Cargo Work

For Maritime Operations

Cargo Work

For Maritime Operations

Seventh Edition

D.J. House

(formerly Kemp & Young's Cargo Work)

Butterworth-Heinemann
An imprint of Elsevier

Cargo Work, 7/e
House

Butterworth-Heinemann
An imprint of Elsevier
Linacre House, Jordan Hill, Oxford OX2 8DP, UK
30 Corporate Drive, Suite 400, Burlington, MA 01803, USA

Original ISBN: 978-0-7506-6555-1

First Printed in India 2009

Indian Reprint ISBN: 978-81-312-2145-7

Published by Elsevier, a division of Reed Elsevier India Private Limited, 14th Floor, Building No. 10B, DLF Cyber City, Phase-II, Gurgaon-122 002, Haryana, India.

Printed and bound at Rajkamal Electric Press

Contents

Preface

The world of cargo operations has changed considerably from the days of the open stowage of merchandise. Unitized cargoes in the form of 'containers' or Roll-on, Roll-off cargoes and pallatization have generated a need for alternative handling methods and changing procedures.

The work of the stevedore/longshoreman has moved on to a vastly different role to that previously employed in general cargo holds. The cargo units are labour saving and tend to require a different mode of working. In many cases, ship's crews or rigging gangs have replaced the role of the previous style of dock labour. The fork lift truck and the container gantry have been the source of the major causes of change within the cargo-handling environment and the demise of labour intensive activities.

Unlike the previous editions of *'Cargo Work'*, this new text has taken the changes to the industry and included the cargo-handling equipment and the procedures being adopted in our present day. It is anticipated that cargoes can no longer be a stand-alone topic and must incorporate the modern methods of handling, stowage and commodity together.

The two topics of cargoes and handling equipment have therefore been combined in order to appeal to a wider readership and give greater coverage to the prime function of shipping.

This edition has been totally revised by:
D.J. House

Master Mariner
Senior Lecturer Nautical Studies
Marine Author
Patent Holder (GB2240748)

About the author

David House started his sea-going career on general cargo/passenger liners in 1963. During his sea-going career he gained experience of many vessel types and trades, including refrigerated (reefer) vessels to South America on the chilled and frozen meat trade.

His activities included shipping containers from Europe to North America and general cargoes worldwide, during which period he gained extensive knowledge on heavy-lift operations.

His bulk cargo experience was obtained from the carriage of a variety of products, inclusive of grain, sugar, tallow, sulphur and coal.

The types of vessels and various trades in which he was engaged has provided the foundation for this up-to-date version of Kemp & Young's original work.

David House has served on Roll-on, Roll-off vessels, as well as container tonnage, dealing with all aspects of modern cargo-handling techniques: steel cargoes, heavy lifts, special cargoes, foodstuffs, livestock, as well as the bulk commodities and general merchandise. He has been involved as both a Junior and a Senior Cargo Officer, and currently lectures on virtually all nautical subjects at the Fleetwood Nautical Campus.

He has researched and published 13 profusely illustrated Marine publications, which are widely read throughout the maritime world. Amongst his books you can find the following: *Navigation for Masters* (1995); *Marine Survival and Rescue Systems* (1997); *An Introduction to Helicopter Operations at Sea – a Guide for Industry* (1998); *Seamanship Techniques*, Volume III 'The Command Companion' (2000); *Anchor Practice – a Guide for Industry* (2001); *Marine Ferry Transports – an Operators Guide* (2002); *Dry Docking and Shipboard Maintenance* (2003); *Seamanship Techniques*, third edition (2004); *Seamanship Examiner* (2005); *Heavy Lift and Rigging* (in press). www.djhouseonline.com

Acknowledgements

B&V, Industrietechnik GmbH
British Nuclear Fuels
British Standards Institution
Bruntons (Musselburgh) Ltd.
Dubai Dry Docks UAE
International Maritime Organization (publications)
James Fisher Shipping Company
MacGregor International Organisation
Maritime and Coastguard Agency
Motor Ship (published by IPC Industrial Press Ltd.)
Overseas Containers Ltd.
P&O European (Irish Sea) Ferries
Scheuerle Fahrzeugfabrik GmbH
Seaform Design (Isle of Man)
Smit International
TTS – Mongstad AS

Additional photography

Capt. K.B. Millar, Master Mariner, Lect., Nautical Studies of Millar Marine Services
Capt. J.G. Swindlehurst (MN) Master Mariner
Capt. A. Malpass (MN) Master Mariner
Mr M. Gooderman, Master Mariner, B.A. Lecturer Nautical Studies
Mr G. Edwards Ch/Eng (MN) Rtd.
Mr P. Brooks Ch/Off (MN)
Mr J. Leyland (Nautical Lecturer)

I.T. Consultant: Mr C.D. House

List of abbreviations used in the context of Cargo Work

°A	Degrees absolute
AAA	Association of Average Adjusters
ABS	American Bureau of Shipping
AIS	Automatic Identification System
B	Representative of the ship's centre of buoyancy
BACAT	BArge CATamaran
BCH	Bulk Chemical Code
B/L	Bill of Lading
BLU (Code)	The Code of Practice for Loading and Unloading of Bulk Cargoes
BOG	Boil-off gas
BS (i)	Breaking strain
BS (ii)	British Standard
BS (iii)	Broken stowage
BT	Ballast tank
C	Centigrade
CAS	Condition Assessment Scheme
CBM	Conventional buoy mooring
CBT	Clean ballast tank
CCTV	Close Circuit Television
CEU	Car equivalent unit
Ch/Off (C/O)	Chief Officer
cm	Centimetres
CNG	Compressed natural gas
CoF	Certificate of Fitness
C of G	Centre of gravity
COW	Crude oil washing
CO_2	Carbon dioxide

CSO	Company Security Officer
CSS	Cargo Stowage and Securing (IMO Code of Safe Practice of)
CSWP	Code of Safe Working Practice
CTU	Cargo transport unit
cu	Cubic
D	Density
DGN	Dangerous Goods Notice
DNV	Det Norske Veritas
DOC	Document of Compliance
DWA	Dock water allowance
Dwt	Deadweight tonnage
EC	European Community
EDI	Electronic data interchange
EEBDs	Emergency escape breathing devices
EFSWR	Extra flexible steel wire rope
EU	European Union
F (i)	Fresh
F (ii)	Fahrenheit
FloFlo	Float-on, Float-off
FO	Fuel oil
FPSOS	Floating Production Storage Offloading System
FSE	Free surface effect
FSM	Free surface moment
FSRU	Floating storage and re-gasification unit
FSU	Floating storage unit
FSWR	Flexible steel wire rope
ft	Feet
FW	Fresh water
FWA	Fresh water allowance
G	Ship's centre of gravity
G/A	General average
gal	Gallons
GG_1	Representation of the movement of the ship's C of G when moving a weight aboard the vessel.
GM	Metacentric height
grt	Gross registered tonnage
GZ	Ship's righting lever
HCFC	Hydro chlorofluorocarbons
HDFD	Heavy duty, floating derrick
HMSO	Her Majesty's Stationary Office
HP (i)	High pressure
(ii)	Horse power

HSC	High-speed craft
HSE	Health and Safety Executive
HSMS	Hull stress monitoring system
HSSC	Harmonized System of Survey and Certification
IACS	International Association of Classification Societies
IBC	International Bulk Cargo (Code)
ICS	International Chamber of Shipping
IG	Inert gas
IGC	Inert Gas Code
IGS	Inert Gas System
ILO	International Labour Organization
IMDG	International Maritime Dangerous Goods (code)
IMO	International Maritime Organization
IOPP	International Oil Pollution Prevention (certificate)
ISGOTT	International Safety Guide for Oil Tankers and Terminals
ISM	International Safety Management
ISPS	International Ship and Port Facility Security (Code)
ISSC	International Ships Security Certification
ITU	Inter-modal transport unit
K	Representative of the ship's keel
kg (k)	Kilograms (kilo)
KM	Representative of the distance from the ship's keel to the metacentre
kN	Kilo-newtons
kt	Knots
kW	Kilowatt
L	Lumber (loadlines)
LASH	Lighter Aboard SHip (system)
lb	Pounds
LCG	Longitudinal centre of gravity
LEL	Lower explosive limit
LFL	Lower flammable limit
L/H	Lower hold
LNG	Liquefied natural gas
Lo-Lo	Load-on, Load-off
LP	Low Pressure
LPG (i)	Liquid propane gas
(ii)	Liquid petroleum gas
m	Metres
M	Metacentre
MA	Mechanical advantage
MARPOL	Maritime Pollution (convention)

MARVs	Maximum Allowable Relief Value Settings
MCA	Maritime and Coastguard Agency
MCTC (MTC)	Moment to change trim 1 cm
MEPC	Marine Environment Protection Committee
MFAG	Medical First Aid Guide (for use with accidents involving dangerous goods)
MGN	Marine Guidance Notice
MIN	Marine Information Notice
mm	Millimetres
MN	Mercantile Marine (Merchant Navy)
MPCU	Marine Pollution Control Unit
MS	Merchant Shipping Act
MSC (i)	Maritime Safety Committee (of IMO)
MSC (ii)	Mediterranean Shipping Company
MSL	Maximum securing load
MSN	Merchant Shipping Notice
MTSA	Maritime Transport Security Act (US)
MV	Motor vessel
MW	Megawatt
NLS	Noxious liquid substances
NMVOC	Non-methane volatile organic compound
NOS	Not otherwise specified
NPSH	Net positive suction head
NRV	Non-return valve
OBO	Oil, bulk, ore (carrier)
OCIMF	Oil Companies International Marine Forum
ORB	Oil Record Book
P	Port
Pa	Pascal
P/A System	Public Address System
PCC	Pure car carrier
PCTC	Pure car and truck carrier
PEL	Permissible exposure limit
PFSP	Port Facility Security Plan
P/L	Protective location
PMA	Permanent means of access
PNG	Pressurized natural gas
ppm	Parts per million
PSC	Port State Control
psi	Pounds per square inch
PSO	Port Security Officer
P/V	Pressure vacuum

R	Resistance
RD	Relative density
RMC	Refrigerated Machinery Certificate
Ro-Pax	Roll-on, Roll-off plus Passengers
Ro-Ro	Roll-on, Roll-off
rpm	Revolutions per minute
RVP	Reid vapour pressure
S (Stbd)(i)	Starboard
S (ii)	Summer
SBM	Single buoy mooring
SBT	Segregated ballast tank
SCBA	Self-contained breathing apparatus
SeaBee	Sea barge
SECU	StoraEnso Cargo Unit
SF	Stowage factor
S.I.	Statutory Instrument
SMC	Safety Management Certificate
SOLAS	Safety of Life at Sea (Convention)
SOPEP	Ships Oil Pollution Emergency Plan
SO_x	Oxides of sulphur
SPG	Self-supporting Prismatic-shape Gas tank
SRV system	Shuttle and Re-gasification Vessel system
SSO	Ship Security Officer
SSP	Ship Security Plan
SW	Salt water
SWL	Safe working load
SWR	Steel wire rope
T	Tropical
T/D	Tween deck
TEU	Twenty feet equivalent unit
TF	Tropical fresh
Tk	Tank
TLVs	Threshold limit values
TPC	Tonnes per centimetre
TWA	Time weighted average
U	Union Purchase – safe working load
UEL	Upper explosive limit
UFL	Upper flammable limit
UHP	Ultra high pressure
UK	United Kingdom
UKC	Under keel clearance
ULCC	Ultra large crude carrier
ULLNGC	Ultra large liquefied natural gas carrier

UN	United Nations
US	United States
USA	United States of America
USCG	United States Coast Guard
U-SWL	Union Rig – safe working load
VCM	Vinyl chloride monomer
VDR	Voyage Data Recorder
VLCC	Very large crude carrier
VOCs	Volatile organic compounds
VR	Velocity ratio
W (i)	Winter
W (ii)	Representative of the ship's displacement
WBT	Water ballast tank
WC	Water-closet (Toilet)
W/L	Waterline
WNA	Winter North Atlantic
wps	Wires per strand
YAR	York Antwerp Rules (2004)

Conversion and measurement table

Imperial/metric measurement

1 in. = 2.5400 cm   1 cm = 0.3937 in.
1 ft = 0.3048 m   1 m = 3.2808 ft

1 in.^{2} = 6.4516 cm^2 1 cm^2 = 0.1550 in.^{2}
1ft^2 = 0.09293 m^2 1 m^2 = 10.7639 ft^2

1 in.^{2} = 16.3871 cm^3 1 cm^3 = 0.0610 m^3
1 ft^3 = 0.02832 m^3 1 m^3 = 35.3146 ft^2
(where in. represents inches)

Metres to feet							
Cm	Feet	Metres	Feet	Metres	Feet	Metres	Feet
1	0.03	1	3.28	17	55.77	60	196.85
2	0.06	2	6.56	18	59.06	70	229.66
3	0.09	3	9.84	19	62.34	80	262.47
4	0.13	4	13.12	20	65.62	90	295.28
5	0.16	5	16.40	21	68.90	100	328.08
6	0.19	6	19.69	22	72.18	200	656.17
7	0.22	7	22.97	23	75.46	300	984.25
8	0.26	8	26.25	24	78.74	400	1312.33
9	0.30	9	29.53	25	82.02	500	1640.42
10	0.33	10	32.81	26	85.30	600	1968.50
20	0.66	11	36.09	27	88.58	700	2296.58
30	0.98	12	39.37	28	91.86	800	2624.66
40	1.31	13	42.65	29	95.15	900	2952.74
50	1.64	14	45.93	30	98.43	1000	3280.83
60	1.97	15	49.21	40	131.23		
70	2.30	16	52.49	50	164.04		
80	2.62						
90	2.95						

Feet to metres							
Inches	Metres	Feet	Metres	Feet	Metres	Feet	Metres
1	0.03	1	0.30	80	24.38	800	243.84
2	0.05	2	0.61	90	27.43	850	259.08
3	0.08	3	0.91	100	30.48	900	274.32
4	0.10	4	1.22	150	45.72	950	289.56
5	0.13	5	1.52	200	60.96	1000	304.80
6	0.15	6	1.83	250	76.20	1100	335.28
7	0.18	7	2.13	300	91.44	1200	365.76
8	0.20	8	2.44	350	106.68	1300	396.24
9	0.23	9	2.74	400	121.92	1400	426.72
10	0.25	10	3.05	450	137.16	1500	457.20
11	0.28	20	6.10	500	152.40	2000	609.60
12	0.30	30	9.14	550	167.64	3000	914.40
		40	12.19	600	182.88	4000	1219.20
		50	15.24	650	198.12	5000	1524.00
		60	18.29	700	213.36		
		70	21.34	750	228.60		

Tonnage and fluid measurement

	US gallons	Imperial gallons	Capacity cubic feet
1 gal (imp)	×1.2	×1	×0.1604
1 gal (US)	×1.0	×0.8333	×0.1337
1 ft^3	×7.48	×0.2344	×1.0
1 l	×0.2642	×0.22	×0.0353
1-tonne fresh water	×269	×224	×35.84
1-tonne salt water	×262.418	×218.536	×35

Weight	Short ton	Long ton	Metric tonne
Long ton (imp)	×1.12	×1.0	×1.01605
Short ton (USA)	×1.0	×0.89286	×0.90718
Metric tonne	×1.10231	×0.98421	×1.0

Grain	Bushel (imp)	Bushel (USA)	Cubic feet
1 Bushel (imp)	×1.0	×1.0316	×1.2837
1 Bushel (USA)	×0.9694	×1.0	×1.2445
1 ft^3	×0.789	×0.8035	×1.0

Miscellaneous

1 lb = 0.45359 kg   1 kg = 2.20462 lb
1 ft^3/tonne = 0.16 imp gal/tonne
1 tonne/m^3 = 0.02787 tonne/ft^3

Chapter 1

General principles of the handling, stowage and carriage of cargoes

Introduction

The transport of cargoes dates back through the centuries to the Egyptians, the Phoenicians, ancient Greeks and early Chinese, long before the Europeans, ventured beyond the shores of the Atlantic. Strong evidence exists that the Chinese Treasure Ships traded for spices, and charted the Americas, Antarctica, Australia and the Pacific and Indian Oceans, before Columbus reportedly discovered America.*

The stones for the Pyramids of Egypt had to be brought up the River Nile or across the Mediterranean and this would reflect the means of lifting heavy weights, and transporting the same was a known science even before the birth of Christ. Marco Polo reported 200 000 vessels a year were plying the Yangtze River of China in 1271 and it must be assumed that commerce was very much alive with a variety of merchandise being transported over water.

Products from the world's markets have grown considerably alongside technology.

Bigger and better ships feed the world populations and the methods of faster and safer transport have evolved over the centuries.

The various cargoes and merchandise may be broadly divided into the following six types:

1. Bulk solids
2. Bulk liquids
3. Containerized units
4. Refrigerated/chilled
5. General, which includes virtually everything not in (1), (2), (3) and (4) above
6. Roll-on, Roll-off (Ro-Ro) cargoes.

*Menzies, G. (2002) 1421 The Year China Discovered the World, Bantam Press.

Bulk cargoes can be loaded and discharged from a ship quickly and efficiently. Conversely, we have yet to see 10 000 tonnes of grain being loaded into a Jumbo Jet. Ships remain the most efficient means of transport for all cargo parcels of any respectable weight or size.

It is here that the business of how it is loaded, how it is stowed and subsequently shipped to its destination is investigated. Later chapters will deal with specifics on the commodities, but the methods of handling prior to starting the voyage and the practical stowage of goods, should be considered an essential element of the foundation to successful trade.

Definitions and cargo terminology

Air draught – means the vertical distance from the surface of the water to the highest point of the ship's mast or aerial.

Bale space capacity – is that cubic capacity of a cargo space when the breadth is measured from the inside of the cargo battens (spar ceiling) and the measured depth is from the wood tank top ceiling to the underside of the deck beams. The length is measured from the inside of the fore and aft bulkhead stiffeners.

Broken stowage – is defined as that space between packages which remains unfilled. The percentage that has to be allowed varies with the type of cargo and with the shape of the ship's hold. It is greatest when large cases are stowed in an end hold or at the turn of a bilge.

Cargo information – means appropriate information relevant to the cargo and its stowage and securing which should specify, in particular, the precautions necessary for the safe carriage of that cargo by sea.

Cargo plan – a ship's plan which shows the distribution of all cargo parcels stowed on board the vessel for the voyage. Each entry onto the plan would detail the quantity, the weight and the port of discharge. The plan is constructed by the Ship's Cargo Officer and would effectively show special loads such as heavy-lifts, hazardous cargoes, and valuable cargo, in addition to all other commodities being shipped.

Cargo runner – a general term used to describe the cargo lifting wire used on a derrick. It may be found rove as a 'single whip' or doubled up into a 'gun tackle' (two single blocks) or set into a multi-sheave lifting purchase. It is part of the derricks 'running rigging' passing over at least two sheaves set in the head block and the heel block, prior to being led to the barrel of the winch. Normal size is usually 24 mm and its construction is flexible steel wire rope (FSWR) of 6 × 24 wires per strand (wps).

Cargo securing manual – a manual that is pertinent to an individual ship, and which will show the lashing points and details of the securing of relevant cargoes carried by the vessel. It is a ship's reference which specifies the on-board securing arrangements for cargo units, including vehicles and containers, and other entities. The securing examples are based on the transverse, longitudinal and vertical forces which may arise during adverse

weather conditions at sea. The manual is drawn up to the standard contained in Maritime Safety Committee (MSC) Circular of the Organization, MSC/Circ. 745.

Cargo ship – defined as any ship which is not a 'Passenger Ship', troop ship, pleasure vessel or fishing boat.

Cargo spaces – (e.g. cargo hold) – means all enclosed spaces which are appropriate for the transport of cargo to be discharged from the ship. Space available for cargo may be expressed by either the vessel's deadweight or her cubic capacity in either bale or grain space terms.

Cargo unit – includes a cargo transport unit and means wheeled cargo, vehicles, containers, flat pallet, portable tank packaged unit or any other cargo and loading equipment or any part thereof, which belongs to the ship and which is not fixed to the ship.

Centre of buoyancy – is defined as the centre of the underwater volume; that point through which all the forces due to buoyancy are considered to act.

Centre of gravity (C of G) – is defined as that point through which all the forces due to gravity are considered to act. Each cargo load will have its own C of G.

Dangerous goods – are defined as such in the Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1990.

Deadweight – means the difference in tonnes between the displacement of a ship at the summer load waterline in water of specific gravity of 1025, and the lightweight of the ship.

Deadweight cargo – is cargo on which freight is usually charged on its weight. While no hard and fast rules are in force, cargo stowing at less than 1.2 m^3/tonne (40 ft^3/tonne) is likely to be rated as deadweight cargo.

Dunnage – an expression used to describe timber boards which can be laid singularly or in double pattern under cargo parcels to keep the surface of the cargo off the steel deck plate. Its purpose is to provide air space around the cargo and so prevent 'cargo sweat'. Heavy-lift cargoes would normally employ heavy timber bearers to spread the load and dunnage would normally be used for lighter-load cargoes.

Flemish Eye – a name given to a Reduced Eye made of three strands (not six), spliced into the end of a cargo runner which is secured to the barrel of a winch (alternative names are Spanish Eye, or Reduced Eye).

Flemish hook – a large hook, often used in conjunction with the lower purchase block in the rigging of a heavy-lift derrick. The hook can be opened to accommodate the load slings and then bolt locked.

Floodable length – the maximum length of a compartment that can be flooded to bring a damaged vessel to float at a waterline which is tangential to the margin line. *Note*: In determining this length account must be taken of the permeability of the compartment.

Freight – the term used to express the monetary charge which is levied for the carriage of the cargo.

Gooseneck – the bearing and swivel fitment, found at the heel of a derrick which allows the derrick to slew from port to starboard, and luff up and down when in operation.

Grain capacity – is that cubic capacity of a cargo space when the length, breadth and depth are measured from the inside of the ship's shell plating, all allowances being made for the volume occupied by frames and beams.

Gross tonnage – is defined by the measurement of the total internal capacity of the ship. GT being determined by the formula: GT = KiV where

$$Ki = 0.2 + 0.02 \text{ Log } 10V$$

V = Total volume of all enclosed spaces in cubic metres

Hallen universal swinging derrick – a single swinging derrick with a lifting capacity of up to about 100 tonnes safe working load (SWL) The original design employed a 'D' frame, to segregate the leads of the combined slewing and topping lift guys. The more modern design incorporates 'outriggers' for the same purpose.

Hounds Band – a lugged steel band that straps around a 'mast'. It is used to shackle on shrouds and stays. It is also employed to secure 'Preventor Backstays' when a heavy derrick is being deployed in order to provide additional strength to the mast structure when making the heavy lift.

Load density plan – a ships plan which indicates the deck load capacity of cargo space areas of the ship. The Ship's Chief Officer would consult this plan to ensure that the space is not being overloaded by very dense, heavy cargoes.

Long tonne – a unit of mass weight, equal to 2240 lb (tonne).

Luffing – a term which denotes the movement of a crane jib or derrick boom to move up or down, i.e. 'luff up' or 'luff down'.

Luffing derrick – a conventional single swinging derrick rigged in such a manner that permits the derrick head to be raised and lowered to establish any line of plumb, as opposed to static rigged derricks, as with a 'Union Purchase Rig'.

Measurement cargo – is cargo on which freight is usually charged on the volume occupied by the cargo. Such cargo is usually light and bulky stowing at more than 1.2 m^3 per tonne (40 cu. ft./tonne), but may also be heavy castings of an awkward shape where a lot of space is occupied.

Passenger Ship – a ship designed to carry more than 12 passengers.

