Ship Stability Formulae

NB. These formulae and symbols are for guidance only and other formulae which give equally valid results are acceptable

$$\rho = \frac{\text{Mass}}{\text{Volume}}$$

$$\Delta = \nabla \times \rho$$

$$RD = \frac{\rho_{\text{Substance}}}{\rho_{FW}}$$

$$DWT = \Delta - \Delta_{\text{Light}}$$

$$\nabla = L \times B \times d \times C_B$$

$$A_w = L \times B \times C_W$$

$$TPC = \frac{A_w \times \rho}{100}$$

$$\text{Sinkage or Rise} = \frac{w}{TPC}$$

$$TPC_{DW} = \frac{TPC_{SW}}{1025} \times \rho_{DW}$$

$$FWA = \frac{\Delta_{\text{Summer}}}{4 \times TPC_{SW}}$$

$$DWA = \frac{(1025 - \rho_{DW})}{25} FWA$$

$$GG_{H/V} = \frac{w \times s}{\Delta}$$

$$GG_{H/V} = \frac{w \times s}{\Delta \pm w}$$

$$KG = \frac{\Sigma \text{ Vertical Moments}}{\Delta}$$

$$GG_H = \frac{\Sigma \text{ Horizontal Moments}}{\Delta}$$

$$\tan(\text{List}) = \frac{GG_H}{GM}$$

$$\tan(\text{List}) = \frac{\text{Listing Moment}}{\Delta \times GM}$$

$$MSS = \Delta \times GZ$$

$$GZ = GM \times \sin\theta$$

$$GZ = [GM + (½ \times BM \times \tan^2\theta)] \times \sin\theta$$

$$GZ = KN - (KG \times \sin\theta)$$

$$FSM = I \times \rho_T$$

$$I = \frac{l \times b^3}{12}$$

$$FSC = \frac{FSM}{\Delta}$$

$$FSC = \frac{I \times \rho_T}{\Delta}$$

$$KM_T = KB + BM_T$$

$$KM_L = KB + BM_L$$

$$BM_T = \frac{I_T}{\nabla}$$

$$BM_L = \frac{I_L}{\nabla}$$

$$BM_T(\text{For Box Shape}) = \frac{L \times B^3}{12 \times \nabla}$$

$$BM_L(\text{For Box Shape}) = \frac{L^3 \times B}{12 \times \nabla}$$

$$MCTC = \frac{\Delta \times GM_L}{100 \times LBP}$$

$$CoT = \frac{\text{Trimming Moment}}{MCTC}$$

$$\text{True mean draught} = \text{Draught aft} \pm \left(\text{Trim} \times \frac{LCF}{LBP}\right)$$

$$Trim = \frac{\Delta \times (LCB \sim LCG)}{MCTC}$$

$$\text{Change of trim aft} = \frac{\text{Trim} \times LCF}{LBP}$$

$$\text{Change of trim for'd} = \frac{\text{Trim} \times (LBP - LCF)}{LBP}$$

$$\text{Distance from Summer LL to Winter LL} = \frac{1}{48} \text{Summer draught}$$

$$\text{Distance from Summer LL to Tropical LL} = \frac{1}{48} \text{Summer draught}$$

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$$AHM=\frac{TVHM}{SF}$$

$$\lambda_0=\frac{\text{Total VHM}}{SF\times\Delta}$$

$$\lambda_{40}=0.8\times\lambda_0$$

$$\text{Approximate Angle of Heel}=\frac{AHM}{MPGHM}\times12^o$$

$$\text{Reduction in GZ}=(GG_H\times\cos\theta)+(GG_V\times\sin\theta)$$

$$\text{Area under curve (SR1)}=\frac{1}{3}\times h\times(y_1+4y_2+y_3)$$

$$\text{Area under curve (SR2)}=\frac{3}{8}\times h\times(y_1+3y_2+3y_3+y_4)$$

$$\text{Wind Heeling Lever } lw_1=\frac{P\times A\times Z}{1000\times g\times\Delta}$$

