

Great Designs in Steel

2011 Grand Cherokee

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May 18, 2011



- **Body Functional Objectives: Essence of the Grand Cherokee**

Mandates:

- Improve performance, increase size & lower weight
- Body Stiffness/Torsion/Bending
- Durability
- NVH
- Impact Performance:
- 3rd Party Rating → including Top Safety Pick (4x SWR Roof Crush)
- Trail Rated Performance

- **Body Design**

- Body Topology Evaluation
- Section / Connection / Continuity
- Structural Front End Module (FEM)
- Steel Gage and Grade Selection
- Resultant Components Chart

- **Development**

- Welding
- Structural Adhesive
- Multi - Disciplinary Optimization (MDO)
- Structural Efficiency Calculation
- Structural Adhesive Application
- Body Static Stiffness
- Body Modes
- NVH

- **Development - Continued**
 - Tow Hooks
 - Water Fording
- **Performance Confirmation**
 - Road Test Simulator (RTS) Validation
 - Proving Grounds Duty Cycles
 - Impact Performance:
 - 3rd Party Rating→ including Top Safety Pick (4x SWR Roof Crush)
 - 'Trail Rated' and Rubicon Performance

Body Functional Objectives: Durability & Capability → Driver Confidence



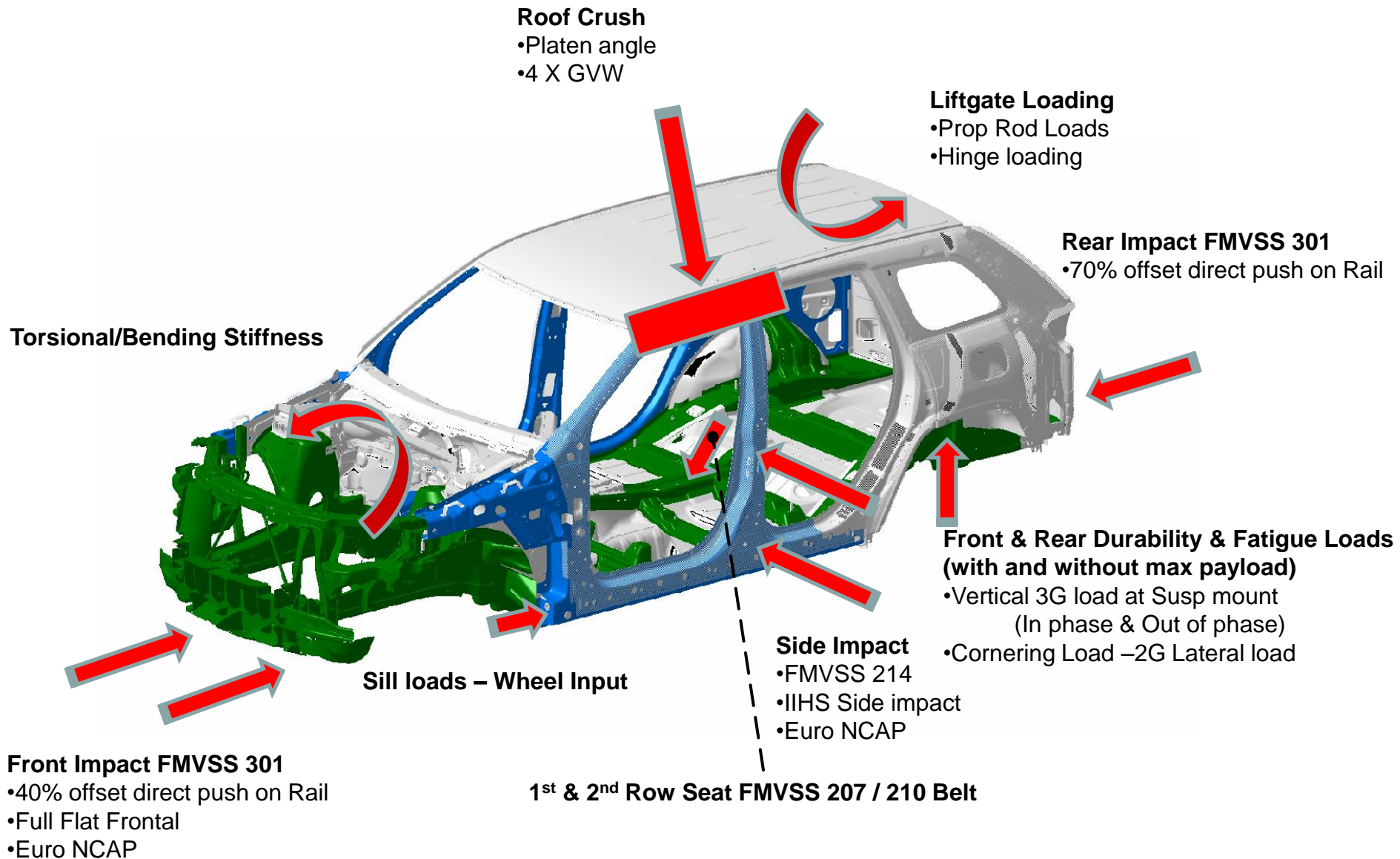
- **Global Body Functional Objectives: Essence of the Grand Cherokee**

Mandates:

- Body Stiffness/Torsion/Bending
- Durability
- Impact Performance:
- 3rd Party Rating → including Top Safety Pick (4x SWR Roof Crush)



WK Load Cases & Functional Requirements



Body Design: Experienced Engineers / State-of-the-Art Tools

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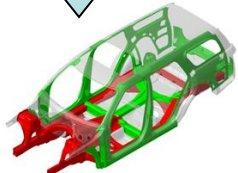
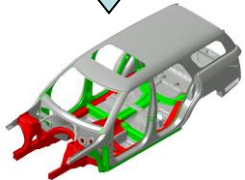
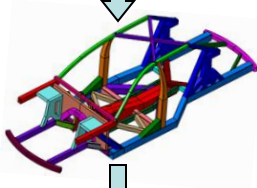
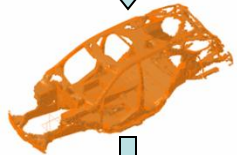
- **Body Design**
 - Body Topology Evaluation
 - Section / Connection / Continuity
 - Structural Front End Module (FEM)
 - Steel Grade Selection
 - Resultant Components Chart



Topology: Mass and Geometry Optimized to Objectives

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Typical Topology Process



Packaging Volume

Holistic Forces:

- Safety
- Refinement
- Durability

Topology Results

Spatial load image

Beam Model

Load paths

Body Design

Detailed Components

Optimization

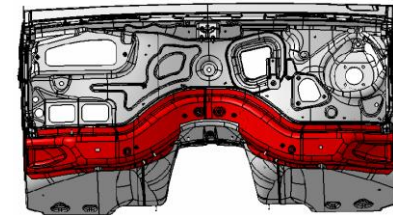
Steel Gauge & Materials

Component

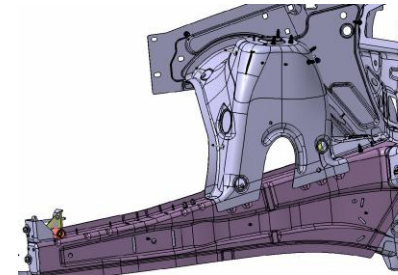
Topology

Design Application

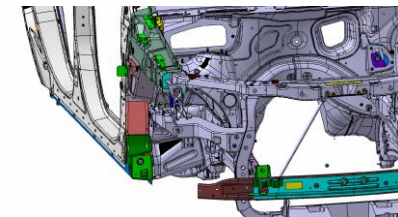
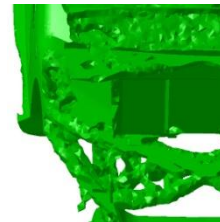
*Toe Board
Crossmember*



