1. $σ\_{e}=280MPa k=2 Mf=5KN$

$$I=\sqrt[3]{\frac{6.Mf.k}{σ\_{e}}}=\sqrt[3]{\frac{6.5000.2}{280.10^{6}}}=0,05984=59,84 mm$$

1. $σ\_{e}=300MPa k=3 Mf=10KN$

$$I=\sqrt[3]{\frac{6.Mf.k}{σ\_{e}}}=\sqrt[3]{\frac{6.10000.3}{300.10^{6}}}=0,08434=84,34 mm$$

1. $σ\_{e}=360MPa k=3 Mf=6KN$

$$I=\sqrt[3]{\frac{6.Mf.k}{σ\_{e}}}=\sqrt[3]{\frac{6.6000.3}{360.10^{6}}}=0,06694=66,94 mm$$

1. $σ\_{e}=220MPa k=2 Mf=5KN$

$$I=\sqrt[3]{\frac{6.Mf.k}{σ\_{e}}}=\sqrt[3]{\frac{6.5000.2}{220.10^{6}}}=0,06484=64,84 mm$$

1. $σ\_{e}=130MPa k=2 Mf=10,31KN$

$$I=\sqrt[3]{\frac{32.Mf.k}{π.σ\_{e}}}=\sqrt[3]{\frac{32.10310.2}{π.130.10^{6}}}=0,11734=117,34 mm$$

1. $σ\_{e}=10MPa k=1,5 Mf=4,66KN$

$$I=\sqrt[3]{\frac{32.Mf.k}{π.σ\_{e}}}=\sqrt[3]{\frac{32.4660.1,5}{π.10.10^{6}}}=0,19237=192,37 mm$$

1. $σ\_{e}=650MPa k=3 Mf=15KN$

$$I=\sqrt[3]{\frac{32.Mf.k}{π.σ\_{e}}}=\sqrt[3]{\frac{32.15000.3}{π.650.10^{6}}}=0,08900=89,01 mm$$

1. $σ\_{e}=50MPa k=2 Mf=2KN$

$$I=\sqrt[3]{\frac{32.Mf.k}{π.σ\_{e}}}=\sqrt[3]{\frac{32.2000.2}{π.50.10^{6}}}=0,09340=93,40 mm$$

1. $σ\_{e}=360MPa k=2 Mf=3KN x=\frac{h}{b}=1,8$

$$d=\sqrt[3]{\frac{6.Mf.k}{x^{2}.σ\_{e}}}=\sqrt[3]{\frac{6.3000.2}{1,8^{2}.360.10^{6}}}=0,03136=31,36 mm$$

$$h=x.b=1,8.31,36=56,448 mm$$

1. $σ\_{e}=130MPa k=1,3 Mf=5,46KN x=\frac{h}{b}=2$

$$d=\sqrt[3]{\frac{6.Mf.k}{x^{2}.σ\_{e}}}=\sqrt[3]{\frac{6.5460.1,3}{2^{2}.130.10^{6}}}=0,04342=43,42 mm$$

$$h=x.b=2.41,42=86,84 mm$$

1. $σ\_{e}=40MPa k=2,5 Mf=7,5KN x=\frac{h}{b}=3$

$$d=\sqrt[3]{\frac{6.Mf.k}{x^{2}.σ\_{e}}}=\sqrt[3]{\frac{6.7500.2,5}{3^{2}.130.10^{6}}}=0,06786=67,86 mm$$

$$h=x.b=3.67,86=203,58 mm$$

1. $σ\_{e}=220MPa k=2 Mf=7,5KN x=\frac{h}{b}=2,4$

$$d=\sqrt[3]{\frac{6.Mf.k}{x^{2}.σ\_{e}}}=\sqrt[3]{\frac{6.7500.2}{2,4^{2}.220.10^{6}}}=0,04141=41,41 mm$$

$$h=x.b=2,4.41,41=99,38 mm$$

1. $σ\_{e}=50MPa k=2,2 Mf=4,5KN y=\frac{d}{D}=0,5$

$$D=\sqrt[3]{\frac{32.Mf.k}{π.\left(1-y^{4}\right).σ\_{e}}}=\sqrt[3]{\frac{32.4500.2,2}{π.\left(1-0,5^{4}\right).50.10^{6}}}=0,12909=129,09 mm$$

$$d=y.D=0,5.129,09=64,54 mm$$

1. $σ\_{e}=130MPa k=3 Mf=6,57KN y=\frac{d}{D}=0,55$

$$D=\sqrt[3]{\frac{32.Mf.k}{π.\left(1-y^{4}\right).σ\_{e}}}=\sqrt[3]{\frac{32.6570.3}{π.\left(1-0,55^{4}\right).130.10^{6}}}=0,11934=119,34 mm$$

