
Crew-centered Design and
Operations of ships and ship systems

# MOORING DECK GUIDELINES

**Duration: 36 months**
**Project Start: 01/10/2012**
**Project End: 30/09/2015**

| | |
|---|---|
| ***Document Name:*** | *MOORING DECK GUIDELINES* |
| ***Document Author/s:*** | *Brian Sherwood Jones (PCL), Margareta Lutzhoft (CTU).* |
| ***Document Editors:*** | *For Nautical Institute book: Francois Laffoucriere (NI).*<br>*Reviewer for CyClaDes Nikos Ventikos (NTUA)* |
| ***Document Reference Number:*** | *D4.2 (excerpt)* |
| ***Security status:*** | *public* |
| ***Circulation:*** | |

## History

| Version | Date | Description | Pages | Checked | Approved |
|---|---|---|---|---|---|
| **1** | **04/03/15** | **Extended version of draft material for inclusion in book.** | | | |
| **1.1** | **23/04/2015** | **Updated version D4.2** | **38** | | |
| **2** | **05/05/15** | **Mooring deck guidelines only excerpt** | **20** | | |
| | | | | | |
| | | | | | |
| | | | | | |

## ABSTRACT

This document is an excerpt from deliverable 4.2, a product of Task T4.3 of the CyClaDes project, which is concerned with assessors (rule makers and authorities). It presents design guidelines for the assessment of mooring decks. The assessment criteria range from risk assessments against a hierarchy of controls, technical risk assessments, and design criteria. It is linked to work on the design of winch control under Task T3.2 of the CyClaDes project.

# Content

# List of Abbreviations

| | |
|---|---|
| AB | Able Seaman |
| C/O | Chief Officer |
| COSWP | Code of Safe Working Practices |
| DMA | Danish Maritime Authority |
| EU | European Union |
| HCD | Human Centred Design |
| IACS | International Association of Classification Societies |
| ILC | International Labour Conference |
| ILO | International Labour Organisation |
| IMO | International Maritime Organisation |
| ISO | International Organization for Standardization |
| MAIB | Maritime Accident Investigation Board (UK) |
| MARS | Mariners' Alerting and Reporting Scheme |
| MCA | Maritime and Coastguard Agency (UK) |
| MLC | Maritime Labour Convention |
| MV | Motor Vessel |
| OSH | Occupational Safety and Health |
| PPE | Personal Protective Equipment |
| QIU | Quality In Use |
| SOLAS | Safety Of Life At Sea Convention |
| SWL | Safe Working Load |
| VLCC | Very Large Crude Carrier |
| VHF | Very High Frequency (radio) |

# Executive Summary


## Problem definition

- Mooring deck operations are dangerous. The degree of hazard is influenced by the design, but there is very little design guidance available.
- Mooring incidents have been described in MARS reports and other reports but these do not seem to be a normal reference source for designers.

## Technical approach

- The technical approach collates available guidance, material from incident reports, and generates guidance aimed at preventing operational problems. Guidance was developed using the preventive principles in the ILO 'Guidelines for implementing the occupational safety and health provisions of the Maritime Labour Convention, 2006' [7].
- This document interacts with the material in the Framework (D2.1 Part A). The content is linked to work on designing a winch control panel in T3.2, reported in deliverable D3.2.
- This document is not the only output from T4.3. The DOW effort statement for T4.3 is 8.4 person-months.

## Results and achievements

- The current situation is that the only assessment of mooring deck designs that could be found is that done by the Swedish Maritime Administration [4]. It is hoped that the guidance produced here could be the basis for more extensive design assessment.
- The ILO preventive principles appear to be a viable approach to developing criteria for ship design assessment.

# Introduction

Mooring operations are recognised as potentially hazardous, and the accident data documented in D1.1 and D3.2 of the CyClaDes project supports this.

There are numerous guides to the safe operation of mooring decks e.g. [1, 2], and useful guidance can be found in the Nautical Institute guides to mooring and anchoring ships [3]. In contrast, there is almost no material on the design of mooring decks and associated equipment. Class Rules do not address design for safe operation. SOLAS has no specific requirements. The only current requirements found were Swedish [4] – discussed below.