Shock tower

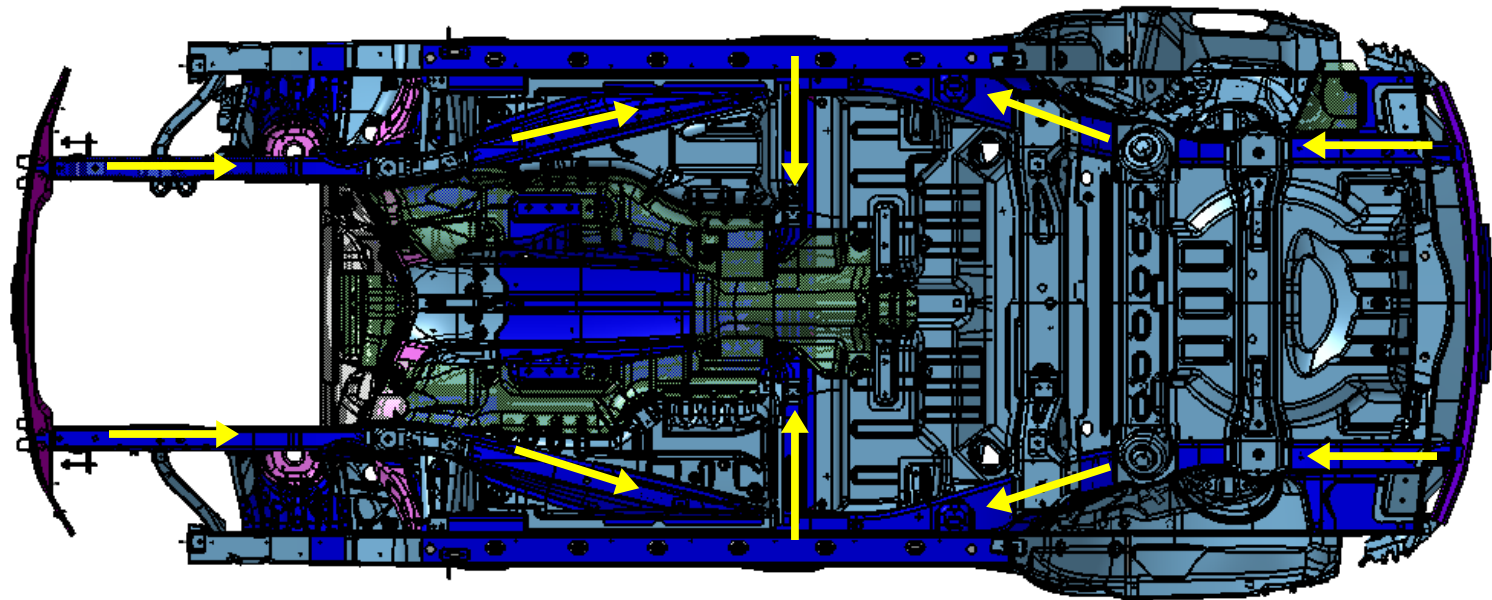


*Upper Load
Path*

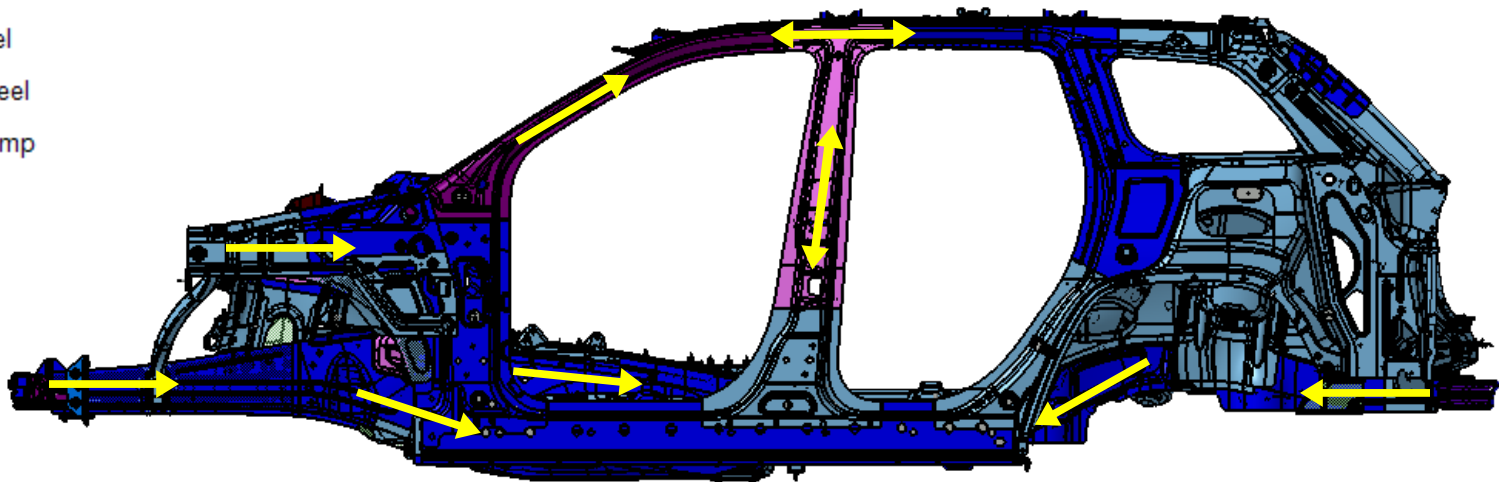


Section / Connection / Continuity: Energy Management Strategy and Execution

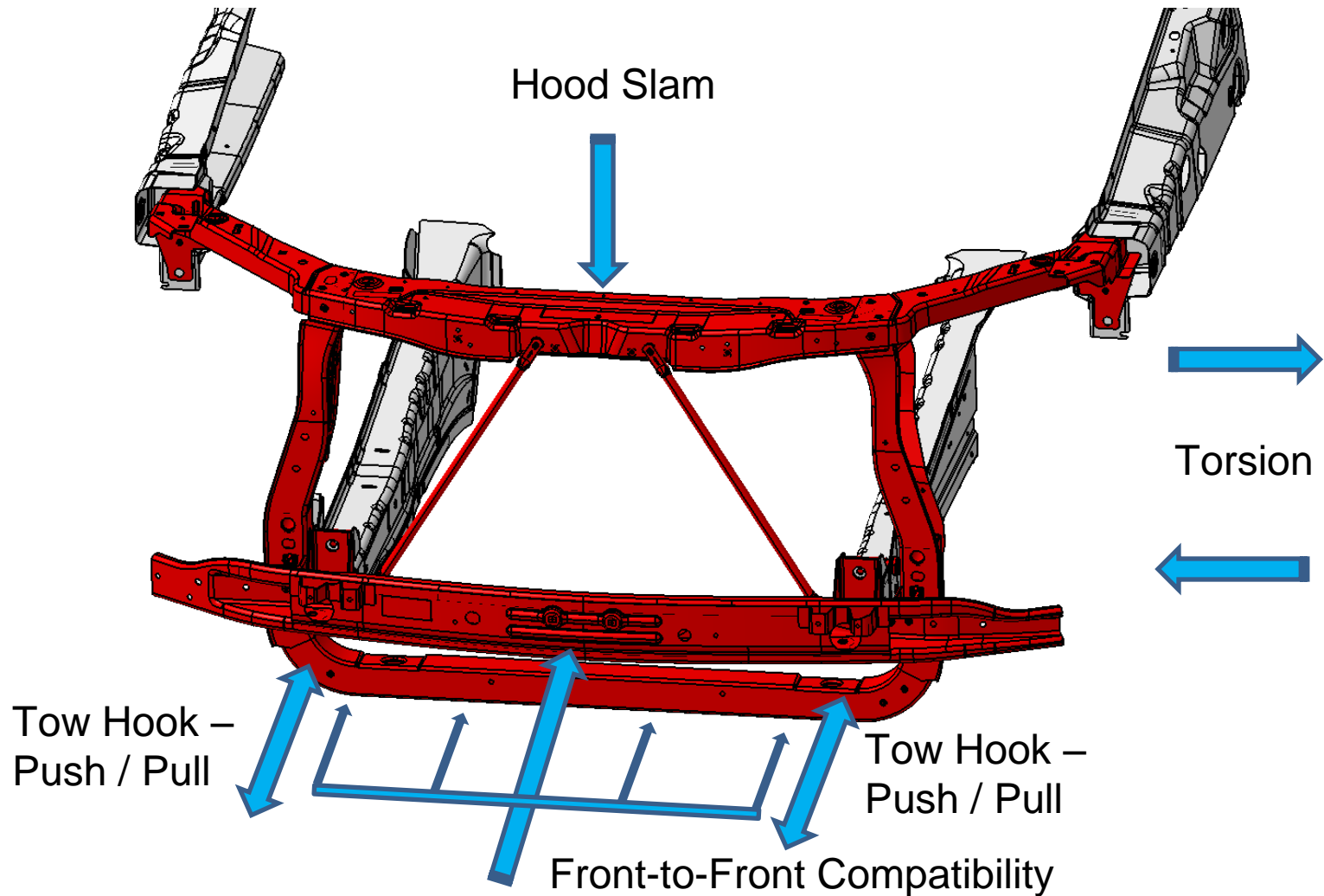
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- Mild Steel
- HS Steel
- AHS Steel
- Hot Stamp
- Other



