



Danish Maritime Accident
Investigation Board

MARINE ACCIDENT REPORT

July 2014



ATAIR J
Mooring accident on 3 October 2013

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Front page: Mooring winch on ATAIR J. Source: Danish Maritime Accident Investigation Board

The marine accident report is available from the webpage of the Danish Maritime Accident Investigation Board www.dmaib.dk.

The Danish Maritime Accident Investigation Board

The Danish Maritime Accident Investigation Board is an independent unit under the Ministry of Business and Growth that carries out investigations with a view to preventing accidents and promoting initiatives that will enhance safety at sea.

The Danish Maritime Accident Investigation Board is an impartial unit which is, organizationally and legally, independent of other parties.

Purpose

The purpose of the Danish Maritime Accident Investigation Board is to investigate maritime accidents and to make recommendations for improving safety, and it forms part of a collaboration with similar investigation bodies in other countries. The Danish Maritime Accident Investigation Board investigates maritime accidents and accidents to seafarers on Danish and Greenlandic merchant and fishing ships as well as accidents on foreign merchant ships in Danish and Greenlandic waters.

The investigations of the Danish Maritime Accident Investigation Board procure information about the actual circumstances of accidents and clarify the sequence of events and reasons leading to these accidents.

The investigations are carried out separate from the criminal investigation. The criminal and/or liability aspects of accidents are not considered.

Marine accident reports and summary reports

The Danish Maritime Accident Investigation Board investigates about 140 accidents annually. In case of very serious accidents, such as deaths and losses, or in case of other special circumstances, either a marine accident report or a summary report is published depending on the extent and complexity of the accidental events.

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1. SUMMARY

At noon on 3 October 2013, the Antigua & Barbuda registered container ship ATAIR J arrived in the Port of Aarhus for discharging and loading general cargo in containers. ATAIR J was in a busy schedule that included five North European ports a week.

On the day of the accident, there was a strong breeze that made it difficult to berth the ship. Therefore, it was decided to use the spring line to hold the bow in place and use the rudder and propulsion to get the stern alongside. The spring line parted shortly after having been secured to the quay bollard. It struck the bosun who was standing in the enclosed forecastle, thus causing fatal injuries.

The flag State of ATAIR J has assisted the Danish Maritime Accident Investigation Board in the investigation of this accident.

2. FACTUAL INFORMATION

2.1 Photo of the ship



Figure 1: ATAIR J
Source: Arjan Elmendorp

2.2 Ship particulars

Name of vessel:	ATAIR J
Type of vessel:	Container ship (fully cellular)
Nationality/flag:	Antigua & Barbuda
Port of registry:	St John's
IMO number:	9296999
Call sign:	V2GF3
DOC company:	Jüngerhans Maritime Services GmbH & Co. KG
IMO company no. (DOC):	1346032
Year built:	2004
Shipyard/yard number:	Hegemann Rolandwerft GmbH & Co. Kg/213
Classification society:	Germanischer Lloyd
Length overall:	139.81 m
Breadth overall:	19.40 m
Gross tonnage:	6,454
Deadweight:	8,505 t
Draught max.:	7.35 m
Engine rating:	7,195 kW
Service speed:	17.90 knots
Hull material:	Steel
Hull design:	Single hull

2.3 Voyage particulars

Port of departure:	Helsingborg, Sweden
Port of call:	Aarhus, Denmark
Type of voyage:	Merchant shipping, international
Cargo information:	General cargo in containers
Manning:	14
Pilot on board:	No
Number of passengers:	0

2.4 Weather data

Wind – direction and speed:	SE 12 m/sec
Wave height:	0.2 m
Visibility:	Good
Light/dark:	Daylight
Current:	Unknown

2.5 Marine casualty or incident information

Type of marine casualty/incident:	Occupational accident
IMO classification:	Very serious
Date, time:	3 October 2013 at 1212 LT
Location:	Port of Aarhus
Position:	56° 9.085' N – 10° 14.166' E
Ship's operation, voyage segment:	Arrival
Place on board:	Forecastle deck
Human factor data:	Yes
Consequences:	One seafarer killed

2.6 Shore authority involvement and emergency response

Involved parties:	Aarhus emergency services
Resources used:	One ambulance One medical car
Speed of response:	Approximately 30 min.
Actions taken:	The medical emergency team were not able to board the ship until it was alongside. Once alongside, the injured crewmember was treated by a doctor.
Results achieved:	Crewmember pronounced dead on the ship.

2.7 The ship's crew

Master:	46-year-old Ukrainian. Served one month on board.
Chief Officer:	38-year-old Ukrainian. Served one month on board.
Bosun:	45-year-old Filipino. Served one month on board.

