The LX BIW Structure
A Great “Steel” Design

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DaimlerChrysler
LX BIW Structure

A Great “Steel” Design

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What Defines a “Great BIW Design”

- Looks (Styling)
- Light Weight (materials/construction)
- Structural Performance
- Flexible Manufacturing Process
- Low Cost ($)

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What Defines a “Great BIW Design”

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Looks (Styling) : The all new Chrysler 300
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A new Classic Proportion for Chrysler

1955 C300  |  2005 300C  
300 C      |  5.7L Hemi V8 (340hp)  
300 Touring |  3.5L V6  
300         |  2.7L V6  

Start of Production: February 2004, in showroom: April 2004
What Defines a “Great BIW Design”

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- Low Cost ($)
What Defines a “Great BIW Design”

- Light Weight (Materials/ Construction)
  - HSS Steel
Light Weight: Materials / Construction

- Near Double Parts with High Strength Steel (HSS)
  - ’98 20% HSS
  - ’05 37% HSS
- Dual Phase Steel for Front Rails
Light Weight: Materials / Construction

05 LX HSS Part <= 280 MPa Yield

United States

'98

'05

300M

300C

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Mpa

Red

Blue

Green

>= 550

>= 340

>= 280

Steel Seminar

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Light Weight: Materials / Construction

05 LX HSS Parts >= 340 MPa Yield
Light Weight: Materials / Construction

05 LX HSS Parts >= 550 MPa Yield

- >= 550 Mpa
- >= 340 Mpa
- >= 280 Mpa
What Defines a “Great BIW Design”

Light Weight (Materials/Construction)

- HSS Steel
- Construction: Section Design
Nominal
Ip1: 2.299 × 10^6 mm^4
Ip2: 1.351 × 10^6 mm^4
A: 888 mm^2

Effective
Ip1: 2.132 × 10^6 mm^4
Ip2: 1.243 × 10^6 mm^4
A: 817 mm^2

Delta %
Ip1: 7.2%
Ip2: 8.0%
A: 8.0%
Light Weight: Materials / Construction

Variable Section Kick-Up C/M

Octagon Shape Front Rail

Double C-Section Rear Rails
Light Weight: Materials / Construction

Load Bearing
Roof Bow

3 Layer Body Side
Sections

Constant Moment B-Pillar

Internal Shear Plate Sill
What Defines a “Great BIW Design”

- Light Weight (Materials/Construction)
  - HSS Steel
  - Construction: Section Design
  - New Technology
05LX Headlamp Mounting Crossmember (HMC)

Metal / Plastic Hybrid
Weight = 16 lbs. savings

Variable cost neutral
Investment = $6.8M savings
Improved Build Tolerances
What Defines a “Great BIW Design”

• Light Weight (Materials/Construction)
  – Bottom line?
### Light Weight: Materials / Construction

#### LX 300C vs LH 300M

<table>
<thead>
<tr>
<th>EXTERIOR</th>
<th>Chrysler 300C</th>
<th>Chrysler 300M</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARD PTS</td>
<td>mm (in)</td>
<td>mm (in)</td>
</tr>
<tr>
<td>Length</td>
<td>5,001 (196.9)</td>
<td>5,023 (197.8)</td>
</tr>
<tr>
<td>Width</td>
<td>1,881 (74.1)</td>
<td>1,892 (74.5)</td>
</tr>
<tr>
<td>Height</td>
<td>1,483 (58.4)</td>
<td>1,422 (56.0)</td>
</tr>
<tr>
<td>Wheel Base</td>
<td>3,048 (120.0)</td>
<td>2,870 (113.0)</td>
</tr>
<tr>
<td>Frt Track</td>
<td>1,600 (63.0)</td>
<td>1,573 (61.9)</td>
</tr>
<tr>
<td>Rr Track</td>
<td>1,603 (63.1)</td>
<td>1,565 (61.6)</td>
</tr>
<tr>
<td>Frt Over Hang</td>
<td>876 (34.5)</td>
<td>1,054 (41.5)</td>
</tr>
<tr>
<td>Rr Over Hang</td>
<td>1,078 (42.4)</td>
<td>1,100 (43.3)</td>
</tr>
</tbody>
</table>

- 7” longer WB
- 1.5” wider track
- RWD vs. FWD
- Improved Safety Cage
- Upgraded NVH
## Light Weight: Materials / Construction

<table>
<thead>
<tr>
<th></th>
<th>LX</th>
<th>Benchmark #1 RWD</th>
<th>Benchmark #2 FWD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Shell Weight</strong></td>
<td>914.8</td>
<td>880.0</td>
<td>829.0</td>
</tr>
<tr>
<td>lbs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Interior Volume ft^3</strong></td>
<td>118.8</td>
<td>114.8</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Weight/Interior Volume</strong></td>
<td>7.7</td>
<td>7.7</td>
<td>7.5</td>
</tr>
</tbody>
</table>
What Defines a “Great BIW Design”

- Looks (Styling)
- Light Weight (Materials/Construction)
- Structural Performance
What Defines a "great BIW Design"

• Structural Performance
  – Torsional Stiffness
Structural Performance: Torsional Stiffness

- **Proposed LX Target Zone**
  
  - LX Sedan: 13,200 ft. lbs/deg
  - LH Sedan: 12,500 ft. lbs/deg
  - 12% Increased stiffness

