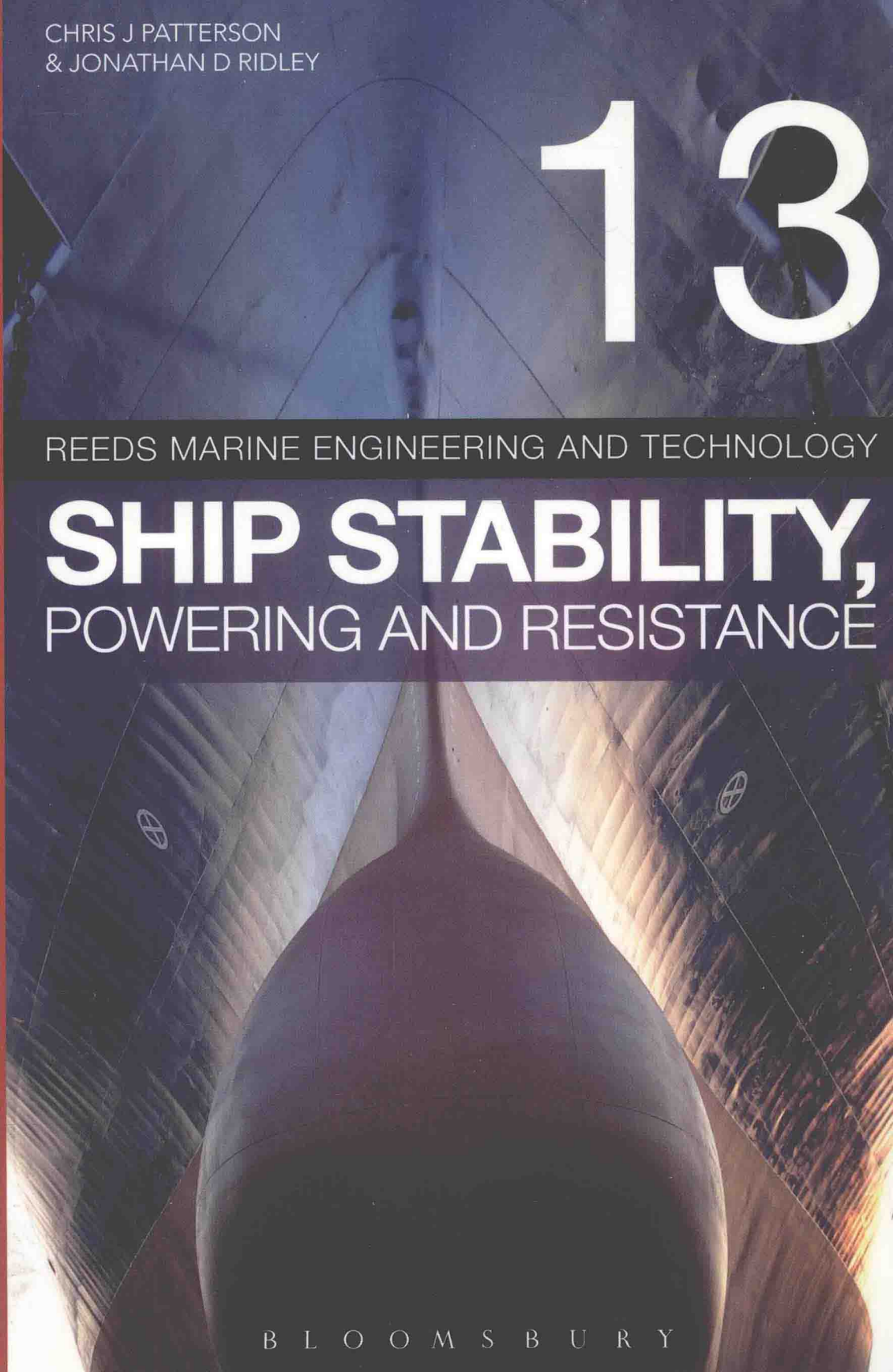
CHRIS J PATTERSON
& JONATHAN D RIDLEY

13

REEDS MARINE ENGINEERING AND TECHNOLOGY

SHIP STABILITY, POWERING AND RESISTANCE



BLOOMSBURY

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Chris J Patterson
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ADLARD COLES NAUTICAL
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For my darling wife Linny

