MA2012-8

MARINE ACCIDENT
INVESTIGATION REPORT

August 31, 2012

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board is to determine the causes of an accident and damage incidental to such an accident, thereby preventing future accidents and reducing damage. It is not the purpose of the investigation to apportion blame or liability.

Norihiro Goto
Chairman,
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

MARINE ACCIDENT INVESTIGATION REPORT

Vessel type and Name:	Pure car carrier VEGA LEADER
IMO number:	9213818
Gross tonnage:	51,496 tons
Accident type:	Injuries on longshoremen
Date and time:	About 0950 hrs, December 1, 2010
Location:	Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port 305° true, about 200 m from Nissan Honmoku Wharf Lighthouse at Yokohama City, Kanagawa Prefecture (Approximately 35°25.4'N, 139°40.7'E)

July 26, 2012
Adopted by the Japan Transport Safety Board
Chairman Norihiro Goto
Member Tetsuo Yokoyama
Member Kuniaki Shoji
Member Toshiyuki Ishikawa
Member Mina Nemoto

SYINOPSIS

<Summary of the Accident>

The pure car carrier VEGA LEADER berthed at Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port, during car loading work on December 1, 2010. While cars were being loaded on a deck panel of car deck No. 7, of which the height had been readjusted, the deck panel fell down onto car deck No. 6 at around 0950 hrs. Six longshoremen stevedoring on the deck panel and four longshoremen stevedoring on car deck No. 6, immediately below the panel—ten persons in total—were injured.

<Probable Causes>

It is somewhat likely that the accident occurred because, while VEGA LEADER was loading cars at Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port, the deck panel of car deck No. 7, a liftable deck, was not supported by the starboard-bow-side deck-support; the load applied on the horizontal guide-plate at the starboard-bow-side and the horizontal guide-plate at the starboard-stern side, supporting the deck panel of car deck No. 7 at their portions overlapping the side stringer, grew larger as the loading on the deck panel progressed; a load exceeding the breaking force was applied to the weld portions connecting both horizontal guide-plates to the deck panel of car deck No. 7 and caused the weld lines to rupture; the deck panel of car deck No. 7 tilted

toward the starboard bow, falling off all the deck-supports and onto car deck No. 6; and the longshoremen working on the deck panel of car deck No. 7 or on car deck No. 6 immediately below the deck panel were injured.

It is somewhat likely that the reason why the deck panel of car deck No. 7 was not supported by the starboard-bow-side deck-support was that, while the ship was navigating to Kanda Port, the work for adjusting the height of deck panels was executed on car deck No. 7 and other decks, the deck panel of car deck No. 7 was readjusted from the middle position to the normal position, the deck panel was lowered without anyone being aware that the starboard-bow-side deck-support was neither fully open nor in the state to support the deck panel, and the deck-support moved outward from the deck panel.

It is somewhat likely that the reason why the starboard-bow-side deck-support was not fully open nor in the state to support the deck panel of car deck No. 7 was not noticed, was that Chief Officer A, considering that the deck supports at the normal position function as a safety device preventing deck panels from getting lower than the normal position, kept them always open, un-retracted, and ready to support a deck panel, believed that the deck support at the normal position was in a state to support the deck panel of car deck No. 7 and did not think of confirming the state.

It is somewhat likely that the fact that the management company had not stipulated specific procedures of the work for adjusting the height of deck panels in their safety management manuals and the fact that the ship had no systems for confirming the states of deck support by, for example, using a check list prior to lowering deck panels, contributed to the occurrence of the accident.

< Recommendations and Remarks >

○Safety Recommendations

The Japan Transport Safety Board, in view of the result of the investigation of the accident, for the prevention of an occurrence of similar accidents, makes the following recommendation to owners and management companies of pure car carriers.

It is somewhat likely that the accident occurred because, while VEGA LEADER was loading cars at Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port, car deck No. 7, not supported by the deck support at the starboard bow end, while the loading of cars on the deck panel of cargo deck No. 7 progressed, fell onto car deck No. 6, and the ten longshoremen working on the deck panel or car deck No. 6 immediately below the deck panel were injured.

It is somewhat likely that the height of the deck panel of cargo deck No. 7, while the ship was navigating to Kanda Port, was readjusted from the middle position to the normal position, the deck panel was lowered without anyone being aware that the deck support on its starboard bow end was neither fully open nor in a state to support the deck panel, and the deck support moved outward from the deck panel.

It is somewhat likely that the absence of stipulation by the management company in their safety management manuals of work-procedures specifically describing the work for readjusting the height of a deck panel and the ship's lack of systems for confirming the state of deck supports by, for example, using a check list prior to lowering deck panels contributed to the occurrence of the accident.

Therefore, it is necessary for owners and management companies of pure car carriers to reconsider and work out measures for ensuring confirmation that deck supports are in a state to

correctly support a deck panel prior to lowering the deck panel and putting it on the deck support, and in addition, instruct their crew members regarding such measures.

Based on the experiences of the accident, a measure for preventing a fall of a deck panel by employing fixed-type deck supports was applied. Since ships are equipped with facilities and other things that may cause a severe accident, involving injury, due to a crew member's absence of confirmation, ship owners in general and others should consider hardware-based safety measures for facilities as a lesson learned from the accident.

Therefore, it is most likely necessary for owners of car carriers to consider and employ safer systems, such as fixed-type deck supports at the lowest level to prevent a panel-falling accident.

○Remarks

It is somewhat likely that the accident occurred, while VEGA LEADER was loading cars at Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port, because the deck panel on the car deck No. 7, not supported by the starboard-bow-side deck-support, while the car loading on the deck panel progressed, fell-down onto car deck No. 6, and the ten longshoremen working on the deck panel or on car deck No. 6 immediately below the deck panel were injured.

It is somewhat likely that, while the ship was proceeding to Kanda Port, the deck panel of cargo deck No. 7, when readjusted from the middle position to the normal position, was lowered without anyone being aware that the starboard-bow-side deck-support was neither fully open nor in a state to support the deck panel, and the deck-support moved outward from the deck panel.

Port-transportation-service providers are recommended to regard deck supports on a liftable deck as dangerous parts and confirm that the deck panel, on which cars will be loaded, should be correctly supported by them before loading.

1 PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Accident

The pure car carrier VEGA LEADER berthed at Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port, during car loading work on December 1, 2010. While cars were being loaded on a deck panel of car deck No. 7, of which the height had been readjusted, the deck panel fell down onto car deck No. 6 at around 0950 hrs. Six longshoremen stevedoring on the deck panel and four longshoremen stevedoring on car deck No. 6, immediately below the panel—ten persons in total—were injured.

1.2 Outline of the Accident Investigation

1.2.1 Set up of the Investigation

The Japan Transport Safety Board appointed an investigator-in-charge and two other investigators to investigate this accident on December 1, 2010. In addition, three regional investigators from Yokohama Office joined the investigation of the accident.

1.2.2 Collection of Evidence

December 1, 2010 and February 3 to 5, 2011: On-site investigations

December 2 and 3, 2010: On-site investigations and interviews

December 8, 13, 14, 21 and 27, 2010, and January 14 and 19, 2011: Interviews

December 13, 15 and 21, 2010, and June 8, 10 and October 18, 2011: Collection of replies submitted to the questionnaires

1.2.3 Interim Report

Based on the factual information gained until then, an interim report was submitted to the Minister of Land, Infrastructure, Transport and Tourism, and was published on March 30, 2012.

1.2.4 Tests and Research by Other Institutes

For investigation and analysis of the accident, JTSB entrusted the analytical investigation of the load applied on the support frames of the liftable deck panel of VEGA LEADER to the National Maritime Research Institute.

1.2.5 Comments from Parties Relevant to the Cause of the Accident

Comments were invited from parties relevant to the cause of the accident.

2 FACTUAL INFORMATION

2.1 Events leading to the Accident

2.1.1 Events leading to the Accident according to the Oral Statement of the Crew Members

According to the oral statements of the master of VEGA LEADER (hereinafter, except for Chapter 5, referred to as “the Ship”), two chief officers (hereinafter, except for Chapter 5, the

outgoing chief officer is referred to as "Chief Officer A," and the other, who boarded at Kanda Port, Kanda Town, Fukuoka Prefecture to replace Chief Officer A, is referred to as "Chief Officer B"), the third officer, the boatswain, and the apprentice officer, the logbook of the Ship, and the replies to a questionnaire from the person in charge of Nippon Yusen Kabushiki Kaisha, the ship charterer (hereinafter, referred to as the "Charterer"), events leading to the accident are as follows.

The Ship, boarded by the master and Chief Officer A with other 18 crew members (eight, nationality of Republic of India; nine, nationality of Republic of Philippines; and one, nationality of Kingdom of Thailand), while proceeding to Kanda Port leaving the Port of Melbourne, the Commonwealth of Australia, received an instruction from Charterer to adjust the height of each of the 46 floor panels (hereinafter referred to as a "deck panel") of car deck 7 and 9 of the 12 of decks installed in the hull, of which the height is adjustable (hereinafter referred to as "liftable deck") to the height compatible with the car stowage plan of the next voyage.

The work for adjusting the height of deck panels (hereinafter referred to as "Panel Work") was executed by Chief Officer A as the controller, the master, the third officer, the boatswain, and the apprentice officer on November 22, 2010.

The Ship, calling at Kanda Port on November 24, and then, at Nagoya Port, Aichi Prefecture, loaded with 3,157 cars in total, berthed at Nissan Motor Honmoku Wharf in Yokohama Section 5, Keihin Port, at around 1500 hrs, November 30.

Chief Officer A was scheduled to disembark at Keihin Port after giving a briefing to Chief Officer B for a handover during the voyage from Kanda Port to Keihin Port.

The Ship, according to a plan to load 77 cars on cargo deck No. 6, 257 on cargo deck No. 7, and 46 on cargo deck No. 8, 380 in total, started the car loading work at around 0830 hrs on December 1; the Ship was scheduled to set out on a voyage at 1130 hrs.

Chief Officer B was on ballasting procedures for even keel in the cargo office located at the starboard stern of cargo deck No. 6; the third officer and the boatswain were monitoring the loading.

The master on the bridge, hearing abnormal sounds, inquired with the third officer on duty with transceiver, and found out that the 8th deck panel, numbered from the stern end, on the starboard side on cargo deck No. 7 (hereinafter, except in Chapter 5, referred to as "the Deck Panel") fell onto cargo deck No. 6.

Chief Officer B, noticing sounds and shouts coming from the outside of the cargo office at around 0950 hrs, knew of the occurrence of the accident.

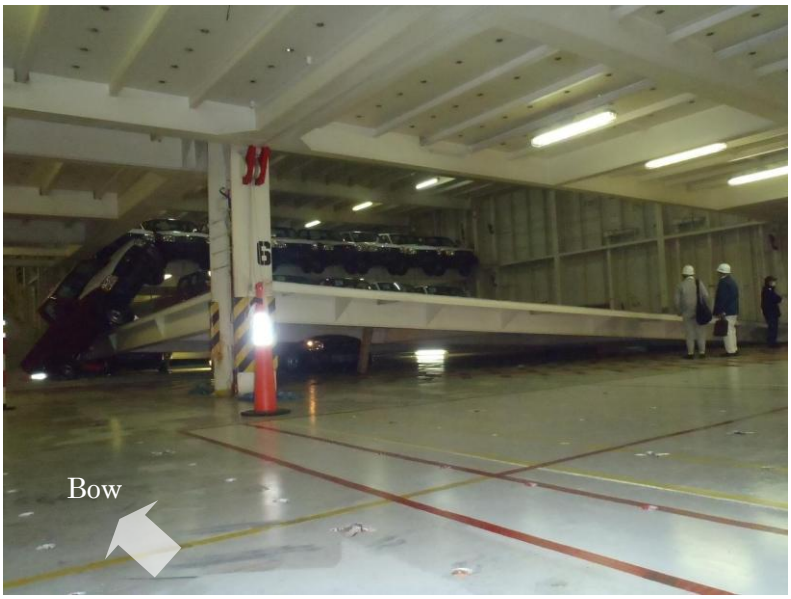
Chief Officer A, preparing to disembarkation in his room, heard a big abnormal sound, got out of the room, was informed of the occurrence of the accident by a crew member, and headed to car deck No. 6.

The third officer, reporting the completion of the cargo handling operation on car deck No. 8, was supervising Chief Officer B and talking about when to give the announcement of one hour to depart, noticed a loud sound and learned of the occurrence of the accident.

The boatswain accompanied by the apprentice officer and an ordinary seaman, watching the progress of the cargo handling operation at the port side of car deck No. 7, learned of the occurrence of the accident when heading to the storage room on the stern by a request from a

longshoreman to give him fabric belts with hooks on both ends necessary for lashing work[1] (hereinafter, referred to as a "lashing belt") because they were running out.

Photo 2.1.1 The Deck Panel, Fallen



2.1.2 Events leading to the Accident according to the Oral Statements from Longshoremen

(1) Foremen and others.

According to the oral statements from a foreman (hereinafter referred to as "Foreman A") from a port transport-service provider (hereinafter referred to as "Company A"), a foreman (hereinafter referred to as "Foreman B") from a port transport-service provider subcontracted by Company A (hereinafter referred to as "Company B), and a gang leader of longshoremen working on lashing and guiding cars from a stevedoring-service provider subcontracted by Company B (hereinafter referred to as "Company C"), the events leading to the occurrence of the accident are as follows.

The cargo handling operation began at around 0830 hrs; 20 drivers from Company B were loading cars; 22 longshoremen from Company C were guiding and lashing cars.

The loading of cars, according to the stevedoring-procedure plan prepared by Foreman B based on the stowage plan[2] prepared by Foreman A, started with the loading on the bow side of car deck No. 7; the loading proceeded sequentially to cargo deck No. 8 and to cargo deck No. 6 by half of the longshoremen having moved there.

When the accident occurred, the cargo handling operation was on-going with a guide-man standing at around the inner-ramp[3] of car deck No. 7 and two separate gangs of five longshoremen from Company C lashing cars separately on two places on the car deck; another two gangs were working similarly on car deck No. 6 immediately below car deck No. 7.

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[1] "Lashing" refers to tying down a cargo with a wire, rope, or chain and other things. to prevent it from moving by weltering while the ship is on the sea.

[2] A "stowage plan" refers to a plan or document describing the stowage positions or methods to load cargoes.

[3] An "inner-ramp" refers to a slope way for the traffic to and from each car deck of a ship.

Foreman A, supervising the cargo handling operation at a position in the port stern end away from the Deck Panel, heard a loud abnormal sound as if a steel plate had be struck hard, and turned to the direction the sound came from; he saw the Deck Panel begin to fall.

Foreman B, standing near the starboard side of the inner-ramp on car deck No. 6, facing the stern-ramp,[4] heard a loud abnormal "Bang!" at around 0950 hrs, and turned around; he saw the Deck Panel fall down onto car deck No. 6, with a roaring sound, and the cars with their lights on flattened. He immediately informed the office of Company B with cell-phone of the accident.

The gang-leader from Company C, checking the lashing situation of cars at the stern end of car deck No. 7, where the cargo handling operation was completed, heard a loud "Ka-Boom!" and turned to the direction the sound came from; he saw the Deck Panel tilted toward the starboard side with its starboard bow side lowered, and the longshoremen on the Deck Panel jump-up, fall, and slide down. Then, he lost sight of the longshoremen and the cars when he heard a roaring sound; finally, he heard a "Ka-Boom!"

(2) Longshoremen on the Deck Panel

According to the oral statements from the longshoremen from Company C on guidance or lashing work on the Deck Panel (hereinafter, they are referred to as "Longshoreman C_1," "Longshoreman C_2," "Longshoreman C_3," "Longshoreman C_4," or "Longshoreman C_5") and the Longshoreman (driver) from Company B driving cars (hereinafter referred to as Driver B_1, events leading to the accidents are as follows.

Drivers from Company B were on driving ; they were parking cars at the instructed positions on the Deck Panel. Longshoremen from Company C were on lashing work; they tied down a car using lashing belts with hooks at both ends by connecting both sides of rear and front ends of car to the Deck Panel by hanging a hook at one end of a belt on an end of a car and a hook at the other end on a hole in the Deck Panel.

