[N]		[°]	[Nm]		[°]	[N/mm]	[mm]	[°]
1	45.00	0.0	9108.9	180	787.02	0.00				
2	220.00	982.9	-2060.3	90	-787.02	-144.00	90			
3										
4										
5										
6										
7										
8										
9										
10										

#### 5.0 Rotating masses

#### 6.0 Material and the type of loading

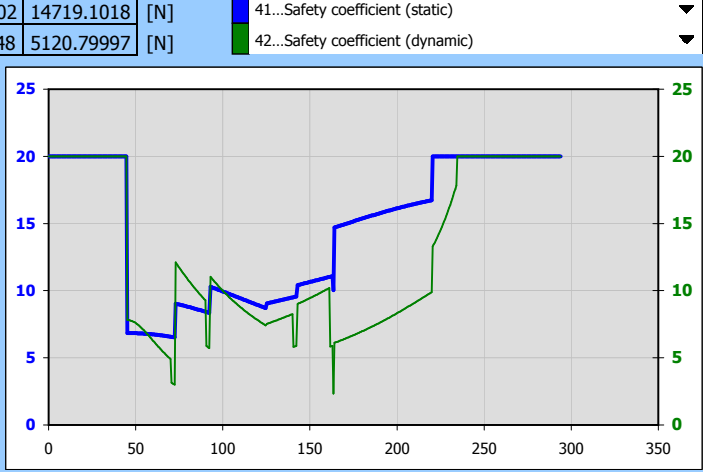
6.1 Shaft material (Ultimate tensile strength min-max)	B...Refined and alloyed steel (500 - 1400)		635	[MPa]	6.17 Dead load	Yes
6.2 Ultimate tensile strength	Su/Rm	635	[MPa]	<input checked="" type="checkbox"/>	6.18 Max. displayed coefficient of safety	20
6.3 Yield strength in tension	Sv/Re	413	[MPa]		6.19 Stress ratio factor	$\alpha_0$ 0.85 <input checked="" type="checkbox"/>
6.4 Yield strength in bending	Syb/Reb	495	[MPa]		6.20 Coefficient of maximum loading	
6.5 Yield strength in shear	Sys/Res	289	[MPa]		6.21 Bending	1.70
6.6 For reversed loading					6.22 Radial load	1.70
6.7 Fatigue limit - tension-pressu	$\sigma_c$	229	[MPa]		6.23 Torsion	1.70
6.8 Fatigue limit - bending	$\sigma_{ec}$	305	[MPa]		6.24 Tension/Compression	1.70
6.9 Fatigue limit - torsion	$\tau_c$	191	[MPa]		6.25 Loading conditions	
6.10 For cyclic loading					6.26 Loading from bending moment	C...Reversed <input type="checkbox"/>
6.11 Fatigue limit - tension-pressu	$\sigma_{nc}$	343	[MPa]		6.27 Loading from radial force	C...Reversed <input type="checkbox"/>
6.12 Fatigue limit - bending	$\sigma_{enc}$	457	[MPa]		6.28 Load from torsional moment	B...Repeated <input type="checkbox"/>
6.13 Fatigue limit - torsion	$\tau_{nc}$	267	[MPa]		6.29 Loading from tension/pressure force	B...Repeated <input type="checkbox"/>
6.14 Specific mass	Ro	7850.0	[kg/m <sup>3</sup> ]		6.30 Dynamic strength check	
6.15 Modulus of elasticity in tensi	E	210000	[MPa]		6.31 Impact from shaft surface	Yes <input type="checkbox"/>
6.16 Modulus of elasticity in shear	G	80000	[MPa]		6.32 Impact from shaft size	Yes <input type="checkbox"/>
					6.33 Impact from stress concentration (notch)	Yes <input type="checkbox"/>

**Results section**

**7.0 Results - summary**

	x	y	z	$\Sigma y+z$	
7.1 Reaction in the support R1	0	1766.70427	14612.6902	14719.1018	[N]
7.2 Reaction in the support R2	-1016.4917	363.883629	-5107.8548	5120.79997	[N]
7.3 Total shaft weight	m	8.90			[kg]
7.4 Maximum deflection	y	0.0290			[mm]
7.5 Maximum angular deflection	$\varphi$	0.0460			[°]
7.6 Angular deflection in R1	$\vartheta$	0.0070			[°]
7.7 Angular deflection in R2	$\vartheta$	0.0030			[°]
7.8 Max. bending stress	$\sigma_e$	22.4			[MPa]
7.9 Max. stress in shear	$\tau_s$	3.5			[MPa]
7.10 Max. stress in torsion	$\tau_t$	21.3			[MPa]
7.11 Max. stress in tension/pressu	$\sigma_g$	0.4			[MPa]
7.12 Max. equivalent stress	$\sigma_r$	39.0			[MPa]
7.13 Min. static safety	SF <sub>st</sub>	6.52			
7.14 Min. dynamic safety	SF <sub>D</sub>	2.34			
7.15 Critical speed (A)	$n_c$	0.0			[/min]
Critical speed (B)	$n_c$	178060.4			[/min]
Critical speed (C)	$n_c$	135522.2			[/min]

7.17 Graph



Shaft freely rotating in bearings, rotating disc between the bearings (K=1)

7.16 Results for X co-ordinate	174.63	1371.60	1397.00	2095.50	2127.25	2127.25	2127.25	2127.25
04...Z - Deflection [mm]	0.00282303	-0.0011402	-0.0011402	-0.0011402	-0.0011402	-0.0011402	-0.0011402	-0.0011402
42...Safety coefficient (dynamic)	6.63344334	20	20	20	20	20	20	20
31...Total coefficient - bending	4.14398595	1.65700083	1.65700083	1.65700083	1.65700083	1.65700083	1.65700083	1.65700083
42...Safety coefficient (dynamic)	6.63344334	20	20	20	20	20	20	20
43...Empty graph	0	0	0	0	0	0	0	0

- 8.0 Graph - Deflection, Bending angle**
- 9.0 Graph - Bending moment, Bending stress**
- 10.0 Graph - Radial force, Stress in shear**
- 11.0 Graph - Axial force, Torsional moment**
- 12.0 Graph - Torsional angle, Reduced stress, Safety coefficient**
- 13.0 Graphical output, CAD systems**