Result

1.1曲面方程

$$Ax^2 + By^2 = z$$

1.2船高

$$H$$

2.1龙骨方程

$$By^2 = H$$

2.2截面方程

2.2.1 xoz平面

$$\begin{cases} Ax^2 = z \\ y = 0 \end{cases}$$

2.2.1 xoz平面

$$\begin{cases} By^2 = z \\ x = 0 \end{cases}$$

2.3甲板方程

$$Ax^2 + By^2 = H$$

3.1重心

表1 船体各部件符号表示

	字母下标	质量/kg	规格/型号 单位/m	重心/m
桅杆	a	0.110	$\phi 0.010 \times 0.500$	(0, 0, 0.312)
船体	b	0.321	$0.379 \times 0.240 \times 0.120$	(0, 0, 0.080)
重物	c	0.770	$\phi 0.020 \times 0.078$	(0, 0, 0.042)
整体	all	1.201	$0.379 \times 0.240 \times 0.120$	(0, 0, 0.053)

已知桅杆重心为$COM_a(0,0,z_{M_a})$，船体重心为$COM_b(0,0,z_{M_b})$，重物重心为$COM_c(0,0,z_{M_c})$

则整体重心为$COM_c(0,0,z_{M_{all}})$

$$z_{M_{all}} = \frac{m_a \times z_{M_a} + m_b \times z_{M_b} + m_c \times z_{M_c}}{m_a + mb + mc} \tag{1}$$

