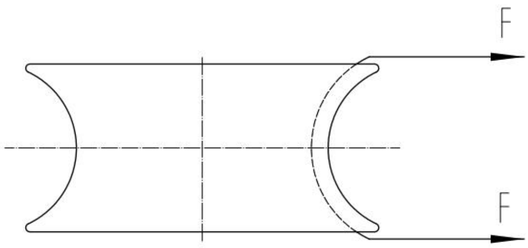
Safety Working Load Calculation Of Panama Chocks

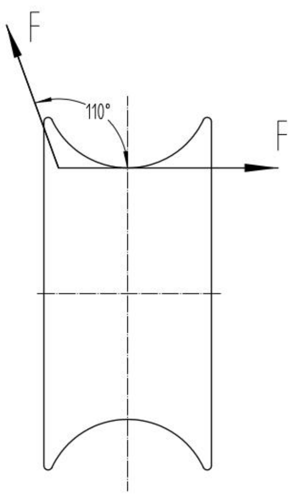
By [Zhiyou Marine]

According to *Panama Canal Authority Rules* Panama chock is a kind of mooring chock that designed and applied to marine ships for crossing Panama Canal. Compared to other chocks, the Panama chock has a slightly higher tensile strength and safety working load.

This article is conduced to show how to calculate SWL (safety working load) of Panama chocks.

1. Force analysis.





Horizontal load Vertical load

As the sketch shows above, F is 2 times mooring rope breaking load.

Following is a example calculation of AC310 model Panama chock. Dimensions of AC310 Panama chock please click here.

2. Calculation of horizontal load.

AC310 Panama chock mooring rope breaking load is 64 N.

F=2×64×9.8=1254.4N.

a. Bending moment from mooring rope to the bottom of marine chock.

M=2F×(130+180)=2×2×64×1000×310×9.8=777728000N·m.

Flexural modulus of the bottom of marine chock.

$W=W_1+W_2$

$W_1=(T\times L4^2)/6=32\times708^2/6=2673408mm^3$.

$W_2=(T\times L5^2)/6=32\times652^2/6=2267221mm^3$.

$W=W_1+W_2=2673408+2267221=4940629mm^3$.

Bending stress.

$\alpha=M/W=777728000/4940629=157.4Mpa$.

b. Shear stress from mooring rope to the bottom of marine chock.

Sectional area of marine chock bottom.

$S=708\times32+652\times32+296\times32\times2=62464mm^2$.

Shear stress.

$\tau=2\times F/S=2\times2\times64\times1000\times9.8/62454=40Mpa$.

c. Synthetic stress.

$\alpha_s=\alpha/2+((\alpha/2)^2+\tau^2)^{1/2}=78.7+88=166.7Mpa$.

Permissible stress of marine chock's material (ZG200-400).

$[\alpha]=0.85\alpha_m=0.85\times200=170Mpa$.

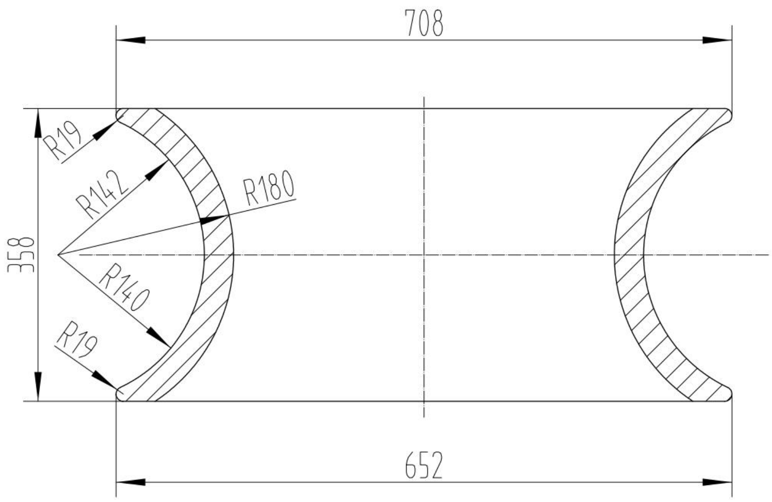
Result: $\alpha_s < [\alpha]$, horizontal load of Panama chock is satisfied.

3. Calculation of middle load.

Shear force from mooring rope to the middle of marine chock.

$T=2\times F=2\times2\times64\times1000\times9.8=2508800N$.

Sectional area shows as below:



S=2×(9305+8239)=2×17544=35088mm^2.

Shear stress.

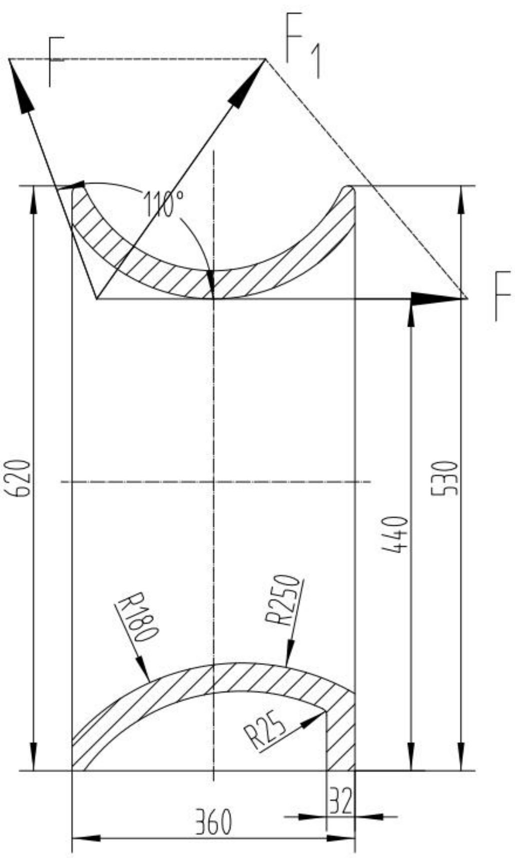
τ=T/S=2508800/35088=70Mpa.

[τ]=0.6α_m=0.6×200=120Mpa.

Result: τ < [τ], middle load of Panama chock is satisfied.

4. Calculation of vertical load.

Force detail of Panama chock bottom as below:



a. Tensile stress from mooring rope to the bottom of marine chock.

$F_1=2F\times\sin(70°/2)=2\times1254.4\times0.57=1438640N$.

Resolve F_1 to horizontal force F_2 and vertical force F_3.

Horizontal force $F_2=F_1\times\cos55°=825170N$.

Vertical force $F_3=F_1\times\sin55°=1178465N$.

Bending moment from horizontal force to the bottom of marine chock.

$M=F_2\times440=825170\times440=363074800N\cdot mm$.

Flexural modulus of the bottom of marine chock.

$W_1=(32^3\times708/12)+(32\times708\times164^2)/180=3396050mm^3$.

$W_2=(32^3\times652/12)+(32\times652\times164^2)/180=3127463mm^3$.

$W=W_1+W_2=6523486mm^3$.

Tensile stress.

$\alpha_1=M/W=363074800/6523486=55.6Mpa$.

b. Vertical tensile stress to the bottom of marine chock.

Sectional area of marine chock bottom.

$S=708\times32+652\times32+296\times32\times2=62464mm^2$.

Vertical tensile stress.

$\alpha_2=F_3/S=1178465/62464=18.8Mpa$.

c. Synthetic stress.

$\alpha=\alpha_1+\alpha_2=55.6+18.8=74.4Mpa$.

Result: $\alpha < [\alpha]$, vertical load of Panama chock is satisfied.

This calculation is a reference for designers who want to choose a suitable model of Panama chocks. More information please contact us.