TEST CASE DOCUMENTATION
AND TESTING RESULTS

TEST CASE ID ICFD-VAL-1.1

Dam Breaking

Tested with LS-DYNA® v980 Revision Beta

Friday 1st June, 2012

Document Information	
Confidentiality	**external use**
Document Identifier	LSTC-QA-LS-DYNA-ICFD-VAL-1.1-1
Author(s)	Iñaki Çaldichoury, Facundo Del Pin
Number of pages	9
Date created	Friday 1st June, 2012
Distribution	External

Contents

1 Introduction

1.1 Purpose of this Document

This document specifies the test case ICFD-VAL-1.1. It provides general test case information like name and ID as well as information to the confidentiality, status, and classification of the test case.

A detailed description of the test case is given, the purpose of the test case is defined, and the tested features are named. Results and observations are stated and discussed. Testing results are provided in section 4.1 for the therein mentioned LS-DYNA® version and platforms.

2 Test Case Information

Test Case Summary	
Confidentiality	external use
Test Case Name	Dam Breaking: 2D collapse of a fluid column
Test Case ID	ICFD-VAL-1.1
Test Case Status	Under consideration
Test Case Classification	Validation
Metadata	FREE SURFACE

Table 1: Test Case Summary

3 Test Case Specification

3.1 Test Case Purpose

This test case simulates the collapse of an inviscid liquid column confined between two vertical walls. The liquid is initially at rest and, at time=0, the right wall is removed triggering the collapse of the liquid column under the influence of gravity. The purpose of the test case is to study the advancing water front behavior.

3.2 Test Case Description

Dam break waves have been responsible for numerous accidents in the past 150 years making it an important field of research for numerical simulation. The experiments carried out by [2] reported the outcome of the collapse of fluid columns over initially dry beds. Figure (2) shows an impression of these early experiments. Figure (1) offers a sketch of the problem. The dimmensions of the problem repoduce those used by [1].

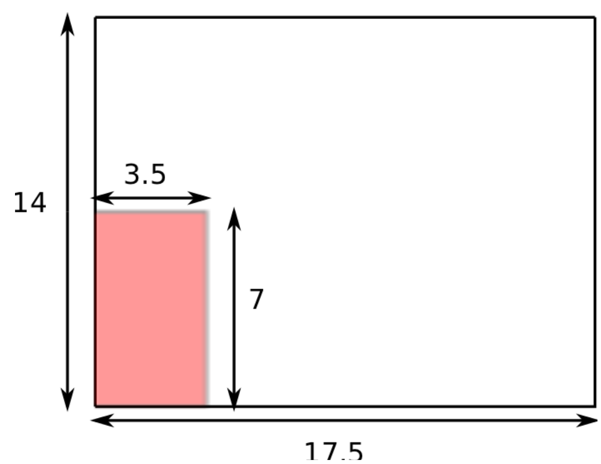

Figure 1: Test Case Sketch

The experiments conducted by [2] measured the time at which the flood wave arrived at certain distances from the gate. The main objective will be to compare these results with the results of the simulation.

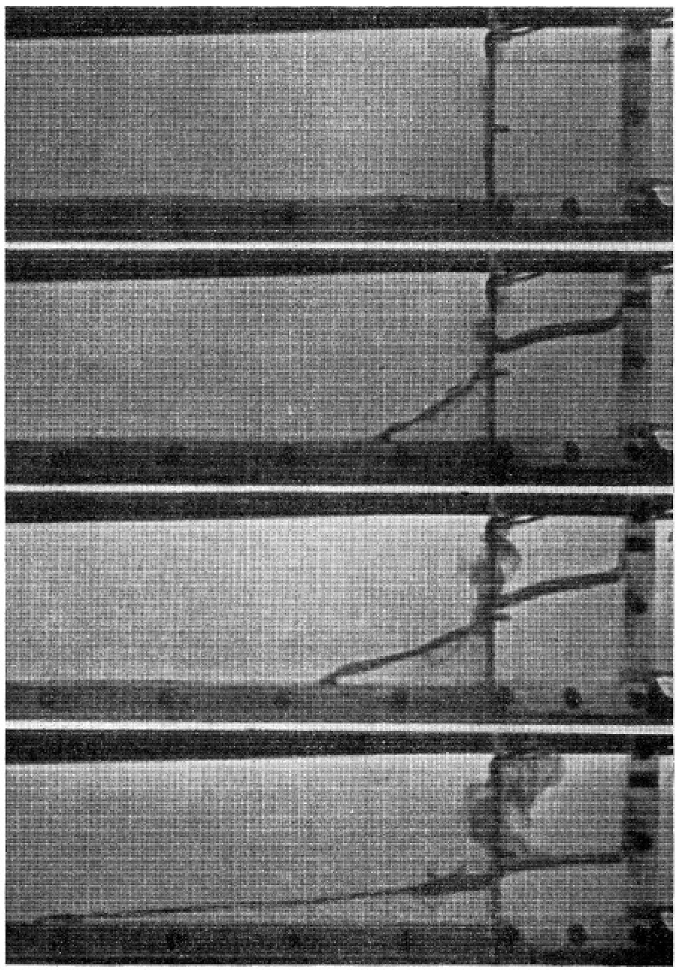

Figure 2: Experiments carried out by [2]