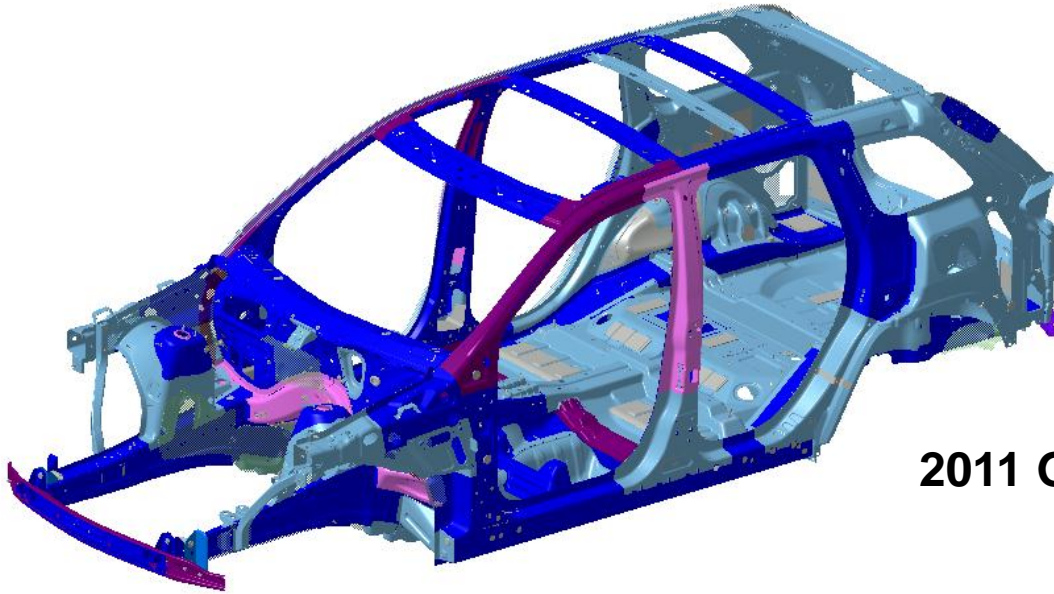
Jeep



Lo Speed Impact → No-Fire Threshold & 16 mph

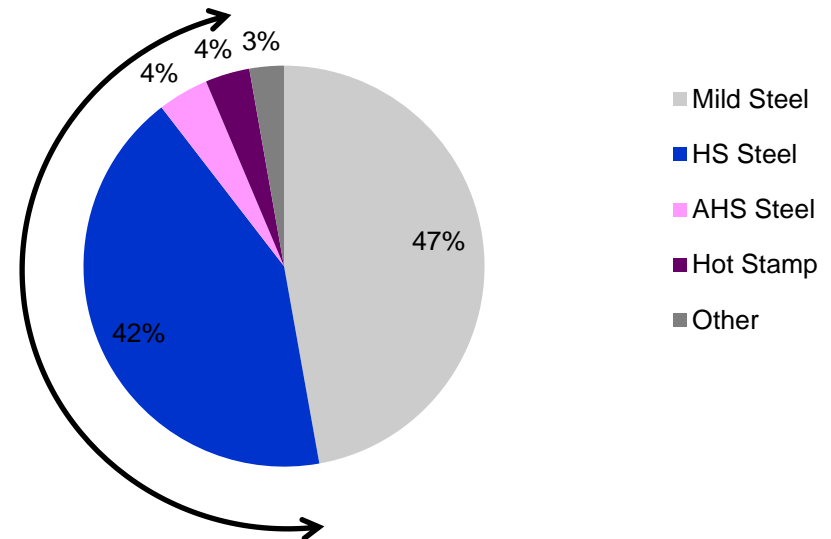
Hi Speed Impact → 20-40 mph

High Strength Steel Usage: Weight Reduction and Impact Performance



2011 Grand Cherokee Material Usage

50% High
Strength
Steel

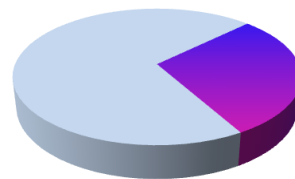
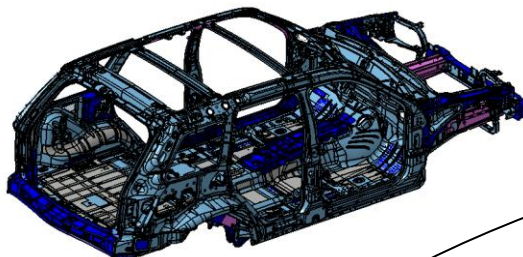


High Strength Steel: YS > 200 MPa

High Strength Steel Usage: Weight Reduction and Impact Performance

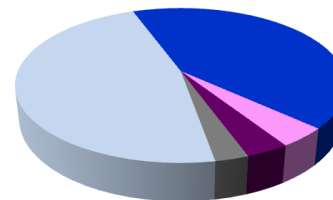
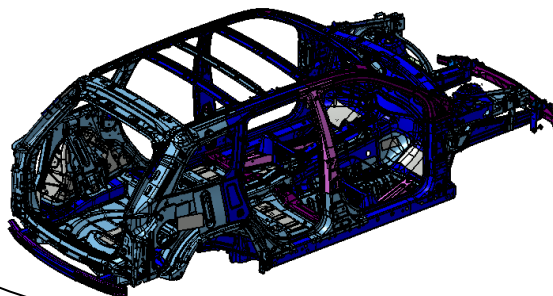
Jeep

