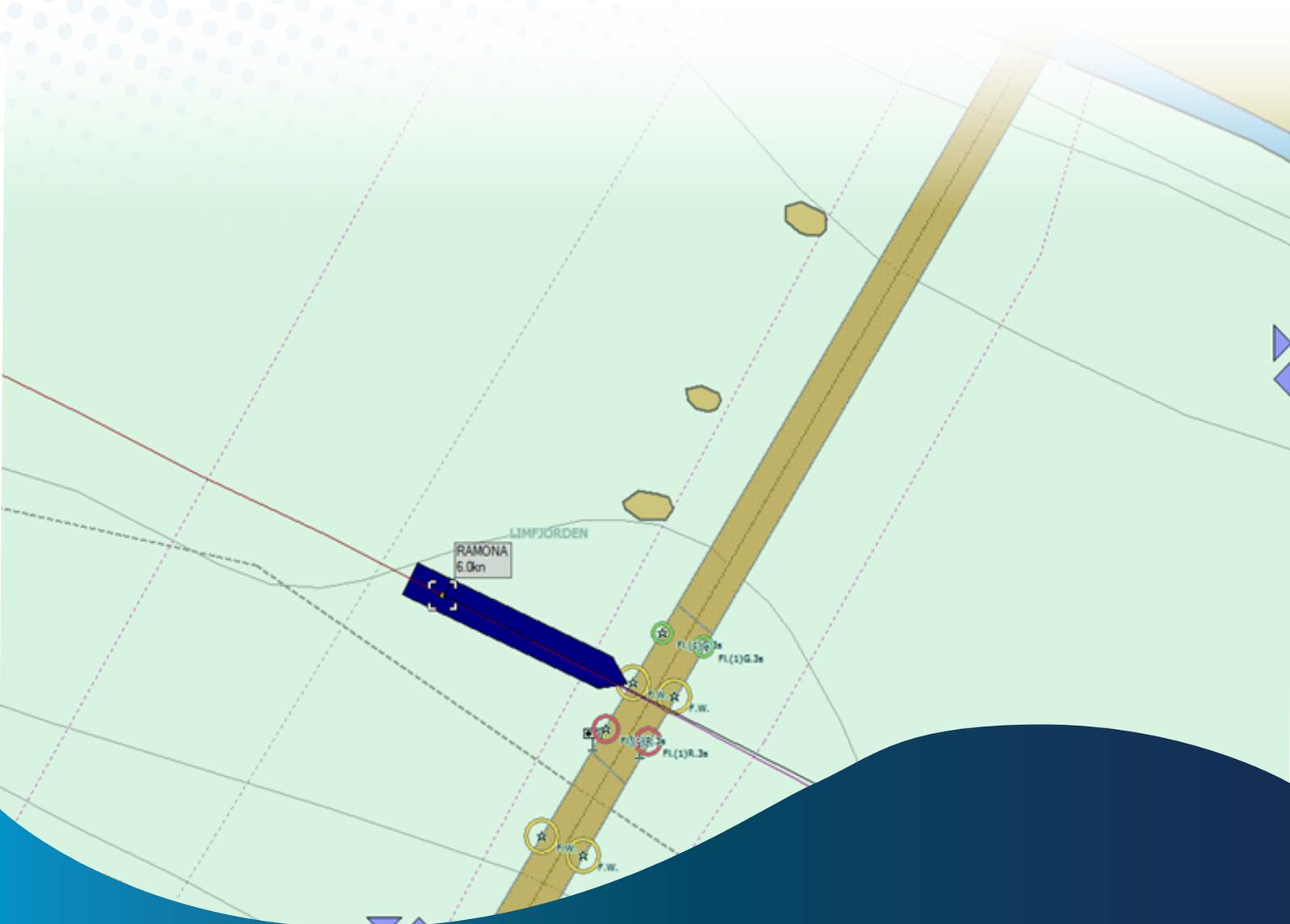




MARINE ACCIDENT REPORT

September 2012



RAMONA
Collision with railway bridge 28 March 2012

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This marine accident report is issued on 24 September 2012

Case number: 201204183

Front page: AIS representation of the situation at the moment of collision

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

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 occupational accidents on board Danish merchant and fishing vessels as well as accidents on foreign ships in Danish territorial 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.

Accident reports

The Danish Maritime Accident Investigation Board investigates approx. 140 accidents per year. In case of a very serious accident, such as a death, a disaster or any other extraordinary circumstances, an accident report is published.

The accident report contains factual information, a narrative, an analysis, a conclusion and recommendations.

The factual information illustrates and describes data and facts related to the accident.

On the basis of information obtained from the persons involved, companies, agencies and the like, the narrative describes the background of the accident and the sequence of events.

The analysis highlights the conditions and factors that caused or contributed to the persons involved acting as they did, to the accident happening and to how it happened.

The conclusion summarizes what has been highlighted in the analysis as key conditions and factors leading to the accident.

The accident report does not highlight how persons, companies or organizations and the like could or should have acted. The report does not show how rules and regulations may have been violated, but in some cases it will point to discrepancies in rules, regulations or other management tools.

The accident report is based on the investigation into the accident in accordance with the act on safety investigations of marine accidents of 18 May 2011, containing provisions implementing Directive 2009/18/EC of the European Parliament and of the Council of 23 April 2009 establishing the fundamental principles governing the investigation of accidents in the maritime transport sector and the IMO Code for the investigation of marine casualties: Code of International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident.

The report was prepared in Danish and this English version is a translation thereof.

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1. SUMMARY

The cargo ship RAMONA sailed into the Railway Bridge on 28 March 2012 at 2226 hours. There were no injuries, but very serious material damage to the bridge and minor damage to the ship.

It had been agreed between the ship and the bridge keeper that passage could take place at 2226 hours. The time matched the train traffic across the bridge and the ship's speed was adjusted accordingly.

The bridge keeper's disposition of the timing up to the passage at 2226 hours was based on specific attention to a train crossing the Railway Bridge and his experience and routine with the typical timing in connection with bascule openings and ship passages. This led to a very narrow time margin from the train crossing the Railway Bridge to the immediately subsequent opening process for the vessel's intended passage through the bridge.

The ship sailed faster than predicted by the bridge keeper and arrived at the Railway Bridge earlier than the bascule could be opened. When the bridge keeper noticed this and informed the ship that it had to stop, the ship was too close to the bridge to do so.

The light signals on the Railway Bridge had no effect on the master's dispositions and manoeuvres as they were not turned on while there was still time and room to manoeuvre. Therefore the master decided to adhere to the verbal agreement on the time of passage.

The investigation has led to a recommendation that the Danish Maritime Authority initiates a dialogue with the relevant parties, including the Danish Transport Authority, Rail Net Denmark, the Danish Road Directorate and pilots, to review relevant aspects of safety of navigation related to bridges in Danish waters.

2. FACTUAL INFORMATION

2.1 Photo of the ship



Figure 1: RAMONA
Source: Rauma Shipping Ltd.

2.2 Ship particulars

Name:	RAMONA
Ship type:	Cargo ship
Nationality/flag:	Finland
Port of registry:	Mariehamn
IMO number:	8420713
Call sign:	OJNN
DOC company:	Ronja Marin Ltd.
IMO company no. (DOC):	1908971
Year built:	1985
Shipyard/yard number:	Hermann Suerken GmbH & Co. KG / 334
Classification society:	Germanischer Lloyd
Length overall:	74.86 metres
Breadth overall:	10.6 metres
Gross tonnage:	1,297
Deadweight:	1,529 tons
Draught max.:	3.391 metres
Engine rating:	441 kW
Service speed:	10 knots
Hull material:	Steel
Hull design:	Single hull

2.3 Voyage particulars

Port of departure:	Skive
Port of call:	Koverhar, Finland
Type of voyage:	International
Cargo information:	Ballast
Manning:	4
Pilot on board:	No
Number of passengers:	0

2.4 The Railway Bridge and railway between Aalborg and Lindholm

The Railway Bridge across the Limfjord was built from 1935 to 1938 and belongs to Rail Net Denmark. The bridge is single-track and runs between Aalborg and Norresundby, connecting the rail network south of the Limfjord with the rail network north of the Limfjord.

The Railway Bridge is a bascule bridge with a counterweight on the bascule of 400 tons. The bridge is 403 metres long and has a width of 5.7 metres.

The passage height for the closed bridge is approx. 4.4 metres at the bridge's southern end and approx. 3.3 metres at the northern end, and the passage width in the bascule is 29 metres. The bascule span is shown with two green and two red positioning lights.

The Railway Bridge opens approx. 4,000 times and is passed by approx. 10,000 vessels annually.

