MAIB

MARINE ACCIDENT INVESTIGATION BRANCH

TIMBER DECK CARGO STUDY

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Extract from

The Merchant Shipping

(Accident Reporting and Investigation)

Regulations 1999

The fundamental purpose of investigating an accident under these Regulations is to determine its circumstances and the cause with the aim of improving the safety of life at sea and the avoidance of accidents in the future. It is not the purpose to apportion liability, nor, except so far as is necessary to achieve the fundamental purpose, to apportion blame

Note

This report is not written with liability in mind and is not intended to be used in court for the purpose of litigation. It endeavours to identify and analyse the relevant safety issues pertaining to the specific accident, and to make recommendations aimed at preventing similar accidents in the future.

Front cover photographs reproduced courtesy of Mike Welsford

CONTENTS

GLOSSARY OF ABBREVIATIONS AND TERMS

Abbreviations

IMO - International Maritime Organization

Terms

Cherrypicker - A hoistable platform

Hog wires - Wires which are attached between port and starboard uprights

Lumber - Sawn timber

Racking - The tendency of a rectangular section of timber deck cargo for instance to distort into a rhomboid under the influence of a disturbing force

Timber rails - Steel structures which are erected at deck edges to support and secure timber deck cargoes

Uprights - Supports which are rigged along the deck edges to help prevent a timber deck cargo shifting transversely

SECTION 1 – INTRODUCTION

1.1 Background

A number of marine accidents involving timber deck cargoes have been reported to the MAIB since the branch was set up in 1989. These accidents did not give cause for particular concern until 2002, when several occurred in quick succession. A trend appeared to be developing and a study into the subject was initiated.

1.2 Cases examined

Eight accidents that involved timber deck cargoes, and which came to the attention of the MAIB in the years 2001 and 2002, have been examined and a short summary of each is contained in Section 2. All the cases involved vessels loaded with sawn timber travelling from a Baltic or north Russian port. The vessels were destined for ports in Great Britain or Ireland, or were passing Britain en route to the Mediterranean. All of the accidents occurred in heavy weather and most during the autumn. Each case involved a transverse shift of the timber deck cargo; there is no evidence that longitudinal movement of timber cargo posed a problem.

In Section 3, the common causal factors and safety issues are identified, analysed and discussed.

The conclusions and recommendations arising from the study are included in Section 4.

SECTION 2 – CASES

CASE 1

Shifted cargo leads to a serious head injury

A vessel, 77m in length, loaded a cargo of sawn timber in Estonia. Her crew did not supervise the stevedores who undertook this work.

The vessel endured very bad weather on passage to the UK, and the master had to seek a sheltered anchorage on four occasions. The voyage took about 2 weeks and, while in the heavy weather, the cargo shifted transversely about a metre, such that timber packages on the port side were overhanging the hatch cover **(Figure 1)**. The crew positioned wooden props under the packages to try to stabilise them.

The vessel eventually reached a Scottish port and berthed port side to **(Figure 2)**. In the early hours of the morning, the crew began preparing the cargo for unloading. All the lashings had been removed **(Figure 3)** and, while the tarpaulins were being taken off, a section of cargo at the aft end on the port side collapsed **(Figure 4)**. While rolling up a tarpaulin at this position, a crew member fell over the side, along with the planks from the broken packages. He hit his head on the dockside, before falling into the water.

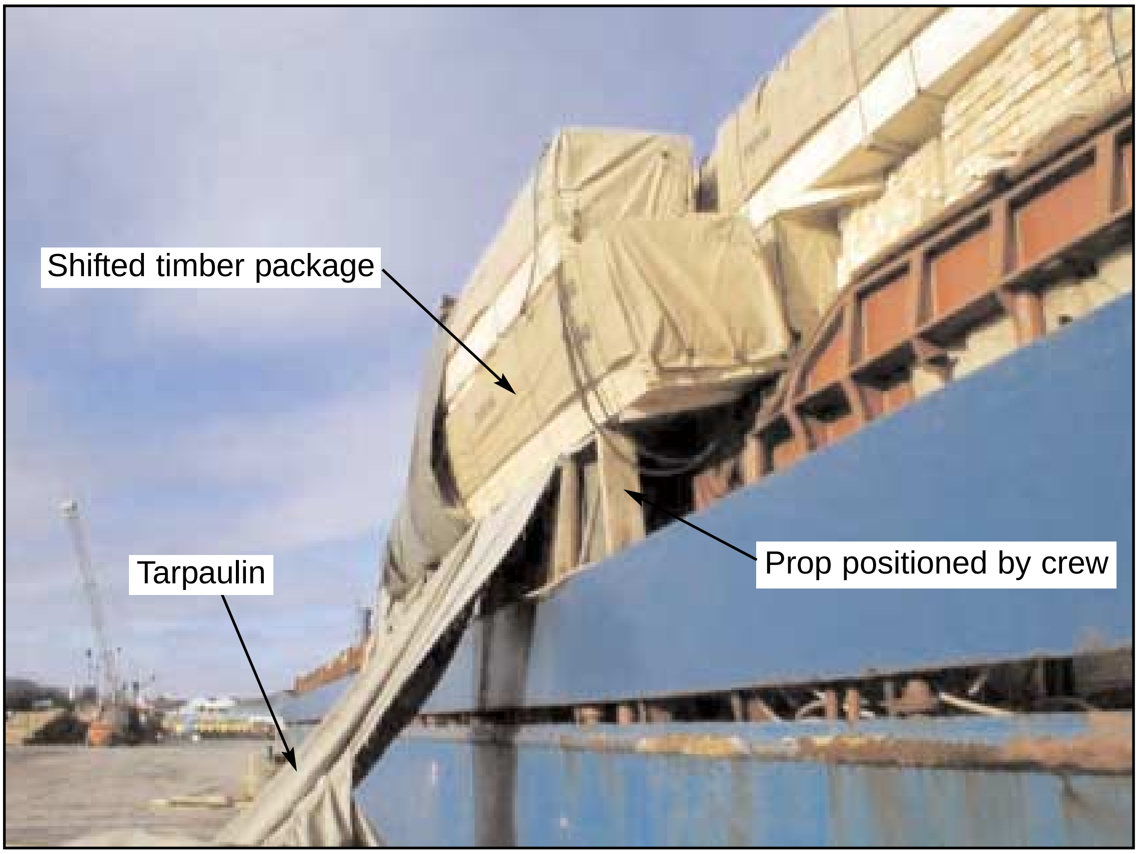
Other crew members who had been working on top of the cargo, heard the packages collapse and noticed that their colleague who had been there had disappeared. He was located in the water between the vessel and the dockside shortly afterwards. A ladder was lowered, and another crew member climbed down and put a rope around the unconscious casualty. He had sustained a very severe head injury, so was lifted up on to the dockside where attempts were made to resuscitate him. He was taken to hospital, where he was examined and treated. He was not expected to survive but, despite remaining in a coma for some time, eventually he did regain consciousness. He subsequently made a full recovery.

The packages of timber each consisted of a bundle of planks on square section timber bearers. Steel bands ran around the planks and the bearers to hold each of the packages together **(Figure 5)**. The packages collapsed when the steel bands broke.

No dunnage was placed under the packages, so the weight was taken on the steel bands underneath the bearers. The poor friction between the deck cargo and the top of the hatch covers was a factor in this accident. There is very little friction between steel surfaces especially when wet.

Lashings, which ran up and over the rectangular stow, were secured to points on the port and starboard main deck edges. The lashings provided downward force, but did not prevent initial sideways movement.