Graph showing torsional stiffness vs. mass for various models:
- 94 Accord*
- 93LH
- 98LH
- 98 Accord*
- JA
- JR

*Estimated BIW Mass
What Defines a "great BIW Design"

• Structural Performance
  – Torsional Stiffness
  – React Chassis Inputs
Design Tools

• FEA: Finite Element Analysis
• Lab & Shaker Testing: Components & Assembly tests
• Proving Grounds: On Road Testing
• RTS: Road Test Simulation
What Defines a "great BIW Design"

- Structural Performance
  - Torsional Stiffness
  - React Chassis Inputs
  - Noise Attenuation / Shake Control
Structural Performance: NVH

Front Rail Assembly
Bulk heads

Front Floor Assembly
Rail Extensions
Structural Performance: NVH

- Double Shear Suspension Attachments
- Tuned Exhaust Attachments
Structural Performance: NVH

Mode Shape
- Global Torsion
- Global Bending

Test Frequency
- 40.1 Hz
- 48.8 Hz

Pre-Test CAE Prediction
- 40.0 Hz
- 49.2 Hz

Frequency, Hz

Mode Shape
- 5.7L four cylinder mode
- 40.1 Hz
- 48.8 Hz

Vehicle Speed, mph
- 0
- 20
- 40
- 60
- 80
- 100
- 120

Engine Speed, rpm
- 0
- 500
- 1000
- 1500
- 2000
- 2500
- 3000

1st Order
- 17" Tire
- 19.8 Hz

Order
- 1st Order
- 2nd Order
- 3rd Order
- 4th Order

Excitation
- 500-650 rpm

Mode Shape Test Pre-Test
- CAE
- Global Torsion 40.1 Hz 40.0 Hz 91%
- Global Bending 48.8 Hz 49.2 Hz 84%

NVH Structure Performance
- Low Speed Fan #1 (19.8 Hz)
- Low Speed Fan #2 (23.3 Hz)
- High Speed Fan #1 (39.7 Hz)
- High Speed Fan #2 (43.7 Hz)
- 1st Acoustic Cavity Mode (48.3 Hz)
CAE Optimization for Low Frequency NVH Performance

- Four Bolt Bumper Attachment
- Radiator Xmbg
- HMC to Rail & Load Beam Joints
- Bulk heads in the Toe board Xmbg
- IP Center Stack

- Shelf Panels
- Shelf Gussets
- Beading of the Rear Floor Pan & battery Tray design
What Defines a “Great BIW Design”

- **Structural Performance**
  - Torsional Stiffness React Chassis Inputs
  - React Chassis Inputs
  - Noise Attenuation / Shake / Control
  - Superior Occupant Safety Cage
Safety Cage: Enginebox
- Dual phase DP 590 octagon shape front rails with defined crush zones
- Dash panel toe-board crossmember, end rail extensions and rail extension to sill to limit intrusion
Structural Performance: Safety Cage

35 mph Flat Frontal Rail Tip Multiple fold / crush Low Intrusion
Structural Performance: Safety Cage

40 mph Front Offset
Mid Rail Body/Chassis Crush
Low Intrusion
Structural Performance: Safety Cage

Safety Cage: Body Sides
- Cross car load bearing roof bow
- C pillar reinforcement rear occupant protection
- A pillar reinforcement for structural integrity for offset events
- Occupant friendly B pillar deformation zones
Structural Performance: Safety Cage

38.5 mph Crabbed Side
Sill / B pillar Engagement
Low Intrusion
Structural Performance: Safety Cage

Safety Cage: Rear Underbody
- Double C section rear rail crush zones balance to rear cradle
- Rear tire tub with designed crush zones
Structural Performance: Safety Cage

50 mph Rear Offset
Multiple Crush Zones
Protected Zone
What Defines a “Great BIW Design”

- Looks (Styling)
- Light Weight (Materials/Construction)
- Structural Performance
- Flexible Manufacturing Process
Flexible Manufacturing Process

LX BIW Process

Underbody – 3 Sub Assemblies
Body Sides – Robot Framed

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
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<tbody>
<tr>
<td>Assembly Plant Welds</td>
<td>2592</td>
</tr>
<tr>
<td>Purchase Sub Welds</td>
<td>1685</td>
</tr>
<tr>
<td>Total Spot Welds</td>
<td>4277</td>
</tr>
<tr>
<td>Adhesive C(mm)</td>
<td>22366</td>
</tr>
<tr>
<td>Drawn Arc Studs</td>
<td>23</td>
</tr>
<tr>
<td>Projection Weld</td>
<td>7</td>
</tr>
</tbody>
</table>

[Bar chart showing spot welds for LX, #1, and #2 processes]
What Defines a “Great BIW Design”

- Looks (Styling)
- Light Weight (materials/construction)
- Structural Performance
- Flexible Manufacturing Process
- Low Cost ($)
• 15% reduction in equalized variable costs
• 40% reduction in capital tooling
What Defines a “Great BIW Design”

- Looks (Styling)
  - Wow!
- Light Weight (materials/construction)
  - Increased HSS Utilization/ Efficient Design Engineering
- Structural Performance
  - Stiffer / Stronger / Safe
- Flexible Manufacturing Process
  - Strategic use of sub-assemblies
- Low Cost ($)

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The LX Sedan BIW Structure
Just The Beginning!