

## Safety Analysis of the Transport Container for Hydrogen Isotopes

150

가

9m

### Abstract

The vessel used for the transport of radioactive materials, containing hydrogen isotopes must be evaluated for hypothetical accident conditions according to national regulations. The computational analysis used in support of the experimental program, performed to qualify the container for the transport of radioactive materials is a cost effective tool to minimize testing and streamline the regulatory procedures. The numerical analysis of 9m free-drop onto a flat unyielding, horizontal surface has been performed using the explicit finite element computer program ABAQUS. The analysis results provide sufficient data to study the failure mechanisms of the container.

1.

가

800

9m

B

, 1m

가

가

가

2.

1

1

가

2

가

3

가

3.

2

9m

3

Spot weld

point 가

가

가

. 1

2

Rigid body

가

, 1

2

Cylinder

Cap

Shell

,

2

part

Solid

. 3

Shell

,

Spot weld

.

Spot weld

가

A

Solid

B , A  
 1 2 37

1.

Node	38,718
2D Shell element	7,660
3D Solid element	24,536
Added point mass	1
Component	13
Contact	37
Material	4

Elastic-Plastic material , 4 가  
 가 . 2 3

2. (STS304)

SS 304	Elastic-Plastic material model
Density	7800 kg/m <sup>3</sup>
Young's Modulus	206 GPa
Poisson's ratio	0.29
Non-linear part	Tangent modulus

A 3  
 4 -

4.

ABAQUS/Explicit , 9m  
 free drop test , 9m drop  
 Rigid wall (1)

$$\begin{aligned}
 v &= \sqrt{2gh} \\
 &= \sqrt{2 \times 9.81 \times 9} \\
 &= 13.2883 \text{ m/s}
 \end{aligned}
 \tag{1}$$

1msec

135.71 kg

(2)

$$\begin{aligned}
 E_{Total} &= \frac{1}{2} mv^2 \\
 &= 11.982 \text{ kJ}
 \end{aligned}
 \tag{2}$$

(3)

$$E_{Internal} = \int \int \int \frac{1}{2} (\sigma_x \epsilon_x + \sigma_y \epsilon_y + \sigma_z \epsilon_z + \sigma_{xy} \epsilon_{xy} + \sigma_{yz} \epsilon_{yz} + \sigma_{zx} \epsilon_{zx}) dV \tag{3}$$

가            가  
1                            가

(4)

$$E_{Kinetic} = \frac{1}{2} mv^2 \tag{4}$$

(5)

$$E_{Total} = E_{kinetic} + E_{Internal} + \dots = constant \tag{5}$$

(6)

$$E_{Total} \approx E_{kinetic} + E_{Internal} = constant \tag{6}$$

가

5

가

5

Stiffness matrix (Shape function)

Reduced Gauss

가

mode , Hourglass(spurious zero energy)

가

Hourglass

Hourglass

가 . 가 가

가 . 가

6 ,

1msec

5msec 4msec .