Previous Grand Cherokee



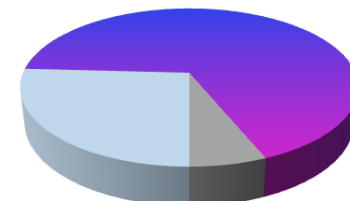
**29%
High Strength**

2011 Grand Cherokee



**50%
High Strength**

**70%
High Strength**



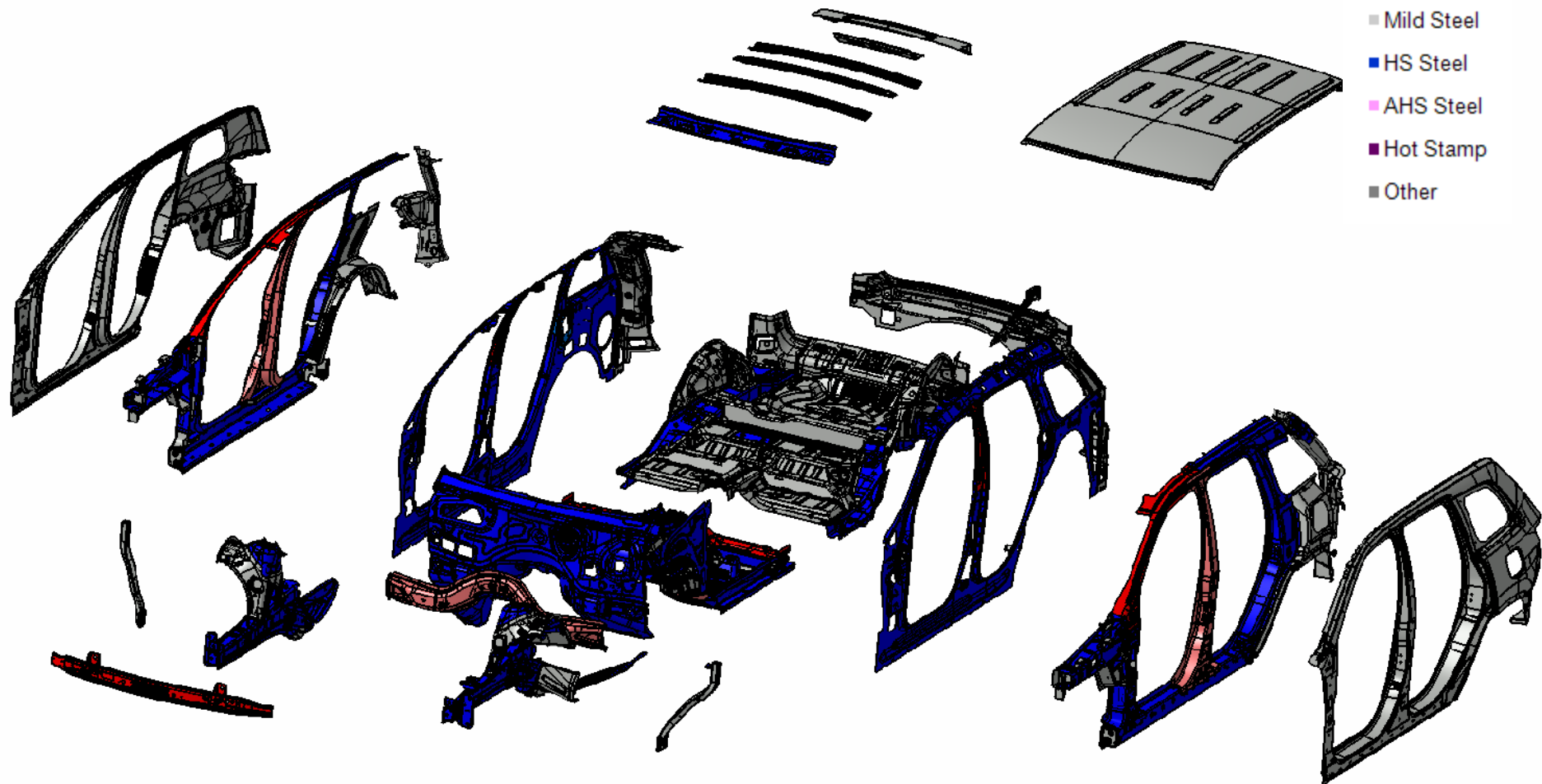
New Vehicles

High Strength Steel:
YS > 200 MPa

- Mild Steel
- HS Steel
- AHS Steel
- Hot Stamp
- Other

WK Body Components Chart: Body Shop Build Strategy

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- **Development**
 - Welding
 - Structural Adhesive
 - Multi - Disciplinary Optimization (MDO)
 - Structural Efficiency Performance Factor (PF)