The logical application of the preventive principles for workplace design in the ILO Maritime Labour Convention (MLC) has the potential to make a considerable difference.

The EU land-based regulations that would be applicable is the Machinery Directive [5], which takes a human-centred approach to assessment and is supported by harmonised norms that address ergonomics.

# Current regulations

Chapter 15 of The Swedish Maritime Administration's Code [4] has a number of sections that address mooring deck occupational safety. The guidelines have drawn from these requirements but should not be taken as demonstrating full compliance with the Code.

MCA guidance [6] potentially addresses mooring deck occupational safety as follows:

> "*2.2 The layout of the installations should be such as to avoid the need for anyone to be stationed or to work in the bight of warp or rope formed by the lead from the winch or windlass round and through the fairleads and over-side. The consequences of failure in any part of the system should be carefully considered and effective precautions taken.*"

The ILO Maritime Labour Convention (MLC) [7] Guideline B.4.3.1 states:

> "*The necessary measures should take due account of the preventive principle according to which, among other things, combating risk at the source, adapting work to the individual, especially as regards the design of workplaces, and replacing the dangerous by the non-dangerous or the less dangerous, have precedence over personal protective equipment for seafarers.*"

The ILO Guidelines on OSH [8] include the following relevant clauses:

> "*27. The ILC adopted at its 91st Session (2003) a global strategy on occupational safety and health designed to promote the implementation of ILO OSH standards. The strategy emphasized the need for tripartite participation and national action to adopt a preventive approach to OSH, which is key to achieving lasting improvements in safety and health at work. Similarly, the MLC, 2006, endorses the implementation of preventive measures, programmes, inspection and reporting systems for the management of OSH on board ships. Preventive principles involve combating risk at the source, adapting work to the individual – especially in the design of workplaces – and replacing the dangerous by the non-dangerous or the less dangerous. Prevention should take precedence over protective equipment for seafarers. The instruments adopted since 1981 strongly emphasize the principle of preventive measures, while personal protective equipment (PPE) is considered a last resort when exposure to risks cannot be prevented, minimized or eliminated.*
>
> *28. Prevention principles are based on collective, rather than individual, preventive methods. The preferred sequence or hierarchy of collective risk control measures is:*

*(1) elimination;*

*(2) substitution;*

*(3) isolation or combating of risk at the source;*

*(4) technical or engineering controls; and*

*(5) organizational measures.*

*29. Technical control measures could include automation, closed systems, ventilation, local extraction and encapsulation of the workplace. The choice of working methods and tools also has a major impact on the level of exposure.*

*30. Organizational measures could include separating a workplace from other workplaces, appropriate maintenance of equipment, provision of special instructions and limiting working time on a job.*

*31. Use of PPE depends upon human response and should only be used as a sole measure when all other options have been exhausted. It should be:*

- *Properly assessed before use to make sure it is fit for purpose;*
- *Maintained and stored properly;*
- *Provided with instructions on how to use it safely; and*
- *Used correctly by seafarers.*

*The competent authority should consider establishing clear criteria for considerations to be made for the use of PPE.*

*47. National laws, regulations or other measures should ensure that: (d) preventive measures, including engineering and design control, include the substitution of processes and procedures for collective and individual tasks, and use of personal protective equipment;*

*63. Guidance to ship owners on the implementation of OSH policies and programmes may include the following:*

*(a) that they ensure the design of the workplace on board takes into account prevention principles and technical progress in the industry, and conforms to relevant international and national laws, regulations, standards or codes of practice;*

*129. Anchoring, mooring and docking operations pose serious risks to the safety of the seafarers involved in such operations and may result in fatalities and or major injuries.*

*146. Ergonomics is the study and design of workspaces (such as the workstation and ship bridge) and their components, work practices and procedures to benefit workers' productivity, health, comfort and safety.*

