MARINE OCCURRENCE REPORT

CAPSIZING

OF THE BARGE "SEASPAN 240"
OFF ADMIRALTY HEAD,
PUGET SOUND, U.S.A.
17 JULY 1996

REPORT NUMBER M96F0019

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

While being towed by the tug "SEASPAN MONARCH", on a voyage from Texada Island, B.C. to Seattle, WA., the barge "SEASPAN 240" capsized on 17 July 1996 at 1030. The total cargo of limerock, carried on the deck of the barge, was lost. There were no injuries as a result of the occurrence and no pollution was reported. The overturned barge was subsequently towed to Vancouver, B.C. where it was surveyed and righted.

Ce rapport est également disponible en français.

[1] All times are PST (UTC minus seven hours)

Other Factual Information

Particulars of the Vessels

Name:		"SEASPAN 240""	"SEASPAN MONARCH"
Flag:Official Number:		Canada	Canada318661383384
Official NumberFlag:		318661	383384CanadaCanada
Type:		Flat deck barge	Tug
Gross Tonnage:	5,886		393
Length:	110m		32m
Crew:		None	Six
Built:		1962, Esquimalt B.C.	1977, Vancouver, B.C.
Propulsion:		None	Diesel(2) 2490 total BHP
Owners:	Seaspan International		Seaspan International
		Ltd. Vancouver	Ltd. Vancouver

The "SEASPAN 240" was built in 1962 as a deck-cargo carrying barge of all-welded steel construction, with a designed cargo deadweight of 10,000 long tons (10,160 tonnes). The hull is subdivided by eight transverse and two longitudinal bulkheads forming twenty-one watertight compartments, together with separate fore peak and after peak spaces. The centre compartments were designed as ballast tanks, and are currently arranged as void spaces similar to the wing tanks. A ballast pump room located forward is now redundant and is also arranged as a void compartment. A short forecastle and 3.7m high steel bulwarks, set in from the port and starboard sides of the barge, form a cargo-box on the main deck. The cargo box is fitted with
31 freeing ports at the bottom of each side wall. Every freeing port consists of forty-nine 1-inch (25mm) diameter holes in three rows and two slots at the deck level.

The skipper of the tug "SEASPAN MONARCH" was familiar with both the cargo and the route he was planning to follow. The tug departed from Blubber Bay, Texada Island, bound for Seattle, WA., with the barge in tow on 16 July 1996 at 1510. The trip, until the capsizing, was described as normal and the tug and tow followed the recommended traffic pattern route. The length of towline was approximately 500m.

At 0700 on 17 July, due to traffic congestion, the skipper decided to leave the southbound lane off Pt. Partridge and cross the traffic separation zone. He would then cross the northbound lane and proceed outside of the traffic scheme closer to the coast north of Admiralty Head on his port side. At about 0800 he rounded Point Partridge at a distance of approximately 1 mile. He steadied the tug and tow on a course 138° True, with the engines driving the propellers at approximately 200 RPM, giving the tug and tow a speed through the water of approximately 7.5 knots.

The tide was ebbing and the tug and tow proceeded against the current of approximately 1 knot. Reportedly, in the vicinity of Admiralty Head, eddies caused by the stronger current were observed on the surface.
At 1030, the skipper conning the tug saw the barge in tow swinging to approximately 90° to starboard. He immediately placed the throttle control at the 'idle' position to reduce the tug's speed and the pull on the barge.

He then released the brake on the drum of the towing winch to slacken the pull even more. However the towline was already sagged low in the water and only a few additional metres came off the drum. In spite of these preventive measures, following the swing the barge started listing to port. In approximately 10 seconds, the barge listed almost 90° and then it overturned quickly. The capsizing took place in a position 48°09.0'N, 122°41.3'W, approximately 5 cables southwest of Admiralty Head.

Subsequently the overturned barge was towed to an anchorage off Port Townsend, U.S.A., where the U.S. authorities conducted an inspection. The barge was then released and towed to Vancouver where a survey was conducted. After a lengthy preparation, it was finally righted on 15 August 1996, using a crane, two tugs and its own ballast tanks.

The inspection carried out after the barge was righted revealed that the port side wall of the cargo box was bent inward and badly damaged. All freeing ports were clean and clear, having been completely submerged while the barge was towed in the capsized condition.