Figure 1



Looking forward on port side

Figure 2

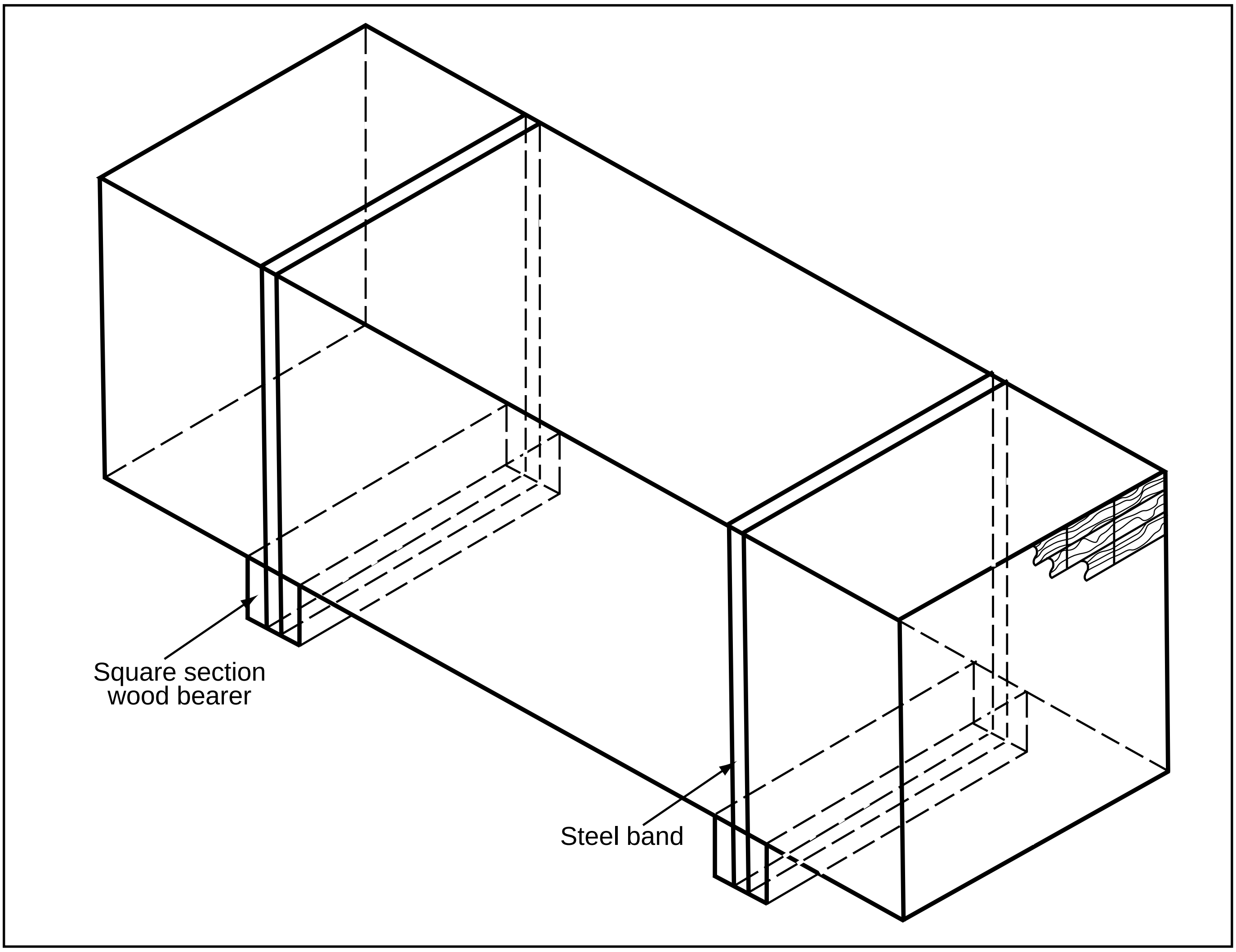
Figure 3

Looking onto deck cargo from wheelhouse

Figure 4

Collapsed timber packages

Figure 5



Timber package

The Lessons

1. **The friction between a timber deck cargo should be maximised, and steel-on-steel interfaces should be avoided if possible. A vessel's crew should always take a close interest in the loading of deck cargo, and should ensure that it is carried out satisfactorily. In this case, dunnage should have been positioned under the packages to create a higher friction wood-on-steel interface with plenty of contact area.**

2. **If a timber deck cargo shifts at sea, it should be unloaded with extreme caution when in port. If possible, the crew should avoid standing on the stow, and the use of cherrypickers should be considered for releasing the lashings and removing the tarpaulins. If crew are sent out on top of the cargo they should wear lifelines.**

3. **A fore and aft angle or flat bar welded to the edges of the hatch covers, would have helped prevent the athwartships movement of the stow on board this vessel. This would have improved her deck cargo stowage.**

CASE 2

Preventing transverse shift

A vessel, 82m in length, loaded a cargo of sawn timber in Latvia. She was not a regular timber carrier. The planks were bundled into packages, which were stacked in three tiers on top of the aft part of the hatch cover. The deck cargo did not overhang the hatch cover when loaded. When all the packages were on board, the deck cargo was covered with tarpaulins and lashed down. Fabric webbing lashings, which ran up and over the timber packages, were attached to securing points on the deck **(Figure 6)**, and tensioned using tensioning devices.

Figure 6

Looking aft on port side

While on passage across the North Sea, heavy weather was encountered. A large wave struck the vessel's starboard side. This shifted the deck cargo and resulted in a port list of about 10°. The timber packages shifted such that they were overhanging the hatch cover on the port side **(Figure 7)** and were set in on the starboard side **(Figure 8)**.

Deck cargo overhanging
hatch cover on port side

Figure 7

Figure 8

Cargo set in from hatch cover
edge on starboard side

The vessel was hove to, and water ballast was added to the starboard side to reduce the list. Once the situation had been stabilised, the master resumed the passage to a Scottish port. This was reached without further incident.

None of the deck cargo was lost overboard. After the cargo shift, the lashings were under greater tension and were rubbing against the relatively sharp edge of the hatch cover **(Figure 9)**. As a result, by the time the vessel arrived in port, some of the lashings had parted **(Figure 10)**.

The lashings were tightened daily, except for the day when the shift occurred. It was considered too dangerous to go out on to the open deck during the heavy weather on that day.

The vessel's cargo securing manual included a section on timber deck cargoes, which consisted of a copy of the IMO Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 1991. There was no specific information for this vessel regarding carrying timber on the hatch cover. The lashings used were not certificated, as required by the IMO Code. Some were relatively flimsy, and were attached to the stiffeners on the hatch coamings **(Figure 11)**.