3.2倾斜135°时的浮心

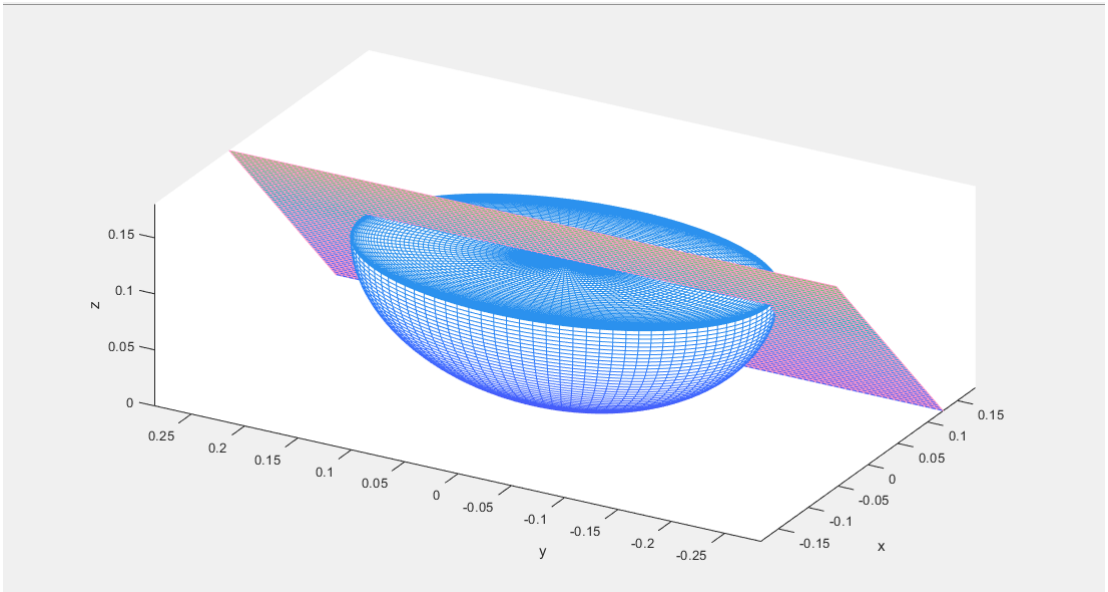

图1 船体倾斜135°时水面方程图三维视图

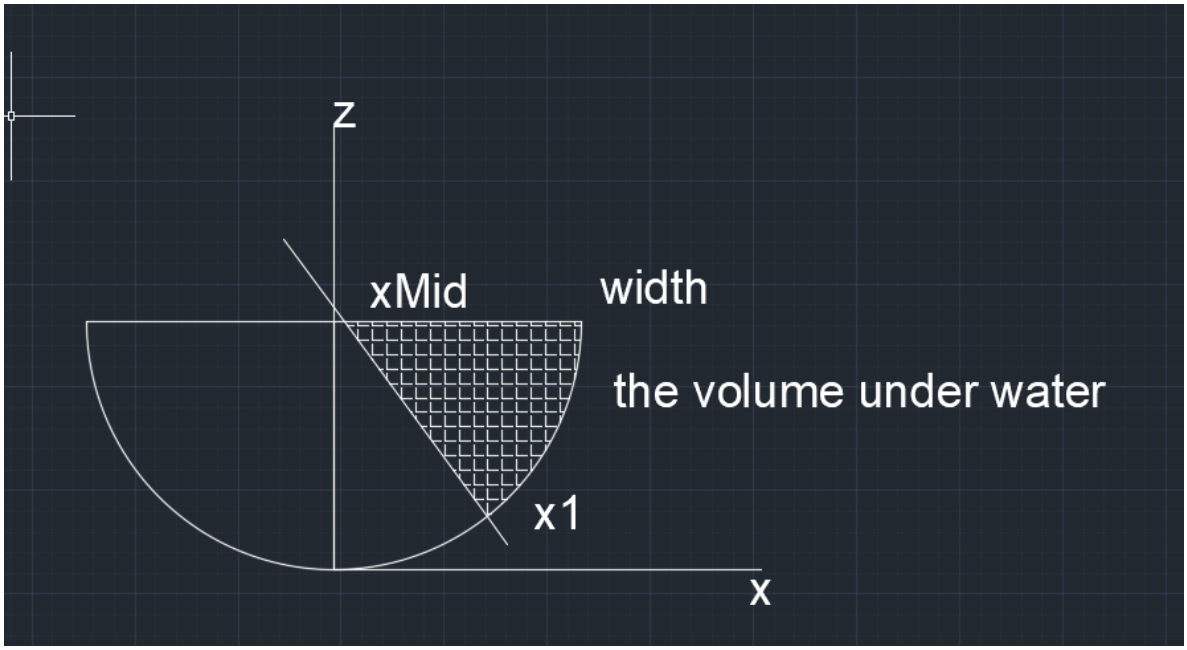

图2 船体倾斜135°时水面方程图xoz截面图

浮心计算(xb, yb, zb)

已知水面方程为$z = px + z_0$，其中$p = tan\theta$，$z_0 = \sqrt{\frac{H - Ax^2}{B}}$

有

$$x_b = \frac{2}{V} \iiint_E x dV \qquad E = \{(x,\ y,\ z) | x_{Mid} \le x \le width,\ y_0 \le y \le 0, 0 \le z \le z_0\} \tag{2}$$