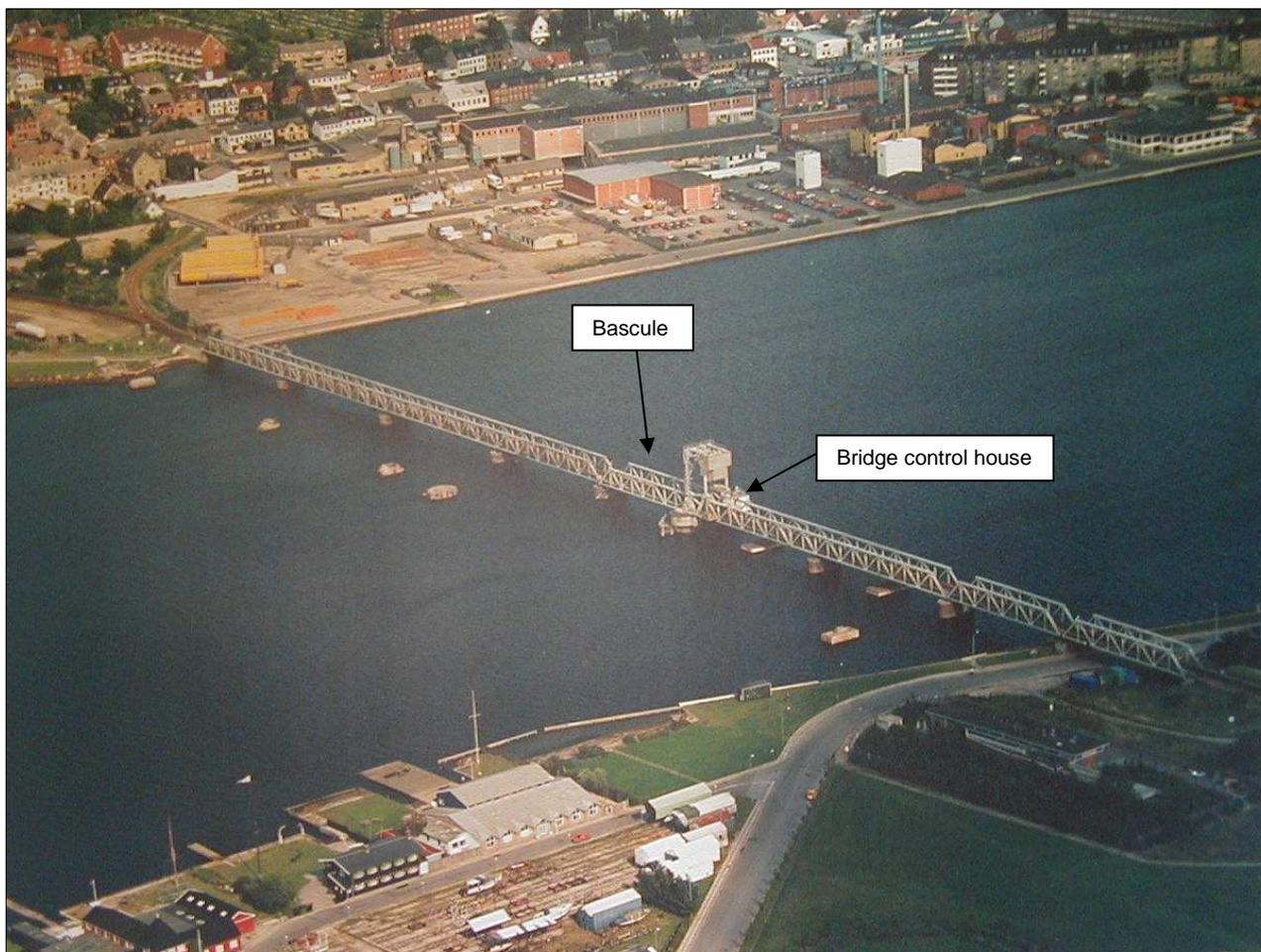


Figure 2: The Railway Bridge over the Limfjord viewed from the south-west
Source: Rail Net Denmark

In addition to the control panel for controlling the rail traffic across the bridge and control devices for opening and closing the bridge, including the control of the signal-to-ship lights, the bridge control house was equipped with a telephone, a direct telephone for the Rail Net Denmark signalling centre in Aalborg, VHF installations, an anemometer, a computer with access to the Internet display of AIS data from www.MarineTraffic.com for the region of the Railway Bridge and certain ships' position, course and speed over the ground.

The Railway Bridge was not equipped with radar or a current speed indicator.

The view to the west of the Railway Bridge control house was somewhat obstructed by the bridge's iron structures.

The distance between the Railway Bridge and the Limfjord Bridge is 670 metres.

2.5 Weather data

Wind direction and speed:	Between the west and north-west 8 m/s, gusting to 13 m/s
Visibility:	Good
Light/dark:	Dark, with urban lighting from Aalborg and Norresundby
Current:	Eastbound approx. 2.5 knots

2.6 Marine casualty information

Type of marine casualty/incident:	Collision with railway bridge
IMO classification	Less serious casualty
Date, time:	28 March 2012 at 22:26:36 hours
Location:	The Railway Bridge over the Limfjord between Aalborg and Norresundby
Position:	57°03.495' N – 009°54.560' E
Ship's operation, voyage segment	Ship in ballast voyage
Human factor data:	Yes
Consequences:	Serious constructive damage to railway bridge Less constructive damage to ship

2.7 The crew

2.7.1 RAMONA

Master:	43 years of age, STCW Reg. II/2 and II/3 certificate as master in ships of less than 3000 GT in the Baltic and the North Sea
Chief officer:	31 years of age, STCW Reg. II/1 certificate as officer of the watch in ships over 500 GT, excluding oil, chemical and gas tankers and passenger ships
Able seaman:	50 years of age
Chief engineer/ordinary seaman:	49 years of age

The ship's manning was in accordance with the ship's safe manning document.

2.7.2 The Railway Bridge

Bridge keeper:	57 years of age, yacht skipper second degree, bridge keeper on the Railway Bridge for six years
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3. NARRATIVE

3.1 The usual process for opening of the Railway Bridge

Usually when a ship approaches the Railway Bridge from the west and wants it opened for passage, it will call the bridge on VHF well in advance and at least half an hour before the estimated time of arrival. The bridge keeper checks whether the requested ship passage matches the railway timetable and rail traffic and contacts the railway signalling centre in Aalborg to arrange a time for the ship's passage, taking account of the rail traffic.

If the ship's estimated time of arrival at the bridge matches the timetable and rail traffic across the bridge, the bridge keeper informs the vessel about an approximate time of passage. Usually the bridge keeper requests a new call from the ship to confirm the agreement when the ship is about to pass the quay "Nordens Bro", 10-12 minutes before the estimated time of arrival at the bridge, see figure 3 below. Both parties then hold VHF channel 12 open until the ship has passed the bridge.

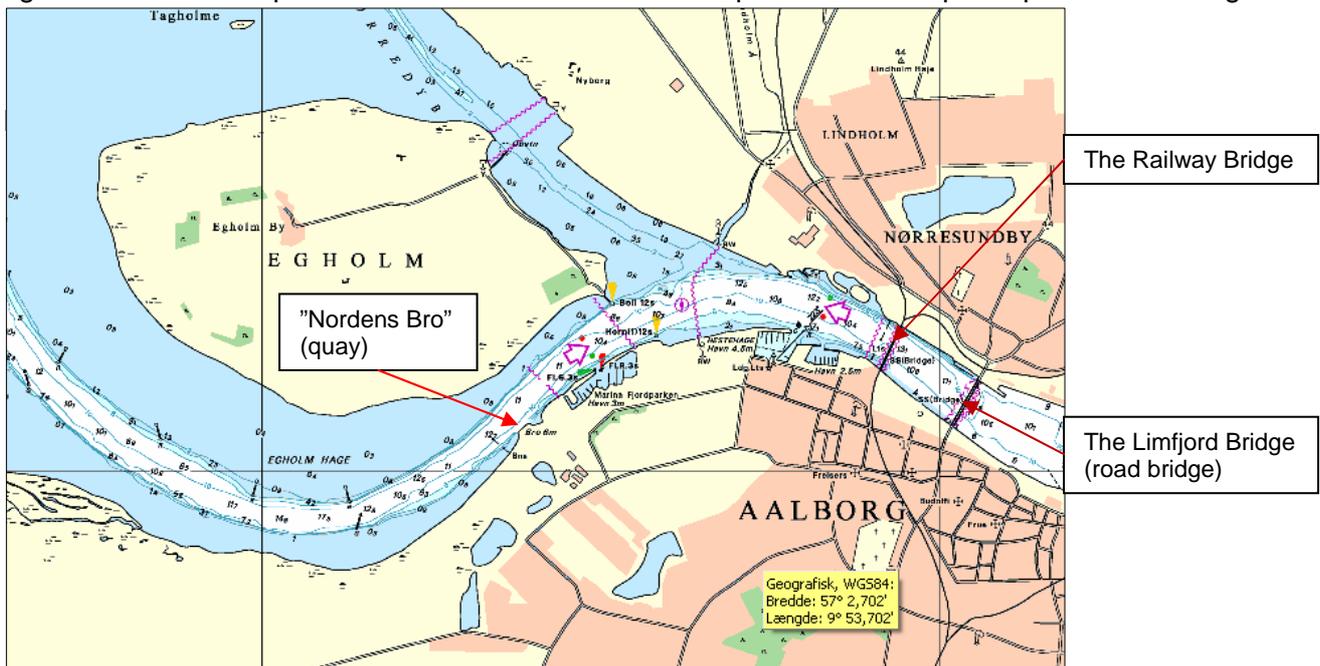


Figure 3: Accident location and area
Source: Det Levende Søkort

When the bridge is expected to be ready for the bridge keeper's disposal, he requests an acknowledgement from the railway signalling centre in Aalborg that the bridge will be made available, i.e. the bridge is closed to rail traffic, and control of the bridge is transferred to the bridge keeper. The bridge is made available for the bridge keeper's disposal for periods of four minutes for quick passage of for example one or a few fishing or pleasure boats or for periods of eight minutes for the passage of one or more large ships.

In exceptional cases when, for example, it could be critical to keep a ship on hold, it can be agreed with the railway signalling centre to keep a train waiting while the bascule is being opened.

When the railway signalling centre is ready to let the bridge open, the railway signalling centre makes the bridge available to the bridge keeper for opening the bascule. This is indicated with signal lights and sound, both in the railway signalling centre and the bridge control house. By touching a button, the bridge keeper acknowledges that he has taken control over the bridge. At the same time, the drive signals for the train traffic across the bridge are blocked. An opening process then takes 1-1½ minutes until the bascule is completely open and ready for a ship's passage.