On the Deck Panel, as shown in the figure below (Figure 2.1.2-1: Work Situation on the Deck Panel), eight cars were loaded on the first row, facing the stern. Their front tires were on the Deck Panel, and their rear tires were on the deck panel next to the Deck Panel toward the bow side. Their fronts were tied to the Deck Panel with lashing belts. The loading of cars to be placed on the second row began; the cars were placed one by one on the second row from the ship center-line side to the starboard side, and when the 7th car on the second row was parked in its position, the accident occurred.

Longshoreman C_1 was sending a cue to the driver to guide the car to its position; when the starboard bow of the Deck Panel sank, he fell to his knees on the Deck Panel, but he rolled on the Deck Panel again and again while the Deck Panel was falling.

Longshoreman C_2, was just starting to lash the rear left of the 7th car on the second row. He feared for his safety at around 0950 hrs, when the starboard bow side of the Deck Panel sank, but he was helpless; a few seconds later, the Deck Panel fell down, tilted toward the starboard side, and during the fall, he was popped-up several times. When the Deck Panel stopped, his body slid toward the shell plating, and his head hit a frame of the shell plating.

Longshoreman C_3 finished the lashing work on the front left of the 6th car on the second

[4] A "stern-ramp" refers to a slope way for loading and unloading facilities installed at the stern of a car carrier, enabling traffic flow to and from quay.

row. Just after the 7th car was parked in its position, the starboard bow side of the Deck Panel sank and then the Deck Panel fell down with several strong vibrations; during the fall, he kept holding a lashing belt.

While Longshoreman C_4 was arranging two lashing belts for the front of the 7th car in front of the left front of the car, the Deck Panel fell.

Longshoreman C_5 was just starting to lash the right rear of the 7th car behind the car parked on its right side; at that time, the Deck Panel fell.

Driver B_1, after driving the 7th car on the second row, parking the car so that it faced the stern on the cue from Longshoreman C_1, putting the shift lever to the low position, pulling the lever on the parking brake and closing the window, stopped the engine; when he tried to get out of the car, at around 0950 hrs, he noticed that the car tilted towards rear left, and the Deck Panel sunk lower three times.

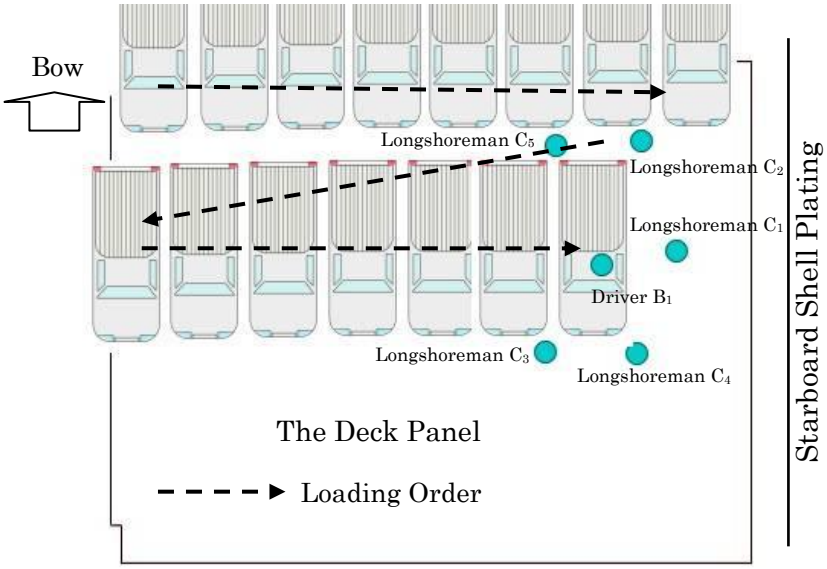


Figure 2.1.2-1: Work Situation on the Deck Panel

(3) Longshoremen on car deck No. 6 immediately below the Deck Panel

According to the oral statements from the longshoremen from Company C on the guidance or lashing work on car deck No. 6, immediately below the Deck Panel (hereinafter, they are referred to as "Longshoreman C_6," "Longshoreman C_7," "Longshoreman C_8," and "Longshoreman C_9"), and the driver from Company B driving a car in the same place (hereinafter, referred to as "Driver B_2), the events leading to the occurrence of the accident are as follows.

On car deck No. 6, cars were loaded one by one from the bow end and lashed. Near the place immediately below the Deck Panel, as shown in the figure below (Figure 2.1.2-2.: Work Situation on Car Deck No. 6 immediately below the Deck Panel), the driver had gotten out of the first car, which was placed at the bow end and ship center side and was in the middle of lashing; while the second car was waiting at the stern end of the first car to park next to the car, the accident occurred.

Longshoreman C_6, standing away to the bow, ahead of the point immediately below the

Deck Panel, and facing the stern, was guiding a car running astern and approaching its instructed position, by sending a cue to the driver. At that time, suddenly, the Deck Panel tilted to the starboard side and sank one meter just in front of him.

Longshoreman C_7, standing in front of the first car and facing the bow, was waiting for the second car to park in its position. At that time, he heard a loud "clunk!" and then someone shouting; immediately after that, his head, neck, and back, in that the order, were hit, and he fell down.

Longshoreman C_8, working on lashing at the right rear of the first car with his body almost under the car, heard a loud "Bang!" and then a sound as if made by something being hit; just after that, the car he was working on with his body under was hit by the Deck Panel, and its whole body was flattened, and his left shoulder and lower back were hit.

Longshoreman C_9, working on lashing at the rear left of a car with his body under the car, heard a roaring sound, and was pushed hard, far toward bow; he, without knowing what had happened, fearing for his physical safety, took shelter under the ship-center inner-ramp.

Driver B_2, after taking-off his helmet and putting it on the front passenger seat, driving a car inside through the stern-ramp, making a u-turn at the stern end toward the accident occurrence site, and reversing and stopping the car under the Deck Panel, waited for a cue from Longshoreman C_6 to park next to the car being lashed; suddenly, he had the tilting Deck Panel in sight, feared for his safety, and touched the shift lever. At that moment, the window shield on the front passenger-seat side was broken, and he was able to exit the car through the broken window with no assistance.

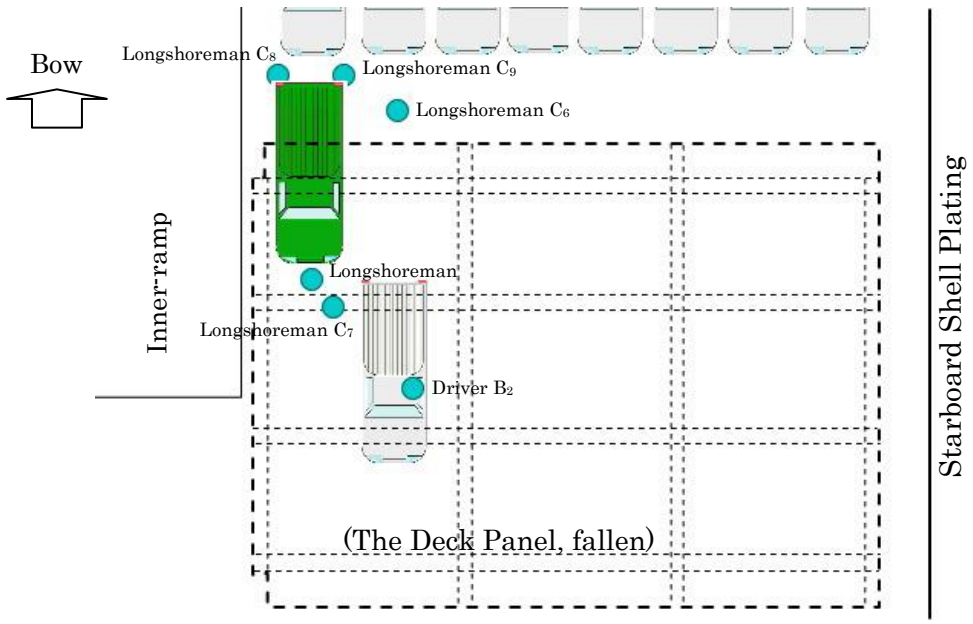


Figure: 2.1.2-2: Work Situation on car deck No. 6 immediately below the Deck Panel

The time and date of the accident occurrence were around 0950 hrs, December 1, 2010, and the location was 305° true, about 200 m from Nissan Honmoku Wharf Lighthouse.

(Refer to Figure 1: Location of the Occurrence of the Accident, Figure 2: General Arrangement Plan, Figure 3: Situation of Panel Work, Photo 1: Bow of the Ship, and Photo 2:

Stern of the Ship)

2.1.3 Rescue

According to the oral statements from Foreman A, Foreman B and the longshoremen from Company C and the records in the logbook of the Ship, Longshoreman C_5 suffered a head injury and waited for the arrival of an ambulance on the floor of car deck No. 6, and the other injured waited near the stern-ramp of car deck No. 6. The ambulance cars arrived at the berth at 1017 hrs, and the injured were transferred separately to three hospitals in Yokohama City.

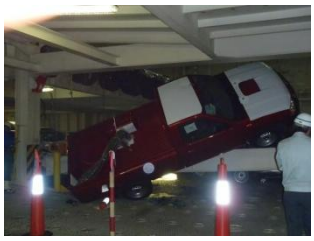
2.2 Injuries or Deaths

According to the medical certificates and the oral statements from the longshoremen from Company C, six longshoremen, including a driver on the Deck Panel, suffered from cervical sprain, and head and knee contusion; four longshoremen, including a driver on car deck No. 6 immediately below the Deck Panel, suffered from cervical sprain, lumbar spine sprain, and back contusion.

2.3 Damage to Cars

One of the cars placed on the Deck Panel fell down onto car deck No. 6 and was damaged; two of the cars placed immediately below the Deck Panel on car deck No. 6 were flattened by the Deck Panel. (Refer to Photo 2.3: Damage to Cars.)

Photo 2.3: Damage to Cars

Fallen Car	Flattened-out Car	Car driven by Driver B_2
 	 	 

2.4 Crew Information

2.4.1 Crew Members of the Ship

(1) Gender, Age, and Certificate of Competence

{1} Master

Male, 48 years old

Nationality Republic of India

Endorsement attesting the recognition of a certificate under STCW regulations: Captain

(issued by Republic of Panama)
Date of Issue September 27, 2006
(Valid until May 3, 2011)

{2} Chief Officer A
Male, 48 years old
Nationality Republic of India
Endorsement attesting the recognition of a certificate under STCW regulation: First Grade Maritime Officer (navigation) (issued by Republic of Panama)
Date of Issue July 29, 2008
(Valid until May 14, 2013)

{3} Chief Officer B
Male, 51 years old
Nationality Ukraine
Endorsement attesting the recognition of a certificate under STCW regulation: Captain (issued by Republic of Panama)
Date of Issue November 22, 2010
(Valid until February 22, 2011)

(2) Major Seagoing Experience

{1} Master
According to the oral statements from the master, his major experience is as follows.
The master, since he first boarded in 1982, has boarded oil tankers, car carriers, container carriers, chemical tankers, etc. Since he served as a captain in 1997, he has been boarding car carriers generally.

{2} Chief Officer A
According to the oral statements from Chief Officer A, he started boarding as a radio officer. After ships began to equip with GMDSS,[5] he received navigation officer training. Upon obtaining a certificate of second officer, he began to board as a navigation officer. Since 2008, he had boarded as a chief officer, and on June 12, 2010, he boarded the Ship as a chief officer.

{3} Chief Officer B
According to the oral statements from Chief Officer B, since he first boarded in 1982, he had boarded container carriers, bulk carriers, and ferry boats. Since around 1997, he had boarded as a chief officer, and he boarded the Ship at Kanda Port on November 24.

2.4.2 Foremen and others

(1) Gender and Age

{1} Foreman A Male, 24 years old

{2} Foreman B Male, 39 years old

{3} Unit Leader Male, 51 years old

(2) Experience, etc

[5] "GMDDSS" (Global Maritime Distress and Safety System) refers to a system for treating communications on ship-distress and safety using satellite communication technology and digital communication technology. It began to be employed in 1992, and the shift of maritime communication systems from Morse code to GMDSS was completed in 1999.

{1} Foreman A

According to the oral statements from Foreman A, he was in his fourth year in Company A.

{2} Foreman B

According to the oral statement from Foreman B, he served as a driver for loading cargo-carriers before serving as a foreman; he had harbour loading and unloading experiences of about 20 years.

{3} Gang Leader

According to the oral statements from the gang leader and longshoremen list of Company C, he joined Company C in 1985; he had about 25-years of harbour loading and unloading experience.

2.5 Vessel Information

2.5.1 Particulars of Vessel

IMO number:	9213818
Port of registry:	Panama (Republic of Panama)
Owner:	ESMERALDA SHIPHOLDING S.A. (Republic of Panama)
Operation company:	NIPPON YUSEN KABUSHIKI KAISHA
Management company:	WILHELMSEN SHIP MANAGEMENT Sdn. Bhd. (Malaysia)
Charterer:	NIPPON YUSEN KABUSHIKI KAISHA
Gross tonnage:	51,496 tons
L × B × D:	180.00 m × 32.26 m × 34.60 m
Hull material:	Steel
Engine:	One Diesel Engine
Output:	13,540 kW
Date of launch:	July 13, 2000
Navigation area:	Ocean (International)
Type of ship:	Pure Car carrier
Number of crew member:	20
Class Society[6]:	Nippon Kaiji Kyokai (Class NK)
Building yard:	Sumitomo Heavy Industry Marine & Engineering Co., Ltd

2.5.2 Load Conditions and other things

(1) Load Condition of the Ship

According to the oral statements from Foreman B and the stowage plan, the Ship was loaded with 3,157 cars at Kanda Port and Nagoya Port. At the time of the occurrence of the accident, at Keihin Port, it had been additionally loaded with about 200 of the 380 cars planned to be loaded.

(2) Cars and their Positions on the Deck Panel

According to the car distribution chart of the Deck Panel, each car placed on the Deck

[6] "Class society" refers to a third-party organization that inspects engines, hulls, or equipment according to the standards by international regulations, etc. and issues certifications of compatibility.

Panel was 5.01 m long and 1.69 m wide, the overall body weight was 1,500 kgf,[7] and the load weight ratio on the front and rear tires was 6 to 4.

On the Deck Panel, eight cars on the first row were placed on the bow end, and seven cars were placed on the second row. The right front tire and rear tire of the car on the ship-center side, out of the seven cars, were placed on the deck panel adjacent to the port side of the Deck Panel, and the total weight of the car was 16,950 kgf.

(Refer to Figure 4: Car Load Distribution Chart on the Deck Panel)

(3) Draft of the Ship

According to the oral statement from Chief Officer B, at the time of the occurrence of the accident, there was almost even trim,[8] and the list was approximately 0.4° to the starboard.

According to the third officer, the draft of the Ship at the time of the occurrence of the accident was approximately 8.6 m fore and approximately 8.8 m aft.

The monitor of the ballast system[9] indicated that the draft of the Ship on the day after the accident was approximately 8.5 m fore and approximately 8.8 m aft. The loading on the Ship had been discontinued since the occurrence of the accident, and there was no change in the draft.

2.5.3 Structures and Equipment of the Ship

The Ship is a pure car carrier having 12 decks from No. 1 to No. 12, named sequentially upward from the bottom. The Ship was equipped on the starboard stern end of car deck No. 6 with a retractable ramp way stretching obliquely backward from the starboard. Car deck No. 5, car deck No. 7 and car deck No. 9 were separated into eight partitions on each of the starboard and port side, 13 partitions on each of both sides, and 12 partitions on each of both sides, respectively. Each partition has the feature of a liftable deck, and the Ship was equipped with 66 deck panels in total.

According to the oral statements from the master, the liftable decks were neither damages nor malfunctioning.