$$d=y.D=0,55.119,34=65,63 mm$$

1. $σ\_{e}=80MPa k=2,2 Mf=4,25KN y=\frac{d}{D}=0,7$

$$D=\sqrt[3]{\frac{32.Mf.k}{π.\left(1-y^{4}\right).σ\_{e}}}=\sqrt[3]{\frac{32.4250.2,2}{π.\left(1-0,7^{4}\right).80.10^{6}}}=0,11614=116,14 mm$$

$$d=y.D=0,7.116,14=81,30 mm$$

1. $σ\_{e}=360MPa k=1,3000 Mf=14KN y=\frac{d}{D}=0,8$

$$D=\sqrt[3]{\frac{32.Mf.k}{π.\left(1-y^{4}\right).σ\_{e}}}=\sqrt[3]{\frac{32.14000.1,3000}{π.\left(1-0,8^{4}\right).360.10^{6}}}=0,09554=95,54 mm$$

$$d=y.D=0,8.95,54=76,44 mm$$

1. $σ\_{e}=360MPa k=1,5 Mf=20KN z=\frac{b}{a}=0,7$

$$D=\sqrt[3]{\frac{6.Mf.k}{σ\_{e.(1-z^{4})}}}=\sqrt[3]{\frac{6.20000.1,5}{360.10^{6}.\left(1-0,7^{4}\right)}}=0,08698=86,98 mm$$

$$b=z.a=0,7.86,98=60,88 mm$$

1. $σ\_{e}=450MPa k=2 Mf=3,5KN z=\frac{b}{a}=0,8$

$$D=\sqrt[3]{\frac{6.Mf.k}{σ\_{e.(1-z^{4})}}}=\sqrt[3]{\frac{6.3500.2}{450.10^{6}.\left(1-0,8^{4}\right)}}=0,05407=54,07 mm$$

$$b=z.a=0,8.54,07=43,26 mm$$

1. $σ\_{e}=360MPa k=2,5 Mf=4KN z=\frac{b}{a}=0,7$

$$D=\sqrt[3]{\frac{6.Mf.k}{σ\_{e.(1-z^{4})}}}=\sqrt[3]{\frac{6.4000.2,5}{360.10^{6}.\left(1-0,7^{4}\right)}}=0,05407=60,31 mm$$

$$b=z.a=0,7.60,31=42,21 mm$$

1. $σ\_{e}=280MPa k=3,5 Mf=6,5KN z=\frac{b}{a}=0,5$

$$D=\sqrt[3]{\frac{6.Mf.k}{σ\_{e.(1-z^{4})}}}=\sqrt[3]{\frac{6.6500.3,5}{280.10^{6}.\left(1-0,5^{4}\right)}}=0,080,41=80,41 mm$$

