TEST CASE DOCUMENTATION
AND TESTING RESULTS

TEST CASE ID EM-BENCH-1.1

TEAM Workshop Problem 4

Tested with LS-DYNA® v980 Revision Beta

Friday 23rd March, 2012

Document Information	
Confidentiality	**external use**
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Author(s)	Iñaki Çaldichoury, Pierre L' Eplattenier
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1 Introduction

1.1 Purpose of this Document

This document specifies the test case EM-BENCH-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	TEAM Workshop Problem 4: The Felix Brick Experiment
Test Case ID	EM-BENCH-1.1
Test Case Status	Under consideration
Test Case Classification	Benchmarking
Metadata	TEAM problem

Table 1: Test Case Summary

3 Test Case Specification

3.1 Test Case Purpose

The purpose of this test case is to analyse the EM solver's capabilities at simulating a uniform magnetic flow.

3.2 Test Case Description

TEAM (Testing Electromagnetic Analysis Methods) represents an open international working group aiming to compare electromagnetic analysis computer codes. TEAM Workshops are meetings of this group. A series of TEAM Workshops was started in 1986 and has been organized in two-year rounds, each comprising a series of "Regional" workshops and a "Final" Workshop, as a satellite event of the COMPUMAG Conference. The TEAM problems consist in a list of test-problems, with precisely defined dimensions, constitutive laws of materials, excitations, etc., and each backed by a real laboratory device, on which measurements can be made.

The TEAM 4 problem consists of a rectangular aluminium brick [1] with a rectangular hole placed in a uniform magnetic field. The magnetic field is perpendicular to the faces with the hole, and decays exponentially with time. The main objective of the problem is to calculate the total circulating current in the brick. Figure (1) [1] shows the results obtained by the different work groups for the total current.

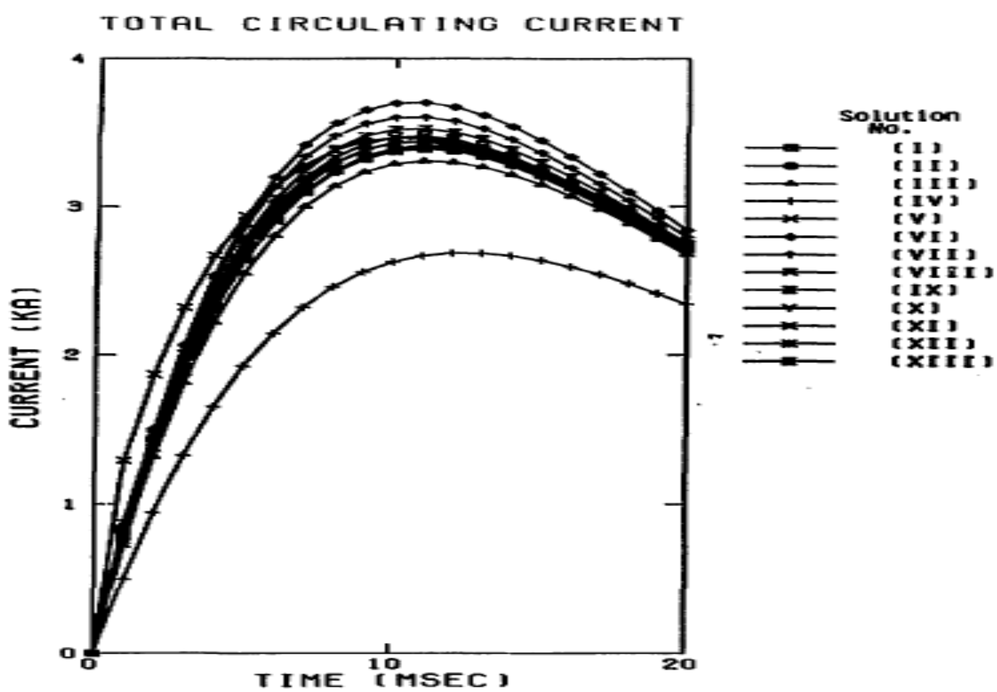

Figure 1: Reference results for time variation of the total circulating current in the FELIX brick [1]

3.3 Model Description

The brick as shown in Figure (2) is made of aluminum alloy 6061, of conductivity $\sigma = 25.38e^6\Omega^{-1}m^{-1}$. Table (2) gives some additional information on the mesh. The applied magnetic field in the z direction is uniform in space and decays exponentially with time as :

$$B_z = B_0 e^{-t/\tau} \tag{1}$$

with $B_0 = 0.1T$ and $\tau = 0.0119s$.

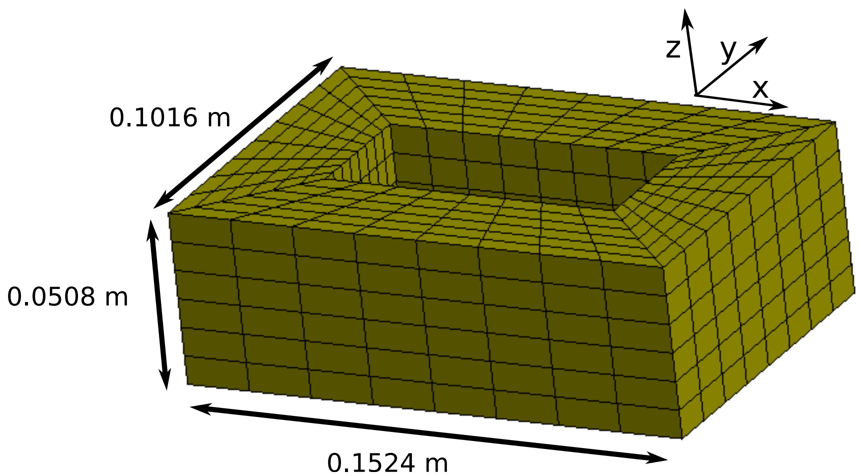

Figure 2: Test case Geometry and Mesh. Central hole 0.0889 m × 0.0381 m

Model information	
Nodes	1568
Solid elements	1152
Surface element size (in z direction)	8.5 mm

