Prepared by Marianne Francois, June 2006
Revised: M. Christon, Feburary, 2007

Broken Dam

Objective

The objective of the broken dam test problem is to test the solution of the incompressible Euler equations with PLIC-VOF, mass and momentum advection, and gravity. The test is meant to be time-dependent. The interface position with time is of interest here and can be compared with the data of Martin and Moyce (1952). This test is a typical dynamic test in free-surface flow.

Definition

A column of fluid initially at rest, falls under gravity and flows along the bottom surface of the mesh, towards an open boundary at the right edge.

Metrics

The shape of the free surface, and the position of the leading edge of the collapsing column, as a function of time. Martin & Moyce provide the following data for the position of the leading edge

$$t^* = t\sqrt{2.0 \times 9.81 / 0.05715} \tag{1.1}$$

$$x^* = x / 0.05715 \tag{1.2}$$

where x is the position of the leading edge, and 0.05715 is the initial width of the column. The table below shows values of (t^*, x^*).

t^*	x^*
0.41	1.11
0.84	1.22
1.19	1.44
1.43	1.67
1.63	1.89
1.83	2.11
1.98	2.33
2.20	2.56
2.32	2.78
2.51	3.00
2.65	3.22
2.83	3.44
2.97	3.67
3.11	3.89
3.33	4.11
4.01	5.00

For the purposes of regression testing, a single run was performed to take the computation forward 140 time-steps from t=0. A restart is used in the regression suite with golden data (built into Capability.py) at 160 time-steps.

Truchas Model

(50 x 22)

The input file name is broken_dam_hex.inp.

Results

At t=0.80, corresponding to 160 cycles, the following “golden” data for comparison is (u,v,w) = (1.15013, 3.33312e-2, 0.0), p=5.83695, and VOF=2.20233e-1 at the proble located at (x,y,z) = (0.1114425, 0.0028575, 0.0028575).

Critique

There is no analytical data for this problem. For the purposes of regression testing (fast go/no-go tests), a single set of data a probe location is sufficient. This test could be used for a validation exercise, but this is not appropriate for regression testing.

References

J.C. Martin and W.J. Moyce, "An Experimental Study of the Collapse of Liquid Columns on a Rigid Horizontal Plane," Philosophical Transactions of the Royal Society of London, Series A, Vol. 244, pp. 312-324, 1952.