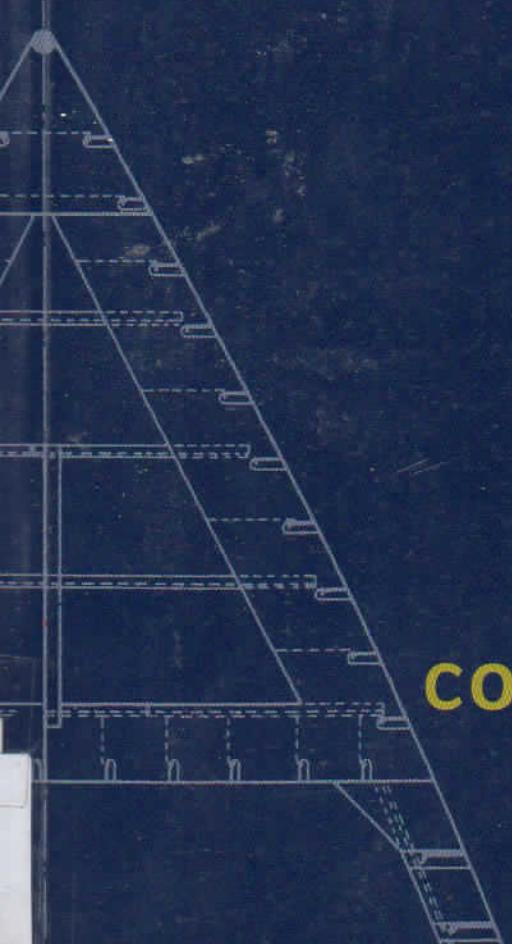


REED'S MARINE ENGINEERING SERIES



5

SHIP  
CONSTRUCTION  
FOR  
MARINE  
STUDENTS

Ref  
623.81  
17874  
2013  
v. 5  
x

# REED'S SHIP CONSTRUCTION FOR MARINE STUDENTS

E A STOKOE

CEng, FRINA, FIMarE, MNECInst

Formerly Principal Lecturer in Naval Architecture at South Shields  
Marine and Technical College



ADLARD COLES NAUTICAL  
London

## CONTENTS

CHAPTER	TOPIC	PAGE
1— Ship types and terms	Passenger ships, cargo liners, cargo tramps, oil tankers, bulk carriers, colliers, container ships, roll-on/roll-off vessels, liquefied gas carriers, chemical carriers. Terms in general use.	1—14
2— Stresses in ship structures	Longitudinal bending in still water and waves, transverse bending, stresses when docking, panting and pounding.	15—23
3— Sections used: Welding and materials	Types of rolled steel section used in shipbuilding. Aluminium sections. Metallic arc welding, argon arc welding, types of joint and edge preparation, advantages and disadvantages, testing of welds, design of welded structure. Materials, mild steel, higher tensile steels, Arctic D steel, aluminium alloys. Brittle fracture.	24—40
4— Bottom and side framing	Double bottom, internal structure, duct keel, double bottom in machinery space. Side framing, tank side brackets, beam knees, web frames.	41—49
5— Shell and decks	Shell plating, bulwarks. Deck plating, beams, deck girders and pillars, discontinuities, hatches, steel hatch covers, watertight hatches.	50—60
6— Bulkheads and deep tanks	Watertight bulkheads, watertight doors. Deep tanks for water ballast	

and for oil. Non-watertight bulkheads,  
corrugated bulkheads.

61—72

**CHAPTER 7—Fore end arrangements**

Stem plating, arrangements to resist  
panting, arrangements to resist pound-  
ing, bulbous bow, anchor and cable  
arrangements.

73—81

**CHAPTER 8—After end arrangements**

Cruiser stern, transom stern, stern-  
frame and rudder, fabricated  
sternframe, cast steel sternframe,  
unbalanced rudder, balanced rudder,  
open water stern, spade rudder, rudder  
and sternframe for twin screw ship.  
Bossings and spectacle frame. Shaft  
tunnel. Kort nozzle, fixed nozzle,  
nozzle rudder. Tail flaps and rotary  
cylinders.