Figure 4: The Railway Bridge viewed from the west with open bascule, the Limfjord Bridge further away with closed bascule
Source: National Survey and Cadastre



Figure 5: View of a nocturnal approach to the Railway Bridge, approximately 700 metres from the Railway Bridge
Source: Port of Aalborg

When the bridge is made available and the bridge keeper initiates the opening process, a light signal to the ship traffic is lit: one red, permanent light with the meaning *"stop, passage is prohibited"*.

When the bascule is completely open, a light signal for the ship traffic is lit: two or three red, permanent lights vertically above each other with the meaning *"passage is permitted"*, respectively for ship traffic from the east or west.

There is no fixed margin from when the railway bridge has been made available to the bridge keeper and the opening of the bascule begins to when the ships begin their approach and hence their distance from the bridge. The aim is that the opening process should begin well in advance, but this is dependent on many variables. For the Railway Bridge such variables could include, for example, trains and possible delays. For the Limfjord Bridge such variables could include, for example, the need not to stop the road traffic for longer than necessary as the ships should preferably sail through the Railway Bridge and the Limfjord Bridge as a continuous movement. For east-bound ship traffic the bascule opening often begins when the ship is passing or has passed the "Nordens Bro" and the ship is in sight from the bridge. Among the bridge keepers, there is variation in how to use light signals, dependent on the traffic characteristics, etc.

The signal lights are positioned visibly from the sea on a stand at the bridge control house.

Passage through the bridge is regulated more by oral communication between the ship and the bridge over VHF than by signal lights. In case of poor visibility where the signal lights cannot be seen within the distance required to manoeuvre safely, including stopping the ship in time, there is no passing through the bridges, or passing takes place with great care after oral VHF information by the bridge keeper about whether the bascule is open or closed.



Figure 6: The Limfjord Bridge and the Railway Bridge viewed from the east with open bascules
Source: National Survey and Cadastre

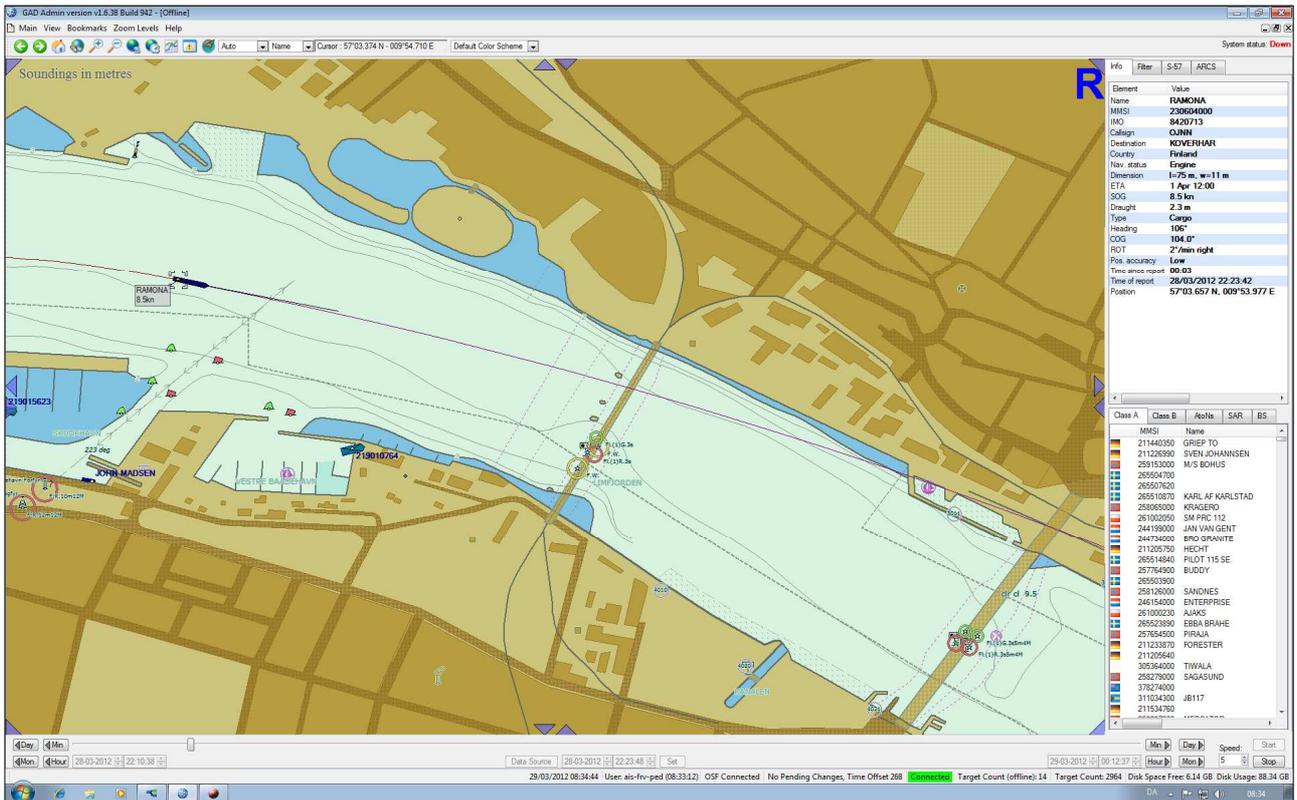


Figure 8: AIS information, at 22:23:48
Source: Danish Maritime Authority

When RAMONA at 22:25:21 was 0.17 nm from the Railway Bridge, the ship's speed over the ground was 7.6 knots according to the AIS information, see figure 9.

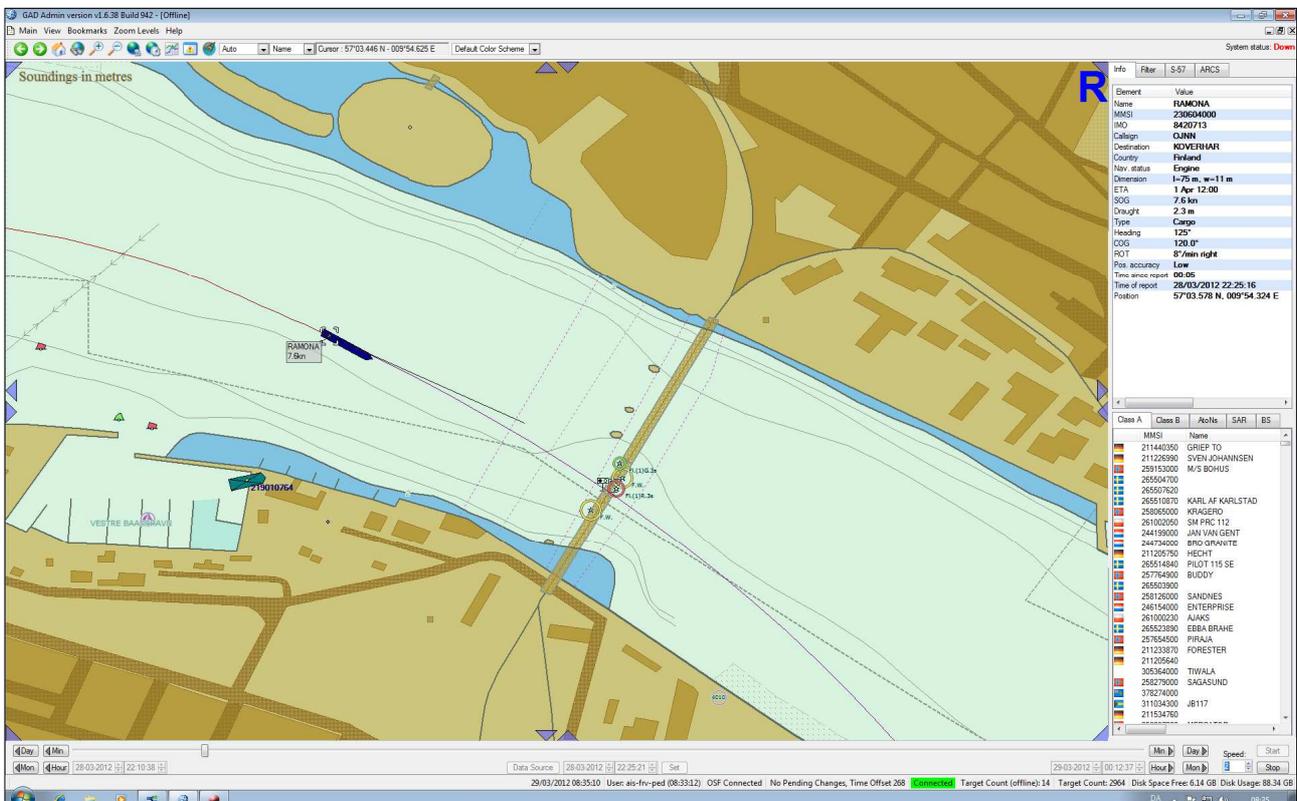


Figure 9: AIS information, at 22:25:21
Source: Danish Maritime Authority

When approaching Aalborg/Norresundby, the vessel was steered manually by the master. There was good visibility, a strong north-westerly wind and a strong easterly current. The ship's ARPA radar was set on 0.5 nm, north up, relative motion, three minutes vectors and no trails. The ship navigated by means of both electronic charts and paper charts.

When the ship approached the Railway Bridge, red and green positioning lights were observed from the ship at the bascule, but no other signal lights on the Railway Bridge. The master was acquainted with the signal lights at the Railway Bridge and their meaning, but he had the notion that the time 2226 hours had to be taken literally for passage as no information was provided about approx. 2226 hour or for example approx. 2230 hours.

The ship proceeded towards the Railway Bridge ready to pass it at 2226 hours.