Permeability – in relation to a compartment space means the percentage of that space which lies below the margin line which can be occupied by water. *Note*: various formulae within the Ship Construction Regulations are used to determine the permeability of a particular compartment. Example values are spaces occupied by cargo or stores 60%, spaces employed for

Permissible length – of a compartment having its centre at any point in the ships length is determined by the product of the floodable length at that point and the factor of subdivision of the vessel:

$$\text{permissible length} = \text{floodable length} \times \text{factor of subdivision.}$$

Riding turn – an expression that describes a cross turn of wire around a barrel of a winch, or stag horn. It is highly undesirable and could cause the load to jump or slip when in movement. The condition should be cleared as soon as possible.

Ring bolt – a deck ring or 'pad eye' often used in conjunction with a doubling plate or screw securing. It is employed to provide an anchor point for associated rigging around a derrick position.

Running rigging – a descriptive term used to describe wire or cordage ropes which pass around the sheave of a block (see also 'Standing Rigging'). Where steel wire ropes are employed for running rigging they are of a flexible construction, examples include: 6 × 24 wps and 6 × 36 wps.

Safe working load – an acceptable working tonnage used for a weight-bearing item of equipment. The marine industry uses a factor of one-sixth the breaking strain (BS) to establish the safe working value.

Safety tongue – a spring clip sealing device to cover the jaw of a lifting hook. It should be noted that these devices are not fool proof and have been known to slip themselves unintentionally. The tongue is meant to replace the need of 'mousing' the hook, and is designed to serve the same purpose as a 'mousing'.

Schooner guy – a bracing guy which joins the spider bands at the derrick heads of a 'Union Purchase Rig'.

Sheer legs – a large lifting device employed extensively within the marine industry. It is constructed with a pair of inclined struts resembling a crane, although the action when working is similar to a craning activity. (Smaller versions of sheer legs were previously used within the marine industry on tankers to hoist pipelines on board or more commonly found in training establishments for training cadets in rigging applications.) The modern day sheer legs are now found on floating heavy-lift (crane) barges and employed for extreme lifting operations usually with 'project cargoes'.

Shore – a term used to describe a support, given to decks, bulkheads or cargo. They are usually timber, but may be in the form of a metal stanchion, depending on the intended use (see tomming).

Slings – a term which describes the lifting strops to secure the load to be hoisted to the lift hook of the derrick or crane. Slings may be manufactured in steel wire rope, chains, rope or canvas.

Snatch block – a single sheave block, often employed to change the direction of lead, of a wire or rope. The block has a hinged clamp situated over the 'swallow' which allows the bight of a wire or rope to be set into the block

Snotter – a length of steel wire with an eye in each end. Employed around loads as a lifting sling, with one eye passed through the other to tighten the wire around the load.

Speed crane – modern derrick design with multi-gear operation which operates on the principle of the single jib, point loading crane.

Spider band – a steel lugged strap found around the head of a derrick which the rigging, such as the topping lift and guys are shackled onto. The equivalent on a mast structure is known as a 'Hounds Band'.

Spreader – a steel or wood batten which effectively spreads the wire sling arrangement wider apart when lifting a large area load. Use of such a spreader generally provides greater stability to the movement of the weight. Formerly referred to as a lifting beam.

Stabilizers – Steel outriders, often telescopic in design and fitted with spread feet, which are extended from the base unit of a shoreside mobile crane. Prior to taking the load the stabilizers are set to ensure that the load on the crane jib will not cause the crane to topple. (Not to be confused with ship stabilizers fitted to ships to reduce rolling actions of the vessel when at sea.)

Standing Rigging – a term used to describe fixed steel wire rope supports. Examples can be found in ship's stays and shrouds. Construction of Standing Rigging is usually 6×6 wps.

Stowage factor – this is defined as that volume occupied by unit weight of cargo. Usually expressed as cubic metres per tonne (m^3/tonnes) or cubic feet per tonne (ft^3/tonne). It does not take account of any space which may be lost due to 'broken stowage'. A representative list of stowage factors is provided at the end of this book.

Subdivision factor – the factor of subdivision varies inversely with the ship's length, the number of passengers and the proportion of the underwater space used for passenger/crew and machinery space. In effect it is the factor of safety allowed in determining the maximum space of transverse watertight bulkheads, i.e. the permissible length.

Tomming off – an expression that describes the securing of cargo parcels by means of baulks of timber. These being secured against the cargo to prevent its movement if and when the vessel is in a seaway and experiencing heavy rolling or pitching motions (alternative term is 'shore').

Tonne – originated from the word 'tun' which was a term used to describe a wine cask or wine container, the capacity of which was stated as being 252 gallons as required by an Act of 1423, made by the English Parliament. It is synonymous that 252 gallons of wine equated to approximately 2240 lb, '1 tonne' as we know it today.

Trunnion – a similar arrangement to the 'gooseneck' of a small derrick. The Trunnion is normally found on intermediate size derricks of 40 tonnes or over. They are usually manufactured in cast steel and allow freedom of movement from the lower heel position of the derrick.

Tumbler – a securing swivel connection found attached to the 'Samson Post' or 'Mast Table' to support the topping lift blocks of the span tackle.

'U' bolt – a bolt application which secures the reduced eye of a cargo runner to the barrel of a winch.

Union Plate – a triangular steel plate set with three eyelets used in 'Union Rig' to join the cargo runners and hook arrangement when a 'triple swivel hook' is not employed. It can also be used with a single span, topping lift derrick to couple the downhaul with the chain preventor and bull wire. Sometimes referred to as 'Monkey Face Plate'.

Union Rig – Alt; Union Purchase Rig. A derrick rig which joins two single swinging derricks to work in 'Union' with cargo runners joined to a triple swivel hook arrangement known as a 'Seattle Hook' or 'Union Hook'. The rig was previously known as 'Yard and Stay' and is a fast method of loading/discharging lighter parcels of cargo. Union Rig operates at approximately one-third of the SWL of the smallest derrick of the pair.

Velle Derrick – a moderate heavy-lift derrick that can be operated as a crane by a single operator. The derrick is constructed with a 'T' bridle piece at the head of the derrick which allows topping lift wires to be secured to act in way of slewing guys and/or topping lift.

Walk back – an expression which signifies reversing the direction of a winch in order to allow the load to descend or the weight to come off the hoist wires.

Weather deck – means the uppermost complete deck exposed to the weather and the sea.

Wires per strand – an expression (abbreviated as wps) which describes the type of construction of the strands of a steel wire rope.

Yard and Stay – alternative descriptive term for Union Purchase Rig.

Conventional general cargo handling

Cargo gear

Derricks, cranes and winches, together with their associated fittings should be regularly overhauled and inspected under a planned maintenance schedule, appropriate to the ship. Winch guards should always be in place throughout winching operations and operators should conform to the Code of Safe Working Practice (CSWP) (Figure 1.1).

Only certificated tested wires, blocks and shackles should be used for cargo handling and lifting operations.

Note: *Wire ropes which have broken wires in strands should be replaced. Whenever 10% of wires are broken in any eight (8) diameters length, the wire should be condemned. Guy pennants, blocks and tackles should be kept in good condition.*

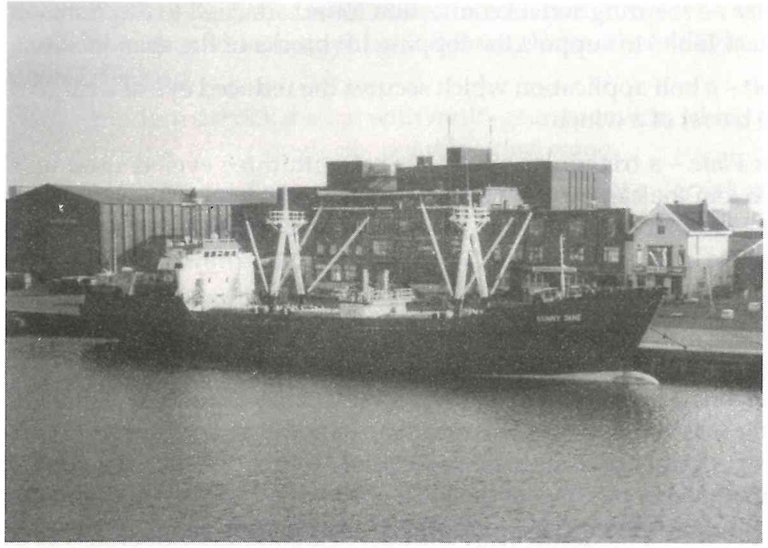


Fig. 1.1 The conventional 'general cargo' vessel 'Sunny Jane' lies port side to, alongside in the Port of Amsterdam. The vessel is fitted with conventional derricks, supported by bi-pod mast structures.

Derrick rigs – Union Purchase Method

The Union Purchase Method of rigging derricks is perhaps the most common with conventional derrick rigs (Figure 1.2). With this operation, one of two derricks plumbs the hatch and the other derrick plumbs overside. The two runner falls of the two derricks are joined together at the cargo 'Union Hook' (this is a triple swivel hook arrangement sometimes referred to as a 'Seattle Hook'). The load is lifted by the fall which plumbs the load, when the load has been lifted above the height of the bulwark or ship's rail, or hatch coaming, the load is gradually transferred to the fall from the second derrick (Figure 1.3).

Cargo movement is achieved by heaving on one derrick runner and slacking on the other. The safe working angle between the runners is 90° and should never be allowed to exceed 120°. There is a danger from overstressing the gear if unskilled winch drivers are employed or if winch drivers do not have an unobstructed view of the lifting/lowering operation. In the latter case, signallers and hatch foremen should always be employed within line of sight of winch operators.

The CSWP for Merchant Seaman provides a code of hand signals for use in such cargo operations.

Single swinging derricks

The conventional derrick was initially evolved as a single hoist operation for the loading and discharging of weights. It was the basic concept as an aid which became popular when combined within a 'Union Rig'. However,

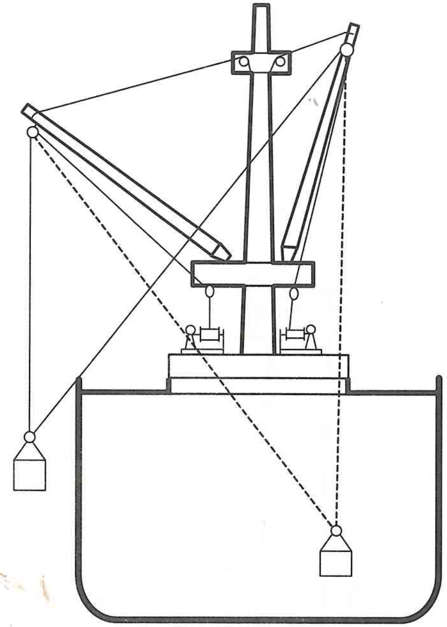


Fig. 1.2 Union purchase. Derrick rig.

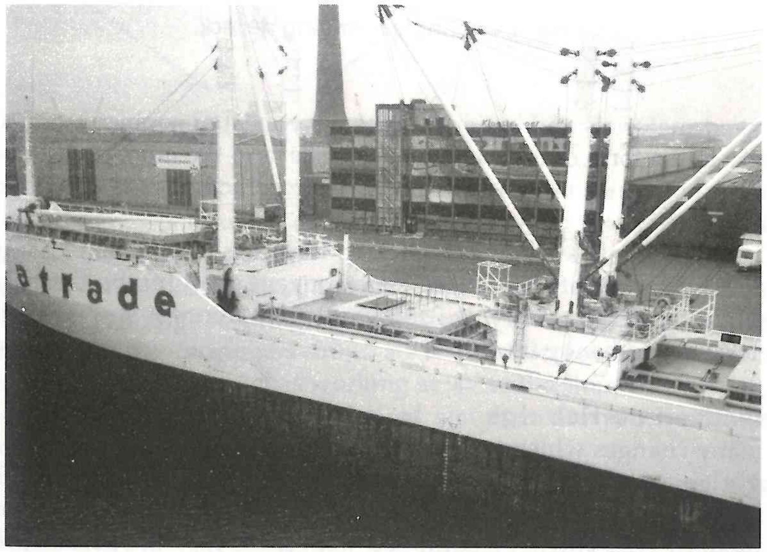


Fig. 1.3 The conventional derrick rig. Modern general cargo vessel rigged with conventional 5 tonne SWL derricks and steel hatch covers. The derricks can be rigged to operate as single swinging derricks or rigged in 'Union Purchase' SWL (U) = 1.6 tonnes. Such vessels are in decline because of the growth in unit

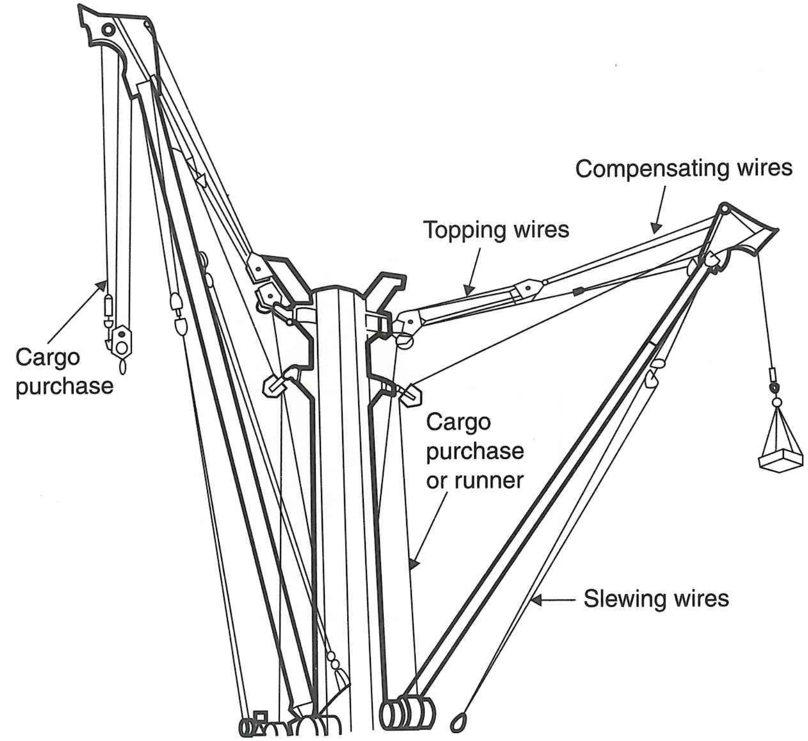


Fig. 1.4 Single swinging derrick.

improved materials and better designs have created sophisticated, single derricks in the form of the 'Hallen', the 'Velle' and the more popular speed cranes. All of which now dominate the reduced activities of general cargo ships (Figure 1.4).

Where the single swinging derrick concept has been retained is in the arena of the heavy-lift operation. Here conventional 'Jumbo Derricks', of the single swinging variety, are still employed amongst specialist rigs as 'Stuelckens' and heavy-lift ships.

Specialized derrick rigs

The many changes which have occurred in cargo-handling methods have brought about extensive developments in specialized lifting gear. These developments have aimed at efficient and cost-effective cargo handling and modern vessels will be equipped with some type of specialist rig for operation within the medium to heavy-lift range.

The 'Hallen derrick'

This is a single swinging derrick which is fast in operation and can

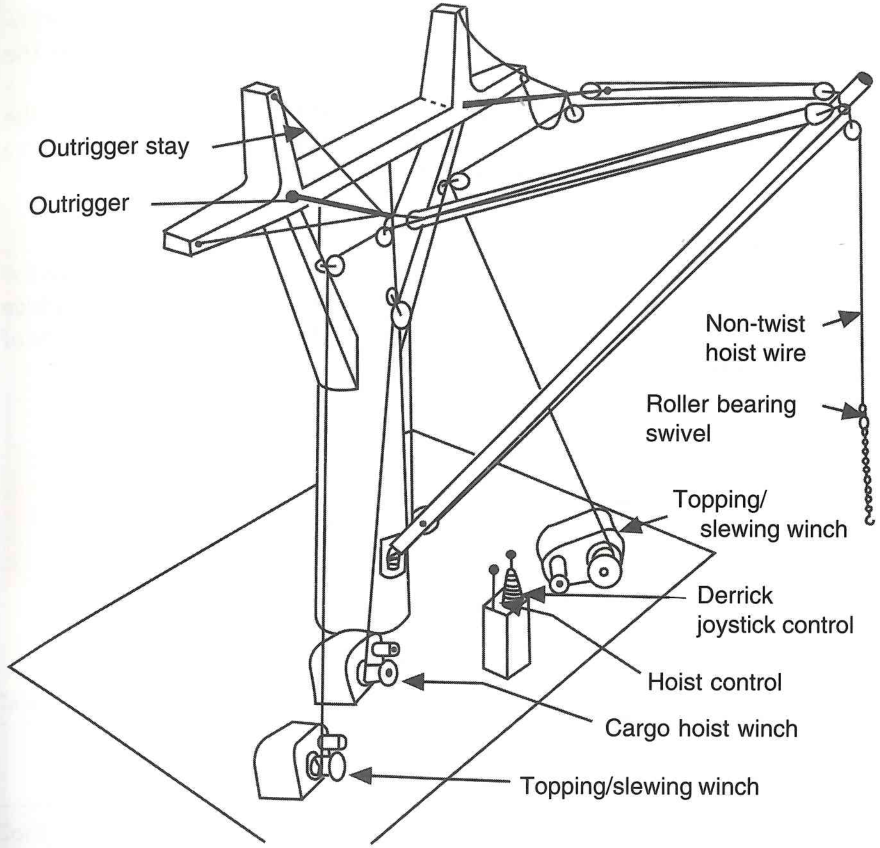


Fig. 1.5 Hallen Derrick.

tonne SWL range and, when engaged, operate under a single-man control (Figure 1.5).

Joystick control for luffing and slewing is achieved by the Port and Starboard slewing guys being incorporated into the topping lift arrangement. Use of the outriggers from a 'Y' mast structure provides clear leads even when the derrick is working at 90° to the ships fore and aft line. A second hoist control can be operated simultaneously with the derrick movement.

As a one-man operation, it is labour saving over and above the use of conventional derricks, while at the same time keeps the deck area clear of guy ropes and preventors. Should heavy loads be involved only the cargo hoist would need to be changed to satisfy different load requirements.

The 'Hallen Derrick' has a similar concept to the 'Velle', in that the topping lift arrangement and the slewing wires are incorporated together and secured aloft, clear of the lower deck. The outreach and slew are wide achieved by the

Both systems are labour saving and can be operated by a single controller, operating the luffing and slewing movement together with the cargo hoist movement.

The Hallen is distinctive by the 'Y' mast structure that provides the anchor points for the wide leads. The derrick also accommodates a centre lead sheave to direct the hoist wire to the relevant winch.

'Velle Derrick'

Similar in design to the 'Hallen' but without use of outriggers. The leads for the topping lift and slewing arrangement are spread by a cross 'T' piece at the head of the derrick. A widespread structured mast is also a feature of this rig (Figures 1.6 and 1.7).

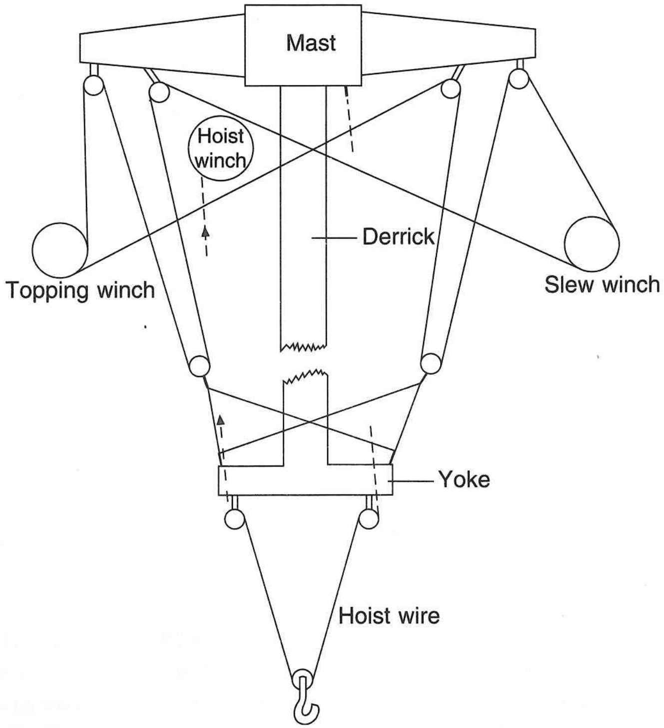


Fig. 1.6 Rigging system on the Velle Derrick. Luffing and slewing actions of the derrick are powered by two winches each equipped with divided barrels to which the bare ends of the fall wires are secured.

Again it is a single-man operation, with clear decks being achieved while in operation. Generally, the 'Velle' is manufactured as a heavier rig and variations of the design with a pivot cross piece at the derrick head are used

Fig. 1.7 Velle derrick.

Table 1.1 SWLs for cordage and FSWR

	Material	*Structure*	*BS formula*	*SWL @ one-sixth BS*
Cordage	Manila	3 stranded hawser laid	$2D^2/300$	$2D^2/1800$
	Polypropylene	3 stranded hawser laid	$3D^2/300$	$3D^2/1800$
	Terylene	3 stranded hawser laid	$4D^2/300$	$4D^2/1800$
	Nylon	3 stranded hawser laid	$5D^2/300$	$5D^2/1800$
FSWR	FSWR	6 × 24 wps	$20D^2/500$	$20D^2/3000$
	Grade 1, stud chain	12.5–120 mm	$20D^2/600$	$20D^2/3600$

Working with a lifting plant

At no time should any attempt be made to lift weights in excess of the SWL of the weakest part of the gear. The SWL is stamped on all derricks, blocks and shackles as well as noted on the 'test certificates'. Wire ropes are delivered with a test certificate on which will be found the SWL of the wire.

Assuming that the SWL is one-sixth of the BS, the regulations require a minimum of one-fifth. The approximate SWL of various materials can be

When lifting loads in excess of about 1.5 tonnes, steam winches should generally be used in double gear. Electric winches are usually fused for a SWL of up to about 3 tonnes. For loads in excess of 2–3 tonnes it would be normal practice with conventional derricks to double up the rig, as opposed to operating on a single part runner wire.

Derricks may be encountered with two SWL marks on them. In such cases the lesser value is usually marked with a 'U' signifying the SWL for use in Union Purchase Rig. In the event the derrick is not marked, and intended for use in a Union Rig, the SWL is recommended not to exceed one-third of the smallest of the two derricks (approx).

Use of lifting purchases

The purchase diagrams shown are rigged to disadvantage. The velocity ratio (VR) is increased by '1' if the tackle is rigged to advantage.

The required purchase (the common ones are illustrated in Figure 1.8). The stress factors incurred with their use can be found by the following formula assuming 10% for friction:

$$S \times P = W + nW\,(10/100)$$

where S is the stress in the hauling part; P is the power gained by the purchase (this is the same as the number of rope parts at the moving block); n is the number of sheaves in the purchase; W is the weight being lifted 10, which is the numerator of the fraction, is an arbitrary 10% allowance for friction.