2.8 Scene of the accident



Figure 2: Scene of the accident – Port of Aarhus
Source: Google Maps

3. NARRATIVE

3.1 Background

The Antigua & Barbuda registered container ship ATAIR J was engaged in regular trade between the Northern European ports of Rotterdam, Gothenburg, Copenhagen, Helsingborg and Aarhus. During the roundtrip the ship had about 10 arrivals/departures a week, which made the crewmembers familiar with the ports and mooring conditions.

All of the crewmembers were familiar with the Port of Aarhus because the ship arrived in the port once a week. Usually the ship did not request tug assistance during arrival and departure due to the navigators' familiarity with the ports in the schedule and because the ship was considered manoeuvrable even under adverse weather conditions.

The 14 crewmembers on ATAIR J had joined the ship in Rotterdam on 26 August 2013 and had thus been on board for one month at the time of the accident.

Time references are based on the ship's local time.

3.2 Sequence of events

After a six-hour voyage from Helsingborg, Sweden, ATAIR J approached the Port of Aarhus on 3 October 2013 at noon.

On the bridge were the chief officer and the master. As usual the master stood in the bridge wing, and the chief officer stood at the conning station in the centre of the bridge. The chief officer communicated with the mooring stations by the master's orders.

At the aft station were three crewmembers: the 2nd officer, one ordinary seaman (OS) and one able seaman (AB).

At the forward station the bosun was in command. He had the overview of the situation and gave instructions to the OSs. One OS was assigned to operate the winch, while the other OS and the bosun were handling the ropes. The bosun communicated with the bridge as he was the only one equipped with a UHF radio.

When the ship was in the channel approaching the port, the master called the port control. They advised to proceed to berth no. 416 and specified which bollards to be used when mooring the ship. The master knew that usually there was a car with flashing lights indicating the position where the ship was to be positioned at the berth.

The master and the chief officer had a conversation about how to go about getting the ship alongside the berth. There was a strong south-easterly force 6 breeze that would make it difficult to berth the ship. The chief officer and master believed that the forward thruster did not have sufficient power to move the ship sideways under the given wind conditions. It was, therefore, decided to manoeuvre the ship alongside by steering the bow upwind, thereby enabling them to use the main engine, rudder and forward spring line to get the ship aligned with the berth (figures 3 and 4). The officers on the bridge had used this method before to approach the berth.

