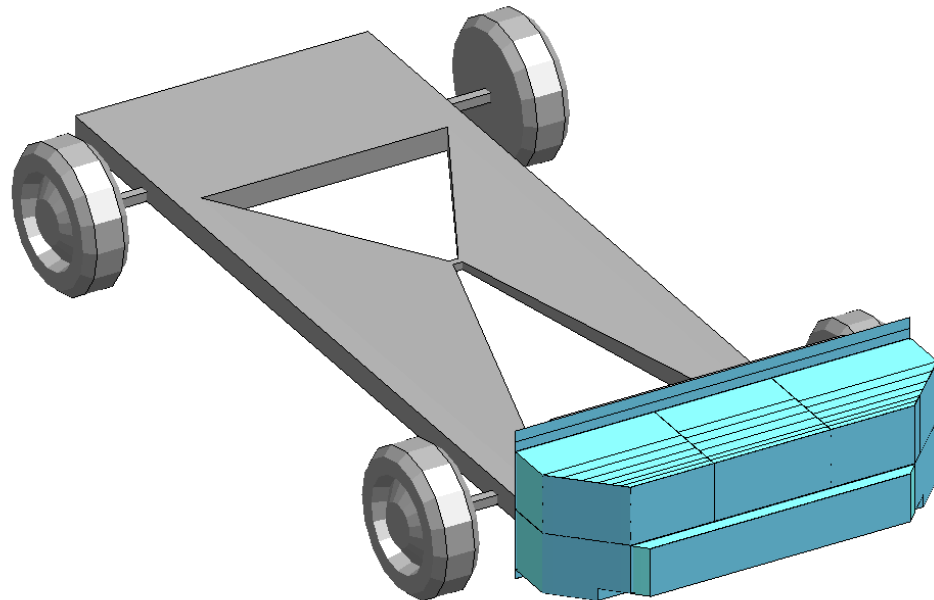


AE-MDB Side Impact Barrier Model Version 1.0



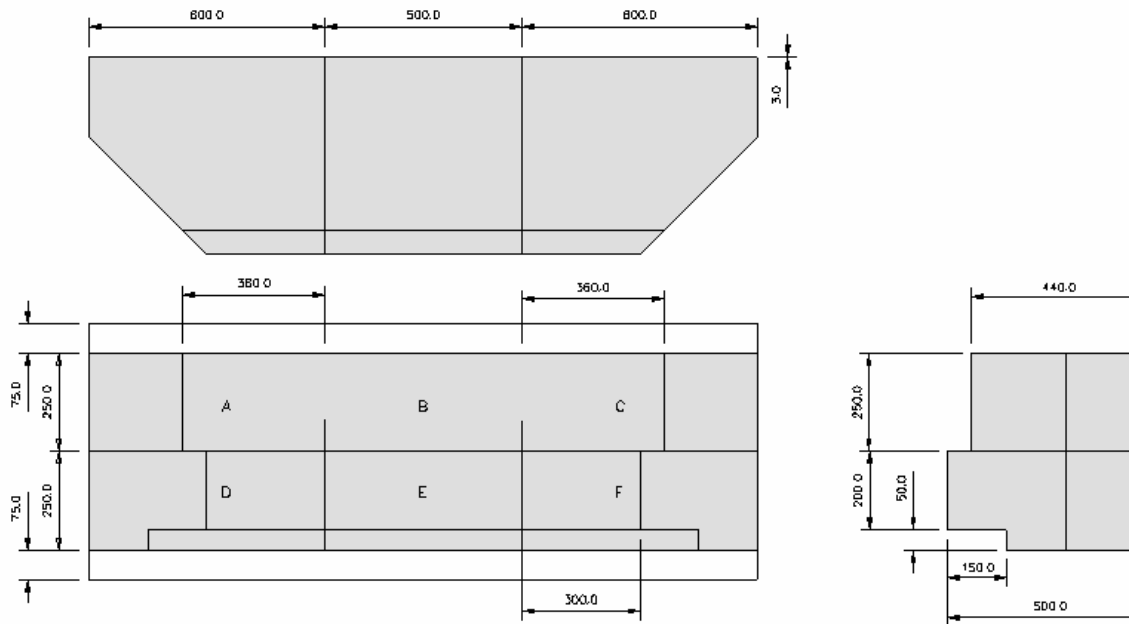
User Manual

December 2006

The specification used for the deformable impact barrier in this documentation has been taken from the APROSYS document 'Development and Evaluation of the Advanced European Mobile Deformable Barrier (AE-MDB) Test Procedure'.