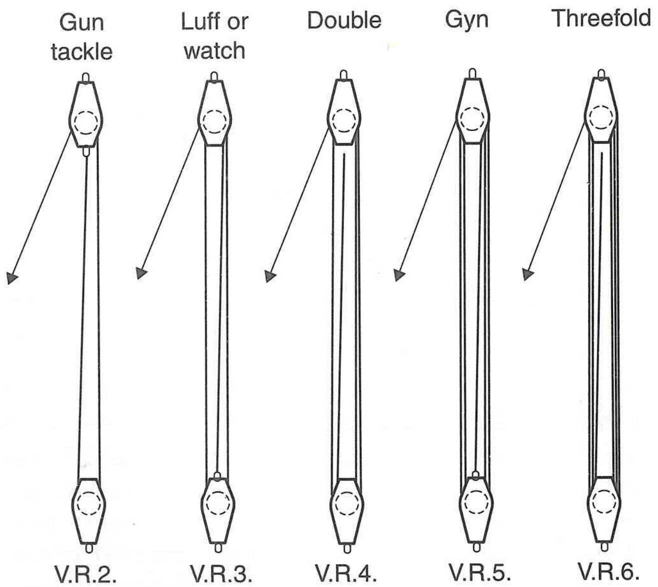


Fig. 1.8 All tackles rove to disadvantage and VRs stated for this rig (when

Cargo-handling equipment – condition and performance

Before any cargo operation takes place it is essential that the Chief Officer is confident that the ships lifting equipment and associated loading/discharge facilities are 100% operational and free of any defects. Under the Lifting Plant Regulations, the International Safety Management (ISM) Code, and ship's planned maintenance schedule all-cargo-handling equipment could expect to be inspected and maintained at regular intervals.

In the case of lifting plant, derricks, cranes, shackles, wires, etc. the following test times would be required:

1. after installation when new
2. following any major repair
3. at intervals of every 5 years.

Testing and inspection of plant

Cargo lifting appliances must be inspected to establish that they are correctly rigged on every occasion they are used. To this end, the Chief Officers would normally delegate this duty to the Deck Cargo Officers to check the rig prior to commencing loading or discharge operations.

A thorough inspection would also take place annually by a 'competent person', namely the Chief Officer himself. This duty would not be delegated to a Junior Officer. This inspection would cause a detailed inspection to take place of all aspects – hydraulic, mechanical and electrical – of the lifting appliances. All wires would be visually inspected for defects and the mousing on shackles would be sighted to be satisfactory. The 'gooseneck' of derricks and all blocks would be stripped down and overhauled.

Thorough inspections would detect corrosion, damage, hairline cracks and excessive wear and tear. Once defects are found corrective action would be taken to ensure that the plant is retained at 100% efficiency. These inspections would normally be carried out systematically under the ship's planned maintenance schedule. This allows a permanent record to be maintained and is evidence to present to an ISM Auditor.

Testing plant

Lifting appliances are tested by a cargo surveyor at intervals of 5 years, or following installation or repairs. The test could be conducted by either of two methods:

1. By lifting the proof load, and swinging the load through the derrick or crane's operating arc, as per the ship's rigging plan. This test is known as the 'dynamic test' and concrete blocks of the correct weight are normally used to conduct this operation.
2. The static test is carried out employing a 'dynamometer' secured to the lifting point of the rig and an anchored position on the deck. The proof load weight is then placed on the rig and measured by the dynamometer,

Certification

Once the testing has been completed satisfactorily, each lifting apparatus would be issued with a test certificate and the Chief Officer would retain all certificates in the 'Register of Ships Lifting Appliances and Cargo-Handling Gear'.

In addition to these test certificates all shackles, wires, blocks, etc. would be purchased as proof tested and delivered to the vessel with its respective certificate. These would be retained in the Chief Officers Register. The SWL and the certificate number are found stamped into the binding straps of each block. Grease recesses are found inside the bush and inside the inner-bearing surface of the centre of each sheave. The 'axle bolt' is of a square cross-section to hold the bearing 'bush', this allows the sheave to rotate about the bush. In the event that a shackle or block is changed, the certificate in the register would also be changed, so keeping the ships records up to date (Figure 1.9).

Derrick maintenance

As with many items of equipment, derrick rigs must similarly be checked and seen to be correctly rigged on every occasion prior to their engagement. It would be normal practice for the Ship's Chief Officer to delegate this supervisory task to the duty Deck/Cargo Officer before loading or discharge operations is allowed to commence.

In addition to the regular working checks, all lifting gear should undergo an annual inspection by a responsible person, namely the Ship's Chief Officer. This annual inspection is never delegated but would be carried out under the scrutiny of the ship's mate. The annual inspection would entail the overhaul and total inspection of all the derrick's moving parts inclusive of the head and heel blocks, the lifting purchase blocks, the topping lift and runner wires. The condition of the guys would also be inspected and the emphasis would be placed on the main weight-bearing element of the 'gooseneck'.

The annual inspections do not usually require the derrick to be tested unless a degrading fault is found in the rig, necessitating a new part or a replacement part to be used. Testing normally taking place at 5-yearly intervals or if repairs have been necessary or in the event of the derricks being brought back into use, after a period of lay up. If testing is required, this would be carried out in the presence of a cargo surveyor and the lifting gear would have to show handling capability up to the proof load.

In order to conduct an annual inspection, the Chief Officer would order the complete overhaul of all the blocks associated with the derrick rig. Normal practice would dictate that the ship's boatswain would strip the blocks down and clean off any old grease and clear the grease recesses in the bush and the inside of the sheaves. The 'bolt' would be extracted and the bush bearing would be withdrawn. Inspection by the Senior Officer would take place and any signs of corrosion, hairline cracks or excessive wear and tear would be monitored. If the steelwork is found to be in good working order without any visible defects or signs of deterioration it would

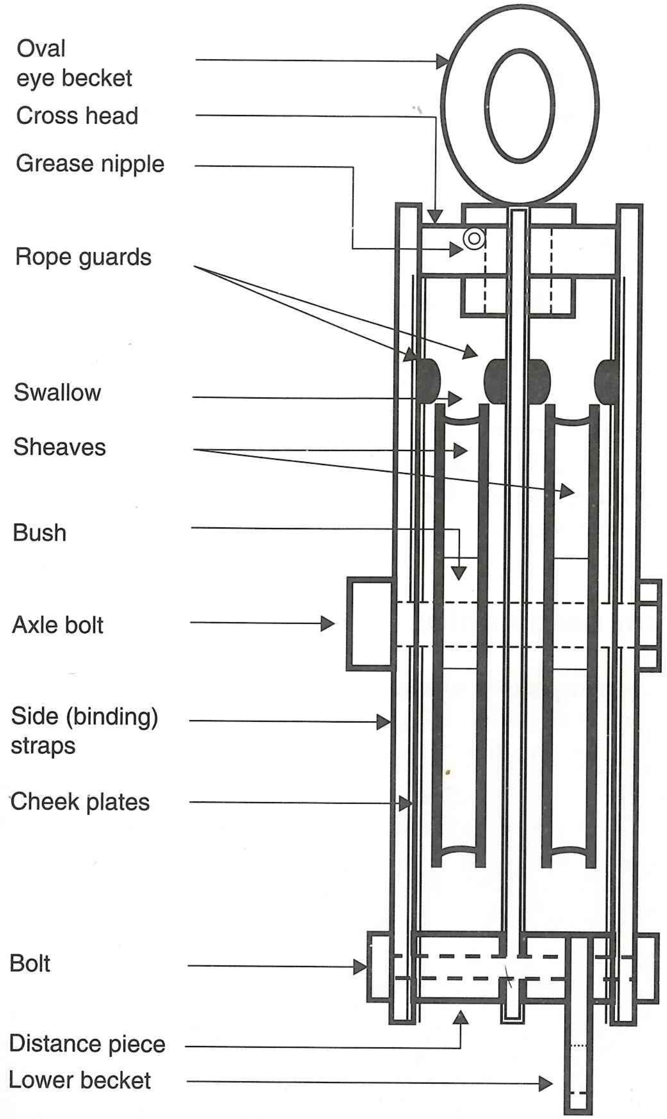


Fig. 1.9 Parts of the Cargo Block.

It is a requirement of the ISM system that lifting gear is correctly maintained and inspected at regular intervals. Most shipping companies comply with this requirement by carrying out such inspections and maintenance under a 'planned maintenance schedule'. Such a procedure ensures that not only lifting gear, but mooring winches, pilot hoists and any other mechanical or weight-bearing equipment is regularly maintained and continuously monitored; inspections, tests and repairs being dated and certificates being retained in the Register of Lifting Appliances and Cargo-Handling Gear.

Deck cranes

Preparation for maintenance of topping lift blocks

Prior to carrying out any overhaul of the topping lift blocks, the wire must be cleared from the sheaves. In order to strip the wire clear of the blocks the derrick should be stowed in the crutch support at deck level. The bare end of the downhaul should be crimped to a cable sock and joined to a heaving line. This will permit the wire itself to be pulled through the sheaves from the end of the wire which has the hard eye shackled to the block. This action will leave the heaving line (long length) rove through the sheaves of the two blocks.

The blocks can then be lowered from the position aloft without bearing the excessive weight of the wire. At deck level the upper blocks can be overhauled in a safe environment.

Once the topping lift wire has been lubricated at deck level, it can be re-rove by pulling the heaving line with the oiled wire back through the sheaves of the blocks.

Cranes on cargo ships

Shipboard heavy duty cranes

To say that cranes are more fashionable than derricks is not strictly a correct statement. To say that they are probably more compact and versatile is

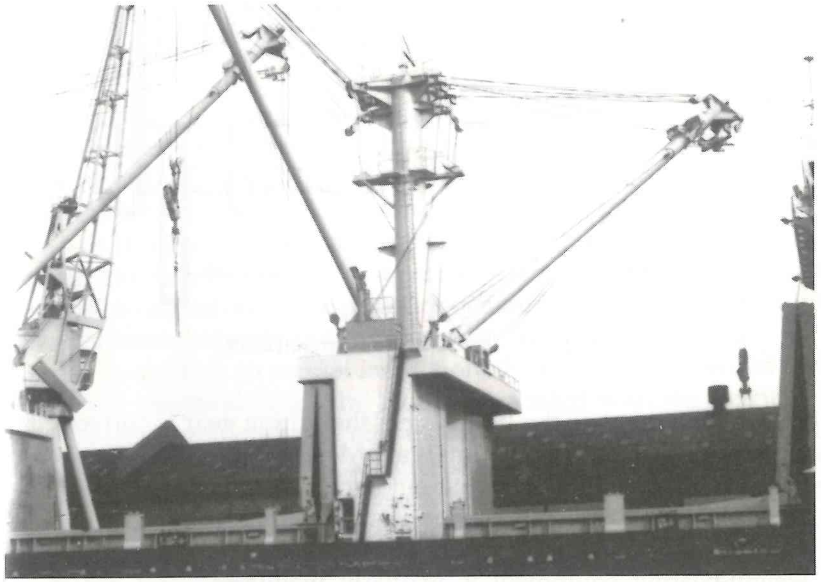


Fig. 1.10 Speed crane/derricks in operation from on top of the Mast House of a general cargo vessel.

more to the point. They tend to be more labour saving than derricks but if comparisons are made for that heavier load capacity and greater lifting capability, then the modern heavy-lift derrick must remain dominant (Figure 1.10).

Single-man drive and control is the key feature of the crane. They can achieve the plumb line quickly and accurately and for up to 40 tonnes SWL they tend to be well suited for shipboard operations. The main drawback for ship-mounted cranes is that the level of shipboard maintenance is increased, usually for the engineering department. They also need skilled labour to handle this increased maintenance workload (Figure 1.11).

In this day and age, flexibility in shipping must be considered essential and such example cranes can be gear shifted into a faster mode of operation

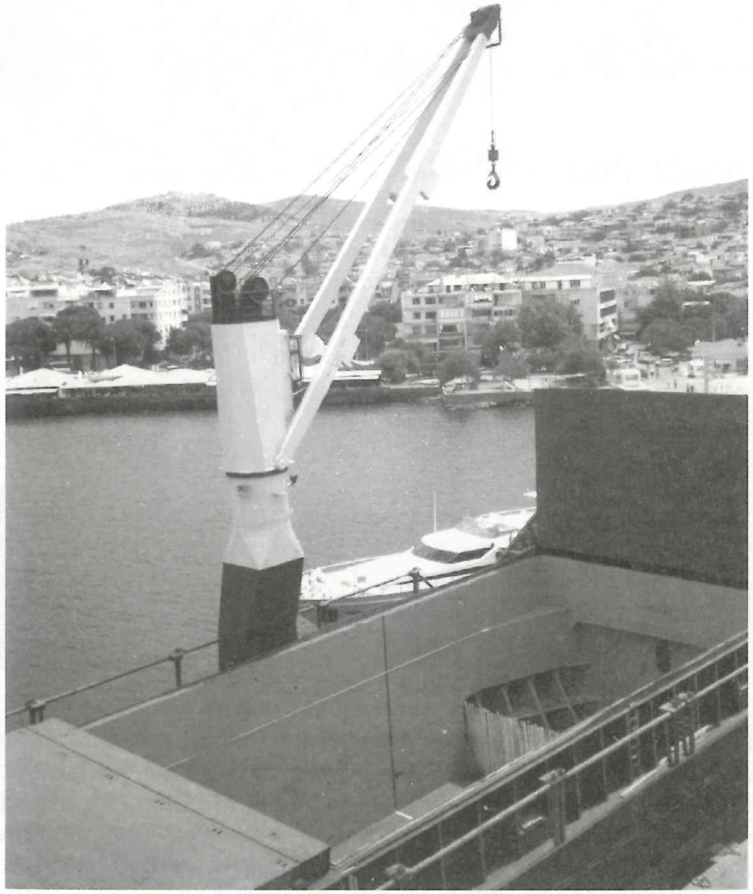


Fig. 1.11 Example of a Deck 25 tonne SWL crane aboard the general cargo vessel Scandia Spirit. The vessel carries two deck cranes, both mounted on the port side of the vessel.

for handling containers up to 36 tonnes or other similar light general cargo parcels (Figure 1.12).

Fig. 1.12 The 'Sir John' general-purpose cargo vessel lies starboard side to in the Port of Barcelona. Fitted with two heavy-duty deck cranes both situated on the starboard side of the vessel.

In the main, shipboard cranes are in a fixed location, often located offset centre, to one side of the vessel; offset centre cranes having the benefit of an extended outreach for the crane jib. The drawback here is that the vessel is then conditioned to berth crane side to, at each docking, unless working into barges.

Cranes are generally operated with specialized wires having a non-rotational, non-twist property, sometimes referred to as 'wirex'. The lay of the wire being similar to a multi-plate design, wove around a central core in opposition to the directional lay of the core; wires being tested in the normal manner as any other flexible steel wire construction. Despite these anti-twist properties, most incorporate a swivel arrangement over and above the hooking arrangement.

Where cranes are employed in tandem, they tend to be used in conjunction with a bridle or spreader arrangement to engage the total load volume. When lifting close to the crane capacity, such additional items need to be included in the total weight load for the purpose of calculation of the SWL (Figures 1.13 & 2.22).

> *Note: Some bridle arrangements are often constructed out of steel section and in them-*

Fig. 1.13 The two deck cranes of the 'Dania' a general cargo/heavy-lift/container option vessel seen lying starboard side to, in Cadiz, Spain. The aft crane is seen in the elevated position while the forward crane is in its stowed position (SWL = 35 tonnes).

Fig. 1.14 The 'Norvik' general cargo vessel pictured in the Port of Limassol, Cyprus. The ship has turned her deck cranes outboard to allow access for the suctions of the grain elevators to discharge a bulk cargo of grain.

Most cranes operate within limits of slew, and with height-luffing limitations. This is not to say that 360° rotational cranes are not available. Virtually all cranes are manufactured to operate through a complete circular arc but limit switches are usually set with shipboard cranes to avoid the jib fouling with associated structures. Safe operational arcs are normally depicted on

Operator cabs are usually positioned with aerial viewing and provide crane drivers with clear views of the lifting and hoist/ground areas. Topping lift arrangements generally passing overhead and behind the cabin space tend not to interfere with the driver's overall aspects. The hoist and topping lift wires are accommodated on winch barrels found in the base of the crane beneath the cab position.

Crane advantage over derricks	Crane disadvantage over derricks
Simple operation.	Comparatively high installation cost.
Single-man operation, derricks are more labour intensive.	Increased deck space required, especially for 'gantry' type cranes.
Clear deck operational views.	Design is more complex, leaving more to go wrong.
Clear deck space of rigging.	Specialist maintenance required. Hydraulics and electrics.
Versatility with heavy loads, and not required to de-rig.	The SWL of cranes is generally less than that of specialist derrick rigs.
360° slew and working arc when compared with limited operating areas for derricks.	
Able to plumb any point quickly making a faster load/discharge operation.	
Enclosed cabin for operator, where as the majority of derrick operators are exposed, offering greater operator protection and comfort.	
Cranes are acceptably safer to operate because of their simplicity, where derrick rigs can be overly complicated in rigging and operation.	
Cranes can easily service two hatches, or twin hatches in the fore and aft direction because of their 360° slew ability. Derrick rigs are usually designed to service a specific space. *Note: There are exceptions though. Some derrick designs with double-acting floating head rigs can work opposing hatches.*	

Ship's cranes are versatile and have become increasingly popular since their conception. This is because of advanced designs having increased lift capacity and flexible features. They are manufactured in prefabricated steel

which incorporate strength section members capable of accepting heavier loads, while at the same time retaining the ability to handle the more regular lighter load.

Gantry cranes (shipboard)

Gantry cranes are extensively found shoreside in the 'container terminals' and these will be described in a later chapter. The use of gantries aboard ships has reduced dramatically on new tonnage because of the extensive facilities found at the terminal ports.

Where gantry rigs do operate, they tend to be 'Tracked Gantry Rigs' which tend to travel the length of the cargo deck in order to service each cargo hold. They also use the rig for moving the hatch covers which are usually 'pontoon covers' that can be lifted and moved to suit the working plan of the vessel when in port.

The gantry structure tends to be a dominant feature and is subject to extensive maintenance attention. However, some small cargo coaster type vessels also use a specific mobile gantry for the sole purpose of lifting off and moving the hatch covers (examples are shown in Figures 1.15 and 1.16).

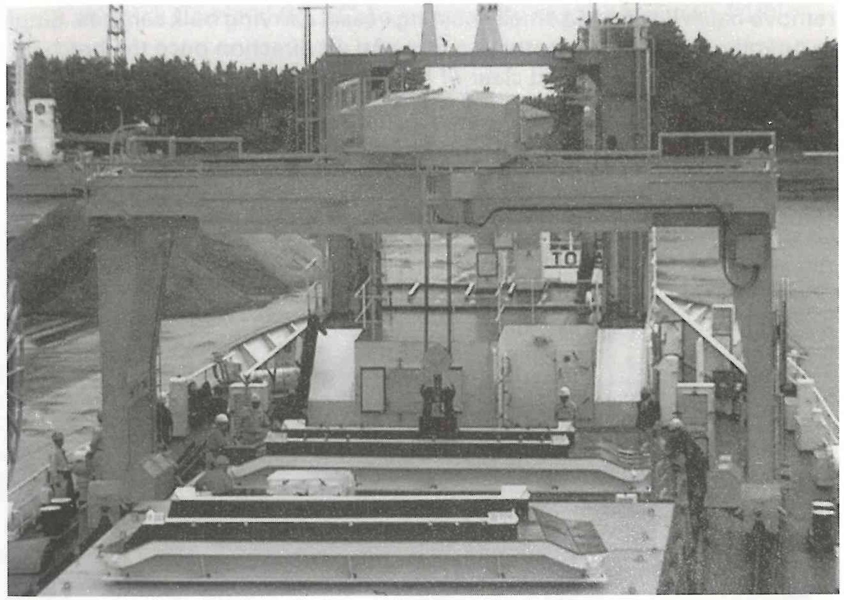


Fig. 1.15 Example of a mobile tracked gantry crane in operation on the ships foredeck. Suitable for a vessel with all aft accommodation.

Gantry operations

Some shipboard gantry cranes are designed solely to remove and stow pontoon hatch covers while others are suitably employed with outreach capability for working containers to the quayside as well as having the flexibility to remove pontoon covers (Figure 1.17).

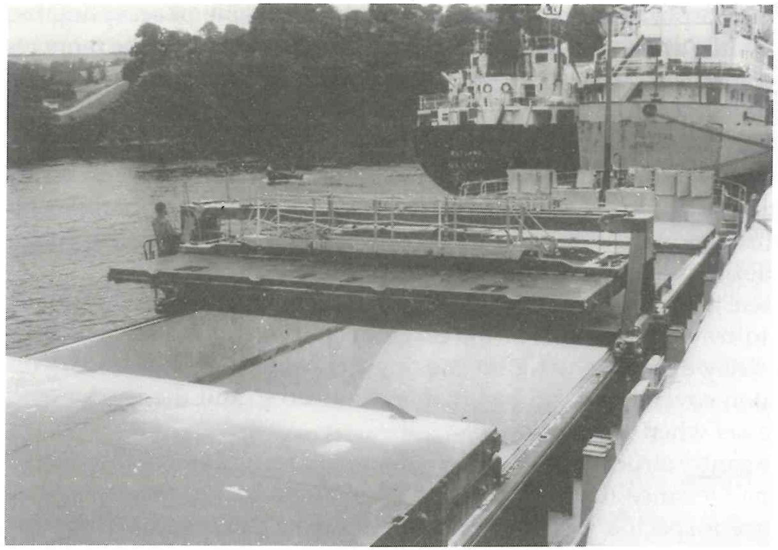


Fig. 1.16 A low lying tracked gantry crane operates down the hatch coaming to remove hatch lids from a small coasting vessel carrying bulk cargoes. Single-man operation drives the gantry in a fore and aft direction once the hatch lid is lifted clear of the hatch track.

Fig. 1.17 Dominant gantry crane mounted above the deck and tracked to move fore and aft. Has an SWL of 25 tonnes and outreach extending to 35 m, either side. Single-man overhead operation.

General cargoes – slinging arrangements

Although the majority of cargoes are carried in containers or unitized in one way or another, some cargoes and certainly ship's stores are required to be 'slung' with associated lifting gear. Many bagged cargoes employed 'canvas slings' but handling bagged cargoes proved costly in the modern commercial world and few bagged cargoes are used these days; products being preferred to be shipped in bulk and bagged ashore if required at the distribution stage.

It should be realised that general cargo ships have declined considerably in number, with the main capacity going into the container or Ro-Ro trades. However, some items like pre-slung packaged timber and palletization have gone some way to bridge the ever widening gap between general and containerized cargoes.

Car slings

Single 'private' vehicles are still sometimes loaded and these are crated, containerized or require the customized 'car sling' for open stow. However, where cars (and trucks) are carried in quantity, then 'Pure Car Carriers' (PCCs) or 'Pure Car Truck Carriers' (PCTCs) are normally engaged (Figure 1.18).

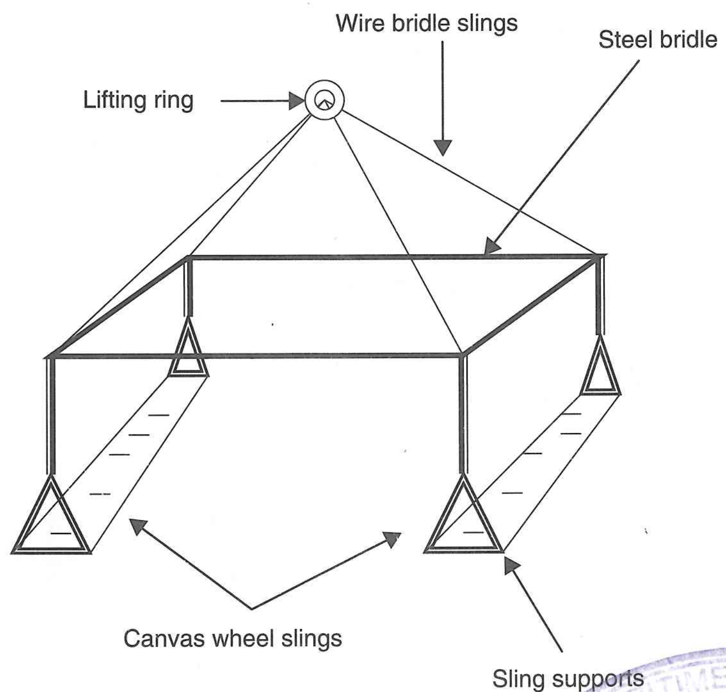


Fig. 1.18 Car sling

Rope slings

Rope slings are probably the most versatile of slinging arrangements employed in the movement of general cargo parcels. They are made from 10–12 m of 25–30 mm natural fibre rope. Employed for stropping boxes, crates, bales and case goods of varying sizes (Figures 1.19 and 1.20).