*147. Ship design and layout, including engineering, should provide a work environment that fosters effective procedures, safe work patterns and seafarers' health, and should minimize or prevent occupational accidents, injuries and diseases which may degrade human performance or increase potential for error.*

*148. A ship as a workplace comprises several specific types of workspaces. On cargo ships, examples include the bridge, engine room, hatches, decks and accommodation.*

*150. The competent authority should ensure that the ship's design incorporates the necessary preventive principles and should ensure that risk assessments are conducted to avoid poor ergonomic design. Testing should include the use of equipment and machinery for long periods of monotonous work, working pace, working in isolation, the design of workspaces, equipment and technical aids, in addition to work methods. Assessments should also evaluate the nature, degree and duration of individual exposure to equipment and machinery used on board. This would include approval of maintenance requirements.*"

The ILO preventive principles are widely used, not just in the Guidelines e.g. [9, 10]. Applying the ILO preventive principles means that the design of the mooring deck should progress through a risk control hierarchy in the following sequence:

(1) **Elimination** of the hazard; Design mooring systems that eliminate the hazards. Automated mooring systems exist that eliminate the major hazards. An example is the Cavotec Moormaster, a vacuum-based automated mooring technology that eliminates the need for conventional mooring lines [20].

Where this is not practicable:

(2) **Substitution** e.g. of toxic materials or substances; this is not particularly relevant to mooring deck design.

(3) **Isolation** or combating of risk at the source; Separate people from the hazards. This could involve remote operation.

(4) **Technical or engineering controls** such as automation, and technical means of reducing exposure to health hazards; Provide protective cages round equipment or operating positions, railings to keep people away from hazardous positions, bars round fairleads, pulleys, bollards to catch whipping lines. Fall protection e.g. from mooring stations. Anti-skid deck surface.

(5) **Organizational** measures, including maintenance, reducing exposure time, instructions. e.g. painted areas on deck, paint on rotating machinery. Training the crew.

The **use of PPE** depends upon human response and should only be used as a sole measure when all other options have been exhausted.

### Standards and good practice

A risk assessment of the extent to which hazards have been eliminated or mitigated by design would appear to be the minimum good practice. ISO 12100 [11] provides relevant good practice on machinery risk assessment and reduction.

Applicable Human Centred Design standards are those for the design of work systems [12] and machinery safety e.g. [13, 14, 15].

## Hazards

A report by the Danish Maritime Authority (DMA) [16] poses the following questions (without providing answers):

"*Both ashore and on board ships, persons are as far as possible removed from risk zones.*

*Otherwise engines and running parts are shielded. The question is, if it possible to do something similar on a mooring deck.*

*• Is it possible to avoid working in the risk zone by improving the mooring arrangement?*

*• Can the risk zone be minimised?*

*• Is it possible to get the crew out of the risk zone and into "safe heavens" before it gets dangerous?*

*• Is it possible to construct winches, so the crew does not have to pull and lead lines, when the winch is running?*"

Hazards with design implications for traditional mooring decks include:

- Poor sightlines.
- Inadequate space.

- Trip hazards such as nets/ save-alls, windlass platforms, forecastle access hatch and bitts.
- Slips aided by oil ,ice, water.
- Falls: Ship's side.
- Elevated winch gratings.
- Manual lifting.
- Complicated winch operation.
- Winch handles that do not return automatically to stop.
- Overload devices inadvertently switched off.
- Lines running wrongly on drums.
- Lines jamming on drum end.
- Inability to halt operations quickly e.g. in event of failure or seafarer in hazardous situation.
- Noise leading to a lack of communications.
- The need to work close to lines while equipment is running.
- Hazard areas not being identified and known.
- Difficulty of identifying need for maintenance.
- Equipment or mooring arrangements that can be used inappropriately – forseeable misuse.

The ILO datasheets on occupational hazards [17] could also be used as a checklist.

## Task requirements

The design should facilitate safe working across the range of tasks and conditions to be encountered.

Task requirements can be derived from analysing tasks, including:

Anchoring and weighing anchor.

Making fast and casting off.

Mooring to buoys.

Towing.

Ship to ship mooring.

Bunkering.