2.5.4 Liftable Decks

(1) Outline of the Liftable Decks

A liftable deck had such a structure that a hydraulic deck lifter mounted on a lift car (refer to Figure 2.5.4-1: Lift car) lifts the deck to set to the following three vertical positions: the high position (top), the middle position (middle) and the normal position (bottom) (refer to Figure 2.5.4-2: Deck Panel Height).

A deck panel had such a structure that four deck-supports mounted on pillars or frames support the deck panel. The height from car deck No. 6 to the bottom surface of the Deck Panel is 3.00 m at the normal position, 3.50 m at the middle position, and 5.18 m at the high

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[7] "kfg (kilogram force)" is a unit of weight or force in the gravitational system of units; 1kfg corresponds approximately to 9.8 N (Newtons) in the SI system of units.

[8] "Trim" refers to the difference between the draft forward and the draft aft. The situation where the draft forward is larger than the draft aft is called "trim by the head," and the situation where the draft aft is larger is called "trim by the stern."

[9] "Ballast system" refers to a system that displays draft, trim and list in an integrated way, to adjust the level of each tank in a ship.

position.

A deck panel was equipped with horizontal-guide plates[10] (refer to Figure 2.5.4-3: Horizontal Guide-Plates and Deck Supports) at four positions on the deck panel in such a way that the horizontal guide-plates are installed in a position aligned with the frames and the pillars installed on the ship-center line. A cut made on the plate and the pillar or frame prevents a deck panel from sliding horizontally.

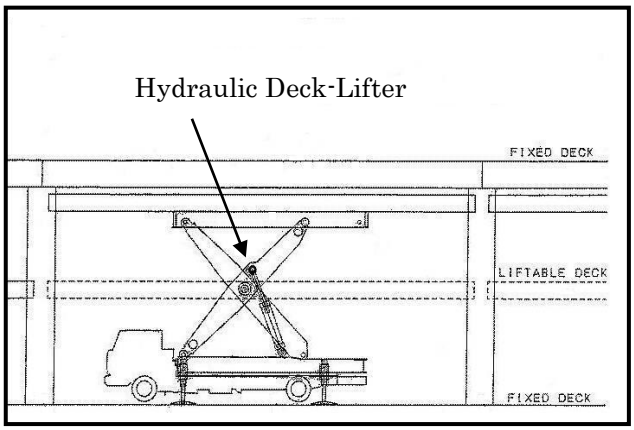


Figure 2.5.4-1: Lift Car

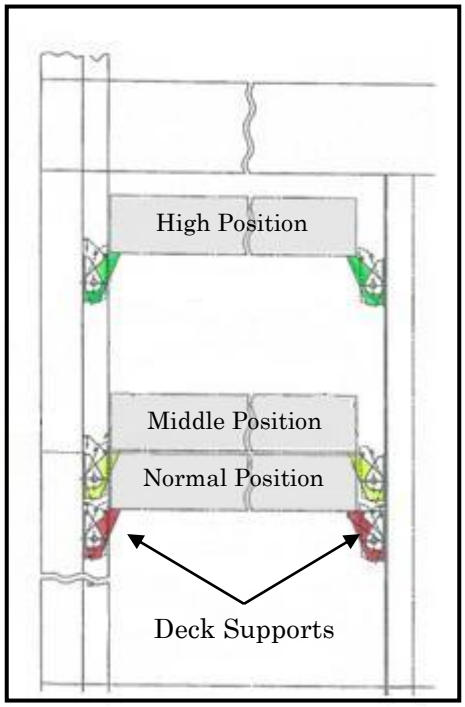


Figure 2.5.4-2: Deck Panel Heights

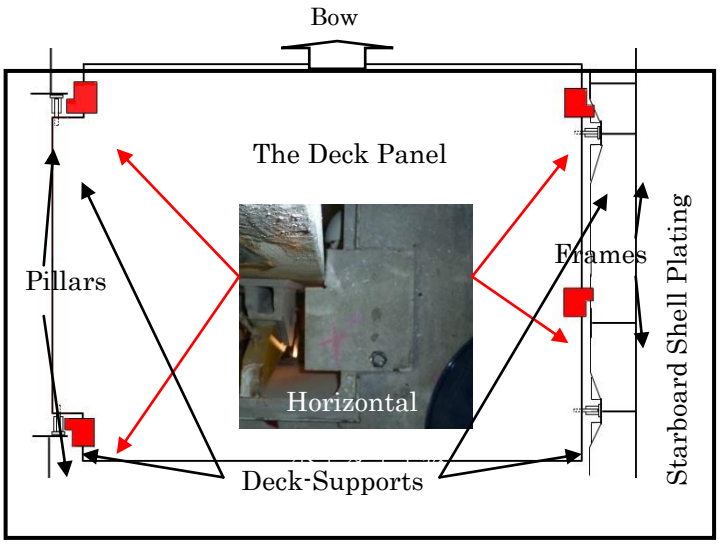


Figure 2.5.4-3: Horizontal Guide-Plates and Deck Supports

(2) The Deck Panel

{1} Shape and Weight

According to the design drawings by the ship builder, the upper surface of the Deck Panel is 12.90 m long in ship-length direction, and 15.51 m long in ship-breadth direction; the lower surface is 11.57 m long in ship-length direction, and 15.27 m in ship-breadth

[10] "Horizontal guide-plate" refers to a plate installed to prevent a deck panel from sliding horizontally. The panel is mounted with a small gap to the pillar or frame to allow a deck panel to move up and down.

direction; and the height from the lower surface to the upper surface (thickness) is 0.475 m.

According to the summary design documents by the ship builder, the weight is 18.82 tons.

{2} Damage

Significant damage, as shown in the photo below (Photo 2.5.4-1: Damage on the Deck Panel), was a bend on the tip of the starboard-bow-side corner of the lower surface. In addition, the surface of car deck No. 6 immediately below the Deck Panel was damaged in the form of dent.

Photo 2.5.4-1: Damage to the Deck Panel	
Tip of the starboard-bow-side corner of the lower surface	Surface dent in car deck No. 6
	

(3) Deck Support

{1} Structure and Size

Each of the deck-supports supporting the Deck Panel at the normal position (hereinafter, except in Chapter 5, the ship-center-bow-side deck-support is referred to as "Deck Support 1," the starboard-bow-side deck-support is referred to as "Deck Support 2," the starboard-stern-side deck-support is referred to as "Deck Support 3," and the ship-center-stern-side deck-support is referred to as "Deck Support 4"), was supported by a steel shaft of 70 mm diameter passing through the deck support, and a pedestal welded on pillars or frames, and rotatable around the shaft.

Each of the deck supports, as shown in the figure below (Figure 2.5.4-4: Deck Support) and the photo below (Photo 2.5.4¬2: Structure of a Deck Support), was retractable. A deck support is retracted by pulling down, on a car deck below the liftable deck, a rope connected to the far end of the deck support and going downward through an eye attached to a ship structure higher than the deck support (hereinafter, referred to as a "pull-up rope").

When a pull-up rope is released, because the center of gravity of a deck support is higher than the steel shaft and away from the shaft toward the deck panel, the gravity pulls the deck support down to tilt the deck support, so that it supports a deck panel. The size of a deck support is 60 mm wide and 80 mm deep, measured on its surface contacting a deck panel.

Note that, on Deck Support 1, there was no rope tied; moreover some of other deck supports at the normal position of other deck panels had lost pull-up ropes.

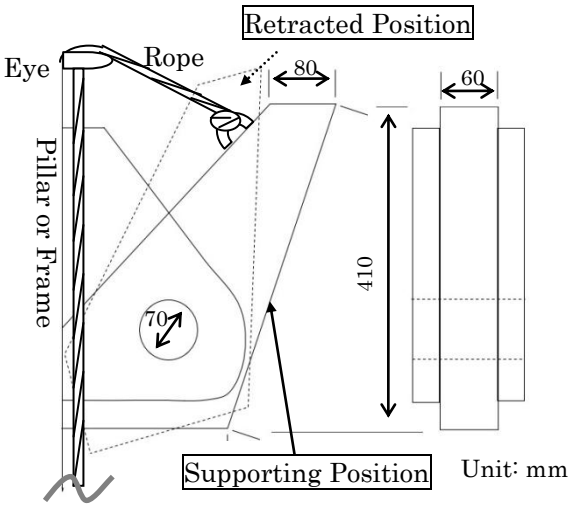
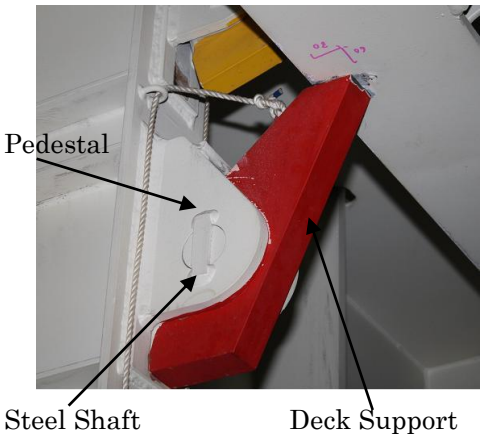


Figure 2.5.4-4: Deck Support

Photo 2.5.4-2: Structure of a Deck Support



According to Chief Officer A, oiling on a deck support had not been executed, because damage to cars, such as contamination by oil, or accidents by tire-slipping, was feared.

According to the oral statements from the person-in-charge at the ship builder, the reason for employing retractable deck support is not clear; however, it is somewhat likely that, by employing retractable deck support, the flared portion from the lines of frames or pillars can be reduced, leading to less damage-risk when large-sized cars are handled.

{2} Installation

Deck-supports were installed facing each other at the ship-center side, and facing toward the ship-center at the shell plating side; deck-supports at normal position were painted in red, those at middle position were in yellow, and those at high position were in green.

{3} Design Withstand Load

According to the summary documents of design by the ship builder, the deck-supports were made of hot-rolling steel with a yield stress of 24 kgf / mm^2 (SS400).

The pressure on a supporting surface of a deck-support when the Deck Panel is fully loaded with the design withstand-load (0.3 tf / m^2) is calculated as follows:

18,820 kgf (deadweight) + 300 kgf / m^2 × (12.9 m × 15.5 m) ≒ 78,800 kgf (total weight)

The response force per one deck-support is 78,800 kgf ÷4 =19,700 kgf; so, because the area of a supporting surface of a deck support is 4,800 mm^2, the pressure on the supporting surface becomes 19,700 kgf ÷4,800 mm^2=4.1 kgf/mm^2.

Therefore, the weight of cargoes, when the Deck Panel is full-loaded at 59,980 kgf, the withstand load per one deck-support is 14,955 kgf.

{4} Damage

The damage to the deck supports was as follows (refer to Figure 2.5.4-5: Damage to Deck Supports)

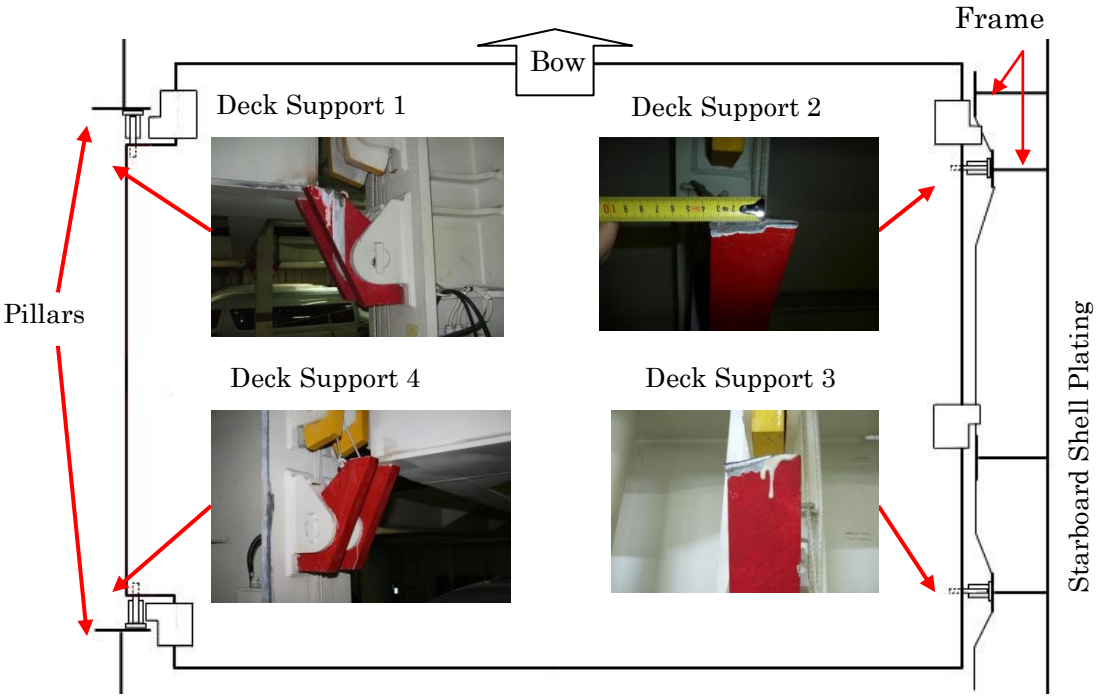


Figure 2.5.4-5: Damage to Deck Supports

a Deck Support 1 had scratch marks running in a lengthwise direction on the painted side-surface.

b Deck Support 2 had, at its tip, a defection about 36 mm wide and about 3 mm deep, and a scratch mark about 24 mm wide; in addition, the Deck Panel had a defection of about 25 mm wide and a scratch mark of about 36 mm wide at its lower surface corner supported by Deck Support 2 (contact surface). (Refer to Photo 2.5.4-3: Damage to Deck Support 2)

Photo 2.5.4-3: Damage to Deck Support 2

Damage to Deck Support 2 (magnified)	Damage to the Deck Panel, on the Contact Surface with Deck Support 2
	

c Deck Support 3 had plastic deformation on its tip.

d Deck Support 4 had no damage.

(4) Horizontal Guide-Plate on the Deck Panel

{1} Shape and Size

The horizontal guide-plates (hereinafter, those guide-plates are referred to as follows: the plate at the ship-center-bow side as "Horizontal Guide-Plate 1," the plate at the starboard-bow side as "Horizontal Guide-Plate 2," the plate at the starboard-stern side as "Horizontal Guide-Plate 3," and the plate at the ship-center-stern side as "Horizontal Guide-Plate 4") were welded at the four corners of the Deck Panel, in such a way that a cut made at a corner of such a guide plate was mated with a pillar or a frame.

Horizontal Guide-Plate 2, as shown in the figure below (Figure 2.5.4-6: Horizontal Guide-Plate 2), was structured with a steel plate 230 mm long, 260 mm wide, and 20 mm thick, with a cut 40 mm long and 80 mm wide in one of its corners. It was fillet-welded on the deck surface of the Deck Panel with a weld leg length of about 10 mm.

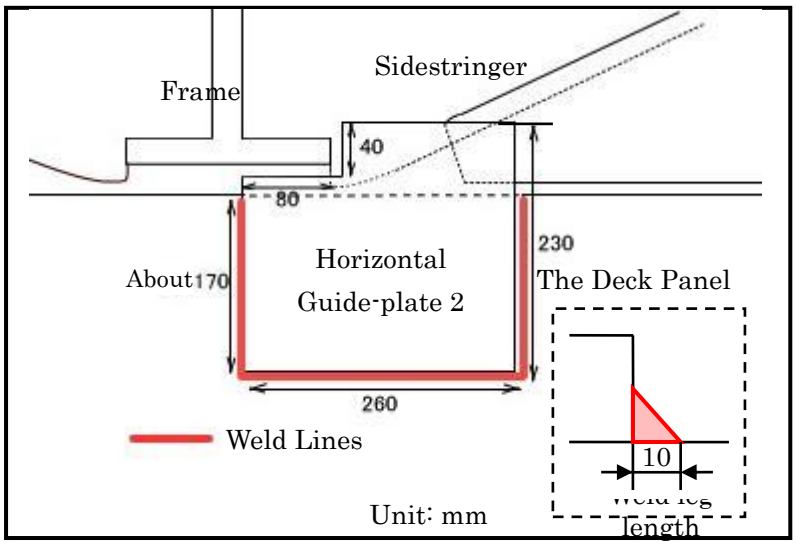


Figure 2.5.4-6: Horizontal Guide-Plate 2

{2} Damage

The horizontal guide-plates were damaged (refer to Figure 2.5.4-7 Damage to Horizontal Guide-Plates) as follows:

a Horizontal Guide-Plate 1 had no damage

b Horizontal Guide-Plate 2 and 3 had their portions extruding out of the Deck Panel bent upward; the weld lines on both sides were broken (refer to Photo 2.5.4-4: Fracture Cross-Section of Weld Line)

c Horizontal Guide-Plate 4 has grind marks around the cut; however, the weld lines were not broken.