Figure 9

Lashing bent over a relatively
sharp hatch cover edge

Figure 10

Figure 11

The Lessons

1. **Fabric webbing lashings stretch more than steel wire rope, so daily tensioning is especially necessary. It is often extremely dangerous to venture on to the open deck of a vessel during heavy weather. In such circumstances, therefore, a crew can be forgiven for missing a routine. However, in these conditions, tightening is most necessary because the movement of the vessel is generally greater, and more load is put on the lashings; causing them to stretch more.**

2. **Up-and-over lashings of this type do not adequately prevent sideways movement. They provided downward force on the deck cargo and this, in association with the friction between the timber packages and the top of the hatch cover, was all that was preventing transverse shift. An angle bar, or flat bar welded to the edge of the hatch cover, or steel uprights slotted into sockets attached to the hatch coamings, would have helped to prevent transverse shift. Alternatively wooden uprights, positioned along the hatch coamings, and connected port to starboard with hog wires, would restrict sideways movement, if no suitable permanent fittings were available.**

3. **Some vessels carry timber deck cargoes only rarely. These vessels should still carry adequate equipment and information. The lashings provided should be properly certificated, and the cargo securing manual should contain specific information for the vessel, so that the master is armed with the best advice to carry the cargo safely. Such advice should include the number of lashings which should be used, and the method of restricting sideways movement.**

CASE 3

Upright supports

A vessel, 97m in length, loaded a cargo of sawn timber in Russia. The planks were bundled into packages which were stacked in tiers on top of the hatch covers. When all the packages were on board, the deck cargo was covered with tarpaulins and lashed down. Turnbuckles were used to tension the lashings, and senhouse slips were incorporated in the system **(Figure 12)**. The deck cargo was stacked relatively high **(Figure 13)**, and uprights, consisting of logs held in position by ropes tied around and between their tops, were used to help secure the stow **(Figure 14 & 15)**.

While on passage to Northern Ireland during the autumn, the vessel encountered heavy weather to the west of the Orkneys. A large wave hit the vessel on the port side and shifted the deck cargo on Nos. 2 & 3 hatch covers **(Figure 16)**, causing a starboard list of about 35°. To save the vessel, the crew released the senhouse slips **(Figure 17)** in the lashings over No. 3 hatch. Most of the timber on this hatch cover then fell over the side, as the vessel rolled, and the uprights on the starboard side aft went over with it **(Figure 18)**.

Subsequently, the vessel reached port safely.