Chapter 25 of the MCA Code of Safe Working Practices (COSWP) [18] could be used as a source of task requirements.

## Design guidelines

This section sets out design guidelines, supported by examples of incidents, under the following headings:

- Sightlines.
- Deck Layout.
- Stowage.
- Winch control.
- Communications.
- Equipment design.

- Ropes, wires and stoppages.
- Bunkering.

## Sightlines

A position for supervising mooring operations should provide visibility of the whole operation.

The vessel's freeboard, design of poop and forecastle decks, especially bulwark heights, can make visual communications between the deck and the tug difficult.

The person in charge should avoid getting involved with the physical operations, so that they can retain an effective oversight.

Good communication must be maintained between all members of the mooring team. Good communication between the tug and vessel being aided are important.

A responsible officer should be in charge of each of the mooring parties, and a suitable means of communication between the responsible officers and the vessel's bridge team should be established.

A bird's eye view of the mooring deck arrangement is recommended (an aerial view from a high point of the vessel can be utilised) to more readily identify danger areas. This may require an elevated platform (with appropriate hazard mitigation such as guard rails, fall protection, anti-skid surface).

Ensure that bulwark access is provided port and starboard to sight the cable and anchors when being hoisted and stowed.

Adequate sightlines should be provided when operating remote control.

Note: As ships have got larger, lines have got thicker, and winch drums higher. This has consequences for sightlines.

## Incident data relating to sightlines

MARS report 200621 "*Although the importance of supervising operations from a good vantage point is recognised, the practice illustrated in the photograph [below] is totally unacceptable. It is recommended that companies not only review their safe mooring operations but also ensure that the design of mooring stations takes into account safe layout for those handling mooring equipment and for those supervising.*"

*Figure 1: taking unacceptable risks to achieve a vantage point (from MARS report 200621)*

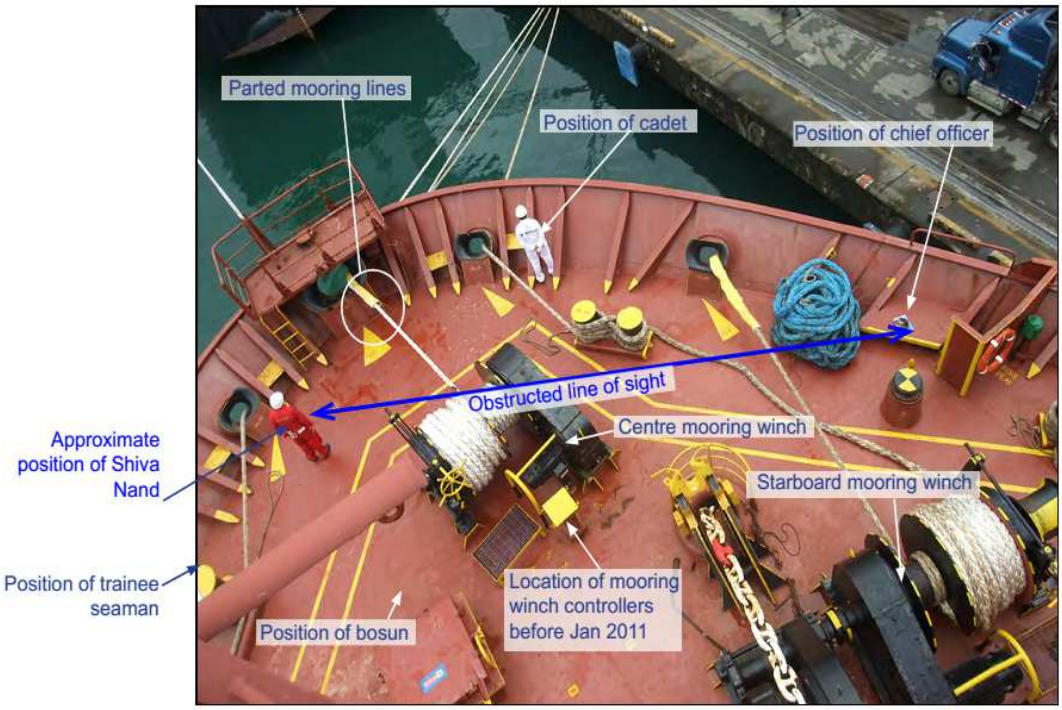
MARS report 201250 "*The trainee seaman, who was driving the winch did not have any visual or verbal contact with AB 1 when he started hoisting the mooring line.* "

