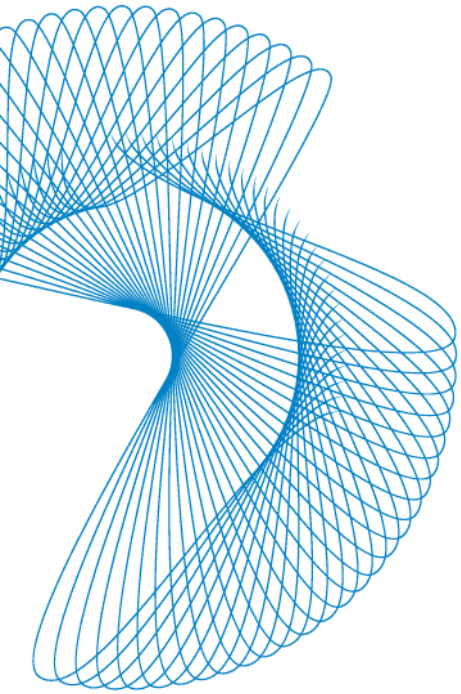
MARITIME NEW ZEALAND



Accident Report

Crane Failure

Sea Angel

31 October 2005

Class B

REPORT NO.: 05 3888

SEA ANGEL - CRANE FAILURE

On 31 October 2005 at approximately 1900 hours New Zealand Daylight Time (NZDT), whilst ***Sea Angel*** was loading logs at Nelson, New Zealand, the port jib arm of No.3 hydraulic crane detached from the crane's heel pin, causing serious damage to the jib of the crane. There were no injuries.

Photograph 1
MV ***Sea Angel*** loading logs in Mount Maunganui New Zealand.

Details of Vessel, Owner & Management, Classification, Navigational Equipment, Manning & Crew:

Name of Vessel:	*Sea Angel*
Vessel Type:	Bulk Carrier
Port of Registry:	Hong Kong
Flag:	Hong Kong
IMO No.:	8309361
Built:	1984
Construction Material:	Steel
Length Overall (m):	181.03
Breadth (m):	31.0
Gross Tonnage:	23 536
Net Tonnage:	13 340
Propulsion Engine:	Sulzer
ISM Company:	China Classification Society (CCS)
Classification Society :	Nippon Kaiji Kyokai (NKK)
Accident Investigator:	Hei Cheung, Maritime Safety Inspector

Owner Details

Cosco Bulk Carrier Co. Ltd, People's Republic of China.

ISM Certificate

Issued by CCS on 15 July 2004 to expire on 4 July 2009.

Master Qualifications

Master Foreign Going.

Manning Details

Safe Manning Requirements:	Actual Manning on Board:
1 x Master	1 x Master
1 x Chief Mate	1 x Chief Mate
2 x Watchkeeping Deck Officers	2 x Watchkeeping Deck Officers
1 x Chief Engineer	1 x Chief Engineer
1 x Second Engineer	1 x Second Engineer
2 x Watchkeeping Engineers	2 x Watchkeeping Engineers
4 x Deck Crew	6 x Deck Crew
3 x Motorman	6 x Motorman
	1 x ASS/Officer
	1 x Bosun
	1 x Carpenter
	1 x Electrical Officer
	1 x SSO
	1 x Chief Cook
	1 x Steward

NARRATIVE

On 30 October 2005 at 0300 hours New Zealand Daylight Time (NZDT), ***Sea Angel*** arrived from Pusan, Korea, and berthed port side to Kings Ford Quay, Nelson, to load a cargo of logs.

On 31 October 2005 at approximately 1530 hours, a gang of stevedores from Port Nelson started their daytime shift and used No. 3 deck crane to load logs into the ship's No. 4 cargo hold.

Evidence of Crane Driver 2

Crane Driver 2 started his daytime shift at about 1530 hours "hatching" for another stevedore, who was rostered to drive No. 3 crane for the first three hours of the shift.

At about 1600 hours the stevedores, heard a loud bang. They stopped work and reported what they had heard to the Shift Foreman. The Shift Foreman took no action so they tried to investigate the situation themselves. They couldn't find anything wrong other than the raised hatch covers at the after end of No. 3 hatch seemed to be 'a little bit wobbly' and they thought the noise could be coming from that source. The stevedores then resumed working until 1830 hours when they had their meal break (smoko).

After the meal break, at about 1900 hours, Crane Driver 2 took over the crane driving duties. This was his first day back at work since 27 October 2005.