4msec

1 2

1 가 가 가 . A

, A 가

7 3

, 3

251 MPa

7

8 2 1

8 3

4msec . 1 3

, A

, 1 2 4msec

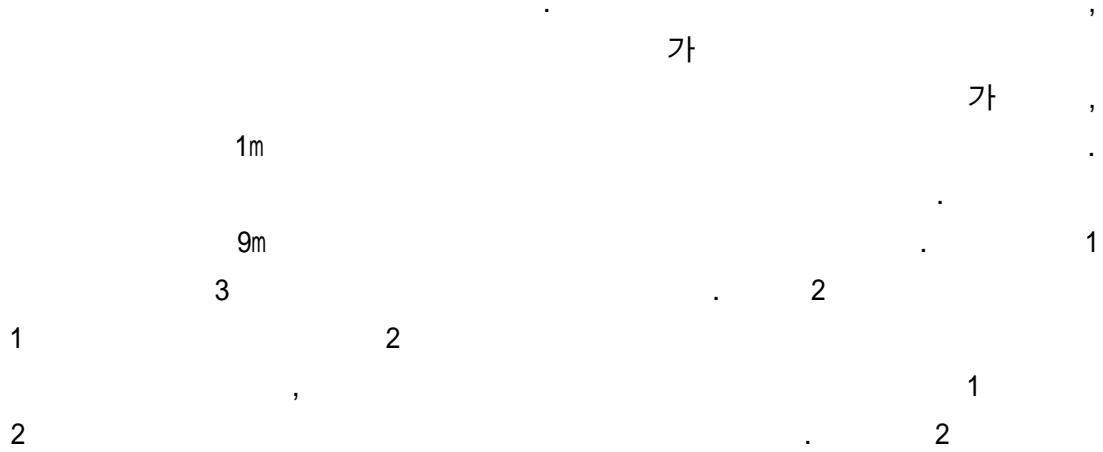
. 5msec 2 204 MPa

2 2 1

1 2 A

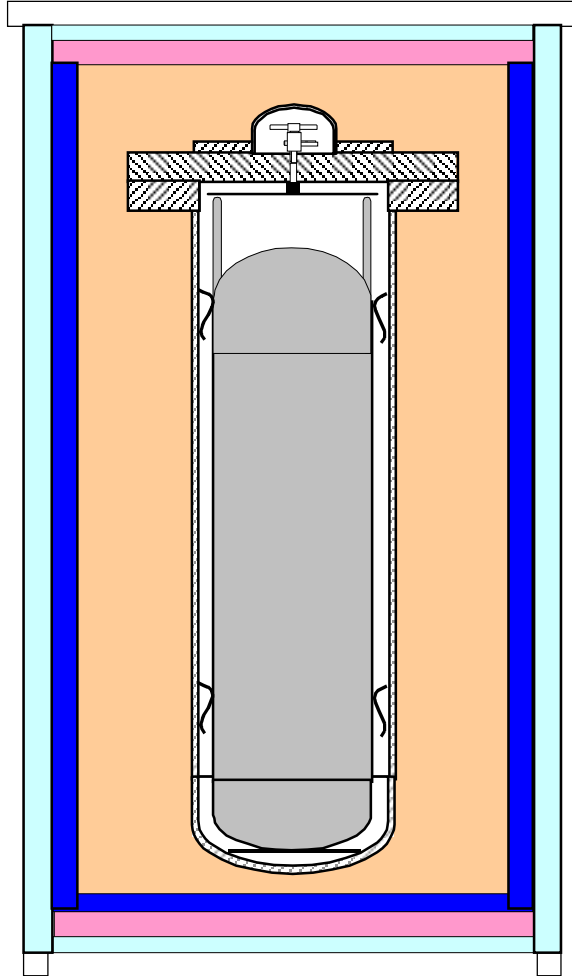
2 가 2 가 .

5.

