

**VS-Einstufung:** OFFEN  
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## **INVESTIGATION OF TANK STRUCTURES UNDER SHOCK LOADING**

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Shock loads are a relevant load case for naval ships and submarines. Especially in case of fluid-structure interaction the reliable assessment of large-scale shock problems is complex. This presentation shows different possibilities to account for hydrodynamic loads on tank structures.

First an overview of related rules from civil engineering is given. The EUROCODE8 deals with calculation methods for liquid storage tanks under earthquake loading. The EUROCODE8 utilizes a potential flow theory, which is also often used for "wet vibration" problems in naval architecture. In this approach, the most practical option is to smear non-structural masses onto the structure. These non-structural masses are also called "added masses".

However, due to the high accelerations during the shock event, cavitation occurs, and therefore the potential flow solutions are not directly applicable. Cavitation limited the resulting pressure in the low-pressure area of the fluid domain. A solution using added masses does not account for this effect.

Therefore, an explicit LS-Dyna FEM model considering cavitation is developed and successfully verified by analytical means. A Lagrange fluid model has been utilized. The fluid elements are coupled with the structural elements using a TIED-contact formulation.

The results of the coupled simulation are compared to a typical added mass model. As expected, the structural damage of the added mass solution is much higher.

Finally, a design methodology using a simple ultimate load approach is proposed.