The ship's searchlight was used at regular intervals to determine whether the railway bridge was open or closed. The master and chief officer observed a train that crossed the bridge from the south to the north at 2224-2225 hours.

The ship was still approaching the Railway Bridge, but no signal lights were lit, and the bascule did not open as expected by the master. The chief officer was on standby on VHF channel 12, and when the ship was close to the bridge, he asked the bridge keeper whether the bascule would soon be opened. The bridge keeper said it would open within a minute and that the ship had to stop.

The chief officer replied that they could not stop the ship at such a short distance. The master had already manoeuvred full astern to stop the ship, but the ship could not stop immediately and hit the bridge at 22:26:36 at a speed of 6 knots over the ground (according to AIS information), see figure 10.

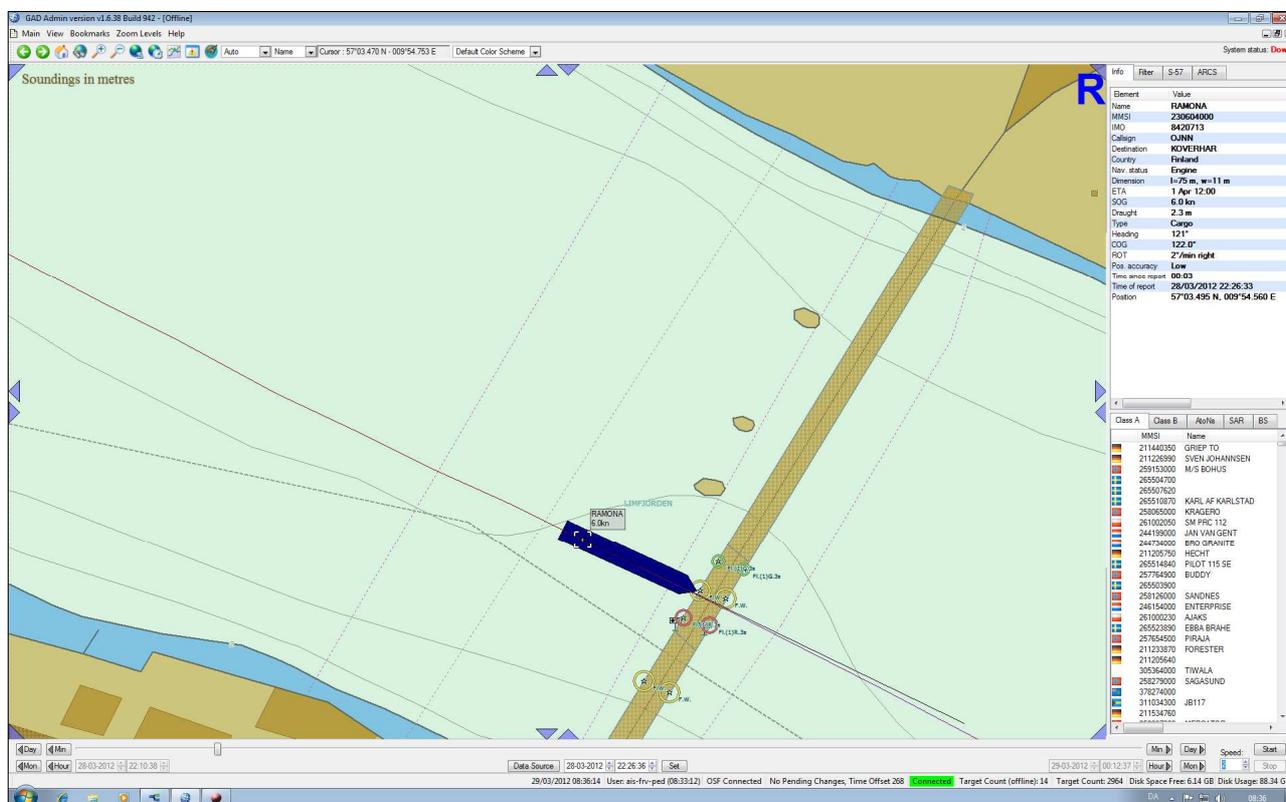


Figure 10: AIS information, at 22:26:36
Source: Danish Maritime Authority

There was moderate damage to the ship's forecastle, and the structure under the forecastle (see figures 11 and 12) and severe damage to the Railway Bridge (see figures 13, 14 and 15).



Figure 11: Damage to RAMONA after collision with the Railway Bridge
Source: DMAIB



Figure 12: Damage to RAMONA after collision with the Railway Bridge
Source: DMAIB



Figure 13: Collision damage to the Railway Bridge
Source: DMAIB



Figure 14: Collision Damage to the Railway Bridge
Source: DMAIB



Figure 15: Collision Damage to the Railway Bridge
Source: DMAIB

After the collision, the ship began to go astern, and the master asked the bridge keeper if he could still open the bridge. The bridge keeper replied that he would examine this first. He quickly reverted with a statement that the bridge could not be opened.

The master notified the relevant authorities via the Port of Aalborg, which directed the ship to berth at the quay "Nordens Bro" west of Aalborg.

After the ship had berthed, a police patrol made a breath test on the master and chief officer. The test indicated a blood alcohol level of 0.00 per cent.

3.2.2 *The sequence of events experienced on the Railway Bridge*

On 28 March 2012, the bridge keeper began his watch on the Railway Bridge at 1300 hours. The watch lasted until 1900 hours on the bridge itself. Then the bridge was manned by the bridge keeper in charge by agreement on ship's passage.

Early in the afternoon, RAMONA's agent telephoned from Skive and announced that RAMONA was expected to pass the Railway Bridge at approx. 0030 hours. The bridge keeper agreed with the agent that the master had to call the Railway Bridge at 1800 hours to confirm the time of passage.

At 1800 hours, the master telephoned the railroad bridge and stated that the ship had departed from Skive earlier than originally anticipated and that the estimated time of arrival at the bridge would be 2230 hours. It was then agreed that the master should call the bridge again half an hour before the estimated time of arrival at the bridge. The conversation was in English.

The bridge keeper informed the railway signalling centre in Aalborg about the estimated passage and left the bridge at 1900 hours. He came back on the bridge at 2130 hours to attend to the bridge opening.

At 2155 hours, the master called the Railway Bridge on VHF channel 16 and it was agreed to switch to channel 12. The bridge keeper reported that RAMONA could pass the Railway Bridge at 2226 hours or approx. 2226 hours. This time suited both parties. It was not said whether the signal lights would be lit for the ship's passage.

For the Railway Bridge the time 2226 hours matched in the sense that a train was expected to cross the bridge with timely departure from Aalborg Vestby Station at 2223 hours to be timely at Lindholm station at 2226 hours. It was agreed between the bridge keeper and the railway signalling centre that the bridge could be available to the bridge keeper, i.e. the bridge was closed to rail traffic and control of the bridge was transferred to the bridge keeper when the train had crossed.

For the ship the time matched in the sense that the speed could be adjusted taking into account the possibility of the bridge opening.

As RAMONA was approaching, the bridge keeper could see the ship visually at a distance of almost 1000 metres. At this time, the train had not crossed the bridge. When the ship was slightly closer than the 1000 metres, the bridge keeper said that the ship could pass in about two minutes. However, it seemed to the bridge keeper that the ship came relatively fast towards the bridge, faster than he had expected. He could see that the ship's searchlight was turned on, which to some degree prevented him from assessing the ship's speed visually.

The bridge keeper was in contact with the railway signalling centre that made the bridge available to the bridge keeper, but he had not yet initiated the opening process, and no signal lights for stop or passage were turned on. As the bridge keeper realised at a later stage that the ship was approaching faster than the bascule could be opened, he said over the VHF that the ship had to stop. He predicted the collision and ran into the southern part of the bridge control house to avoid being hit if the ship hit the bridge control house. Immediately after, the ship collided with the bascule.

3.3 Train crossing the Railway Bridge just before the collision

The train that crossed the Railway Bridge just before the ship's collision with the bridge was timely scheduled and had scheduled departure from:

- Aalborg Station 22:21
- Aalborg Vestby Station 22:23
- Lindholm Station 22:27

The train crossed the bridge at 2224-2225 hours and arrived at Lindholm Station at 2226 hours.

The driving distance from Aalborg Vestby station to the Railway Bridge's south end is approx. 400 metres. Over the Railway Bridge approx. 400 metres and from the Railway Bridge's north end to Lindholm station approx. 1000 metres, see figure 16.



Figure 16: Map excerpt showing the railway over the fjord between Aalborg Vestby station and Lindholm station
Source: Krak

Rail Net Denmark's railway signalling log shows:

- 22:26:12 The train had passed the "I-signal" for Lindholm.
- 22:26:15 The bridge keeper made a "request for bridge".
- 22:26:22 The Railway Bridge was made available to the bridge keeper, see figure 17 below.