MARS report 201265 "*The vessel was fitted with a large wave breaker right forward, which meant that the forecastle deck had very little clear area. Standing on a small bulwark platform on the starboard side, the C/O was leading the team and also operating the mooring winches remote control levers located close by. The bridge team had no view of the forward mooring station due to the tall wave breaker and high deck cargo.*" Comments by experienced seafarers as part of the CyClaDes project were that this deck is too small for safe operation.

MARS report 201364; "*included operation without sight lines (or VHF radios). Safety action taken: The control units of the winches on the stern of the vessel (and her sister ship) have been moved to a position further forward and each equipped with a safety cage for the winch driver.*"

MV FREMANTLE EXPRESS accident

Figure 3




Reconstruction of forward mooring station

*Figure1: MV FREMANTLE EXPRESS  Crown Copyright [19]*

The MAIB accident report [19] concludes:

> *1. The re-positioning of Fremantle Express's forward mooring deck winch controllers in January 2011 was ill-considered, and no forethought had been given to the potential consequences of moving them.*

*2. The requirement for the bosun to face aft while operating the winch controllers removed his ability to monitor the deck, and so prevented him from supporting the chief officer with his experience.*

*3. The chief officer was unaware of the risk of the mooring rope parting until it was too late to give a warning, and the bosun was unaware that Shiva was standing in the snap-back zone behind him.*

*4. Had the bosun been operating the mooring winch in a central position facing forward, it is likely that he would have recognised the risk of the rope parting and would have warned the chief officer and Shiva accordingly*."

## Deck layout

Ships should be fitted with suitable mooring equipment for safe mooring under all operational conditions.

The mooring and towing arrangements should be appropriate for the crew and the equipment e.g. self-tensioning or traditional. The mooring arrangement should minimise crew winch head work e.g. use of automatic mooring windlasses.

The operating area for mooring windlasses should be so designed that the operator is well protected and has a good overview of the working area.

Mooring arrangements have to cope with a variety of berthing situations. Some mooring arrangements have so many different solutions that, cumulatively, the whole deck is a potential snap-back zone. Designs that use a small consistent set of snap-back zones are likely to place lower demands on training and supervision.

Mooring arrangements should be so arranged and positioned that those who work with the mooring lines have adequate space and are able to stand well clear of windless ends, wire drums and the like and also so that there is sufficient space where the mooring lines are coiled.

The mooring leads should be situated correctly for the harbour berths to be encountered, and the tugs which will be used.

Taking on board and securing towlines from a tug should be so arranged that manual handling of the towing lines is avoided as far as possible.

The layout of the installations should be such as to avoid the need for anyone to be stationed or to work in the bight of warp or rope formed by the lead from the winch or windlass round and through the fairleads and over-side.

The design should provide means of reducing exposure to hazards; Provide protective cages round equipment or operating positions, railings to keep people away from hazardous positions, bars round fairleads, pulleys, bollards to catch whipping lines. Fall protection e.g. from mooring stations.

The deck layout should provide adequate space:

- Such that personnel essential to the operation should as far as reasonably practicable be able to stand in a protected position.
- Where moorings are to be heaved on a drum end, to station one person at the drum end. For heavy moorings and large vessel operations, there should be space for a second person backing and coiling down the slack.
- To allow people to avoid all ‘Snap-Back’ Zones
- For a minimum of two people to each mooring station throughout the operation.

- Next to, or behind, bollards the clear space should be at least 0.4 metres. In front of the bollard or the place where a person works on securing or releasing, there should be a clear breadth of at least 1.2 metres.
- Space behind the winch head, i.e. the place where a person stands when casting, should be at least 2 metres. Alongside the winch head there should be a space of at least 1 metre.
- Next to the wire drum there should be a clear space with a breadth of at least 0.6 metres if the wire has to be rolled manually.