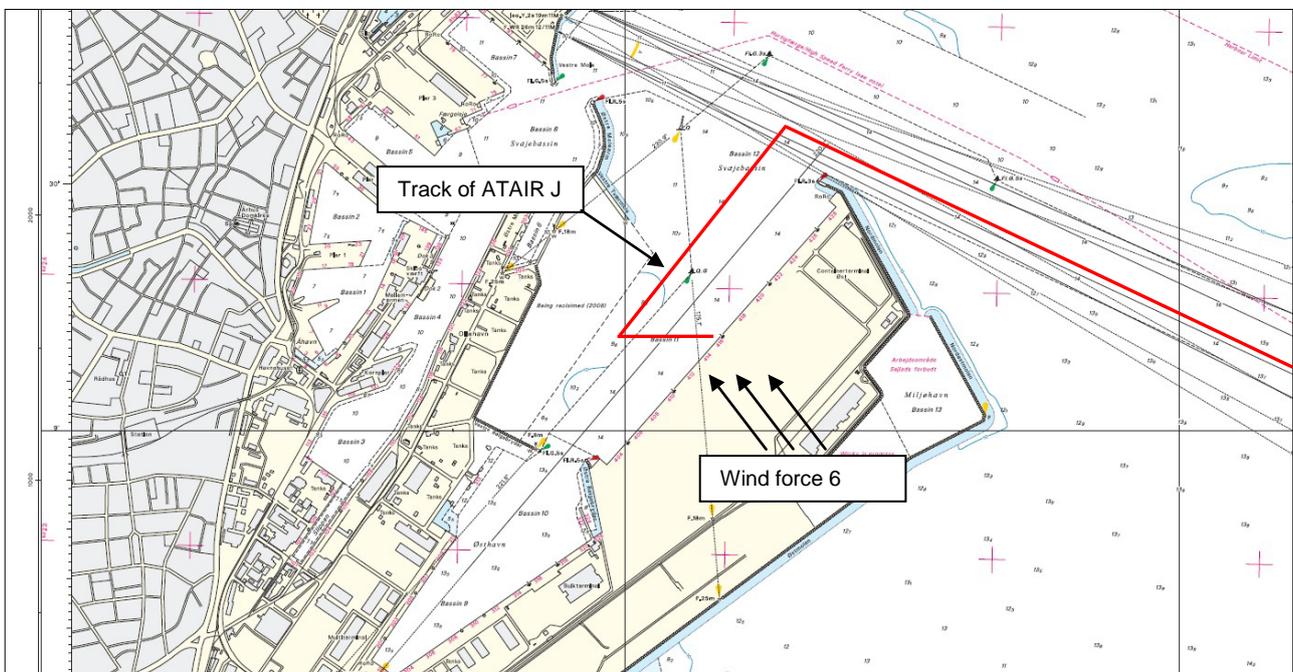


Figure 3: ATAIR J approaching the Port of Aarhus
Source: Danish Geodata Agency

Once the ship was in the harbour basin, it was turned to port so that the bow was at a 45° angle to the berth, at a distance of approximately 10 metres, enabling the crew on the forward mooring station to throw the heaving line ashore (figure 4). The master was satisfied with the approach, and everything went according to his plan. As per the usual procedure, the officers on the bridge wanted a relatively long spring line as a first line. The master and chief officer usually ordered a long spring line fastened because they were of the opinion that it would be able to withstand more tension than a short line. They were of the opinion that having a long spring line would enable the rope to stretch more than a short spring line – allowing for the rope to be more flexible and thus avoid excessive tension.



Figure 4: ATAIR J approaching the berth – a few minutes after the accident
Source: Port of Aarhus

The spring line was sent ashore at a length of approximately 35-40 metres, and immediately thereafter, the bosun was ordered to send in the head line for holding the forward end of the ship alongside. One OS went to prepare the head line, while the bosun instructed the OS at the winch to slacken and heave the rope as appropriate, as the winch operator did not have a view of the fairlead and bollard on shore from the winch control. On the quay were two lines men who heaved the ropes ashore and put them onto the bollards.

After the spring line had been fastened to the quay bollard, the main engine and rudder were used for getting the aft part of the ship alongside.

As the master manoeuvred the ship alongside, there was an increasing tension on the spring line that made loud noises from the friction between the fairlead and the rope. The crewmembers on the forecastle were concerned that the spring line would break. Therefore, the bosun positioned himself in what was considered a safe area, where he had sufficient overview of the mooring line. From there he instructed the OS to slowly slacken the spring line to minimize the tension on the rope. The other OS was instructed to prepare the head line. It took several attempts to get the heaving line ashore as the distance to the berth had slowly increased.

At 1212, the spring line suddenly parted, approximately 18 metres from the eye on the bollard, and struck the bosun who was standing behind a pillar in the enclosed part of the forecastle. The other seamen rushed to the bosun and quickly realized that he was seriously injured. They took the radio from the bosun and reported to the bridge that the spring line had parted and hit the bosun's chest area. The chief officer, not yet knowing the seriousness of the situation, called the engine room to get the engineers to assist on the forward station and told them to bring the medical equipment.

When the chief officer received additional information from the forecastle, he realized how serious the condition of the bosun was. He then called the port authority by the VHF and requested an ambulance.

The master told the chief officer that he was able to get the ship alongside by himself and that the chief officer should go to the mooring station to assist with the medical treatment of the bosun and mooring the ship. When the chief officer got to the forecastle, the 2nd officer had already arrived there from the aft mooring station. Together they placed the injured bosun on a stretcher and provided first aid. Once they had established that he was breathing, they moved him from the forecas- tle to the starboard side by the forward hold. The chief officer began preparing for mooring the ship. Meanwhile, other crewmembers continued to provide first aid to the bosun.

As the chief officer had left the bridge, the master called the port control for a tug boat to assist in getting the ship alongside as fast as possible. The tug should hold the ship in position while the remaining crewmembers moored the ship. The master was told by the port authority that the ship had clearance to get the ship alongside at any possible berth. Shortly after, at 1230, a tug boat arrived and started pushing the vessel to get it alongside. A pilot, who arrived with the tug boat, came on board to assist the master.

The ambulance arrived within minutes after being called and at 1248, when ATAIR J was along- side, the paramedics and a doctor came on board and started the medical treatment of the bosun. The bosun was pronounced dead on board the ship.

3.3 Mooring arrangements and operations at the time of the accident

3.3.1 Mooring arrangements and mooring rope

The forecastle on ATAIR J was enclosed with two openings on each side of the ship and one in front. This gave the crew a view of the mooring lines as they passed through the fairleads and, furthermore, enabled them to throw heaving lines ashore.

The mooring arrangement consisted of two winches with split drums – one storage drum and one tension drum that were situated in the centre of the deck area (figure 5 below). Both winches were combined anchor and mooring winches with electric drives with pole changing multi-speed motors and were operated by a control box located at the winches. There was thus a three step regulation of the speed of the winch.

At the time of the accident, the winch on the starboard and port side functioned normally and had no technical defects that influenced the operation of the winch.

