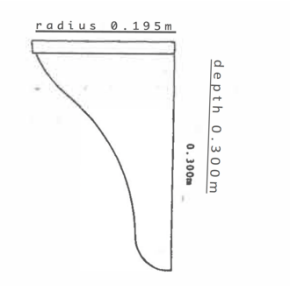
Deep Blue Data Ref: Impact time series for three dimensional cusped body (ref. Troesch and Wang, 1987)

An example time series of hydrodynamic impact on a cusped body is presented. This scaled acceleration time series has been used in the graduate class, NA540, as an example of hydrodynamic impact. The cusped body is axisymmetric and resembles the bow profile of a ship with flare. Sketches of the body are shown below:



The experiments from which the time series were scaled were conducted at the Ship Hydrodynamics Laboratory (SHL), currently named the Marine Hydrodynamics Laboratory (MHL) at the University of Michigan.

The vertical accelerations were measured for using accelerometer transducers (PCB Piezotronics Inc., model no. 302A02) which had natural frequencies exceeding 35KHz. An instrument package was constructed and could be bolted into the top of the shape with the whole assembly made watertight.

Analog signals from the accelerometers were digitized at a sampling rate of 21KHz. Due to the flexibility of cusped body, the total system natural frequency was significantly lower than the natural frequency of the individual transducers. Body natural frequencies of approximately 275 hz were estimated. These frequencies resulted in adequate rise times for lower drop heights where the initial velocities were relatively small and the duration of impact stretched out. However, at the higher drop heights, the steep rise time produced significant dynamic system response increasing the measured maximum acceleration.

In order to get the acceleration of the center of gravity of the impact body from an accelerometer suspended inside that body, the entire system was modeled as a single degree-of-freedom spring-mass-damper system experiencing base excitation.

For the purposes of the NA540 homework, the time series given in the data file has been scaled to a geometrically similar shape with a radius of 3.815m radius. The magnitude of the impact has been reduced to more reasonably represent impact experienced by typical ocean-going ships.

Details of the experiments, data reduction, and theoretical calculations may be found in Troesch, A.W. and Kang, C.-G., "Hydrodynamic Impact Loads on Three Dimensional Bodies," Proceedings of the 16th Symposium on Naval Hydrodynamics, Berkeley, July 1986. (National Academy Press, Washington, D.C., 1987)