Baltimore collision

(27 March 2024)

At 01:28:43 local time on March 26, 2024, a container ship hit a main pillar of a bridge over the Patapsco River in Baltimore and the bridge collapsed [1].

See video of the event in real time here (Ctrl left click to open in new tab).

See a plot of the ship's route here (Ctrl left click to open in new tab).

See the marine chart of the location at bottom.

1. Technical data

The ship is 300 m long, 48 m in breadth, and her draft was 12.20 m. The displacement, or mass, was of the order of 125,000 metric tons.

The ship was navigating in a 215 m wide channel dredged to 15 m, on a 141 ° course, and at a speed of 8.5 knots, or 4.4 m/s.

The span of the bridge over the channel was 366 m.

2. Weather conditions

At the time of the events, weather conditions were quite benign:

- Wind was light, ESE 3 m/s
- Tide amplitude was shallow, at about 0.3 m
- Tidal current was of the order of 0.5 knots, or 0.25 m/s
- Air temperature was 9.6 °C
- Water temperature was 8.8 °C
- Visibility was good

[1] *I shall refrain here from the usual but frightful word "condolences", or any other virtuous vocable, which does not mean that I am not overwhelmed by grief when imagining the horror for those who fell to a sure death from a height of 56 meters.*

3. Crew

A typical ship's crew present on the bridge and on deck when exiting a harbor would be composed of at least:

- The Captain on the navigation bridge, in charge of operations[i] (see endnote regarding the responsibility of the Captain);
- A Senior Officer, usually the First Mate, on the navigation bridge to assist the Captain and record events;
- One Junior Officer at the bow, plus the Boatswain and a number of Able Seamen, the Boatswain being usually in charge of dropping anchors if so ordered;
- One Junior Officer at the stern, plus a number of Able Seamen;
- A Helmsman on the navigation bridge, at the helm;
- At least one Pilot of the Association of Maryland Pilots, the oldest state-codified organization of Pilots in the nation (see endnote regarding the responsibility of the Pilot).

4. Timeline of events (local EDT)

00:27:25	Ship departs dock
01:24:32	Power goes off for 59 seconds;
01:25:18	Anchor, probably on starboard, is seemingly dropped [2], 46 seconds after power loss;
	Heading 141 °
	Speed: 8.5 knots or 4.3 m/s
01:25:31	Power is resumed for 66 seconds;
01:26:37	Power goes off for 32 seconds;
01:27:09	Power is resumed for 99 seconds;
01:28:43	Bow hits west pillar, 205 seconds after anchor was dropped;
	Heading 155 °, or 14 ° off course to starboard
	Speed: 7.6 knots or 3.8 m/s
	Distance since anchor was dropped: about 900 m
01:28:48	Bridge collapses, 5 seconds after the collision;
	Ship apparently loses power again.

[2] *As suggested by the plot of the ship's route*

Note: pictures taken at the break of day show that the second anchor was dropped at some point.

5. Remarks

A. Regarding nautical events

a. The analysis of available information suggests that the starboard anchor was dropped while the ship was moving at a speed of 8.5 knots or 4.3 m/s. At such speed the ship goes her entire length in a little over a minute.

b. Seafaring practice dictates that anchors never be dropped when speed exceeds a knot or two, lest the anchor drag on the sea bottom and fail to bury itself in the mud and stop the ship. Even if the anchor were somehow stopped abruptly at such speed, chances are that the anchor, or one of the links, or the chain stopper on deck would fail because of the ship's inertia.

   Furthermore, the ship is likely to have carried 20 tons anchors and about 750 m of 4 ½ inch chain. Assuming that the anchor immediately hold firm and the length of chain paid out be 2/3 of its total length, the ship would have had to be stopped over a distance of 500 m.

   It can be calculated that stopping a 125,000 metric tons ship going 8.5 knots within 500 m would require a force of 240 metric tons applied during a little under 4 minutes. However, the holding strength of a 20 ton anchor is 100 tons only and its proof tested load does not exceed 160 tons. Also, the torque applied to the capstan brake would have been quite disproportionate.

c. The plot and calculation show that when she hit the pillar the ship was still going 7.6 knots, or 3.8 m/s.

d. However, while the dragging anchor would fail to slow the ship in any sensible way, it would not fail to swing the bow to starboard, which it did, at the rate of 4° per minute. It seems that the talus, or side slope of the channel, also affected the yaw, one way or the other, since the ship's draft was deeper than the sea floor outside of the channels.

e. Given the benign meteorological conditions, it would seem that had the anchor **not** been dropped the ship would have carried her way on course and would have gone safely under the bridge while avoiding the pillars, even if she had ended up stranded somewhere on the shore downstream.

f. Regarding the decision to drop anchor, which would have proved useless even if it had not been fatal, either:

   i. It was made by the Pilot, despite his extensive experience of the environment of Chesapeake Bay and all its tributaries and of all its obstacles, although it is quite unlikely (though not impossible) that he should have requested from the Captain to drop anchor at such short distance from the bridge and at a speed exceeding 8 knots[3], or

[3] *Although one may be tempted to contend that the speed was perhaps excessive, in reality said speed was probably required to ensure the proper maneuverability of the ship.*

ii. It was made by either:

α. The Boatswain or the Junior Officer on the bow, without order, or

β. The First Mate or the Captain from the bridge.

g. In each instance, the decision would have been made in a state of panic[4].