82—98

**CHAPTER 9—Oil tankers, bulk carriers, liquefied gas  
carriers and container ships**

Oil tankers, longitudinal framing,  
combined framing, cargo pumping and  
piping, crude oil washing. Bulk  
carriers, ore carriers. Liquefied gas  
carriers, fully pressurised, semi-  
pressurised/partly refrigerated, semi-  
pressurised/fully refrigerated, fully  
refrigerated, safety and environmental  
control, boil off, operating  
procedures. Container ships.

99—122

**CHAPTER 10—Freeboard, tonnage, life saving  
appliances, fire protection and  
classification**

Freeboard definitions, basis for  
calculation, markings, conditions of  
assignment, surveys. Tonnage, 1967  
rules, definitions, underdeck, gross  
and net tonnage, propelling power  
allowance, modified tonnage,  
alternative tonnage. 1982 rules, gross

and net tonnage calculation. Life saving appliances, lifeboats, davits. Fire protection, definitions, passenger ships, dry cargo ships, oil tankers. Classification of ships, assignment of class, surveys, discontinuities. 123—140

**CHAPTER 11— Ship Dynamics**

Propellers, wake distribution, blade loading, controllable pitch propellers, contra-rotating propellers, vertical axis propellers. Bow thrusters, controllable pitch thrusters, hydraulic thrust units. Rolling and stabilisation, reduction of roll, bilge keels, fin stabilisers, tank stabilisers. Vibration, causes and reduction. 141-158

**CHAPTER 12— Miscellaneous**

Insulation of ships. Corrosion, prevention, surface preparation, painting, cathodic protection, impressed current system, design and maintenance. Fouling. Examination in dry dock. Emergency repairs to structure. Engine casing. Funnel. 159—175

**Selection of Examination Questions —**  
**Class 2** 176—180

**Selection of Examination Questions —**  
**Class 1** 181—187

**Index** 188—192

# INDEX

- A**
- A-class bulkheads 133
  - Accommodation 12
  - Active controlled tanks 155
  - Active fin stabilisers 152
  - Advantages and disadvantages of welding 31
  - After end arrangement 82 *et seq.*
  - After peak 2, 77
  - Alternative tonnage 129
  - Aluminium alloy 39, 117, 166
    - " sections 27
  - Anchors and cables 79
  - Angle bar 24
  - Anodes, sacrificial 165
  - Arc welding, argon 30
    - " metallic 28
  - Arctic D steel 38
  - Argon arc welding 30
  - Assignment of class 136
- B**
- B-class bulkheads 133
  - Balanced rudder 89
  - Ballast tanks 2, 41, 68
  - Beam knees 20, 48
  - Beams 19, 53
    - " cant 82
    - " longitudinal 53
    - " strong 173
  - Bending moments 15, 17
    - " longitudinal 15 *et seq.*
    - " transverse 19
  - Bergensfjord, m.s. 166
  - Bilge blocks 21
    - " keels 151
    - " radius 14
    - " shores 21
  - Boil-off 119
  - Bossings 93
  - Bottom longitudinals 101, 112
    - " shell 50
  - Bow height 121
  - Bow thrusters 146
  - Bracket floor 44
  - Breadth extreme 13
    - " moulded 13
    - " tonnage 127
  - Brine trap 161
  - Brittle fracture 39
  - Built pillars 54
  - Bulb angle 25
    - " plate 25
  - Bulbous bow 78
  - Bulk carriers 5, 110 *et seq.*
- Bulkheads** 61 *et seq.*
- " A and B-class 133
  - " centreline 69
  - " collision 75
  - " corrugated 71, 103
  - " deep tank 69
  - " longitudinal 4, 101, 110
  - " non-watertight 71
  - " oiltight 103
  - " swaged 72
  - " transverse 61, 103
  - " watertight 61
- Bulkwork** 51
- Buoyancy curve** 15
- Butt strap** 137
  - " welding 30
- C**
- Cable gland** 64
    - " lifter 80
    - " stopper 80
  - Camber** 13
  - Cant beam** 82
    - " frame 82
  - Cargo hatch** 3, 55
    - " liner 2
    - " piping 105
    - " pumps 105
    - " tramp 4
  - Casings, engine** 171 *et seq.*
  - Cathodic protection** 165
  - Ceiling** 42
  - Centre girder** 42
  - Centreline bulkhead** 69
  - Chain locker** 2, 79
    - " pipes 79
  - Channel bar** 26
  - Chemical carriers** 10
  - Classification of ships** 135 *et seq.*
    - " societies 135
  - Coamings, hatch** 55
  - Cofferdams** 4, 47
  - Coffin plate** 85
  - Colliers** 6
  - Collision bulkhead** 75
  - Conditions of assignment** 125
  - Container ships** 8, 121, *et seq.*
  - Continuity of structure** 104, 138
  - Contra-rotating propellers** 144
  - Controllable pitch propellers** 143
  - Corrosion** 162, *et seq.*
    - " bi-metallic 165
    - " prevention of 164
  - Corrugated bulkheads** 71, 103
  - Covers, hatch** 4, 55
  - Crack arrestors** 137