The board and canvas slings tend to be specialized for bagged cargo or sacks. With the lack of bagged cargoes being shipped these days, they have

Fig. 1.19 Roped cargo sling arrangements.

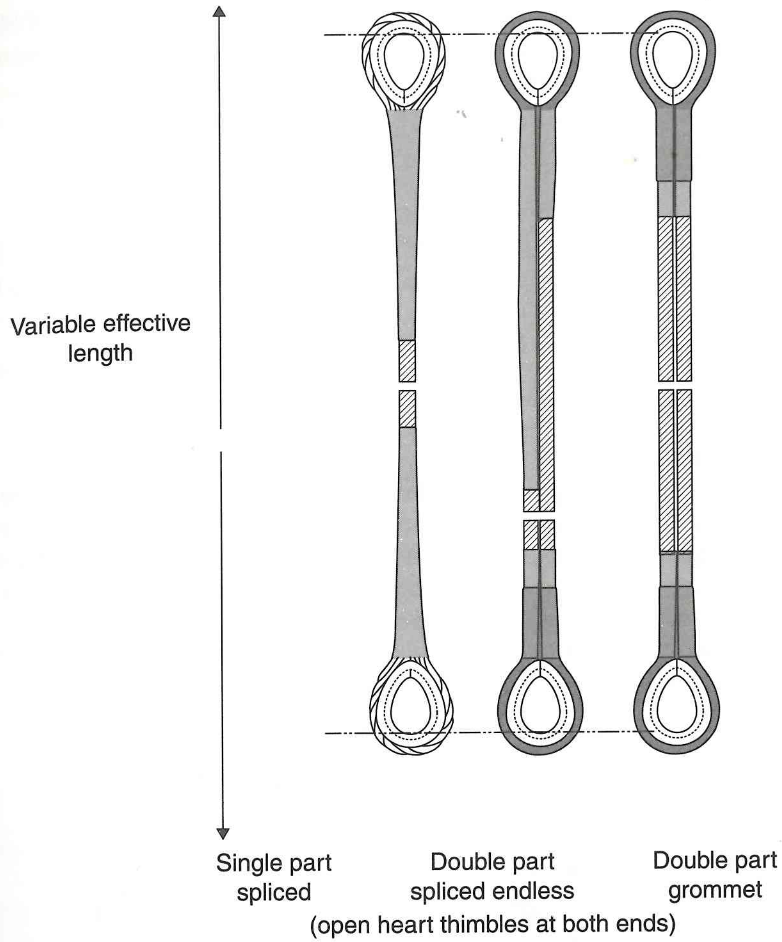


Fig. 1.20 Wire rope slings. Reproduced with kind permission from Bruntons (Musselburgh), Scotland.

dropped away from general use, except in the smaller third world ports; most bagged cargoes now being containerized or shipped on pre-stow pallets.

Multi-legged slings

The permitted working load of a multi-leg sling, for any angle between the sling legs, up to a limit of 90°, is calculated by using the following factors:

2 leg slings	1.25	times the SWL of the single leg
3 leg slings	1.60	
4 leg slings	2.00	

where the angle between the sling legs has limitations and angles of 90° or less are too restrictive, a permissible working load for angle between 90° and 120° can be calculated as follows:

2 leg slings	1.00	times the SWL of the single leg
3 leg slings	1.25	
4 leg slings	1.60	

> *Note: In the case of three-legged slings the included angle is that angle between any two adjacent legs. In the case of a four-legged sling, the included angle is that angle between any two diagonally opposing legs.*

Palletization

Prior to the massive expansion in the container trade 'palletization' became extremely popular as it speeded up the loading and discharging time of general cargo ships. This meant that the time in port was reduced, together with associated Port and Harbour fees, a fact that was not wasted on shippers and vessel operators. Pre-packed loaded pallets are still widely used around commercial ports and are packed in uniform blocks to minimize broken stowage. Typical cargoes suitable for loading to pallets are cartons, small boxes, crates, sacks and small drums (Figure 1.21).

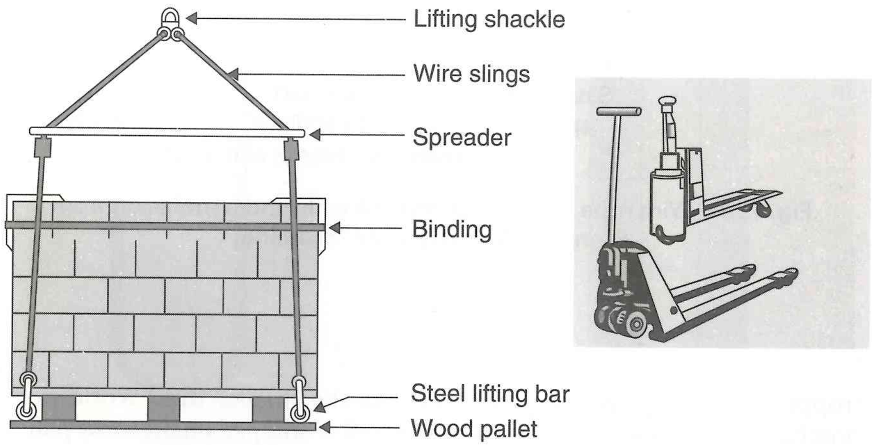


Fig. 1.21 Loaded pallet and pallet transporter.

Palletization has distinct advantages when compared with open stow, general cargo, break bulk-handling methods:

1. less handling of cargo
2. less cargo damage (no hook use and limited pilferage)
3. faster loading discharge times.

Vessels were designed specifically for the purpose of handling pallets and were usually fitted with large open hatchways which allowed spot landing by crane. The ship's design was often multi-deck and fitted with side elevators, shell doors or roll systems to move cargoes into squared-off hatch corners; Tween deck heights being such as to allow access and use of 'fork lift trucks'.

Pallet transporters, battery or manually operated, are useful for 'stuffing' containers where the container floor will generally not have the capacity to support a fork lift truck and its load.

Use of fork lift trucks

The use of pallets and case goods often requires the use of 'fork lift' trucks, either on the quayside or inside the ship's cargo hatches. They have the capability to move cargo parcels out from underdecks into the hatch square to facilitate easy lifting during discharge. Similarly, they can stow heavy individual parcels into a tight stow into hatch corner spaces. It is appreciated that 'bull wires' could be employed for such movements, but rigging and operation of bull wires takes excessive time while the fork lift truck can be effective very quickly. The main disadvantage of fork lift truck use is that the vehicle requires manoeuvring space inside the hatch and, as the hatch is loaded, available space becomes restricted (Figure 1.22).

Fig. 1.22 A fork lift truck operates case goods, stacked timber parcels and palletized drums on the quayside for general cargo vessels.

Ground handling the large load

Fork lift trucks are manufactured in different sizes and are classed by weight. Ship's Officers are advised that the truck itself is a heavy load and will be fitted with a counter weight which provides stability to the working vehicle when transporting loads at its front end. It would be normal practice to separate the counter weight from the truck when lifting it into a ship's hold, especially so if the total combined weight was close to, or exceeded, the SWL of the lifting gear. Once on board the ship the counter weight could then be reunited with the fork lift truck for normal operation (Figure 1.24).

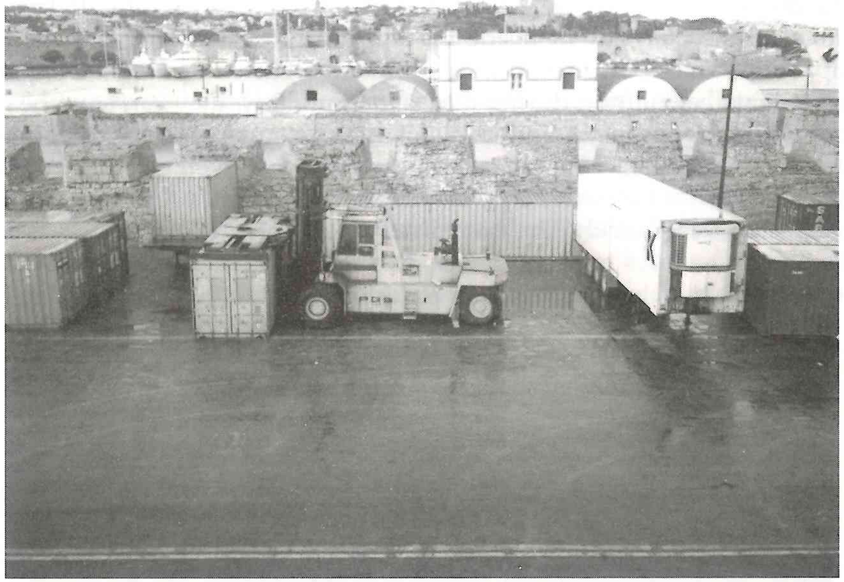


Fig. 1.23 Ground handling of large loads, like containers, can also be achieved by using the larger, high capacity 'fork lift' trucks on the quay side. Expansion forks of extended length are used for wide loads up to about 12 tonnes.

The use of fork lift trucks is a skilled job and requires experienced drivers. Possible problems may be encountered if decks are greasy or wet which could cause loss of traction and subsequent loss of control of the truck when in operation. Spreading sawdust on the deck as an absorbent can usually resolve this situation and keep operations ongoing.

Cargo Officers should exercise caution when working with these trucks aboard the vessel. Although the field of view for the driver is generally good, some cargoes could obscure the total vision and cause blind spots. The nature of the work is such that the number of men inside the hatch should be limited, thereby reducing the possibility of accidents.

Fork lift truck – alternate uses

Probably the most versatile transporters for a variety of cargo parcels that the industry has ever used. The basic fork lift can convert to a mini-crane, drum handler or clamp squeeze tool to suit package requirements. The main forks can be side shifted to work awkward spaces and working capacity can start from 2 tonnes upwards. Height of operations is dependent on the model engaged (Figure 1.24).

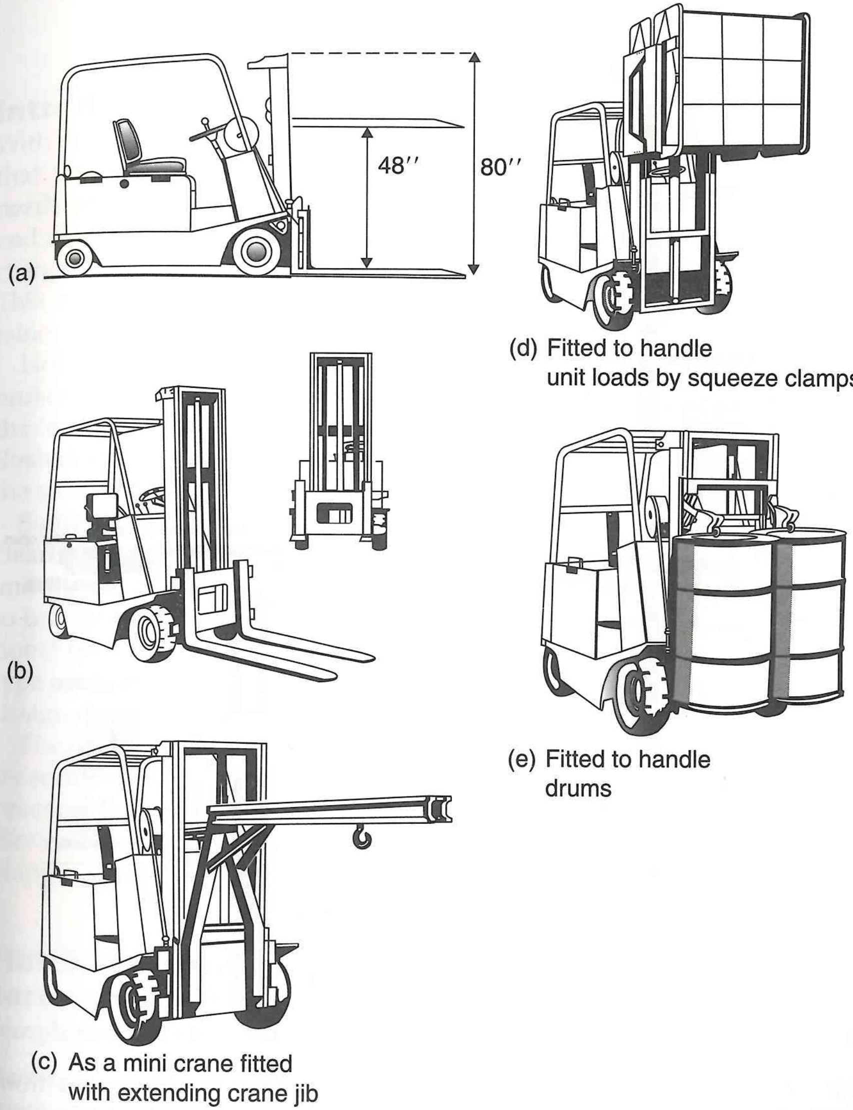


Fig. 1.24 Fork lift trucks

Side loading practice

Several ships have been constructed with side loading facilities for specific commodities, i.e. paper and forestry products, on the Baltic trades. Watertight hull openings work in conjunction with internal elevators to move cargoes to differing deck levels. These openings, shell doors as such, may function as a loading ramp or platform depending on cargo and designation, fork lift trucks being engaged on board the vessel to position cargo parcels (Figure 1.25).

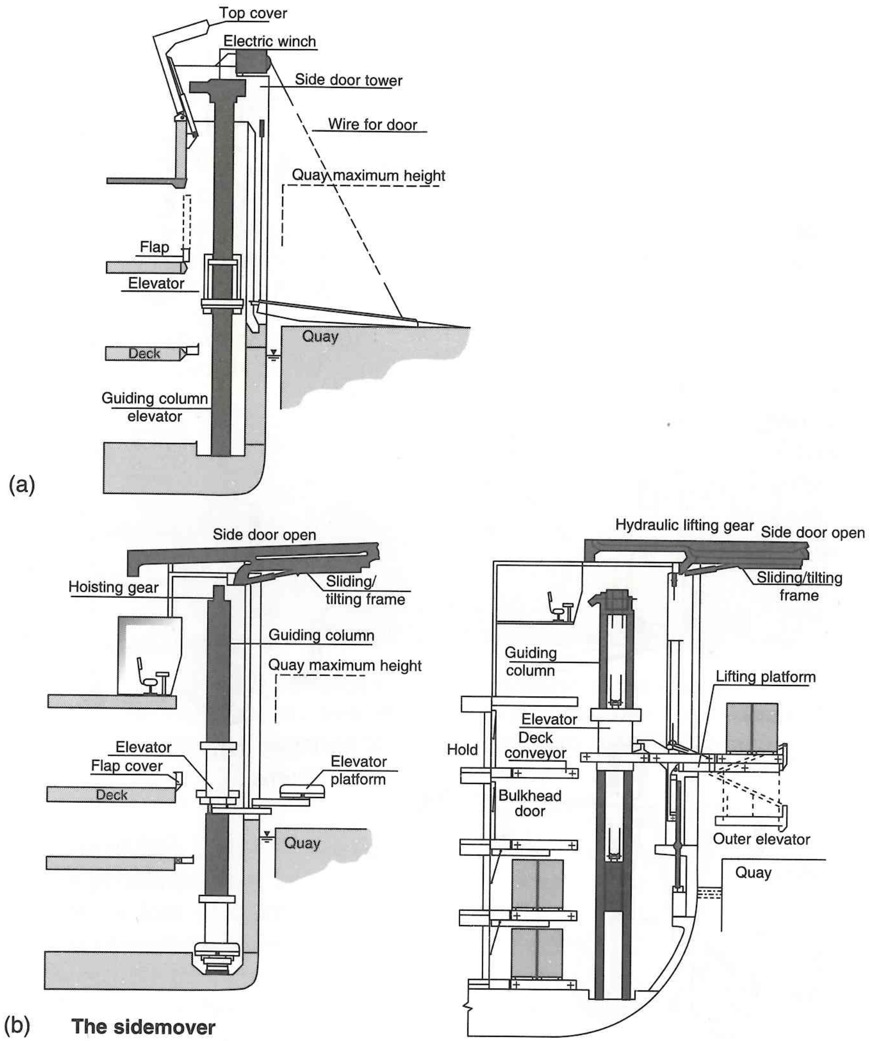


Fig. 1.25 Side loading methods. Reproduced with kind permission from Transmarine, Specialists in Marine Logistics, Equipment, Systems and Services Worldwide

Chapter 2

Hatchwork and heavy-lift cargoes

Introduction

With the many changing trends of cargo transportation, it would be expected that the design and structure of cargo holds would change to meet the needs of modern shipping. This is clearly evident with container tonnage and the vehicle decks of the Roll-on, Roll-off (Ro-Ro) vessels. However, the changes in the carriage of general cargoes have been comparatively small. This is possible because most merchandise will suit the more popular container or similar unit load movement.

Hold structures have tended to go towards square corners to reduce broken stowage (BS), and suit palletization, pre-slung loads and the use of the fork lift truck inside the holds. Stowage by such vehicles are aided by flush decks in way of the turn of the bilge, as opposed to the angle turn in the sides of the holds of older tonnage.

Some specialist cargoes, like 'steel coils', still suit conventional holds and clearly would not be compatible inside containers, because of the shape and weight of each item. As with large case goods or castings, which tend to transport better by means of conventional stowage in the more conventional type vessel. Such merchandise is clearly edging towards heavy-lift type loads and these heavier loads are covered in detail here, alongside the designated heavy-lift ship and project cargoes.

The objective of this chapter is to provide an overall picture of an industry sector which is an essential part of cargo handling and general shipping practice. It does not have such a high profile as the container or Ro-Ro movement, but it is, nevertheless, an indispensable arm to the practice of shipping.

Hatchwork and rigging (definitions and terminology)

(employed with heavy-lifts and cargo operations)

Backstays – additional strength stays applied to the opposing side of a mast structure when making a heavy lift. These stays are not usually kept permanently rigged and are only set as per the rigging plan when a heavy lift is about to be made.

Bearers – substantial baulks of timber, used to accept the weight of a heavy load on a steel deck. The bearers are laid for two reasons:

1. To spread the load weight over a greater area of deck.
2. To prevent steel loads slipping on the steel deck plate.

Breaking strength – defined by the stress necessary to break a material in tension or compression. The stress factor is usually obtained by testing a sample to destruction.

Bridle – a lifting arrangement that is secured to a heavy load to provide a stable hoist operation when the load is lifted. Bridles may be fitted with a spreader to ensure that the legs of the bridle are kept wide spread so as not to damage the lift and provide a balanced hoist operation.

Bulldog grip (wire rope grips) – screw clamps designed to join two parts of wire together to form a temporary eye or secure a wire end.

Bull wire – (i) a single wire, often used in conjunction with a 'lead block' rigged to move a load sideways off the line of plumb. An example of such a usage is found in dragging cargo loads from the sides of a hold into the hold centre. (ii) a wire used on a single span topping lift, swinging derrick, to hoist or lower the derrick to the desired position. The bull wire being secured to a 'union plate' to work in conjunction with the chain preventor and the down haul of the topping lift span.

Cradle – a lifting base manufactured usually in wood or steel, or a combination of both, employed to accept and support a heavy load. It would normally be employed with heavy lifting slings and shackles to each corner.

Double gear – an expression used when winches are employed in conjunction with making a heavy lift. The purchase and topping lift winches together with any guy winches are locked into 'double gear' to slow the lifting operation down to a manageable safe speed.

Double up – a term used with a derrick which allows a load greater than the safe working load (SWL) of the runner wire but less than the SWL of the derrick, to be lifted safely. It is achieved by means of a longer wire being used in conjunction with a floating block. This effectively provides a double wire support and turns a single whip runner wire, into a 'gun tackle'.

Jumbo Derrick – colloquial term to describe a conventional heavy-lift derrick.

Kilindo rope – a multi-strand rope having non-rotating properties and is a type employed for crane wires.

Lateral drag – the term describes the action of a load on a derrick or crane during the procedure of loading or discharging, where the suspended weight is caused to move in a horizontal direction, as opposed to the expected vertical

direction. The action is often prominent when the ship is discharging a load. As the load is passed ashore the ship has been caused to heel over towards the quayside. As the load is landed, the weight comes off the derrick and the ship returns to the upright causing the derrick head to move off the line of plumb. This change of plumb line causes the lifting purchase to 'drag' the weight sideways, e.g. lateral drag.

Lead block – a single sheave block secured in such a position as to change the direction of a weight-bearing wire. Snatch blocks are often used for light working engagement.

Lifting beam – a strength member, usually constructed in steel suspended from the lifting purchase of a heavy-lift derrick when engaged in making a long or wide load lift. Lifting beams may accommodate 'yokes' at each end to facilitate the securing of the wire slings shackled to the load.

Limit switch – a crane feature to prevent the jib outreach from working beyond its operational limitations.

Load density plan – a ships plan which indicates the deck load capacity of cargo space areas of the ship. The Ship's Chief Officer would consult this plan to ensure that the space is not being overloaded by very dense, heavy cargoes.

Maximum angle of heel – a numerical figure usually calculated by a Ship's Chief Officer in order to obtain the maximum angle that a ship would heel when making a heavy lift, to the maximum outreach of the derrick or crane, prior to the load being landed.

Overhauling – (i) an expression used to describe the correct movement of a block and tackle arrangement, as with the lifting purchase of a heavy-lift derrick. The term indicates that all sheaves in the block are rotating freely and the wire parts of the purchase are moving without restriction. (ii) this term can also be used to describe a maintenance activity as when stripping down a cargo block for inspection and re-greasing. The block would be 'overhauled'. (*Note*: the term overhauling is also used to express a speed movement of one ship overtaking another.)

Plumb line – this is specifically a cord with a 'plumb-bob' attached to it. However, it is often used around heavy-lift operations as a term to express 'the line of plumb' where the line of action is the same as the line of weight, namely the 'line of plumb'.

Preventor – a general term to describe a strength, weight bearing wire, found in a 'Union Purchase' Rig on the outboard side of each of the two derricks. Also used to act as support for a mast structure when heavy lifting is engaged. Preventor Backstays generally being rigged to the mast in accord with the ships rigging plan to support work of a conventional 'Jumbo' Derrick.

Proof load – that tonnage value that a derrick or crane is tested to. The value is equal to the SWL of the derrick/crane + an additional percentage weight allowance, e.g. derricks less than 20-tonne SWL proof load is 25% in excess; derricks 20–50-tonne SWL proof load equals +5 tonnes in excess of SWL; derricks over 50-tonne SWL proof load equals 10% in excess of SWL.

Purchase – a term given to blocks and rope (Wire or Fibre) when rove together. Sometimes referred to as a 'block and tackle'. Two multi-sheave blocks are rove with flexible steel wire rope (FSWR) found in common use as the lifting purchase suspended from the spider band of a heavy-lift derrick.

Ramshorn Hook – a heavy duty, double lifting hook, capable of accepting slings on either side. These are extensively in use where heavy-lift operations are ongoing.

Register of ships lifting appliances and cargo handling gear – the ships' certificate and approvals record for all cargo handling and lifting apparatus aboard the vessel.

Saucer – alternative name given to a collar arrangement set above the lifting hook. The function of the saucer is to permit steadying lines to be shackled to it in order to provide stability to the load, during hoisting and slewing operations. They can be fixed or swivel fitted. (*Note*: The term is also employed when carrying 'grain cargoes' where the upper level of the grain cargo is trimmed into a 'saucer' shape.)