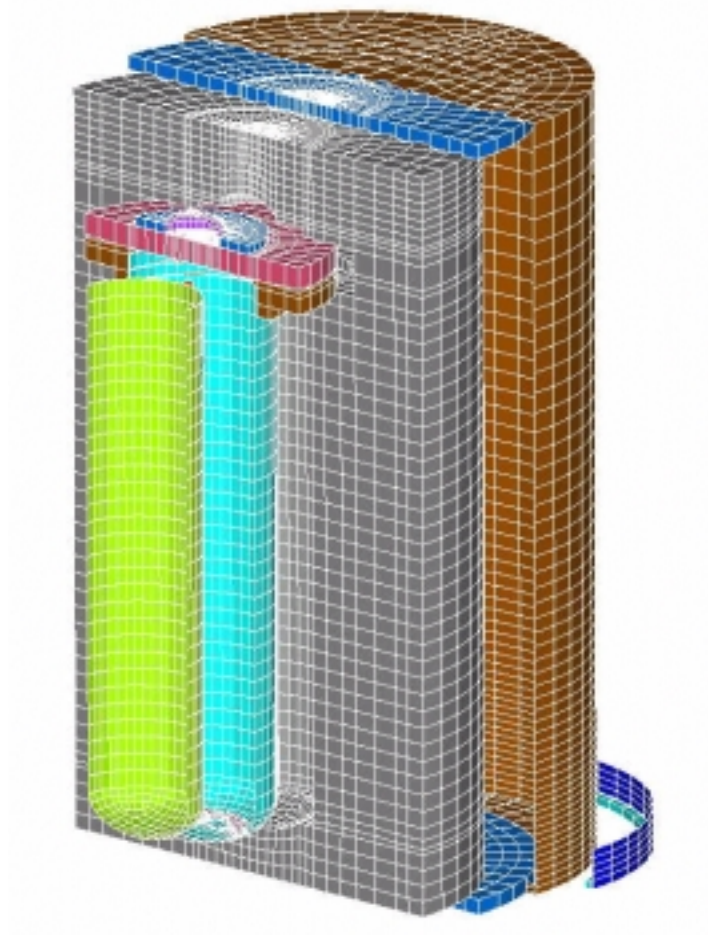


6.

1. , , , " , 17 4 , pp. 226 232, 2000
2. , " 가 " , (2001)
3. Zaouk, A., Bedewi, N. E., Kan, C. D., and Marzougui, D., "Development and Evaluation of a C-1500 Pick-up Truck Model for Roadside Hardware Impact", FHWA Simulation Conference, Langley, VA, FHWA and GWU July(1996)
4. 96-38 , " " , 1996
5. ABAQUS/Explicit User's Manual

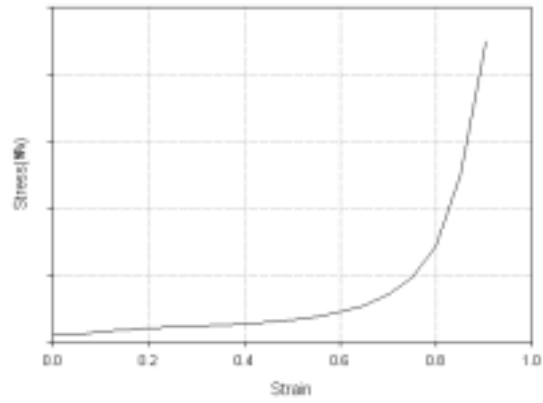


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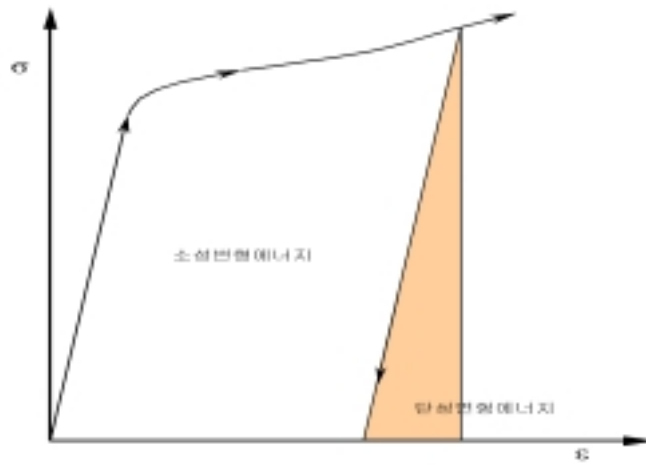


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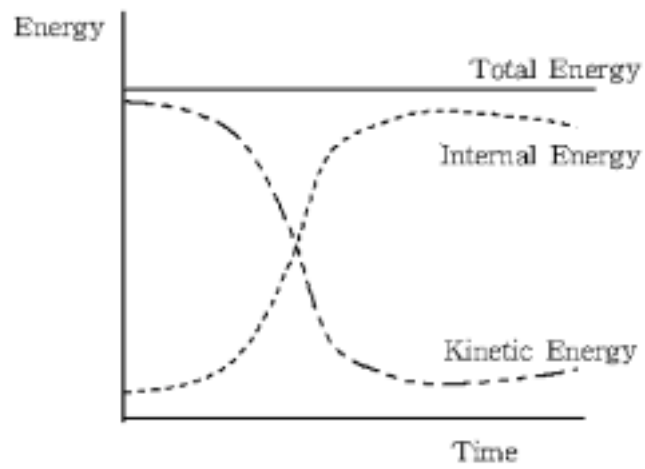