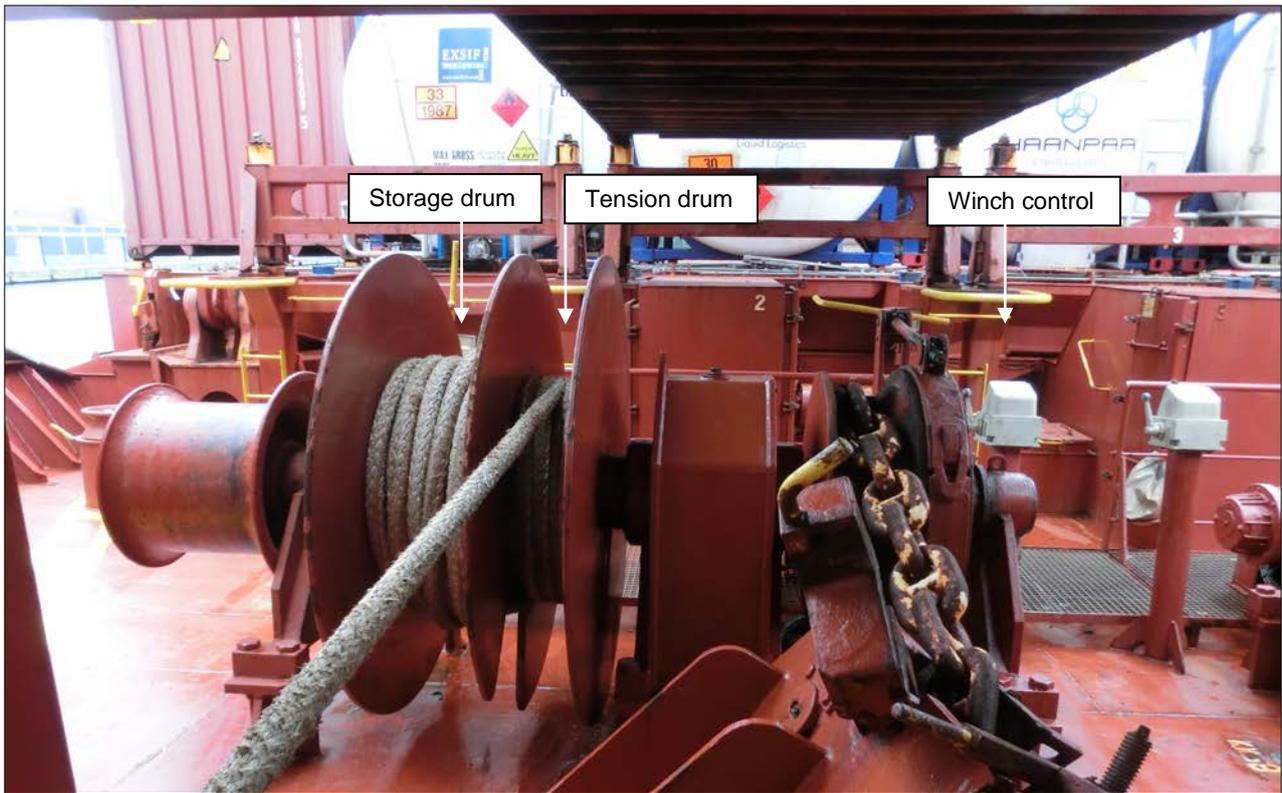


Figure 5: View of starboard winch
Source: DMAIB

Several bits, pedestal bits and bollards were mounted forward of the winches, enabling a wide variety of mooring configurations. Aft of the winches, a platform was mounted approximately 20 cm above the deck giving the operator a view over the winches. Snap-back zones were not painted on the deck area aft or forward, but information about snap-back zones was available in the safety management system, however, not specific for this ship.

All the mooring ropes had been certified and brought on board in 2011. They were manufactured by Gleistein Ropes and were of the type UKTA Marine 24F, three strand rope made of polyolefin and polyester (PES), 60 mm diameter and 110 metres long. The breaking load was 56,340 daN – approximately 57 ts.

On figures 6 and 7 below, are two pictures showing the rope that broke. There are many variables that affect rope strength. Factors like load history, bending radius, abrasion, chemical exposure or a combination of some of these factors are important when evaluating the state of the rope. The rope that broke had suffered medium to severe abrasions on the outer as well as on the inner strands. The abrasions were a result of normal tear and wear as it was subjected to rough edges and surfaces on deck, on rollers, and on the ship side when it was used as a spring line.