3.3 Model Description

Figure 3 offers a view of the geometry and mesh. Table 2 describes the mesh and Table 3 gives the physical parameters that will be used. The model consists of two phases, the liquid column and the air or vaccum. Therefore the physical parameters given correspond to the fluid's parameters. In this case, the viscosity of the fluid is neglected. Two boundary conditions for the ground, non-slip and free surface, will be tried and analysed.

Model information	
Surface Element size	0.1
Volume Nodes	23537
Volume Elements	46496

Table 2: Test Case Mesh Information

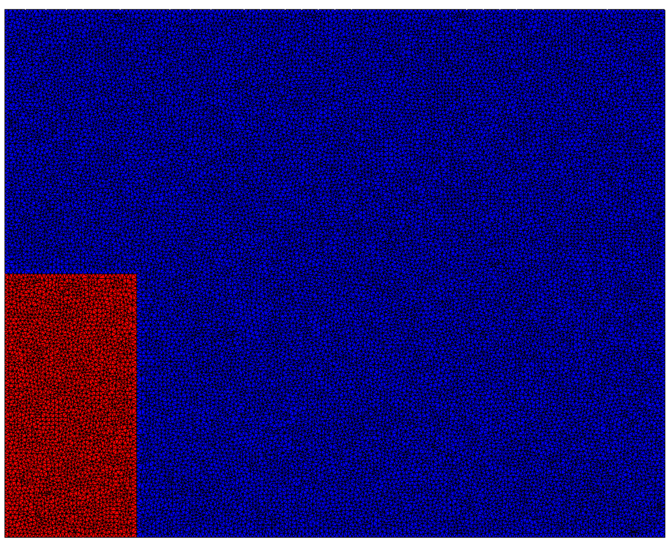

Figure 3: Test Case Mesh

Model physical parameters	
Fluid Density	1000
Viscosity	0.000
Gravity	1

Table 3: Test Case Parameters

4 Test Case Results

4.1 Test Case observations

The different phases of the dam break can be observed in Figure (5). Figure (4) shows the very good agreement between the numerical and the experimental solution. The error remains small throughout the whole simulation for both boundary conditions, non and free slip but it is interesting to note that the free slip condition is slightly less dissipative. A better correlation with the experimental results using the non-slip condition could however be anticipated as this boundary condition represents better physical reality.

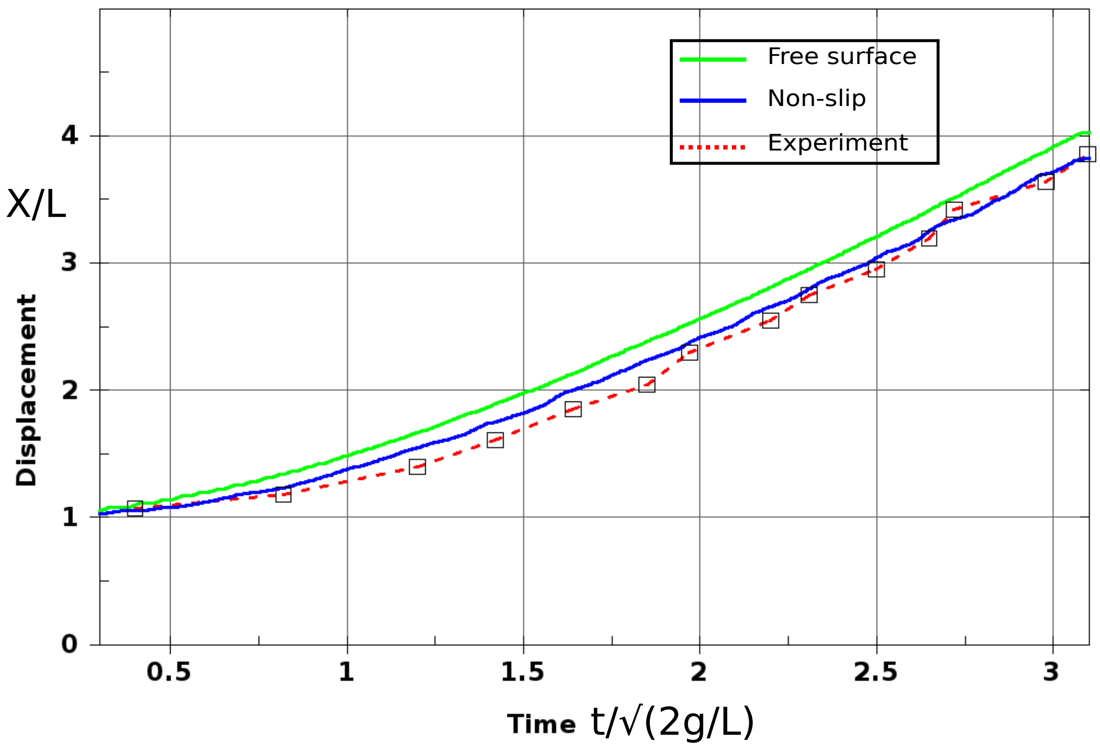

Figure 4: Superimposition of both numerical and experimental solutions.