$$xb = \int_{xMid}^{x_1} \int_0^{y_0} \int_{px+z_0}^{H} x dz dy dx \tag{3}$$

计算得浮心$COB = (0.061, 0, 0.097)$

3.3复原力矩

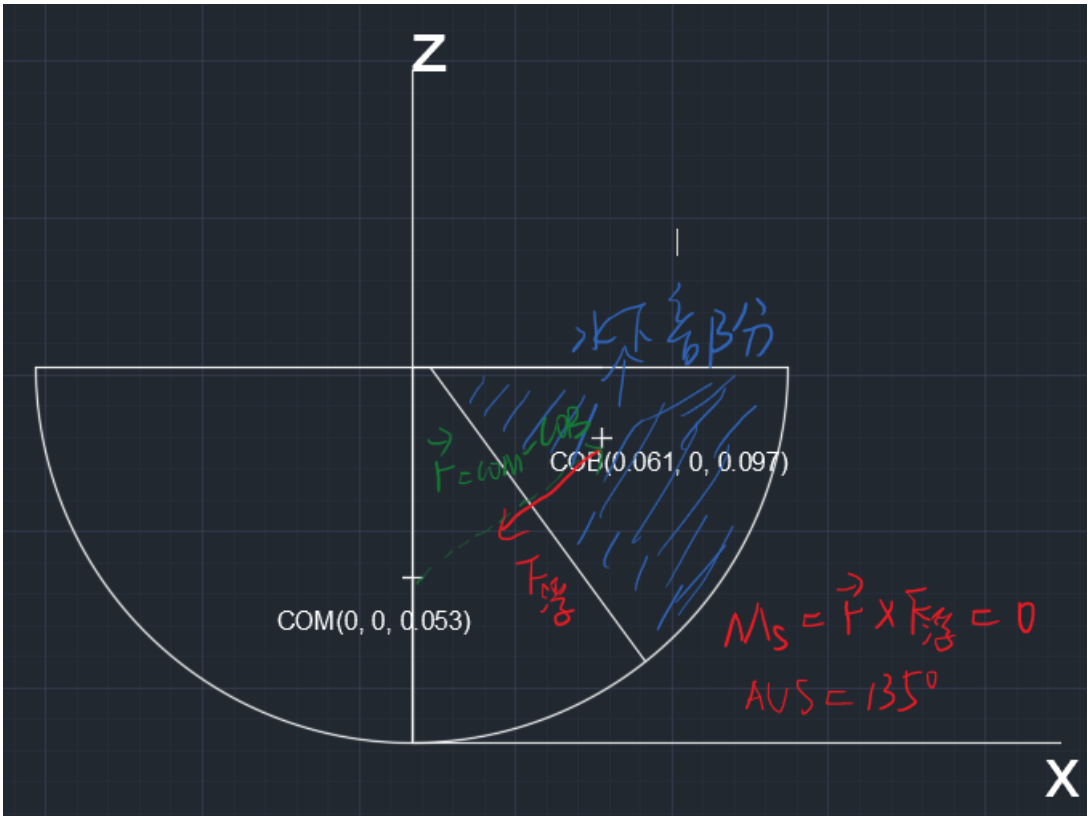

图3 船体倾斜135°复原力矩图

已知$COM(0,0,z_m)$，$COB(x_b,0,z_b)$

浮力$F_{浮}=<tan\theta,0,-1>\lambda)$，其中$\lambda=\frac{G_{all}}{tan^2\theta+1}$

复原力臂$r=COM-COB=<0,0,z_m-z_b>$

复原力矩$M_s=r\times F_{浮}=0$

4.吃水线

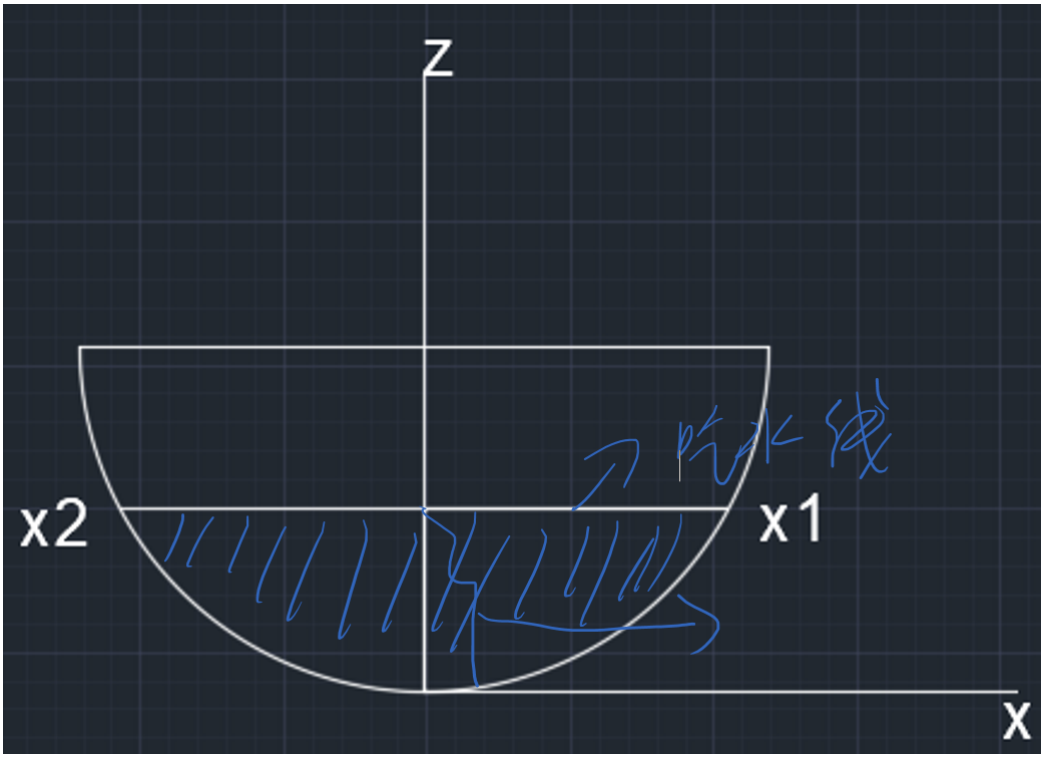

图4 水平吃水线

已知船体总重量为m_{all}，有$m_{all} = \rho g_{水} v_{排}$

吃水线方程为$z = h$

有

$$v_{排} = \iiint_E dV \qquad E = \{(x,\ y,\ z) | x_{Mid} \leq x \leq width,\ y_0 \leq y \leq 0, 0 \leq z \leq z_0\} \tag{4}$$

$$v_{排} = \int_{xMid}^{x_1} \int_0^{y_0} \int_{Ax^2+Bx^2}^{h} x dz dy dx \tag{5}$$

5.数量关系图

5.1重物与吃水线