






Addressing Mooring Forces and Snapback Hazards

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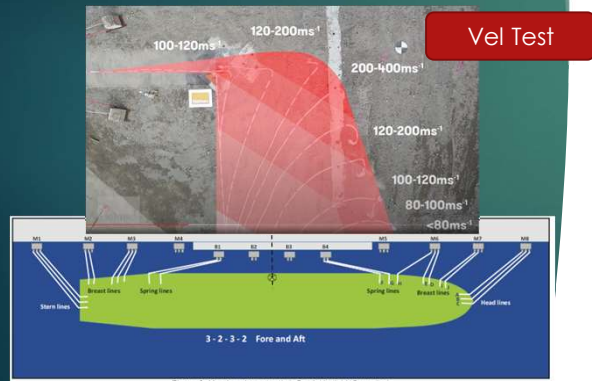
Overview

-  Definition / Issue
-  History of Incidents
-  Standards and Guidelines
-  Awareness / Approach
-  Concluding Remarks

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Snap-back

- ▶ Rupture in a mooring line
- ▶ Parted line snap-back like a rubber
- ▶ Significant Safety Risk to personnel on wharf and ship decks



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Two seafarers killed when struck by a parting mooring line

Crewmember in coma – struck on the head by a parting mooring line

3/O sustained 90% partial amputation of leg and fractured elbow

A/B suffered a fractured hip when struck by a parting mooring line

Both legs broken when struck by a parting mooring line

Mooring line slipped from windlass drum and struck crewmember's head

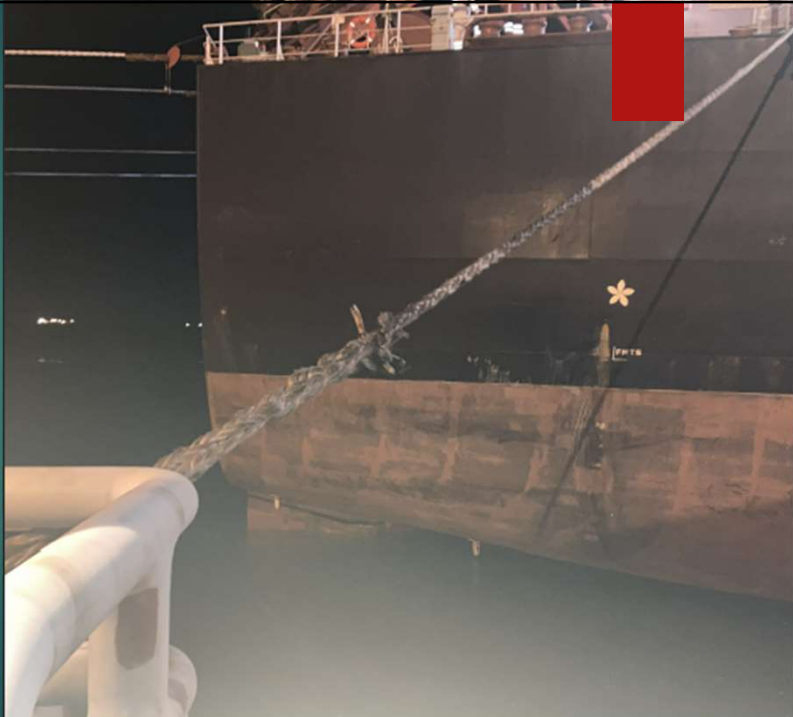
C/O killed when tow-line to barge parted and snapped back

Deck cadet suffered serious arm injuries during mooring operations

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Incident recorded on 12 June 2022

- ▶ VLC Bulk Carrier (292m LOA)
- ▶ Mooring configuration 4+2+2
- ▶ Breast line was parted shortly after the high water
- ▶ A slight spike on the Berth Alert System was recorded although the system remained in the Green status



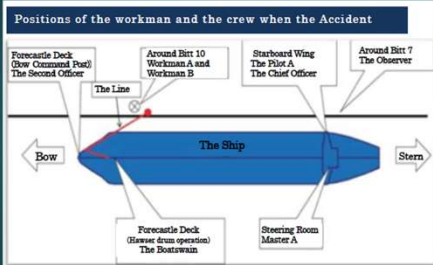
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Serious Accident

While in docking operation for a container ship, a mooring rope attached onto a bitt on the berth broke, and snapped back, hitting mooring workers, and took their lives

Outline: the container ship (the Ship) was docking at Port Island Container-Berth 18 at about 0736 hrs, May 20, 2009, when a mooring rope attached onto a bitt on the berth broke, snapped back and hit two workmen engaged in mooring work. Both of them died.