Crane Driver 2 completed his first lift of log cargo from the adjacent wharf and put them on the port side of the stow of logs in the ship's No. 4 hold without any problem. He then proceeded to lift a second load of logs from the wharf. He put them on top of the log stow, slightly to starboard of the ship's centre line. Crane Driver 2 then lifted the bundle of logs approximately 400mm so they could be brought towards a digger driver who had lined up his digger on the starboard side of the cargo hold *(See Photograph 3)*. It was at this point that Crane Driver 2 heard a lot of loud 'crushing noises' coming from the port side of the ship.

Crane Driver 2 looked down and saw the after end of the port crane jib start to collapse *(See Photographs 2 & 4).* Crane Driver 2 then heard a loud bang and saw the aft port side crane jib slipping off its mounting cone. The crane jib then dropped back and under the tower of the crane until it became jammed against the raised hatch covers at the after end of No. 3 hatch *(See Photograph 2).* As a result of the two crane jibs failing, the bundle of logs landed on log stow and the load on the hoist wire was released. When the load settled down, the crane jib stopped toppling further. As soon as this stopped, Crane Driver 2 climbed down from the crane and spoke to the Shift Foreman. Crane Driver 2 suggested they should stop work and check the rest of the cranes to ensure that they were safe before work resumed. However, no action was taken at that time because the stevedores had a tight schedule to enable the ship to sail. Work was continued using the other three cranes, without incident, until the next 'smoko'.

Crane Driver 2 estimated the weight of the load at the time of the crane failure to be approximately 15 tonnes.

Evidence of the Master

Sea Angel arrived at Port Nelson, New Zealand on the 30 October at 0300 hours. The stevedores commenced loading logs at 0400 hours. They were working on 3 shifts/roster to load a log cargo in No's.1, 2, 3, 4 & 5 cargo holds. Loading was scheduled to be completed by 0400 hours on 1 November.

On 31 October at about 1900 hours, the Master received a VHF radio call from the duty officer, who reported that the port jib arm of No. 3 crane had failed. It was found that the port heel jib bearing had detached from the heel pin with the result that the jib arm had moved backwards and struck the raised hatch covers at the after end of No. 3 hatch. Although the starboard jib arm had remained attached to the heel pin/shaft, two of the four connecting bolts were found to have fractured.

No. 3 crane's luffing and hoisting wires did not part before the load of logs landed on the stow of logs and the weight was released. The two wire slings around the bundle of logs did not release and the whole bundle was laid and tilted towards the aft starboard side of the cargo hold at an angle of about 5 to 10 degrees *(See Photograph 3).*

After the accident, the log cargo was checked and a total of 61 logs were found in the sling. The weight of the log cargo was not known.

While the ship's crew were removing the damaged jib from the crane, one of the stevedores was seen removing information tags/stickers from both end of the logs which he put into his pocket. The ship's crew obtained two information tags from the logs and took photographs as evidence.

The Master, who did not witness the accident, believed the following reasons had caused the crane jib to fail:

1. Overloading: The Master believed that if the crane had not been overloaded, the stevedore would not have started to remove the information tags from both ends of the logs. The Master believed this action was an attempt to destroy information/evidence of the actual weights of the cargo being lifted.

   In commenting on the draft report the Manager, Tasman Bay Stevedores, informed Maritime NZ "*The Master stated that the stevedores removed the tags to conceal information; the fact is I personally remove the tags to verify the weight of the heave should the question of overloading come about. I still have the tags which if necessary can be rescanned to give an accurate weight."*

2. Rough handling during cargo operations: The Master believed the practice used by the stevedores to pull heavy loads at an angle within the cargo hold caused the crane jibs to fail. He made the following remarks in support of this conclusion:

   The photographs taken after the accident showed that the sling of logs was still properly piled up in the cargo hold which would indicate that it had not fallen from a substantial height.

   The photograph also showed that only one end of the log sling, the end closest to the digger, was tilted at a small angle to the centre line of the ship, with the inner end of the log sling parallel to the ship's centre line.

   The Master thought that it would be more convenient for the digger driver to stow the logs in the cargo hold if the logs were landed in a position that was perpendicular to the digger. Therefore the stevedores had to correct this situation.

   The Master thought that the stevedores did not want to lift the log cargo again because only one end of the log sling was tilted at a small angle to the ship's centre line. If the stevedores lifted the log cargo again, they might find it turn/rotate into a bigger angle or different position that would make it even more difficult to be handled/corrected.

   Based on the above, the Master believed that the stevedores decided to drag the logs in order to prevent this situation from occurring. The Master believed that the stevedores had lowered the crane jib first in order to reverse the centre of gravity of the log sling from the forward to the after end. While keeping the crane wire under tension, the stevedores operated the crane and slewed it rapidly towards the starboard side of the hold. The crane was turning so fast that the jib bent towards the left as a result of this excessive pulling force. At the same time the left jib arm detached from the heel pin.