Steadying lines – cordage of up to about 24 mm in size, secured in adequate lengths to the load being lifted in order to provide stability and a steadying influence to the load when in transit from quay to ship or ship to barge. Larger, heavier loads may use steadying tackles for the same purpose. However, these are more often secured to a collar/saucer arrangement, above the lifting hook, as opposed to being secured to the load itself. Tackles are rove with FSWR, not fibre cordage.

Stuelcken mast and derrick – trade name for a heavy-lift derrick and supporting mast structure. The patent for the design is held by Blohm & Voss A.G. of Hamburg, Germany. This type of heavy lifting gear was extremely popular during the late 1960s and the 1970s with numerous ships being fitted with one form or other of Stuelcken arrangement.

Tabernacle – a built bearing arrangement situated at deck level to accept the heel of a heavy-lift derrick. The tabernacle allows freedom of movement in azimuth and slewing from Port to Starboard.

Cargo vessel

Modern trend, cargo hold construction

The more modern vessel, probably operating with cranes, may be fitted with twin hatch tops to facilitate ease of operation from both ends of a hold,

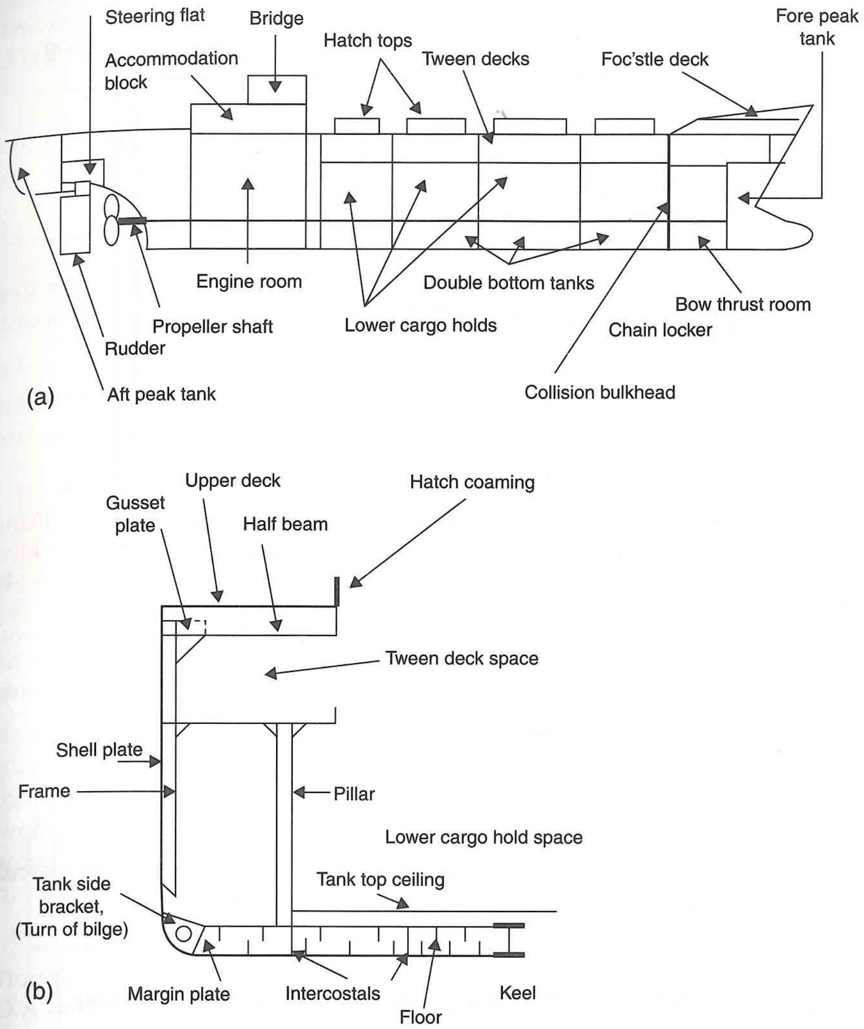


Fig. 2.1 Conventional ship design. (a) general cargo vessel; (b) athwartship – half profile.

while the construction of the hold tends to be spacious to accept a variety of long cargoes. Double hold space with or without temporary athwartships bulkheads which can section the hold depending on the nature of the cargo, provide flexibility to accommodate a variety of cargo types. Figure 2.1(a) shows the conventional ship design of a general cargo vessel. Figure 2.1(b) shows a half profile of the athwartships bulkhead.

Square corner construction lends to reducing BS especially with containers, pallets, vehicles or case goods. Flush 'bilge plate access' is generally a feature of this type of design. Where steel bilge covers (previously limber

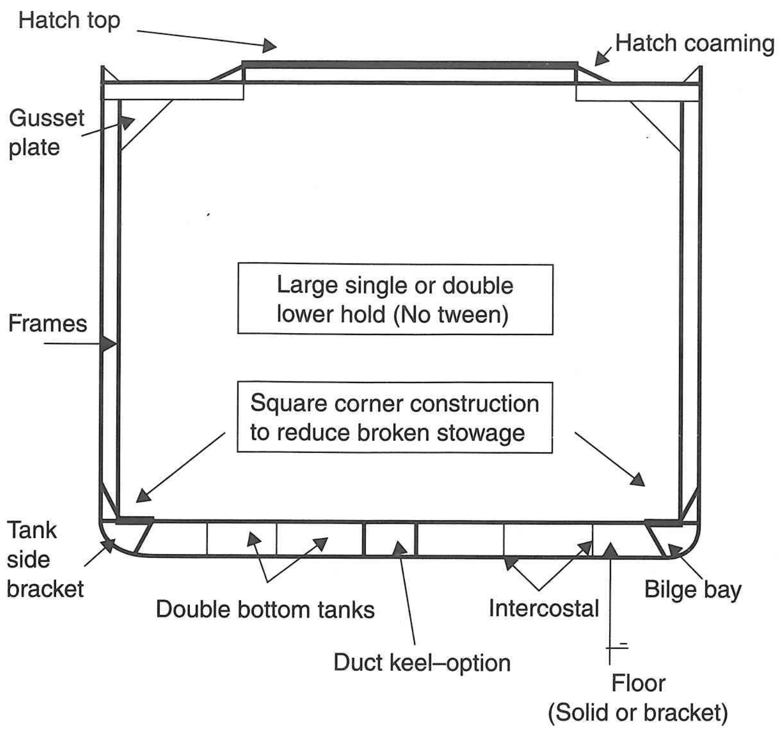


Fig. 2.2 Modern trend, cargo hold construction.

boards) are countersunk into the deck so as not to obstruct cargo parcels being manoeuvred towards a tight side or corner stow (Figure 2.2).

The conventional hatch (tween deck and lower hold (L/H))

An example of the conventional hatch in a general cargo ship is shown in Figure 2.3. This type of hatch was previously covered by wooden hatch boards or slabs but these have been superseded by steel hatch covers. Operated by mechanical means (single pull chain types) or folding 'M types' (hydraulic operation).

Hatch covers

Direct pull (Macgregor) weather deck hatch covers

Figure 2.4 shows a direct pull weather deck hatch cover operation. In this diagram, all hatch top wedges and side locking cleats removed and the tracks are seen to be clear. The bull wire and check wire would be shackled

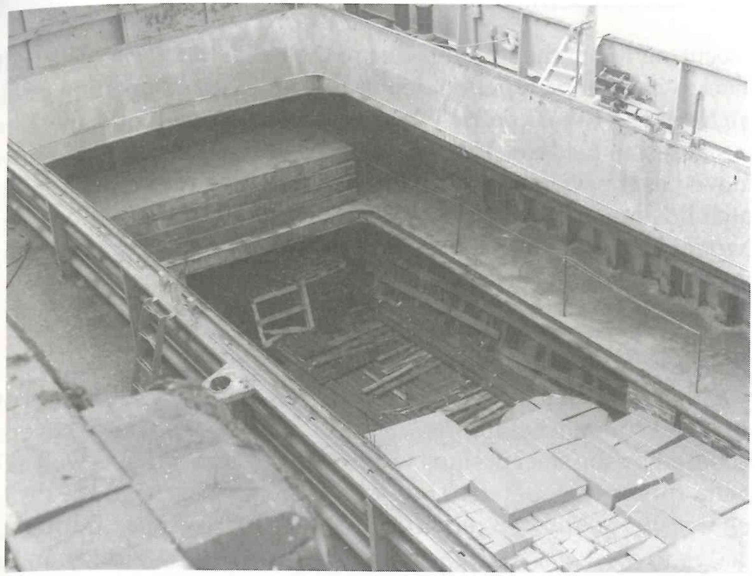


Fig. 2.3 General cargo seen at the after end of the L/H, while the pontoon tween deck covers are sited stacked in the fore end of the tween deck. Exposed dunnage lies at the bottom of the hold where cargo has been discharged and cargo battens can be seen at the sides of the hold. Safety guard wires and stanchions are rigged around the tween deck in compliance with safety regulations.

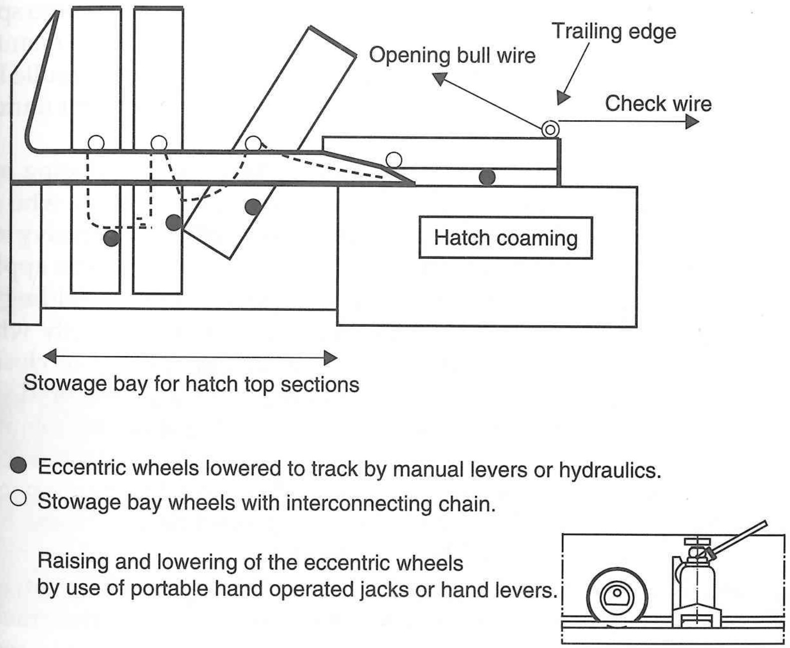


Fig. 2.4 Direct pull weather deck hatch cover. Inset reproduced with kind

to the securing lug of the trailing edge of the hatch top. (*Note*: The bull wire and check wire change function depending on whether opening or closing the hatch cover.) The eccentric wheels are turned down and the 'stowage bay' is sighted to be clear. The locking pins at the end of the hatch would be removed as the weight is taken on the bull wire to open the hatch. Once the hatch lids are open and stowed vertical into the stowage bay, the sections would be locked into the vertical position by lock bars or clamps, to prevent accidental roll back.

Weather deck hatch covers

Steel weather deck hatch covers now dominate virtually all sectors of general, bulk and container shipping. Conventional wooden hatch covers have been eclipsed by the steel designs which are much stronger as well as being easier and quicker to operate. The advantages far outweigh the disadvantages in that continuity of strength of the ship is maintained throughout its overall length. Better watertight integrity is achieved and they are labour saving, in that one man could open five hatches in the time it would take to strip a single conventional wooden hatch. The disadvantages are that they are initially more expensive to install, and carry a requirement for more levels of skilled maintenance.

Once cleated down, a hard rubber seal is created around the hatch top perimeter providing a watertight seal, on virtually all types of covers. Hydraulically operated covers cause a pressure to generate the seal, while mechanical cleating (dogs) provide an additional securing to the cargo space below. The engineering department of the ship usually cater to the maintenance of the hydraulic operations and the draw back is that a hydraulic leak may occur due to say a burst pipe, which could cause subsequent damage to cargo.

Extreme caution should be exercised when opening and closing steel covers, and adequate training should be given to operators who are expected to engage in the opening and closing of what are very heavy steel sections. Check wires and respective safety pins should always be applied if appropriate, when operating direct pull types. Hydraulic folding 'M types' incorporate hydraulic actuators with a non-return capacity which prevents accidental collapse of the hatch tops during opening or closing. Whichever type is employed, they are invariably track mounted and such tracks must be seen to be clear of debris or obstruction prior to operation (Figure 2.5).

Strong flat steel covers lend to heavy lifts and general deck cargo parcels and have proved their capability with the strengthened pontoons which are found in the container vessels. The pontoons having specialized fittings to accept the deck stowage of containers over and above the cargo hold spaces. Similarly, specialized heavy-lift vessels have adopted strengthened open steel decks in order to prosecute their own particular trade sector (Figure 2.6).

Fig. 2.5 Folding hydraulic operated, steel hatch covers, seen in the vertical open position. Securing cleating seen in position prevents accidental roll back.

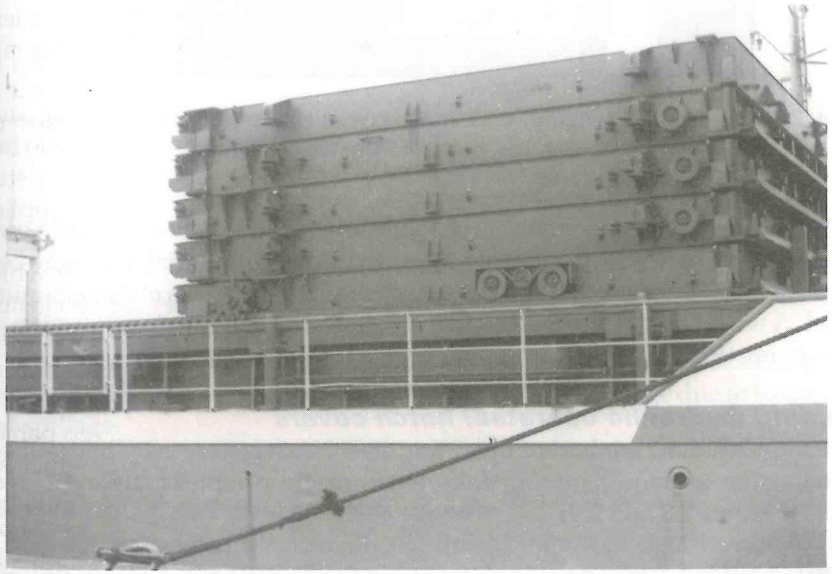


Fig. 2.6 Rack and pinion horizontal stacking steel hatch covers seen in the hatch open position. The drive chain running the length of the hatch tracks

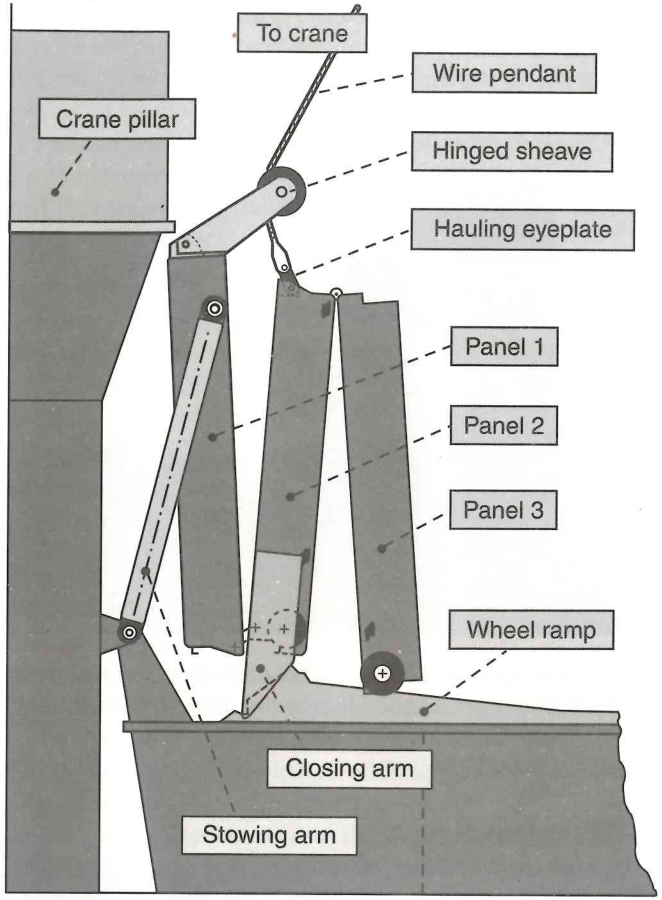


Fig. 2.7 Alternative weather deck hatch cover. Direct pull type. Reproduced with kind permission from MacGregor.

An alternative arrangement is possible when space is not available outboard of the hatches for the deck mounted closing pedestal, e.g. between twin hatches. With this alternative the closing arm operates above coaming level. A wheel ramp is necessary to assist in the initial self-closing action of the covers (Figure 2.7).

Folding (hydraulic operated) hatch covers

The more modern method of operating steel hatch covers is by hydraulics, opening the sections in folding pairs, either single, double or triple pair sections (Figures 2.8 and 2.9).

Multi-folding weather deck hatch covers (MacGregor type)

There are several manufacturers of steel hatch covers and they all generally achieve the same function of sealing the hatchways quickly. Operationally,

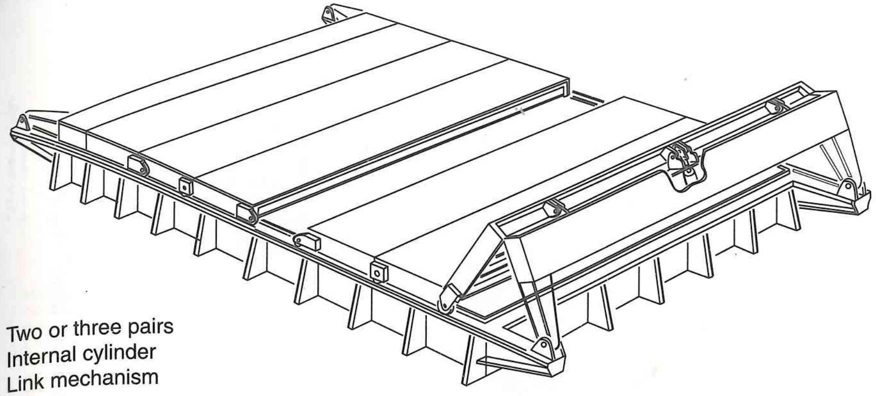


Fig. 2.8 Folding (hydraulic operated) hatch covers. Reproduced with kind permission from MacGregor.

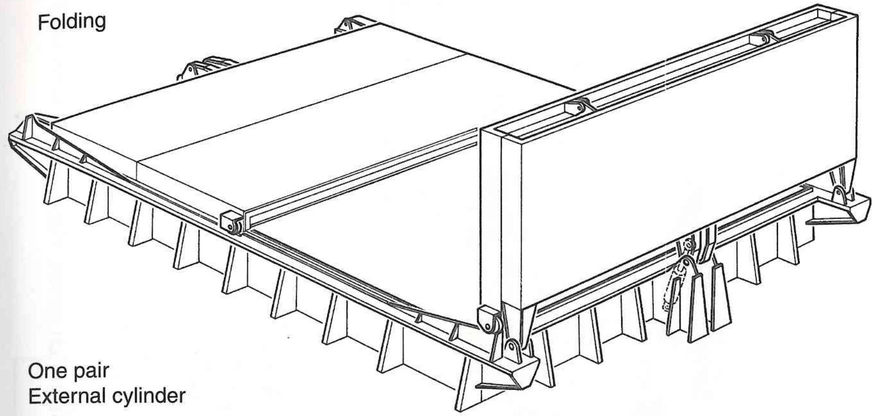


Fig. 2.9 Single pair hatch cover. Hydraulic operated by single external cylinder. Reproduced with kind permission from MacGregor.

one man could close up five or six hatches very quickly by switching on the hydraulic pumps, releasing the locking bars to the stowed sections and operating the control levers designated to each set of covers.

The main disadvantage of hydraulic operations is that the possibility of a burst pipe is always possible, with subsequent cargo damage due to hydraulic oil spillage.

Single pull fixed chain hatch covers

These are automated covers with self drive by built in electric motors (see inset, Figure 2.10). All operations for open and closing the hatch are by push button control. Inclusive of raising the lowering of the covers and operation of the cleating. If desired, these covers can be supplied with sufficient

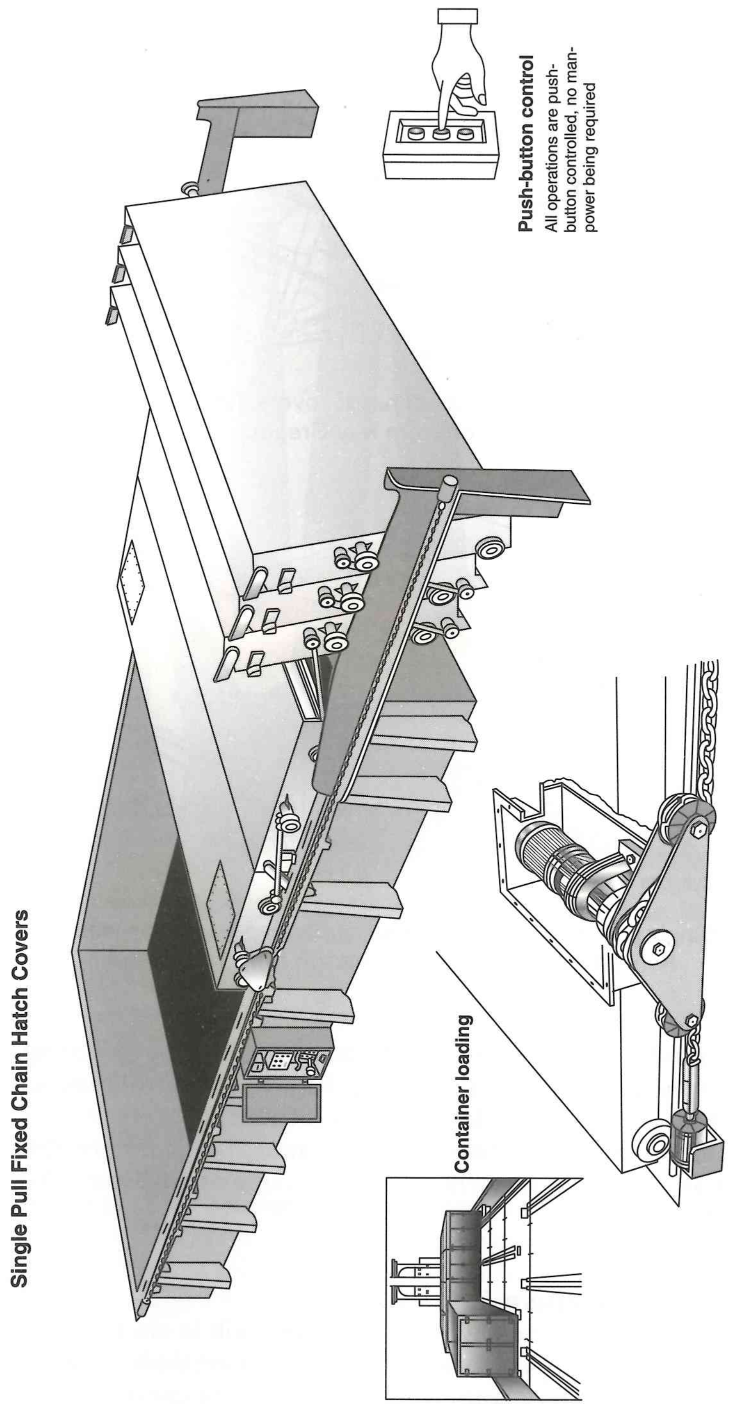


Fig. 2.10 Single pull fixed chain hatch cover. Reproduced with kind permission from MacGregor.