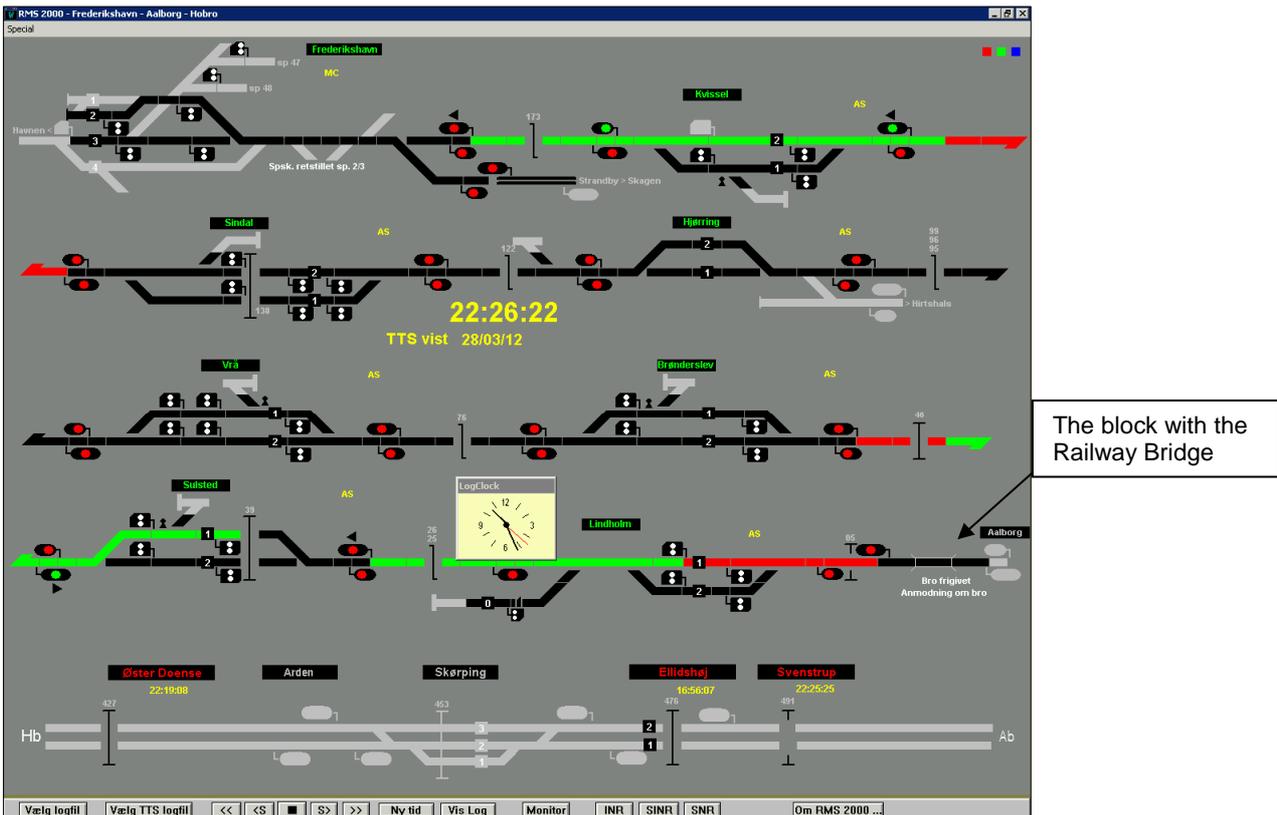


Figure 17: Extract from Rail Net Denmark's railway signal log
Source: Rail Net Denmark

The next train to run over the Railway Bridge had scheduled departure from:

- Lindholm station 22:44
- Aalborg Vestby station 22:47
- Aalborg station 22:50

3.4 Passing speed and manoeuvrability

The bascules in the Railway Bridge and the Limfjord Bridge are not on line. Ships passing through both bridges must change course between the bridges.

According to Rail Net Denmark's instructions for operating, etc. the Railway Bridge, large merchant ships should be able to pass through both the Railway Bridge and the Limfjord Bridge "without having to slow down." By agreement between the bridge keepers on both bridges about the passage period, the ship's speed and the bridges' openings should be planned so that passage can take place as a smooth progression through both bridges.

According to "order on navigation through specific bridges in Danish waters", ships within a distance of 250 metres on each side of the bridge are permitted to navigate only at the speed necessary to preserve the ship's manoeuvrability.

In practice, ships prefer to pass through the bridge's bascule at the speed that is appropriate, paying due consideration to all relevant circumstances and not least the relatively short and narrowly defined readiness period during which the bascule is typically open. It often means a higher speed than that necessary to manoeuvre.

Large ships passing through the Railway Bridge and the Limfjord Bridge have limited manoeuvring ability close to the bridges. The waters allow manoeuvres, including altering speed, stopping the ship, altering course and turning, when the appropriate conditions are present.

Significant ship manoeuvres such as stopping or turning a ship close to the bridges may be quite drastic steps that require mental and practical preparation by the officer of the watch.

Relevant circumstances for major ship manoeuvring in connection with passage through the bridges are in this context, among other things, the weather and current conditions, the individual ship's speed, manoeuvrability, the navigator's knowledge and experience in the fairway and bridges, the time available for any manoeuvres and not least the navigator's mental and practical preparation.

For RAMONA's planned passage on the evening of 28 March 2012, no technical issues in the ship limited the ship's manoeuvrability and no technical issues at the Railway Bridge restricted the bascule opening process.

RAMONA had passed the Railway Bridge using a pilot on 27 March 2012 at 0619 hours, bound for Skive at a passage speed of 7.7 knots over the ground. The direction and speed of the current are not registered for this time. There is no log of the current in the Limfjord.

The master and chief officer did not consider navigation through the Limfjord as problematic in any way. On the passage towards Skive on 27 March 2012, the master had, however, thought that, in his view, the bridges between Aalborg and Norresundby opened relatively late in relation to the ship's arrival at the bridges

3.5 Pilotage

Vessels with a draft of more than 3.1 metres should use a pilot when passing the dredged fairway Mejlgrunden and Logstor Grounds.

Vessels with a length overall of 80 metres or more should use a pilot when passing the Railroad Bridge over the Limfjord at Aalborg. Since the accident, this rule has been changed so that it applies to vessels of 53 metres or more.

On the westward voyage for Skive through the Limfjord on the day before the collision, RAMONA had used a pilot because the ship was loaded and had a draft of more than 3.1 metres.

On the eastward voyage from Skive through the Limfjord on 28 March 2012, the ship did not use a pilot because the ship was in ballast and had a draft of 1.8 metres fore and 2.3 metres aft.

3.6 Regulations

The bridge keeper's obligations as well as passage through the railway bridge is regulated by:

- *"Banedanmarks instruks for betjening, eftersyn og vedligehold af Jernbanebroen"* (Rail Net Denmark's instructions for operation, inspection and maintenance of the Railway Bridge),
- *"Bekendtgørelse om sejlads gennem visse broer i danske farvande"* (Order on navigation through specific bridges in Danish waters),
- *"Den danske Havnelods"* (The Danish Harbour Pilot), and
- *"Admiralty Sailing Directions, Baltic Pilot Volume 1"*.

An extract from Rail Net Denmark's instructions for operation, inspection and maintenance of the Railway Bridge is shown in Danish in this report, section 7.

An extract from the "order on navigation through specific bridges in Danish waters", which lays down general rules for navigation, etc. through some bascule bridges and fixed bridges in Danish waters, including the Railway Bridge over the Limfjord, is shown in Danish in this report, section 7.

An extract from the Danish Harbour Pilot is shown in Danish in this report, section 7. The Danish Harbour Pilot is available in Danish from the www.danskehavnelods.dk that is updated every Wednesday at 1200 hours.

Regulation for ships passing the Railway Bridge over the Limfjord is available in English in "Admiralty Sailing Directions, Baltic Pilot Volume 1, NP 18, Section 5155 and 5156". An extract hereof is shown in this report, section 7.

3.7 Signals

Extract from the *"order on navigation through specific bridges in Danish waters"*:

Signals from ships

Section 6 All ships and vessels that want to pass the bridge shall show this by giving the following signal at a distance of at least 0.5 nautical miles from the bridge:

- 1) At day: The international signal flag N – or, if this is not available, the national flag – hoisted half at the foretop as well as a long and a short blast with a whistle or a foghorn.
- 2) At night: A white light at the bow as well as a long and a short blast with a whistle or a foghorn.

Signals from bridges

Section 7 When a ship or a vessel shows or has given a signal to show that it would like the bridge to be opened, the following reply signal will be given from the signal mast of the bridge both during the day and at night:

- 1) One red, permanent light signifying that passage is prohibited.
- 2) Two red, flashing lights signifying that the bridge will be opened for a ship approaching from N or E. Passage shall not take place until the signal described under para 3) below has been given.
- 3) Two red, permanent lights signifying that a ship approaching from N or E can pass the bridge.
- 4) Three red, flashing lights signifying that the bridge will be opened for a ship approaching from S or V. Passage shall not take place until the signal described under para 5) below has been given.

5) Three red, permanent lights signifying that a vessel coming from S or V may pass the bridge.

2. Both during the day and at night, a loud sound signal, a long blast, shall signify that the bridge cannot be opened despite the given signal for passage. If conditions allow, the signal for passage will also be switched off.

3. Until a signal for passage has been received, a ship or vessel shall remain at a safe distance from the bridge so that a risk of colliding with the bridge does not occur.'

In practice, the signals from the ship as specified in section 6 are not used. Instead the telephone and VHF are used to request the bridge opened.

The signal lights from the bridge, as specified in section 7, are used – with variation among the bridge keepers.

For example, the signals with two or three red, flashing lights were not always used as changes were often made directly from one red, permanent light for "*stop, passage is prohibited*" to two or three red, permanent lights for "*passage is permitted*" from east and west respectively.

The signal lights, including at first the signal one red, permanent light for "*stop passage is prohibited*", were lit on the Railway Bridge when the opening process started. The opening process could thus begin so late, related to a ship's arrival at the bridge, that the signal light for "*stop, passage is prohibited*" did not appear in due time to allow the ship to stop as a result of the signal light.

3.8 The master's knowledge of the rules for passing the Railway Bridge

The master was familiar with the regulations, including the meaning of the signal lights, regarding passage through the Railway Bridge from the "Admiralty Sailing Directions" which was on board the ship, and from the pilot information provided during the westbound voyage the day before.

3.9 Anchoring

According to the order on navigation through specific bridges in Danish waters every ship passing through the bridge must be prepared to let go the anchor.

In practice, some ships are prepared to let go the anchor when passing the Railway Bridge and the Limfjord Bridge, but not all.