$$\text{Rolling Period T(Sec)}=\frac{2\times C\times B}{\sqrt{GM}}$$

$$C=0.373+0.023\left(\frac{B}{d}\right)-0.043\left(\frac{L_{w1}}{100}\right)$$

$$GM=\frac{w\times s\times length}{\Delta\times deflection}$$

$$\text{GM at Angle of Loll}=\frac{-2\times\text{Initial GM}}{\cos\theta}$$

$$\tan(\text{Angle of Loll})=\sqrt{\frac{-2\times GM}{BM_T}}$$

$$\tan(\text{List}) \text{ Zero GM}=\sqrt[3]{\frac{2\times w\times s}{\Delta\times BM_T}}$$

$$\text{Approximate angle of heel on turning: } \tan\theta=\frac{V^2\times\left(KG-\frac{d}{2}\right)}{g\times R\times GM}$$

$$\tan(\text{Angle of DEI})=\frac{\text{Freeboard}}{½\times B}$$

$$\text{Draught when Heeled}=(\text{Upright Draught}\times\cos\theta)+(½\times B\times\sin\theta)$$

$$P=\frac{\text{Trim}\times MCTC}{LCF}$$

$$P=\text{Reduction in TMD}\times TPC$$

$$\text{Loss of GM}=\frac{P\times KM}{\Delta}$$

$$\text{Loss of GM}=\frac{P\times KG}{\Delta-P}$$

$$\text{Effective Length}=l\times\mu$$

$$\text{Solid Factor}=\frac{1}{RD}$$

$$\text{Permeability}(\mu)=\frac{\text{Volume available for water}}{\text{Volume available for cargo}}$$

$$\text{Permeability}(\mu)=\frac{\text{SF of Cargo}-\text{Solid Factor}}{\text{SF of Cargo}}$$

$$\text{Volume of lost buoyancy}=l\times b\times d\times\mu$$

$$\tan(\text{List})=\frac{BB_H}{GM_{Bilged}}$$

$$\text{Sinkage}=\frac{\text{Volume of lost buoyancy}}{\text{Intact water plane area}}$$

$$I_{\text{Parallel Axis}}=I_{\text{Centroid Axis}}+As^2$$

Accepted Abbreviations

AHM	Actual Heeling Moment
AMD	Arithmetic Mean Draft
AP	After Perpendicular
BM	Height of Metacentre from Centre of Buoyancy
C_B	Block Coefficient
CoT	Change of Trim
C_W	Coefficient of Water Plane Area
FP	Forward Perpendicular
FSC	Free Surface Correction
FSE	Free Surface Effect
FSM	Free Surface Moments
FWA	Fresh Water Allowance
GG_H	Horizontal shift in Centre of Gravity
GG_V	Vertical shift in Centre of Gravity
GM	Metacentric Height
GZ	Righting Lever / Arm
IWPA	Intact Water Plane Area
KB	Height of Centre of Buoyancy from Keel
KG/Kg	Height of Centre of Gravity from Keel
KM	Height of Metacentre from Keel
LBP	Length Between Perpendiculars
LCB	Longitudinal Centre of Buoyancy
LCF	Longitudinal Centre of Floatation
LCG/Lcg	Longitudinal Centre of Gravity
LOA	Length Over All
MCTC	Moment to Change Trim by one Centimetre
MPGHM	Maximum Permissible Grain Heeling Moment
MSS	Moment of Statical Stability
RD	Relative Density
RDS	Residual Dynamic Stability
RM	Righting Moment
TCG	Transverse Centre of Gravity
TMD	True Mean Draft
TPC	Tonnes Per Centimetre Immersion
TVHM	Total Volumetric Heeling Moment
VCG	Vertical Centre of Gravity
VHM	Volumetric Heeling Moment
WHM	Wind Heeling Moment
WPA	Water Plane Area
θ_{dei} or φ_{dei}	Angle of Deck Edge Immersion
θ_f or φ_f	Angle of Flooding