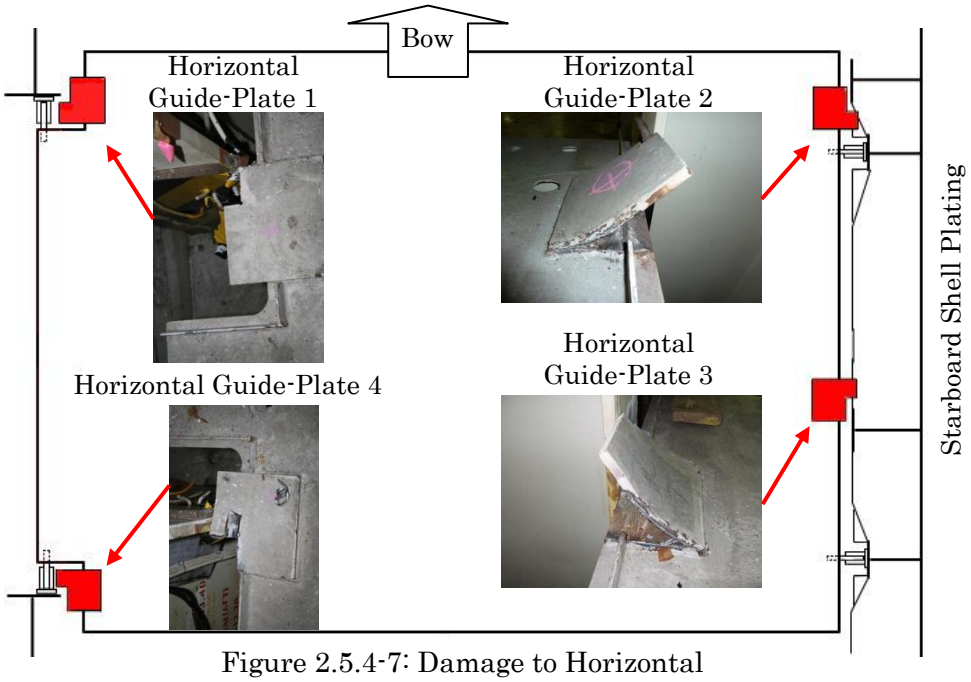


Figure 2.5.4-7: Damage to Horizontal Guide-Plates

Photo 2.5.4-4: Fracture Cross-Section on Weld Line

{3} Horizontal Guide-Plates 2 and 3, and Sidestringer

As shown in the photos below (Photo 2.5.4-5: Positional Relation of Horizontal Guide-Plate 2 and Sidestringer), the sidestringer was installed in such a way that, when the Deck Panel was set on its normal position, the upper surface of the Deck Panel leveled the sidestringer installed as a ship structure.

As shown in the photos below (Photo 2.5.4-6: Situations of Horizontal Guide-Plate 2, Horizontal Guide-Plate 3, and Sidestringer), the contact mark on the lower surface of Horizontal Guide-Plate 2 was identical to that on the upper surface of the sidestringer.

In addition, when the Deck Panel was lifted up to the normal position, and the bends of Horizontal Guide-Plate 2 and Horizontal guide-Plate 3 were removed, the tips of Horizontal Guide-Plate 2 and 3 overlapped the sidestringer.

Photo 2.5.4-5: Positional Relation of Horizontal Guide-Plate and Side Stringer

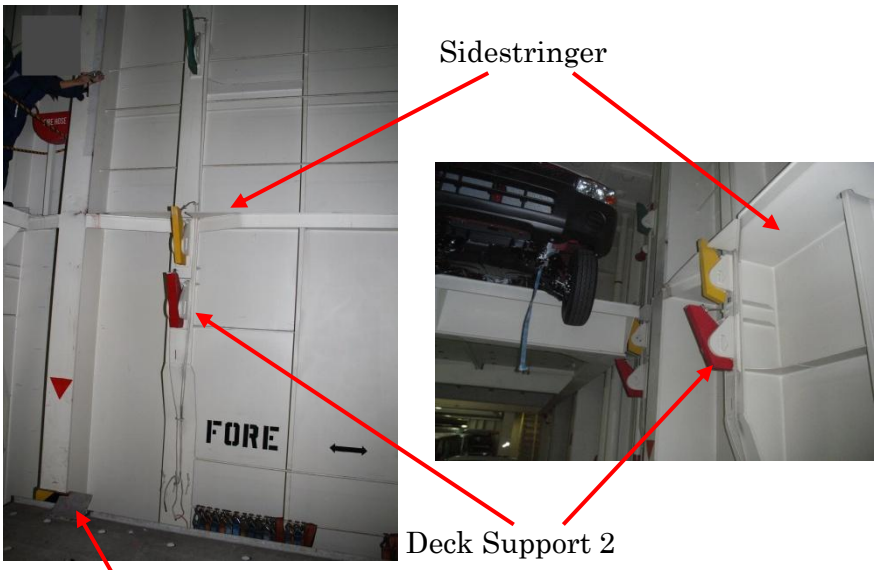
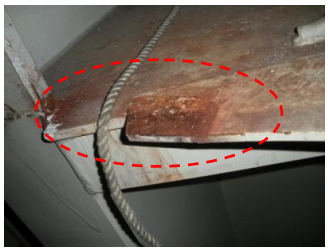


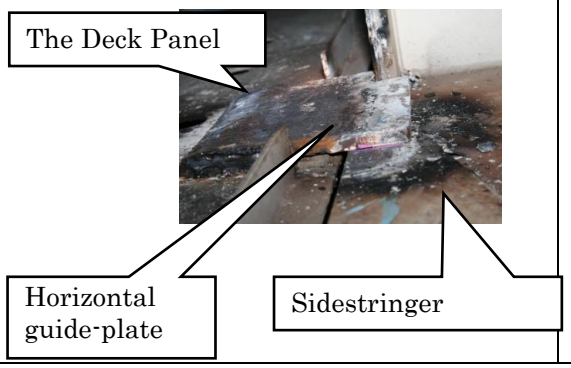
Photo 2.5.4-6: Situations of Horizontal Guide-Plate 2, and 3 and Sidestringer

Contact mark on the lower surface of Horizontal Guide-Plate 2

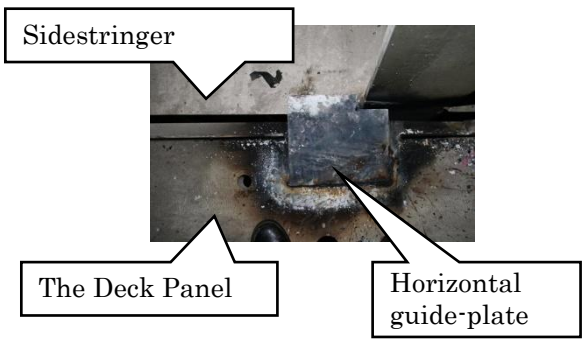
Contact mark on the contact part of the side stringer with Horizontal Guide-Plate 2



Horizontal Guide-Plate 2 after the bends were removed



Horizontal Guide-Plate 3 after the bends were removed



(5) Gaps between the Deck Panel and surrounding Structures

The following gaps were measured after setting the Deck Panel on the normal position, and recovering the horizontal guide-plates bent in the accident into their normal state without bends: the gaps between the horizontal guide-plates and pillars or frames; and the gaps between the Deck Panel and the adjacent deck panels. The gaps measured in the

normal state are shown in the figure below (Figure 2.5.4-8: Gaps between the Deck Panel and surrounding Structures)

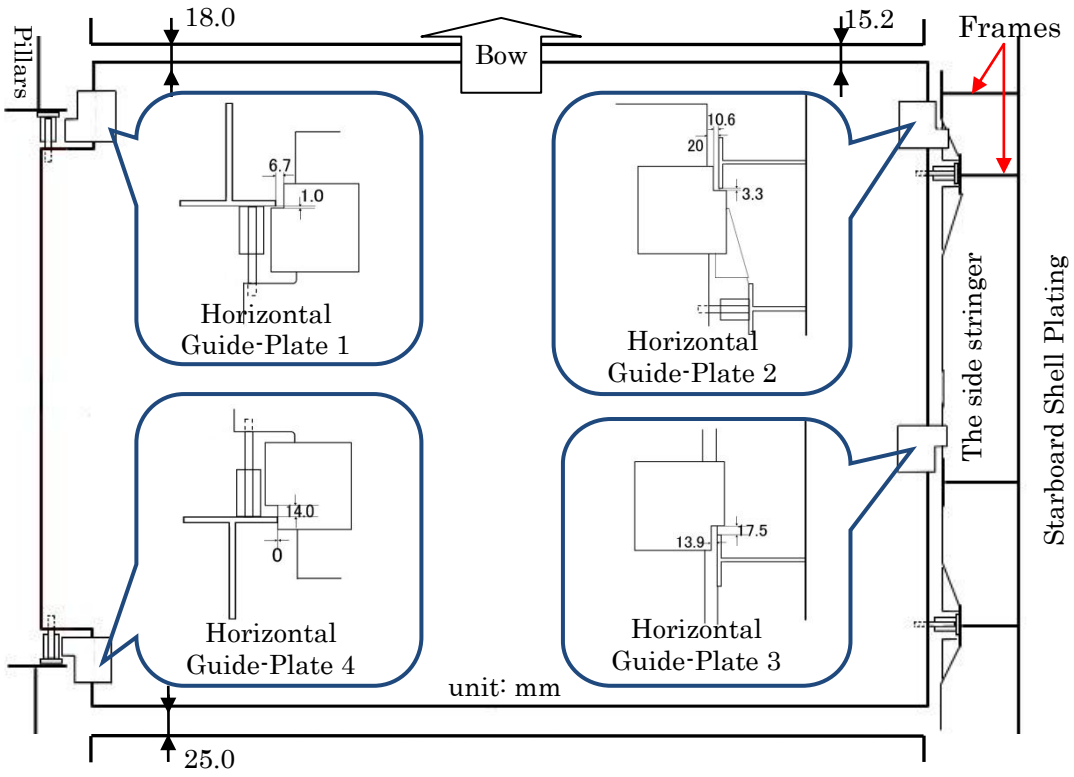


Figure 2.5.4.-8: Gaps between the Deck Panel and surrounding Structures

(6) Amount of Deflection on the Deck Panel caused by Load

{1} Amount of Deflection by Design

According to the summary documents of design by the ship builder, when the Deck Panel is loaded with the design load, the Deck Panel deflects 56 mm downward at its center, and shrinks by about 2 mm horizontally.

{2} Measurement by Site Investigation

The table below shows the variation of the measurement of the amount of deflection of the Deck Panel supported by the deck supports at the normal position from a dead load situation to a loaded situation with a load of 84 drums cans of about 200 kg filled with water and placed on the Deck Panel in such a way that they create almost the same weight distribution as that when the accident occurred.

The horizontal shrink of the Deck Panel was too small to measure.

(Unit: mm)

	← Ship Center						Starboard →	
Bow End	−4	−11	−16	−19	−16	−9	−6	0
Stern End	0	N. A.	−2	−3	−2	−3	−2	0

(Refer to Photo 3: Situation of Measurement of Deflection of the Deck Panel)

2.5.5 Breaking Force of Horizontal Guide-Plate broken in the Accident

According to the oral statements from the person-in-charge in the ship-builder, the horizontal guide-plates, designed for restricting the horizontal slide of deck panels, were not designed to hold a vertical load; however, as shown in 2.5.4(4){3}, the tips of Horizontal Guide-Plate 2 and Horizontal Guide-Plate 3 overlap the sidestringer.

To compare the load applied to Horizontal Guide-Plates 2 and 3 with the breaking force of the weld lines of Horizontal Guide-Plates 2 and 3, the estimation of those forces was consigned to the National Maritime Research Institute, and the results are as follows.

(1) Load applied to Horizontal Guide Plate 2

The reactive forces at the support points (corresponding to Horizontal Guide-Plates 2 and 3, and Deck Supports 1, 3, and 4) by a load distribution set for the analysis in such a way that it should be the same as that at the time of the accident occurrence, where the cars were loaded one by one as described in 2.5.2(2), were obtained by elastic finite element analysis with the boundary condition set on the Deck Panel as shown in the figure below (Figure 2.5.5-1: Setting of Boundary Condition on the Model of the Deck Panel); the results are shown in the figure below (Figure 2.5.5-2: History of Reactive Force at Each Support Point).

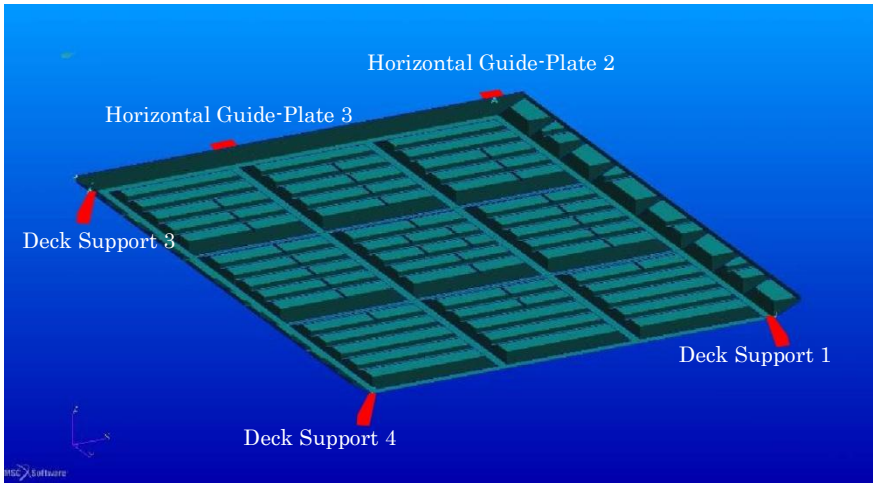


Figure 2.5.5-1: Setting of Boundary Condition on the Model of the Deck Panel

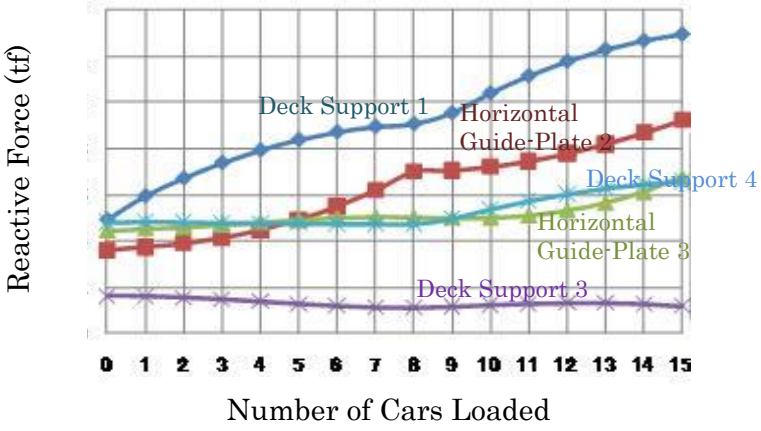


Figure 2.5.5-2: History of Reactive Force at each Supporting Point

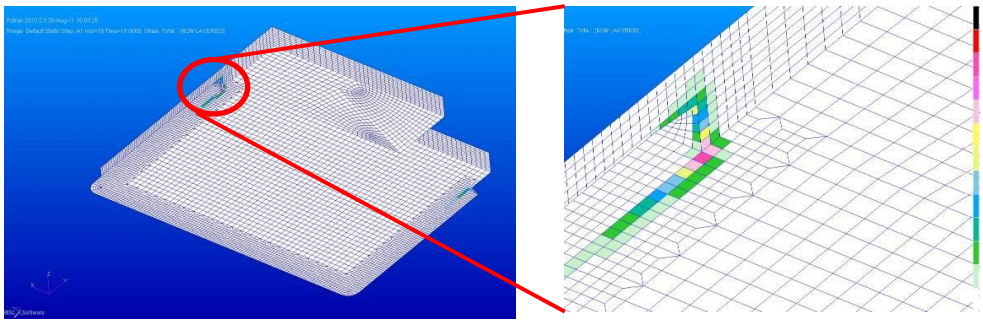
(2) Breaking Force on the Weld Lines of Horizontal Guide-Plate 2

Each breaking force of each of the weld lines on Horizontal Guide Plates 2 and 3 was estimated by elastic finite element analysis as shown below, on the following assumptions.