RAMONA was not prepared to let go the anchor. Both navigators were on the bridge, and the other two crew members were off duty.

3.10 Time and clock

Timing on board ships is typically taken from GPS. At the Railway Bridge, a radio controlled wall clock was used.

4. ANALYSIS

4.1 The ship and navigation towards the Railway Bridge

The cargo ship RAMONA and her voyage from Skive on 28 March 2012 was, in terms of ship type, tonnage, crew, equipment, visibility from the bridge, cargo, etc., typical of a considerable proportion of the traffic on the Limfjord by merchant ships passing the bridges between Aalborg and Nørresundby. No circumstances in the ship or her navigation until immediately before the collision differed significantly from other similar ships and their navigation through the bridges.

The ship's crew met the manning as laid down in the safe manning document, which is a permitted minimum. A crew of the minimum size and composition in question, however, requires a careful predisposition of working hours and off duty. It is of importance whether the crew are on or off duty as a lookout or on the forecastle, ready to let go the anchor when passing bridges. This situation can be regarded as typical of merchant ships as RAMONA.

During the voyage westward through the Limfjord for Skive on 27 March 2012, the master wondered about the narrow time margins between the arrival of ships at the bridges and the bridges opening, but he was reassured by the pilot. This can be taken as meaning that when you sail often through the bridges, the boundaries for when you are "close" will move.

RAMONA did not use a pilot during the voyage on 28 March 2012, but had done so during the voyage for Skive the day before. These dispositions were determined by the rules of pilotage. The master and chief officer had skills to navigate the ship, and they were accustomed with navigation in the archipelago and experienced with navigation and close passage in narrow channels and the like.

On the evening of 28 March 2012, RAMONA approached Aalborg/Norresundby with all the parties involved expecting a smooth passage at 2226 hours.

The ship maintained a speed that was determined by an oral agreement over VHF between the ship and the bridge about passage through the bridge at 2226 hours, and the master thought that the time 2226 hours should be taken literally.

When RAMONA at approx. 2223 hours was approx. 0.5 nm (nearly 1000 metres) from the Railway Bridge, the ship's speed over the ground was 8.5 knots and the train had not crossed the bridge.

The ship's speed was reduced a bit, and at 22:25:21 at a 0.17 mile (about 350 metres) distance from the Railway Bridge the ship's speed over the ground was 7.6 knots, and the train had crossed the Railway Bridge.

At about this time, the bridge keeper was engaged in the opening process or was about to begin the opening process when he realised that the ship had come closer than expected. And also about this time, the bridge keeper informed the chief officer that the bascule would be open in one minute and that the ship had to stop.

Stopping or reversing a ship like RAMONA by propeller and rudder manoeuvres at a speed of approx. 7.6 knots with approx. 2.5 knots co-current within 300-400 metres from the Railway Bridge is a quite dramatic and practically unrealistic manoeuvre, among other things for the following reasons: Only 1-2 minutes at the ship's actual speed would pass before the ship reached the Railway Bridge. At a speed of approx. 7.6 knots over the ground and approx. 2.5 knots co-current, the ship's speed through the water was approx. 5 knots and could not be significantly reduced without loss of steering. It was dark and in the darkness it was difficult to see whether the bascule was open. There was limited space west of the Railway Bridge for manoeuvres with a ship of RAMONA's dimensions. The ship's navigators were not experienced with the waters, and in anticipation of a smooth passage at 2226 hours they were not mentally and practically prepared to make emergency manoeuvres.

Using anchor to stop the ship under the same conditions, including first and foremost the ship's speed, the proximity to the Railway Bridge and thus the given narrow timing margins, would not be realistic either. The ship could not stop in due time using the anchor.

4.2 The bridge keeper's conditions, procedures and dispositions

The bridge keepers' dispositions on the Railway Bridge were primarily determined by the operation of the railway, the timetable and the trains on the Railway Bridge. Any opening of the bascule was coordinated with and approved by the railway signalling centre in Aalborg, taking into account mainly the rail traffic.

Only in exceptional cases, could it be opened for ship passage and let the train traffic wait. The bridge keeper could not stop the train and take over control of the bridge without the acceptance and participation of the railway signalling centre.

On the Limfjord Bridge, the bridge keeper's dispositions were more flexible because it could only be a question of stopping the road traffic to open the bascule for passage. In special cases, such as emergency driving over the Limfjord Bridge, it could be necessary to let the ship traffic wait.

The aim was to allow passage through the Railway Bridge and the Limfjord Bridge in one continuing process. Thus, the time of passage of the Railway Bridge and the Limfjord Bridge was primarily determined by the possibility of opening the Railway Bridge.

In connection with the planned passage of the Railway Bridge on the evening of 28 March 2012, the possibility of the bridge keeper to effectively coordinate the opening and safe passage through the bascule was limited by several factors: It was dark as the ship approached the bridge and thus it was difficult for the bridge keeper to assess the ship's speed, there was a strong light from the ship's searchlight, the view from the bridge control house was not optimal because of the bridge's construction, there was no current speed indicator on the bridge to provide fast and accurate information about the current, and the bridge's instrumentation was not optimal in terms of rapid and efficient determination of the ship's speed over the ground. The situation and conditions were not unusual, and these limitations meant that the bridge keeper's actions had to be based largely on experience and routine.

At 2155 hours, it was agreed between the ship and the Railway Bridge that the passage could take place at 2226 hours or at approx. 2226 hours. When the bridge keeper first, at approx. 2223 hours, visually observed RAMONA at a distance of approx. 0.5 miles, the train had not yet crossed the bridge. Based on his knowledge that the train was on time and therefore was expected to cross the bridge within approx. one minute and based on his experience and routine, the bridge keeper believed there was time for the train to cross the railway bridge and for opening the bascule before the ship arrived at the bridge. The bridge keeper then informed the ship that passage could take place two minutes later.

However, the ship approached the Railway Bridge faster than expected by the bridge keeper, and the time needed to open the bascule was not available. When the train had crossed the bridge and the ship was coming close to the bridge, the opening process, including switching on the signal lights, did not begin. The ship asked about the opening of the bridge, and the bridge keeper gave notice that it would take one minute and that the ship had to stop. The narrow time margin that had been taken into account by the bridge keeper was reduced. The bridge keeper was short of approx. one minute before the bascule could be opened.

There was a lack of time for opening the bascule because the time 2226 hours or approx. 2226 hours was perceived differently on the bridge and on board the ship:

- For the bridge keeper, 2226 hours was the time when the train arrived at Lindholm station and the bridge was made available to the bridge keeper for beginning the opening process.
- On board the ship, 2226 hours was the exact time when the master and the chief officer expected that the bascule would be open.

The narrow time margins were caused by the fact that bridge operation is controlled by timetables and thus, in contrast to shipping, naturally based on minutes. Like when a train departed on schedule from Aalborg Vestby station to cross the bridge a few minutes before the agreed time of the ship's passage, while RAMONA was about 0.5 nm from the Railway Bridge.

The bridge keeper's basis for regulating navigation through the railway bridge safely and effectively was not optimal. Measures and actions were governed by a general account of the rail traffic and were characterized by a routine which was essentially based on own and colleagues' experience seen from the bridge itself and less on the understanding of the situation as it was experienced from the ship: For example that the ship could not be stopped at such a short distance.

It is not clear whether the ship and the Railway Bridge had agreed on passage at 2226 hours or at approx. 2226 hours. However, this question is not critical because, according to Rail Net Denmark, approx. 2226 hours must be seen as the time between the hours of 22:26:00 and 22:27:00 and thus not as 2224, 2225, 2227 or 2228 hours. Thus, in this context 2226 hours and approx. 2226 hours in practice means the same.

In connection with the control of rail traffic, minutes – even seconds – are applied according to Rail Net Denmark. In connection with shipping, arrival and passage within a given minute are more problematic and matters of seconds can be regarded as irrelevant.

This illustrates how railway and shipping meet at the Railway Bridge under assumptions that are significantly different for the parties involved.

4.3 Regulations on navigation through bridges

The bridge keeper's obligations and passage through the railway bridge are regulated by:

- *"Banedanmarks instruks for betjening, eftersyn og vedligehold af Jernbanebroen"* (Rail Net Denmark's instructions for operation, inspection and maintenance of the Railway Bridge),
- *"Bekendtgørelse om sejlads gennem visse broer i danske farvande"* (Order on navigation through specific bridges in Danish waters),
- *"Den danske Havnelods"* (The Danish Harbour Pilot), and
- *"Admiralty Sailing Directions, Baltic Pilot Volume 1"*.

Rail Net Denmark's (Banedanmark) instruction is aimed at Rail Net Denmark's staff. The order on navigation through specific bridges in Danish waters, the Danish Harbour Pilot and Admiralty Sailing Directions establish general rules of navigation, etc. for certain bascule bridges and other bridges in Danish waters. The order on navigation through specific bridges in Danish waters and the Danish Harbour Pilot are available only in Danish, while the Admiralty Sailing Directions are in English.

Some provisions of Rail Net Denmark's instructions, the order on navigation through specific bridges in Danish waters, the Danish Harbour Pilot and Admiralty Sailing Directions do not match, and others are not operationally useful. Consequently, a practice has developed deviating from the requirements.

For example:

Rail Net Denmark's instruction stipulates that one of the light signals must be switched on by the bridge keeper, but does not contain anything about when the signal should be switched on.

Similarly, the Admiral Sailing Directions state that a bridge opening request will be answered by a light signal from a mast, however, not when.

According to the order on navigation through specific bridges in Danish waters and the Danish Harbour Pilot, a response signal (light signal) will be given from the bridge signal mast when a ship or a vessel shows or has given signal to indicate that the bridge is desired opened.