As an un-manned barge built before 1 September 1977, and not carrying pollutants, the "SEASPAN 240" is not subject to inspection by the Marine Safety Branch of Transport Canada. The barge is not required to comply with CCG regulatory (Interim) stability requirements.

The barge has a Load Line assigned in accordance with the International Convention on Load Lines 1966, with a minimum summer (effective) freeboard of 6' 2". This loadline is directly related to the designed cargo deadweight of 10,000 long tons (10,160 tonnes). However the barge was exempted from provisions respecting load lines by virtue of it being on an international voyage within the “treaty zone” (Ref. Treaty Series 1934, No. 10, between Canada and the United States, in force July 26, 1934). The treaty and current TC regulations respecting the assignment of international load lines make reference to the boundaries of the “treaty zone” in which U.S. and Canadian vessels are exempted from these requirements.

Measurements recorded prior to and on completion of loading at Blubber Bay Quarry show mean freeboard figures of 21'6½" and 4'4½" respectively, and a loaded cargo deadweight of 12,717 short tons (11,536 tonnes). The records also indicate that on departure the barge was virtually upright and trimmed approximately 1'0" by the stern.

The barge was very heavily laden, so that the mean freeboard recorded on departure was significantly less than the assigned minimum summer effective freeboard of 6'2".

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[2] Imperial Units used where reference is made to certificate values.

Reportedly, the cargo was distributed fairly evenly throughout the cargo-box area, with a maximum height of some 5'6" (1.7m) above the top of the side bulwarks. Conflicting information indicating the configuration of the deck cargo to be comprised of several conical mounds of limestone was also made available. The most likely fore and aft cargo distribution on the "SEASPAN 240" was derived from and directly related to the recorded departure draughts.

Based on the derived cargo distribution, the recorded trim and freeboards, and the cargo deadweight as determined by the loading personnel from the barge's Deadweight Scale, the barge had positive initial transverse stability on departure. However, the range of positive stability was limited because of the low freeboard, and the maximum righting lever was reached at about 8.4° heel.

A draught survey carried out by a naval architect after the occurrence to re-verify the barge lightship weight, resulted in a lower figure than that incorporated in the 1985 deadweight scale used by the loading personnel. The lower re-verified lightship resulted from the removal of entrapped material from a previously sealed conveyor compartment within the hull. Consequently the actual total deadweight would have been slightly more than the cargo deadweight recorded on departure.

The limerock cargo, consisting of pieces varying in size from a fine dust to approx 75mm, has an angle of repose of approximately 36° to 38°. While limestone does not absorb any significant amount of water, its surface can retain rainwater by capillary attraction, making it prone to slipping when its established angle of repose is approached or slightly exceeded. Reportedly, while it was being loaded by a shore conveyor boom, the barge was shifted fore and aft to facilitate the loading.

The weather on departure from Blubber Bay and throughout the voyage remained good with light wind and calm seas. However during the night following the departure, the tug and tow encountered rain. Reportedly, at times it was raining heavily. The climatological station of the Environment Canada located on Saturna Island recorded 0.31" (7.9mm) of precipitation on 17 July 1996.

According to the tide tables, at the time of the capsizing the predicted tidal current in Admiralty Inlet was ebbing with a rate of approximately 3 knots in the middle of the inlet. The pattern and the rate of the surface current were significantly different near the shore and close to Admiralty Head.

The barge "SEASPAN 240" capsized once before, in 1986. This occurrence is recorded in MCI Report No. 503. It was loaded with 11,296 tons (11,480 tonnes) of limestone rock from Blubber Bay quarry and capsized alongside a discharging wharf at Tilbury Island, B.C.

For over 60 years it has been left to the barge owners/operators discretion as to how deep barges can be safely loaded for voyages within the treaty zone of "sheltered waters of the west coast of North America."

Analysis

Based on the derived cargo distribution, the recorded departure trim and freeboards, and the re-verified lightship weight, review of the barge's stability shows characteristics slightly inferior to those derived from the data

available before the occurrence. The initial transverse stability remains positive, with the maximum righting lever attained at 8.1° heel, and deck edge immersion at midships occurring at 6.5° heel.

The barge's intact stability was such that in static calm water conditions and with a secure cargo, a constant transverse heeling moment of some 8,000 ft-tons (2477 metre-tonnes) would be required to overcome its righting ability. However, in the dynamic conditions resulting from a combination of the barge's sea motions and the initial cargo shifting, the magnitude of a suddenly-applied heeling moment necessary to cause capsizing would be significantly lower.