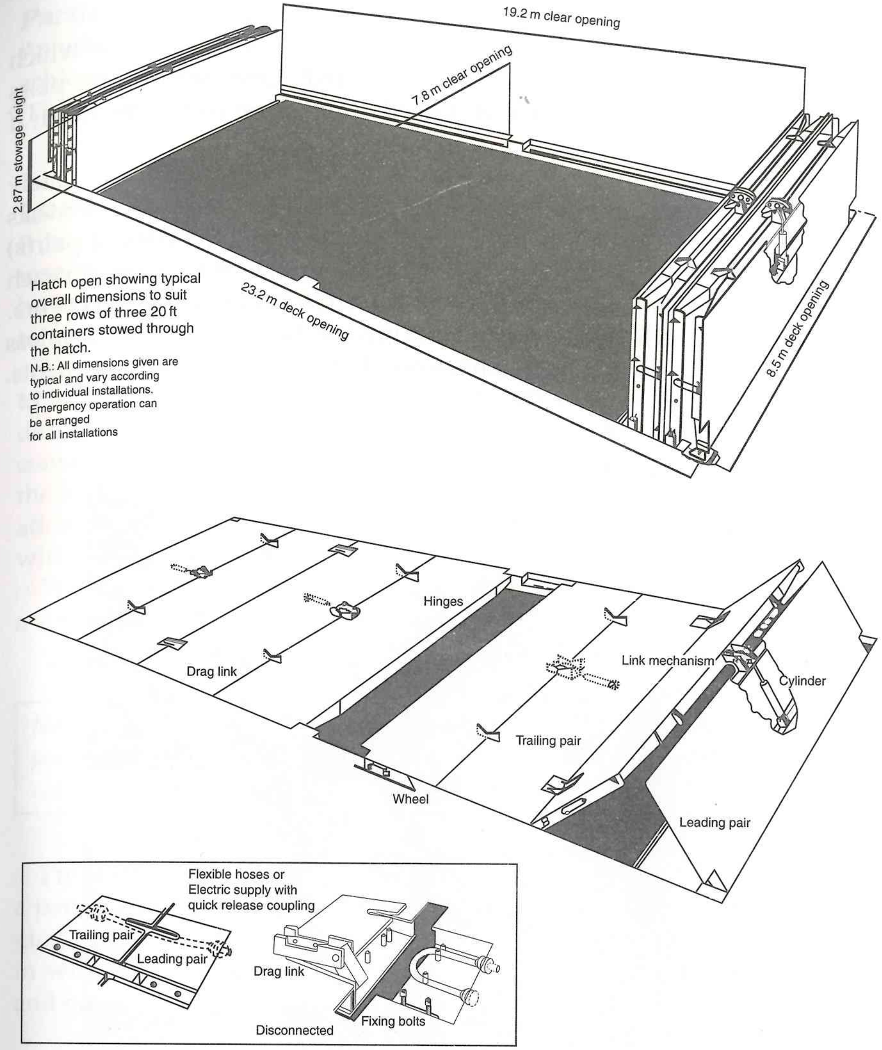


Fig. 2.11 Tween deck 'M type' hydraulic folding hatch covers. Reproduced with kind permission from MacGregor.

strength and the necessary container location sockets to permit the load on top of deck-mounted containers.

Tween deck 'M-type' hydraulic-folding hatch covers

These covers provide a flush and strong deck surface which is ideal for the working of fork lift trucks inside tween deck spaces. Hydraulically oper-

Operation of steel hatch covers (tween decks)

Folding hatch covers are operated in pairs by hydraulic cylinders which actuate link mechanisms working from 0° to 180°. One, two or three pairs of cover panels can be linked and stowed at the same end of the hatch if required.

To open the hatch, the leading pair of covers is first operated, immediately pulling the remaining pair(s) into a rolling position on the recessed side tracks and tow the hatch end. Once the leading pair is raised the trailing pair(s) can follow into vertical stowage positions where they are secured to each other. The operational sequence is reversed when closing the hatch covers.

Tween deck hatch covers are not required to be watertight and unless specifically requested they would have no additional cleating arrangements.

Fig. 2.12 Two bulk carrying 'feeder' coasting vessels lie port side to, alongside the grain elevator in Barcelona. The lead ship is seen discharging with partially opened steel hatches, operated by its own mini-gantry crane. The

Partial opening

As with many types of steel covers partial opening is a feature and can be achieved comparatively quickly by the operation of quick release 'drag links' (Figure 2.12).

Loading and discharging heavy lifts

It is normal sea going practice for the Chief Officer of the vessel to supervise the movement of heavy lifts, both in and out of the vessel. This is not, however, to say that the Mate of the ship will not delegate specific functions to the more Junior Cargo Officer or to the stevedore supervisor.

Prior to commencing the lift, the derrick and associated lifting gear needs to be prepared. Many vessels are now fitted with the large 'Stulken-type' derricks, or specialized Hallen or Velle derricks as opposed to the more conventional 'Jumbo' Derrick. Manufacturers' instructions and reference to the ship's rigging plan should always be consulted regarding the preparations of setting up the lifting gear, especially when officers are unfamiliar with the style of rig.

Where a load is outside the SWL of a ship's gear, either a floating crane or a specialized heavy-lift vessel would be employed.

> **Note:** *If loading a weight by means of a floating crane, Chief Officers must check that the port of discharge has equivalent lifting apparatus, on the basis that the ship's gear will not be viable for discharge.*

Preparation time for the derrick can vary depending on the type, but a period of up to 2 h would not be unusual. Man-management of the rigging crew and advance planning with regard to the number of lifts and in what order they are to be made, in relation to the port of discharge and order of reception of cargo parcels, would be the expected norm.

Stability detail

It must be anticipated that the vessel will go to an angle of heel when making the lift with the derrick extended. This angle of heel should be calculated and the loss of metacentric height ('GM') ascertained prior to commencing the lift. Clearly, any loss of positive stability should be kept to a minimum and to this end any frees surface effects in the ship's tanks should be eliminated or reduced wherever possible.

Operation

Adequate manpower should be available in the form of competent winch drivers and the supervising controller. Winches should be set into double gear for slow operation and steadying lines of appropriate size should be secured to points on the load to allow position adjustments to be made.

Heavy-lift cargoes

When loading or discharging heavy-lifts Deck Officers should be aware of the following precautions and procedures:

1. The stability of the vessel should be adequate and the maximum angle of heel should be acceptable. All free surface effects (FSE) should be eliminated by either 'pressing up' or 'emptying' tanks.
2. If a conventional 'Jumbo' Derrick is employed, then the rigging plan should be referred to with regard to the positioning of 'Preventer Backstays' to support any mast structure.
3. A careful check on the condition of the derrick and associated gear should be made before commencing the lift. Particular attention should be paid to the SWL of shackles, blocks and wires.
4. Ensure all the ship's moorings are taut and that men are standing by to tend as necessary. Fenders should be pre-rigged and the gangway lifted clear of the quayside.
5. All cargo winches affecting the load should be placed in 'double gear'.
6. The deck area where the load is to be landed should be clear of obstructions, and heavy bearers laid to accept and spread the deck weight.
7. The ship's deck capacity plans should be checked to ensure that the deck space is capable of supporting the load.
8. The winch drivers and controller should be seen to be competent, and all non-essential personnel should be clear of the lifting area.
9. Any ship's side rails in the way of the load should be lowered or removed and any barges secured to the ship's side should be cast off.
10. Steadying lines should be secured to the load itself and to the collar of the floating block if fitted.
11. All relevant heads of departments should be advised before commencing the lift.
12. Use the designated lifting points and take the weight slowly. Stop, and inspect all round once the load clears the deck, before allowing the lift to continue.

Examples of slinging arrangements – heavy lifts

Weight and bulk often go together and many of the maritime heavy lifts are not only heavy in their own right but are often extremely bulky by way of having a large volume. Numerous methods have been employed over the years in order to conduct lifting operations in a safe manner. Many types of load beams and bridle arrangements have been seen in practice as successful in spreading the overall weight and bringing added stability to the load

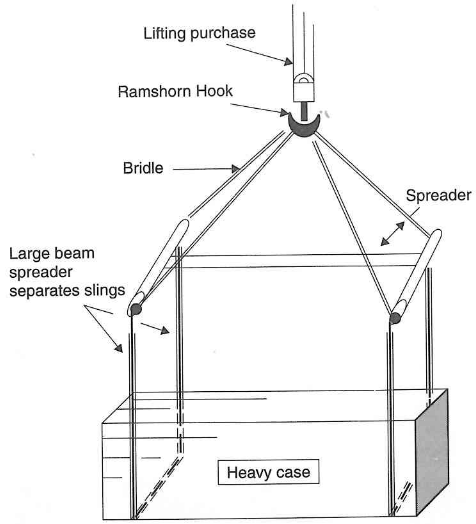


Fig. 2.13 Heavy-lift slinging arrangement.

Fig. 2.14 Use of heavy duty lifting beams. Two Huisman shipboard cranes (each at 275-tonne SWL) hoist the new ferry load Fiorello, by means of two heavy duty lifting beams, aboard the Mammoet vessel 'Transporter'.

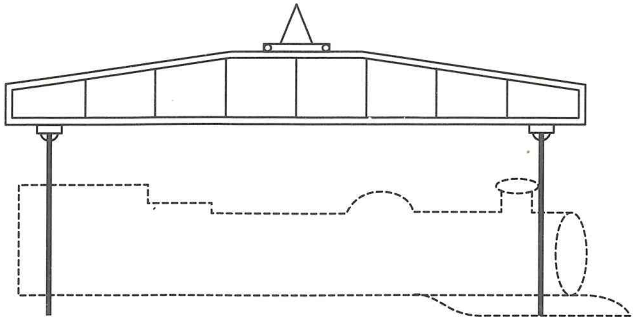


Fig. 2.15 Typical lifting beam employed for long heavy-lift load in the form of a locomotive.

Fig. 2.16 A nuclear waste flask (weighs up to 120 tonnes) is loaded to a customized low load transporter by means of individual heavy duty strops and shackles.

The conventional heavy lift: 'Jumbo' Derrick

In Figure 2.17, a 75-tonne SWL Jumbo Derrick is stowed against the supporting Samson Post structure. The head of the derrick is clamped in the upright position against the upper steel platform. The topping lift is anchored to the underside of the table platform set across the two posts

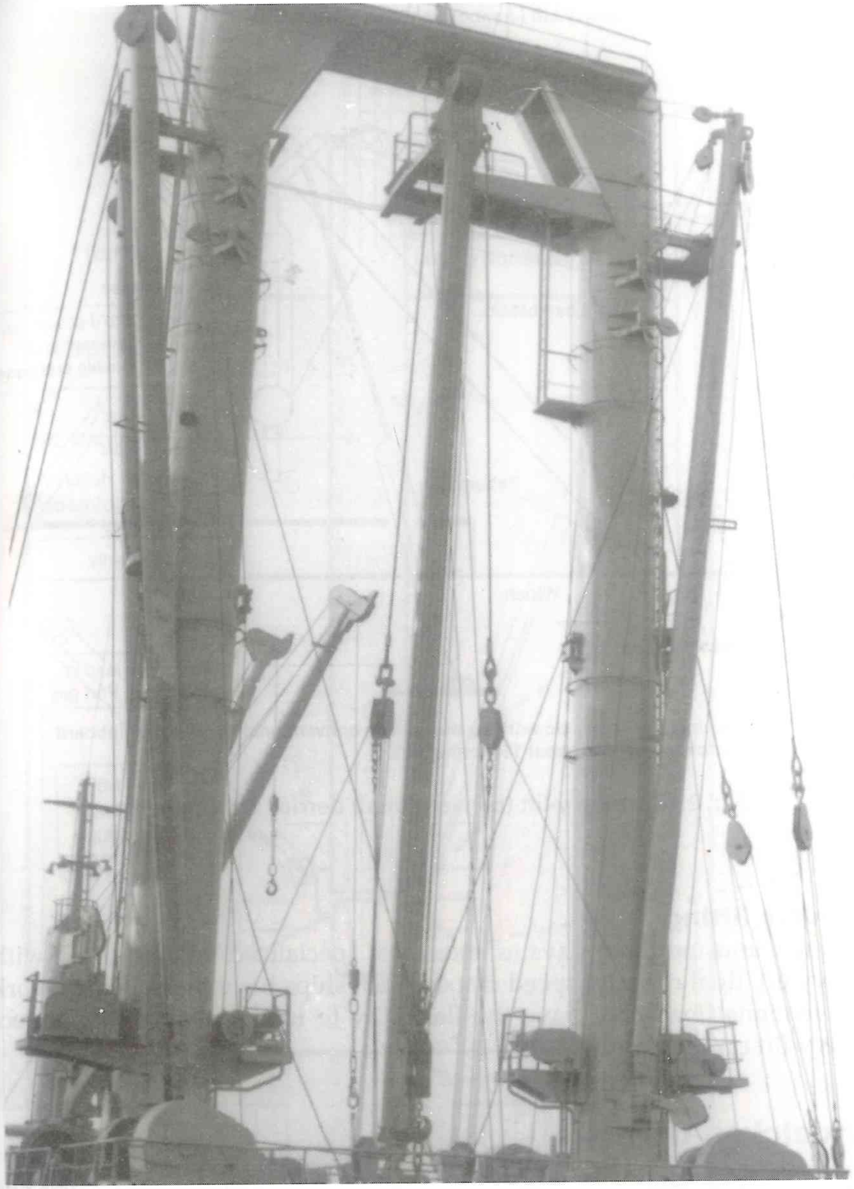


Fig. 2.17 The conventional heavy lift – a 'Jumbo' Derrick.

(*Note*: The Samson Post structure also supports four conventional 10-tonne SWL conventional heavy Derricks). The terminology and basic working design of a conventional heavy-lift shipboard derrick found up to 150-tonne SWL is shown in Figure 2.18 and for the Jumbo Derrick heavy lift in Figure 2.19.

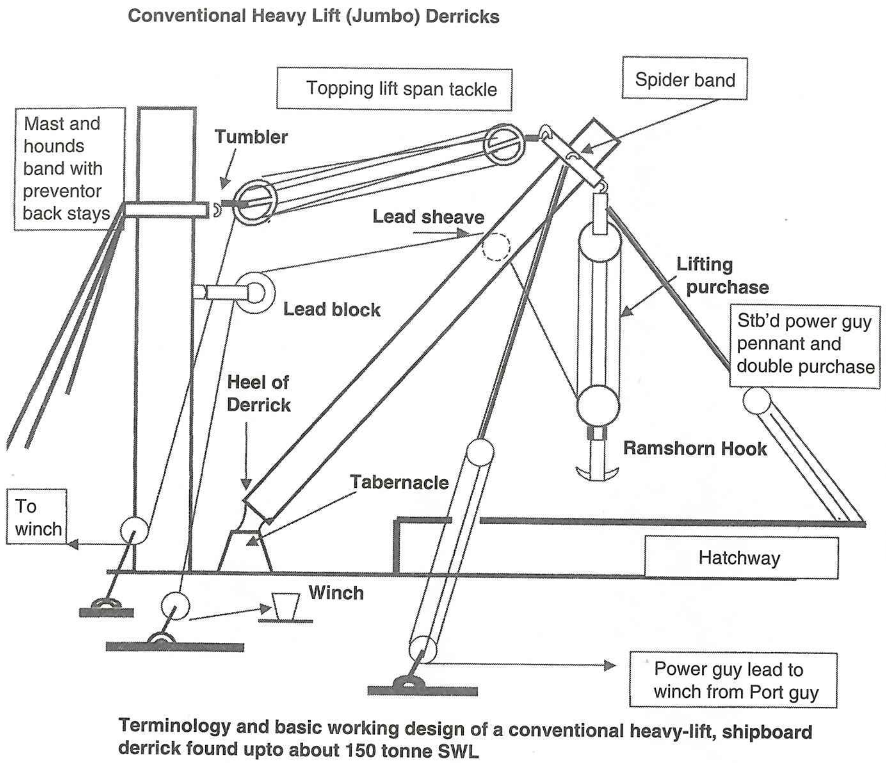


Fig. 2.18 Heavy-lift (conventional) derrick arrangement.

Tandem lifting

It is not unusual these days to encounter specialized vessels, fitted with heavy lift, dual capacity speed cranes. Such ships have the ability to work conventional loads but have the flexibility to load containers or project heavy-lift cargoes Figure 2.20.

Stuelcken derricks

The Stuelcken mast – cargo gear system

The Heavy Lift, Stuelcken systems are noticeable by the prominent angled support mast structure positioned either side of the ship's centre line. The main boom is usually socket mounted and fitted into a tabernacle on the centre line. This positioning allows the derrick to work two hatches forward and aft and does not restrict heavy loads to a single space, as with a conventional derrick.

The Stuelcken Posts, set athwartships, provide not only leads for the topping lifts and guy arrangement but also support smaller 5- and 10-tonne

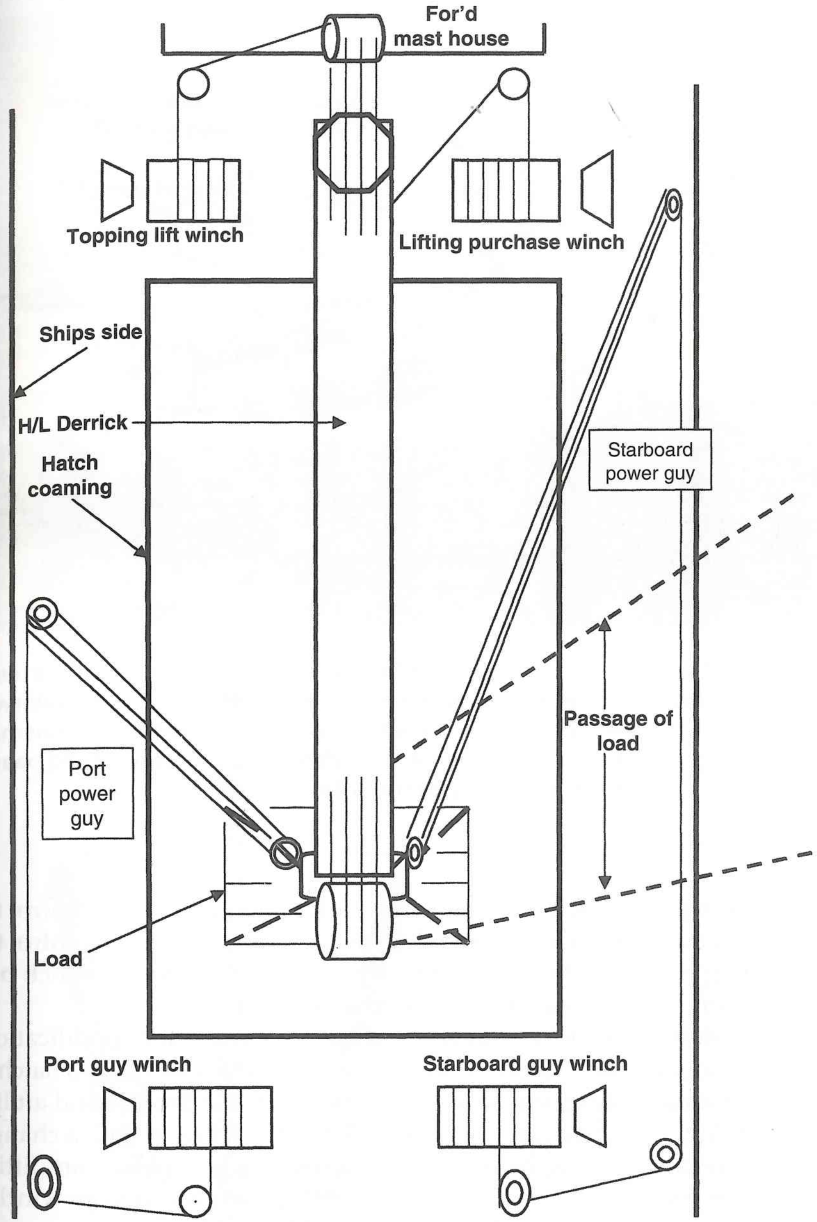


Fig. 2.19 Conventional Heavy-lift 'Jumbo' Derrick arrangement.

derricks with their associated rigging. The posts are of such a wide diameter that they accommodate an internal staircase to provide access to the operator's cab, usually set high up on the post to allow overall vision of the operation.

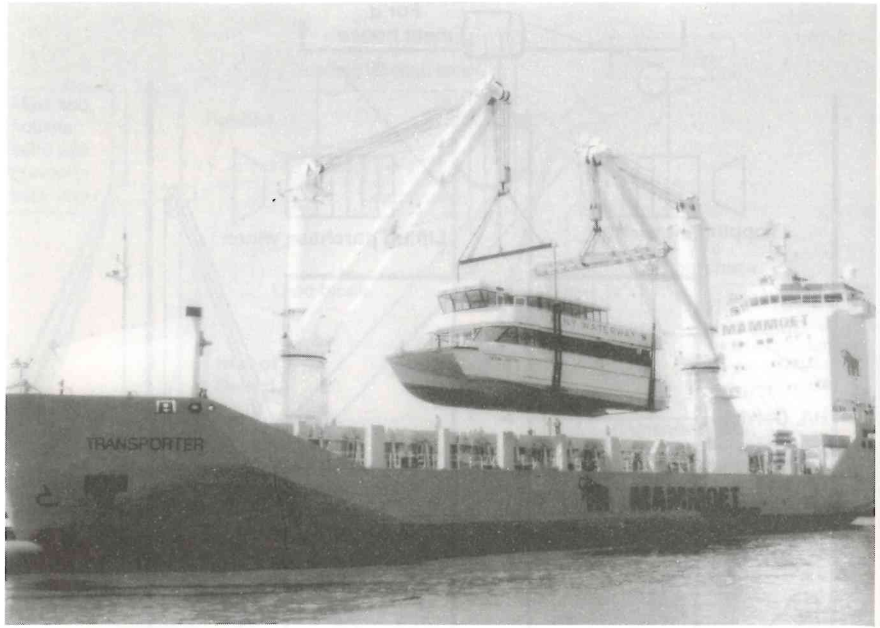


Fig. 2.20 The 'Transporter' of the Mammoet Shipping Company is seen engaged in the lifting of a ferry vessel destined for the New York Waterway system. The lift is being made by means of two heavy-duty ships 'Huisman' cranes, each of 275-tonne SWL. The tandem lift takes place using lifting beams having a capacity of up to 250-tonne SWL.

The rigging and winch arrangement is such that four winches control the topping lift and guy arrangement while two additional winches control the main lifting purchase. Endless wires pay out/wind on, to the winch barrels, by operation of a one-man, six-notch controller.

Various designs have been developed over the years and modifications have been added. The 'Double Pendulum' model, which serves two hatches, operates with a floating head which is allowed to tilt in the fore and aft line when serving respective cargo spaces. A 'Rams Horn Hook' with a changeable double collar fitting being secured across the two pendulum lifting tackles. The system operates with an emergency cut-off which stops winches and applies electro-magnetic locking brakes (Figure 2.21).

Stuelcken derrick rigs are constructed with numerous anti-friction bearings which produce only about 2% friction throughout a lifting operation. These bearings are extremely durable and do not require maintenance for about 4 years, making them an attractive option to operators.