Figure 12

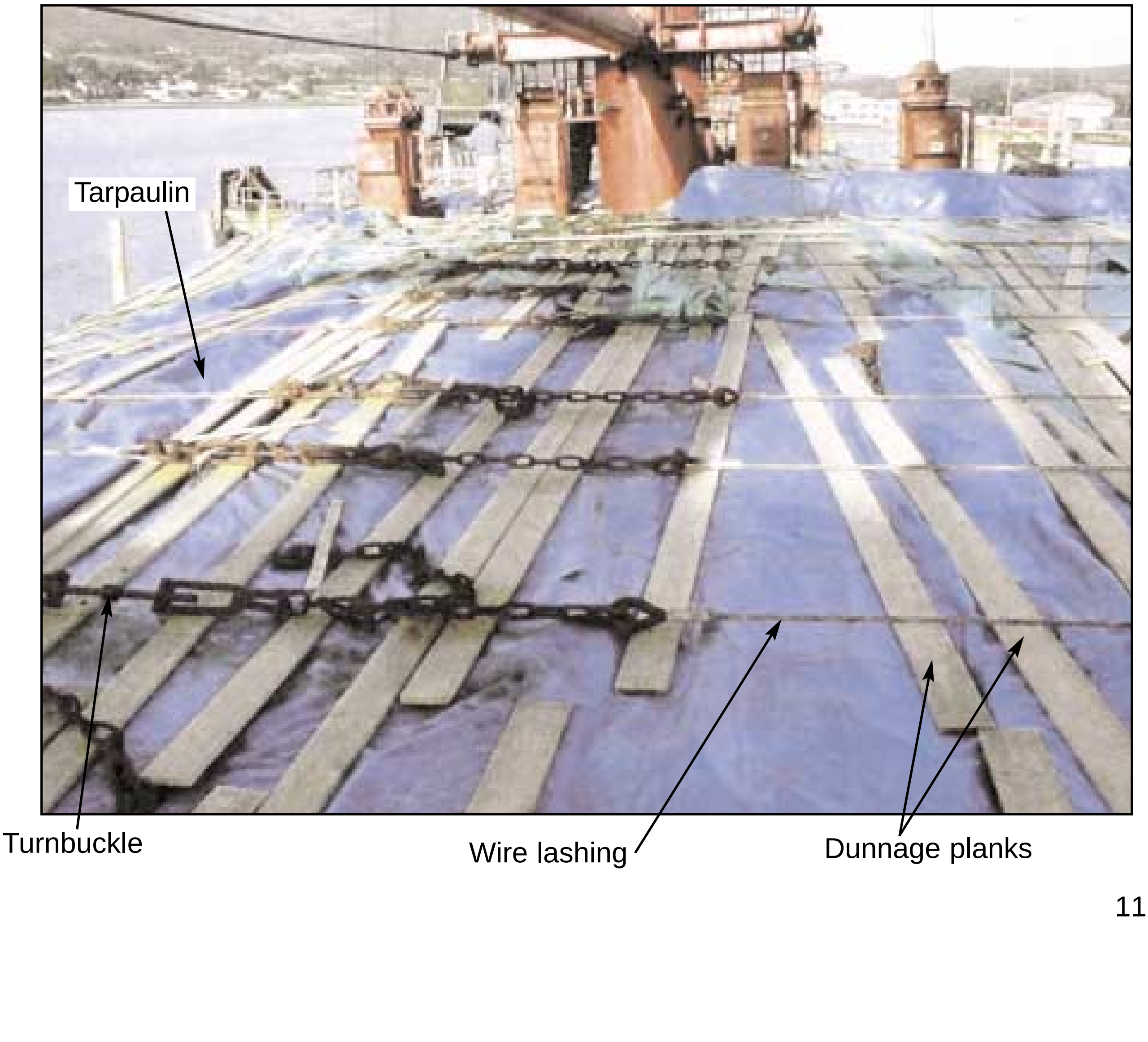


Figure 13

Figure 14

Looking forward on starboard side

Figure 15

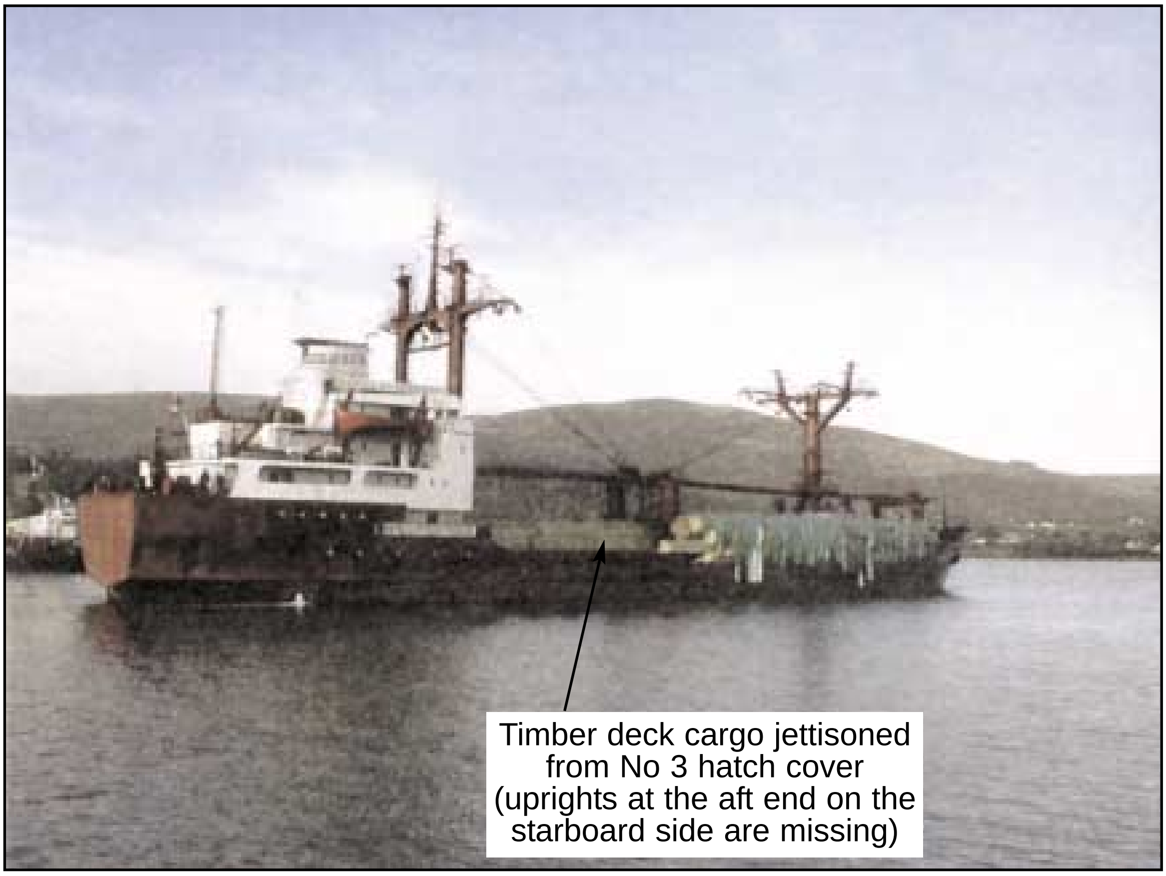
Looking forward on port side

Figure 16

Looking forward on starboard side

Figure 17

Figure 18



The Lessons

1. **Uprights on many timber carriers consist of steel stanchions firmly fitted into sockets welded to the deck. The logs used on this vessel were not fitted into sockets, and the rope used to tie them together did not provide a secure arrangement. Had the uprights been connected with hog wires running in between the tiers of the cargo, the stow would have been much more secure. Hog wires positioned in this way are held in place by the weight of the cargo in the tiers above.**

2. **Lashings, which run from securing points at the main deck edges, and then up and over the cargo, do not provide a good arrangement in restricting transverse shift. Also, it is not good for preventing racking, especially when the cargo is relatively high, as was the case here. Uprights, connected by hog wires in association with this lashing arrangement, will provide a stow that is much more secure.**

3. **The crew who went out on to the open deck in heavy weather to release the deck cargo on No. 3 hatch put their lives in danger. A remotely operated jettisoning system would have avoided this.**

CASE 4

Hog wires

A general cargo vessel, 132m in length **(Figure 19)**, was loaded with 10,000m^3 of timber packages at a Swedish port, about one third of which was stowed on deck. Uprights were rigged on the port and starboard sides, but hog wires were not run between them.

The vessel encountered a severe gale and high seas while on passage in the English Channel on a winter's evening. Proceeding directly into the wind and sea caused her to pound. This made it unsafe for her crew to check and tighten the wire lashings securing the deck cargo.

Although speed was reduced from 12 knots to 8 knots, large quantities of water were shipped on to the deck cargo. About 2 hours after darkness had fallen, loud bangs were heard from the cargo deck as two of the wooden uprights **(Figure 20)**, used to help secure the stow, were broken. The master realised the deck cargo had started to shift, and altered course to port to close the French coast; the nearest place of safety. Speed was also increased to 12 knots. On the new course, the sea was about 35° on the starboard bow, and the vessel started to roll more heavily. About 20 minutes later, the vessel rolled heavily to port, which caused the deck cargo to shift about 0.5m across the deck and break all of the remaining uprights on the port side. The vessel immediately listed to between 10° and 15° to port.

Speed was reduced to 8 knots, and course was altered very slowly to put the sea on the port side to try and shift the cargo back to starboard. As the vessel's motion was more comfortable on this heading, speed was again increased to 12 knots to close the English coast. Two tanks on the starboard side were then ballasted but, although this reduced the vessel's roll, her list continued to increase.

Several hours later, the vessel experienced a total electrical failure, and the main engine stopped. Soon after, an attempt was made to jettison some of the deck cargo but, although the crew managed to cut the after-most wire lashing, the cargo did not move. As the next lashing wire could only be reached by moving along the edge of the bulwark outside the cargo stow, the cutting of further wire lashings was considered to be too dangerous. The chief engineer then succeeded in restarting one of the vessel's main generators, which ran for less than 2 hours. During this time, however, the main engine could not be restarted because its fuel boost pumps had been saturated by water from a damaged pipe.

After being informed that there was little prospect of either electrical power or propulsion being restored, and as the list had increased to about 40°, the master requested assistance. The crew were evacuated by helicopter and taken to safety. The abandoned vessel grounded about 12 hours later. About 70% of her timber deck cargo was lost overboard and swept up on to nearby beaches. Subsequently, the vessel was salvaged.

Photograph courtesy of FotoFlite

Figure 19

Vessel shown without deck cargo

Figure 20

Looking aft on starboard side after salvage (the deck cargo was stowed similarly on the port side)

The Lessons

1. **The use of uprights, by vessels carrying packaged timber deck cargoes, has decreased in recent years; indeed many modern vessels have no provision to have them fitted. When uprights are used, however, the support they provide is considerably increased when hog wires are also rigged.**

2. **It is no coincidence that nearly all timber cargo shifts occur during bad weather. In such conditions, a deck cargo can be hit with great force by considerable amounts of water taken over the bow. Large quantities of water can get under tarpaulin covers and among the cargo, and pounding and rolling can generate tremendous loading on the cargo and its lashings. Obviously, bad weather should be avoided if at all possible, even if this means deviating from the passage plan and sheltering for several hours. When this is not an option, each course and speed alteration must be carefully judged, bearing in mind the vulnerability of the deck cargo. As the relevant IMO Code of Practice advises:**

    > ***In cases where severe weather and sea conditions are unavoidable, masters should be conscious of the need to reduce speed and/or alter course at an early stage in order to minimise the forces imposed on the cargo, structure and lashings. The lashings are not designed to provide means of securing against imprudent shiphandling in heavy weather.***

3. **During the course of a voyage, vibration causes a timber deck cargo to settle. This results in its lashings loosening, leaving little else but the timber's own weight to keep it in place. This problem is usually overcome by checking, and if necessary tightening, the lashings on at least a daily basis when on passage. However, when the seas are rough and a cargo shift is most likely to occur, this is not always possible. It certainly cannot be done safely unless guard wires or lifelines are rigged to provide safe access to tightening devices.**

4. **Jettisoning a timber deck cargo can be extremely dangerous, even when slip hooks are fitted on each wire lashing. Usually, someone is required to stand on the cargo which is to be jettisoned; this is like sawing off a branch while sitting on it! A remote device is the only safe way of jettisoning a timber deck cargo.**

5. **Ships' machinery is generally designed to operate up to an angle of heel of 22.5°. It should not be relied on thereafter.**

CASE 5

Remote jettisoning

A vessel, 132m in length, loaded a cargo of sawn timber in Sweden. Some of the packages were stowed on top of the hatch covers and were covered with tarpaulins and lashed down. During the passage, the lashings were tightened regularly.

The voyage to the Mediterranean was uneventful until the vessel encountered heavy weather in the English Channel. When the wind reached force 9 the vessel was hove to. In the early part of the autumn evening, a large wave struck the vessel. This shifted the timber deck cargo, resulting in a port list of about 20°.

The master decided to seek shelter, and headed for Torbay on the south coast of England. The wind was on the port quarter while on this course, and the vessel was rolling between 10° to starboard and 35° to port.