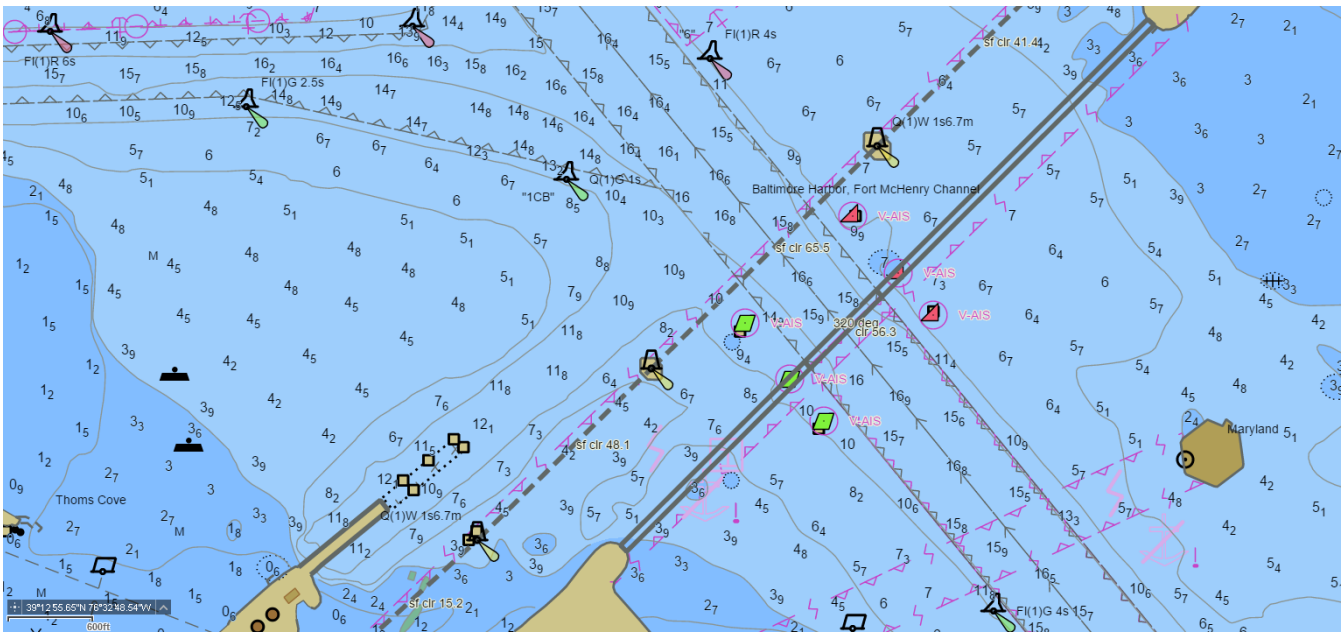
h. In all instances, it appears that dropping the anchor will be considered a Nautical Fault, which has the potential to exonerate the ship owner from any liability.

B. Regarding the design of the bridge over the Patapsco River

When the bridge was designed at the end of the 1960s large ships had a displacement, or mass, of 25,000 metric tons and were 180 long and 24 meters in breadth. The ship that hit the bridge had a mass of 125,000 metric tons, or 5 times as much, with a length of 300 m and a breadth of 48 m.

Location of the Patapsco River bridge

Soundings in meters



[4] *The author of this short study is not judging in any way those who took instant decisions with such a devastating effect, since the succession of unusual events happened at a very fast and unexpected clip. Talk is cheap:*

Note regarding the responsibility of Pilots and Captains

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[i] As reflected in an official statement adopted by the Trustees of the American Pilots' Association in 1997:

Navigation of a ship in United States pilotage waters is a shared responsibility between the pilot and the master/bridge crew. The compulsory state pilot directs the navigation of the ship, subject to the master's overall command of the ship and the ultimate responsibility for its safety. The master has the right, and in fact the duty, to intervene or to displace the pilot in circumstances where the pilot is manifestly incompetent or incapacitated or the vessel is in immediate danger (in extremis) due to the pilot's actions. With that limited exception, international law requires the master and/or the officer in charge of the watch to "cooperate closely with the pilot and maintain an accurate check on the ship's position and movement."