TECHNICAL LEAFLET IVR

STRENGTH AND LOADING ISSUES

From time to time, cases/casualties involving the **breaking and subsequent salvage of inland navigation barges** occur. The incidents mostly occur during or shortly after loading operations. The first questions that then arise are:

- did the barge give way due to poor construction?

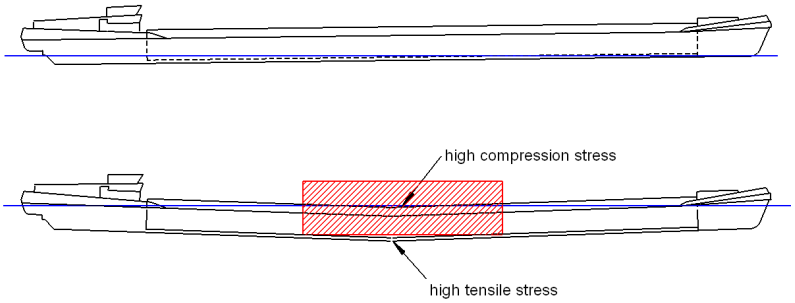
or

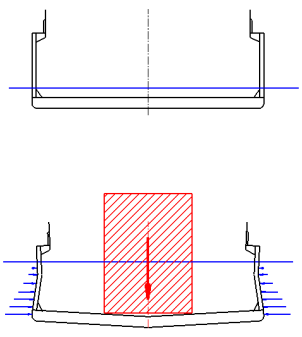
- was the collapse caused by faulty loading or something else?

Some older barges may indeed suffer from degraded sections in their construction. At the same time, investigation has shown that this may not necessarily be the case, but that an incorrect loading and even an incorrect unloading procedure was to blame.

The construction design of an inland navigation barge cannot be compared to that of a seagoing vessel. While seagoing vessels are designed to withstand heavy weather, rough seas, waves, etc., an inland navigation barge is designed to sail in sheltered water. Moreover, historically, barges are designed to carry cargo in bulk or in bags, which should be equally spread over the entire tank top of the cargo hold.
Sometimes even, when the vessels construction was calculated in these calculations a method of loading is taken into account in relation to the maximum load, which is noted down in the stability calculations. However, due to change of owner, sometimes this required method of loading is unknown, to the new owner, or the stability book is lost, with all related consequences.

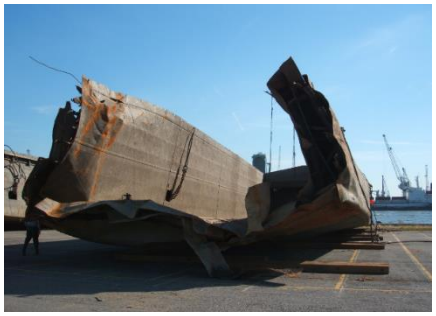
When the principle of method of loading or equal spreading is not respected, the barge tends to bend in the middle, a condition which is also known as “sagging”. This condition generates high compression stresses in the hatch coaming, and high tension stresses in the bottom plating. Once these stresses exceed the buckling resistance of the hatch coaming construction, or the yield strength of the bottom steel plates, the vessel folds in the middle.





Furthermore, a proper athwart ship distribution of the cargo load should be respected. Once the cargo is loaded any other way, the bottom tends to bent in transverse direction, the effect of which is increased by the hydrostatic water pressure in the ship’s sides.

The photograph about the barge loaded with heavy steel plates shows an example of such faulty loading. The heavy steel plate stacks do not cover the entire length of the cargo hold; moreover, the cargo weight is concentrated near the barge centre line, rather than having been spread sideways. Shortly after leaving its berth, this barge suddenly collapsed and sank immediately.

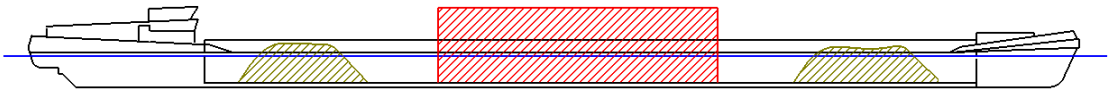


After salvage of the wreck, the typical failure mechanism as described above could be clearly noted; the barges' bottom was bent downwards in transverse direction, its sides were pushed inwards and its hatch coaming was heavily buckled.

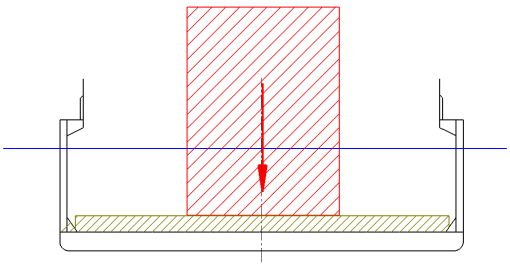
Solutions:

When concentrated heavy loads have to be loaded on board of an inland navigation barge, it is possible to take certain precautions in order to avoid the risk of breaking.

The longitudinal bending by cargo that cannot be loaded over the full length of the hold, can be compensated by adding ballast, (e.g. sand) in the forward part, respectively aft part of the hold



In order to avoid excessive transverse bending by loading narrow heavy cargo in the centreline of the barge, transversal beams or wooden battens or thick steel plates spread over the full breadth of the cargo hold can be used.



Anyhow, for loading very heavy and concentrated cargo, it is recommended to carry out a strength calculation beforehand on basis of which it can be determined which measures have to be taken to avoid overload of the barge construction.

This advice does not only apply on old barges. Even new barges do not resist when the basic strength principles and the vessels required loading methods are not respected.