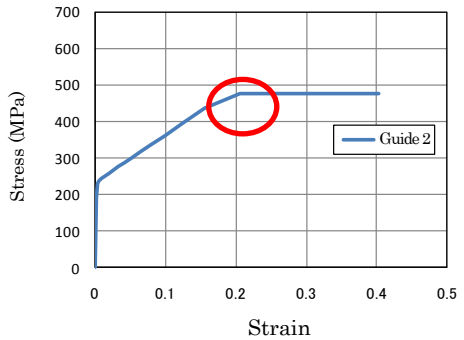
Each of Horizontal Guide-Plates 2 and 3 was welded at the three sides on the upper surface, and they were both 20 mm thick — it was the actual situation. The weld length of each Horizontal Guide-Plate is 10 mm. The material characteristics of each of Horizontal Guide-Plates 2 and 3 are compatible with SS400 of JIS(Japanese Industrial Standards)G3101. The material characteristics of welding metal are compatible with D5816 of JISZ3212. The pressure is applied solely and uniformly on the overlap portion of the starboard side sidestringer and Horizontal Guide-Plates 2 and 3. The table below shows the relation of stress to strain of the elements in the Horizontal Guide-Plate 2 side, where the strongest force would be applied.

The results of the analysis are shown in the table below, using the relationship between the stress and strain on the Horizontal Guide-Plate side elements in the weld edges, where the strength condition is severest, (refer to Figure 2.5.5-3: Corresponding Deflection Distribution Contour (Horizontal Guide-Plate 2)).

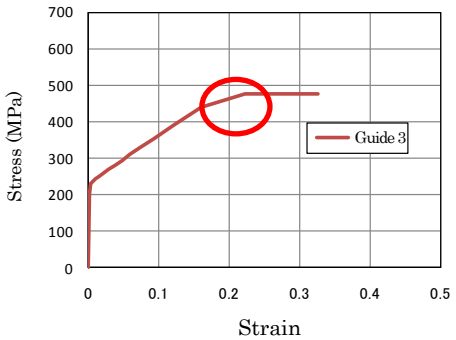
Figure 2.5.5-3: Corresponding Stress Distribution Contour (Horizontal Guide-Plate 2)



(The welded portion is seen through the Deck Panel upward)



Horizontal Guide-Plate 2



Horizontal Guide-Plate 3

The stress stops growing and stays at a constant value when the strain approaches the elastic limit of the horizontal guide-plate material (designated by a red circle around 0.2). It is considered that the ruptures of the weld line of the horizontal guide-plate begins around there, where the load applied on the horizontal guide-plate is estimated to be about 9.5 tf for Horizontal Guide-Plate 2, and about 8.5 tf for Horizontal Guide-Plate 3. After the loaded point is ruptured, the stress on the weld edge becomes larger, and then the break-down grows sequentially at the load.

The loads applied on Horizontal Guide-Plate 2 and Horizontal Guide-Plate 3 at the time of the accident occurrence are shown in the table below, compared with the estimated breaking force on the weld lines of Horizontal Guide-Plates 2 and 3.

	Load at the time of the occurrence of the accident	Estimated breaking force on the weld line
Horizontal Guide-Plate 2	Approximately 9.25 tf	Approximately 9.5 tf
Horizontal Guide-Plate 3	Approximately 6.77 tf	Approximately 8.5 tf

The result shows that the load on Horizontal Guide-Plate 2 at the time of the occurrence of the accident is very close to the estimated breaking force.

The estimated breaking force on the welding line is larger than the load at the time of the occurrence of the accident. The reason is considered that the assumption of 10 mm, the weld leg length of horizontal guide-plates, used in the model, is an over-estimated value when the non-uniformity of the actual weld lines is taken into account, and the actual strength would be less than that of the estimated value.

2.6 Operation

2.6.1 Operation of the Ship

According to the stowage plan of the Ship and VOYAGE MEMO, the planned unloading ports, after the accident, were as follows: CALDERA (Republic of Chile), CALLAO (Republic of Peru), IQUIQUE (Republic of Chile), and SAN ANTONIO (Republic of Chile). The loading ports in the previous voyage were as follows: Mitajiri-Nakanoseki Port, Hofu City, Yamaguchi Prefecture; Mizushima Port, Kurashiki City, Okayama Prefecture; Nagoya Port; and Keihin Port. Cargoes were unloaded at the followings ports in the Commonwealth of Australia: Port of BRISBANE, PORT KEMBLA, and Port of MELBOURNE. In addition, on each of the four voyages prior to the voyage mentioned above, the Ship made voyages where cars were loaded at MANZANILLO and ACAPULCO (The United Mexican States), and unloaded at ports in Central and South America such as PUERTO QUETZAL (Republic of Guatemala), MANTA (Republic of Ecuador).

2.6.2 Safety Management

(1) Documents of Compliance and Safety Management Certificate

DET NORSKE VERITAS AS issued a document of compliance based on the ISM Code, to the management company on April 6, 2006. Nippon Kaiji Kyokai (Class NK) issued a Safety Management Certificate based on the ISM Code to the Ship on July 20, 2006.

(2) Safety Management Manual

The safety management manual, prepared by the management company following the ISM Code, had descriptions on the safety check prior to loading or discharging as follows:

7.9. Preparation for Cargo Loading / Discharging Operations

(omitted)

7.9.4.3. Pre-Arrival Checks And Reports

The chief officer shall ascertain that all compartments wherein cargo will be loaded are in a safe condition to receive the cargo.
(omitted)

2.6.3 Manuals and In-ship Education for Panel Work

(1) Manuals for Panel Work

According the oral statements and the written reply to the questionnaire from the person-in-charge of the Charterer, the situation is as follows.

The Charterer had prepared the following material and provided it to the pure car-carriers chartered by the company: computer-based education software titled "PCC -STARS" (Shipboard Training and Assessment Recording System, hereinafter referred to as the "Education Software"), which compiled what the Ship was supposed to do for cargo-handling from the standpoint of the charter. The Education Software establishes the handling manuals for the pure car-carriers titled "Manual for Car Carriers," and contains the following provisions on panel handling:

II Before arriving first port
(omitted)
2 PREPARATION FOR LOADING
(omitted)
4 Panel operations
1) Liftable panels should be set in accordance with the instruction from NYK.
2) The unused Liftable deck support should be folded.
3) Stanchions, safety ropes and safety signs are erected at the gaps between the panels.
(omitted)

Crew members were permitted to log-in and view the Education Software using the accounts issued to them.

"The Instruction from NYK" is video education material distributed by the Charterer. It contained, in addition to scenes showing the panel handling, a scene with a caption telling "Confirm all stoppers are engaged after panel is lifted" and with a crew member confirming deck supports supporting a deck panel.

(2) On-ship Education

According to the oral statements from Chief Officer A and the master, the Ship had an on-ship education system where newly-onboard crew members were obligated to watch the video-education materials distributed by the Charterer on a personal computer installed in the office on the Ship. Crew members were requested to sign a checklist for the master to confirm after watching the materials. In addition, on a site of actual panel handing after the education, chief officers made instructions for training.

2.7 Panel Work

2.7.1 Deck Panel, Height-readjusted Prior to Entry to Kanda Port

According to the written reply to the questionnaire from the person-in-charge of the Charterer, the deck panels on the car decks were readjusted as follows: on car deck No. 5, no deck panels were

readjusted; on car deck No. 7, on the port side, four panels, the first to the fourth counted from the stern end, were readjusted from the high position to the normal position, and 18 deck panels, including the Deck Panel, on both the starboard and port sides, from the fifth counted from the stern end toward the bow, were readjusted from the middle position to the normal position; on car deck No. 9, all 24 deck panels were readjusted from the middle position to the normal position.

(Refer to Figure 3: Situation of Panel Work)

2.7.2 Deck Supports in Normal Position

According to the oral statements from Chief Officer A, deck supports in the normal position, expected to work as a fail-safe device in an emergency, were always kept open to support deck panels.

2.7.3 Panel Work

According to the oral statements from Chief Officer A and the video learning material contained in the Education Software, the procedures for readjusting a deck panel from the middle position to the normal position were described as follows:

(1) Move a lift car onto the car deck immediately below the deck panel to readjust, put down the four legs of the lift car and fix them on the marks on the car deck, and then, extend upward the pneumatic deck-lifter to slightly push the deck panel upward and hold.
(2) Have the station crew members under the four deck supports pull the Roll-up Rope to retract the deck supports in the middle position that have supported the deck panel so far, fix the Roll-up Rope, and then confirm that the deck supports in the normal position are open so that the deck supports are able to support the deck panel.
(3) Has Chief Officer check the state of the four deck supports in the normal position, then lower the deck panel with the pneumatic deck-lifter so as to put the panel on the deck supports, and finally, visually check that the deck supports correctly support the deck panel.

The panel work of the Deck Panel was executed following procedure (1) to (3) described above. The Deck Panel, previously in the middle position, was readjusted to the normal position.

2.7.4 Safety Confirmation by Port Transportation Service Providers and others

According to the manuals prepared by Company A, regarding what to do prior to beginning cargo handling operation, the following matters to be confirmed concerning liftable decks and the area around them were described in the work manual for the foreman:

[3-3] What to confirm onboard

After the opening meeting, carriers and caster-drivers must walk along the routes in order to find a critical point for safety and execute safety measures; in addition, before starting operations, a foreman, with gang-leaders or team-leaders, must confirm the safety measures, and instruct to add safety measures if necessary. If more than one gang is involved, gangs are permitted to start working along the order of the completion of safety-measure confirmation.

Furthermore, a foreman, during stevedoring, must keep watching and continue safety

confirmation.

(omitted)

(5) Confirmation of Panel Position and Inner-ramp Position

Confirm that panels are, as ordered, in the right place and at the right height, and that the inner-ramp is set on the loading deck.

(6) Confirmation of Ventilators in Operation, and Lights-on

(omitted)

2.8 Weather and Sea conditions

2.8.1 Observations of Weather and Sea Conditions

(1) At the time of the occurrence of the Accident

According to the Yokohama Marine Observatory, located northwest of approximately 2.8 km from the site of the accident occurrence, the observations were as follows:

December 1 0900 hrs: weather slightly cloudy; wind direction N; wind speed 1.9 m/s
1000 hrs: weather fine; wind direction NNW; wind speed 1.9 m/s

(2) At the time of Panel Work prior to Entry to Kanda Port

According to the logbook of the Ship, on November 22, when the Panel Work was executed, the position of the Ship at noon was 29° 17'N, 134° 09'E; according to the weather chart on November 2010 published by the Japan Meteorological Agency (CD-ROM Edition), the marine observations near the Ship position at noon on November 22 are as follows:

0900 hrs (29° 42'N, 134° 30'E)

Wind direction ESE; wind speed 15 knots (approximately 7.7 m/s)

Wave period and height five seconds and 1.0 m; swell period and height six seconds and 1.5 m

0900 hrs (29° 42'N, 132° 18'E)

Wind direction SE; wind speed 16 knots (approximately 8.2 m/s); weather cloudy; wave period and heigh three seconds and 1.0 m; swell direction, period, and height SE, six seconds, and 2.5 m

1500 hrs (29° 48'N, 132° 18'E)

Wind direction, SSE; wind speed, 15 knots; weather, rain

2.8.2 Observation by Crew

According to the oral statements from the master, the sea was smooth on November 22, when the Panel Work was executed.

3 ANALYSIS

3.1 Situation of the Accident Occurrence

3.1.1 Course of the Events

According to 2.1 and 2.7, it is highly probable that the events leading to the accident are as follows.

(1) On November 22, 2010, the Ship was underway to Kanda Port with five crew members including Chief Officer A, on car decks No. 7 and No. 9, both liftable, and Panel Work was executed on panels at 46 positions in total; as a result, the Deck Panel on car deck No. 7 was readjusted from the middle position to the normal position.

(2) At around 1500 hrs, November 30, the Ship, after being loaded with 3,157 cars at Kanda Port and Nagoya Port, berthed at Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port

(3) At around 0830 hrs, December 1, according the stowage plan to load 380 cars in total on car deck No. 7 and car deck No. 8, the cargo-loading was started. At around 0950 hrs, in the middle of the car loading on car deck No. 7, the Deck Panel fell onto car deck No. 6, with an attitude of tilting toward the starboard bow.

(4) The fall of the Deck Panel caused injuries to ten longshoremen in total, including six working on the Deck Panel and four working on car deck No. 6 immediately below the Deck Panel.

3.1.2 Date and Location of the Occurrence of the Accident

According to 2.1, it is certain that the time of the occurrence of the accident was around 0950 hrs, December 1, 2010, and the location was Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port.

3.1.3 Situation of the Fall of the Deck Panel

According to 2.1, it is highly probable that the situation of the fall of the Deck Panel was as follows.

On car deck No. 7, cars were placed one by one from the bow end to the stern end; on the Deck Panel, eight cars on the first row were placed facing the stern with their front tires on the Deck Panel and their rear tires on the deck panel adjacent to the bow side of the Deck Panel; in the middle of placing cars on the second row, one by one behind the first row from the ship-center side to the starboard side, the Deck Panel, at the moment when the 7th car was placed, fell onto car deck No. 6.

3.2 Causal Factors of the Accident

3.2.1 Crew

According to 2.4.1(1), the master, Chief Officer A, and Chief Officer B each had a valid certificate of competence.

3.2.2 Analysis of Deck Panel and other things

(1) Deck Supports

According to 2.5.4(1), 2.5.4(3), and 2.7.2, it is probable that on the Ship, although the deck supports for the liftable decks were retractable, they were not retracted in the normal position when they were not in use.

(2) Damage to the Deck Panel and other things

According to 2.5.4 (2) to (4), it is probable that the damage to the Deck Panel, Horizontal Guide-Plates 2 to 4, and Deck Supports 1 and 3 were caused when the Deck Panel fell down.

In addition, it is somewhat likely that the damage to Deck Support 2, which was not completely lowered to the supposed supporting position when the deck panel was lowered to the normal position, was caused by the lower-surface corner of the Deck Panel hitting the tip of Deck Support 2.

(3) Amount of Horizontal Shift of the Deck Panel

According to 2.5.4(1), (4), and (5), it is probable that the amount of horizontal shift of the Deck Panel, limited by the distance between the Horizontal Guide-Plate and a pillar or frame, was 20.8 mm at its maximum in the ship-length direction and 17.3 mm at its maximum in the ship-breadth direction; therefore, even if moving horizontally at its maximum, the Deck Panel would not have fallen off the supporting surface of the deck support.

(4) Amount of Horizontal Shrink caused by the Deck Panel Deflection

According to 2.5.4(6), it is probable that, while the Deck Panel showed deflection by 19mm downward at the bow center-line side due to cars weight the same as that at the occurrence of the accident, the amount of horizontal shrink caused by the deflection was too small to measure; therefore, the Deck Panel would not fall off the supporting surface of the deck support.

(5) Withstand Load of Deck Support

According to 2.5.2(2) and 2.5.4(3){3}, it is probable that, because the deck supports were installed so that they withstand the load of 59,980 kgf, the design load of the Deck Panel at the full load is 14,990 kgf per one deck support, and, even if only Deck Supports 1 and 2 on the bow end supported the weight of the car placed at the bow end—16,950 kgf—, the load per one deck support was 8,475 kgf; consequently Deck Supports 1 and 2 would be able to support the cars weight at the time of the occurrence of the accident.