Barrier Characteristics

- The mass of the barrier including instrumentation should be 1500kg.
- The front and rear track width of the trolley should be 1500 mm.
- The trolley wheelbase should be 3000 mm.
- The centre of gravity of the barrier lie on the barrier's lateral centerline, 1000mm rearward of the front axle and 2000mm rearward of the barrier face, and 500mm above the ground.



Material Characteristics

- The main body of barrier is made up of 6 individual etched honeycomb cores with differentiated strength through the impact axis. The main body is clad in 0.5mm aluminium sheet
- The bumper honeycomb block should have a crush strength of $1.69 \text{ N/mm}^2 \pm 0.103 \text{ N/mm}^2$. The front face of the bumper block should be covered with 3 mm aluminium sheet.

Calibration Procedure

No calibration test is specified for the deformable impact barrier as its crush performance is characterised by its material properties.

Model Description

- The units of the model are Newtons, Tonnes, seconds and millimeters. Versions of the model in other unit systems are available on request.
- The Barrier is oriented in standard vehicle coordinates, with the z-axis pointing upwards and the y-axis pointing forward, towards the side of the vehicle.
- The barrier will need to be translated so that it is correctly positioned relative to the vehicle.
- The model mesh is shown in fig 1.1.

Control Parameters

There are two Control Cards defined in the barrier model.

- Control Contact - In order to allow contact between the rigidwall ground and the rigid trolley, option RWPNAL in this card has been set to 0.1. The user will need to review this control card and add in any other Control Contact option they use as standard.
- Control Timestep - This control card has been added to the model to specify the mass scaling option (see following page for more details)

Contact Surfaces

There are two contact definitions in the barrier model:

- An automatic single-surface contact which contains all the contact parts of the barrier (null shells, cladding etc.)
- An automatic surface-surface contact for setting up the contact with the vehicle. A part set with an id of 3 will need to be created containing the parts for the vehicle side of the contact.

Instrumentation

The model is equipped with an accelerometer at the COG of the vehicle (Node id 50000). This can be used to output nodal displacements/velocities/accelerations

Adhesive Material Card

In LS-DYNA version 970 5434a and earlier the option to add a title to *MAT_ARUP_ADHESIVE was unavailable. As such the barrier model may need to be modified to remove the titles from this material card. The following example show how the barrier model needs to be changed.

LS-DYNA version 970 6763 and later

```
*MAT_ARUP_ADHESIVE_TITLE
Main Core - Plate Adhesive
      4      1.0E-9      900.0      0.0      0.8      0.1      0.0      0.0
      2.0      2.0      0.0      0.0      0.0      0.0      0      0.0
```