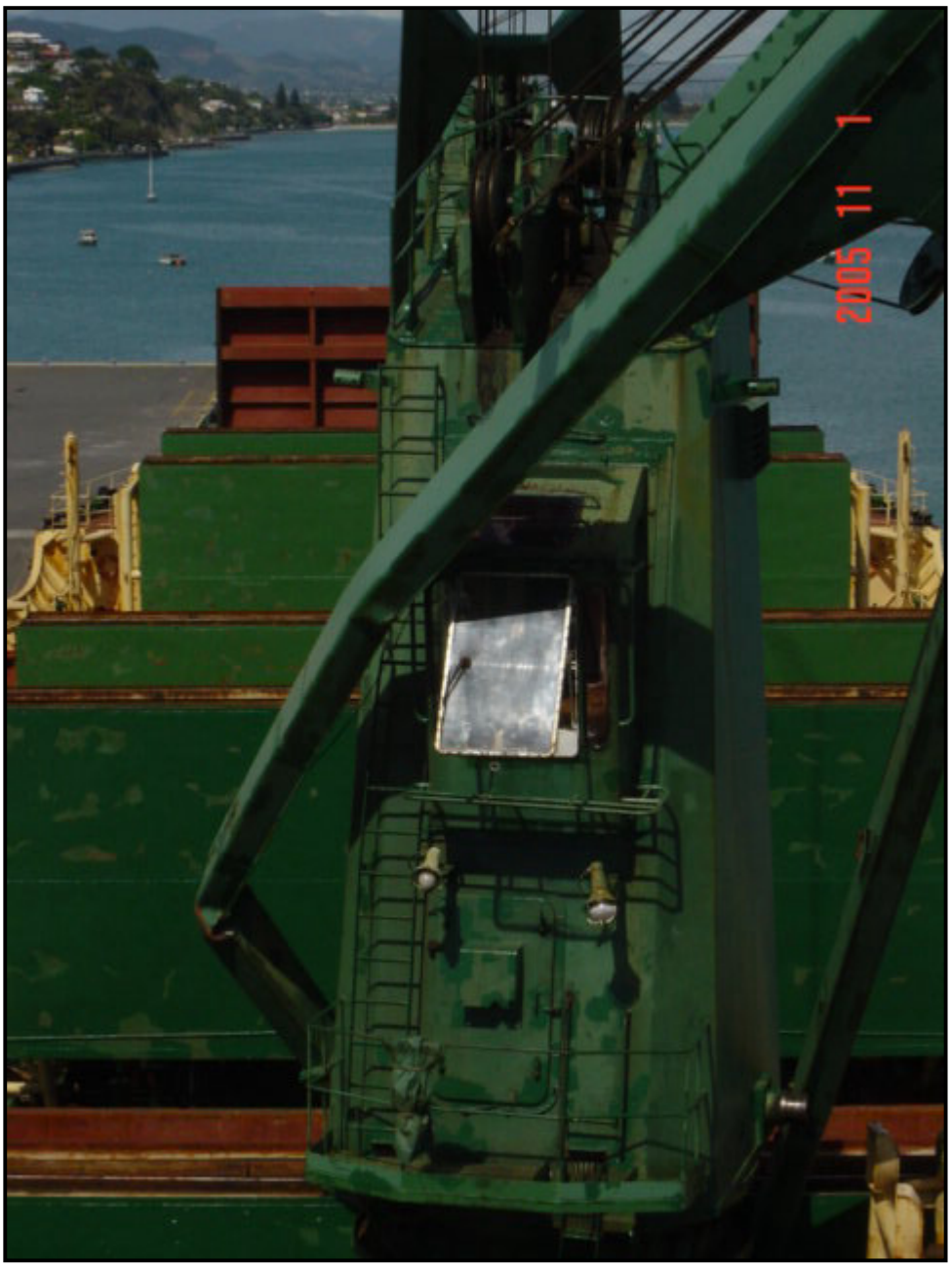
After realising that something had gone wrong the stevedores immediately slewed the crane to the left. This was only stopped from turning further to the left after it struck No. 3 hatch cover.

