Cellbond – Arup
Barrier Development Programme

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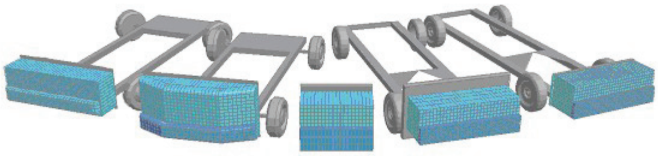

CELLBOND ARUP Barrier Models

Background Information

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- Arup currently has a range of barrier models.
- These models were developed 1996-2001 and use methodologies and technology that were available at the time.
- There are also a number of new barriers which have since been developed in the crash technology industry e.g. AE-MDB, PDB
- Arup has the CAE modelling skills and LS-Dyna knowledge required to develop CAE barrier models.
- Cellbond has knowledge of the design and manufacturing processes of aluminium honeycomb and crash test barriers.
- An agreement was reached between Arup and Cellbond to develop, a number of crash test barrier models.

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Barriers to be Considered

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The barriers which have been agreed upon for development are:

Models	**Release Date**
IIHS	Q4, 2005
AE-MDB	Q1, 2006
NHTSA (FMVSS214)	Q2, 2006
EEVC Frontal ODB	Q2, 2006
Full Width Compatibility Barrier	Q3/Q4, 2006
PDB (Progressive Deformable Barrier)	Under consideration

Note: This list is not exhaustive and additional barrier models will be added as needed.

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Modelling Methodology

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•Static testing on honeycomb samples at a range off strong-axis angles.

Dynamic testing on honeycomb samples at a range off strong-axis angles.

• Dynamic full barrier testing,
  - •Rigid wall – Full face,
  - •Rigid pole test,
  - •Rigid sill test.

•Use of barrier in a full car test (If data exists).

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Development Process - IIHS

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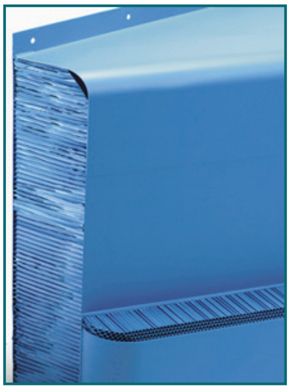

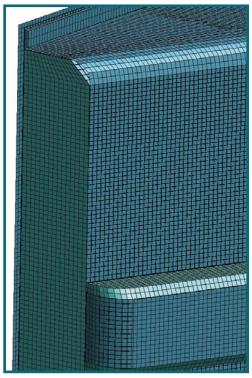

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Current Models	**New Models**
Characteristic element size: 25mmx25mmx50mm.	Characteristic element size: 10mmx10mmx20mm.
Honeycomb modeled using Mat 26 and Mat 126 with first yield surface i.e. LCA > 0.	Honeycomb modeled using Mat 126 with 2nd yield surface i.e. LCA < 0 and ECCU > 0.
Honeycomb elements grouped together in columns of 2 x 2 solid elements. These columns are connected together in turn by beam elements in order to allow large shear deformation.	No beams used to connect honeycomb solids together. Relying on the smaller element size and the improved material model to allow for shear deformation.
Aluminium cladding modeled using Mat 24.	Aluminium cladding modeled using Mat 123 to allow for failure due to thinning strain.
Adhesive between cladding and honeycomb modeled using beam elements.	Adhesive between cladding and honeycomb is modeled using solid Mat Arup Adhesive elements.

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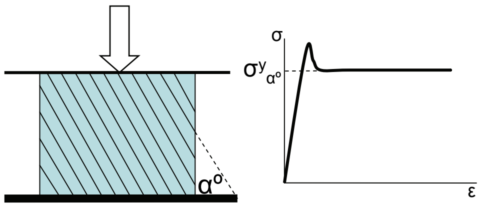
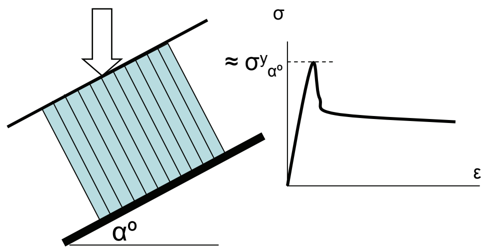
Static Testing

- Static shear compression tests were carried out at a number of angles in the range 0º - 90º to generate the yield stress vs. off-axis angle data.
- Ideal test method requires cutting the sample such that the strong axis runs across the sample at the required angle.
- Producing these samples proves to be both expensive and difficult.
- A large number of these tests needs to be carried out.
- A practical testing technique was used to generate this data.
- Strong and weak axis hardening stress data was generated using normal compression tests.