LS-DYNA version 970 5434a and earlier

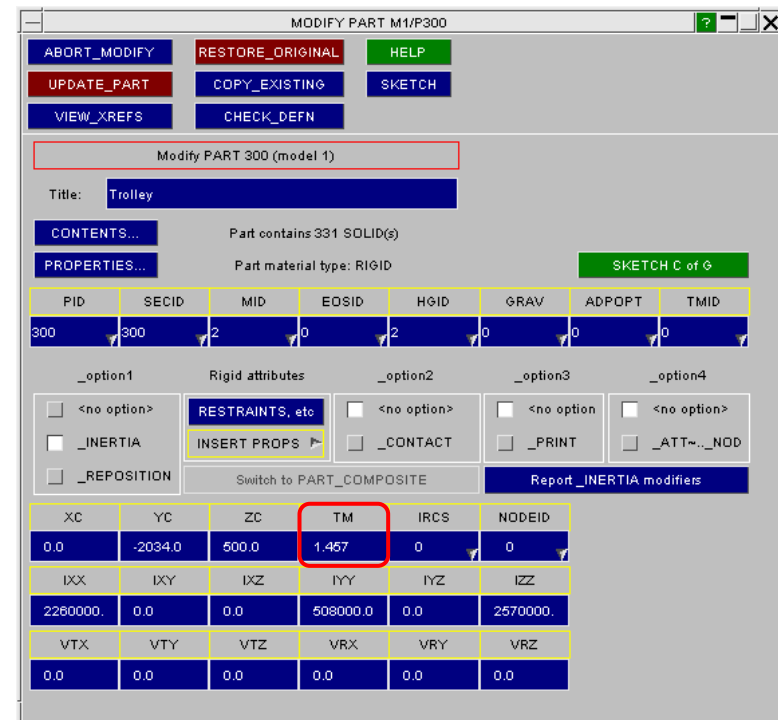
```
*MAT_ARUP_ADHESIVE
      4      1.0E-9      900.0      0.0      0.8      0.1      0.0      0.0
      2.0      2.0      0.0      0.0      0.0      0.0      0      0.0
```

Mass Scaling

The Mass Scaling in this model is set such that the actual timestep will be 1.2E-6 sec. This can be modified but the trolley mass as defined on the *PART_INERTIA card for part no. 300 will also need to be adjusted to take into account the change in mass of the barrier.

The following table gives the required trolley mass for a selection of different timesteps.

Actual Timestep (sec)	DT2MS Value	Part 300 Mass (tonne)
1.2e-6	-1.333e-6	1.457
1.1e-6	-1.222e-6	1.461
1.0e-6	-1.111e-6	1.465
0.9e-6	-1.000e-6	1.468
0.8e-6	-0.888e-6	1.471
0.7e-6	-0.777e-6	1.472
0.6e-6	-0.666e-6	1.472
0.5e-6	-0.555e-6	1.472
0.44e-6	0.0 (No Mass Scaling)	1.472



NB: The timestep as specified in the DT2MS option of the *CONTROL_TIMESTEP card is multiplied by the timestep scale factor (TSSFAC) option also on the *CONTROL_TIMESTEP card to give the actual analysis timestep.

This scale factor defaults to 0.9 as such a value of -1.333e-6 sec entered in the DT2MS option will give an actual analysis timestep of 1.2e-6 sec

List of parts

The following parts were used in this model:

Part Number	Part Description
100	Bumper Cladding
101	Bumper Core
102	Bumper Backplate
103	Adhesive - Bumper Core to Bumper Backplate
104	Adhesive - Bumper Core to Bumper Cladding
105	Bumper Null
106	Bumper Internal Null
201	Main Cladding Upper
202	Main Cladding Lower
203	Backplate 1
204	Backplate 2
205	Dacron Adhesive - Main Core to Side Cladding
206	Adhesive - Main Core to Cladding
207	Adhesive - Main Core to Backplate
208	Adhesive - Main Core to Cladding
209	Core Null
210	Core Internal Nulls

Part Number	Part Description
221 to 227	Core – Block A1 to A7
231 to 237	Core – Block B1 to B7
241 to 247	Core – Block C1 to C7
251 to 255	Core – Block D1 to D5
261 to 267	Core – Block E1 to E7
271 to 275	Core – Block F1 to F5
300	Trolley
301	Trolley Contact Shells
400	Adhesive - Bumper Backplate to Main Cladding

