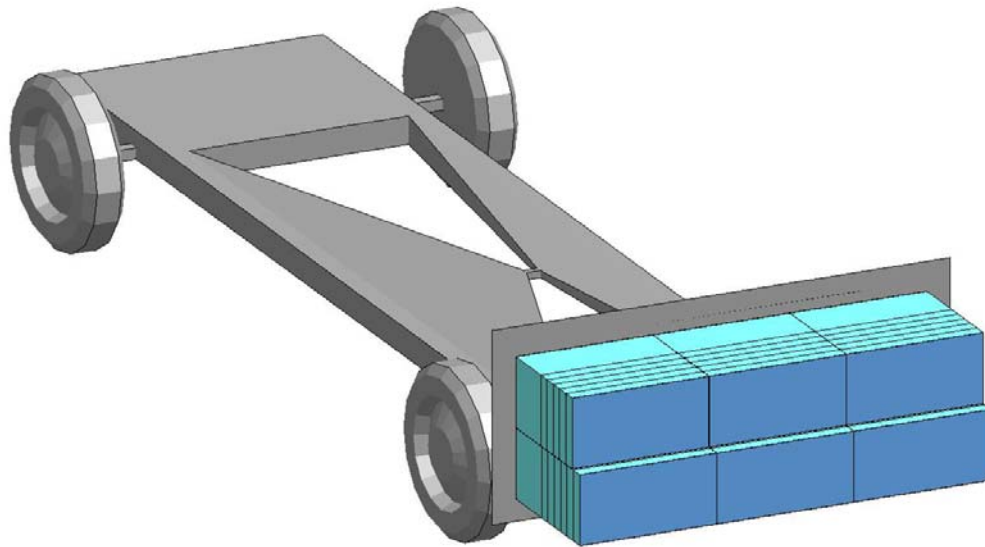


Advanced 2000  
European (EEVC) Side Impact Barrier Model  
Version 1.1



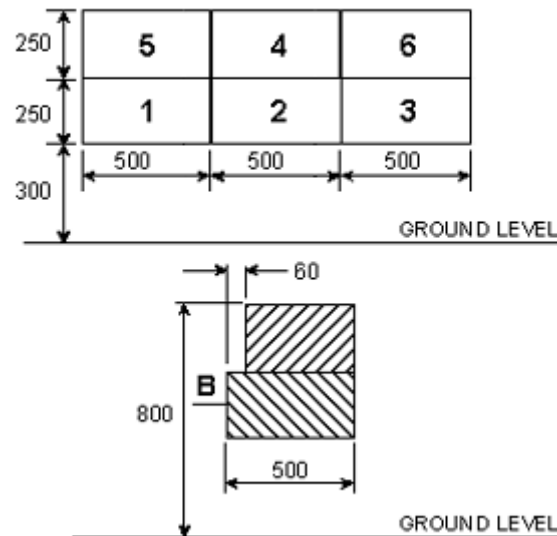
User Manual

June 2007

The specification used for the deformable impact barrier in this documentation has been taken from the ECE R95 Amendment 3 dated September 2003.

### Barrier Characteristics

- The mass of the barrier including instrumentation should be 950kg.
- The impactor consists of six single blocks of aluminium honeycomb, which have been processed in order to give a progressively increasing level of force with increasing deflection. Front and rear aluminium plates are attached to the aluminium honeycomb blocks.
- The centre of gravity of the barrier lies on the barrier's lateral centerline, 1000mm rearward of the front axle, 2000mm rearward of the front face, and 500mm above the ground.