[Note: the dimensions above are taken from Swedish requirements [4]]

For vessels regularly employing tug assistance, ensure mooring equipment forward and aft and throughout length of vessel is compatible.

For vessels employed on specific routes operating from dedicated terminals, ensure that the position of mooring equipment is fully compatible with terminal.

Ensure that the arrangement of equipment, self-tensioning winches, warping ends, capstans, etc., and their alignment with roller and pedestal fairleads, panamas and bollards, is compatible with normal good mooring practice (e.g. [3]) and provides adequate flexibility for a number of mooring scenarios.

Mooring arrangements should be arranged so that mooring lines can be led directly from the fairlead or snatch cleat to the winch or cable drum. Where this is not possible the least possible deviation from the direct hauling rope should be made, with a maximum of two guide rollers (roller fairleads) between the fairlead or snatch cleat and windless end or drum winding.

Where possible, lines should not be led round pedestals except during the operation of mooring the vessel

The arrangement should enable the leads used to be those most suited and not create sharp angles.

Ropes and wires should not need to be fed through the same leads or bollards.

Ensure that easy and safe access is provided to windlass and winch manually operated brakes.

Vessels with low freeboard need safe mooring arrangements for times when the wharf is higher than the main deck.

Mooring arrangements should avoid (prevent?) mooring lines being run from the underside of the rope drum.

Measures should be provided to prevent ropes becoming jammed e.g. rope deflectors.

Large ships may use many lines; the hazards associated with working and moving around these need to be considered carefully.

Wide ships, such as large container ships, have winches widely spaced. Co-ordinated operation of these winches may involve considerable movement by operators. The hazards arising from this should be addressed.

Manual handling for large ships with heavy lines and small crews may need to be re-considered as there may not be the resources to perform the tasks safely. The design should take account of the small crews available for mooring e.g. supply dedicated winches where there is a standard mooring pattern to avoid having to heave up, stopper off and then turn up mooring lines on bitts.

A standard yard specification is likely to offer only 14 wires on winches and a centralised high pressure hydraulic system. A VLCC should have at least 20 mooring wires on winches, with a remote control facility to save on manpower and two independent hydraulic systems, based

preferably on low pressure equipment, which is expected to have lower maintenance and a longer life span. It is also useful to incorporate additional leads to give the vessel the flexibility to carry out ship to ship transfer with ease. The benefits lie in safety and pollution prevention where a vessel has to be safely secured to a loading or discharge berth.

## Stowage

Ensure that secure stowage is provided for mooring wires and ropes – compatible with service on which the vessel is to be used. Spare mooring equipment should be stowed clear of the deck, preferably on a pallet and in a dry ventilated position. If mooring ropes and wires are stowed on deck during sea passages they should not be exposed to sunlight, sea spray or funnel soot. It is suggested that canvas or heavy duty polyethylene covers will prolong the life of the ropes/wires.

Check on facilities for secure stowage of anchors.

Volume of anchor locker to be checked.

## Winch control

The indications and controls should ensure that excessive loads do not arise on mooring, towing and hauling lines.

Winch drums or drum ends should never be left turning with the winch control lever unattended. The winch handle should automatically return to zero when released.

The winch control system should provide ease of testing and diagnostics.

Remote control should provide feedback of load on line.

Switching off the overload device: If this has to be done, there are to be very clear indications of maximum load for the operators.

Controllers for windlasses, winches and capstans are correctly positioned in relation to the equipment they control, the operating crew and the necessary sightlines for safe operation.

Emergency stops should be provided, and positioned where they can be used in an emergency.

The ‘slack’ and ‘heave’ positions should be clearly marked. The design should consider what operating positions may be used for the control.

Winch design should not complicate quickly easing out the wire, and should not ease out in jerks.

It should be easy to estimate the load on the line.

SWL should be clearly marked and visible to operators.