Ideal test method



Practical test method

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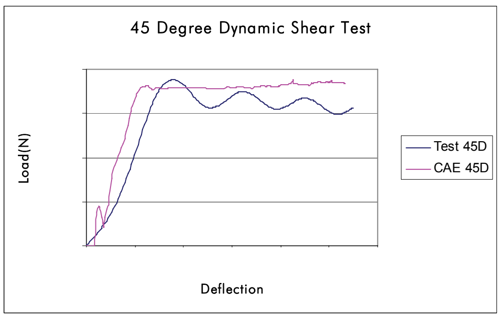
Dynamic material testing

Dynamic shear testing was performed using a drop-test tower to further validate the material model.

Dynamic shear drop-test setup



Results – comparison test to CAE

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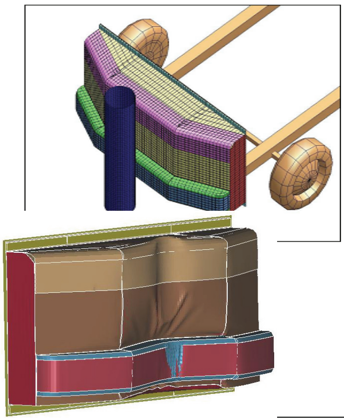
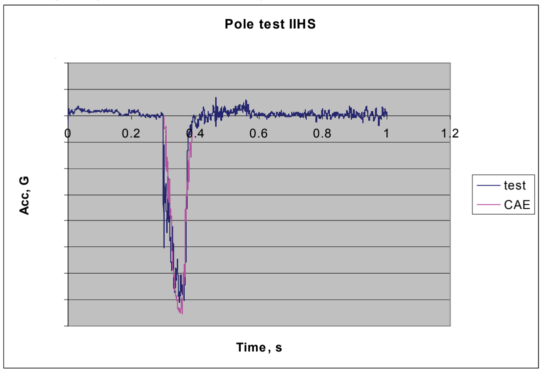
Dynamic full barrier testing

Three variations of full barrier testing were performed by Jaguar Land Rover.

Condition A

This test involves the barrier on a trolley impacting a rigid pole. The velocity is 5.5 m/s (20 km/h).





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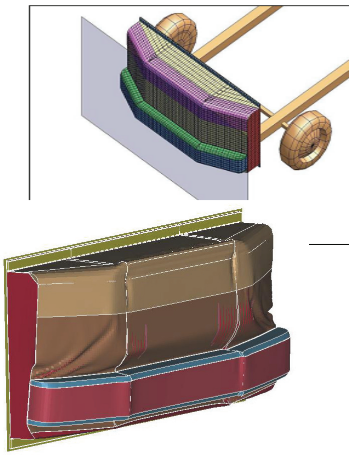
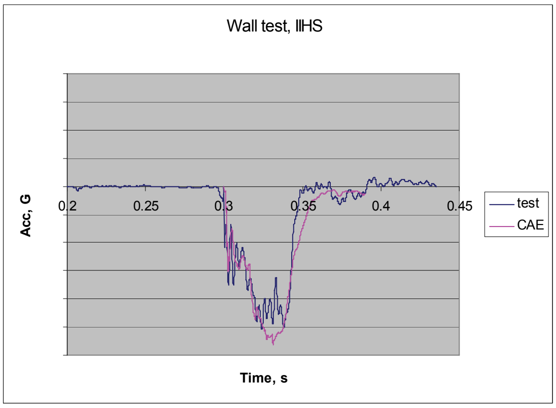
Condition B

This test involves the barrier on a trolley impacting a rigid wall. The velocity is 8.3 m/s (30 km/h).





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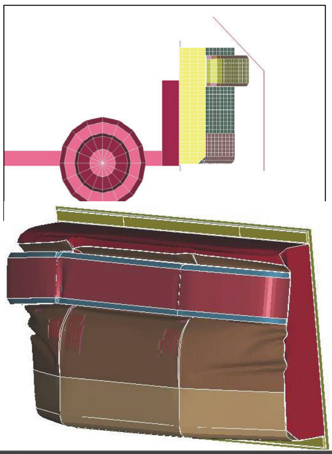
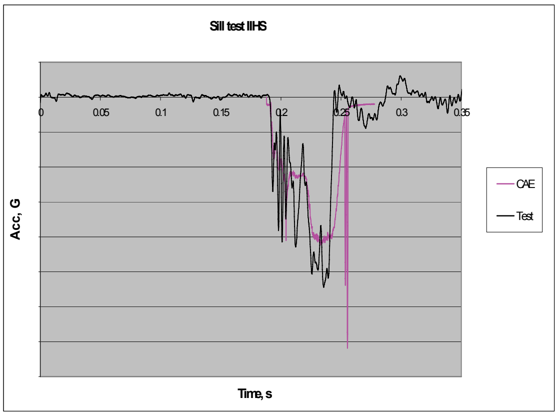
Condition C
This test involves the barrier on a trolley impacting a rigid sill. The velocity is 7 m/s (25 km/h).





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Remaining work

• Further investigation into the full barrier sill test to improve correlation of the model.

• Implementation of the barrier model into an existing full vehicle side impact model to validate performance against crash test data.

• Model to be released for sale in Q4, 2005.

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Company and Contact Information

Barrier Development Programme

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