$$b=z.a=0,5.80,41=40,21 mm$$

1. $σ\_{e}=180MPa Mf=5,625KN $

$$w\_{z}=\frac{k.Mf}{σ\_{e}}=\frac{1.5625}{180x10^{6}}=0,00003125=31,25 mm^{3}$$

$$W\_{z}=32 cm^{3}$$

$$Perfil selecionado=76,2x63,7 mm$$

1. $σ\_{e}=180MPa Mf=7KN $

$$w\_{z}=\frac{k.Mf}{σ\_{e}}=\frac{1.7000}{180x10^{6}}=0,00003889=38,89 mm^{3}$$

$$W\_{z}=71,7 cm^{3}$$

$$Perfil selecionado=152,4x48,8 mm$$

1. $σ\_{e}=180MPa Mf=4,1KN $

$$w\_{z}=\frac{k.Mf}{σ\_{e}}=\frac{1.4100}{180x10^{6}}=0,00002278=22,78 mm^{3}$$

$$W\_{z}=24,6 cm^{3}$$

$$Perfil selecionado=101,6x9,53 mm$$

1. $σ\_{e}=180MPa Mf=11,4KN $

$$w\_{z}=\frac{k.Mf}{σ\_{e}}=\frac{1.1140}{180x10^{6}}=0,00006333=63,33 mm^{3}$$

$$W\_{z}=64 cm^{3}$$

$$Perfil selecionado=127x15,88 mm$$

1. $σ\_{e}=280MPa Mfn=1,8p k=2 Seção quadrada l=85 mm $

$$P=\frac{σ\_{e}.l^{3}}{6.k.n}=\frac{280x10^{6}.85^{3}}{6.2.1,8}=7960,88 N$$

1. $σ\_{e}=300MPa Mfn=1p k=2 Seção circular d=70 mm $

$$P=\frac{σ\_{e}.π.d^{3}}{32.k.n}=\frac{300x10^{6}.π.70^{3}}{32.2.1}=5051,09 N$$

1. $σ\_{e}=360MPa Mfn=4p k=2,5 Seção retangular b=90 mm h=120 mm $

$$P=\frac{σ\_{e}.b.h^{2}}{6.k.n}=\frac{360x10^{6}.90.120^{2}}{6.2,541}=7776 N$$

1. $σ\_{e}=280MPa Mfn=3p k=1,5 Seção tubular D=80 mm d=65 mm $

$$P=\frac{σ\_{e}.π.\left(D^{4}-d^{4}\right)}{32.D.k.n}=\frac{280x10^{6}.π.\left(80^{4}-65^{4}\right)}{32.80.1,5.3}=1764,59 N$$

1. $σ\_{e}=450MPa Mfn=10,5p k=3 Seção caixão a=80 mm b=60 mm $

$$P=\frac{σ\_{e}.\left(a^{4}-b^{4}\right)}{6.a.k.n}=\frac{450x10^{6}.\left(80^{4}-60^{4}\right)}{6.80.3.10,5}=833,33 N$$

1. $σ\_{e}=180MPa Mfn=2p k=2 Wx=52,4 cm^{3} $

$$P=\frac{σ\_{e}.Wx}{k.n}=\frac{180x10^{6}.52,4}{2.2}=2358 N$$

1. $σ\_{e}=180MPa Mfn=2,1p k=1,5 Wx=82,9 cm^{3} $

$$P=\frac{σ\_{e}.Wx}{k.n}=\frac{180x10^{6}.82,9}{1,5.2,1}=4737,14 N$$

1. $σ\_{e}=180MPa Mfn=1,8p k=2 Wx=38 cm^{3} $

$$P=\frac{σ\_{e}.Wx}{k.n}=\frac{180x10^{6}.38}{2.1,8}=1900 N$$

1. $σ\_{e}=300MPa k=2 Mf=4,5KN x=\frac{h}{b}=2 x=\frac{h}{b}=0,5$

$$b1=\sqrt[3]{\frac{6.Mf.k}{x^{2}.σ\_{e}}}=\sqrt[3]{\frac{6.4500.2}{2^{2}.300.10^{6}}}=0,03557=35,57 mm$$

$$b2=\sqrt[3]{\frac{6.Mf.k}{x^{2}.σ\_{e}}}=\sqrt[3]{\frac{6.4500.2}{0,5^{2}.300.10^{6}}}=0,08963=89,63 mm$$

$$h1=x.b=2.35,57=71,44 mm$$

$$h2=x.b=0,5.89,63=44,81 mm$$

1. $σ\_{e}=180MPa Mf=37,5KN Perfil I $

$$w\_{x}=\frac{k.Mf}{σ\_{e}}=\frac{1.37500}{180x10^{6}}=208,33 mm^{3}$$

$$W\_{x}=236 cm^{3}$$

$$Perfil selecionado=203,2x101,6 mm$$

1. $σ\_{e}=300MPa k=2,5 Mf=7KN y=\frac{d}{D}=0,8$

$$D=\sqrt[3]{\frac{32.Mf.k}{π.\left(1-y^{4}\right).σ\_{e}}}=\sqrt[3]{\frac{32.7000.2,5}{π.\left(1-0,8^{4}\right).300x10^{6}}}=0,10021=100,21 mm$$

$$d=y.D=0,8.100,21=80,17 mm$$

1. $σ\_{e}=360MPa k=1,75 Mf=12KN$

$$I=\sqrt[3]{\frac{32.Mf.k}{π.σ\_{e}}}=\sqrt[3]{\frac{32.12000.1,75}{π.360.10^{6}}}=0,08407=84,07 mm$$

1. $σ\_{e}=450MPa k=3 Mf=41KN$

$$I=\sqrt[3]{\frac{6.Mf.k}{σ\_{e}}}=\sqrt[3]{\frac{6.41000.3}{450.10^{6}}}=0,11793=117,93 mm$$

1. $σ\_{e}=280MPa k=2 Mf=8KN z=\frac{b}{a}=0,65$

$$D=\sqrt[3]{\frac{6.Mf.k}{σ\_{e.(1-z^{4})}}}=\sqrt[3]{\frac{6.8000.2}{280.10^{6}.\left(1-0,65^{4}\right)}}=74,73 mm$$

$$b=z.a=0,65.74,73=48,58 mm$$