Figure 6: Mooring rope where it broke. View of the strands.
Source: DMAIB

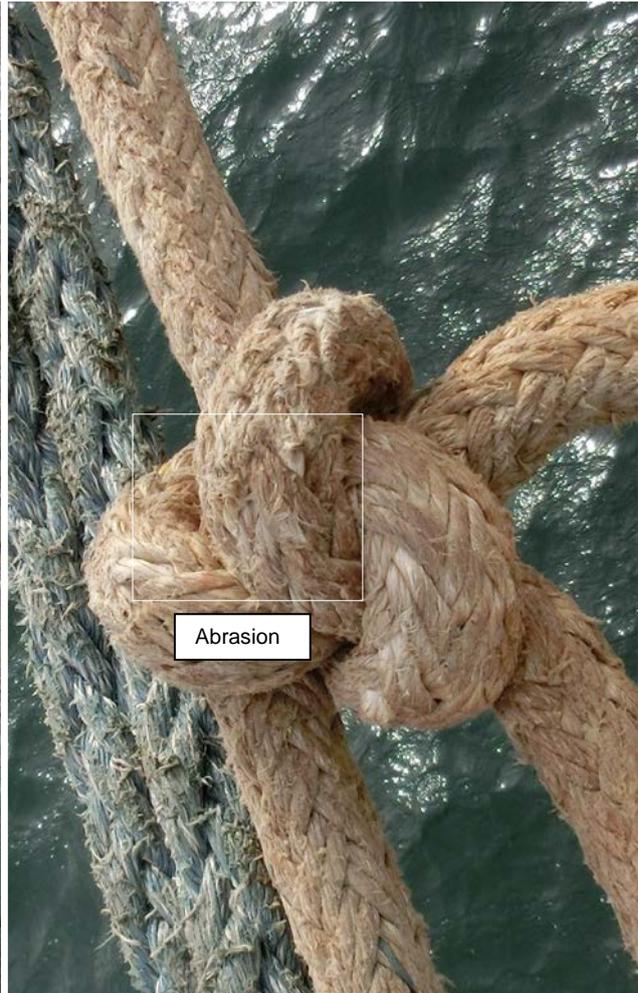


Figure 7: Knot tied on mooring rope after it broke. Showing general condition of the rope.
Source: DMAIB

As synthetic materials are made of large, in the case of thermoplastics and elastomers, entangled molecule chains, these glide or disentangle under external load by which irreversible elongation occurs. This means that such ropes increase in length and will not return to the original length and that the elasticity is diminished.

The stretching capabilities and breaking load of a mooring rope can be reduced by applying excessive loads either as creep¹ or shock loads causing permanent elongation. After a permanent elongation, the crewmembers would not be able to visually judge the actual load on the rope by observing the stretching of the rope. It is uncertain how much the broken rope had been damaged by stretching.

The rope parted approximately 18 metres from the eye on the bollard, which means that the rope parted approximately 10-20 metres from the fairlead.

3.3.2 Mooring operations

On arrival, the master usually manoeuvred the ship alongside by positioning the forward part of the ship close enough to get a heaving line ashore and thereafter make the forward spring line fast. A

¹ Creep is defined as a material's slow deformation that occurs while under load over a long period of time. Creep is mostly nonreversible.

forward momentum of the ship would then bring it alongside. At departure, it was not uncommon to use the spring line to distance the aft part of the ship from the berth.

ATAIR J was considered a manoeuvrable ship, and the crew therefore relied on tug assistance only when the weather conditions were above force 6 – depending on the wind direction and loading condition. On the day of the accident, the master did not order tugs in spite of the strong breeze because the Port of Aarhus had considerable space for turning manoeuvres, and the berth offered plenty of space. Furthermore, the master had considerable experience in arriving and departing from the regular ports in the schedule.

The distance from the bridge to the forecastle was 120.5 metres. With cargo on deck, the master had little view of the mooring situation forward (figure 8). Therefore, the master relied on the effectiveness of the communication between the crewmembers on deck and the chief officer who relayed the information to the master. During manoeuvring, the chief officer was usually stationed by the conning station (figure 9), and he was the only one on the bridge in direct communication with the crewmembers on deck.



Figure 8: View from starboard bridge wing on the day of the accident
Source: DMAIB



Figure 9: Approximate view from conning station
Source: DMAIB

Mooring the ship was considered a routine operation by the crewmembers because the ship had approximately five port calls a week. The crewmembers were, therefore, experienced in mooring the ship under varying and sometimes adverse weather conditions.

Usually the forward and aft mooring stations were manned by the same crewmembers, which enhanced the cooperation between the crewmembers – i.e. agreements on who does what and when. There was one officer on deck, who was stationed at the aft mooring station because of the concern of getting the mooring ropes entangled in the propeller.

The spring line was usually configured as seen on figure 10 below. ATAIR J was typically moored two and one – i.e. two head lines and one spring line. As there were only two winches with one storage drum each, one of the head lines was tightened by the capstan on the winch and fastened on a bitt. The spring lines were usually 30 to 50 metres long, allowing the rope to stretch in order to lower the tension on it when manoeuvring the ship alongside.