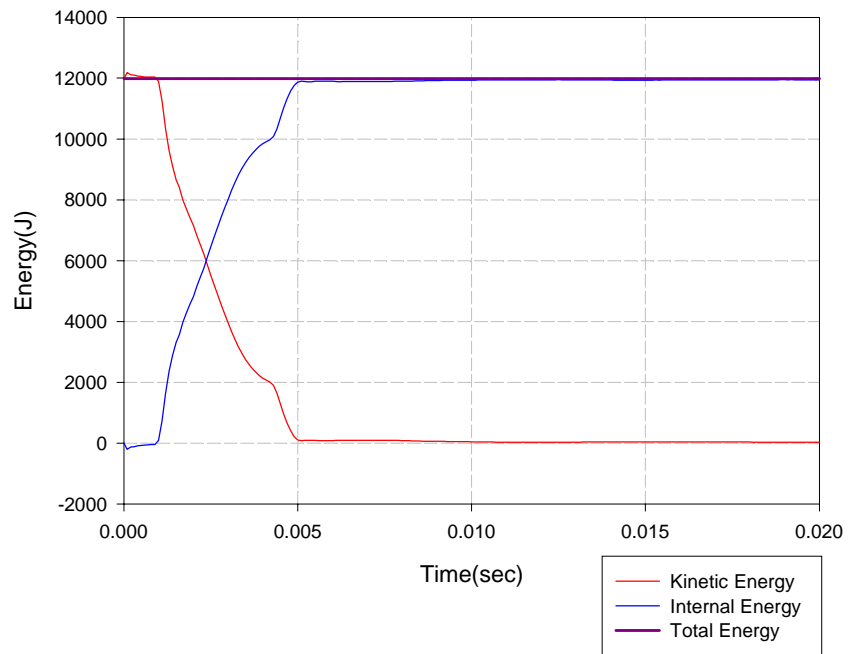
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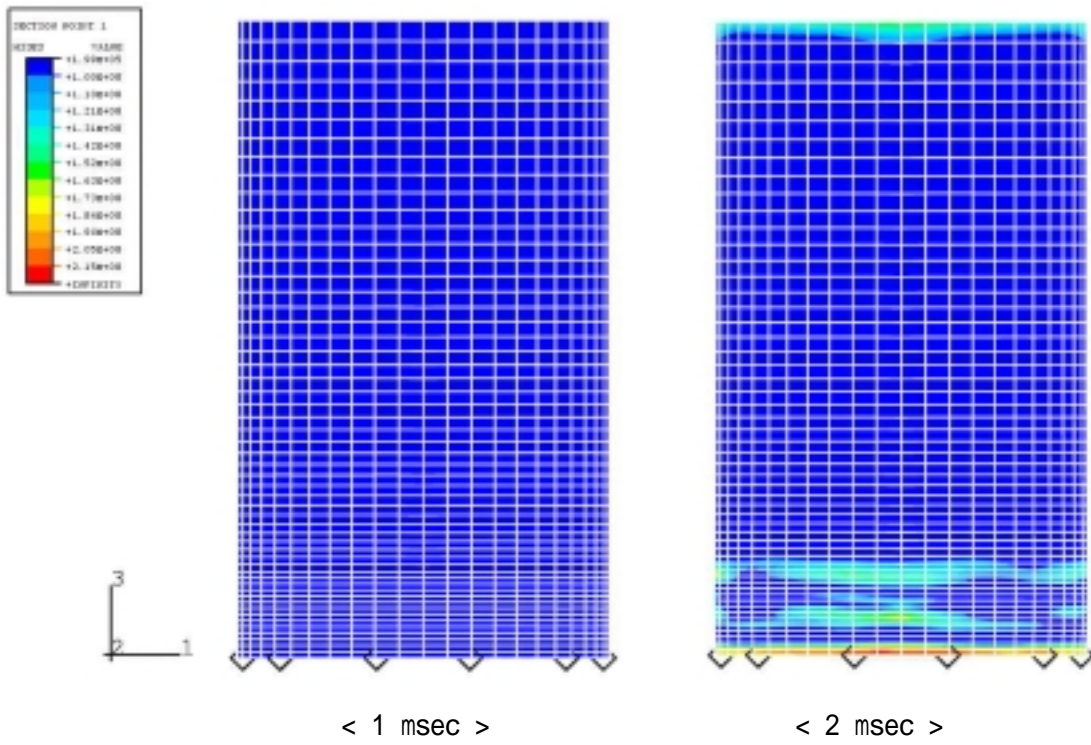
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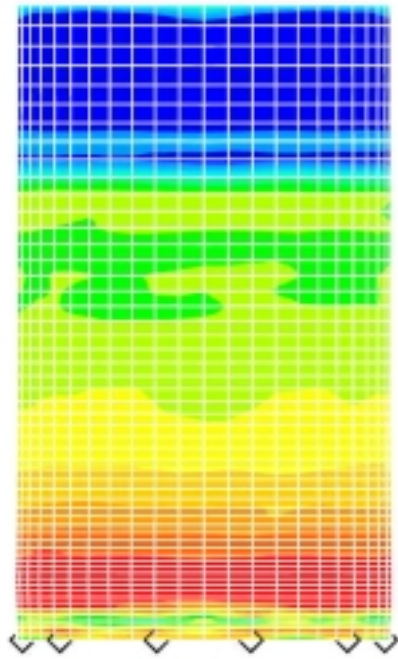