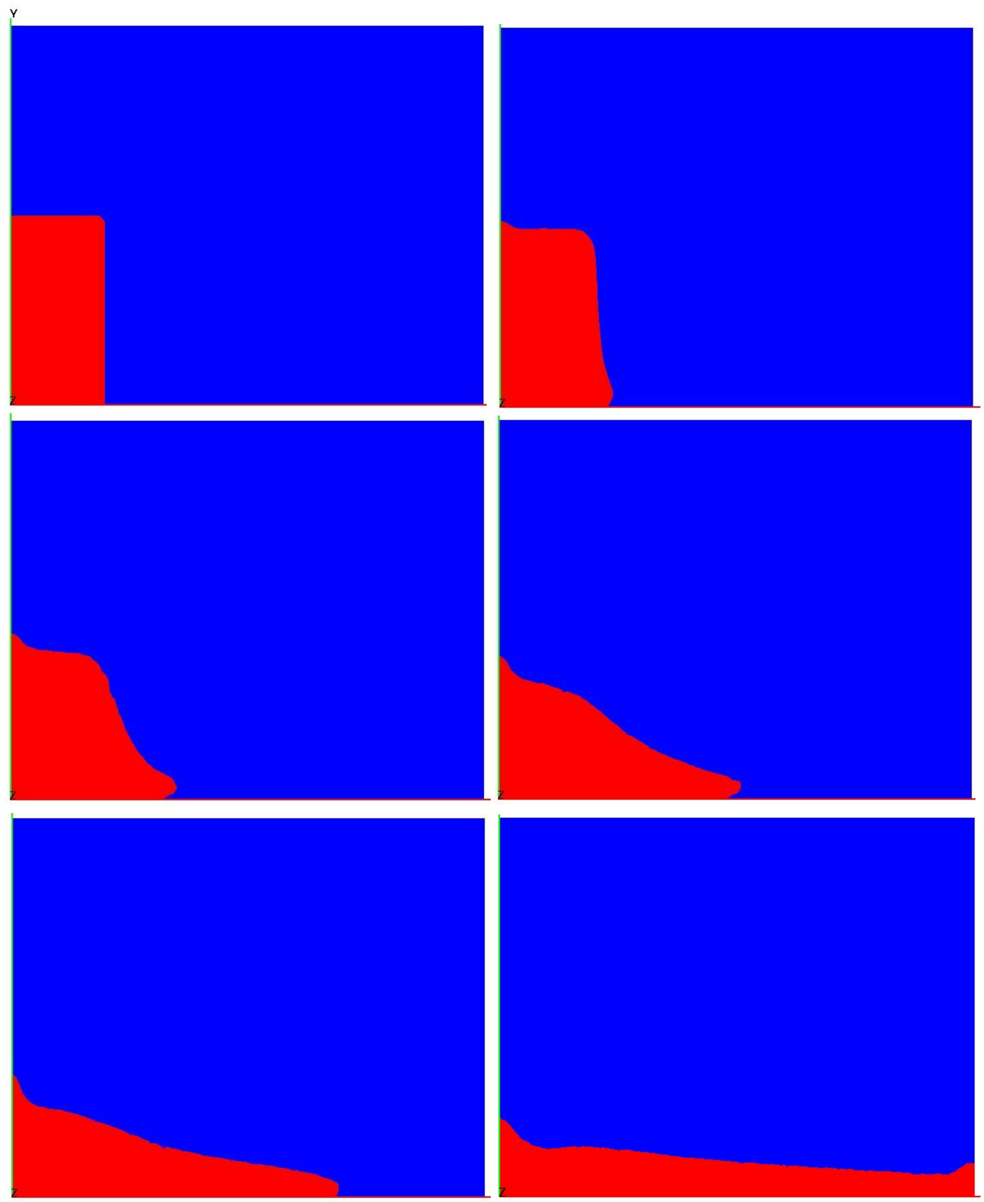

Figure 5: Fringes showing the progressive collapse of the water column

References

[1] P. Hansbo, *The characteristic streamline diffusion method for the time-dependent incompressible navier-stokes equations*, Computer Methods in Applied Mechanics and Engineering 99, (1992), pp. 171–186.

[2] W. J. M. J. D. Martin, *Part iv. an experimental study of the collapse of liquid columns on a rigid horizontal plane*, Philosophical Transactions of the Royal Society of London., 1952.