Crane 173  
 " rail support 173  
 Crew spaces 12  
 Crude oil washing 109  
 Cruiser stern 82 *et seq.*

**D**  
 Davits 131  
 Deadweight 14  
 Deck 52 *et seq.*  
     " beams 53  
     " camber 13  
     " girders 53  
     " line 125  
     " longitudinals 53  
     " machinery 54  
     " plating 52  
     " sheathing 53  
 Deep tanks 4, 68  
     " " for water ballast 69  
     " " for oil 69  
 Depth extreme 13  
     " moulded 13  
     " tonnage 127  
 Design and maintenance 167  
     of welded structure 35  
 Destructive testing 32  
 De-wedging device 65  
 Dimensions 12  
 Discontinuities 138  
 Displacement 14  
 Docking brackets 21, 103  
     " stresses 21  
 Doors, casing 171  
     " hinged 68  
     " watertight 65  
 Double bottom 41 *et seq.*  
     " " in machinery  
         space 46  
     " " internal  
         structure 42  
 Drainage of insulated spaces 161  
 Draught extreme 13  
     " moulded 13  
 Drydock, examination in 169  
     " support of ship in 21  
 Duct keel 21, 45

**E**  
 Edge preparation 30  
 Electrodes 28  
 Electrolytic action 162  
 Emergency repairs 170  
 End connections of  
     longitudinals 100  
 Engine casing 171 *et seq.*  
     " room crane 173  
 Equipment 136  
 Examination in dry dock 169

Examination Questions,  
     Class 1 181 *et seq.*  
     " Questions,  
         Class 2 176 *et seq.*  
 Extra notch-tough steel 37, 99

**F**  
 Fabricated sternframe 85  
 Faults in welded joints 34  
 Fillet welds 30  
 Fin stabiliser 152  
 Fire protection 133 *et seq.*  
 Flame cleaning 164  
 Flat plate keel 18, 50  
 Floors, bracket 44  
     " solid 43  
     " watertight 42  
 Fore end construction 73 *et seq.*  
     " peak 2, 75  
 Forecastle 4  
 Fouling 167 *et seq.*  
 Frames, main 47  
     " side 19, 47  
     " 'tween deck 48  
     " web 49  
 Framing, combined 102  
     " longitudinal 99  
     " transverse 47  
 Freeboard 13, 123 *et seq.*  
     " conditions of  
         assignment 125  
     " markings 125  
     " surveys 127  
     " tabular 123  
 Freeing ports 52  
 Fresh water allowance 125  
 Fully pressurised tanks 113  
 Fully refrigerated tanks 115  
 Funnel 174

**G**  
 Gangway, longitudinal 4, 126  
 Garboard stake 50  
 Gas venting system 108  
 Girders centre 42  
     " deck 53  
     " horizontal 69  
     " intercostal 43  
     " side 42  
 Grades of steel 37  
 Gravity davit 131  
 Gross tonnage 127  
 Gudgeons 85