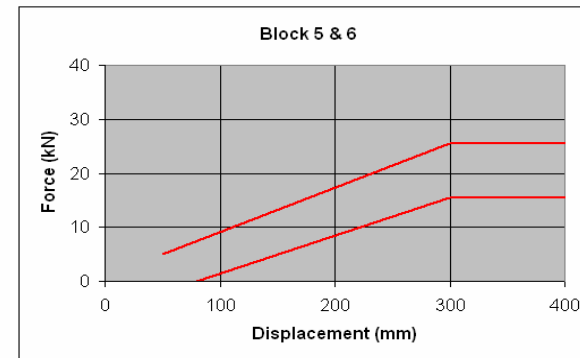
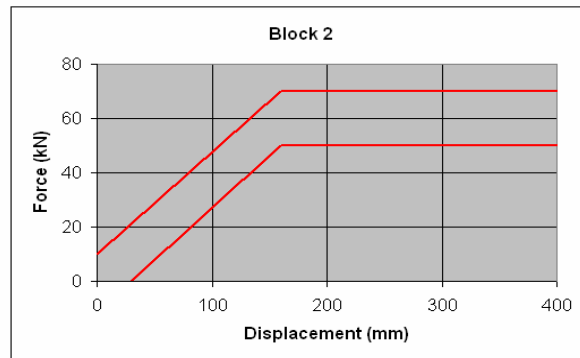
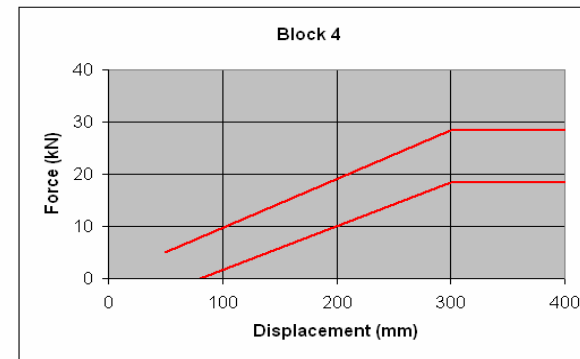
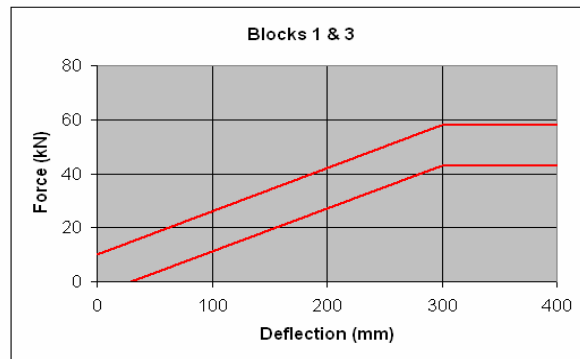


## Material Characteristics

- Each of the aluminium blocks that make up the barrier have a progressive crush strength as specified in the graphs below.

## Calibration Procedure

- A static crush test is carried out on a sample of each block.
- A dynamic rigid wall impact is carried out on every hundredth barrier



## 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.

There is also a series of Database Cross Sections set up along the back face of the barrier to record the barrier force.

## 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

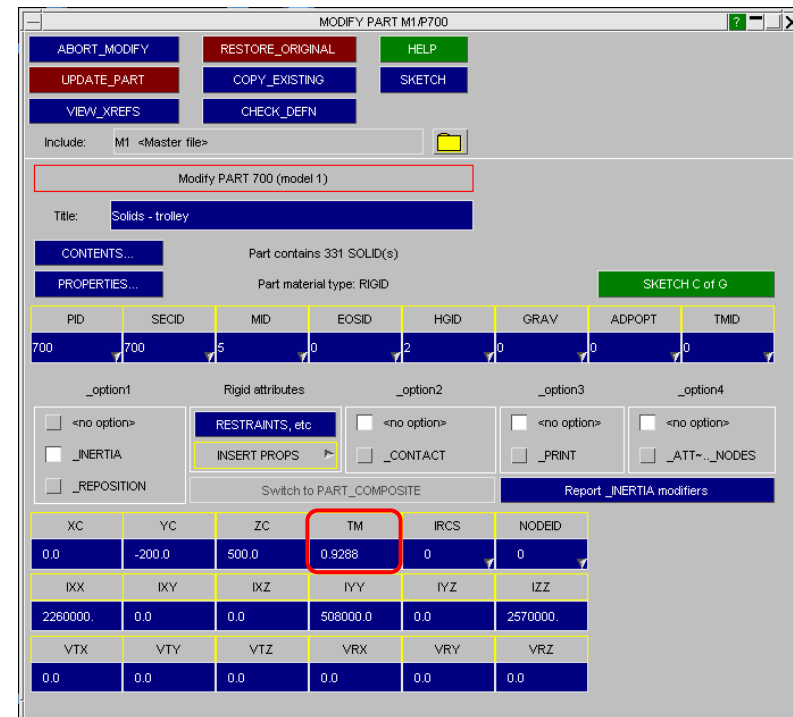
```
*MAT_ARUP_ADHESIVE
      4      1.0E-9      900.0      0.0      0.8      0.1      0.0      0.0
      2.0      2.0      0.0      0.0      0.0      0.0      0      0.0
```

## 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. 700 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	0.9057
1.1e-6	-1.222e-6	0.9111
1.0e-6	-1.111e-6	0.9161
0.9e-6	-1.000e-6	0.9206
0.8e-6	-0.888e-6	0.9247
0.7e-6	-0.777e-6	0.9282
0.6e-6	-0.666e-6	0.9305
0.5e-6	-0.555e-6	0.9317
0.162e-6	0.0 (No Mass Scaling)	0.9322



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

## Model Description (cont.)

### List of parts

The following parts were used in this model:

Part Number	Part Description
101	Block 1 & 3 Part 1
102	Block 1 & 3 Part 2
103	Block 1 & 3 Part 3
104	Block 1 & 3 Part 4
105	Block 1 & 3 Part 5
106	Block 1 & 3 Part 6
107	Block 1 & 3 Part 7
201	Block 2 Part 1
202	Block 2 Part 2
203	Block 2 Part 3
204	Block 2 Part 4
205	Block 2 Part 5
401	Block 4 Part 1
402	Block 4 Part 2
403	Block 4 Part 3
404	Block 4 Part 4
405	Block 4 Part 5
406	Block 4 Part 6