The barge's actual righting ability on departure was markedly lower than the minimum criteria specified. However, it should be noted that the "SEASPAN 240" was not required to comply with CCG STANDARD: STAB 8 (Interim Standard for the Intact Stability for Unmanned Barges).

However, review of the barge's stability characteristics shows that if the barge had been loaded to the assigned (effective) freeboard of 6'2", with 10,000 long tons (10,160 tonnes) of deck cargo trimmed and distributed in a manner similar to that reported, the "SEASPAN 240" would have met the CCG minimum criteria, providing a much stronger resistance to capsizing than prevailed at the time of the occurrence.

The maximum righting lever and total righting energy of the barge would have been respectively 2.7 and 5 times greater than when loaded.

Capsizing usually occurs when a vessel loses transverse stability, and can be due to an individual cause or a combination of contributory causes. In the case of an intact and initially stable vessel, capsizing is often initiated by the transverse movement of a weight already onboard. The magnitude of the weight required depends on the athwartship distance through which it is moved, and also on the righting ability of the vessel at the time. Consequently, an initially small moment can induce a vessel with low transverse stability to heel, so that the sloping sides of a bulk deck cargo are tilted beyond their established angle of repose. The subsequent shift of cargo and resultant increase in heeling moment can cause the heeling to continue and accelerate, until transverse stability is suddenly overcome.

Those attending the loading operation, or who were onboard the tug during the voyage, acknowledged, and further post-occurrence inspections and enquiries confirmed, that:

1) the barge was virtually upright and trimmed slightly by the stern on departure;

2) all bilges were virtually dry prior to and on completion of cargo loading, with no significant free-surface effect to adversely affect the barge's transverse stability;

3) no underwater hull damage was incurred during the voyage, nor any asymmetrical flooding which could have initiated heeling;

4) there were no reported actions due to high wind, sea or towrope to impose any significant or sudden heeling forces on the barge;

5) there was only intermittent rainfall during the loading operation and throughout the voyage, and, consequently, little likelihood of any significant retention of rainwater within the cargo box area; and

6) no shipped seas were seen to be retained on the barge, and no change of trim noticed prior to the sudden capsizing.

Any adverse effects on the barge's stability from the above possibly contributing factors may be discounted as insignificant. It is deduced that the capsize was caused by a transverse shift of deck cargo.

It is highly likely that the actual configuration of the limestone inside the cargo box was less uniform than the ideal reported. Some asymmetrical settling of the sloping faces of cargo, already at its natural angle of repose, would then be initiated by the barge's rolling motion.

When the bow of the barge entered the stronger current off Admiralty Head, it sheared to starboard. The rolling motion was induced by the swell, in conjunction with the couple of the forces due to the current acting on the underwater hull and restraint of the towline acting on the upper part of the hull. Thus, a slight heel to port was initiated.

Only a relatively small initial transverse shift of cargo would be needed to cause the deck edge to immerse and the barge to assume a small angle of heel. Subsequent rolling about this heeled angle would subject more of the sloping cargo surfaces to angles greater than their established angle of repose. Further transverse shifting would thus be caused. This sequence would continue at an accelerating rate until the barge's righting ability was overcome, resulting in the sudden capsizing reported by those on the tug.

Findings

1. The cargo deadweight and its configuration on departure was such that the barge did not retain sufficient intact transverse stability to withstand what was initially a relatively small shift of deck cargo.

2. The trimmed and sloping surfaces of the cargo were such as to allow a transverse shift to occur at only a slight angle of heel.
3. On departure, the barge was upright and trimmed slightly by the stern.

4. No underwater hull damage or asymmetrical flooding were incurred during the voyage.

5. The barge capsized in good weather when the current slewed it at right angles to the direction of the tow.

6. Exemptions granted from regulatory provisions by virtue of its age and nature of its voyages within the "treaty zone" allowed loading of the barge such that its intact stability was below the limits set by the Interim Standard for Intact Stability for unmanned barges.

Causes and Contributory Factors

The "SEASPAN 240" capsized because the cargo deadweight and it's configuration on departure was such that the barge did not retain sufficient transverse stability to withstand a relatively small shift of deck cargo The shift of cargo and subsequent heeling were initiated by a combination of sea actions, pulling and slewing forces acting on the barge when positioned at right-angles to the tow.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 26 August 1998.