Positions of the workman and the crew when the Accident



weather at the time of the accident
 average wind speed: 3.6 ~ 3.7m/s
 max. instantaneous wind speed: 9.8m/s
 wind direction: NE

the break of the mooring
 A "spring line" is a mooring line taken backward from the bow, or taken forward from the stern.

A "hawser drum" is a rotating drum that can wind up a rope about 200m in length, and is used for heaving or veering a mooring rope.

A "bollard" is a post installed on the deck used for latching mooring ropes. Generally, a pair of two posts is called a "bollard." On the other hand, a single post is called a "bitt."

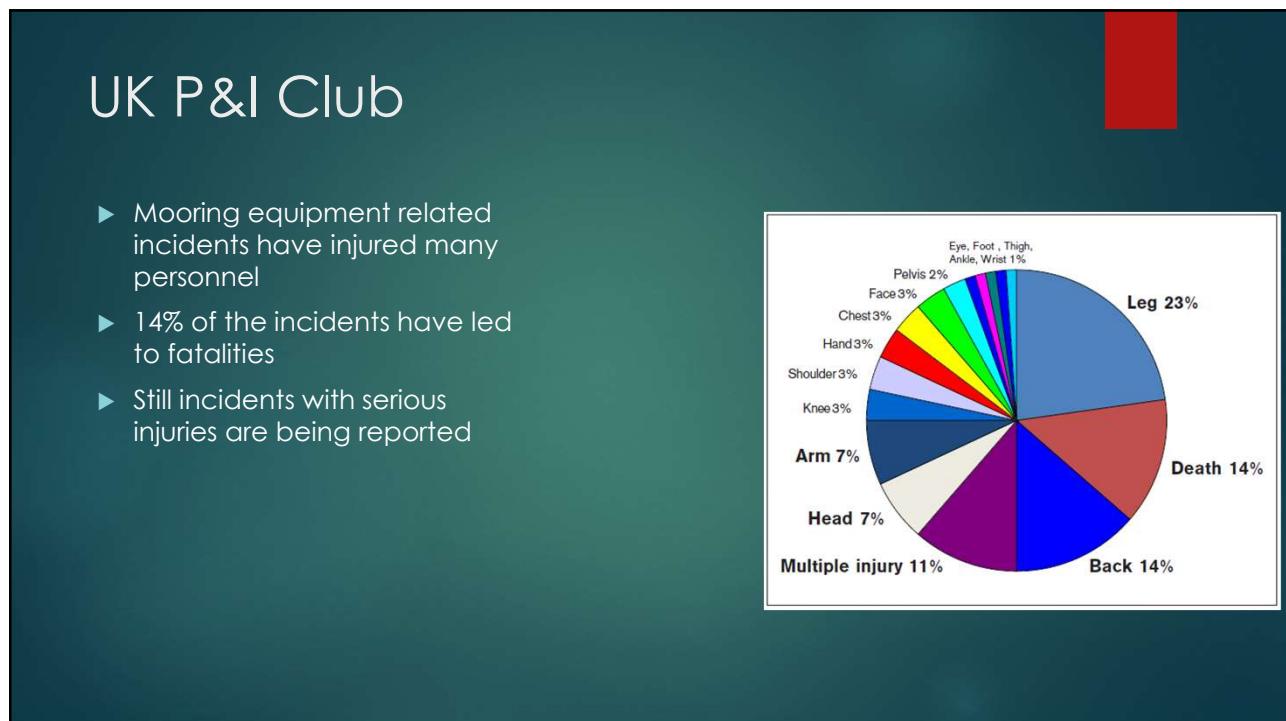
Causal relations

Causal relations	The Ship (container ship)
Hull - Container Liner. Regularly uses the same berth, moored in the same way. - Specially designed for loading with as many containers as possible.	Gross tonnage: 15,050 tons L x B x D : 168.13 m x 27.30 m x 13.50 m Port of registry: Hong Kong Crew : 20 crew members
Mooring Line - Had been used for less than a year. - No criteria for discarding or replacing fiber ropes. - No inspection or maintenance required clearly in the safety management manual. - Differently routed from the original routing at the construction.	- Used the mooring rope with localized damage and losses. - Possibility of break under a stress less than the specified breaking load.
Communication Pilot A ↔ Master, Chief Officer: English Master A ↔ Crew, Chinese Pilot A ↔ Tug, Japanese - No requests from Pilot A on the speed and the progress of docking, and no report from Master to Pilot.	- Against what the Pilot A intended, Master A gave a direction to heave the Line. - Additional tension on the Line touching the Bend Point. - Impulsive tension caused by the winding moment in the hawser drum tension due to Wind Pressure. - Tension due to the headway of about 0.3 kn.
Docking Assignment - Different from the regular assignment: Pilot A, Master A and Chief Officer on the deck. - Second Officer at the bow and Third Officer on the stern.	- Second Officer gave a direction to heave the Line on the bow commanding post, from where the Bend Point are not visible. - To reduce the headway by the Line, directed to heave.
Ship handling while docking - About 0.3 kn, forward headway at the time of running over the designated position.	- Wind force 3 (Maximum instantaneous, 9.8 m/s), starboard quarter. - The Ship was being blown off the Berth by the wind pressure.