According to Rail Net Denmark's instructions, ships must as far as possible remain at a distance of at least 100 metres from the bridge until the signal for passage has been received.

According to the order on navigation through specific bridges in Danish waters, ships must remain at a safe distance from the bridge until a signal for passage has been received.

According to the Danish Harbour Pilot and Admiral Sailing Directions, ships must remain at a distance of at least 100 metres from the Railway Bridge until a signal for passage has been received.

A practice has evolved according to which signalling with signal lights begins with the opening process, i.e. considerably later than the time of the manifestation of the request to have the bascule opened, and typically when the ship is relatively close to and not at a safe distance from the bridge. The use of oral agreements over VHF and the narrow time margins have contributed to this practice.

When no light signal appears on the bridge either to stop or permit passage of a ship approaching the Railway Bridge, and there is a verbal agreement over the VHF about an open bascule and passage through the bridge at a given time, the oral agreement can and will be perceived as a valid signal. Among other things, because oral messages over VHF are widely used as a means of communication during ship operations and manoeuvres.

Therefore, as regards the ships concerned, it has become common practice to pass the bridge predominantly on the basis of verbal agreement over VHF rather than the display of signal lights.

Signalling, including the first signal for "*stop, passage is prohibited*", does not appear earlier or permanently because the stop signal will prohibit passage by all traffic and also traffic that does not need opening of the bascule. Therefore the bridge keeper will wait for as long as possible to begin the opening process. This practice is not expedient since it delays signalling. A light signal signifying stop or permission to pass which is turned on and thus can be observed by a ship only so late that the ship cannot stop in due time has no effect.

According to the order on navigation through specific bridges in Danish waters, ships within a distance of 250 metres on either side of the bridge may proceed only at the speed needed to preserve the ship's manoeuvrability. According to the Danish Harbour Pilot and Admiral Sailing Directions, this applies within distances of 200 metres.

According to Rail Net Denmark, it is customary that ships "creep" around the corner and stop at a safe distance from the bridge. When the signal for passage is given from the bridge, the ships speed up and pass the bridge.

This would seem to be ideal, but it is inexpedient and not always possible for large ships for reasons described in this report's section 3.2.4. Practice has been derived by pilots and others with the experience that the opening of the Railway Bridge is primarily regulated in consideration of the rail traffic.

Ships prefer to pass the bridge at the speed that is expedient, taking account of all relevant factors. This is derived from necessity, possibilities and limitations in connection with a ship's manoeuvres. A sharply defined and strict restriction within 250 or 200 metres is not realistic for large ships passing the bridge, where the passage is part of a long manoeuvring process.

According to the order on navigation through specific bridges in Danish waters, ships and vessels within a distance of 250 metres from the bridge should abide by the instructions given by the bridge keeper. According to the Danish Harbour Pilot and Admiral Sailing Direction, this applies within a distance of 200 metres from the bridge.

A cargo ship of the same type and tonnage as RAMONA that is about to pass a bascule bridge will, at a distance of 250 or 200 metres of the bridge, typically have a speed that is appropriate for safe navigation through the bridge without any substantial opportunity of manoeuvring according to the directions of the bridge keeper. Therefore, this provision can primarily be relevant for small vessels capable of manoeuvring in a very small area.

5. CONCLUSIONS

No circumstances related to RAMONA or her navigation until immediately before the collision differed significantly from other similar ships and their navigation through the bridges between Aalborg and Norresundby.

RAMONA did not use a pilot during the voyage on 28 March 2012 because the ship was not under the obligation to use a pilot and the master did not consider it necessary.

RAMONA maintained a speed that had been determined by an oral agreement over VHF between the ship and the bridge to pass at 2226 hours.

RAMONA approached the Railway Bridge under the expectation of all parties involved of a passage free of problems. No technical defect in the vessel or on the bridge was to the contrary.

At a later stage, the bridge keeper realised that, at the current speed, the ship would be at the bridge before the bascule could be opened and said over the VHF that the ship had to stop. At about this time, the bridge keeper was engaged in the opening process or was about to begin the opening process. RAMONA could not stop at the current speed and co-current within the given distance from the Railway Bridge.

When RAMONA arrived at the bridge at the agreed point in time, the bascule was not open. The ship hit the bascule at a speed of 6 knots over the ground.

The master realized too late during the voyage towards the Railway Bridge that the bridge would not be open in time for passage. Thus, his reverse manoeuvre did not have sufficient effect to stop the ship.

The master and the bridge keeper had acted on the basis of different understandings of the meaning of the agreed opening time.

The master's understanding was that he had been given an exact time when the bascule would be open for passage and that the bascule could open late in relation to the ship's arrival. He relied on an expectation that the passage could take place at the agreed time and adjusted the ship's speed accordingly.

The bridge keeper's understanding was that the Railway Bridge would be made available to him at the specified time so that he could begin the opening process. He relied on his experience and routine, according to which passing ships would take into account the time of the opening process.

When the master realized that the Railway Bridge bascule would not be open at the specified time, the ship was so close to the bridge and there was so little time available that he could not stop the ship or take any other precautions to avoid a collision.

Similarly, within the very narrow time margin when the ship was very close to the bridge, the bridge keeper had no opportunity to act by speeding up the opening process. The bridge keeper could only ask the ship to manoeuvre, even if there was no opportunity to avoid collision by manoeuvring.

The incident reflects the fact that it is risky to operate with very narrow margins where rail traffic meets shipping. The very narrow time margins involve an additional security-related risk in case of possible technical defects that may hinder the bascule's opening.

There is little or no chance of the ship preventing or modifying an unexpected event, particularly when it is not clearly communicated between the bridge and the ship during which time passage is possible.

The time margins are caused by timetables and rail traffic, and shipping adapts to this to the extent possible. However, shipping operates under conditions that cannot always be adapted to these margins – ranging from conditions such as ship's speed, current, steering and manoeuvrability, darkness, confined space, navigator's knowledge of the waters, etc. This may give rise to potential risks of which the navigator must be mentally and practically prepared.

The regulations on navigation through bridges require and establish conditions for navigation that are not realistic in relation to the operational reality. Therefore, a practice has developed that deviates from the regulations and which RAMONA's master was not or could not be aware of.

6. SAFETY RECOMMENDATIONS

This investigation has revealed a number of indications that existing regulations and practices are not adequate to ensure safe navigation through Danish bridges. Furthermore, there is a need for Rail Net Denmark and the relevant maritime bodies to have a dialogue on common issues.

On this basis, the Danish Maritime Accident Investigation Board recommends that the Danish Maritime Authority initiates a dialogue with the relevant parties, including the Danish Traffic Authority, Rail Net Denmark, the Danish Road Directorate and pilots, to review relevant aspects of safety of navigation related to bridges in Danish waters.

7. APPENDICES

7.1 Instruction for the Railway Bridge

Banedanmarks instruks for betjening, eftersyn og vedligehold af Jernbanebroen er senest revideret i 2009. Instruksen er omfattende, og nedenfor vises uddrag af instruksens afsnit 3:

Rail Net Denmark's instruction for operation, inspection and maintenance of the Railway Bridge was last reviewed in 2009. The instruction is comprehensive, and below is shown excerpts of the instruction's section 3 (in Danish):

Gennemsejling for erhvervsskibe

Ud fra betingelser fra Søfartsstyrelsen, skal større skibe kunne sejle gennem både Jernbanebroen og Vejbroen uden at skulle bremse op.

Det skyldes miljø- og sikkerhedshensyn både for skibe og for risiko for påsejling broerne.

Det er brovagten, der afgør hvilke, der er større skibe. I antal skønnes, at det drejer sig om 2 skibe pr. uge i gennemsnit.

Derfor er der med ledelsen for Vejbroen aftalt følgende:

Efter at et større erhvervsskib har kaldt Jernbanebroen – senest ½ time før gennemsejling – og anmodet om gennemsejling, ringer brovagten til FC for at få fastlagt en tidsperiode af ca. 8 – 10 minutter for passage af Jernbanebroen.

Hvis f.eks. brovagten ringer kl. 17.30 og spørger, om han kan få en frigivning af broen kl. 18.00, er det FC-lederen, der afgør, hvornår broen kan frigives.

Når der er aftalt et tidspunkt, skal det overholdes.

Ved rettidig toggang vil en frigivning af broen selvfølgelig foregå i et togfri interval, og derfor ikke give problemer. Er der ikke rettidig toggang, planlægges efter aktuelt kendskab til togenes køretider.

De aftalte tider skal overholdes - også ved forsinkelser/lyderligere forsinkelser af tog. I værste fald, må togene vente.

Hvis der opstår togforsinkelse, der udløser en hændelse, kan kode 900 i RDS bruges.

Når gennemsejlingsperioden er aftalt, taler brovagten med skibet og Vejbroen over VHF. Herefter planlægges skibets fart og broernes åbning således, at gennemsejlingen kan ske "uhindret" i et forløb gennem begge broer.

Kontakt med skib

Brovagten skal besvare eventuelle opkald fra skibe via fastnet telefon eller VHF-radioen, og han vil i fornødent omfang kunne kontakte skibene over VHF.

VHF radioen skal være tændt i vagtperioden på kanal 16. Samtaler føres på kanal 12 eller 13.

Skibe uden radioforbindelse skal afgive signaler i en afstand fra broen af mindst 600 m ved anvendelse af følgende signal:

1. Om dagen: Det internationale signalfalg N (eller i mangel heraf, nationalflaget) hejst på halv fortop og en lang og en kort tone (_____) med fløjte eller tågehorn.