In commenting on the draft report the Manager, Tasman Bay Stevedores, informed Maritime NZ *"At no time was the crane operated outside its limits. It is normal practice for the heave of logs to be positioned in the hold then lifted for the digger to push the heave into its final position, there is no need to slew the logs across the stow as the digger eliminates this practice."*

The Investigator is of the opinion that the crane driver tried to reposition the bundle of logs to make it more convenient for the digger driver to stack them in the required position within the hold**.** When Crane Driver 2 lifted the bundle of logs to a height of approximately 400mm to move it towards the starboard side of the hold, the port heel pin bolts suddenly failed and the port crane jib heel bearing became detached from the shaft/pin**.** As a result, the port jib arm dropped and struck against the raised hatch covers at the after end of No.3 hatch. At the same time as this occurred the bundle of logs fell back onto the log stow in the manner shown on *Photograph 3.*

The crane's starboard jib arm became weaker and continued to swing to the left, until the lower end of the starboard jib arm started to fail and bend. The mid section of the starboard jib arm then bent after it struck the crane driver's cabin *(See Photograph 3).*

When the port jib arm struck the raised No. 3 hatch covers, it became jammed between the port heel pin/shaft and the raised hatch covers. Instantly, the momentum of the jib was reversed. As a result, two of the four 36mm x160mm diameter right jib arm connection bolts fractured. The jib arm then found its new equilibrium and stayed raised at an angle of about 50 degrees to the horizontal. The tension of the hoist wire rope was released but the wire slings remained attached to the crane hook with the log cargo still held by the two slings.



Photograph 2
Photo showing damaged No. 3 crane jib.

Photograph 3
No. 4 cargo hold. Note condition/position of log sling and digger.

Photograph 4

FINDINGS

Sea Angel, built by Namura Shipbuilding Company Ltd, Japan in 1984, was fitted with four Mitsubishi hydraulic deck cranes.

Each crane's Safe Working Load (SWL) is 25 tonnes at a radius of 22 metres. A Nippon Kaiji Kyokai (NKK) Certificate of test And Examination Of Cranes at Quadrennial Survey, Certificate No. 4ZG-0177CG3-(1/1) was issued on 5 August 2004. A thorough examination of lifting appliances and loose gear was stated to have been carried out by an NKK Surveyor at Burnie, Tasmania, on 29 August 2005.

The Port Nelson Stevedoring Safety Officer stated that after the accident occurred, he saw the ship's crew open the remaining cranes' heel pin bearing covers to check the condition of the retaining bolts. They found that the paint on all heel pin bearing covers had not been touched/disturbed, indicating the retaining bolts had not been inspected for some time. The ship's crew had to use a chisel to break off the rubber seal before they could remove the covers. On inspection, it was found that the retaining bolts' triangular locking plates were not bent over onto the locking positions. The Safety Officer observed that the ship's crew tightened all the heel pin retaining bolts to a torque estimated to be of 54-60 Newton-metres (40-45 foot-pounds) maximum, before cargo work was resumed.

By the time the vessel arrived at Tauranga on 6 November 2005, the No. 3 crane jib had been removed and stowed on deck. A visual inspection of the internal jib, near the cut off sections, showed the steelwork of the jib to be in good condition. No. 3 crane's starboard heel jib swivel bearing was still connected to the crane's heel pin/shaft. Close examination of the heel pin bearing cover confirmed that the paint coated on the cover's joints and bolts had not been disturbed or broken for some time, indicating that the heel pin retaining bolts had not been checked or inspected recently. When the starboard jib heel pin bearing cover was removed by the Investigator, all three retaining bolts were found to be locked properly in position by the triangular locking plate. Subsequently, however, when the bolts were tested with a spanner, only two of these bolts were found tight and intact. The remaining bolt was loose. When the loose bolt was removed, it was found that the bolt had fractured near the bolt head *(See Photographs 7 & 8).* The bolt also showed beach marks on the fracture surface *(See Photograph 7),* that are a characteristic of fatigue cracking over a period of time under cyclic loading. Similar marks were found on the broken retaining bolts that were found on *S. Venus'* Mitsubishi crane that collapsed at Tauranga in July 2004.

A close visual examination of the three retaining bolts that had detached from No. 3 crane's port heel pin, showed that on all three, the last two threads, close to the bolts' outer edge, were stripped of any thread and that four of their threads, near the bolt heads, were partially stripped of thread. The remaining ten threads in the middle of all three bolts were found in good condition. When the three bolts were sent to the inspection company SGS, for a Non Destruction Crack Test, fatigue cracks on all three bolts were found at the bottom of the second threads and near the bolt head *(See Appendix 1 - SGS Magnetic Particle Inspection Report and Photographs 8 and 9, showing the location of the cracks found on all three bolts that had detached from No.3 crane. Note also the position where No. 3 crane's right heel bolt fractured)*.

Examination of the heel pin threaded/tapped holes revealed that they were in good condition, except the outer most two threads that showed signs of damage. Examination of the triangular locking plate on No. 3 crane's port heel pin found that the locking plate edges were cracked or damaged through repeated use *(See Photograph 11).*

After the accident occurred, a NKK Surveyor reported that an occasional survey was carried out on the cranes whilst the vessel was at Nelson. The Surveyor reported that the remaining cranes' heel pin keeper plate retaining bolts had all been checked and found to be intact. In commenting on the draft report, the NKK surveyor informed Maritime NZ "*This is incorrectly stated as the brief of the surveyor was only to carry out an occasional survey after damages to no. 3 crane. As a result of the surveyor's findings, he recommended that the remaining heel pin keeper plate bolts and their lock plates be checked. This task was carried out by the crew and found by them to be intact at that time."* The subsequent inspection conducted by the Investigator at Tauranga, a few days later, showed that of No.