## Incident data related to winch control

MARS report 201250 “*the electrical winch had no emergency stop arrangement. It was also observed that when the control lever was moved to the stop position, the winch drum did not stop immediately, but continued to rotate a further half revolution*.”

MARS report 201364 “*He immediately let go of the winch’s spring-loaded operating lever, which then clicked back to the neutral position. However, due to the normal stop delay of the winch control he was nonetheless dragged nearly two metres across the deck. When the winch stopped, the loop in the stern line together with the trapped right leg of the victim had already reached the winch drum*.” … “*...the assisting crew briefly moved the operating lever of the winch in the wrong direction by mistake, causing the victim to be pulled slightly further onto the winch.*” “*Tests showed that the stopping time of the winch was about 3.5 seconds after the operating lever is released. During this period the winch’s angle of rotation is 210*

*degrees. If the emergency stop button is pressed immediately after the operating lever is released, the stopping time is about 1 second*."


*Figure 5: Poor winch control design (from MARS report 201364)*

MARS report 201413 Lessons learned: "*1 Need for better guarding of the area concerned (and to eliminate the 'trip hazard' caused by the two low rails by the addition of a higher rail)*."


*Figure 6: Guardrail design (from MARS report 201413)*

*Figure 7: MV TAMINA [20] Ambiguity in operating direction*

The Transport Styrelsen Report [20] states: "*The breast line was lead in a tight angle between the winch and the bollards on board with the roller in the center. As the line was sent ashore and made fast the second officer was standing at the winch. According to the second officer he heard the Master calling something from the bridge and turned around so his back was facing the railing. He now had the maneuvering handle of the winch in front of him and was not sure whether to slack out or heave on the line. He then started to heave on the line by pulling the handle.*

*After securing the spring line the cadet on the forecastle was about to go aft to assist with the other lines when he heard a cracking sound. He looked towards the place where the second officer was standing and saw the roller being torn off its fitting. The second officer was hit by the line as it came loose. He fell and instinctively held on to the maneuvering handle. This caused the winch to continue heaving and as a result he was caught with his legs in it before he released the handle.*"

## Communications

Ensure that communication systems provided are correctly located for communication with the bridge - check protection rating of electrical equipment mounted on open decks.

Provide facilities to enable communications when there is high ambient noise. This may include ear defenders with radio communications.

Written instructions should be available in the appropriate languages.

## Equipment design

Ensure that an efficient anchors/hawse pipe washing system is fitted and that the control valve is located in a safe and accessible location. Ensure that the arrangement and alignment of hawse pipes and cables provide for efficient dropping, hoisting and stowage of the anchors and self-stowing of the cables.

Pedestal roller fairleads, lead bollards and mooring bitts - only one line to be used on each item.

It should not be possible for the line to be trapped between the drum end and the brake.

Wire drums should be fitted with such arrangements that the wire end does not whip up towards a person upon winding on.

## Ropes wires and stoppers

In connection with the mooring arrangement there should be the requisite number of mechanical stopping arrangements or means of attachment for chain and manila stoppers, unless the running mooring gear is spun directly on to an automatic or specially constructed mooring windlass.

On large ships where slip-wires from buoys are employed, there should be special arrangements to hold the mooring line fast while it is being taken to the bollard.

Mechanical stopping arrangements should be placed near the fairlead or snatch cleat if the attachment place is not located close to the dragline between the fairlead and windlass. The fastening point for the second stopper should be so placed that the stopper may be positioned at a suitable distance from the fairlead or snatch cleat.

It should be easy to detect failure and to check condition of ropes wires and stoppers.

It should be easy to determine load limits of ropes wires and stoppers.

## Environmental design

The design should consider environmental aspects of working on the mooring deck.

Physical hazards to be highlighted should not be limited to snap-back areas, bulkhead frames, mooring bits, pedestal fairleads and cleats. It should also include structures such as platforms at the windlass and hawse pipe covers.

Decks should have anti-slip surfaces provided by fixed treads or anti-slip paint coating.

The need to operate in cold conditions, including snow covered decks may need to be considered

Hazardous machinery should be painted in appropriate colours.