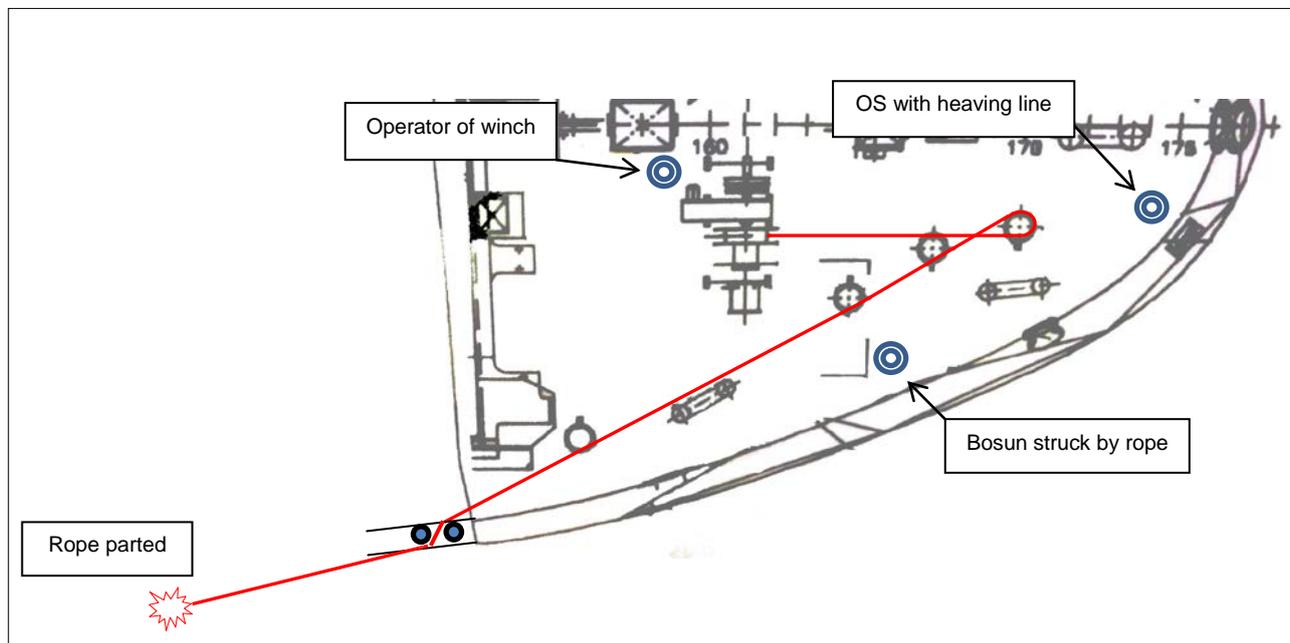


Figure 10: Overview of scene of accident
Source: DMAIB

During mooring operations, there were usually three crewmembers on the forecastle who communicated in English.

The operator of the winch had little or no overview of the situation and he slackened or heaved according to instructions from the bosun or the other OS. He would be able to judge the tension on the rope only by the sound it made when stretched. Judging the elongation was difficult because the distance from the winch to the pedestal bitt in front of the winch was short, approximately 2-3 metres. The winch control did not in itself present reliable indications of tension. Therefore, the operator of the winch relied on communication and signalling from the other crewmembers, who had an outboard view of the rope, when judging the tension applied on the rope. Furthermore, the fairlead typically used for the spring line was not visible to the operator of the winch.

There was no formalized approach to familiarize new crewmembers with the mooring arrangements on board. The crewmembers all signed on the ship together and the senior officers relied on the previous training that the crewmembers had received. Mooring operations were not a topic at the regular safety meetings as the crew had not experienced any safety-related problems in their daily mooring operations.

3.3.3 The accident

On the day of the accident, the bosun had instructed the OS operating the winch control to slowly slacken the spring line to take some of the tension of the rope. Without warning the rope parted, hit a pillar, whipped around it and hit the bosun across the chest area (figures 11 and 12).