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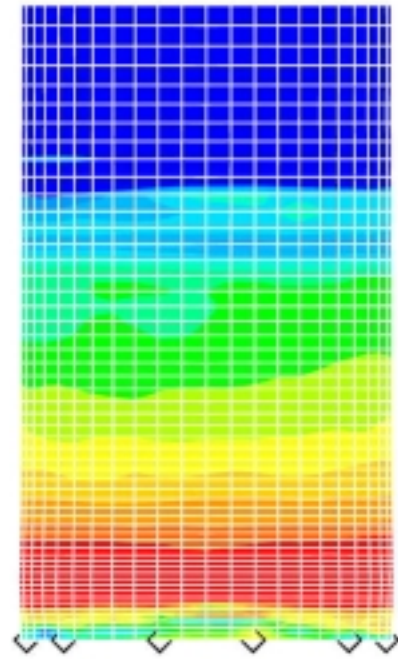


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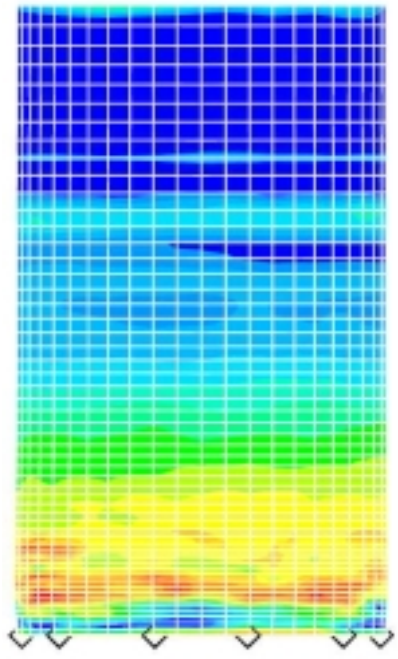