4 crane's six heel pin bolts, three of the heel pin retaining bolts were loose namely, two from the port heel pin and one from starboard heel pin/shaft. These bolts were removed and sent to SGS for a Non Destructive Test. Cracks were found on all three bolts. The cracks were similar to those found on the bolts on No. 3 crane's port heel pin/shaft *(See Appendix 1 - SGS Magnetic Particle Inspection Report & Photographs below showing signs of crack on all three loose bolts found on No. 4 crane)*

From the above inspections and the Non Destructive Crack Test results, it would appear that the cracks that were found in the loose heel pin bolts of No.4 crane, after the vessel arrived at Tauranga and prior to working cargo at that Port, could already have been cracked before the ship's crew re-tightened them to a torque of 54-60 Newton-metres maximum, following the crane accident.

After No.4 crane was put back into service, the pre-existing cracks in these re-tightened bolts could have propagated quite readily due to stress concentration. Therefore, the pre- tensile load in the tightened bolts would reduce gradually until such time that it was completely released and the bolts loosened. If the bolt was properly locked up by the locking plate and prevented from turning, as happened to the broken bolt found on ***Sea Angel's*** No. 3 crane right heel pin/shaft, the bolt would eventually fracture under fatigue cyclic stress. If the bolts were not properly locked up, as happened on ***Sea Angel's*** No.3 crane's port/left heel pin retainer bolts, the loose bolts would eventually work their way out of the bolt holes, allowing the jib to detach from the jib heel pin/shaft.

Mitsubishi Heavy Industries (MHI) Ltd. issued their "*Technical Information (No. D-42004) Of Mitsubishi Deck Crane Inspection Of Jib Gooseneck*" in March 1987, to ships fitted with Mitsubishi deck cranes. This requested ship's owners/masters to immediately inspect the thrust stopper-bolts for the end plate of the jib gooseneck shaft namely, the heel pin retaining bolts. A copy of this *Technical Information* document was filed in the MHI crane operation manual held by the Chief Engineer on board ***Sea Angel***. While the Chief Officer of ***Sea Angel*** was responsible for the maintenance and inspections of the deck cranes, he was not aware of the existence of the MHI *Technical Information* because the MHI crane operation manual that he used did not contain this document. Neither the Master nor the Chief Engineer were aware of the existence of the *Technical Information* document or of the requirements regarding the inspection of heel pin retaining bolts *(See Appendix 2 - MHI Technical Information).*

The first reported MHI hydraulic deck crane failure in New Zealand occurred at Tauranga on 3 February1991, on ***Ken Spring***. This vessel, which had been built in 1989, was fitted with 30 tonnes SWL cranes. The jibs of the crane were attached using four 20mm diameter heel pin retaining bolts that were fitted at each end of the crane's heel pin/shaft. The second MHI crane failure occurred at Tauranga on 29 May 1992, on ***Maritime Integrity***. This vessel was fitted with 25 tonnes SWL cranes using three 20mm diameter heel pin retaining bolts on each heel pin/shaft.

Following the second crane accident, a *Memorandum to Shipping Agents and Stevedores in Tauranga* (Memo), dated 20 July 1992, was issued by the then Maritime Transport Division of the Ministry of Transport to advise ship owners and masters to follow the inspection requirements of heel pin retaining bolts as recommended by the MHI Technical Information booklet. Another Memo, that was similar to the original, was issued in February 1994 by the then Maritime Safety Authority after Maritime Safety Inspectors (MSI's) found several ships at Tauranga where MHI cranes heel bolts had not been inspected properly by the ships' crew, broken bolts were found in at least one crane on every ship subsequently inspected by the MSI's *(See Appendix 3 - Memo).*

Notwithstanding the above actions, MSI's in Tauranga continued to find loose or broken heel bolts aboard ships installed with MHI cranes during Port State Control Inspections, any of which could have resulted in a serious accident.