Mooring Operation - Part-time workers, sufficiently skilled. - No sufficient safety education to specify the snap-back hazardous zone of a broken line and leave from the hazardous zone as promptly as possible. - More than one line latched onto a bitt. - Working close to the Line.	- Hit the workmen working inside the hazardous zone of snap back. - Injury causing death.

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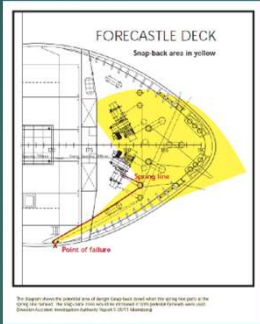


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Maritime Coastguard Agency



Code of Safe Working Practices for Merchant Seafarers
2015 edition – Incorporating Amendment 1, October 2016



FORECASTLE DECK
Snap back area in yellow
Point of failure

The diagram shows the potential area of danger (snap back) based upon the spring line part in the yellow. The diagram is not intended to be used as a guide for the design of the deck area. The diagram is not intended to be used as a guide for the design of the deck area. The diagram is not intended to be used as a guide for the design of the deck area.

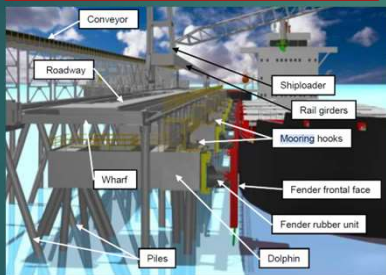
- ▶ Highlights
 - ▶ Conduct risk assessment for each new mooring operation and implement control measures
 - ▶ 26.3.2 the entire deck area should be considered a potential snap-back zone
 - ▶ 26.3.3 no painting for identifying snap-back zones should be done as this may give a false sense of security

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Mooring Infrastructure and Mooring Line Issues

- ▶ Design Principles for Dry Bulk Marine Terminals PIANC MarCom WG 184

Linear Wharf Structure supported by piles



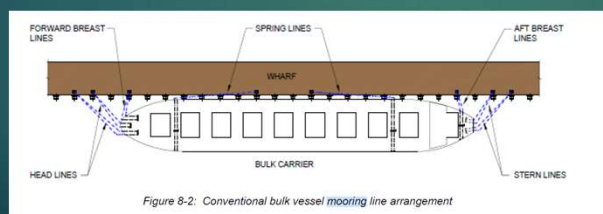
Linear Wharf Structure supported by caissons



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Mooring Bulk Vessels

- OCIMF Mooring Equipment Guidelines (MEG04-2018)
- BS 6349 Maritime works
 - Part 4: Code of practice for design of fendering and mooring systems
- PIANC 153 (2016) - Recommendations for the Design and Assessment of Marine Oil and Petrochemical Terminals
- PIANC 186 Safe Mooring of Large Ships at Quay Walls

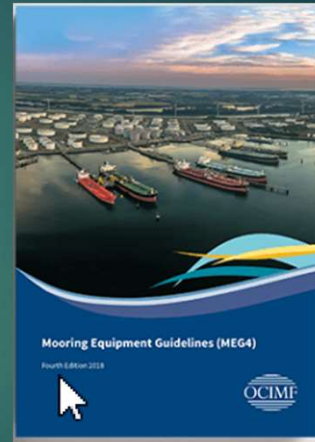


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Snap Back – Standards Point of View

- **MarCom WG 184**

- Limited to snapback awareness
- Refer to OCIMF (Mooring equipment guidelines, 2018) guideline for further details such as identifying the danger area which can be used to plan suitable barriers
- No guideline to how implement a physical protection