The standard wires for the rig are 40 mm and the barrels of winches are usually spiral grooved to safeguard their condition and endurance. The length of the span tackles are variable and will be dependent on the length

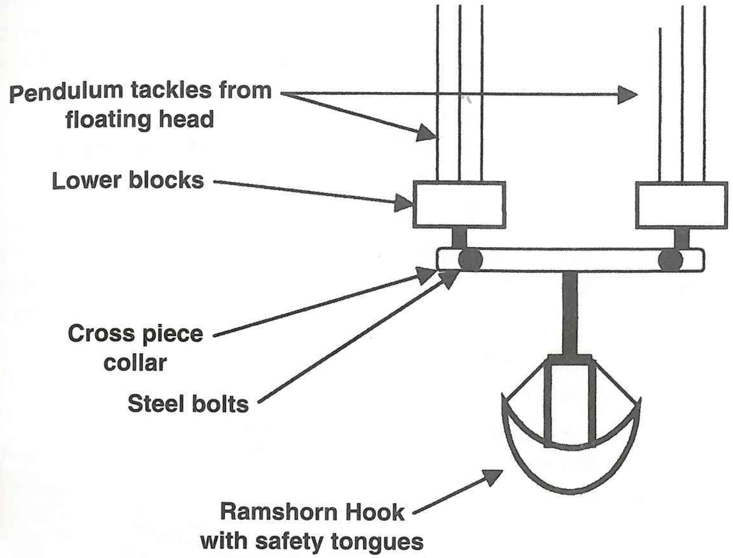
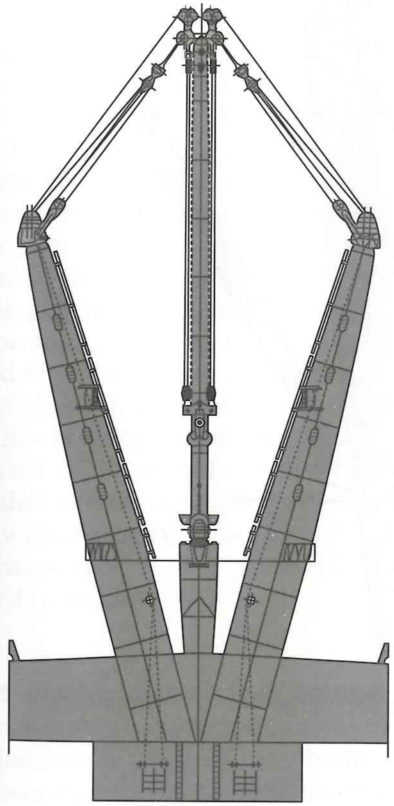


Fig. 2.21 Cargo gear system – double pendulum model.



Type: Double pendulum

Capacity: 300-tonne SWL
Derrick length: 29.5 m
Outreach: 10.0 m
(beyond the ship's side)
Operation up to: 12.5° list
±2.0° trim
Classification:
Lloyd's Register of Shipping
Additional Equipment:
+4 sets of mast cranes for handling of light cargo
+1 set of lifting beams (300-tonne SWL) consisting of main traverse with spindle device and cross beams.

Type: Pivot type

Capacity: 250-tonne SWL
Derrick length: 30 m
Outreach: beyond portside 14.15 m
beyond starboardside 10.0 m
Operation up to: 5° list
±2° trim

Designed for three slewing ranges of each 100°. Change of slewing range without load. Total slewing range 260°.

Classification: Germanischer Lloyd

Additional equipment:

+ Each Pivot type equipped with two log/lumber type derricks of each 35-tonne SWL.

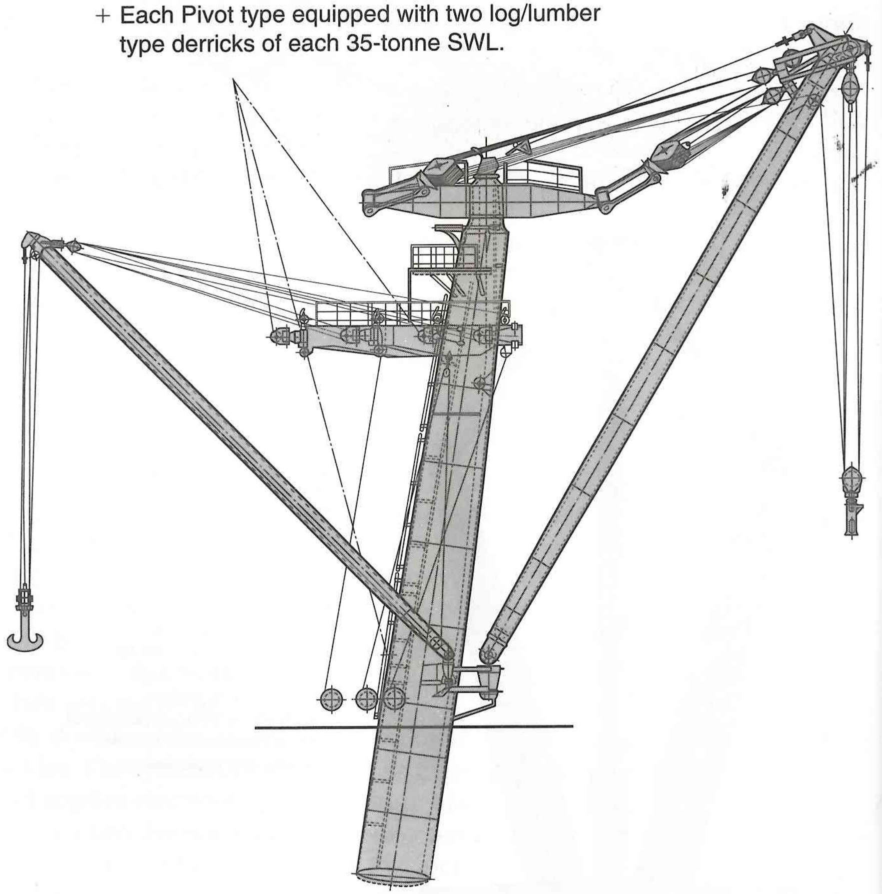


Fig. 2.23 Stuelcken masts and cargo lifting arrangement.

Although Stuelcken rigs still remain operational, their use has diminished with the improved designs of heavy-lift vessels, which previously tended to dominate the 'Project' cargo section of the industry.

Heavy-lift floating crane

Conventional heavy cargo loads, which are scheduled for carriage by sea, are often required to be loaded by means of a floating crane. When the load is too great to be handled by the ship's own lifting gear, the floating crane option is usually the next immediate choice. Most major ports around the world have this facility as an alternative option for heavy specialist work. The type of activity is two-fold, because, if loaded by this means at the port of departure, the same load must be discharged at its destination by similar or equivalent methods. (Ship's Chief Officers need to ascertain that if the load is above the ships lifting gear capability, that the discharge port has means of lifting the load out.)

A Ship's Cargo Officer needs to ensure that the heavy load is accessible and that the floating crane facility is booked in advance in order to make the scheduled lift. Booking of a special crane would normally be carried out via the ship's agents, leaving a ship's personnel very much in the hands of external parties; the Port Authority often controls the movement of all commercial and specialist traffic in and around the harbour.

The 'floating crane' should not be confused with the specialist 'crane barge'. Floating cranes differ in that they may not be self-propelled and may require the assistance of tugs to manoeuvre alongside the ocean transport, prior to engaging in the lift(s). The construction of these conventional cranes is such that the crane is mounted on a pontoon barge with open deck space to accommodate the cargo parcel, the pontoon barge being a tank system that can be trimmed to suit the necessity of the operation if the case requires.

The main disadvantage against the more modern, floating sheer legs, is that generally speaking the outreach of the crane's jib is limited in its arc of operation. Also, the lift capacity can be restrictive on weight when compared with the heavier and larger units which tend to operate extensively in the offshore/shipyard arenas.

When booking the facility, agents need to be made aware of the weight of the load and its overall size; also its respective position on board the vessel, together with its accessibility. Hire costs of the unit are usually quite high and with this in mind, any delays incurred by the ship not being ready to discharge or accept a scheduled load on arrival of the crane, could become a costly exercise.

The crane/sheer leg barge (self-propelled)

Derrick/crane barges tend to work extensively in the offshore sector of the marine industry but their mobility under own propulsion, together with thruster operations, provide flexibility to many heavy-lift options. Some

Fig. 2.24 The Smit 'Cyclone' floating sheer leg barge, engages in a general cargo heavy-lift operation on the vessels offshore side.

builds incorporate dynamic positioning and depending on overall size, have lifting capacity up to and including 6000 tonnes with main crane jib operations (Figure 2.24).

Heavy-lift ships and project cargoes

The need for heavy-lift ships developed alongside the immense size of the loads required within the development of the offshore industry. Its origins probably come from the idea of the 'floating dry dock' which has been around for many years before the offshore expansion. The principle difference between the floating dock and the heavy-lift ship is that one is always self-propelled and acts as a regular means of transportation, while the floating dock is usually annexed to a shipyard and if it is required to move position, such a move would normally be handled by tugs.

They both have operational tank systems which allow them to work employing the same Archimedes principle of flotation. Submerging themselves to allow a load to float in, or over, prior to de-ballasting and lifting the load clear of the water line. The Heavy-Lift Ship generally does not submerge its loading deck more than to a calculated depth, but enough to allow 'float over' methods to operate (Figures 2.25–2.28).

Float over loading methods must therefore be capable of accommodating the draught drawn by the load when waterborne, the actual load usually

Fig. 2.25 The steel deck of the 'Baltic Eider' fitted to receive containers overall. Seen in a part-loaded condition passing through light ice in the Baltic Sea.

Fig. 2.26 The steel deck space of the 'Sea Teal' a heavy-lift transport. The tank ballast system, allows the deck to be submerged to allow a Float-On, Float-Off, system to take place for heavy-lift or project-cargoes.

Fig. 2.27 The heavy-lift vessel 'Super Servant 3' seen loaded with the crane barge AL-Baraka 1, lies at anchor awaiting to discharge its load by Float-off methods.

being rafted and towed or pushed by tugs to a position over the transports deck. Once in position over the load deck, the de-ballast operation of the heavy-lift vessel can take place allowing the deck to rise and so raising the load clear of the surface. The load, complete with raft (if employed), is then transported under the vessel's own power.

Elements for consideration for heavy-lift transports:

1. Overall size-dimensions of the load
2. Weight of the load
3. Weight of lifting accessories
4. SWL of Lifting elements
5. Weather conditions
6. Positive stability of transporting vessel
7. Density of water in load and discharge ports
8. Ballast arrangements for trim and list of vessel
9. Passage plan of transport route
10. Fuel burn on route
11. Speed and ETA of passage
12. Loadline zone requirements not infringed
13. Method of discharge
14. Facilities of discharge Port

Fig. 2.28 Stern view of the heavy-lift vessel 'Super Servant 3' with the crane barge load seen in the Arabian Gulf area.

15. Manpower requirements for loading/shipping/and discharging
16. Documentation for the load
17. Specialist handling personnel
18. Communication facilities to accommodate loading/discharge
19. Securing arrangements for load on route
20. Load management on voyage

Large heavy loads tend to accrue logistical problems from the time of construction to that moment in time when the load arrives at its final destination. The shipping element of the load's journey is just one stage during the transportation. Cargo surveyors, safety experts, company officials and troubleshooters of various kinds tend to move alongside the passage of the load up to that time of final delivery.

Planning for project cargo transport

It would be natural for the layman to assume that the heavy load just moves on its own with the help of a police escort, but this is clearly not the case for the extreme load, or that larger-than-large plant (Figure 2.29). Planning of the delivery must be known prior to the load being built. A company may be able to build for the customer but if the load cannot be transported safely, because of weight or size, then the actual building becomes a 'white elephant', in more ways than one.

Also costs for the transportation could be considerable and these would expect to influence financial agreements and be included at the contract stage.

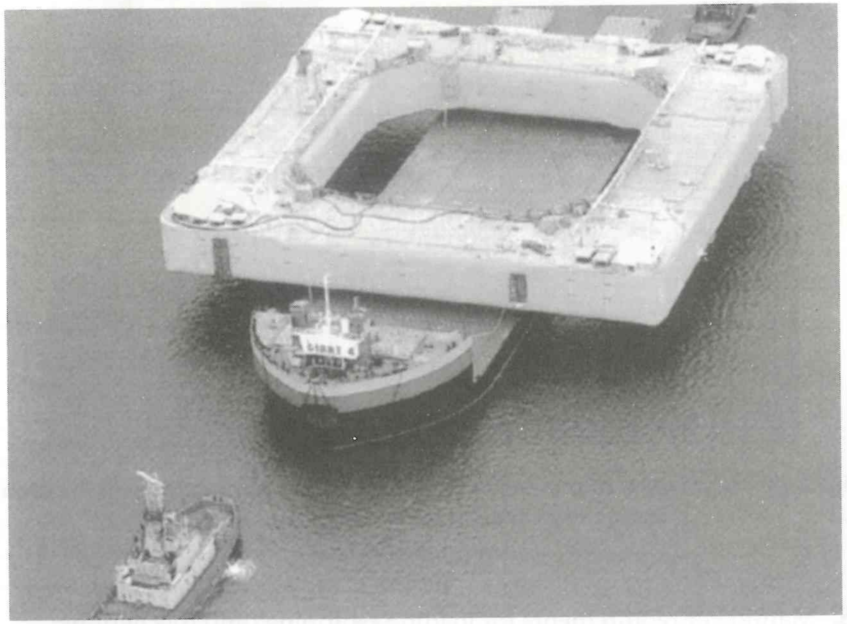


Fig. 2.29 Project type cargoes. The Smit 'Giant 4' heavy-lift transport engages with a 6500-tonne lift, designated for the 'Visund Field' offshore. Giant 4, is a 24 000 dwt submersible heavy duty transport barge. The operation was conducted by a Load-out/Float-off arrangement in June 1997.

Transportation – planning considerations, project cargoes

Measurement of the load

Not only weight measurement of the cargo, but its overall length, breadth and depth will be required. If the load is structured to float during the loading or discharging period, then the draught at which flotation occurs together with the freeboard measurement; the centre of gravity (C of G) of the load mass; and if applicable, the centre of buoyancy; density of water at the loading point; and density of the water at the point of discharge, must be calculated. Tidal considerations at the load and discharge positions should also be calculated for the designated periods.

Transport vehicle-considerations

Capability of the carrier to carry out the task……

In the case of a ship, is the vessel capable of accepting the load? What is the displacement and physical size of the vessel and its deck load density capability? What is the metacentric height ('GM'), and what will be the new 'GM' with the load added? Further consideration must be given for the general assessment of the ship's stability throughout all stages of the passage; endurance of the vessel; and the effect of burning bunker oil and consuming water; ballast movement and the ability to trim or list the vessel for the purpose of loading/discharging; number of crew; experience of the master; Charter rates; and not least the availability of the vessel.

Shoreside administration for heavy-lift operations

Every heavy-lift operation will pass through various degrees of administration prior to the practical lift taking place. The manufacturers/shippers will be required to provide clear information as to dimensions, weight, lifting and securing points, and the position of the C of G before the load can be accepted by the ship; while the ship may be required to give details of its crane capability, inclusive of outreach and load capacity.

The loading operation itself as to whether it will be from the quayside, or from a barge, must also be discussed, together with the detail of use of ship's gear or floating crane. Weather conditions and mooring arrangements may also be featured at this time. Once loading is proposed, the stability data and the maximum angle of heel that will be attained would need to be calculated. Ballast arrangements pertinent to the operation may well need to be adjusted prior to contemplating the actual lift.

The ship would no doubt be consulted on voyage and carriage details, as to the securing of the load, the deck capacity to accommodate the load, and the stability criteria. The ship would also require assurances regarding the port of discharge and the capabilities of said port. If the load is beyond the capacity of a ship's lifting gear, then the discharge port must have accessibility to a floating crane facility and that this facility will be available at the required time.

Where road transport is involved in delivering the load to the quayside, road width and load capability would need to be assessed. A 500-tonne load on the back of a low-loader may well cause landslip or subsidence of a roadside, which must be clear of obstructions like bridges and rail crossings. Wide loads or special bulky loads may require police escort for movement on public highways to and from loading/discharge ports.

Once loaded, the weight will need to be secured and to this end a rigging gang is often employed. However, prudent overseeing by Ship's Officers is expected on this particular exercise. Bearing in mind that the rigging gang are not sailing with the ship, and once the ship lets her moorings go, any movement of the load will be down to the ship's crew, to effect re-securing.

Customs clearance would also be required as per any other cargo parcel and this would be obtained through the usual channels when the manifest is presented, to clear the vessel inwards. Export licences, being the responsibility of the shipper, together with any special details where the cargo is of a hazardous nature, covered by special clearances, e.g. armaments.

Movement logistics of the large load

Clearly, the task of transporting 'project' cargoes does not lend itself easily to the use of public roads. Fortunately, the building sites for such items are often located by coastlines and generally do not encroach on public highways. For example, shipyards build and transport modules or installations within their own perimeters and transport within those same perimeters. However, occasionally, that one-off project requires a specialized route. Timing is critical at all stages of the journey to ensure minimal disruption to the general public, and police escort must be anticipated door to door (Figures 2.30 and 2.31).

For the transport of heavy loads (ground handling equipment), further reference should be made to the IMO publication on '*The Safe Transport of Dangerous Cargoes and Related Activities in Port Areas*'.

Voyage planning

The movement of project cargoes is, by the very nature of the task, generally carried out at a slow speed. This is especially so as in the examples shown as extreme lifts on pages 62/65. Tug assistance is often employed and the operation must be conducted at a safe speed for the circumstances, the movement between the loading port of departure, towards the discharge position, being carried out under correct navigation signals appropriate to each phase of the passage.

As with any passage/voyage plan, the principles of 'passage planning' would need to be observed, but clearly specialist conditions apply over and above those imposed on a conventional ship at sea. Passage planning involves the following phases:

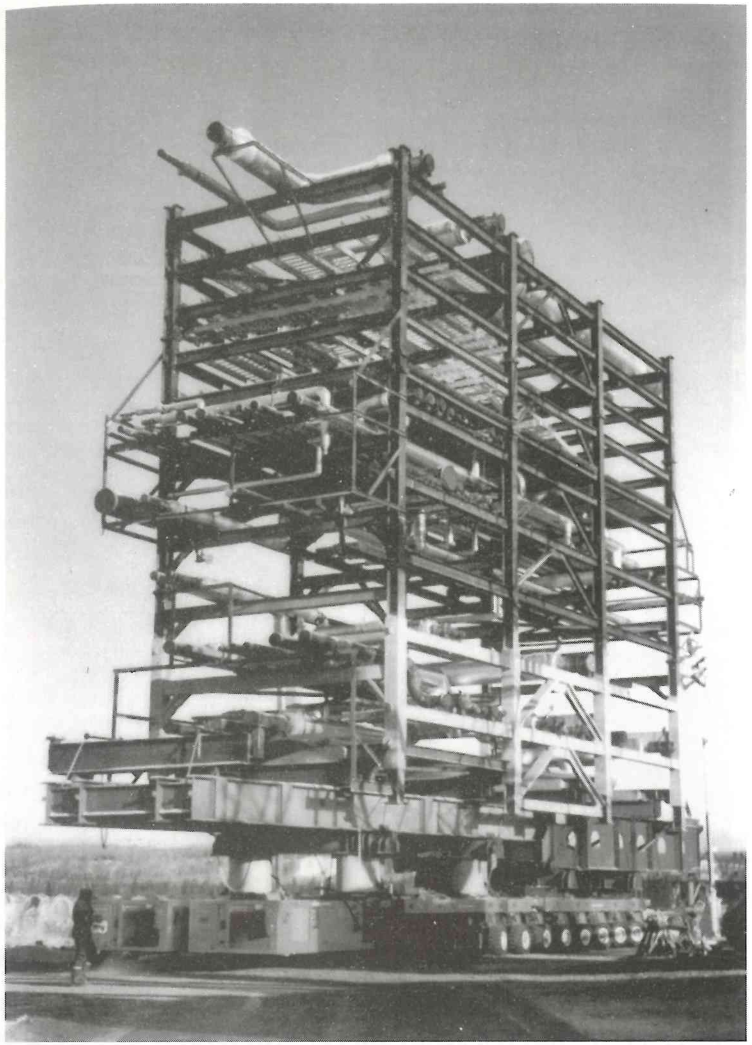


Fig. 2.30 Mobile transport platform employed for ground handling of steel installation. This section of the movement plan must be considered prior to the build stage.

Appraisal – the gathering of relevant charts, publications, informations and relevant datas to enable the construction of a charted voyage plan.

Planning – the actual construction of the plan to highlight the proposed route. To provide details of way points, bunkering stations, navigation hazards, margins of safety, currents and tidal informations, monitoring points, contingency plans, traffic focal points, pilotage arrangements, underkeel clearances, etc.

Fig. 2.31 Multi-wheel heavy load transports. Manufactured by the Scheuerle Company of Germany. The mobile platforms provide multi-axle transport for the large heavy load and are regularly inter-connected for the project load carrying up to 10 000 tonnes. Variations for smaller loads range from the 15-tonne low-bed trailers to platform trailers of up to 1000 tonnes.

Execution – the movement of the transport to follow the plan through to its completion. The positive execution of the plan by the vessel.

Monitoring – the confirmation that the vessel is proceeding as per the designated plan. Position monitoring is taking place and the movement of the

> *Note: A passage plan is equally meant to highlight the areas where the vessel should not go, a particular important aspect to vessels engaged with 'project cargoes'. The load may restrict passage through canals, under bridges or through areas of reduced underkeel clearance (UKC).*

Voyage plan acceptance

Once the plan is constructed, it would warrant close inspection by the Project Manager and the Ship's Master. Such a plan would need to incorporate a considerable number of special features prior to being considered acceptable to relevant parties. Passage plans are made up to ensure 'berth to berth' movement is achieved safely and a plan for movement of a project cargo would expect to include the following special features:

Risk assessment Completed on the basis of the initial plan (passage plans are flexible and circumstances may make a deviation from the proposal to take a necessary action when on route).

Communications Methods: VHF channels; Secondary methods: Advisory contacts, Coastguard, VTS, Hydrographic Office, Meteorological Office, Agents, Medical contingency. Most towing operations and project movements would normally be accompanied by a navigation warning to advise shipping likely to be affected. Such warnings could be effected by Coast Radio Stations, Port and Harbour controls, and/or the Hydrographic Office of the countries involved.

Loading procedures Methods: Various examples: Lift-On/Lift-Off, Float-On/Float-Off, etc. Tug assistance, marine pilots, rigging and lifting personnel as required. Tidal conditions, weather conditions monitored.

Securing procedures Personnel and associated equipment, Surveyor/Project Manager inspection. Contractors: riggers, lashings, welders.
Risk assessment – Tolerable.

Safety assessment LSA/manpower, Navigation equipment test. Engine test. Weather forecast 48 h, long-range forecast.

Route planning Weather, ports of call, mooring facilities, UKC, width of channel. Position Monitoring methods: communications to shore to include progress reports, Navigation hazards, Command Authority, canal passage or bridge obstructions. Traffic focal points. Seasonal weather considerations.

Contingencies Endurance, bunkers, manpower, emergency communication contacts. Weather, mechanical failure, steering failure, tug assistance. Use of anchors, safe anchorages. Special signals. Support services (shore based).

Schedule Timing to effect move, speed of move relevant to each movement phase. Charter Party, delivery date, 'penalty clauses'. Sailing plan, monitoring and tracking operations, progress reports.
Risk assessment – Per phase of voyage.

Discharge procedure Methods: Ground handling equipment, secondary transport. Specialist personnel and equipment. Quayside facilities and tidal considerations. Risk assessment.

Personnel requirements Surveyors, specialist handlers, various contractors.
Insurance – Shoreside administration.

Documentation/Customs clearances Reception, delivery communications, Export licences.

Ancillary units Tugs, Lifting units, equipment, consumables.

Specialist equipment Ice regions.

Accommodations Airports, hotels, local transport facilities, labour force.

Security Piracy, road transport, in port, at sea, communications. Police, military, security codes affecting contingencies.

Costs Market assessment, Political considerations.