In June 1999, MHI sent a letter to the then Maritime Safety Authority office at Tauranga requesting the local MSI's to cease their inspection of MHI cranes jib heel pin retaining bolts. This was because the additional inspection of MHI cranes had apparently caused concern to some of the ship owners/operators whose vessels were fitted with these cranes. In support of their request, MHI sent a copy of the "*Technical Report Of The Incident Of Deck Crane*" (Document No. DR00111330) dated August 1992. The stress analysis of the retaining bolts in this report showed that, for MHI 30 tonnes SWL cranes, fitted with four 20mm diameter heel pin retaining bolts, when the direction of lift was changed from the vertical to 20 degrees from the vertical, the safety factor would reduce from 1.83 to

1.04. At 25 and 30 degrees from the vertical the safety factor reduced to 0.88 and 0.77 respectively, indicating that the heel pin retaining bolts would be well overloaded at these angles of lift. MHI has since modified their cranes and all new and some of existing MHI cranes are now fitted with the larger six 30mm diameter heel pin retaining bolts. Maritime NZ is not aware of any incidents that have occurred with these new or modified cranes. It would appear therefore that the use of larger diameter retaining bolts have prevented further accidents from occurring. For this reason, Maritime NZ has stopped inspecting MHI cranes that were built after 1993 and any other MHI cranes that have been modified with the larger diameter heel pin retaining bolts.

To date, however, MHI have not made any recommendation to modify the retaining bolts on any of their cranes built before 1993 which are still fitted with three or four 20mm diameter heel pin retaining bolts *(See Appendix 4 - Technical Report of Incident of Deck Crane & Calculation Results)*.

Unfortunately, the MHI *Technical Report Of The Incident Of Deck crane* had been misfiled at the Maritime New Zealand office in Tauranga and accordingly had not been sighted by the Investigator when he investigated the MHI crane failure on ***S Venus*** in August 2004. The number of broken and fatigue cracked bolts that were found on the cranes of this vessel raised serious doubts in the mind of the Investigator at the time that the safety factor or design stresses of the three 20mm diameter retaining bolts fitted on each heel pin swivel/bearing, were sufficiently adequate to meet the cranes operational cyclic loading requirements. On receipt of the draft report into the accident on ***S Venus***, MHI made the following comment regarding the improvements that had been made to 25 tonnes SWL deck cranes "*We have applied the improvement on the retaining bolts of the Jib's heel pins of our 25 t SWL cranes delivered since 1993 as well as the improvement of that was done on 30 t SWL cranes after the incidents in Tauranga in 1992. This improvement was determined due to our lateral thinking ways in considerations of rough handling use in Tauranga in order to diminish the risk of the problem* ***although our cranes in previous model (before 1993) have enough structural strength of the parts of the Jib's heel pins***" - Maritime New Zealand emphasis (*See Appendix 5*).

CONTRIBUTING FACTORS

1. Before the introduction by the stevedores in Tauranga of a "digger" to stow logs inside a ship's cargo hold, they had had difficulty in stowing logs, particularly in the areas of the cargo hold under the upper ballast wing tanks and the cross-deck. This necessitated the stevedores having to 'drag' the logs in the required direction by slewing the jib of the crane. It would appear that the MHI 25/30 tonnes SWL cranes that are still fitted with the lesser diameter 20mm heel bolts are not suitable for dragging logs or other cargoes, if the crane hoist wires are required to be used at angles beyond 20 degrees from the vertical, in order to achieve a proper/safe stow within a cargo hold.

   The Master of ***Sea Angel*** stated that the vessel had loaded logs about a year ago at an overseas port. He was not sure whether a digger was available or not at that time. It is possible that the heel pin retaining bolts could have been overloaded and cracked if the crane hoist wire was used at angles beyond their designed limitation. The heel pin retaining bolts would have gradually loosened after the cracks occurred.

2. The ship's crew did not follow the inspection & maintenance requirements/recommendations of *MHI Technical Information* because:

   - There was no safe access platform built on the cranes to facilitate inspection/maintenance *(See Photograph 10).*

   - The Master and Officers were not aware of the existence of the *Technical Information* that is attached in *Appendix 2* to this report.