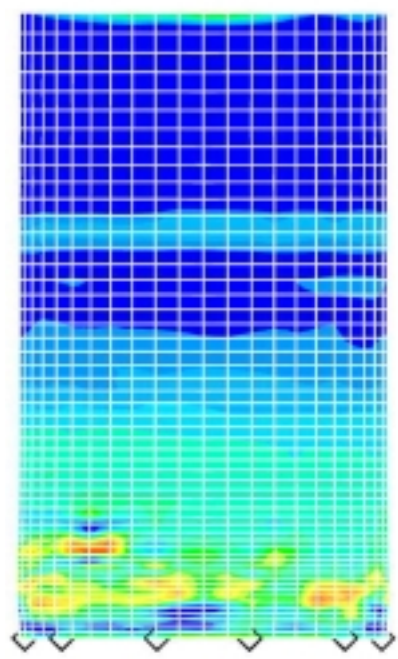
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< 4 msec >



< 5 msec >

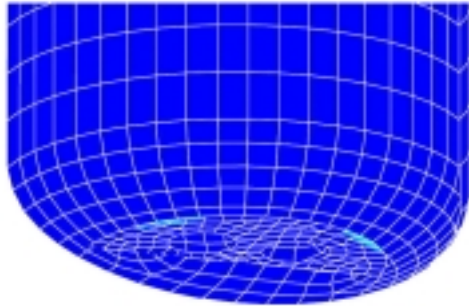
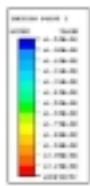


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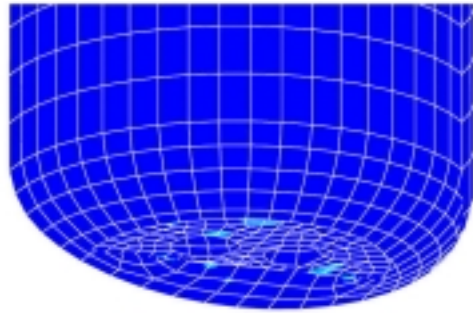
7.

9m

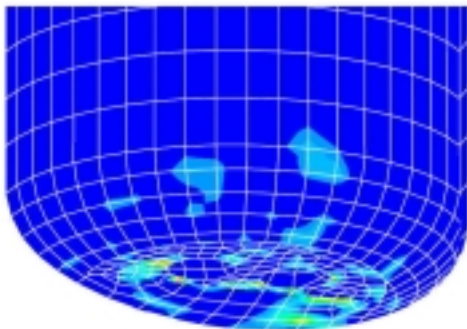
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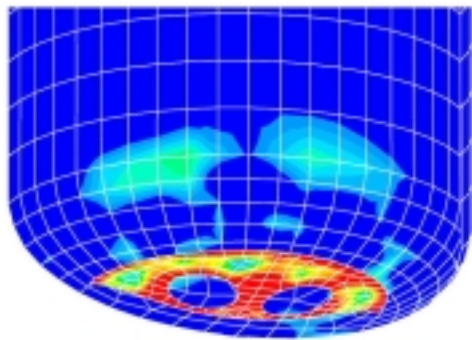
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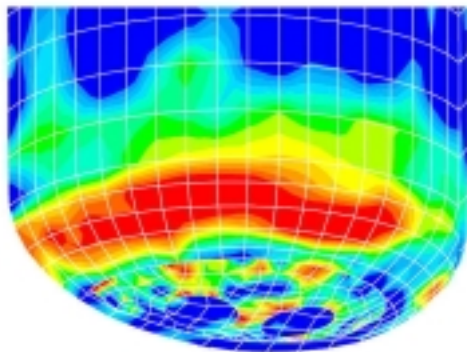
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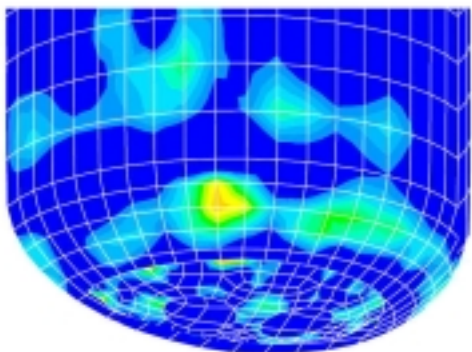
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