(6) Analysis of the Rupture of Horizontal Guide-Plates 2 and 3

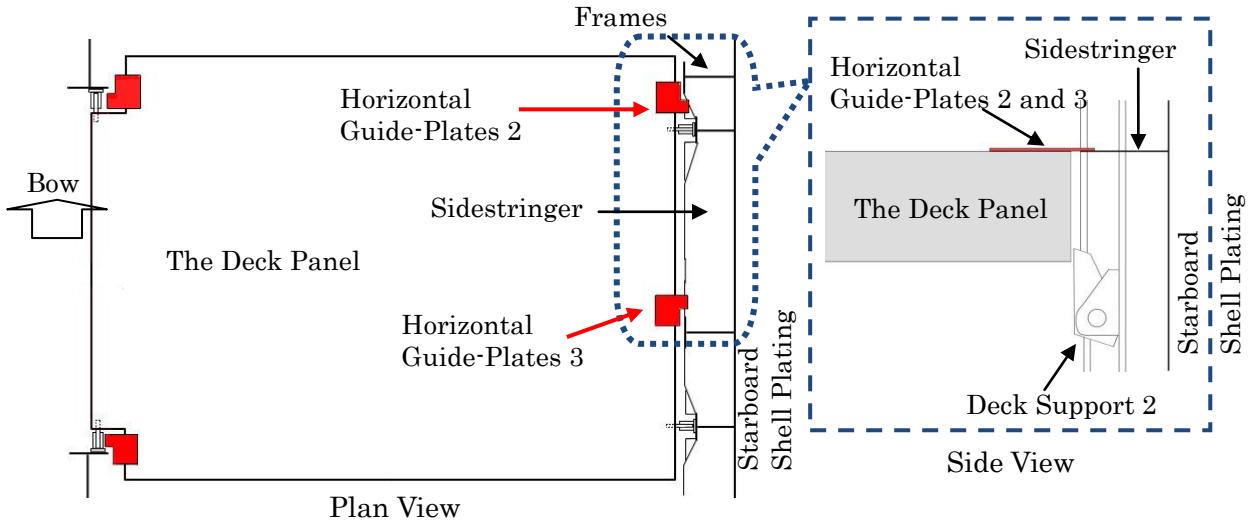
According to 2.5.4(4){2}, 2.5.4(4){3}, and 2.5.5(2), it is probable that the tips of Horizontal Guide-Plates 2 and 3, overlapping the upper surface of the side stringer when the Deck Panel was in the normal position, were structured to be able to support the Deck Panel (refer to the figure below), and Horizontal Guide-Plates 2 and 3 got bent upward due to the rupture of the weld lined on both sides. Also, it is probable that the load applied on Horizontal Guide-Plate 2 at the time of the occurrence of the accident caused a weld-line rupture, leading to a

weld-line rupture of Horizontal Guide-Plate 3.

(7) Analysis of the Support-situation of the Deck Panel

According to 2.1 and (3) to (6) described above, it is somewhat likely as follows.

Deck Support 2 did not support the Deck Panel, judging from the fact that the starboard bow of the Deck Panel first sank, and then the Deck Panel fell down, but the tips of Horizontal Guide-Plates 2 and 3, overlapping the upper surface of the sidestringer, supported the Deck Panel, and the weld lines of Horizontal Guide-Plates 2 and 3 seemed to be rupture because the weight of cars were applied to them.



3.2.3 Panel Handling of the Deck Panel

According to 2.1, 2.5.4(3) {4}, 2.5.4(4), 2.6.2, 2.6.3, 2.7.2, 2.7.3, and 3.2.2, it is as follows.

(1) It is probable as follows: the Panel Work of the Deck Panel was executed by five crew members, including Chief Officer A, and while the lift car was holding the Deck Panel up, each crew member stationed under each of the four Deck Supports pulled each Pull-up Rope at the middle position to retract each Deck Support, and then confirmed each Deck Support at the normal position to be in a position to support the Deck Panel. It is also probable as follows: Chief Officer A confirmed the state of the Deck Supports in the normal position, but the confirmation was executed by sight only, and described later in 3.2.7.(4) below, that the Ship had no systems to confirm the state by, for example, using a check list.

(2) It is probable that Chief Officer A, although the manuals contained in the Education Software provided by the Charterer required that the deck supports not in use must be retracted, for the reason that the deck supports had a safety-device function to prevent deck panels from sinking lower than the normal position, kept such deck supports not retracted but always open to be able to support deck panels.

It is somewhat likely that, therefore, Chief Officer A, believing that the deck supports in the normal position were in the state to support the Deck Panel, not thinking of confirming the states, did not notice that Deck Support 2 was not in the position to support the Deck Panel.

(3) It is somewhat likely that when the Deck Panel was readjusted down to the normal position, Deck Support 2, not fully open to support the Deck Panel correctly, with its tip hit by the lower surface corner of the Deck Panel and pushed off the Deck Panel, did not support the Deck Panel. It is also somewhat likely that, on the other hand, the tips of Horizontal Guide-Plates 2 and 3, overlapping a sidestringer, supported the Deck Panel at the overlapping portions.

While, it is somewhat likely that the rotation of Deck Support 2 around the steel shaft running through Deck Support 2 was not good enough, the situation remained unproved.

3.2.4 Situations leading to the Fall of the Deck Panel

According to 2.1, 2.5.4(3){4}, 2.5.4(4), 3.2.2 and 3.2.3, it is somewhat likely as follows: as the load applied on Horizontal Guide-Plate 2 and Horizontal Guide-Plate 3 grew larger according to the progress of the loading of cars, the weld-portions of both guide-plates, receiving loads exceeding their rupture load, broke down; then the Deck Panel tilted toward the starboard bow side and fell off all the Deck Supports, falling onto car deck No. 6.

3.2.5 Situations leading to the Injuries of Longshoremen

According to 2.1 and 2.2, it is considered as follows.

(1) The Deck Panel

When the Deck Panel fell onto car deck No. 6, Longshoreman C_1, Longshoreman C_2 to C_5, and Driver B_1 suffered cervical sprain and head contusions while working on car guidance, while working on lashing cars placed in their positions, and when parking the 7th car on the second row and getting out the car, respectively.

(2) Car deck No. 6 immediately below the Deck Panel

When the Deck Panel fell down on car deck No. 6, Longshoreman C_6 was in the middle of guiding cars, Longshoreman C_7 was waiting for the second car to park at its position with lashing belts in his hands, Longshoreman C_8 and C_9 were in the middle of lashing with their bodies under the car. Longshoreman C_{7S} head and back were hit by the structure of the Deck Panel, Longshoreman C_8 and C_9 were hit by the first car flattened by the Deck Panel, and Longshoreman C_7, C_8, and C_9 suffered cervical sprain, lumbar spine sprain, and back contusion.

3.2.6 Weather and Sea Conditions

(1) At the Time of the Occurrence of the Accident

According to 2.8.1(1), it is probable that the Ship received no disturbance because the weather was fine, and the wind was 1.9 m/s N to NNW.

(2) During the Panel Work prior to Entry to Kanda Port

According to 2.8.1(2), it is probable as follows: according to the summary of the observations at the observation points—such summarization will be allowed because there were no major differences among the observations—, the weather was cloudy or rainy, the wind was SE to SSE around 15 knots (approximately 7.7 m/s), and as for sea conditions, there were waves caused by wind with a height of approximately 1.0 m and a period of approximately three seconds, and swells from the SE with a period of approximately six

seconds and a height of approximately 2.5 m; however, the weather and sea conditions were not so severe as to disturb the Panel Work.

3.2.7 Safety Management

According to 2.6.2 to 2.6.3, 2.7.3, and 2.7.4, it is as follows.

(1) It is certain that the ship management company, although stipulating in its safety management manual that a chief officer must confirm the safety of all the facilities for accepting cargoes prior to the start of cargo loading, had not prepared any specific procedure of the Panel Work.

(2) It is certain that the Charterer, by providing the Ship with the Education Software summarizing what is required for the chartered ships on the handling of cargoes from the standpoint of the Charterer, and by obligating newly onboard crew members to view the manuals installed in the personal computer on the ship and video materials to learn the Panel Work themselves, had prepared a system of in-ship education on the Panel Work.

(3) It is probable that the Charterer, although preparing, in the video material contained in the Education Software provided to the Ship, a sequence of procedures for the Panel Work, had no other operation manuals for the Panel Work.

(4) According to (1) to (3) described above, it is probable that the Ship had no system to confirm the states of the deck supports prior to lowering the deck panels by, for example, using a check list. Therefore, it is somewhat likely that, as described above in 3.2.3(2), Chief Officer A did not notice that Deck Support 2 was not in a position to support the Deck Panel. It is somewhat likely that, if such a system to confirm the states of deck supports by, for example, using a check list had been prepared, the occurrence of the accident would have been prevented.

It is somewhat likely that the absence of stipulation by the management company in their safety management manual of specific operation procedures and the Ship's lack of systems for confirming the states of deck supports by, for example, using a check list prior to lowering deck panels contributed to the occurrence of the accident.

(5) It is probable that, although Company A required in its operation manual for a foreman as a pre-loading operation to confirm hazardous places for safety along the route on the ship, to take safety measures, and to confirm that deck panels on liftable decks were set in the place and height as planned, it prepared no descriptions in the manual on confirming the supporting state of the deck support of a deck panel, because it had not acknowledged that liftable decks are a dangerous place.

3.2.8 Occurrence of the Accident

The description from 2.1, 2.2, 2.5.4, 2.6.2 to 2.6.3, 2.7, 3.2.2 to 3.2.6 and 3.2.7 indicates the followings.

(1) It is highly probable that on the Ship, navigating to Kanda Port, on November 22, 2010, by five crew members, including Chief Officer A, executed Panel Work of the 46 positions in total on car deck No. 7, liftable, and car deck No. 9, also liftable, and the Deck Panel was readjusted from the middle position to the normal position.

(2) It is probable as follows: although the manual contained in the Education Software provided by the Charterer stipulated panel works ensuring that deck supports not in-use are

retracted, considering that deck supports in the normal position functioned as a safety device to prevent a deck panel from falling lower than the normal position, Chief Officer A kept the deck panel open and available for supporting a deck panel; therefore, during Panel Work, Chief Officer A, believing that the Deck Supports in the normal position were in the state to support the Deck Panel, not thinking of confirming the state of the Deck Support, did not notice that the Deck Support was not in a state to support the Deck Panel.

(3) It is somewhat likely that, when Chief Officer A lowered the Deck Panel to the normal position, Deck Support 2, with its tip hit by a lower-surface corner of the Deck Panel, moved outward from the Deck Panel into a situation where it did not support the Deck Panel; on the other hand, Horizontal Guide-Plates 2 and 3, overlapping a sidestringer, supported the Deck Panel at the overlapping portions.

(4) It is somewhat likely that, while the Ship was loading cars in Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port, because the load applied to Horizontal Guide-Plates 2 and 3 grew larger as the loading of cars on the Deck Panel proceeded, weld lines on Horizontal Guide-Plates 2 and 3 ruptured, the Deck Panel tilted toward the starboard bow, falling off all the Deck Supports, and then, the Deck Panel fell onto car deck No. 6.

(5) It is highly probable that the falling of the Deck Panel caused injuries to ten longshoremen in total, that is, the six longshoremen working on the Deck Panel and the four longshoremen working on car deck No. 6 immediately below the Deck Panel.

(6) It is probable that the management company had not prepared a work procedure describing specifically the panel work, and the Ship, equipped with no other manuals for panel work than the video education-materials provided by the Charterer containing a sequence of panel work, had no systems for confirming the state of deck supports by, for example, using a check list prior to lowering a deck panel.

(7) It is somewhat likely that the absence of stipulation by the management company in their safety management manual of specific operation procedures and the Ship's lack of systems for confirming the states of deck supports by, for example, using a check list prior to lowering a deck panel contributed to the occurrence of the accident.

4 PROBABLE CAUSES

4.1 Findings

(1) Situation of the Occurrence of the Accident

{1} On November 22, 2010, while the Ship was navigating to Kanda Port, five crew members, including Chief Officer A, executed Panel Works on liftable car decks No.7 and No.9 at 46 positions in total; as a result, the Deck Panel on car deck No. 7 was readjusted from the middle position to the normal position.

{2} The following is highly probable:

Since around 0830 hrs, December 1, 2010, the Ship had been loading cars at Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port; while the Ship was loading cars on the Deck Panel, the Deck Panel fell onto car deck No. 6 and ten longshoremen on the

Panel Work were injured

(2) Analysis of The Deck Panel and other things

{1} It is probable that the Deck Panel would not fall off the Deck Support due to horizontal shift or the influence of the loaded cars, because the horizontal shift of the Deck Panel was limited by the horizontal guide-plates, and in addition, the amount of shrink of the Deck Panel due to the deflection caused by the weight of the cars applied to the Deck Panel was too small to measure.

{2} It is probable that Deck Supports 1 and 2 were able to support the weight of the cars at the time of the occurrence of the accident, because the Deck Supports were installed so that they withstand a load of 59,980 kg—cargo weight on the Deck Panel at full load—, and even if the situation was such that Deck Supports 1 and 2 on the bow end solely supported the weight of 16,950 kg—the total weight of the cars placed on the bow end of the Deck Panel—, the load per one deck support was 8,475 kg.

{3} The following is probable:

Horizontal Guide-Plates 2 and 3 were mounted in such a way that, at the normal position, their tips overlap the upper surface of the sidestringer to support the Deck Panel, the weld lines on Horizontal Guide-Plates 2 and 3 were ruptured during the accident, and Horizontal Guide-Plates 2 and 3 were bent upward.

Also, it is probable that the weld lines of Horizontal Guide-Plate 2 under a load the same as that applied at the time of the accident occurrence is ruptured first, and then the weld lines on Horizontal Guide-Plate 3 is ruptured.

{4} It is somewhat likely that Deck Support 2 did not provide support, judging from the fact that the starboard bow side of the Deck Panel sank first and that the Deck Panel then began to fall, and as described above in {1} to {3}, it is probable that the Deck Panel was supported by a surface portion where the tips of Horizontal Guide-Plates 2 and 3 overlap the upper surface of the sidestringer and received the load of the cars, and the weld lines on Horizontal Guide-Plates 2 and 3 were broken down.

(3) Analysis of Panel Work

{1} It is probable that the Ship had no systems to confirm the state of deck supports by, for example, using a check list prior to lowering the Deck Panel, judging from the fact that, whereas it is probable that Chief Officer A confirmed the state of the deck supports after the readjustment of the Deck Panel, executed by five crew members including Chief Officer A, from the middle position to the normal position, Chief Officer A only visually confirmed the state of the deck supports.

Also, it is somewhat likely that Chief Officer A, considering that the deck supports in the normal position function as a safety device preventing a deck panel from falling below the normal position, keeping them always open and ready to support, believing that the deck supports at the normal position were in a state to support the Deck Panel, and not thinking of confirming the states of the deck supports, did not notice that the deck supports were not in a state to support the Deck Panel.

{2} It is somewhat likely that Chief Officer A lowered the Deck Panel to the normal position, Deck Support 2 was neither fully open nor in the state to support the Deck Panel, and the

lower surface corner of the Deck Panel, hitting the tip of Deck Support 2, caused Deck Support 2 to move away from the Deck Panel. Also, it is somewhat likely that, on the other hand, the tips of Horizontal Guide-Plates 2 and 3, overlapping the sidestringer, supported the Deck Panel at the overlapping portion.

(4) Fall of the Deck Panel

It is somewhat likely that, along with the progress of the loading of cars, the load applied on Horizontal Guide-Plates 2 and 3, supporting the Deck Panel, grew larger, a load exceeding the breaking force was applied to the weld portions of both the horizontal guide-plates to cause them to rupture, and the Deck Panel tilted toward the starboard bow, fell off all the deck supports and onto car deck No. 6.