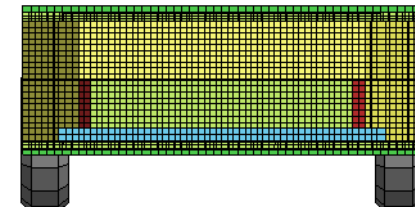
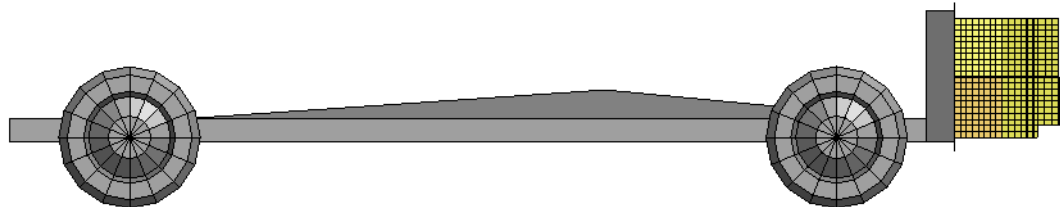
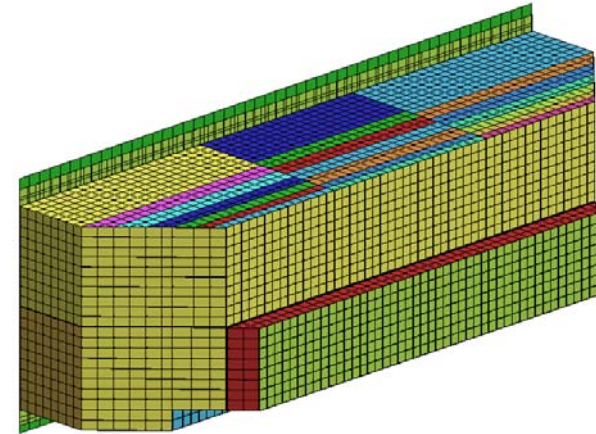
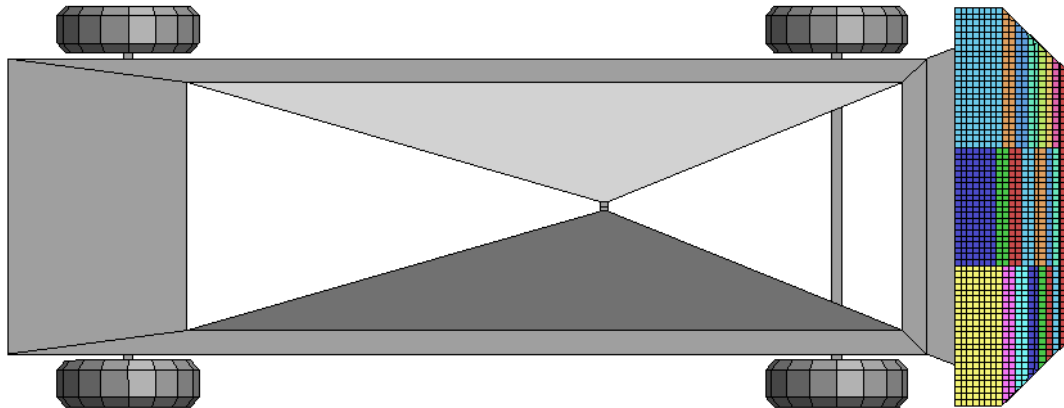
Model Size

The number of elements in the model is as follows:

Element Type	Number
Deformable solids	26412
Deformable shells	4852
Total deformable elements	31264
Null shells	29188
Rigid solids	331
Rigid shells	1150

Figure 1.1 – AE-MDB barrier model

AE-MDB Barrier Model



The NHTSA model is developed by Cellbond Composites in association with Arup.



www.cellbond.com



www.arup.com

For more information on the model please contact the following:

UK:

Arup

The Arup Campus
Blythe Valley Park
Solihull, West Midlands
B90 8AE
UK
T +44 (0)121 213 3399
F +44 (0)121 213 3302
dyna.support@arup.com

China:

Arup

39/F-41/F Huai Hai Plaza
Huai Hai Road (M)
Shanghai
China 200031
T +86 21 6126 2875
F +86 21 6126 2882
china.support@arup.com

India:

nHance Engineering Solutions Pvt. Ltd (Arup)

Plot No. 39, Ananth Info Park
Opposite Oracle Campus
HiTec City-Phase II
Madhapur
Hyderabad - 500081
India
T +91 (0) 40 44369797 / 8
india.support@arup.com