The whole working area should be adequately lit for operations under taken during periods of darkness.

Lighting should not cast shadows that may hide potential hazards.

## Bunkering

The majority of ships these days are not designed to allow for the berthing of barges/lighters alongside. On small ships this is not a problem as the barge can use the customer ships own mooring points on the fo'csle and poop. However, on larger vessels these mooring points will be too far from the barge. It is therefore necessary to provide closed fairleads and bitts in the vicinity of the manifold and the midsection of the vessel. These comments are particularly applicable to large bulk carriers, car carriers and RoRos. On larger vessels the bitts are often situated some distance from the fairleads. This is not really necessary and involves a lot of extra pulling for todays small crews. The following factors need to be considered:

- Closed fairlead in vicinity of manifold to take barges spring line.
- Further closed fairleads forward and aft of this point to take barges head and stern ropes.
- Put bitts close to fairleads.
- Consider the implications of obstructions such as accommodation ladders and fashion plates to "walking" the ropes from the barge to the leads.

## Concluding remarks

It has proved possible to assemble a substantial body of guidance that could be used for the assessment of mooring decks e.g. at the plan approval stage. The ILO preventive principles appear to be a sound basis for using design to reduce risks to the crew.

# References

MARS references can be found on the Nautical Institute website at
http://www.nautinst.org/en/forums/mars/search-all-mars-reports.cfm

1. Mooring – Do it safely, Seahealth, Denmark 2013 http://www.seahealth.dk/sites/default/files/media/Billeder_Publikation/Guidance_Mooring%20-%20do%20it%20safely_0.pdf
2. Risk Focus: Mooring UK P&I Club http://www.ukpandi.com/loss-prevention/risk-management-advice/risk-focus-mooring/
3. Mooring and Anchoring Ships, Volumes 1 and 2. Nautical Institute.
4. The Swedish Maritime Administration's Code of Statutes SJÖFS 2005:25 (SFH 1.2.2.1)3.
5. Directive 2006/42/EC of the European Parliament and of the Council on machinery.
6. Maritime and Coastguard Agency Marine Guidance Note MOORING, TOWING OR HAULING EQUIPMENT ON ALL VESSELS - SAFE INSTALLATION AND SAFE OPERATION MCA MGN 308 (M+F)
7. Maritime Labour Convention, 2006, General Conference of the International Labour Organization.8. 'Guidelines for implementing the occupational safety and health provisions of the Maritime Labour Convention, 2006' MEMOSH/2014/6, 2014.
9. Fundamental principles of occupational health and safety, Benjamin O. Alli; International LabourOffice–Geneva: ILO, 2008.
10. BS OHSAS 18001:2007 Occupational health and safety management systems.11. ISO 12100:2010 Safety of machinery -- General principles for design -- Risk assessment and risk reduction.12. ISO 6385:2004 Ergonomic principles in the design of work systems.
13. EN894 Safety of machinery. Ergonomics requirements for the design of displays and control actuators. Parts 1-4.
14. EN 614-1:2006+A1:2009: Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles.
15. EN 614-2:2000+A1:2008: Safety of machinery - Ergonomic design principles - Part 2: Interactions between the design of machinery and work tasks.
16. Danish Maritime Authority Safety Study Mooring Accidents on Merchant Ships 1997-2006' www.dma.dk.
17. 'International Hazard Datasheets on Occupation Seaman, Merchant Marine'. (ILO WCMS 190247)
18. Maritime and Coastguard Agency Code of Safe Working Practices for Merchant Seamen (COSWP) 2006
19. MAIB Accident Report NO 29/2011 DECEMBER 2011 MV FREMANTLE EXPRESS Fatality during mooring operation Veracruz (Mexico) 15 July 201120. MV TAMINA Transport Styrelsen Report RAPPORT Bunkerfartyget TAMINA IMO-nr 7805150 - SIPT - personskada den 7 juli 2010

20 Cavotec MoorMaster Automated Mooring (http://www.cavotec.com/en/ports-maritime_6/)