&

For Leanne

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NOMENCLATURE

Symbol	Units	Name
AC	–	Admiralty coefficient
AP	–	Aft perpendicular
AWP	m^2	Waterplane area
b	*m*	Tank beam
b	*m*	Compartment beam
B	–	Centre of buoyancy
B	*m*	Waterline beam of a box shaped vessel
BAR	–	Propeller blade area ratio
BM	*m*	Vertical position of the metacentre above B
BM	*tonne metres*	Bending moment
BM_L	*m*	Vertical position of the longitudinal metacentre above B
B_P	–	Propeller power coefficient
B_{WL}	*m*	Waterline beam
C_B	–	Block coefficient
C_F	–	Frictional resistance coefficient
C_F	*m FOAP*	Longitudinal centre of flotation
C_M	–	Amidships area coefficient
C_R	–	Residuary resistance coefficient
C_T	–	Total resistance coefficient
C_W	–	Waterplane area coefficient
d	*m*	Distance of a mass from the centreline
d	*m*	Transverse shift in the centre of buoyancy due to bilging in a side compartment
D	*m*	Draught
D	*m*	Propeller diameter
D_A	*m*	Draught at the aft perpendicular
D_B	*m*	Bilged draught
δ	–	Propeller speed coefficient
Δ	*tonnes*	Displacement or ship mass including contents
D_F	*m*	Draught at the forward perpendicular
D_{Heeled}	*m*	Heeled draught

Symbol	Units	Name
D_I	*m*	Initial draught
D_{LCF}	*m*	True mean draught (draught at the LCF)
D_M	*m*	Mean draught
D_{TMD}	*m*	True mean draught (draught at the LCF)
DW	–	Subscript used to identify dock water
DWA	*mm*	Dock water allowance
η_{DUCT}	–	Waterjet duct efficiency
η_H	–	Hull efficiency
η_{JET}	–	Waterjet jet efficiency
η_{JS}	–	Waterjet system efficiency
η_M	–	Engine mechanical efficiency
η_O	–	Propeller open water efficiency
η_P	–	Propeller efficiency
η_{PUMP}	–	Waterjet pump efficiency
η_R	–	Propeller relative rotative efficiency
η_T	–	Transmission efficiency
FC	–	Fuel coefficient
Fn		Froude number
FOAP	–	Forward of aft perpendicular
FP	–	Forward perpendicular
FSC	*m*	Free surface correction (loss in GM due to FSM)
FSM	m^4	Free surface moment (not corrected for fluid density)
FSM	*tonne metres*	Free surface moment (corrected for fluid density)
FWA	*mm*	Fresh water allowance
G	m/s^2	Acceleration due to gravity (taken as 9.81 m/s^2)
G	–	Centre of gravity
GM	*m*	Metacentric height
GM_I	*m*	Initial metacentric height (at zero heel)
GM_L	*m*	Longitudinal metacentric height
GZ	*m*	Righting lever, righting arm, arm of statical stability, lever of statical stability
h	*m*	Height of a watertight flat or double bottom depth
I or Inertia	m^4	Transverse second moment of area of the waterline measured through the centreline

