Use of vibroacoustic diagnostics in the exploitation of a vessel in real conditions

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Abstract. A sea vessel is the largest mode of transport and a complex technical object. Equally complex is the structure of materials. Currently, the vibroacoustic diagnosis is carried out on machine parts as well as the whole machines, hull and superstructure of a vessel. The study attempts to assess, when and in what way it is possible to apply the using vibroacoustic diagnostics in real operating conditions of the ship.

Keywords: sea vessel, vibroacoustic diagnostics, real conditions, exploitation of ships.

1. Identification of vibrations on a sea vessel

A sea vessel is the largest mode of transport and a complex technical object. The structure of the vessel's design contains elements of very small to large values of the bulk, area and space (relative to other modes of transport). Equally complex is the structure of materials.

The hull, superstructure, equipment, pipelines and power systems are mostly made of metals of different chemical composition and different crystal structure.

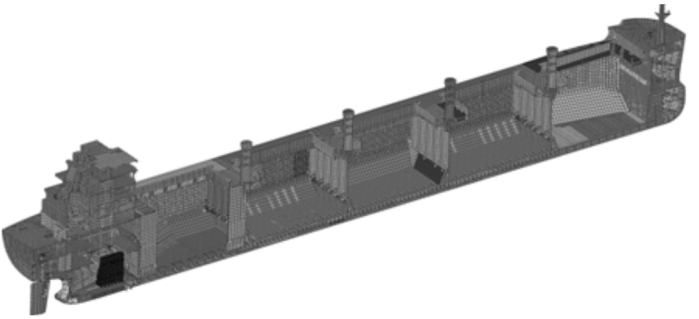


Fig. 1. Hull calculation model [1]

Fig. 2. Oil/chemical tanker "New England" in storm [2]

Connectors, gaskets, thermal, acoustic and vibration insulation are often made of plastics. The elements of a vessel are connected hardwired, disjointed and cooperate in tribological nodes. It is

thus a very complex resilient center that undergoes vibroacoustic processes in the marine environment. These processes are local due to the influence of the elements of a vessel, as well as working appliances, and concern the whole vessel including the impact of the wind or the sea.

Currently, the vibroacoustic diagnosis is carried out on machine parts as well as the whole machines. The actual data collected during the testing on real objects is analyzed in laboratories and during operating conditions. This helps in the creation of models of varying complexity using various methods.

The test is carried out according to various criteria. These criteria are:

1) Failure of components of machines and structures, including:
– level of geometric use,
– change in crystal structure,
– loss of material's continuity
– deformation,
– and other,
2) Effect on human beings:
– noise,
– vibrations,
– the impact on the environment

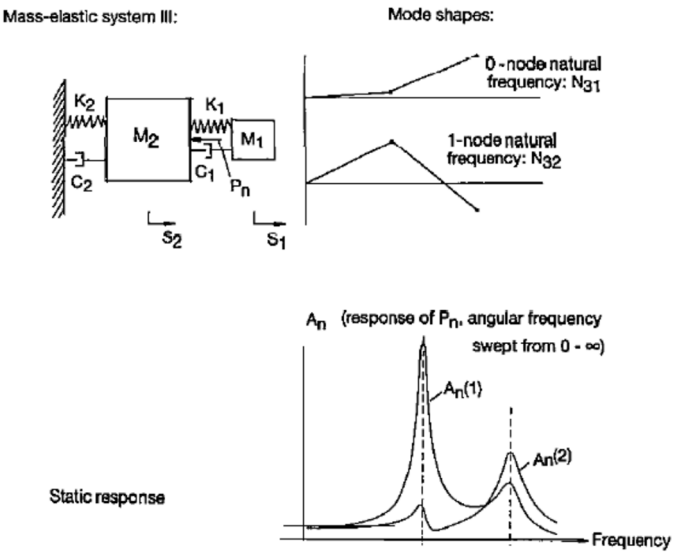


Fig. 3. Explanation of vibration terms [3]

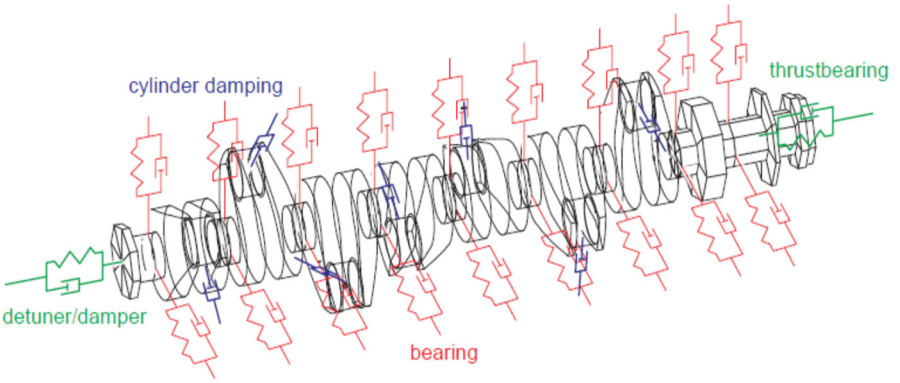


Fig. 4. The calculation model used for dynamic analysis of the crankshaft and Bering [4]