About 30 minutes after heading for shelter, the chief engineer informed the master that the ship was about to lose power, because the single ready-use fuel tank was contaminated with seawater. The water had downflooded through the tank vent when it dipped below the waterline, because of the list and the rolling. When the power failed, the vessel drifted so that the starboard beam faced the wind, and the port heel was at times 40° to 50°.

The master decided to jettison some cargo in an attempt to reduce the list. Some of the crew went out on to the open deck to try to achieve this. Conditions were hazardous, with no deck lights and gale force winds. Two of the lashings for the cargo on the hatch nearest to the superstructure were undone, and the other eleven were cut with an axe. This released about 1600m^3 of timber, which reduced the list. About 30 minutes later, power was restored and the vessel subsequently reached Torbay. The ballast system would not work at this large angle of list, so more of the deck cargo was jettisoned in Torbay **(Figures 21 and 22)**, until she was more or less upright.

When the weather improved, the vessel sailed for Falmouth, where the remaining deck cargo was removed and restowed.

The Lessons

1. **The crew who went out on to the open deck put themselves in a very dangerous situation to release some of the deck cargo. However, this action probably saved the vessel and was, therefore, justified. A remotely operated jettisoning system would have been a much safer way of dealing with the problem.**

2. **If timber is carried on the hatch covers, there is a danger of it shifting in heavy weather, and causing a large angle of list. This means that downflooding of fuel tank vent pipes is possible unless they are in protected positions. If power is lost, and the vessel goes beam on to the weather with a shifted deck cargo, as was the case here, the crew is in great danger.**

Figure 21

Jettisoned timber packages

Figure 22

Photographs 21 and 22 reproduced courtesy of Mike Welsford

CASE 6

Failed timber rail

A vessel, 85m in length, loaded a cargo of sawn timber in Sweden. Initially the passage to the UK was uneventful, but when south of Cornwall she encountered heavy weather. After rounding Lands End, the vessel was hit by a large wave on the port side. Initially, she heeled about 35° to starboard before coming back to about 25°. The master turned on the deck lights and saw that the timber deck cargo had shifted about a metre to starboard at the forward end. He called the coastguard to inform them of the problem, and then turned the vessel into the wind to minimise the motion. Once hove to, ballast water was added to reduce the list to about 10°.

A search-and-rescue helicopter flew out to the scene and some of the crew were airlifted off as a precaution, leaving the master, mate and engineer on board. The vessel remained hoved to all night. The next day, the situation was assessed. The master considered it safe to proceed to port, so they started making way, escorted by an MCA emergency towing vessel. They reached port safely.

Lashings were secured to points at the port and starboard main deck edges. They were then run up and over the rectangular cargo stow. The lashings provided downward force, but initially did not prevent sideways movement. None of the lashings failed, and no cargo was lost during the voyage.

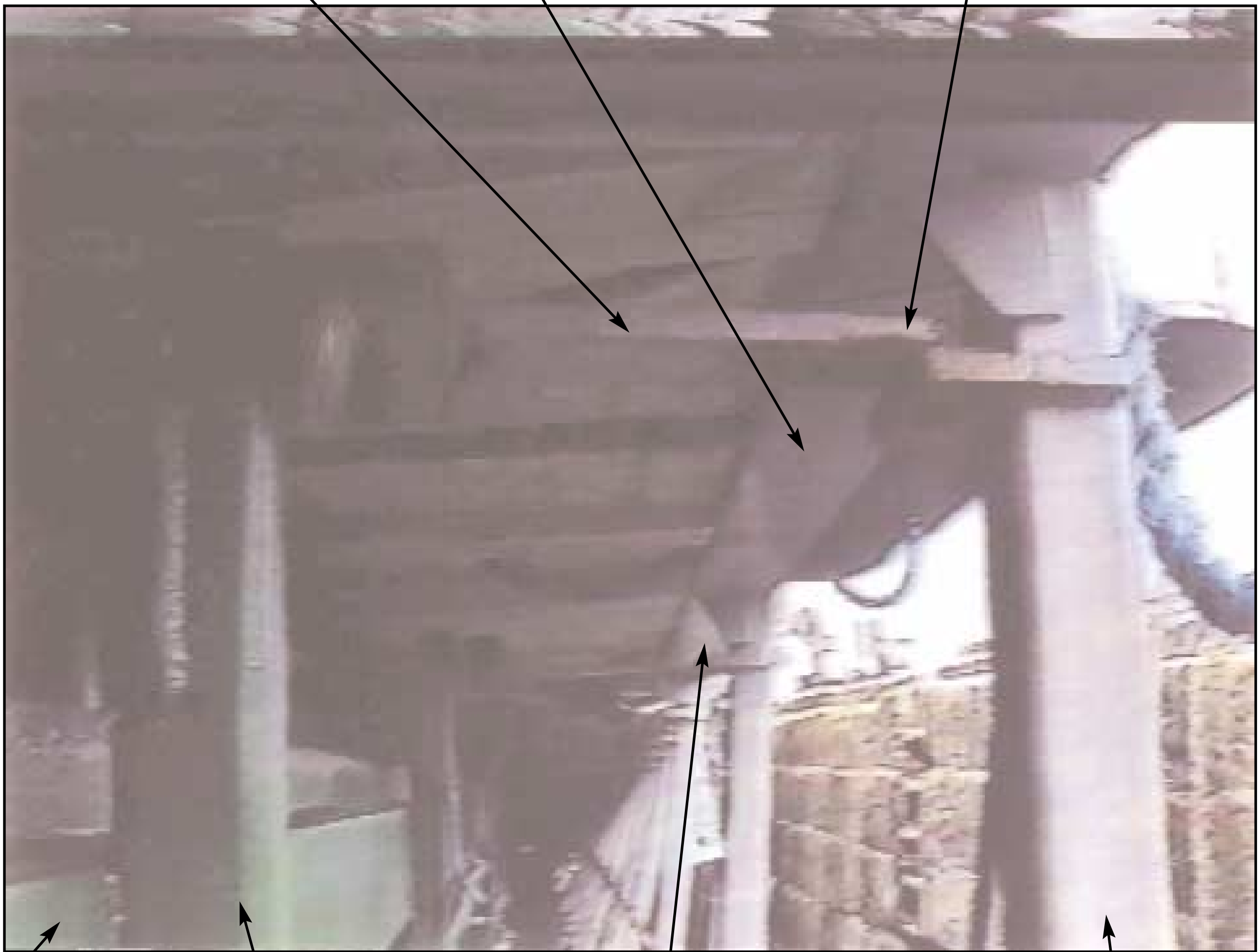
The main cause of the accident was found to be a failed starboard timber rail. The timber rail was a steel framework, consisting of outer stanchions along the main deck edge, and short inner stanchions attached to the sides of the hatch coamings. The stanchions were connected with tie bars **(Figure 23)**. A horizontal angle bar was welded to the tops of the outer stanchions, to tie the framework together and stop the cargo shifting outboard.

When the wave hit, the cargo probably moved slightly, and the tie bars failed, allowing the deck cargo to move further. There were no structural calculations for the timber rails, and the strength of those frameworks was not properly verified.

Timber rails also feature in Case 7 of this study, but in that case the rail did not fail. The photograph with Case 7, clearly shows how the angle bar prevents the transverse movement of the deck cargo.