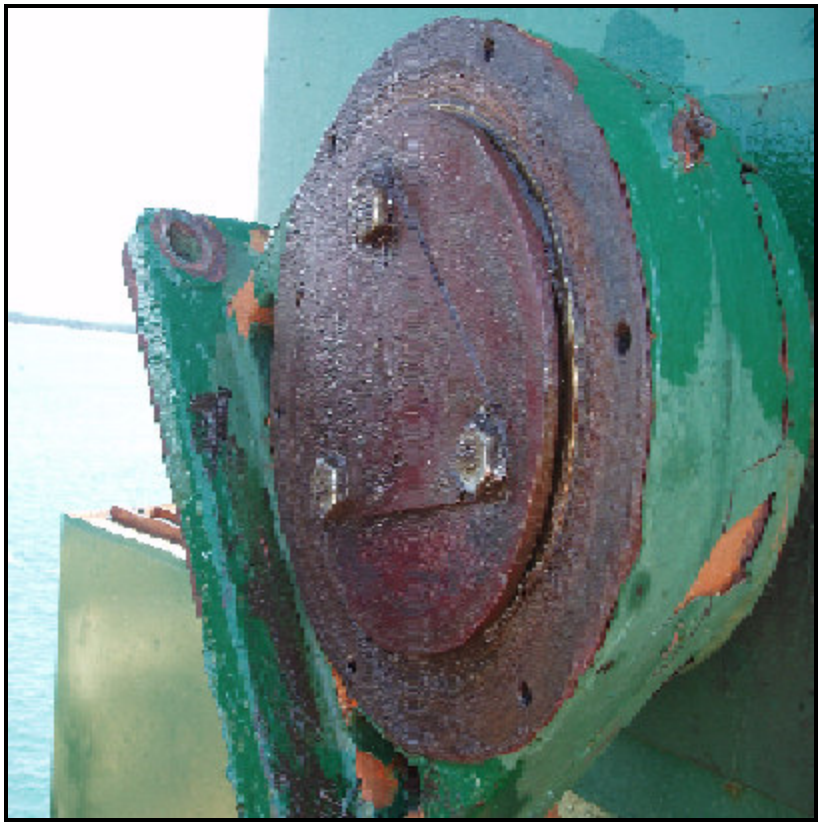
     Moreover, there appears to have been no regular checks by the crew of the heel pin retaining bolts as evidenced by the lack of any paint disturbance on the heel pin bearing covers.

3. The NKK Class Surveyor who allegedly conducted a thorough examination of the vessel's lifting appliances in Australia about two months before the accident was either not aware of the MHI Technical Information or did not follow the MHI inspection requirements/recommendations.

4. The stevedores at Nelson were not aware of the MHI *Technical Information* and of the problem of the MHI cranes and they did not check if any inspection requirements had been carried out by the crew before the ship worked cargo.

   In commenting on the draft report the Manager, Tasman Bay Stevedores, informed Maritime NZ *"Prior to loading logs we undertake a preload survey by a Lloyds surveyor. Neither party had any technical information to indicate there is a problem with MHI cranes or prior information to indicate that there had been any problems with this model of crane."*

5. The poor condition of the heel pin locking plate/device was considered to be one of the possible contributing factors for the heel bolts to work loose. However, the discovery of cracks on all the loose bolts found on No. 4 crane and all the detached bolts from No. 3 crane would make the condition of the heel bolt locking plate/device only a minor contributing factor to the eventual failure of the crane jib, because, if the bolts were properly locked up, they could still fracture and fail, as occurred in the failure of the MHI crane aboard ***S Venus*** in 2004.



Photograph 5

Photograph 6

Both photographs show the No. 3 crane's right heel pin bolts and securing arrangement *(Note – a hammer test failed to detect the fractured bolt and it was found only by using a spanner).*

Photograph 7
No. 3 crane heel bolts, 3 detached from left heel pin, 1 fractured at right heel pin.

Photograph 8
No. 3 crane heel bolts indicating a crack, note position of cracks to fractured bolt.

Photograph 9
No. 4 crane heel bolts indicating crack by Magnetic Particle Test

Photograph 10
Showing crew standing on hatch cover while working on No. 4 crane because there was no working platform fitted.

Photograph 11
No. 3 Crane heel bolts locking plate showing crack

SAFETY RECOMMENDATIONS

1. A copy of the report be forwarded to ***Sea Angel's*** owner/operator with the following recommendations:

    - A platform should be fitted on all their ship's cranes to facilitate safe access when carrying out the required maintenance and inspections of cranes

    - To consider urgently, in consultation with the crane manufacturer, MHI, and the relevant Classification Society, the modification/upgrade of all their vessels' pre-1993 manufactured MHI 25 tonnes and 30 tonnes SWL cranes to the manufacturer's revised specifications as shown in drawing No.DSB110481 and No. OSC1102043 respectively, Hydraulic Deck Crane Assembly Of Gooseneck For Jib *(See Appendices 4 & 5).*

2. It is recommended that a copy of this report be sent to the International Association Of Classification Societies (IACS) for their Member Societies' general information and guidelines:

    - IACS to specifically draw the attention of their Member Societies' Surveyors that during every inspection or examination of MHI hydraulic deck cranes, both 25 & 30 tonnes SWL built before 1993, which have not been upgraded, the *MHI Technical Information* document should be consulted and strictly followed. At every inspection or examination of these particular deck cranes, the Surveyors should ensure that all heel pin bearing cover plates are removed and each bolt is tested with a spanner or similar tools. Any broken, loose or suspected bolts that are found should be replaced immediately with the manufacturer's specified parts.