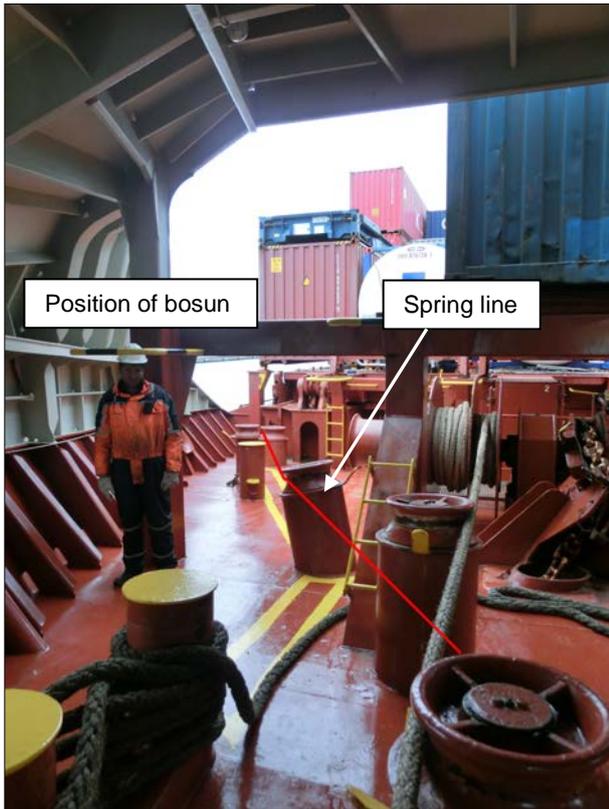


Figure 11: Position of bosun when he was struck by rope.
Source: DMAIB

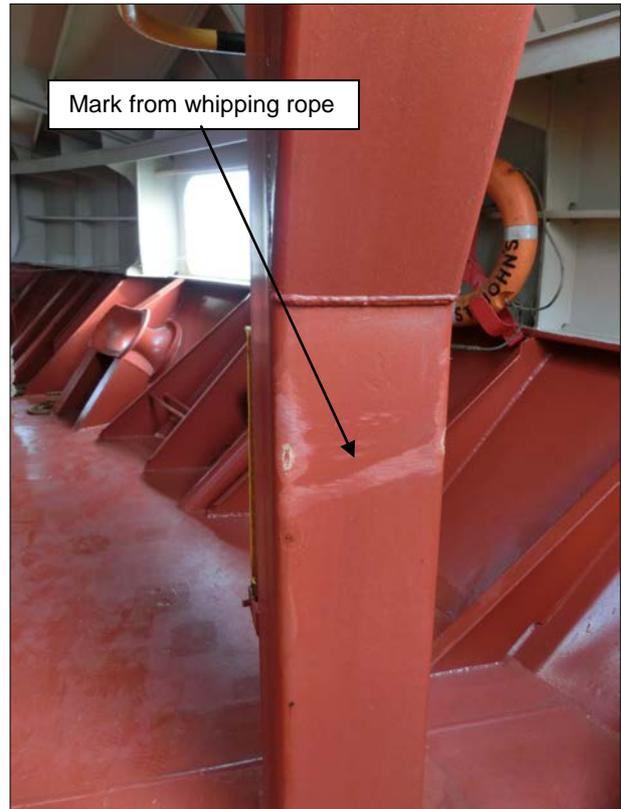


Figure 12: Pillar with marks from rope.
Source: DMAIB

As the rope parted, it whipped back through the fairlead in its entire length. It is, however, uncertain how the parted rope travelled in order to hit the bosun. The other crewmembers on the forecastle were having their attention occupied by different tasks related to the mooring operation and did not see the actual event. Furthermore, immediately after the accident, the parted rope was used as a head line and therefore the position of the rope after the accident was uncertain.

4. ANALYSIS

4.1 The accident

The accident occurred as a result of several factors, such as the weather conditions, wear of mooring lines and design of mooring arrangements. These factors coincided and created a hazardous situation. The circumstances on deck were not much different from any other arrival in Aarhus or in another port in adverse weather conditions.

ATAIR J approached the berth bow first, using the spring line to hold the ship in position while getting the stern alongside. This manoeuvre, together with a strong breeze, created considerable tension on the spring line causing it to break, whip back onto the forecastle, around a pillar and then hit the bosun. It has not been possible to establish the exact path of the rope, but it is likely that it hit one or more obstacles before it hit the pillar and bosun, thereby making the path of the rope unpredictable and difficult to reconstruct. It is uncertain whether the bosun was struck by the end of the broken rope that travelled through the fairlead or by a loop created by the sudden slack in the rope.

The spring line was under a considerable amount of tension as the ship was manoeuvred alongside. It is uncertain what the actual tension was. It is, however, established by the accidental events that a ship of ATAIR J's size, having a forward momentum by the propulsion and affected by a strong breeze, will create forces beyond the breaking load of a spring line with medium to severe abrasions. It should be noted that using this method for getting the ship alongside can be successful for some time, but will exhaust the elongation properties of the mooring rope to such an extent that it diminishes its elasticity. It can then break without warning, because it will not stretch to the same extent as before. Therefore, the ship might be considered too large for using the one spring line and propulsion for getting the ship alongside during adverse weather conditions.