(5) Situations leading to the Injuries of Longshoremen

{1} The Deck Panel

Longshoreman C_1, guiding cars, Longshoreman C_2 to Longshoreman C_5, lashing the cars loaded, and Driver B_1, getting out of the 7th car after parking it in the second row, were hit when the Deck Panel fell onto car deck No. 6, and suffered cervical sprain and head contusion.

{2} Car-deck No. 6 immediately below the Deck Panel

Longshoreman C_6 was guiding cars and Longshoreman C_7 to C_9 were lashing cars when the Deck Panel fell onto car deck No. 6; Longshoreman C_7, hit by structures of the Deck Panel, suffered cervical sprain and lumbar spine sprain; Longshoreman C_8 and Longshoreman C_9, hit by the first car with its body sunk and flattened by the Deck Panel, suffered cervical sprain and lumbar spine sprain.

(6) Safety Management

{1} It is certain that the management company had not prepared a procedure specifically describing the Panel Work in their safety management manuals available on the Ship.

{2} It is considered probable that the Ship was equipped with no other manuals for Panel Work than the video learning material containing a sequence of panel work procedures, provided by the Charterer, and the Ship had no systems for confirming the states of the deck supports prior to lowering a deck panel by, for example, using a check list.

{3} It is somewhat likely that the fact that the management company had not stipulated specific procedures of the Panel Work in their safety management manuals, and the fact that the Ship had no systems for confirming the states of deck supports by, for example, using a check list prior to lowering a deck panel contributed to the occurrence of the accident.

(7) Causal Factors of the Accident Occurrence

{1} The following is somewhat likely:

The Deck Panel on car deck No. 7, a liftable deck, was not supported by Deck Support 2 in the loading of cars at Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port. Because of the lack of support by Deck Panel 2, the weld portions connecting Horizontal Guide-Plates 2 and 3 to the Deck Panel, receiving a load exceeding the breaking force as the load applied to Horizontal Guide-Plates 2 and 3 supporting the Deck Panel at the

portions overlapping the sidestringer grew larger along with the progress of the loading, ruptured. The rupture of the deck supports caused the Deck Panel to tilt toward the starboard bow, the Deck Panel fell off all the deck supports and onto car deck No. 6. The longshoremen working on the Deck Panel and the longshoremen working on car deck No. 6 immediately below the Deck Panel were injured.

{2} The following is somewhat likely:

The Ship, while navigating to Kanda Port, executed Panel Work on car deck 7 and other decks so as to readjust the Deck Panel from the middle position to the normal position. The Deck Panel was lowered without anyone noticing that Deck Support 2 was neither fully open nor in a position to support the Deck Panel, or that it moved outward from the Deck Panel and did not support it.

{3} It is somewhat likely that Chief Officer A, considering that the Deck Supports at the normal position function as a safety device to prevent the Deck Panel from falling lower than the normal position, keeping the Deck Support always open and ready to support Deck Panels, believing that the Deck Supports 2 in the normal position were in a state to be able to support the Deck Panel, and not thinking of confirming the state, did not notice that the Deck Supports were not in a state to be able to support the Deck Panel.

{4} It is somewhat likely that the fact that the management company had not stipulated specific procedures of the Panel Work in their safety management manuals, and the fact that the Ship had no systems for confirming the states of deck supports by, for example, using a check list prior to lowering a deck panel contributed to the occurrence of the accident. (Refer to Attached Figure 5: Casual Factors of the Accident Occurred (Summary))

4.2 Probable Causes

It is somewhat likely that the accident occurred because, while the Ship was loading cars at Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port, the Deck Panel of car deck No. 7, a liftable deck, was not supported by Deck Support 2; the load applied on Horizontal Guide-Plates 2 and 3, supporting the Deck Panel at their portions overlapping the side stringer, grew larger as the loading on the Deck Panel progressed; a load exceeding the breaking force was applied to the weld portions connecting both horizontal guide-plates to the Deck Panel and caused the weld lines to rupture; the Deck Panel tilted toward the starboard bow, falling off all the deck-supports and onto car deck No. 6; and the longshoremen working on the Deck Panel or car deck No. 6 immediately below the Deck Panel were injured.

It is somewhat likely that the reason why the Deck Panel was not supported by Deck Support 2 was that, while the Ship was navigating to Kanda Port, the Panel Work was executed on car deck No. 7 and other decks, the Deck Panel was readjusted from the middle position to the normal position, the Deck Panel was lowered without anyone being aware that Deck Support 2 was neither fully open nor in the state to support the Deck Panel, and Deck Support 2 moved outward from the Deck Panel.

It is somewhat likely that the reason why Deck Support 2 was not fully open nor in the state to support the Deck Panel was not noticed, was that Chief Officer A, considering that the deck supports at the normal position function as a safety device preventing deck panels from getting lower than the normal position, kept them always open, un-retracted, and ready to support a deck panel, believed that the deck support at the normal position was in a state to support the Deck

Panel and did not think of confirming the state.

It is somewhat likely that the fact that the management company had not stipulated specific procedures of the Panel Work in their safety management manuals and the fact that the Ship had no systems for confirming the states of deck support by, for example, using a check list prior to lowering deck panels, contributed to the occurrence of the accident.

5 SAFETY RECOMMENDATIONS

The Japan Transport Safety Board, in view of the result of the investigation of the accident, for the prevention of an occurrence of similar accidents, makes the following recommendation to owners and management companies of pure car carriers.

It is somewhat likely that the accident occurred because, while VEGA LEADER (hereinafter referred to as "the Ship") was loading cars at Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port, car deck No. 7, not supported by the deck support at the starboard bow end, while the loading of cars on the deck panel of cargo deck No. 7 (hereinafter referred to as "the Deck Panel") progressed, fell onto car deck No. 6, and the ten longshoremen working on the Deck Panel or car deck No. 6 immediately below the Deck Panel were injured.

It is somewhat likely that the height of the Deck Panel, while the Ship was navigating to Kanda Port, was readjusted from the middle position to the normal position, the Deck Panel was lowered without anyone being aware that the deck support on its starboard bow end was neither fully open nor in a state to support the Deck Panel, and the deck support on the starboard bow end moved outward from the Deck Panel.

It is somewhat likely that the absence of stipulation by the management company in their safety management manuals of work-procedures specifically describing the work for readjusting the height of a deck panel and the Ship's lack of systems for confirming the state of deck supports by, for example, using a check list prior to lowering deck panels contributed to the occurrence of the accident.

Therefore, it is necessary for owners and management companies of pure car carriers to reconsider and work out measures for ensuring confirmation that deck supports are in a state to correctly support a deck panel prior to lowering the deck panel and putting it on the deck support, and in addition, instruct their crew members regarding such measures.

Based on the experiences of the accident, a measure for preventing a fall of a deck panel by employing fixed-type deck supports was applied. Since ships are equipped with facilities and other things that may cause a severe accident, involving injury, due to a crew member's absence of confirmation, ship owners in general and others should consider hardware-based safety measures for facilities as a lesson learned from the accident.

Therefore, it is most likely necessary for owners of car carriers to consider and employ safer systems, such as fixed-type deck supports at the lowest level to prevent a panel-falling accident.

6 REMARKS

It is somewhat likely that the accident occurred because, while the Ship was loading cars at Nissan Motor Honmoku Wharf, Yokohama Section 5, Keihin Port, the Deck Panel on the car deck No. 7, not supported by Deck Support 2, while the car loading on the Deck Panel progressed, fell-down onto car deck No. 6, and the ten longshoremen working on the Deck Panel or on car deck No. 6 immediately below the Deck Panel were injured.

It is somewhat likely that, while the Ship was proceeding to Kanda Port, the Deck Panel, when readjusted from the middle position to the normal position, was lowered without anyone being aware that Deck Support 2 was neither fully open nor in a state to support the Deck Panel, and Deck Support 2 moved outward from the Deck Panel.

Port-transportation-service providers are recommended to regard deck supports on a liftable deck as dangerous parts and confirm that the deck panel, on which cars will be loaded, should be correctly supported by them before loading.

7 ACTIONS TAKEN

7.1 Preventive Measures by Owner

The owner installed and firmly welded a large supporting material in such a way that it covers Deck Supports at the normal position as shown in the photo below (Photo 7.1: Improved Deck Support).

Photo 7.1: Improved Deck Support

7.2 Preventive Measures by Management Company

The ship management company stipulated a procedure manual describing the procedure of the Panel Work which includes follows:

1. Determined the adjusting procedures for raising and lowering the Deck Panel.
2. Panel Work shall be executed by six crew members headed by Chief Officer.
3. Chief Officer shall confirm that deck panels are properly supported by deck supports.

7.3 Preventive Measures by Charterer

The Charterer, on December 3, 2010, sent a letter-of-attention to crew members, management companies, and owners of all the pure car carriers they charter, in order to share information on the accident and introduce the following requirements as emergency measures:

(1) Confirm that all deck panels are correctly supported by deck supports.
(2) Confirm that each of the deck panels is adequately supported by its deck supports.
(3) Confirm that none of the deck panels slants to one direction.
(4) Have Panel Work done by appropriately stationed persons under the supervision of the master or a chief officer. Obligate the first officer to confirm the state of each of the deck panels and each of the deck supports, after the completion of the Panel Work.
(5) Make a report with a photo attached, on the occasion when abnormalities are found.

In addition, the Charterer prepared a check list according to the specification of a pure car carrier to request crew members to confirm by the check list that each of the deck panels is correctly supported by deck supports, and report to the operator by e-mail, and submit the check list to the foreman at the port of loading, prior to the start of loading.