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MEG4-2018 TOC

Sec 1 Introduction to Mooring

- Ship mooring management
- Mooring system management plan

Sec 2 Human Factors

- Safety critical task analysis
- Human-centred design

Sec3 Mooring forces and environmental criteria

- Calculation of forces
- Site-specific environmental data and mooring line loads

Sec 4 Mooring arrangement and layout

- Piers and sea islands

Sec 5 Mooring lines

- Introduction
- Mooring system design and line selection
- **The hazard of snap-back**
- Factors influencing mooring line performance
- Maintenance, inspection and retirement
- Steel wire ropes
- High Modulus Synthetic Fibre line
- Conventional fibre lines
- Synthetic mooring tails

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GEM4-2018 TOC – cont'd

Sec 6	Mooring winches
Sec 7	Mooring and towing fittings
Sec 8	Structural reinforcements
Sec 9	Berth Design and fittings
Sec 10	Ship/shore interface
Sec 11	Alternative mooring technology
Appendix A	Wind and current drag coefficients
Appendix B	Guideline for the purchasing and testing of mooring lines and tails

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Design / Operation

- ▶ Addressing mooring forces
- ▶ Addressing mooring arrangement
- ▶ Addressing mooring line materials
- ▶ Snapback protection barrier
 - ▶ No standards addressing this issue
 - ▶ No consistence practice
 - ▶ Relies on site risk assessment and experiences
 - ▶ It is based on trial and error

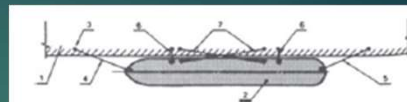


Figure 3-11. Marginal wharf. Typical layout of mooring lines: 1—dock structure; 2—ship; 3—bollard; 4—bow line; 5—stern line; 6—breasting line; 7—spring line.

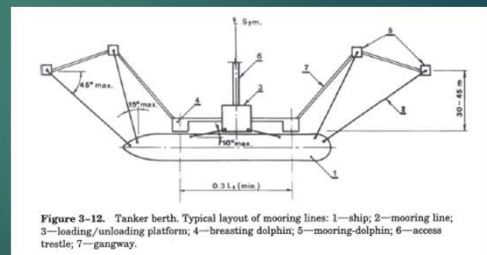


Figure 3-12. Tanker berth. Typical layout of mooring lines: 1—ship; 2—mooring line; 3—loading/unloading platform; 4—breasting dolphin; 5—mooring dolphin; 6—access trestle; 7—gangway.

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Some Industrial Practices (Physical Barriers)

- ▶ Basis for Design
 - ▶ Rope tip impact velocity
 - ▶ Impact energy imparted on barrier

Cage



Fencing Sys



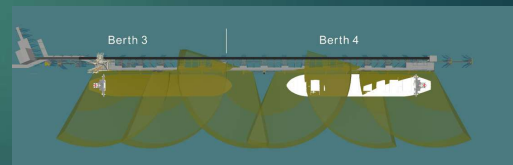
Concrete



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Other Control Measures

- ▶ Classifying as material risk
- ▶ Frequent Incident Audit / Review
- ▶ Line vetting prior to mooring
- ▶ Utilising quick release hook with line management plan
- ▶ Cell load monitoring with warning signals
- ▶ Utilising vessel drift detection system
- ▶ Fender loads monitoring – no record has been seen



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▶ More collaborative works between various stakeholders need to be done in this space

▶ A new TOR needs to be defined for the committee

▶ Forming a working group containing representatives of key stakeholders seems inevitable

Scope of WG

- ▶ Address the issue thoroughly
- ▶ Collate and analysis the incidents and lessons learnt
- ▶ Identify the gap and current risk
- ▶ Enhance guidelines
 - ▶ Design (infrastructure, mooring equipment)
 - ▶ Physical protection
 - ▶ Operational/ Risk Management
 - ▶ Key control measures

Awareness / Approach

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Concluding Remarks

- ▶ Snap-back is hazardous
- ▶ There are still gap and uncertainties in the guidelines and industrial practices
- ▶ The usage of physical barriers and control measures is not regulated and consistent across the port industry
- ▶ More works need to be done in this space to ensure the safety of every personnel working around mooring equipment is maintained properly
- ▶ Extensive incident reports along with industrial practice can be utilised to enhance the current guidelines or develop a new one if needed

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Reviewers Comments

- ▶ Excellent subject and opinions, requires tighter sentence structure and more industry facing recommendations.
- ▶ See comments in returned file - grammar through-out can be improved - try to keep sentences shorter - emphasize call for an international working group report in abstract and especially in the presentation



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