Symbol	Units	Name
$I_{Centroid}$	m^4	Second moment of area measured through the centre of a shape
I_{EDGE}	m^4	Second moment of area measured through the edge of the shape
I_{GG}	m^4	Second moment of area measured through the centre of a shape
I_L *or Inertia*$_L$	m^4	Longitudinal second moment of area of the waterline measured through the LCF
$I_{ROLL\ AXIS}$	m^4	Second moment of area of the waterplane measured through the centre of the waterplane
I_{XX} *or* I_X, I_{YY} *or* I_Y	m^4	Second moment of area measured through a point away from centre of a shape
J	–	Propeller advance coefficient
K		The intersection of the centreline and the keel
K_Q	–	Propeller torque coefficient
K_T	–	Propeller thrust coefficient
KB	m	Vertical position of the centre of buoyancy
KM	m	Vertical position of the metacentre above the keel
KM_L	m	Vertical position of the longitudinal metacentre above the keel
KG	m	Vertical position of the centre of gravity
$1 + k$	–	Frictional form factor
l	m	Tank length
l	m	Compartment length
L	m	Waterline length of a box shaped vessel
λ	m	Heeling arm
λ_0	m	Grain heeling arm at 0 degrees
λ_{40}	m	Grain heeling arm at 40 degrees
LBP	m	Length between perpendiculars
LCB	*m FOAP*	Longitudinal position of the centre of buoyancy
LCF	*m FOAP*	Longitudinal centre of flotation
LCG	*m FOAP*	Longitudinal position of the centre of gravity
L_{WL}	m	Waterline length
m	kg	Mass
$\dot{m}$	kg/s	Mass flowrate
M	–	Metacentre
$MCTC$	*tm/cm*	Moment to change the trim by 1 cm

Symbol	Units	Name
$MCTC_2$	*tm/cm*	Used in draught surveys – the MCTC at the corrected midship draught (row 13) plus 0.50 m
$MCTC_1$	*tm/cm*	Used in draught surveys – the MCTC at the corrected midship draught (row 13) minus 0.50 m
MHM	*tonne metres*	Mass heeling moment, used in the grain regulations
MSS	*tonne metres*	Moment of statical stability, or righting moment
μ	–	Compartment permeability
μ	*kg/ms*	Dynamic viscosity
n	*rev/s*	Propeller revolution speed
N	*rpm*	Propeller revolution speed
N	–	Intersection of the line of action of buoyancy and a horizontal line from the keel
∇	m^3	Underwater or submerged volume
v	m^2/s	Kinematic viscosity
P_v	*Pa*	Vapour pressure
P	*tonnes*	Up-thrust during dry-docking
P	*m*	Propeller pitch
P_D	*W*	Delivered power
P_E	*W*	Effective power
P_{EN}	*W*	Effective naked power
P_I	*W*	Installed power
P_S	*W*	Shaft power
P_T	*W*	Thrust power
Q	*Nm*	Propeller torque
r	*m*	Turn radius
ρ	t/m^3	Fluid density
R_F	*N*	Frictional resistance
R_n	–	Reynold's number
R_R	*N*	Residuary resistance
R_T	*N*	Total resistance
s	*various*	Ordinate spacing when using Simpson's Rule
S	m^2	Wetted surface area
SCF	–	Ship correlation factor

Symbol	Units	Name
SF	m^2/t	Stowage factor
SF	*tonnes*	Shear force
sfc	*kg/kW hr*	Specific fuel consumption
σ	–	Cavitation number
SW	–	Subscript used to identify sea water (taken as 1.025 m^3)
t	–	Thrust deduction factor
T	*N*	Propeller thrust
TCB	*m*	Transverse position of the centre of buoyancy
TCG	*m*	Transverse position of the centre of gravity
∴	–	Mathematical symbol meaning 'therefore'
θ	*degrees*	Angle of inclination, list, heel or loll
~		Difference between
TPC	*t/cm*	Tonnes per centimetre immersion
v	*m/s, knots*	Ship speed
v_A	*m/s*	Advance speed
v_M	*m/s*	Model speed
v_S	*m/s*	Ship speed
v_W	*m/s*	Wake speed
VHM	m^4	Volumetric heeling moment, used in the grain regulations
w	*tonnes*	Mass of an item of cargo
x	*various*	Generic term for an unknown variable
Z	–	Number of propeller blades
Z	–	Intersection of the line of action of buoyancy and a horizontal line from the centre of gravity

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