NASA TECH BRIEF

Marshall Space Flight Center

The Impact of Water on Free-Falling Bodies

A report has been published which discusses measures to cushion the impact on a body falling into water. Heavy loads are created during the impact which may damage instrumentation inside the body (e.g., rocket components, meteorological instrumentation, air-dropped cargo, and the like). When the body drops into the water two effects occur: First, heavy loads are generated due to the impact, and second, additional loads are created by pressures of the water cavity collapsing onto the body.

An effective method to cushion the impact is to use screens around the body. These have to be contoured to the body shape. Several arrangements varying in the number and spacing of the screens were tested and discussed in the report. A 1-in. (2.5-cm) sphere is used as the laboratory model of the body dropping into a flat water surface (e.g., no waves). The flat water surface has been selected because it creates the largest impact forces on the falling body.

Preliminary results show that the screens substantially attenuate the peak loading occurring during the impact. They first reduce the velocity of the impacting water and second aerate the water to provide additional cushioning.

Next in the report the physics of the water-cavity collapse is discussed. A mathematical model is presented to permit the approximation of peak cavity collapse loads. One important observation in the laboratory tests is that entrapped air plays an instrumental role in cushioning the impact of the collapsing water onto the body. An important conclusion from this analysis is that in subscale model tests realistic cavity collapse pressures can be obtained only when the environment is pressure scaled. In other words, additional pressure effects come into play when large bodies are studied.

The study has wider implications. For example, the concepts discussed are also useful in protecting dikes, levees, and similar structures that are subject to wave damage during large storms.

Note:

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Technology Utilization Officer
Marshall Space Flight Center
Code AT01
Marshall Space Flight Center, Alabama 35812
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Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

Patent Counsel
Marshall Space Flight Center
Code CC01
Marshall Space Flight Center, Alabama 35812

Source: H. A. Wright, P. J. Remington, and R. Madden of
Bolt Beranek and Newman, Inc.
(MFS-23310)

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