    - IACS Member Societies should strongly encourage their clients, whose ships are fitted with MHI 25 & 30 tonnes SWL hydraulic cranes, delivered before 1993 and still fitted with either three or four 20mm diameter retainer bolts to arrange to have their crane's jib heel pin retaining bolts modified and up-graded to meet the revised requirements/specifications as shown in drawing No. DSB110481 and NO. OSC1102043 respectively for 25t and 30t Hydraulic Deck Crane Assemble Of Gooseneck For Jib, as soon as practicable).

3. It was recommended in the Maritime New Zealand report into the crane accident on ***S Venus*** that:

    "*MHI promulgates advice to the owners/operator of all ship's currently installed with 25 tonnes SWL cranes, delivered before 1993, and still fitted with three 20 mm diameters retaining bolts, of the need to implement, as soon as practicable, the appropriate steps required to modify and upgrade the heel pin retaining bolts to meet the revised/new specifications as shown in drawing No. DSB110481,25t Hydraulic Deck Cranes Assembly of Gooseneck For Jib"*.

    It wound appear that MHI did not agree with this recommendations and instead put forward their own counter measures as outlined in their reply comment/letter dated 7 December 2004 *(See Appendix 5).*

    Sea Angel's crane failure, which occurred at Port Nelson just over one year after the ***S Venus'*** crane accident, would indicate that the counter measures that were recommended by MHI, have failed to prevent similar crane accident occurring, because:

    - MHI *Technical Information* is not always passed on after crews change,

    - It would appear the majority of crew do not acquire the required experience to detect a loose or fractured bolt which is properly secured by a locking plate/device,

    - It is difficult to inform and convince relevant parties of the importance to strictly follow the inspections and maintenance requirements as specified in MHI *Technical Information*,

    It is recommended therefore, that a copy of this report be forwarded to the crane manufacturer, MHI, with the following recommendations:

(a) MHI urgently consider the need to carry out stress analysis, similar to their SWL 30 tonnes cranes fitted with four 20mm diameter retaining bolts and on their SWL 25 tonnes cranes fitted with three 20mm diameter retaining bolts to determine the angle of lift from the vertical at which the heel bolts would be overloaded. This information should be promulgated to all ship owners/operators who operate ships fitted with these cranes to strictly follow the instruction to limit the angle of lift as specified. If, during any cargo operation, this angle of lift is exceeded, the crane heel pin retaining bolts should be inspected as soon as practicable and any loose, or suspected bolts should be replaced before the next cargo operation.

(b) The Results Of Calculation Table 1 of MHI Technical Report Of The Incident Of Deck Crane, showed for their SWL 30 tonnes cranes with six retaining bolts, that when the slant angle changed from 0 to 35 degrees, the safety factor changed from 1.88 to 1.65. However, for the same cranes fitted with only four retaining bolts, the safety factor changed from 1.83 to 0.77. In order to make the cranes fault proof, all un-controlled human factors in cranes' operations/maintenance should be eliminated. To achieve this, it is considered that the safest way forward is for all pre-1993 built 25/30 tonnes SWL MHI hydraulic deck cranes be modified and upgraded to the specifications shown in drawing No. DSB110481/OSC1102043, Hydraulic Deck Crane Assemble Of Gooseneck For Jib.

Accordingly, it is recommended that MHI re-consider the recommendation set out in 3. above that was made in the Maritime New Zealand report into the crane failure on ***S Venus***.

4. It is recommended that a copy of this report be sent to all the stevedoring and port companies in New Zealand with a recommendation that they ensure the following is conducted:

(a) Before cargo commences, the ship's records are carefully checked to ensure that those MHI cranes which were built before 1993, and have not been upgraded, are being correctly maintained and inspected as specified in the MHI *Technical Information (See Appendix 2).*

(b) While loading, not to permit crane hoist wires to be used at angles beyond those specified in the crane manufacturer's instructions namely, the cranes should not be used to drag out slings from under logs at angles exceeding 20 degrees from the vertical.

5. It is recommended that a copy of this report be sent to the Maritime NZ district offices in New Zealand, so that when MSI's are carrying out Port State inspection or any inspections at the request of a concerned party, they ensure that:

(a) The required inspections of MHI cranes, as specified in the MHI Technical Information booklet, have been carried out and recorded in the format shown in the Technical Information's "Check List Of Trust Stopper Bolts"

(b) There is a record/evidence of heel pin bearing cover plates having been removed for inspections during the last six or three months as appropriate.

If there is any doubt about the condition of the cranes or whether inspections have been properly carried out, heel pin bearing cover plates should be removed and each bolt tested using a spanner.

6. It is recommended that a copy of this report be forwarded to the International Maritime Organisation.