The crewmembers did not realize that the mooring rope was in a questionable condition. It can be difficult to judge the condition of the mooring rope without in-depth knowledge about the specific type of rope, its age and prior history. During the actual mooring operation, the crewmembers had limited options for discarding a rope as no extra ropes were readily available on the winches. The ship did not have a formalized way of evaluating the condition of the ropes. Therefore, the evaluation was based on the judgment by the crewmember and not the actual limitations stated by the manufacturer of the rope.

4.2 Risk factors and design

Risk factors related to operations on mooring decks are difficult to assess. There is a difference between the way in which risk is perceived and described in formal risk assessment forms and the way in which risk is perceived in real-time operations. Risk factors are not always easily identifiable and recognized by a crewmember. The lack of available evidence will thus make it difficult to foresee what will happen in the immediate future. Real-time risk-awareness is focused on the risks that individuals are facing in specific situations. This risk awareness is biased by the practicalities of getting the job done and the individual's prior experiences of successful outcomes of any given action.

Even though risk assessments are made, they seldom address the difficult choices that deck hands have to make in their everyday work – e.g. the choice between slackening the rope to avoid breaking it or holding the ship in position with the risk of breaking the rope.

There can be a conflict between the master's perspectives on risk and the deck crewmembers' view of the hazards presented by a situation. On deck, the immediate priority is to avoid breaking the mooring lines, which is based on a subjective evaluation of the situation. Therefore the crewmembers on the forecandle on ATAIR J slackened the rope without prior permission from the master, knowing that he would disapprove.

The crewmembers on deck would not necessarily know the master's plan for getting the ship alongside. They had an immediate sense of when a situation would become dangerous, without the officers on the bridge realizing the seriousness of the situation. Furthermore, the master had multiple concerns during manoeuvring – with an overall priority of getting the ship alongside, but with little or no overview of the situation on deck. With no direct communication, the master's perception of risk would not be aligned with that of the deck hands.

The crewmembers at the forward mooring station were aware that the rope was under a considerable tension and thus slackened it little by little. When they became concerned about the tension on the rope, they positioned themselves in places they considered to be safe areas. However, investigations by the DMAIB have previously found that it is inherently difficult to judge certain areas on mooring decks as safe and others as unsafe² – as a rope that breaks can have an unpredictable path dependent on where it breaks, its load and angle.

² Safety Report about mooring accident on PACHUCA: <http://www.dmaib.com/Ulykkesrapporter/PACHUCA%20-%20occupational%20accident%20on%2014%20December%202012.pdf>

Only little space was available on the mooring deck for carrying out the normal operations as indicated in figures 10 and 11. This influenced the decision not to have snap-back zones painted on deck. The underlying thinking in painting snap-back zones is that the mooring rope parts in a specific place when it is under tension within a specific angle. However, ATAIR J used a variety of mooring configurations dependent on the design of the berth and position of the ship. Therefore, it was not possible to define safe and unsafe areas without creating a confusing workplace on the mooring deck.

As indicated in figures 5 and 11, the operator of the winch had little or no overview of the mooring situation and therefore relied on instructions from the bosun. Once the spring line was secured, the crewmembers had to prepare the head lines, throw heaving lines, guide the ropes from the storage drum to the tension drum and communicate with the linesmen ashore – while giving the winch operator instructions. In this stressful environment, the design properties of the deck area challenged the deck hands' ability to create an overview of the situation and assess the real-time risk factors.

5. CONCLUSIONS

The accident on ATAIR J occurred because excessive tension was applied to a worn spring line, while the officers on the bridge were manoeuvring the ship in an attempt to get it alongside the berth in adverse weather conditions. The excessive tension on the spring line was the result of using the propulsion and rudder, while holding the ship with the spring line in order to get the ship alongside.

It is not uncommon that mooring ropes part under different adverse circumstances such as strong winds, malfunctioning winches, strong currents and tides etc. Though the parting of the mooring rope was the determining accidental event, it is not a sufficient explanation for understanding why the normal task of mooring the ship resulted in a fatality. A determining factor for the fatality was the fact that the crewmembers were challenged by the basic design of the mooring arrangement, i.e. lack of overview, small working area and exposure to ropes under tension. In that workplace environment with changing operational circumstances, the accident occurred.

Furthermore, it is inherently difficult to identify and assess the specific risk factors, while negotiating these risks with the goals of everyday work – e.g. working fast to get the ship alongside in adverse weather conditions. This accident is an example of the difficulty encountered in assessing the risk of being hit by a broken mooring line because the bosun was standing in what was considered a safe place during a normal mooring operation.

Another mooring accident where the design features of the mooring deck constituted a determining factor for the consequences of a parting rope occurred on board PACHUCA, as previously referenced.