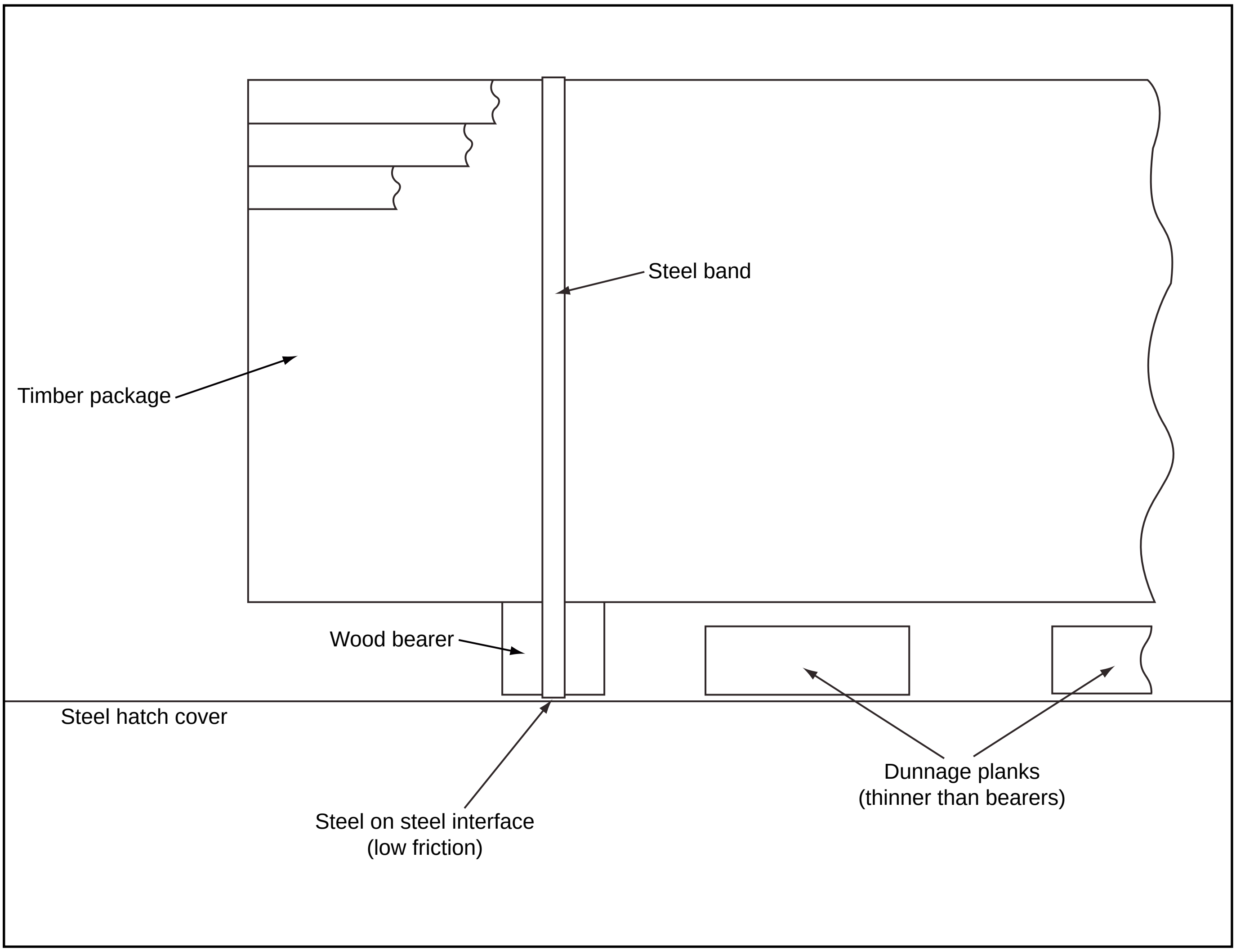
The timber packages were similar to those described in Case 1 **(Figure 5)**. The bundle of planks sat on two square section timber bearers. Steel bands ran around both the bundle and the bearers to hold the packages together. Dunnage planks were placed under these packages but, because they were not as deep as the bearers, the packages were effectively sitting on the steel bands **(Figure 24)**. There is very little friction between steel surfaces, especially when wet. The poor friction between the cargo and the top of the hatch covers was a factor in the accident.

Figure 23



Looking forward at main deck level on the starboard side

Figure 24



The Lessons

1. **If timber rails are fitted, they should have adequate strength. Detailed structural calculations should have been made to ensure they were strong enough, and this should have been verified by a classification society.**

2. **The friction between timber deck cargoes and the hatch covers should be maximised. In particular, steel on steel interfaces should be avoided, as the friction is very poor. Wood against steel is much better. Painting the tops of the hatch covers with high friction paint is good practice, especially if deck cargoes are to be carried.**

CASE 7

Slippery plastic covers

A vessel, 82m in length, loaded a cargo of sawn timber in Sweden. The planks were bundled into packages, which were stacked in two tiers on top of the hatch covers **(Figure 25)**. When all the packages were on board, the whole deck cargo was covered with tarpaulins and lashed down.

The vessel encountered a quartering swell while sailing across the North Sea on an autumn evening. She fell into a deep trough, which caused a large heel to port. When the vessel was heeled over, the upper tier of packages moved bodily to port. The shift resulted in an angle of list of about 10° to port, but none of the lashings parted. The vessel was turned, to put the weather on the bow, and the power was reduced. While hove to, ballast was added to the starboard side until she was more or less upright.

The passage was resumed, but when the vessel returned to her original course she encountered another heavy swell. The upper tier of the deck cargo moved bodily to starboard **(Figure 26)**, and a 20° angle of list to starboard resulted. A large wave carried away the vessel's lifeboat . The vessel was heaved to again, and the coastguard was called by radio to advise them of the problem. The starboard ballast water was pumped out and ballast was added to the port side to bring the vessel more or less upright again. The vessel remained hove to for the next two days until the weather improved. The remainder of the passage to Ireland was uneventful.

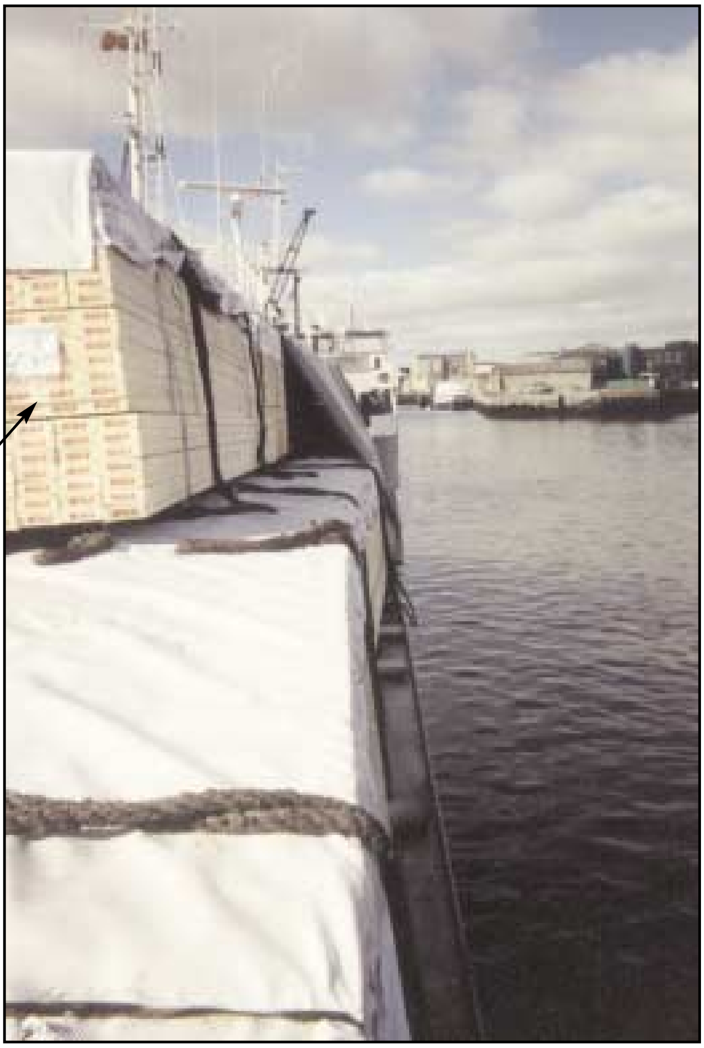
A waterproof covering was fitted over the upper part of each package **(Figure 25)**. These plastic sheets did not have a high friction coating, and became slippery when wet. The timber packages were similar to those described in Case 1 **(Figure 5)**. The bundle of planks sat on two square section timber bearers. Steel bands were run around the bundle of planks and the bearers to hold each package together. The bearers provided very little contact area and friction between the first and second tiers of the deck cargo**.** The lack of friction between the upper and lower tiers was the main cause of this accident.