Part Number	Part Description
501	Block 5 & 6 Part 1
502	Block 5 & 6 Part 2
503	Block 5 & 6 Part 3
504	Block 5 & 6 Part 4
505	Block 5 & 6 Part 5
506	Block 5 & 6 Part 6
507	Block 5 & 6 Part 7
600	Cladding
601	Adhesive - Core to Plate
602	Backplate
603	Core Null
604	Core Internal Null
700	Trolley
701	Trolley Contact Shells

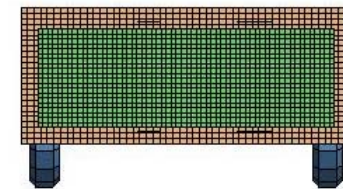
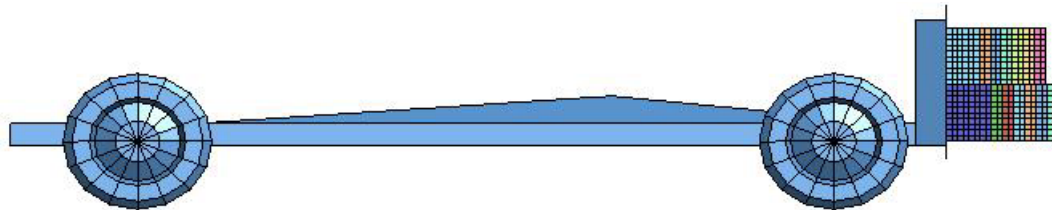
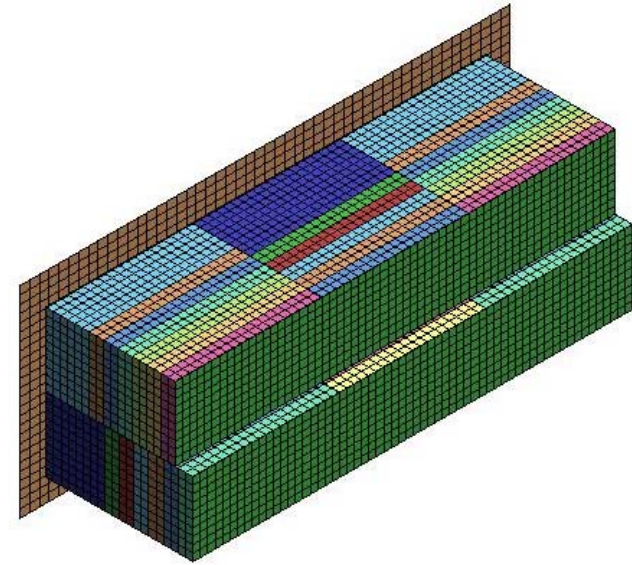
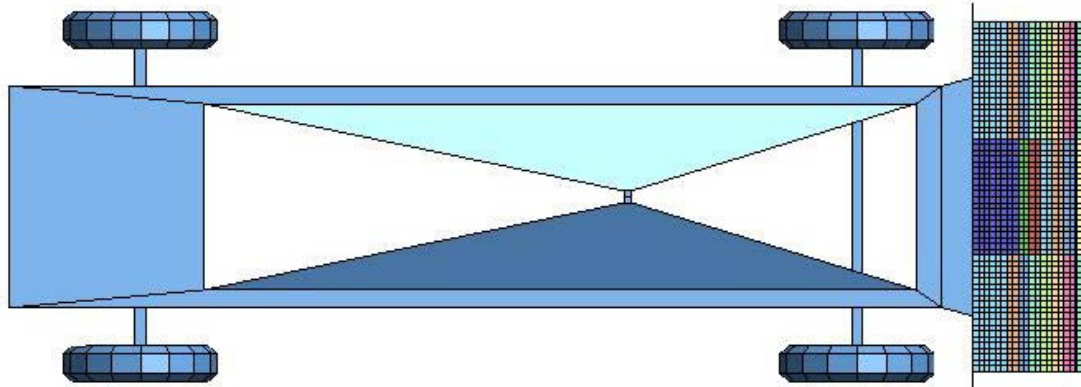
## Model Size

The number of elements in the model is as follows:

Element Type	Number
Deformable solids	25200
Deformable shells	2400
Total deformable elements	27600
Null shells	30840
Rigid solids	331
Rigid shells	1250

Figure 1.1 – ADV 2000 barrier model

Advanced 2000  
EEVC Side Impact Barrier Model



The Advanced 2000 model is developed by Cellbond Composites in association with Arup.



[www.cellbond.com](http://www.cellbond.com)



[www.arup.com](http://www.arup.com)

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