

COPY

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20th September, 1943.

REPORT ON THE SINKING OF THE CONCRETE-STEEL BARGE "ST. ANNE"  
ON 3rd SEPTEMBER, 1943.

The Swim Barge "ST. ANNE" (400 tons deadweight) was lying off Penhithe with approximately 400 tons of cement clinker. The tug, having left it moored, returned for some reason and in doing so struck into the barge. The barge being low in the water the stern of the tug over-rode the deck and either the rudder or the propeller of the tug penetrated the shell on the starboard side of the cabin in the after swim. The hole in the side, as seen subsequently, was between frame 16 and 17 - the top of the hole was about 2 ft. below deck, the bottom about 4 ft. below deck and was approximately oval in shape, i.e. about 2 ft. deep and about 6 ins. wide - the barge was lying on a shelf at a fairly steep slope which exposed the forward end of the deck at low tide.

The barge was lifted on the 6th September by the P.L.A., approximately 70 tons of cargo having first been removed by grabbing, the lifting being done in the usual way by working chains under the barge so that it was lifted at the four corners immediately opposite the two bulkheads - when carrying out the lifting operations the forward peak was pumped out.

We inspected the barge on the 8th September when it was still partly loaded. We were able to see the fracture and also to observe the effects of lifting, and also noticed distortion of the forward bulkhead.

Although it has been reported that two days after the accident the blade of the propeller of the tug fell off it may well be, from the positioning of the hole, that the damage was caused by the rudder. To avoid repetition of this type of accident we propose, in future barges, to have two more runs of 3" half-rounds 2 ft. apart below the gunwale, and have already provided these on the second barge under construction. Although these bars are situated fairly well below the deck their effect on longitudinal strength is such that the 3" diameter bars situated below the gunwale bar in the shell of the barge may now be omitted, and this, to some extent, offsets the additional steel required in the additional half-rounds.

In barges it is not entirely established as to whether the bulkheads should be watertight or not. Indeed in all steel barge designs examined by us the strength of the bulkheads is not sufficient to take water pressure up to deck level without failure. In most cases they are perforated at the bottom so that bilge water is dealt with by one set of pumps. This is not entirely satisfactory as water entering by chance to the swims finds its way into the hold. In this barge the bulkhead was watertight, i.e. unperforated. The effect of this is not, as might be imagined, to delay the sinking of the vessel. Water entering one swim only has the effect of tilting the barge, and it is found, by calculation, that when the barge is fully loaded it will only require one-third of the quantity of water to enter a swim to sink the vessel as would be required if uniformly distributed. We do not, however, think that this experience should lead us to abandon the idea of a watertight bulkhead but we are of the opinion that the two swims should be connected together by pipes so that water entering one is communicated to the other, and by maintaining a uniform trim sinking is delayed, which may well enable the barge to get to shallow water. In the second barge under construction we have arranged for this by pipes running through the concrete blocking of the bilges.

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067626-007638-0489



It is clear that when salvaging barges the only lifting that can be relied upon are at bulkheads. This mathematically the best place to lift a barge from the view of stresses, but on the other hand secondary matters and so forth arise. On these grounds it is better to lift at bulkheads. Particularly would this be the case if the barge were lying on its side. We have made calculations of stresses involved when lifting the vessel at these points and find that the shear steel in the side of the barge during lifting operations, stresses well beyond normal stresses, causing diagonal cracking of the concrete, but closing up when the excessive conditions were removed. There is a little likelihood of the cracks being penetrable by water without no detriment to the strength of the vessel. We are of the opinion, however, that to deal with this condition in future barges, appropriate diagonal steel adjacent to the bulkheads should be doubled up. The tonnage of steel involved is very small and we have arranged for this on the second barge.

The lifting operations inflicted a considerable sagging bending moment - calculations of this condition show, however, that the steel provided in the bottom at midspan is ample to meet this and there are no signs of undue strain in the bottom.

As stated above, the forward peak was pumped out during the salvage operations and with the inclination of the barge with the water just lapping the edge of the forward scum, the mean pressure of water inflicted on the forward bulkhead was at least 8 ft. Even without the operation of pumping out the condition of pressure would occur during sinking. Calculations show that at this pressure the steel at the centre of the bulkhead reaches a stress of about 20 tons to the square inch, well beyond its elastic limit, whereas at the ends the steel is subjected to a stress of not more than half this figure. These calculations agree with observation of the bulkhead. At about half the depth it has bulged forward, cracking the concrete. The bulkhead is just as useful now as it ever need be, nothing is needed to make good cracks and repainting. We are of the opinion that in future barges, to deal with this contingency, some additional vertical bars should be placed on either side of the bulkhead concrete shell to assist the steel joists. At the centre  $\frac{1}{2}$ " bars at 3" centres have the effect of doubling the strength in which case the limiting figure of 8 ft. would be increased to 16 ft. which should be ample to meet any emergency - the steel involved is very small and would make the bulkhead as strong as a steel bulkhead in a steel barge.

In our opinion the barge stood up to the salvage operations very well - had it been of normal reinforced concrete construction it might have been rather different, particularly the bulkhead. The problem of course is to reduce the possibility of sinking and this we have, we think, done by reducing vulnerability by the provision of the extra protecting bars, but if it should happen that the barge is sunk then the consequential damage should be minimised, and this, we think, we have done by the addition of comparatively small quantity to deal with salvage stresses in the light of this experience.

The hole in the shell was repaired in the afternoon of September 15, and with the precautionary coating of paint in our opinion, nothing further to be done to make the barge seaworthy.



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