**H**  
 Hatches 55 *et seq.*  
     " coamings 55  
     " covers 56  
     " deep tank 58  
     " oiltight 104

- Hatches steel 57  
     ,, watertight 58  
     ,, webs 56  
 Hawse pipes 79  
 Heating coils 108  
 Higher tensile steel 38  
 Hogging 16  
 Holding down bolts 46  
 Holds, cargo 2  
 Hopper tanks 5, 113  
 Hydraulic thrust unit 148
- I**  
 Impressed current system 166  
 Inerting 120  
 Inner bottom 41  
 Intercostal girders 43  
 Intermittent welding 30  
 Internal structure of double bottom 42  
 Insulants 159  
 Insulated hatch plug 161  
 Insulation 117, 159 *et seq.*  
     ,, fire 133  
 In-water survey 138
- J**  
 Joint, types of 30  
 Joists 26
- K**  
 Keel 18, 50  
     ,, bilge 151  
     ,, blocks 21  
     ,, duct 21, 45  
 Kort nozzle 95  
     ,, rudder 97
- L**  
 Lap joint 30  
 Length between perpendiculars 13  
     ,, overall 13  
     ,, tonnage 127  
 Lifesaving appliances 131 *et seq.*  
 Lifeboats 131  
 Liferafts 131  
 Lightening holes 42  
 Lightweight 14  
 Liquefied gas carrier 9, 113 *et seq.*  
 Lloyd's Register of Shipping 135 *et seq.*  
 Load diagram 16  
 Load Line Rules 123  
 Longitudinal beams 53  
     ,, bending 15 *et seq.*  
     ,, bulkhead 4, 101, 110  
     ,, frames 44, 99  
     ,, gangway 4, 126  
     ,, material 18
- Longitudinal strength 15
- M**  
 Machinery casings 171  
     ,, space 2  
     ,, space tonnage 128  
 Magnetic crack detection 34  
 Main vertical zones 134  
 Maintenance 167  
 Manhole cover 42  
 Margin plate 42  
 Material, longitudinal 18  
     ,, non-combustible 133  
     ,, transverse 19  
 Materials: 37 *et seq.*  
     Aluminium alloys 38  
     Arctic D steel 38  
     Higher tensile steel 38  
     Mild steel 37  
 Membrane tanks 117  
 Metallic arc welding 28  
 Midship section, bulk carrier 6, 112  
 Midship section cargo vessel 60  
     ,, .. chemical carrier 10  
     ,, .. collier 8  
     ,, .. container ship 121  
     ,, .. cylindrical tank system 114  
     ,, .. liquefied gas carrier 11  
     ,, .. oil tanker 5, 100, 101  
     ,, .. ore carrier 6, 111  
     ,, .. prismatic tank system 116  
     ,, .. showing dimensions 12  
     ,, .. spherical tank system 115
- Mild steel 37  
 Mill scale, removal of 164  
 Modified tonnage 128
- N**  
 Net tonnage 127  
 Non-combustible material 133  
 Non-destructive testing 33  
 Non-watertight bulkheads 71  
 Notch-tough steel 37, 99  
 Nozzle, Kort 95
- O**  
 Oil fuel tanks 2, 41, 69  
 Oil tankers 4, 99 *et seq.*  
     ,, .. combined framing 102  
     ,, .. longitudinal framing 99  
 Oiltight bulkhead 103  
     ,, hatch 104  
 Open water stern 91  
 Ore carriers 5, 110

P	
Painting	165
Panting	23
" arrangements	73
Passenger ships	1
" " fire protection	134
Passive tanks	154
Peaks	2, 75
Pickling	164
Pillars	53
Pintles	87
Piping, main cargo	105
Plating, deck	18, 52
" shell	18, 50
" stem	73
Pounding	23
" arrangements	72
Prismatic tanks	116
Profile, bulk carrier	7
" cargo liner	3
" cargo tramp	3
" collier	7
" container ship	7
" liquefied gas	
" carrier	11
" oil tanker	3
" roll-on/roll-off vessel	9
" showing dimensions	11
Propeller, examination of	170
Propellers	141
" contra-rotating	144
" controllable pitch	143
" vertical axis	145
Propelling Power Allowance	128
Protection, cathodic	165
" fire	133 <i>et seq.</i>
Pump rooms	4, 105
Pumping arrangements of oil	
tankers	105
Pumps, cargo	105, 120
" stripping	105
R	
Racking	20
Radiographic testing of welds	33
Rails, crane	173
Raised quarter deck	8
Reduction of roll	151 <i>et seq.</i>
Refrigerated vessels	2
" insulation of	159
Repair	170
Rise of floor	14
Rolled steel sections	24 <i>et seq.</i>
Rolling and stabilisation	150 <i>et seq.</i>
Roll-on/Roll-off vessels	9
Rotating cylinders	98
Round of beam—see camber	13
Rounded gunwale	18
Rudder carrier	88