The friction between the lower tier and the hatch covers might well have been poor, but the timber rail prevented this layer from moving transversely. The timber rail comprised a steel framework consisting of stanchions along the main deck **(Figure 27)**, which were connected to the sides of the hatch coamings with tie bars. An angle bar was welded to the tops of the stanchions. The timber deck cargo rested mainly on the hatch covers, but the outer parts rested on one surface of the angle bar. The upright part of the angle bar stopped the cargo shifting transversely **(Figure 28)**.

Figure 25

Looking aft on starboard side

Figure 26



Looking aft on port side

Figure 27

Figure 28

The Lessons

1. **A high friction coating should be incorporated into plastic covers used as described here.**

2. **If bearers are fitted under packages, dunnage should be used to increase the contact area between tiers.**

3. **If there is a shift of timber deck cargo which leaves the stow poorly secured and unstable, water ballast should only be added to reduce the list. If the vessel is ballasted upright, and the deck cargo then shifts the other way, a dangerous list may result because the moment causing list will then comprise the shifted deck cargo and the ballast water.**

CASE 8

Seek shelter at an early stage

A vessel, 80m in length, loaded a cargo of sawn timber in Sweden during the autumn. The timber packages were stacked in three tiers on top of the hatch covers. During the passage, the lashings over the deck cargo were checked daily and, if necessary, tightened. The master obtained regular weather forecasts as the voyage proceeded. When the vessel neared the UK, the weather worsened to such an extent that the master was forced to heave to.

While riding out the storm, the vessel was hit by a large wave and lurched heavily. This caused the lashings at the aft end of the stow to break and about ten packages of timber to fall over the side. Other packages also broke, leaving planks strewn across the deck. The lost cargo caused a port list, which was reduced when ballast water was pumped on board. The coastguard was informed and the master decided to seek the shelter of the Orkney Islands.

When the vessel reached a sheltered position, the crew went out on deck and secured the cargo as best they could. The Kirkwall lifeboat stood by in case one of the crew fell overboard. The master waited until the weather settled before resuming the voyage to Northern Ireland, which was reached without further incident.

The Lessons

1. **Although regular weather forecasts were obtained, with the benefit of hindsight, the master should have sought shelter earlier. It should be borne in mind that carrying a timber deck cargo makes a vessel more vulnerable in heavy weather.**

2. **The cargo was stowed fairly well, but some improvements could have been made using the information in the vessel's cargo securing manual.**

3. **The master was right to call the coastguard. He needed to advise them of the danger to his vessel, and to inform them about the hazard to shipping caused by the lost timber packages.**

SECTION 3 – ANALYSIS

3.1 COMMON CAUSAL FACTORS

All of the relevant incidents reported to the MAIB during 2001 and 2002 related to the shifting of packaged timber deck cargoes and, perhaps surprisingly, none concerned the carriage of logs. All of the incidents involved the consequences of transverse movement of cargo in heavy weather. In the large majority of cases, the initial movement was caused by waves hitting the stow, and this was exacerbated by the movement of the vessel in rough seas. In each of the cases, a failure in the methods of stowing and lashing the cargo was identified as contributory. These failures, and possible ways to alleviate the problems, are analysed further in the following subsections.

3.1.1 Friction

In most of these cases, inadequate friction between the timber deck cargo and the tops of the hatch covers was a feature of the accident. Hatch covers are made from steel, which with an ordinary paint coating, does not provide a non-slip surface, especially when wet. A proprietary high friction coating, applied to the tops of the hatch covers, would be of great benefit in reducing the risk of cargo shift. Alternatively, mixing sand with the paint, and applying this to these surfaces, would increase friction considerably.

A typical timber deck cargo consists of rectangular bundles of sawn timber planks, each with square section timber bearers. Each package - planks and bearers - is held together with steel bands. The steel bands under the bearers then form the packages' contact surface with the steel tops of the hatch covers. Steel-on-steel provides a very low level of friction, especially when wet, and should be avoided. One way to alleviate this problem is to place dunnage planks under the packages. These planks should be thicker than the bearers, to provide a wood-on-steel interface with a much higher coefficient of friction. Sufficient dunnage should be used to make the contact area large. Also, the planks should have rough unplaned surfaces, to maximise friction.

Some bearers incorporate a groove in the lower surface for the steel band to slot into. This avoids the steel band providing the contact surface, and their use is considered to be good practice. However, only a small contact area is provided by the bearers alone and so, once again, sufficient dunnage planks should be placed under the packages.

3.1.2 Up and over fabric lashings

Fabric webbing lashings were used in most of the cases examined. The ends of these lashings were fitted with steel rings and shackles, which were usually attached to securing points on the port and starboard deck edges. The lashings were then taken up and over the rectangular shaped stow to tensioning devices on top of the timber.

Sometimes, lashings were made from steel wire rope; these are probably better, as they stretch less than fabric. They do, however, have the disadvantage that they damage the timber at the corners of the stow. Securing points were usually D rings, padeyes or eyeplates welded to the deck.

All lashings should be checked daily and, if necessary, tightened while on passage. This is especially important for fabric lashings, which have a greater propensity to stretch than steel wire rope. However, this routine is often missed in heavy weather, when venturing out on top of the timber stow to carry out this function is considered too dangerous. As a vessel rolls and pitches in heavy weather, accelerations are imparted to the stow, and the lashings are subjected to the highest loads. The stretching of fabric lashings will be greater at such times. When lashings are stretched, their effectiveness is reduced and the risk of a shift is, therefore, increased. The vessel should be heaved to if it helps the crew to carry out this function safely.

If a timber deck cargo does shift, the lashings will tighten and, providing they don't break, will eventually arrest the shift. In most of the cases examined in this study, cargo shifted by about a metre before the arrest occurred. A shift results in an angle of list, which can be reduced by adding ballast water to the high side. However, a vessel should **not** be ballasted upright, because the lashings at this stage are doing very little to prevent a shift the other way. If a shift the other way occurs, the weight of the ballast water will increase the list; perhaps to dangerous proportions on that side.

The tendency for the deck cargo to slide will be reduced if a high friction coating is applied to the hatch covers. However, ideally, a timber rail, an angle or flat bar welded to the longitudinal edges of the hatch covers, or uprights secured with hog wires, should be fitted to restrict transverse movement.

3.1.3 Upright supports and hog wires

In some of the cases examined, log upright supports were positioned at the sides of the deck cargo. It is believed the stevedores used these to help ensure that the sides of the stow were fairly level i.e. they were used to help with the loading. Improperly secured log uprights will do little to prevent deck cargo shifting in heavy weather. Upright supports, which are rigged for the sole purpose of assisting loading, may give the master a false sense of security.