Figure 1: Location of the Occurrence of the Accident

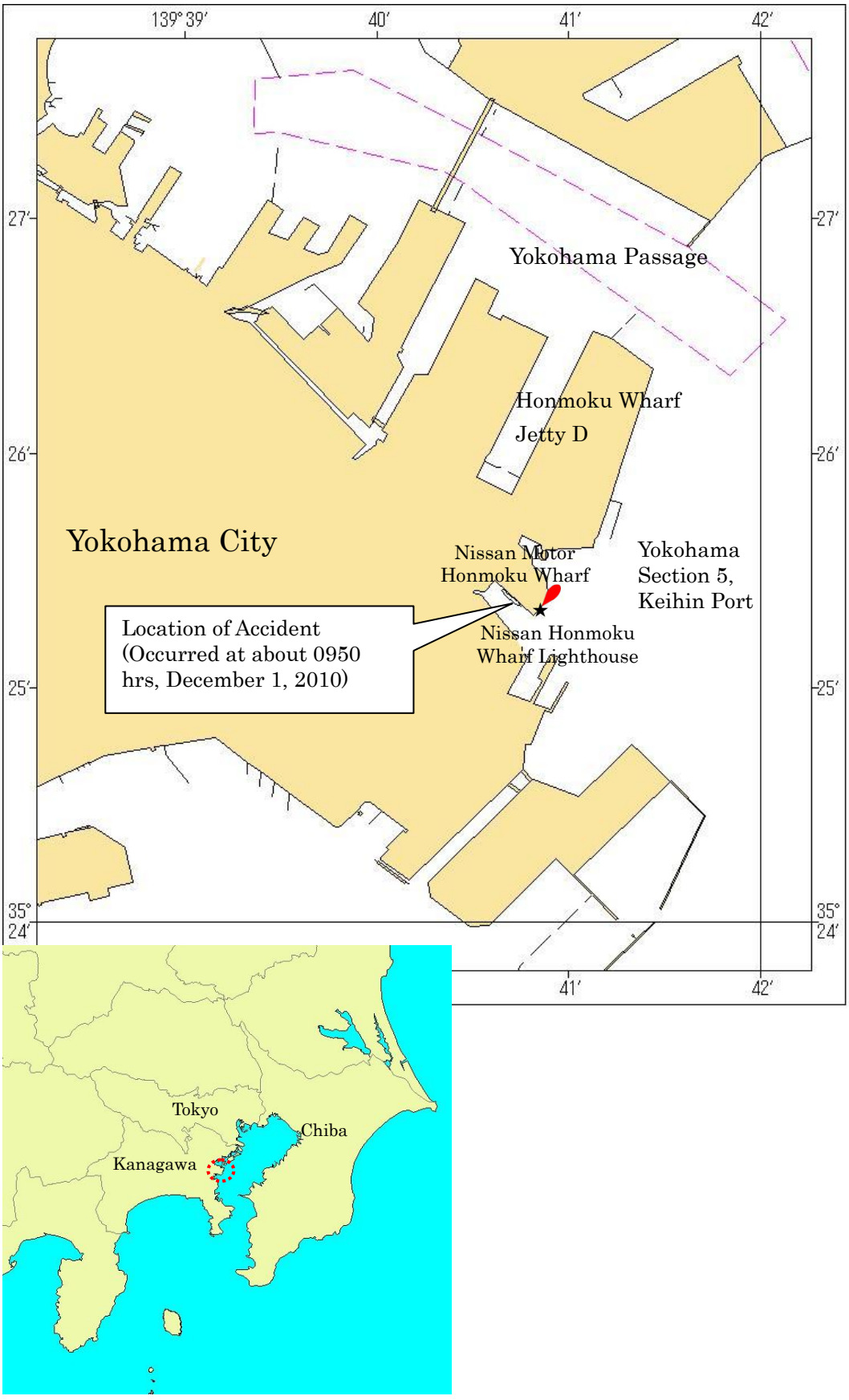


Figure 2: General Arrangement Plan

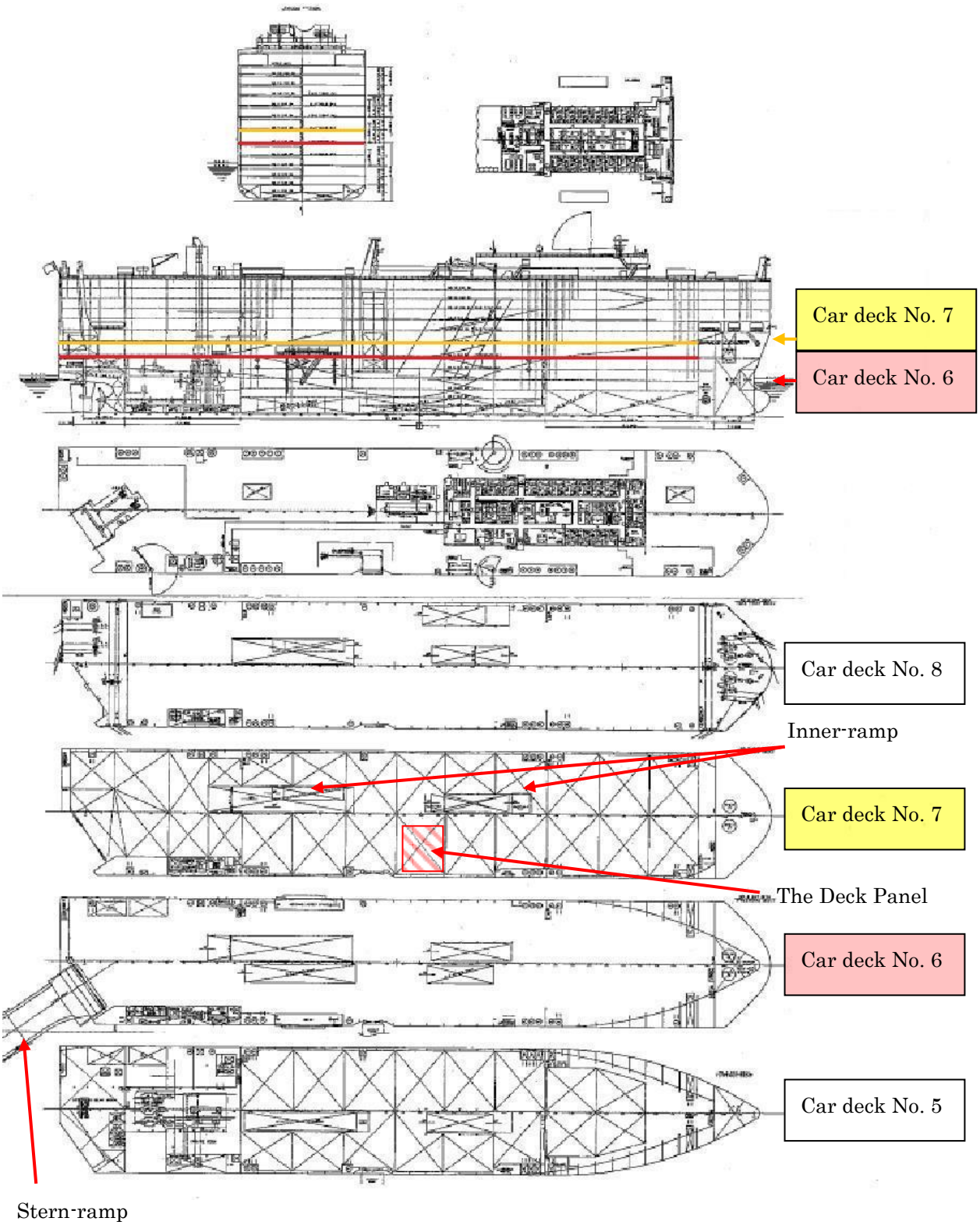
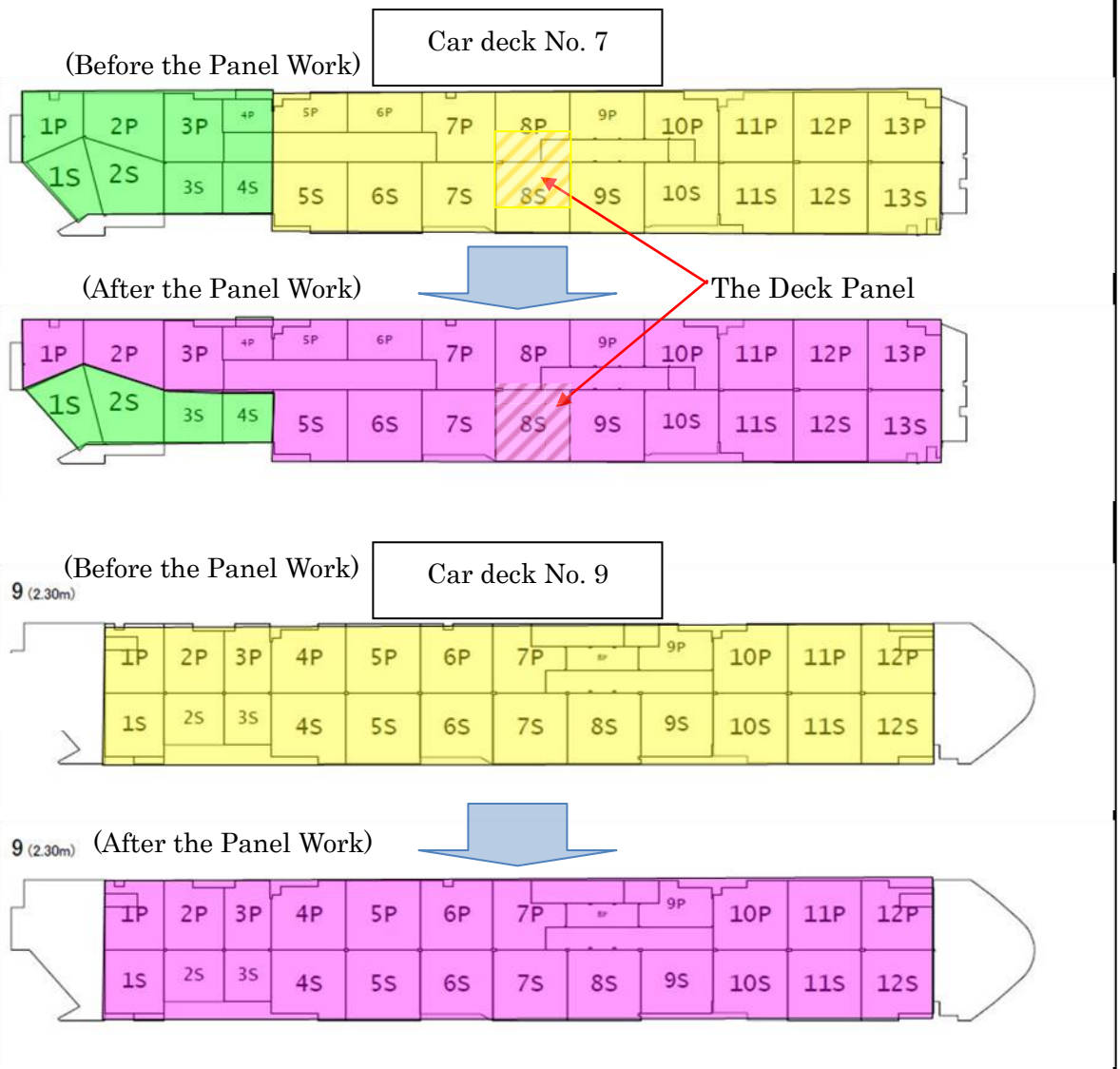
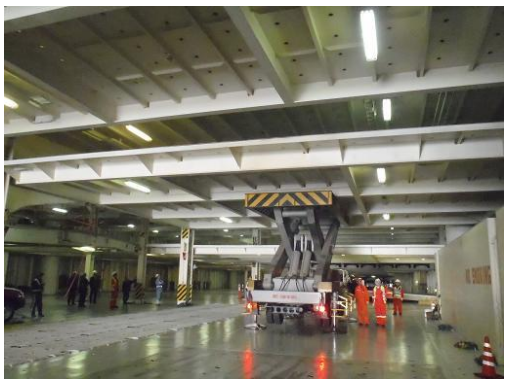


Figure 3: Situation of Panel Work

Green, yellow, and red respectively correspond to High, Middle, and Normal positions



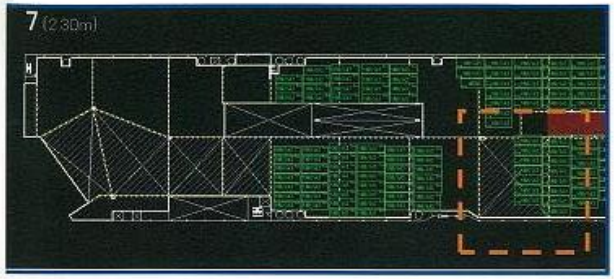
Lift Car



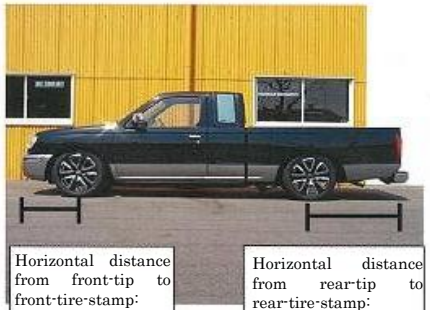
Situation of Panel Work

Figure 4: Car Load Distribution Chart on the Deck Panel

VEGA LEADER 7Dk Car Distribution on Liftable Deck 8S



Information of Car



Length: 501cm

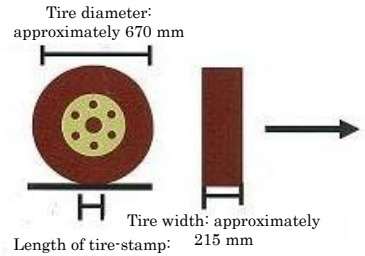
Width: 169cm

Height: 162cm

Weight : 1500kg

Load ratio: Front: 6 Rear: 4

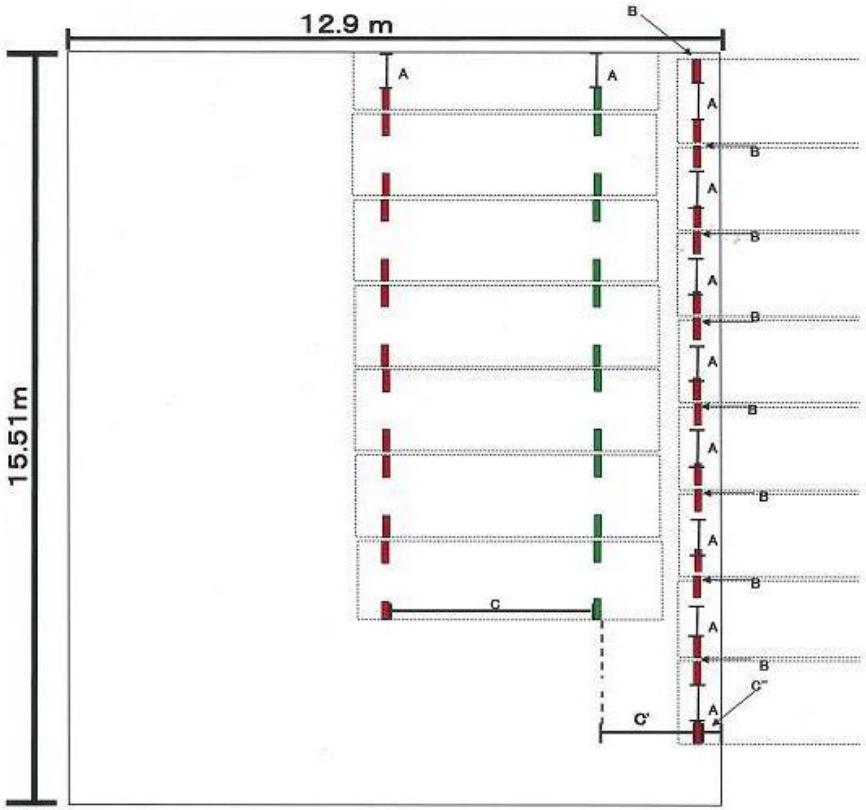
Information of Car Tire



Details of Tire-stamp

Length of tire-stamp: Approximately 100mm

Tire-stamp Distribution



Separation of tire-stamp
A: 1260mm
B: 100mm
C: 2930mm
C': 2180mm
C'': 330mm

Rear-tire-stamp load (green)
Load per stamp: 300kg

Load on tire-stamp per unit area: 1,395kg/cm²

Front-tire-stamp load (red)
Load per stamp: 450kg

Load on tire-stamp per unit area: 2,093kg/cm²

Figure 5: Casual Factors of the Accident Occurred (Summary)

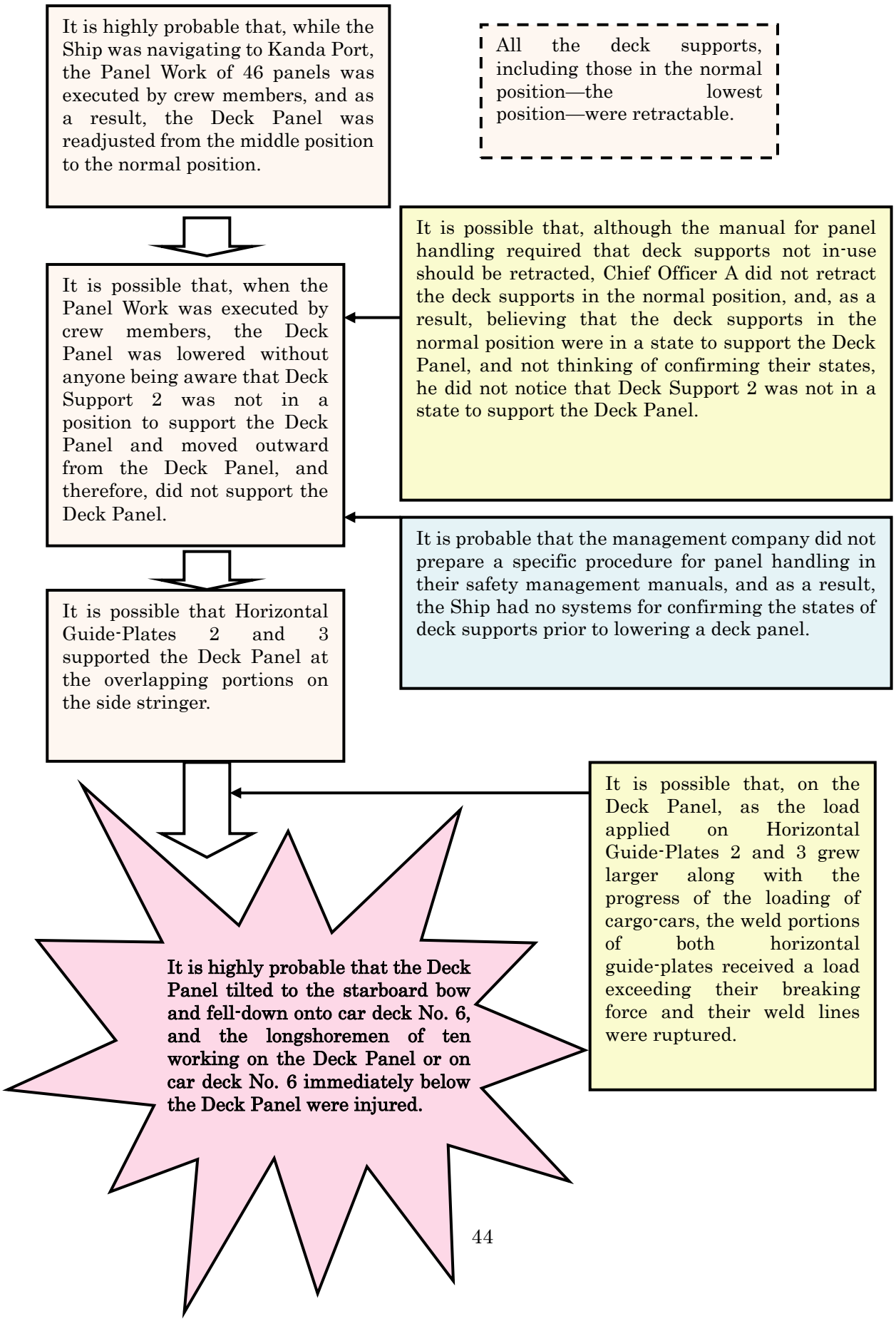
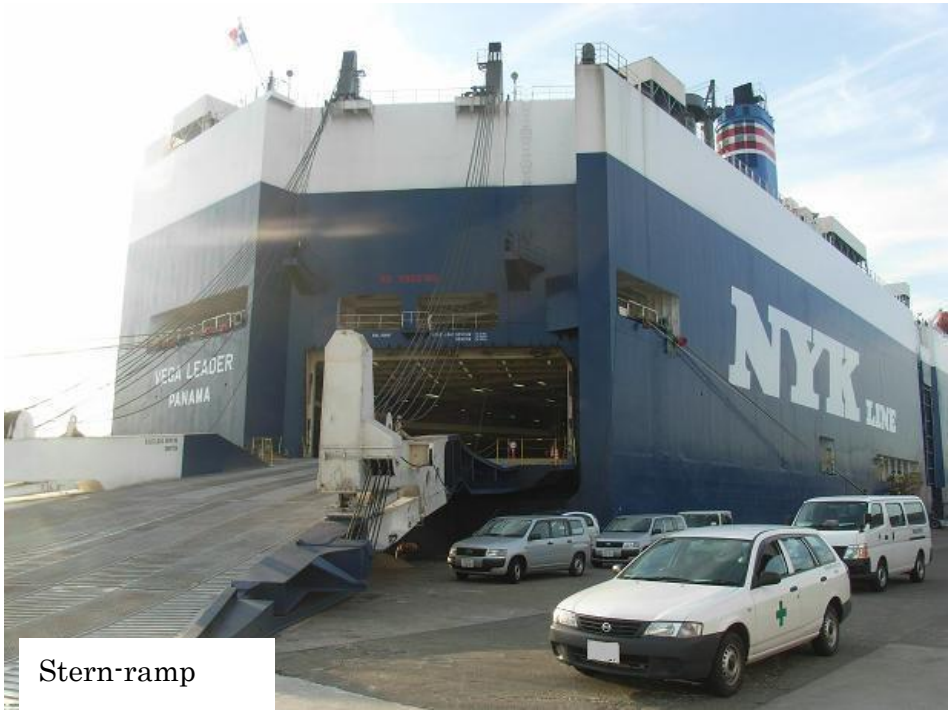


Photo 1: Bow of the Ship

Photo 2: Stern of the Ship



Stern-ramp

Photo 3: Situation of Measurement of Deflection of the Deck Panel