The reliability of the test results depends on several factors, including:
– the accuracy of the test method chosen,
– the accuracy of the measurement,
– sensitivity of the sensors,
– loss of signal transmission lines,
– loss of signal converters,
– the accuracy of the form of signal visualization in the aspect of the capability to determine the trend of changes in the tested state.

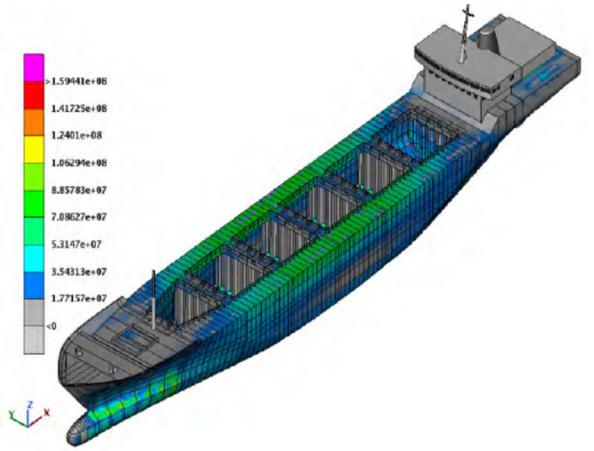


Fig. 5. Stresses in the different area of ship hull [5]

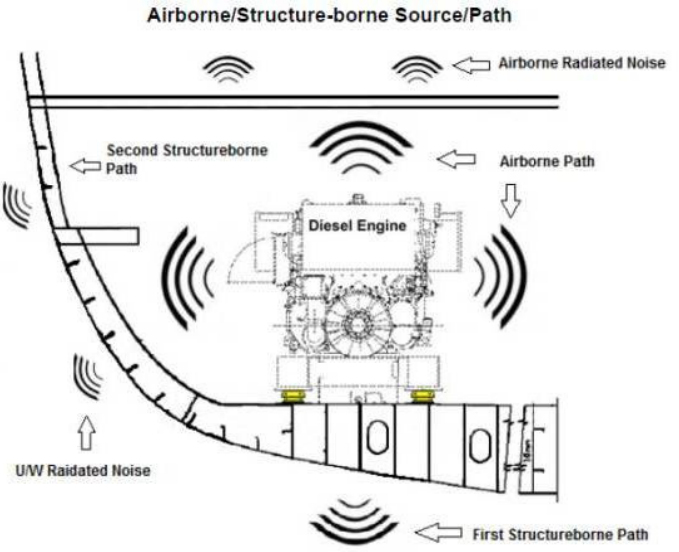
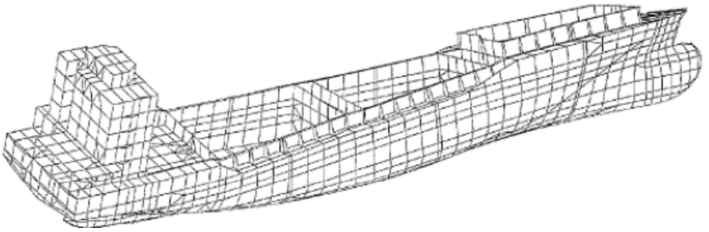


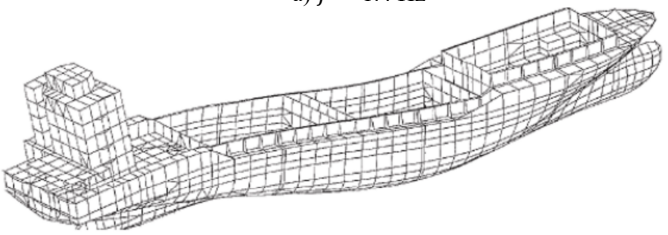
Fig. 6. The impact on the environment and on human [3]

2. Conclusions

The study attempts to assess what areas of the organizational structure of a vessel and its equipment, and what operating conditions of a sea vessel, are conducive to the accuracy and reliability of the diagnosis using vibroacoustic diagnostics.



a) $f = 1.4$ Hz



b) $f = 3.3$ Hz

Fig. 7. Deckhouse model and bending modes [3]

References

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