Rudders	84 <i>et seq.</i>
" balanced	89
" Kort nozzle	97
" semi-balanced	92
" spade	91
" unbalanced	85
S	
Sacrificial anodes	165
Sagging	17
Scantlings	137
Scuppers	126
Seating, winch	54
Sections, aluminium	27
" steel	24 <i>et seq.</i>
Self polishing copolymers	168
Self trimming collier	8
Semi-pressurised tanks	114
Settling tanks	2
Shaft stools	95
" tunnel	2, 94
Sheathing, deck	53
Sheer	14
Sheerstrake	18, 50
Shell plating	50 <i>et seq.</i>
Ship types	1 <i>et seq.</i>
Shot blasting	165
Side framing	20, 47, 102
" girders	18, 42
" shell	18, 50
" shores	22
Solid floors	43
Solid pillars	54
Spade rudder	91
Spectacle frame	93
Sprinkler system	134
Stays, funnel	174
Steel, extra notch-tough	37, 99
" hatch covers	57
" sections	24 <i>et seq.</i>
Stem bar	73
" construction	73, 78
" plating	73
Stern, cruiser	82
" transom	84
Sternframe, cast	89
" fabricated	85
" open water	91
" twin screws	92
Stiffeners, bulkhead	62
Still water bending	15
Strength, longitudinal	15
" transverse	19
Stresses	15 <i>et seq.</i>
Stringer plate	18, 50
Stripping pumps	105
Strong beams	173
Superstructure, aluminium	166
Surface preparation	164

- Surveys, annual 127, 136  
     " in-water 138  
     " special 136  
 Swedged bulkheads 72
- T**  
 T bars 27  
 Tabular freeloading 121  
 Tailshaft weardown 138, 170  
 Tail flaps 98  
 Tank margin 42  
     " side brackets 20, 47  
 Tank stabiliser 154  
     " top 2, 41  
 Tankers—see oil tankers 99 *et seq.*  
 Tanks, deep 4, 68  
     " double bottom 2, 41  
     " peak 2, 75  
     " testing of 42  
 Terms in general use 12 *et seq.*  
 Testing, destructive 32  
     " non-destructive 33  
     " of tanks 42  
     " of welds 32  
 Tonnage 127 *et seq.*  
     " 1967 Rules 127  
     " 1982 Rules 129  
     " alternative 129  
     " deductions 127  
     " enclosed spaces 130  
     " gross 127  
     " mark 129  
     " modified 128  
     " net 127  
     " underdeck 127  
 Torsion boxes 122, 140  
 Transom floor 85  
     " stern 84  
 Transverse bending 19  
     " bulkheads 61, 103  
     " framing 47
- Transverse material 19  
     " strength 19  
     " webs 101, 112  
 Tumble home 14  
 Tunnel, shaft 2, 94  
 Tween decks 2  
 Types of ships 1 *et seq.*  
 Type-A ship 121  
 Type-B ship 122
- U**  
 Unbalanced rudder 85  
 Ultrasonic testing of welds 34  
 Underdeck tonnage 127  
 Uptakes, funnel 174
- V**  
 Vertical axis propellers 145  
 Vibration 156 *et seq.*
- W**  
 Water ballast tanks 2, 41, 69  
 Water pressure 19, 62  
 Watertight bulkheads 61 *et seq.*  
     " doors 65 *et seq.*  
 Wave bending 18  
 Weathering 164  
 Web frames 49  
 Weight curve 15  
 Welded joints 30  
     " plate collars 40  
 Welding, advantages and disadvantages of 31  
 Welding, argon arc 30  
     " faults 34  
     " metallic arc 28  
     " testing 32  
 Wood sparring 49
- X**  
 X-rays 33

Off 8/27/15