VE Commodore
Body Structure

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Introduction

• VE and WM sedans launched 2006
• Ute launched 2007
• Wagon launched 2008
• Most comprehensive body in white program ever
• Stiff body structure ranks among best large cars
• Crash performance, N&V improvements, occupant safety – biggest wins
• High strength steels – significant increase in usage
Introduction

- Entire architecture program done virtually
- Crash and durability modelling used extensively
- Accuracy, cost efficiency and speed to market
- Concept and feasibility studies began in 1999
- Benchmarks included Mercedes, Audi and BMW
Crash performance

- Met offset frontal, full frontal, rear and side impact requirements
- 5 star ANCAP rating
- Met front crash requirements despite reduced crush space
- Use of high-strength steels
- Careful design of front rail section and joints
- Clearly defined load paths
Crash performance

- For frontal impact, three load paths created through upper rails, longitudinal rails and engine cradle
Crash performance

- For side impact, load paths include B pillar, IP cross-beam, three floor cross-members, rocker, door intrusion beam, structural roof bow design
Crash performance

- For rear impact, strategy involved rear longitudinal rail, rocker and C pillar brace design
- Fuel tank relocated to be forward of rear wheels
Material utilisation and body stiffness

• Weight a key issue
• Achieved a very high level of body stiffness
• Torsion and bending modes increased enormously – excellent structural feel, sense of safety and solidity
• One-piece body side outer
  • biggest Holden has ever produced
• Delivers quality improvements
  • better fit and finish
Automotive steels used in VE

1. Low strength
   • mild steel & interstitial-free (IF) steel, used for skin panels, small brackets

2. Medium strength
   • bake hardening, used for door skins

3. Conventional high strength
   • HSLA / High Strength Low Alloy, used for structural members

4. Advanced high strength
   • dual phase (DP), recovery annealed, used for rockers, cross-members

5. Ultra high strength
   • hot stamped / press-hardened, used for Centre Pillar, door beams
Automotive steels used in VE

- Low Strength
- Medium Strength
- High Strength
- Advanced High Strength
- Ultra High Strength
## Automotive steels – mechanical properties

<table>
<thead>
<tr>
<th>Grade</th>
<th>Yield Strength (MPa)</th>
<th>Tensile Strength (MPa)</th>
<th>Elongation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Strength</td>
<td>140-180</td>
<td>270-330</td>
<td>40</td>
</tr>
<tr>
<td>Medium Strength</td>
<td>180-300</td>
<td>300 min</td>
<td>32</td>
</tr>
<tr>
<td>High Strength</td>
<td>340-400</td>
<td>400 min</td>
<td>22</td>
</tr>
<tr>
<td>Advanced High Strength</td>
<td>550-700</td>
<td>980 min</td>
<td>10</td>
</tr>
<tr>
<td>Ultra High Strength</td>
<td>950-1100</td>
<td>1200 min</td>
<td>8</td>
</tr>
</tbody>
</table>
Steel Usage – VT to VZ

- Low Strength: 88%
- Medium Strength: 12%
Steel Usage – VE

- High Strength Steel 36%
- Medium Strength 32%
- Low Strength 19%
- Advanced High Strength Steel 10%
- Ultra High Strength Steel 3%
Steel Usage

- Low Strength
- Medium Strength
- High Strength
- Advanced High Strength
- Ultra High Strength
- Aluminium
High Strength Steel Usage

- **YS=340-400 MPa HIGH STRENGTH**
- **YS=550-700 MPa ADVANCED HIGH STRENGTH**
- **YS=950-1100 MPa ULTRA HIGH STRENGTH**
Steel Usage – Press Hardened / Hot Stamped

- Ultra high strength steel
- Centre Pillar Reinforcement
- YS = 950MPa, TS = 1200MPa
- Blank is heated above 900°C, stamped, quenched
- Enables complex geometry, little springback
- Process video
Steel Usage – Dual Phase

- Advanced high strength steel
- Rocker Inner, #4 Bar, Rail Extn, U/B Brace
- YS = 650MPa, TS = 980MPa
- Folding, bending, simple stampings

![Stress-Strain Diagram]

<table>
<thead>
<tr>
<th>Stress (MPa)</th>
<th>Strain</th>
</tr>
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<tbody>
<tr>
<td>DP 200/400</td>
<td></td>
</tr>
<tr>
<td>DP 250/800</td>
<td></td>
</tr>
<tr>
<td>DP 300/500</td>
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<tr>
<td>DP 350/600</td>
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</tr>
<tr>
<td>DP 500/900</td>
<td></td>
</tr>
<tr>
<td>Mild Steel</td>
<td></td>
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</tbody>
</table>

YS=550-700 MPa
DUAL PHASE
Steel Usage – Recovery Annealed

- Advanced high strength steel
- Rocker Outer
- YS = 700MPa, TS = 900MPa
- Roll-forming
Steel Usage – HSLA

- Many underbody panels
- Yield strength = 340-400MPa
- Tensile strength > 400MPa
- Stamping process

YS=340-400 MPa HIGH STRENGTH
Steel Usage – HSLA

- Many upper structure panels
- Yield strength = 340-400MPa
- Tensile strength > 400MPa
- Stamping process

YS=340-400 MPa HIGH STRENGTH
Steel Technology – Tailor Welded Blanks (TWB)

- Efficient way of combining different thickness or material grade into a single component
- Two blanks (flat sheets) are laser welded together
- Stamped as a single part in a single die
- Mass saving, get thickness or strength in the right area
- Used in front rails, #2 cross-bar, door inner

Front portion (grey) is lighter gauge (1.8mm)
Rear portion (blue) is heavier gauge (2.3mm)
Tailor weld line
Composite wheel tub

- Lightweight spare wheel tub a GM first
- Composite – not steel
- Glued into steel body
- Delivered a weight saving of about 6kg
The Future

Current

2013?
Conclusion

- Body structure – among best and stiffest in the world
- First use of high strength steels for Holden
- Next generation will use even more advanced steels
Questions?