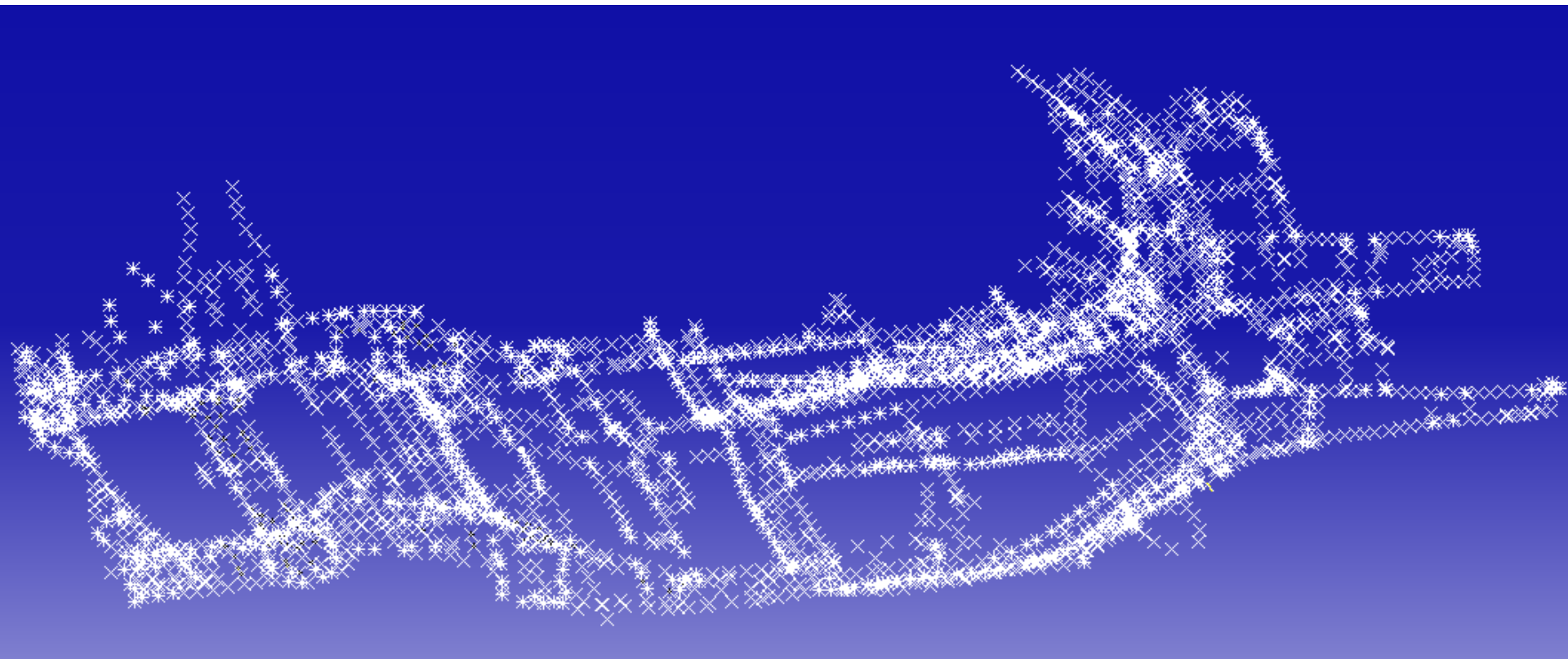




WK Underbody Spot Welding: Connecting the Structure for Jeep Capability



3308 Spot Welds in Underbody Shell



WK Upperbody Spot Welding: Connecting the Structure for Jeep Capability



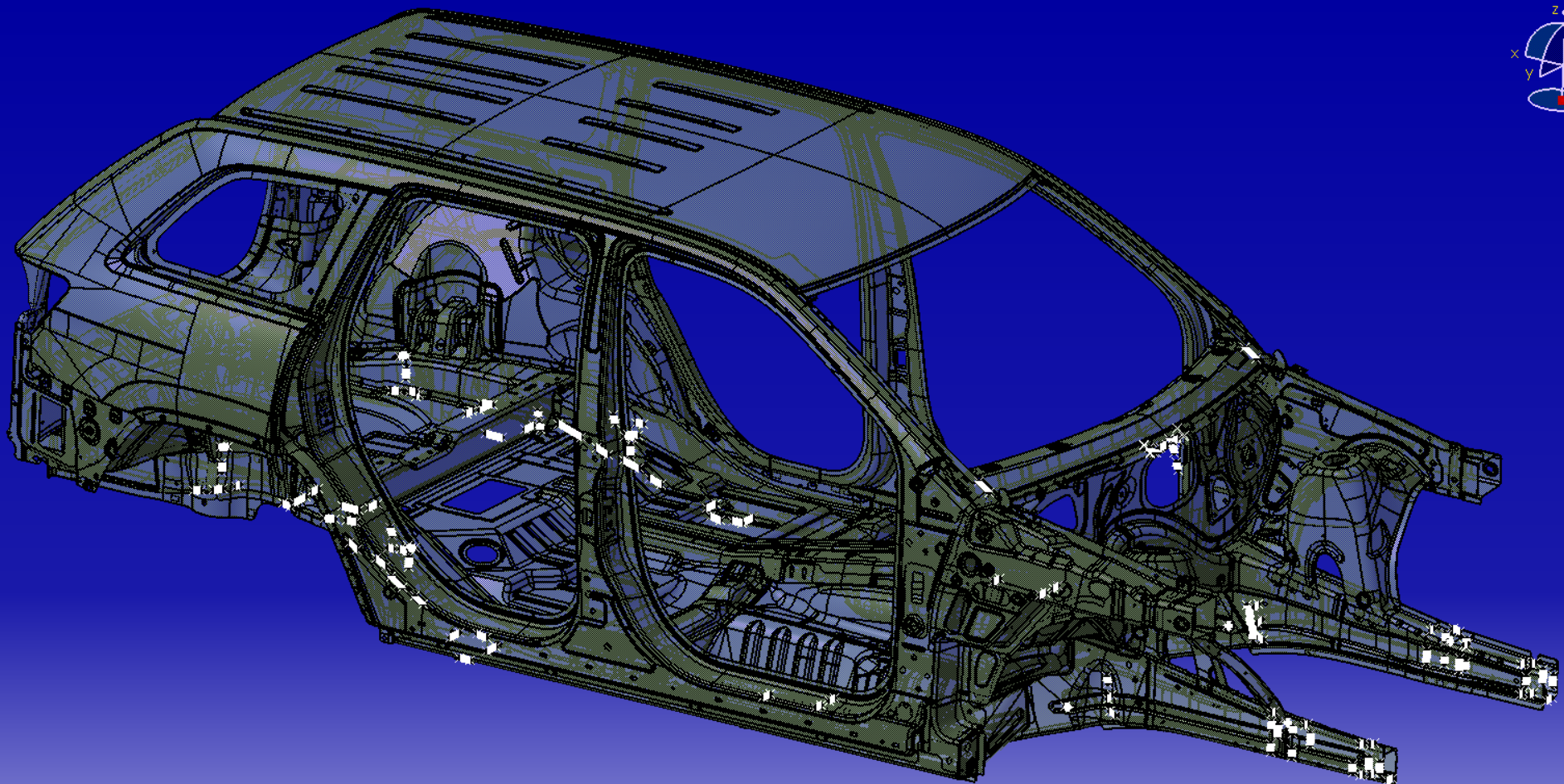
2069 Spot Welds in Upperbody Shell



WK MIG welding: Connecting the Structure for Jeep Capability

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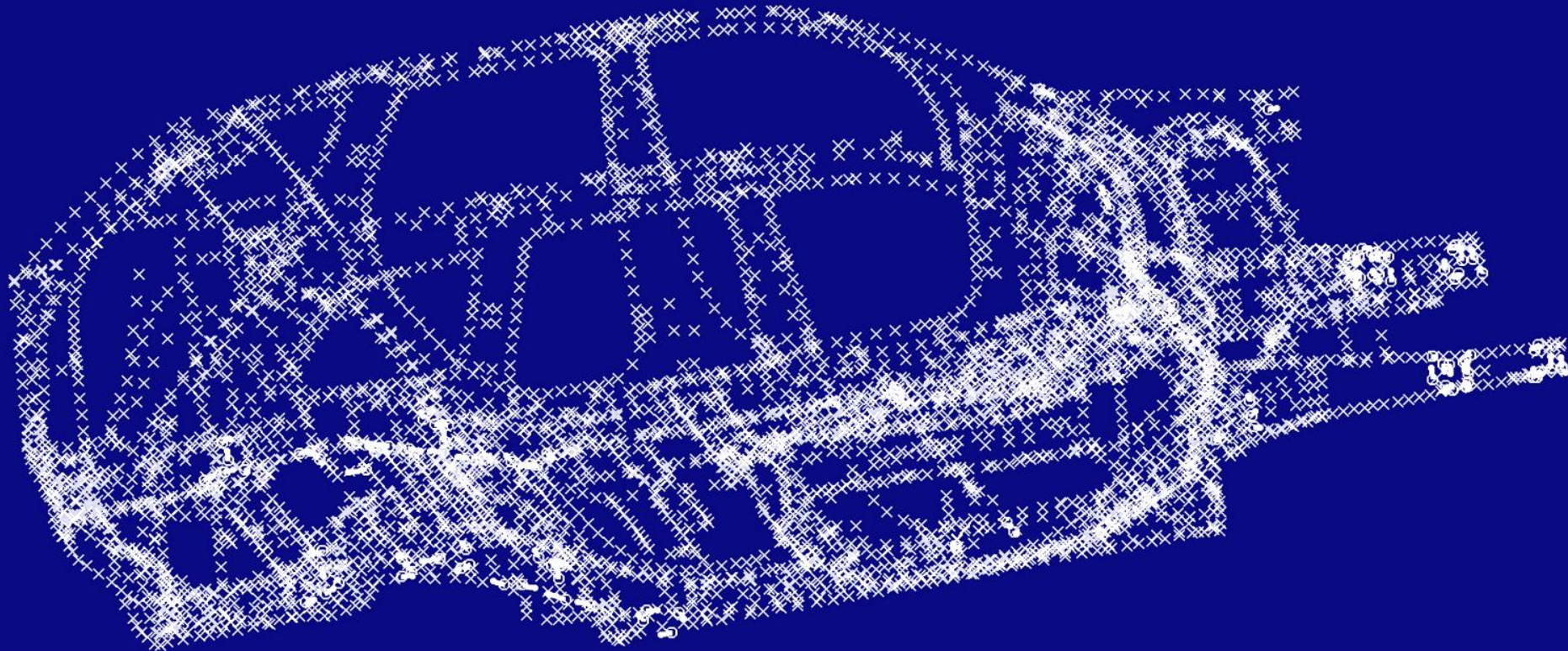
- *112 Mig Welds in Body Shell (Total mig weld length of 3494mm)*