The use of upright supports is helpful, but they must be properly secured. Starboard side log uprights should be connected to port side uprights with hog wires, which are run between each layer of cargo. The weight of the cargo will help to hold the hog wires in place, and this arrangement will provide a rigid box structure, which has resistance to racking and transverse shift.

If steel upright supports, with suitable sockets along the sides of the vessel, are provided, the use of hog wires may be unnecessary, providing the uprights and sockets are of substantial construction. If any doubt exists about their strength, hog wires should be fitted. A little extra time spent ensuring a really secure deck stow could well pay dividends on passage, especially in the autumn months when gales are frequently encountered.

3.1.4 Remote jettisoning

A timber deck cargo, which has shifted badly during heavy weather, can put a vessel and crew in great danger. Examples can be found in the cases examined in this study.

The MAIB undertook a full investigation into Case 4. The report was published in January 2002, and contained a recommendation to the MCA that remote jettisoning systems should be considered. However, at least one problem with this recommendation is perceived: if a remote jettisoning system is fitted, crew may be tempted to use it too early. Although this would probably quickly remove any danger to the vessel involved, the jettisoned timber would present a hazard to other vessels. Nevertheless, jettisoning may be the only way of saving a vessel with a badly shifted timber deck cargo, and achieving this remotely is preferable to sending crew members out on deck in stormy conditions to cut the lashings. This study supports the recommendation.

It is easiest to incorporate a jettisoning system with a wiggle wire securing system. A wiggle wire system works in a similar way to lacing a shoe (see the IMO Code of Safe Practice for Ships Carrying Timber Deck Cargoes - the IMO Timber Code). In these systems, pulling on two wiggle wires with winches is often all that is required to tighten the whole lashing arrangement. Conversely, releasing the wiggle wires is a way of jettisoning the cargo. However, judging by the cases examined here, wiggle wires are not widely used. Therefore, a jettisoning device that can be incorporated into the frequently used up-and-over lashing system would be advantageous.

3.1.5 Structural solutions

Timber rails are effective in helping to prevent transverse movement of the deck cargo. However, they need to have adequate strength. Timber rails, and the frameworks that support them, should be subjected to detailed structural calculations, which are checked and approved by a classification society. The failure of a timber rail can put a vessel in danger, as illustrated by one of the cases in this study. The standard for designing and constructing timber rails, should equal that of the hull's main structure.

In the absence of structures like timber rails or metal upright supports, a flat or angle bar welded to the longitudinal sides of hatch covers, to provide a raised lip, will also help prevent transverse movement of a timber deck cargo.

If steel upright supports and associated sockets are fitted, they, too, should be subjected to detailed structural calculations, checked and approved by a classification society. As with timber rails, their failure could put a vessel in danger.

3.1.6 Plastic covers

Plastic sheeting is often used on packages of sawn timber to help protect cargo. High friction coatings can be incorporated into plastic sheeting and, although this makes the covering more expensive, is considered an important means of improving the safe transport of these cargoes. One of the cases outlined earlier, exemplifies the danger caused by slippery plastic covers within an open deck stow of timber.

3.2 RESEARCH

The issues raised in this study include:

- friction between timber deck cargoes and hatch covers
- lashings (especially fabric lashings)
- uprights
- hog wires
- remote jettisoning
- timber rails and other structural steel methods of restricting sideways movement
- plastic covers.

It is proposed that research should be carried out into these topics in relation to timber deck cargoes.

A fundamental reason for research into deck cargoes is to gain a knowledge of the accelerations imparted to those cargoes while vessels are in heavy weather. The MCA is currently carrying out a research project, looking at this topic. Although this will cover all types of deck cargo, it is intended that some timber cargoes will also be included. The specification for the work requires accelerometers to be attached to deck cargoes so as to record accelerations while vessels are on passage. It is expected that suitable heavy weather will be encountered to provide the necessary data.

The MAIB believes that, in addition to this research, a further research project is necessary to address the other issues mentioned in this study. The further research should include a review of the current requirements in the IMO Timber Code and, if necessary, suggest amendments and additions to it.

3.3 IMO CODE OF SAFE PRACTICE FOR SHIPS CARRYING TIMBER DECK CARGOES

The IMO Timber Code contains much helpful advice and guidance. However, it appears to be quiet on many of the issues raised by these cases. It does not mention fabric lashings, for instance, and, judging by the cases examined here, lashings made from fabric webbing are now the most commonly used. The results of this study indicate that there may well be a need to review and update the Code.

3.4 ACTION BY SHIPOWNERS

Although solutions to the problems raised in this report would benefit from further research, it is considered that action on some of the issues can be taken now. As a result three recommendations have been made to shipowners who operate timber deck cargo vessels. Copies of this report are being sent to all the main shipping companies that carry timber deck cargoes on the seas around Europe.

SECTION 4 – CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

Eight serious accidents involving vessels carrying timber deck cargoes have been reported to the MAIB in under two years. This raises serious concerns about the safety of this trade. The common factors in these accidents indicate clearly that the present methods of stowing and securing these cargoes is insufficiently robust when heavy weather is encountered on passage.

The analysis of the common factors indicates areas where further research is needed. These areas include:

1. Maximising the friction between timber deck cargoes and hatch covers, and between tiers of packaged timber.
2. Making the most efficient use of lashings; especially fabric webbing lashings.
3. The use and security of upright supports and hog wires.
4. The design and fitting of remote jettisoning devices.
5. The design and strength of timber rails and other structural steel methods of restricting transverse cargo movement.
6. The adequacy of the present provisions in the IMO Code of Safe Practice for Ships Carrying Timber Deck Cargoes.

Notwithstanding the need for research, it is considered that there is sufficient evidence to warrant shipowners taking action now on friction, lashings and structures.

4.2 RECOMMENDATIONS

The Maritime and Coastguard Agency is recommended to:

1. Sponsor a research project into the carriage of timber deck cargoes based on the issues raised in this study and, subsequently, to take action to improve the safe carriage of these cargoes as deemed necessary by the results of the research.

Shipowners operating timber deck cargo vessels are recommended to:

2. Maximise the friction between timber deck cargoes and hatch covers and between tiers of packaged timber. Avoid steel on steel contact where possible, and only use plastic wrapping incorporating a high friction coating.

3. Ensure that lashing arrangements, especially where fabric webbing lashings are used, are sufficient to prevent the cargo from moving laterally and strong enough to withstand the forces generated in rough sea conditions. The use of uprights and hog wires should be encouraged.

4. Ensure that any structures, for example timber rails, which are fitted to help secure timber deck cargoes, are strong enough to withstand the forces generated during rough sea conditions.

REFERENCES

It is hoped that this study will be a useful reference guide.

Other references on the carriage of timber deck cargoes include:

Lashing and Securing of Deck Cargoes – Edition 3, by John Knott, published in 2002 by the Nautical Institute, ISBN 1870077180. Pages 85-108 cover timber deck cargoes.

Lumber Deck Cargo Loading Manual, by Mike Fothergill, published in 2002 by the Nautical Institute, ISBN 1870077628.

Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 1991, published by the International Maritime Organisation, Sales number IMO-275E, ISBN 9280112856.

Report on the investigation of the cargo shift, abandonment, and grounding of mv *Kodima* in the English Channel on 1 February 2002. Available on the MAIB website at www.maib.gov.uk under publications and then investigation reports, or by contacting the MAIB in writing, or by calling 023 8039 5500.