Table 2: Test Case Mesh information

4 Test Case Results

4.1 Test Case observations

On Figure (3), the current flowing around the brick can be observed. The current density decreases from the outer surface to the interior hole due to diffusion effects. The total current flowing through a section of the Brick is shown on Figure (4) and is in good agreement with the results shown on Figure (1).

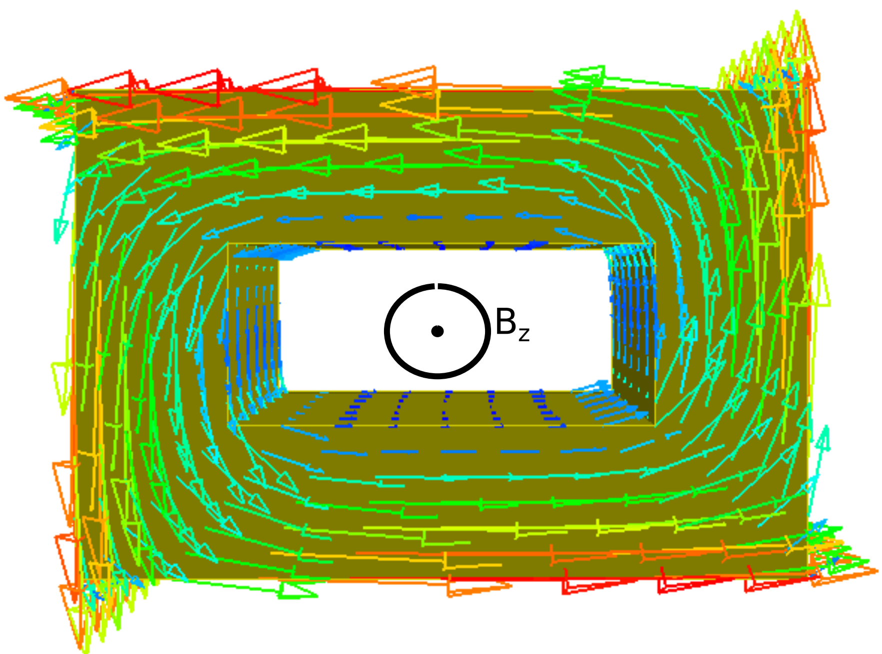

Figure 3: Test Case Density current vectors at peak instant

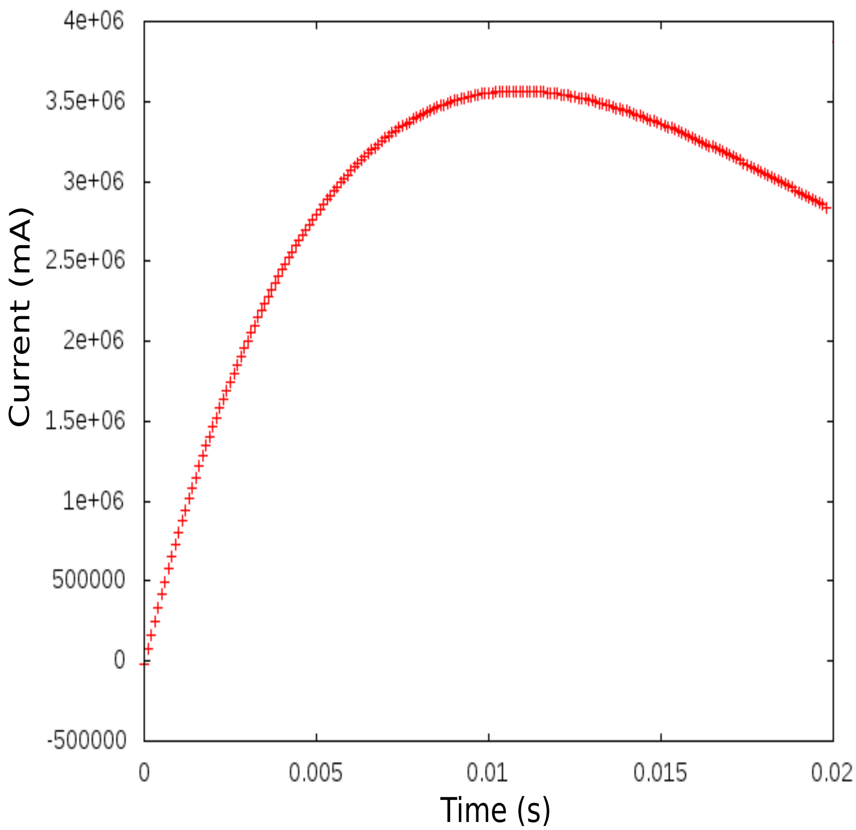

Figure 4: Time variation of the total circulating current in the FELIX brick

References

[1] A. Kameari, *Results for benchmark calculations of problem 4 (the felix brick)*, COMPEL, Vol 7. Num 1 (1988).