WK Welding Complete: Connecting the Structure for Jeep Capability





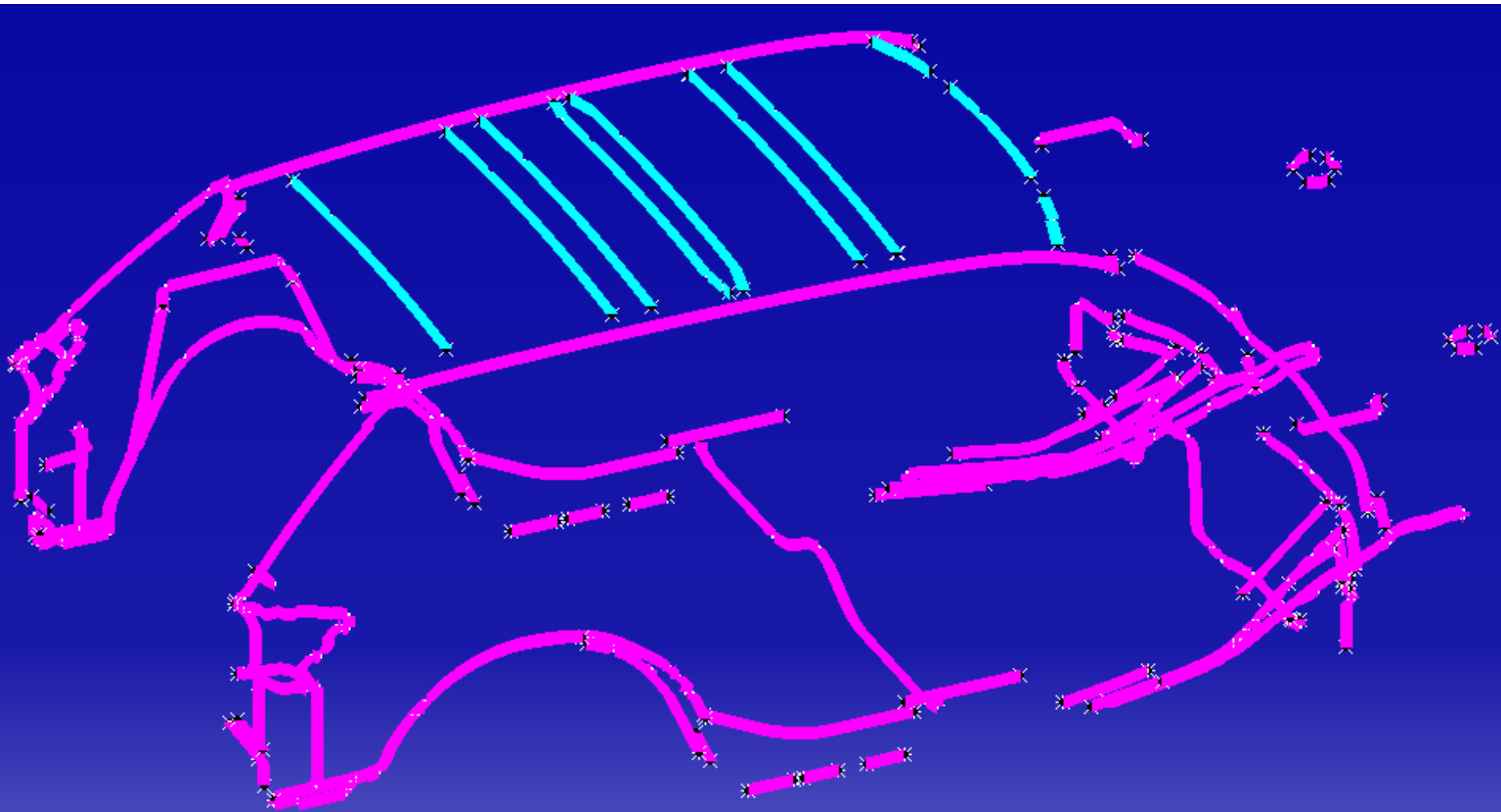
5489 Total Welds in Body-in-White Complete



WK Body Adhesive & Anti-Flutter: Finalization of Body Build Construction



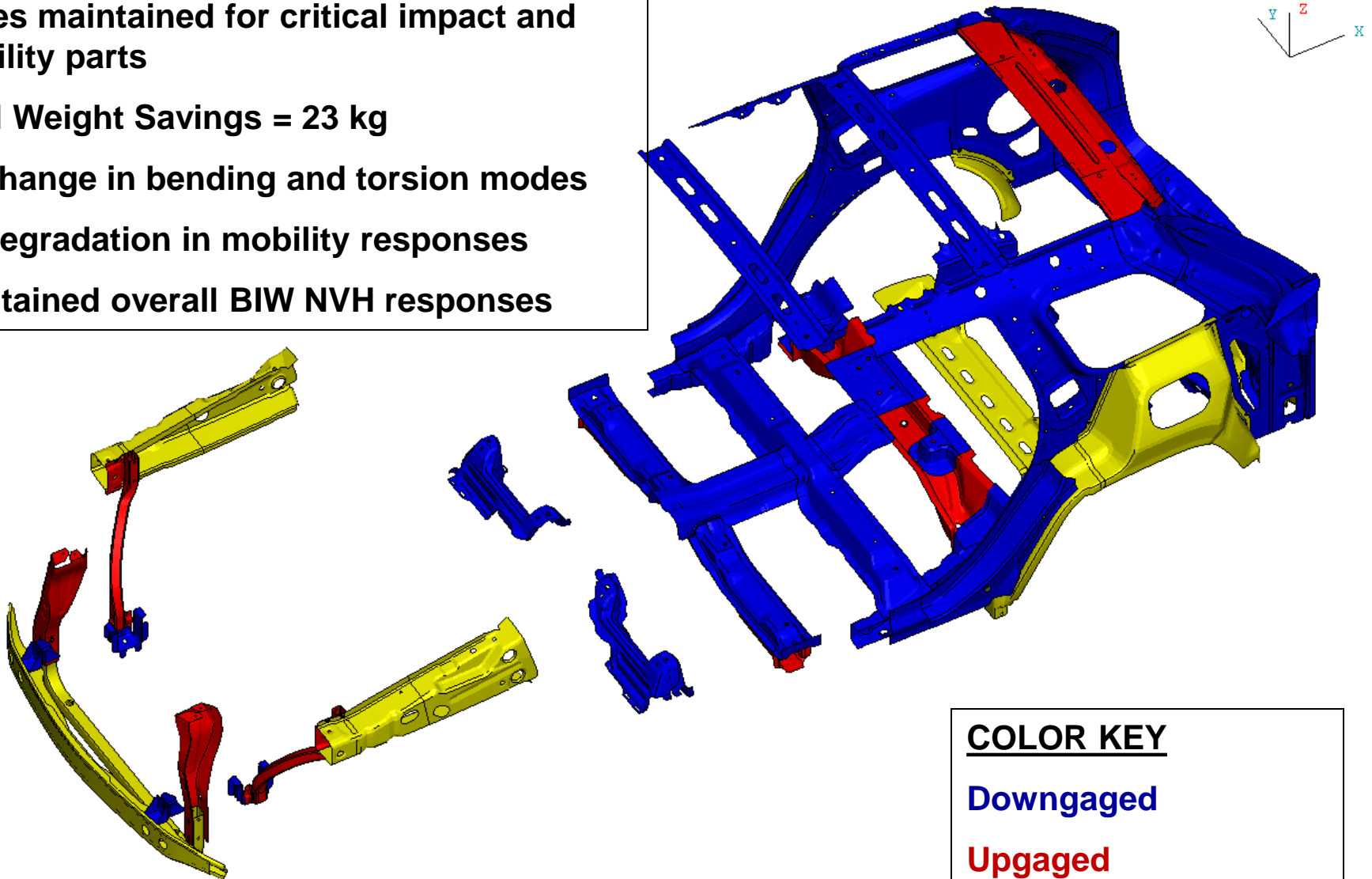
-  *Structural Adhesive (3mm bead) 108.6m total length*
-  *Anti-Flutter (5mm bead or gum drop) 8.3m total length*



WK Multi - Disciplinary Optimization (MDO): Wt. Optimization with no Functional Degradation

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- Gages maintained for critical impact and durability parts
- Total Weight Savings = 23 kg
- No change in bending and torsion modes
- No degradation in mobility responses
- Maintained overall BIW NVH responses



COLOR KEY

Downgaged

Upgaged

No Gage Change

Resultant Body: To Be Classified as a Jeep

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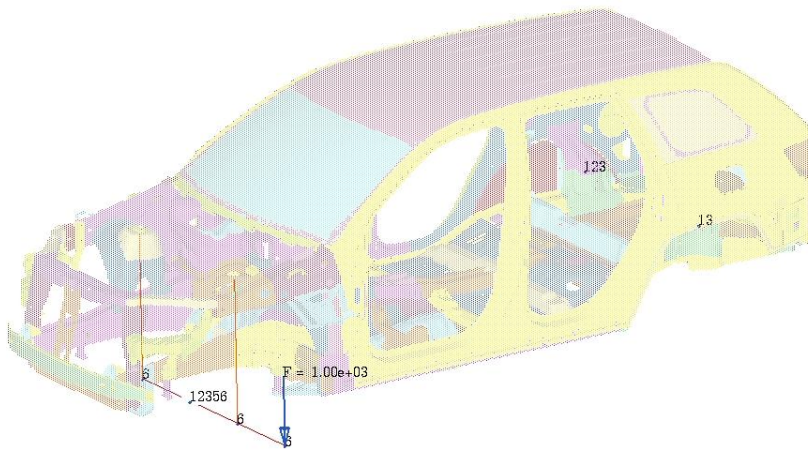
- **Development**
 - Body Static Stiffness
 - Body Modes
 - NVH