Chapter 3

Stowage properties of general cargoes

Introduction

General cargo is a term which covers a great variety of goods. Those goods may be in bags, cases, crates, drums or barrels, or they may be kept together in bales. They could be individual parcels, castings or machinery parts, earthenware or confectionary. They all come under the collective term of 'general cargo'.

The Chief Officer is usually that person designated on board the vessel who is responsible for the handling and safe stowage of all cargoes loaded aboard the ship. He is responsible for receiving the cargoes, and making sure that the holds are clean and ready to accept stowage and shipping in a safe manner. He is ultimately responsible for the carriage ventilation and delivery in good condition of all of the vessel's cargo.

In order to carry goods safely, the vessel must be seaworthy and the cargo spaces must be in such a condition as not to damage cargo parcels by ships sweat, taint or cause any other harmful factor. To this end the Chief Officer would cause a cargo plan to be constructed to ensure that separation of cargoes are easily identifiable and that no contamination of products could take place during the course of the voyage. The Chief Officer's prime areas of duty lie with the well-being and stability of the vessel together with the safe carriage of the cargo. Clearly, with the excessive weights involved with cargo parcels, the positive stability affecting the vessel's safe voyage could be impaired.

A correct order of loading with the capability of an effective discharge, often to several ports, must be achieved to comply with the safe execution of the voyage and also to stay within regulatory conditions, i.e. loadline requirements. This chapter is directly related to the details affecting stowage of particular cargoes and the associated idiosyncrasies, affecting the correct stow and carriage requirements to permit a lawful and successful venture.

Preparation of cargo spaces

The Chief Officer is generally that person aboard who is responsible for the preparation of the ship's holds to receive cargo. The preparations of the cargo compartments will usually be the same for all non-containerized general cargo parcels with additional specific items being carried out for specialized cargoes.

1. Holds and tween deck spaces should be thoroughly swept down to remove all traces of the previous cargo. The amount of cleaning will depend on the type of the previous cargo and the nature of the next cargo to be carried. On occasions the hold will need to be washed (salt water wash) in order to remove heavy dust or glutinous residues, but the hold is only washed after the sweepings and wastes have been removed.
2. Bilge bays and suctions should be cleaned out and tested, while the hold is being swept down. Tween deck scuppers should also be tested and rose boxes should be sighted and clear. All non-return valves in the bilge lines should be seen to be free and operating normally.

> **Note:** *If the previous cargo was a bulk cargo, then any plugs at the bilge deck angle should be removed to allow correct drainage.*

3. Check that all limber boards or bilge bay covers are in good condition and provide a snug fit. If bilges are contaminated, say from the previous cargo, and have noticeable odours, these should be sweetened and disinfected.
4. The spar ceiling (sometimes referred to as cargo battens) should be examined and replaced where necessary. In specific cases, like with an intended 'coal cargo', the spar ceiling should be totally removed from the compartment prior to loading.
5. All tween deck hatch coverings should be inspected for overall general condition and correct fitting. Tween deck guard rails, chains and stanchions should be fitted and seen to be in a good secure order.
6. Any soiled dunnage should be removed and, if appropriate, clean dunnage laid to suit the intended cargo to be loaded.
7. Checks should be made on the hold lighting, fan machinery, ventilation systems and the total flood fire detection/operation aspects.
8. Conduct a final inspection to ensure that the hold is ready to load. Some cargoes, like foodstuffs, may require the compartments to be inspected by a surveyor, prior to commencement of loading.

Duties of the Junior Cargo Officer (dry cargo vessels)

Cargo Officers will have a variety of duties before, during and after cargo operations begin. He/she should be aware that monitoring the cargo movements and ensuring parcels remain in good condition is protecting the owners' interests. Extensive ship keeping activities also go along with loading and discharging the vessel's cargo.

Prior to cargo operation

1. Check that the designated compartments are clean and ready to receive cargo.
2. Check that the drainage and bilge suctions are working effectively.
3. Ensure that cargo battens (spar ceiling) is in position and not damaged (some cargoes require cargo battens to be removed).
4. Make sure the relevant hatch covers are open and properly secured in the stowed position.
5. Check the rigging of derricks and/or the cranes are operating correctly.
6. Check that the hatch lighting's are in good order.
7. Order engineers to bring power to deck winches.
8. Inspect all lifting appliances to ensure that they are in good order.
9. Inspect and ensure all means of access to the compartments are safe.
10. Guard rails and safety barriers should be seen to be in place.
11. Ensure all necessary fire-fighting arrangements are in place.
12. Check that the ship's moorings are taught.
13. Note the draughts fore and aft.
14. Check that the gangway is rigged in a safe aspect.

During cargo transfer

1. Note all starting and stopping times of cargo operations for reference into the log book.
2. Note the movement of cargo parcels into respective compartments for entry onto the stowage plan.
3. Refuse damaged cargo and inform the Chief Officer of the action.
4. Monitor the weather conditions throughout operations.
5. Note any damage to the ship or the cargo-handling gear and inform the Chief Officer accordingly.
6. Maintain a security watch on all cargo parcels and prevent pilferage.
7. Tally in all special and valuable cargoes and provide lock-up stow if required.
8. Maintain an effective watch on the gangway and the vessels moorings.
9. Ensure that appropriate dunnage, separation and securing of cargo takes place.
10. Monitor all fire prevention measures.
11. Check the movement of passengers' baggage (passenger-carrying vessels).
12. Make sure all hazardous or dangerous cargoes have correct documentation and are given correct stowage relevant to their class (International Maritime Dangerous Goods (IMDG) Code).
13. Inspect compartments and the transit warehouse at regular intervals to ensure cargo movement is regular.
14. Inform Chief Officer prior to loading heavy lifts.
15. After discharge operations, search the space to prevent parcels being overcarried.

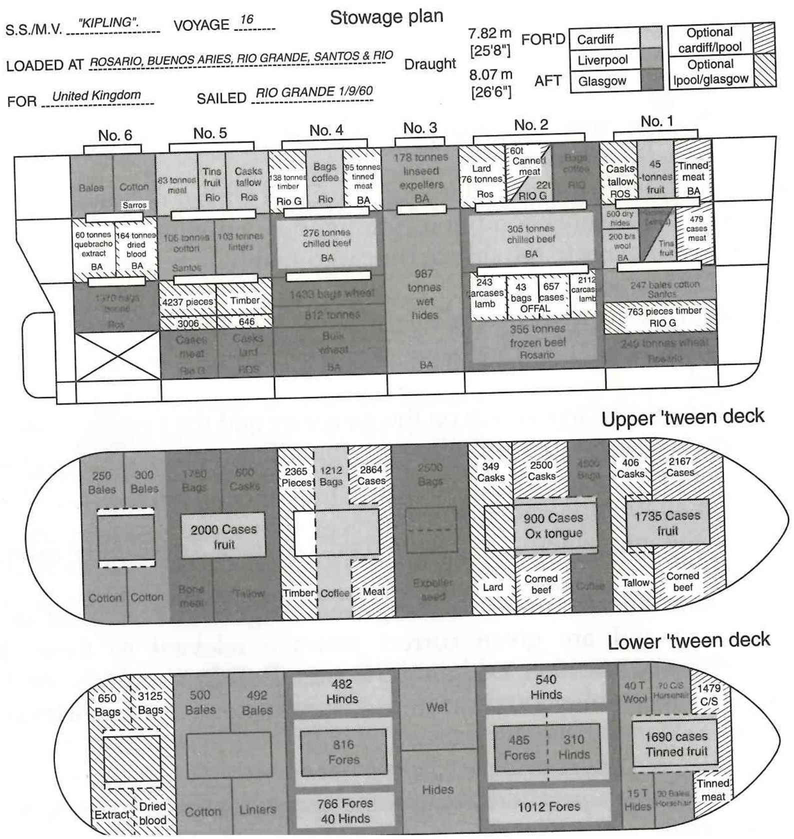
16. Ensure that the local by-laws are adhered to, throughout.
17. Note the draughts on the completion of loading/discharging.

After cargo operations

1. Close up hatches and lock and secure access points.
2. Inform engineering department to shut down power to deck winches.
3. Secure all lifting appliances against potential damage or misuse.
4. Enter the days working notes into the deck log book.
5. Inform the Chief Officer that the deck is secure and the current draughts.

Miscellaneous

The Chief Officer would ensure that the cargo stowage plan is kept updated when the vessel is in a loading situation. The officer's workbooks and tally sheets would be used at this stage. He would also at some time order the density of the dock water to be ascertained by means of the hydrometer. Cargo loaded/discharged, being then ascertained by means of the deadweight scale.



The cargo stowage plan

The function of the 'stowage plan' is to identify the various cargo parcels by quantity, destination and nature of goods (Figure 3.1).

It permits the Chief Officer to assess the number of stevedore gangs for respective compartments and the times associated with cargo operations. Additionally, it shows the location of special cargoes like 'heavy lifts' or 'hazardous goods', valuables and the lock-up stow goods.

Ventilation and fire-fighting procedures can be influenced by the disposition or respective cargoes, while the owners/Charterers are provided with notification of available space between discharge ports, useful for diverting the vessel for further cargo.

Stowage plans provide the following relevant details in addition to the pictorial cargo distribution plan:

Cargo distribution summary (tonnes)

Port of discharge	Colour code	No. 1 Hold	No. 2 Hold	No. 3 Hold	No. 4 Hold	On deck	Port total
1st							
2nd							
3rd							
4th							
5th							
6th							
Total							

Deadweight particulars

Draughts:
Forward --
Aft --
Mean --
Density correction ---------------------------------- Scale D/W
S.W. draught ---------------------------------- tonnes

Cargo ---------------------------
Fuel ---------------------------
Fresh water ---------------------------
Ballast ---------------------------
Stores ---------------------------

Total D/weight =
Scale D/weight =

Difference

The above information with the ship's name and port(s) of loading, together with date of sailing, are all included on the plan. Fuel, ballast and fresh water are usually depicted in alternative colours to colour codes as used for discharge ports.

Tanker stowage plan (profile + pipeline) (Chapter 5)

Particularly useful with product tankers where the disposition of grades of cargo can be clearly illustrated. The plan can ensure that adjacent tanks are not likely to generate contamination.

The pipeline system is often employed in conjunction with the plan to ensure that correct lines are operational with the correct grade of product. Quantities and type of each product can be easily identified, but clearly this plan is not as detailed as with say an open stow general cargo vessel carrying many different types of cargoes.

Roll-on, Roll-off stowage plans (plan view) (Chapter 7)

These are generally computer generated and like other stowage plans helps to identify individual units. This is specifically required for any units carrying dangerous/hazardous products. It also permits the order of discharge to be pre-arranged. Modern loadicators are usually involved with the planning of cargo stowage with Roll-on, Roll-off (Ro-Ro) vessels. They permit known weights aboard the vessel to be pre-programmed and the centre of gravity of each unit, with its respective stowage space, can be entered to provide the ships overall metacentric height (GM), very quickly.

Container stowage plans (elevation + cross section) (Chapter 8)

Container stowage plans are a proven way of tracking specific units during the sea passage. The plan identifies each unit and allows shippers to estimate arrival times and the whereabouts of their goods during every stage of shipment. It is also an effective security aspect for knowing which unit is where and tracing what goods are in what particular unit.

Pre-load plans

Provides a provisional distribution plan for the intended cargo parcels. They may be accompanied by capacity space set against cargo capacity to reflect unused space. They can determine access points or detail pipeline arrangements prior to commencing cargo operations. They are generally used on all types of vessels.

Steel cargoes

Probably the most physically dangerous, of all cargoes, is steelwork. Steel cargoes tend to come in all shapes and sizes, from the biggest 'casting' to the long steel 'H' girders used extensively in the construction industry. Long and heavy loads are difficult to control and the slightest contact with ...nding structures could generate extensive damage or injury to per-

safely extremely difficult. One of the exceptions to this, amongst the steel cargoes, is the loading and carriage of bulk scrap metal. Also a dangerous cargo but for different reasons. It is loaded/discharged by heavy grabs that generally cause some fall out between quayside and shipside.

Steel coils

Another form of steel cargo is heavy steel coils. The round shape makes this cargo a high risk to shifting in a seaway, especially if it is not properly secured. In the event of the cargo shifting, the ship could expect to take on a list which, if considered dangerous, could necessitate the vessel altering course to a port of refuge. The prime purpose for this would be to discharge and then to re-secure cargo, a costly business.

Steel coils are normally stowed in a double tier with the bottom coils on athwartships dunnage and wedged against athwartships movement, each coil being hard-up against the next (Figures 3.2 and 3.3). The objective is to

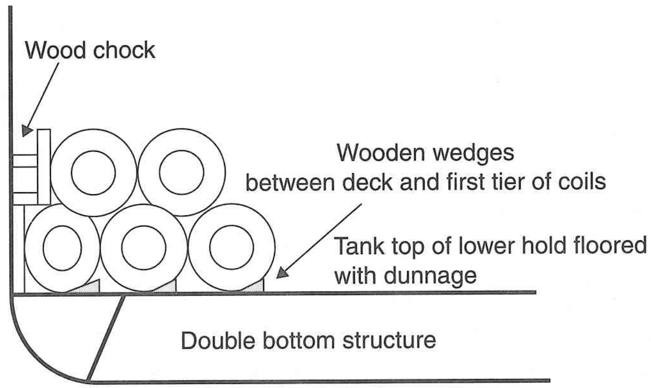


Fig. 3.2 Secure stowage of steel coils.

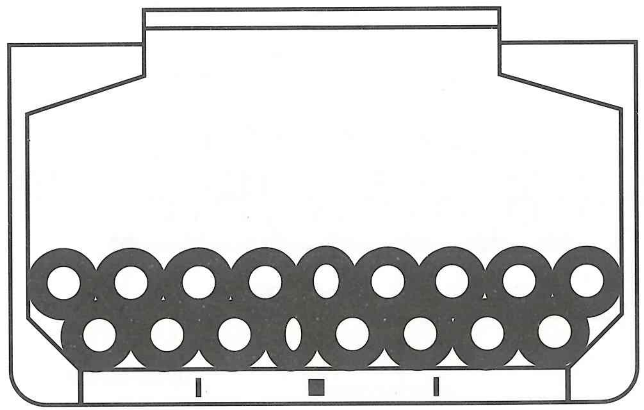


Fig. 3.3 Steel coil loading Diamond bulker design with complete double hull is

form a large immovable stow with any void spaces between coils chocked off with dunnage. End of stows would be fenced with timber battens and 'locking coils' together with the top tier of coils would most certainly be lashed with steel wire rope lashings. With such a heavy cargo, the ship could be expected to reach her loadline marks quickly leaving some considerable broken stowage with this type of cargo.

The turn of the bilge is protected by vertical dunnage and the second tier of coils is then placed on top. As the second tier is filled, it should be recognized that the stow will have 'key' locking coils and these should be lashed into position by steel wire lashings, while remaining accessible. It is also worth noting that the size and weight of individual coils is not always uniform and, as such, differences create small gaps between the cargo stow. These gaps, where substantial, should be 'chocked' with baulks of timber, while wedges can be used to prevent movement between smaller gaps (Figure 3.4).

Cargo Officers should be wary when working this cargo as the method of lifting during the loading process will usually be by a standard crane with adequate safe working load. However, when discharging, the odd coil may be of a heavier variety and cause the lifting gear to be overloaded (some coils go up to 10 tonnes).

The main concern for any Ship's Master with coils within his cargo is that they are correctly secured and to this end it is not unusual to hire a rigging

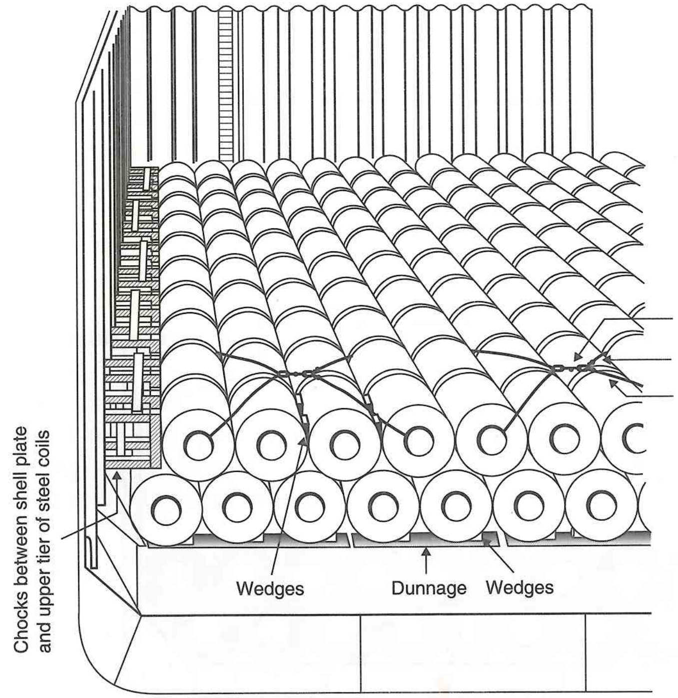


Fig. 3.4 Securing of steel coils.

gang during the period of loading. The ship's stability must also be taken into consideration with such a heavy cargo and as such, coils tend to be always loaded in lower holds, as opposed to tween deck spaces. Such a loading pattern would tend to generate a favourable 'GM'.

The quantity of cargo is usually restrictive, because its overall weight will soon bring the vessel to her loadline marks. Geographically, the loading port will dictate which loadline zones the vessel must route through to reach her port of discharge and as such, the passage plan should reflect a route that would minimize the ship's rolling pattern wherever possible.

Steel plate

Steel plates come in a variety of sizes from very long to heavy bundles of about 2 m in length. Various methods are employed to handle this commodity from plate clamps on chain slings to electromagnetic expanding beams (Figure 3.5). The weight and overall size tend to make this an awkward and dangerous cargo to load or discharge and once stowed requires chain securings.

Being heavy it is usually given bottom stow and floored with dunnage to accommodate any overstowing. Large plates may incur damage to the vessel and/or other cargoes during movement and careful handling should be the order of the day.

Modern-handling techniques where steel plate is a regular cargo, tend to employ gantry cranes working with electromagnetic, expandable beams. These are similar to steel stockyard cranes and are now seen in Port Terminals working in a similar manner to container gantry cranes, e.g. at the Port of Immingham, UK.

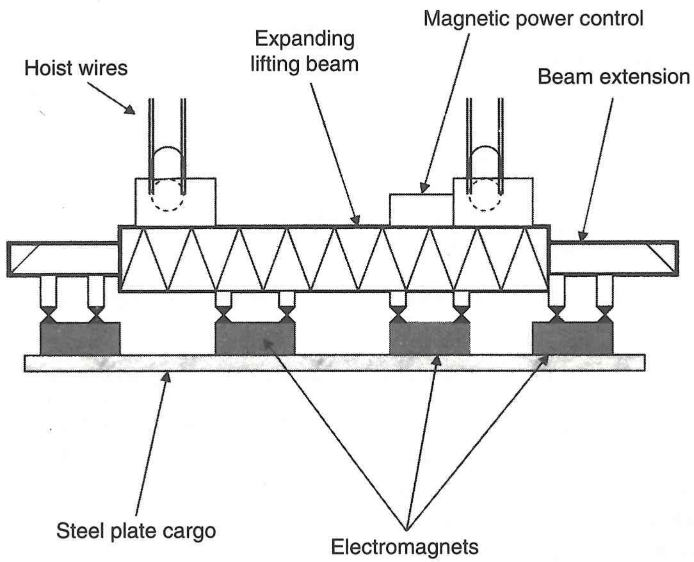


Fig. 3.5 Operating principle of Telescopic Magnetic Lifting Beam.

Bagged cargoes

There are many examples of bagged cargoes: fishmeal, grain, beans, cocoa, etc. to name but a few. They may be packed in paper bags like cement, or Hessian sacks, as employed for grain or bean products, loading taking place either in containers or on pallet slings. Size of bags tends to vary depending on the product, and are seen as a regular type of package for general cargo vessels.

However, handling bagged cargo is expensive by today's standards and many of the products lend more easily and more economically to bulk carriage or container stow. Where bags are stowed they should be on double dunnage, stacked either bag on bag or stowed half bag as shown in Figure 3.6.

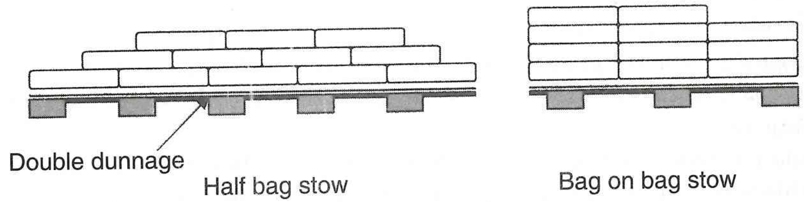


Fig. 3.6 Examples of bagged stowage.

When receiving bagged cargo the bags should be seen to be clean and not torn. Neither should they be bled in order to get a few extra bags into the compartment. Such an action would only increase the sweepings after discharge and lead to increased cargo claims.

Slings should be made up, in or close to, the square of the hatch. If they are made up in the wings, then bags are liable to tear as the load is dragged to the centre. Stevedores should not use hooks with paper bags and bags should not be hoisted directly by hooked lifting appliances.

Shippers frequently provide additional unused bags to allow for residual sweepings. This allows for all bags being discharged ashore, even torn bags, to ensure that a complete tally is achieved.

Bags containing oil seeds of any type must be stowed in a cool place as these are liable to spontaneous combustion.

Examples of products for bag stowage:

Bone meal – other than keeping dry, no special stowage precautions are required.

Cattle food – should be kept dry and away from strong smelling goods.

Cement – paper bags require care in handling. Stow in a dry place and not more than fifteen (15) bags high. Alternative carriage in bulk in specially designed ships for the task. Bilges should be rendered sift proof and compartments must be thoroughly clean to avoid contamination which would render cement useless as a binding agent.

Cocoa – stow away from heat and from other cargoes which are liable to taint.

Coffee – requires plenty of ventilation and susceptible to damage from strong smelling goods.

Copra – dried coconut flesh. Liable to heat and spontaneous combustion. It could taint other cargoes and cause oxygen deficiency in the compartment. Requires good surface ventilation.

Dried blood – used as a fertilizer and must be stowed away from any cargoes liable to taint (similar stow for bones).

Expeller seed – must be shipped dry. It is extremely high risk to spontaneous combustion and must not be stowed close to bulkheads, especially hot bulkheads.

Fishmeal – gives off an offensive odour and requires good ventilation. This cargo is liable to spontaneous combustion and requires continuous monitoring of bags and surrounding air temperatures. Bags should not be loaded in a wet or damp condition, or if they are over 35°C or + 5°C above ambient temperature whichever is higher.

Flour – easily tainted. The stow must be kept dry and clear of smelly goods.

Potatoes – loaded in paper sacks. Require a cool, well-ventilated stow.

Quebracho extract – this is a resin extract used in the tanning industry. Bags are known to stick together and should be separated on loading by wood shavings.

Rice – see next page.

Salt – requires a dry stowage area.

Soda ash – should be stowed away from ironwork and foodstuffs, and must be kept dry.

Sugar – also carried as bulk cargo. Bagged green sugar exudes a lot of syrup. Stowage should be kept clear of the ship's side as the bags are susceptible to tearing as the cargo settles. Dry refined sugar and wet or green sugar must not be stowed together. Cover steelwork with brown paper for bulk sugar and keep dry.

Rice

Rice is considered as a 'grain' cargo and would need to meet the requirements of the Grain Regulations affecting stowage. A ship's condition format would be required to show the cargo distribution and a curve of statical stability for the condition would need to be constructed.

Rice cargoes are now usually carried in bulk. This eliminates the costs of handling bags for the shipping phase. It is more economical and common to bag rice products at the distribution stage.