2. Om natten: Et hvidt lys for boven og en lang og en kort tone med fløjte eller tågehorn.

Signaler om gennemsejling:

En af følgende signalkombinationer fra de på broen anbragte signallanter skal stilles af brovagten:

- 1 rødt lys, der betyder, at passage er forbudt*
- 2 røde blinkende lys, der betyder, at broen vil blive åbnet for skibe kommende fra øst*
- 2 faste røde lys, der betyder, at skibe fra øst kan passere*
- 3 røde blinkende lys, der betyder, at broen vil blive åbnet for skibe kommende fra vest*

• 3 faste røde lys, der betyder, at skibe fra vest kan passere
Ved at give et kraftigt lydsignal (_____) tilkendes det, at broen trods det afgivne signal for gennemsejling ikke kan passeres. Signalet for gennemsejling stryges, og der sættes et rødt lys.

Indtil passagesignalet modtages, skal skibet så vidt muligt holde sig i en afstand af mindst 100 m fra broen.

7.2 Order on navigation through specific bridges in Danish waters

Excerpts of the notice (in Danish):

Regler for gennemsejling

§ 4. Skibe og fartøjer, jf. dog stk. 4, kan vederlagsfrit forlange broen åbnet for gennemsejling inden for broens normale åbningstid. Da muligheden for at åbne broen for gennemsejling er afhængig af den stedlige jernbane- eller vejtrafik, kan der for den enkelte bro være fastsat særlige perioder, inden for hvilke broen kan åbnes.

Stk. 2. Gennemsejling af broer kan sædvanligvis finde sted uden for broens normale åbningstid, såfremt der inden for denne åbningstid er truffet aftale med brovagten om gennemsejling på et nærmere angivet tidspunkt. For en sådan gennemsejling kan der være fastsat en særlig afgift.

Stk. 3. Åbningstider for en bro samt andre særlige bestemmelser vedrørende gennemsejling af broen og sejladsikkerheden i broområdet kan fastsættes eller ændres efter samråd med Søfartsstyrelsen. De således fastsatte eller ændrede åbningstider eller særlige bestemmelser vil efterfølgende blive bekendtgjort i »Efterretninger for Søfarende« og vil ved først kommende lejlighed blive optaget i de relevante sejlads håndbøger. Eventuelle rettelser til søkortene som følge af sådanne ændringer meddeles i »Søkortrettelser«. Ændringer eller nye bestemmelser, der er fastsat i løbet af et kalenderår og bekendtgjort i »Efterretninger for Søfarende«, vil blive gentaget i førstkommande »Efterretninger for Søfarende«, nr. 1.

Stk. 4. Skibe og fartøjer, der kan passere den lukkede bro, eksempelvis ved at lægge masten ned, kan ikke forlange broen åbnet.

Brovagtens beføjelser

§ 5. Når hensynet til trafikken kræver det, kan brovagten nægte skibe gennemsejling. Brovagten kan endvidere tilbageholde et fritidsfartøj i indtil 30 minutter eller arrangere fælles gennemsejling for fritidsfartøjer på særlige fastsatte tidspunkter.

Stk. 2. Brovagten kan endvidere nægte skibe gennemsejling, når den efter brovagtens skøn vil kunne medføre fare for broens sikkerhed. I tvivlstilfælde kan brovagten forud forhandle med det stedlige lodseri.

Stk. 3. Inden for en afstand af 250 m fra broen skal skibe og fartøjer rette sig efter de anvisninger, som brovagten giver.

Stk. 4. Kommer et skib i drift, således at der er fare for, at det påsejler broen eller dennes beskyttelsesværker, skal skibets fører så vidt muligt efterkomme de anvisninger, der gives af brovagten for at undgå beskadigelse af broen.

Signaler fra skib

§ 6. Alle skibe og fartøjer, der ønsker at passere broen, skal tilkendegive dette ved i en afstand fra broen af mindst 0,5 sømil at afgive følgende signal:

- 1) Om dagen: Det internationale signalflag N - eller i mangel heraf nationalflaget - hejst på halv fortop samt en lang og en kort tone med fløjte eller tågehorn.
- 2) Om natten: Et hvidt lys for boven samt en lang og en kort tone med fløjte eller tågehorn.

Signaler fra bro

§ 7. Når et skib eller fartøj viser eller har givet signal for at tilkendegive, at broen ønskes åbnet, vil der fra broens signalmast blive afgivet følgende svarsignal såvel om dagen som om natten:

- 1) 1 rødt, fast lys, der betyder, at gennemsejling er forbudt.
- 2) 2 røde, blinkende lys, der betyder, at broen vil blive åbnet for et skib, der kommer fra N eller Ø. Passage må ikke finde sted, før signalet under punkt 3 afgives.
- 3) 2 røde, faste lys, der betyder, at et skib, der kommer fra N eller Ø, kan passere broen.
- 4) 3 røde, blinkende lys, der betyder, at broen vil blive åbnet for et skib, der kommer fra S eller V. Passage må ikke finde sted, før signalet under punkt 5 afgives.
- 5) 3 røde, faste lys, der betyder, at et skib, der kommer fra S eller V, kan passere broen.

Stk. 2. Såvel om dagen som om natten vil et kraftigt lydsignal, en lang tone, tilkendegive, at broen trods det afgivne signal for gennemsejling ikke kan åbnes. Hvis forholdene tillader det, vil signalet for gennemsejling også blive slukket.

Stk. 3. Indtil gennemsejlingssignalet modtages, skal et skib eller fartøj holde sig i en sikker afstand fra broen, således at risiko for påsejling af broen ikke opstår.

Stk. 4. Der kan ved enkelte broer være fastsat særlige bestemmelser for passage af sejlførende skibe, samt for fritidsfartøjer, der, såfremt de kommer fra hver sin side af broen, kan tillades at passere denne samtidigt og på eget ansvar. Sådanne særlige bestemmelser fremgår af sejladshåndbøgerne.

Passageregler

§ 8. Broåbningen må kun passeres af eet skib ad gangen, jf. dog § 7, stk. 4.

Stk. 2. Ethvert skib, der skal passere broen, skal have et anker klar til at falde. Der skal endvidere være truffet alle fornødne foranstaltninger til at undgå påsejling af broen som følge af ankre, rigning, udenbordsfartøjer, davider m.v.

Stk. 3. Såfremt flere skibe samtidigt vil komme til at passere broen fra samme side, skal sejlskibe have fortrinsret for maskindrevne skibe.

Stk. 4. Alle fritidsfartøjer, der er udstyret med motor, skal benytte denne under passage af broen.

Stk. 5. Inden for en afstand af 250 m på hver side af broen må skibe kun sejle med den for bevarelse af skibets manøvreevne nødvendige fart.

7.3 The Danish harbour Pilot Den danske Havnelods

Excerpts (in Danish):

5.3. Signaler fra bro

5.3.1. Når et skib viser eller har givet signal for at tilkendegive, at broen ønskes åbnet, vil der fra broens signalmast blive afgivet følgende svarsignal såvel om dagen som om natten:

1) 1 rødt, fast lys, der betyder, at gennemsejling er forbudt.

2) 2 røde, blinkende lys, der betyder, at broen vil blive åbnet for et skib kommende fra øst. Passage må ikke finde sted, før signalet under punkt 3 afgives.

3) 2 røde, faste lys, der betyder, at et skib kommende fra øst kan passere broen.

4) 3 røde, blinkende lys, der betyder, at broen vil blive åbnet for et skib kommende fra vest. Passage må ikke finde sted, før signalet under punkt 5 afgives.

5) 3 røde, faste lys, der betyder, at et skib kommende fra vest kan passere broen.

5.3.2. Såvel om dagen som om natten vil et kraftigt lydssignal, en lang tone, tilkendegive, at broen trods det afgivne signal for gennemsejling ikke kan åbnes. Hvis forholdene tillader det, vil signalet for gennemsejling også blive slukket.

5.3.3. Indtil gennemsejlingssignalet modtages, skal skibe holde sig i en afstand af mindst 100 m fra broen, således at risiko for påsejling af broen ikke opstår.

5.4. Passageregler

5.4.1. Broåbningen må kun passeres af ét erhvervsskib ad gangen.

5.4.2. Skibe med en længde over 53 m (l.o.a.) må kun passere broen under vejledning af en lods. Lodseriet meddeler i hvert tilfælde brovagten, hvorvidt vejr- og strømforholdene efter lodseriets skøn tillader passage. Brovagten afgør herefter, om tilladelse til gennemsejling skal gives.

5.4.3. Ethvert skib, der skal passere broen, skal have et anker klar til at falde. Der skal endvidere være truffet alle fornødne foranstaltninger til at undgå påsejling af broen som følge af ankre, rigning, udenbordsfartøjer, davider mv.

5.4.4. Inden for en afstand af 200 m på hver side af broen må skibe kun sejle med den for bevarelse af skibets manøvreevne nødvendige fart. Maskindrevne skibe må kun passere broen med hovedmaskineriet klar til øjeblikkelig brug eller med behørig bugserassistance.

7.4 Admiralty Sailing Directions

Excerpts of the Admiralty Sailing Directions, Baltic Pilot Volume I:

5.152

- 2 *Mooring to bridge or works, and landing at the bridge, is prohibited.*

Within 100 meters of the Limfjordsbridge, and within 200 meters of the Railway Bridge, vessels must proceed at minimum manoeuvring speed.

Within 200 meters of the bridges, anchoring is prohibited except in an emergency, and the vessel must act under the orders of the uniformed bridgemaster.

- 3 *Vessels which can pass the bridges by lowering the mast, or whose masts are of such a height that they can pass beneath the bridges, cannot demand that they be opened.*

Until the passage signal is received, a vessel must keep at least 100 meters from either bridge.

5.156

- 1 *These signals will be answered from a mast on either bridge by one of the sets of lights.*