WK BIW Static Stiffness: Solid / Confident Driving Experience

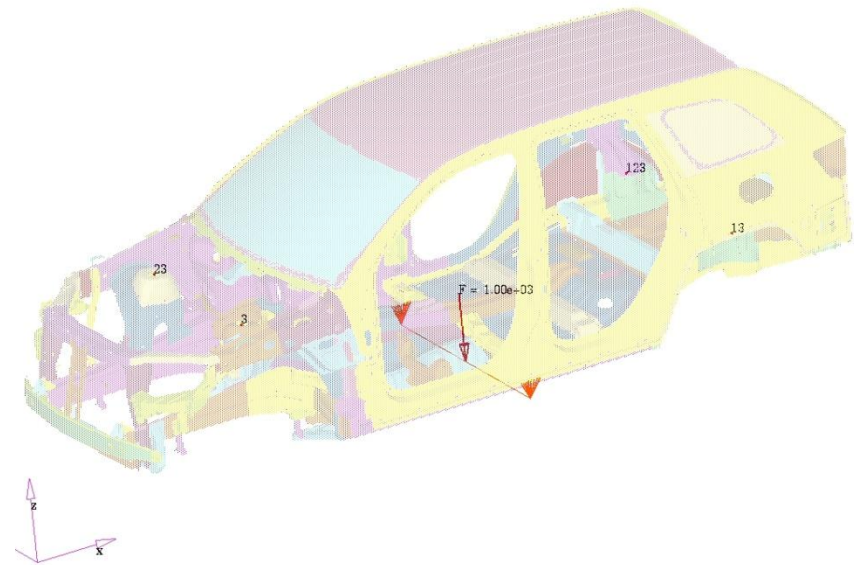


Torsional Stiffness Setup



Torsional Stiffness = 23000 N-m/deg (CAE)

Bending Stiffness Setup

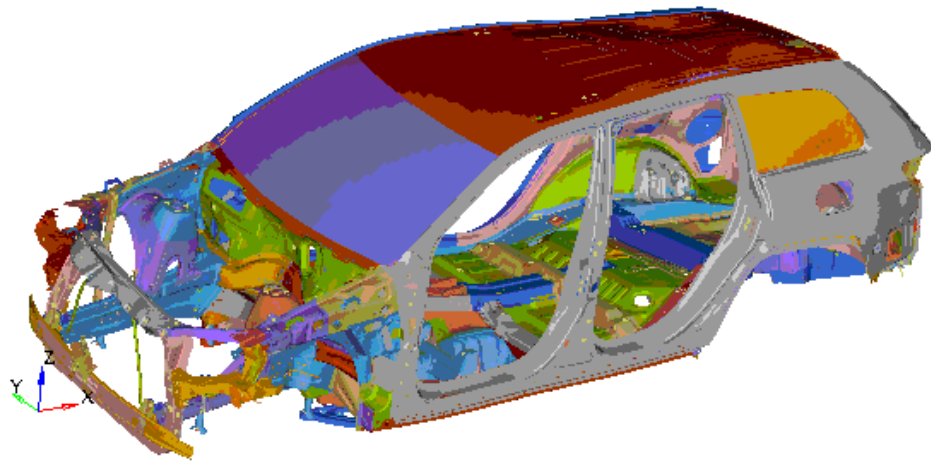


Bending Stiffness = 10200 N/mm (CAE)

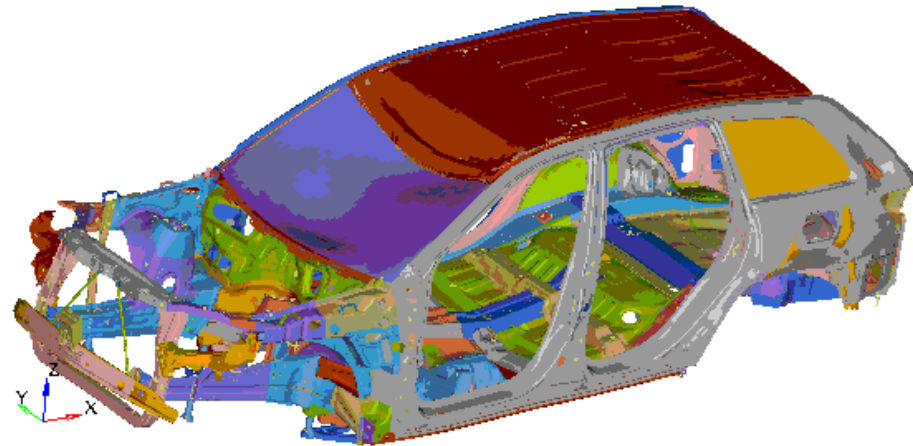
11WK BIW Normal Modes: Solid / Confident Driving Experience

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First Torsion Mode 43 Hz



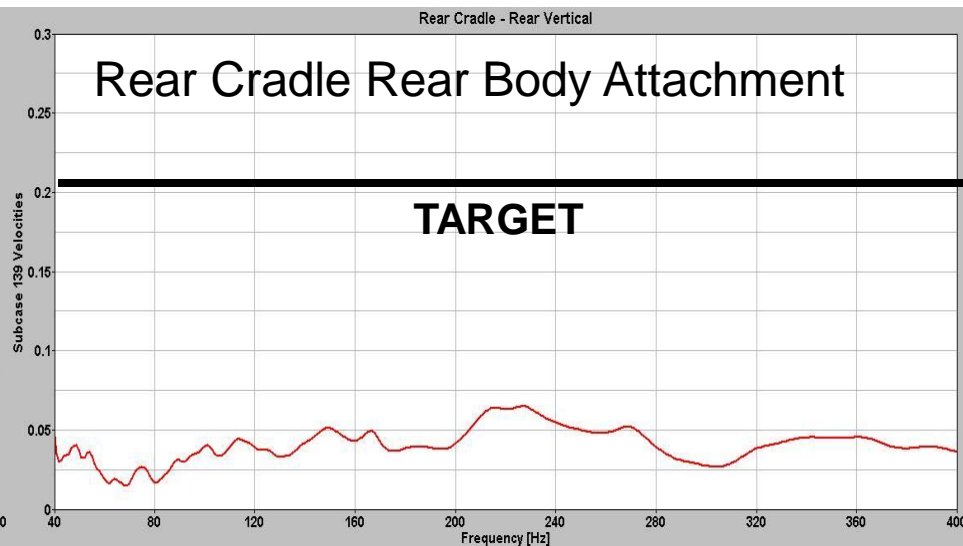
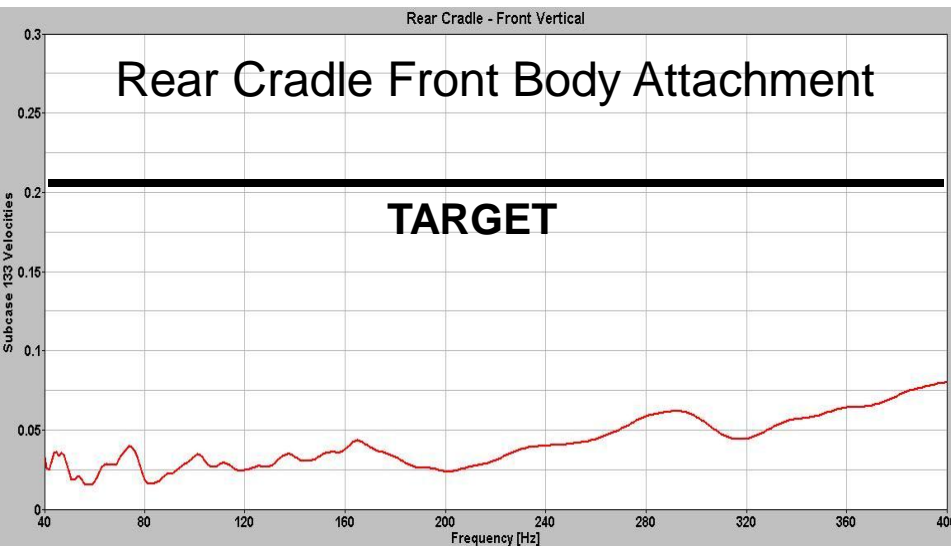
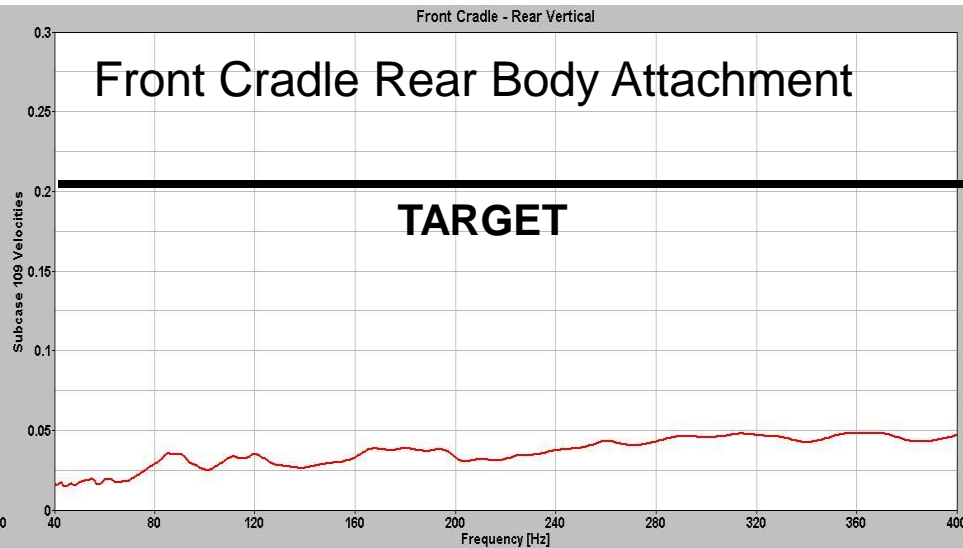
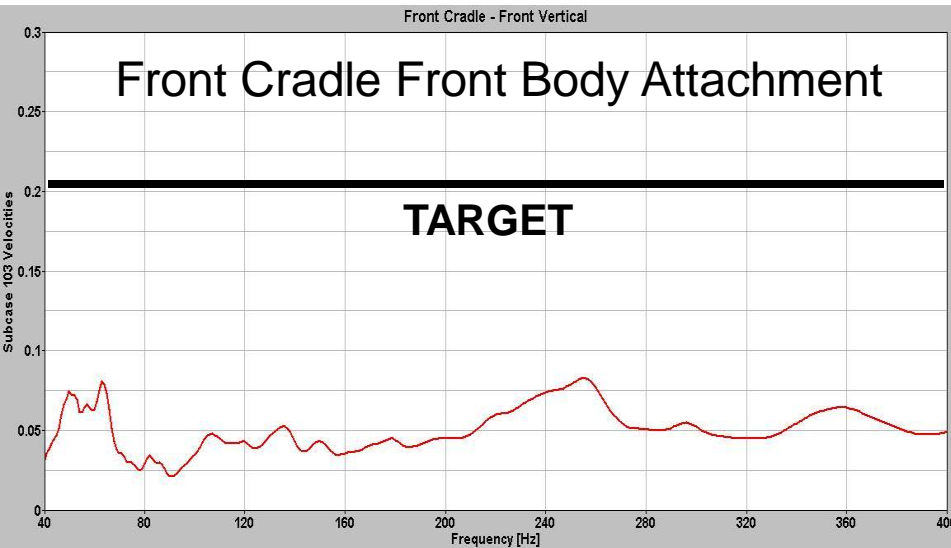
First Bending Mode 51 Hz



11WK Mobility Responses to Inputs @ Body Attachments to Cradles: NVH Achieved



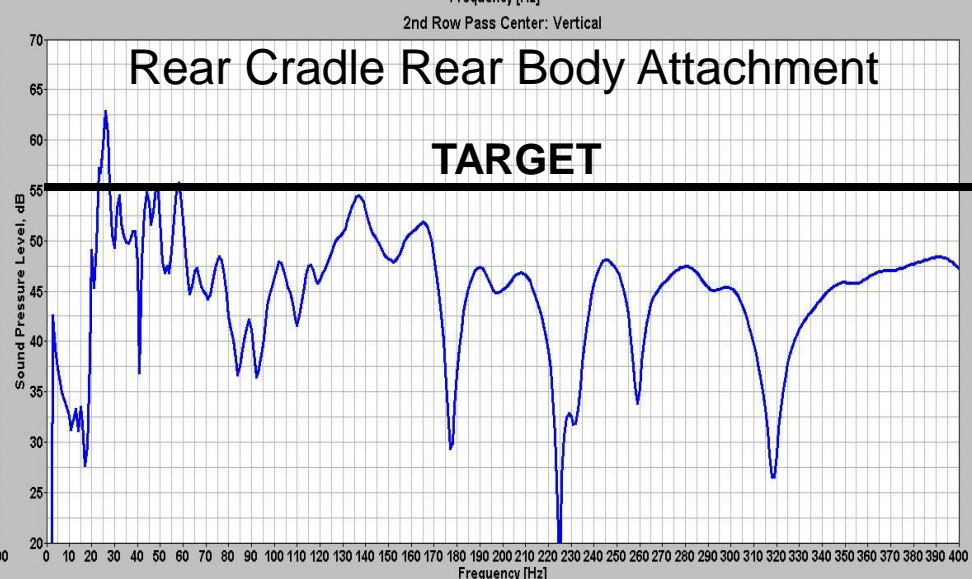
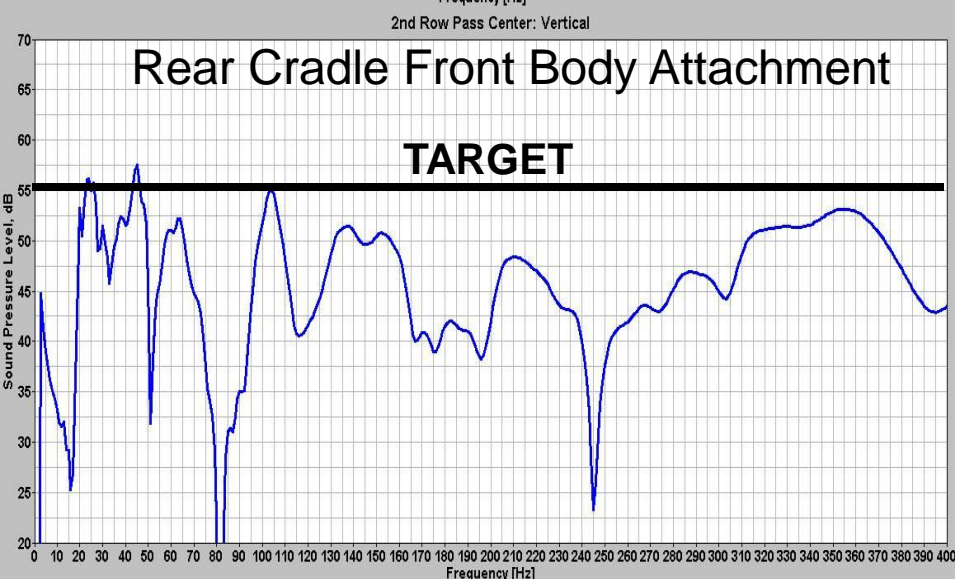
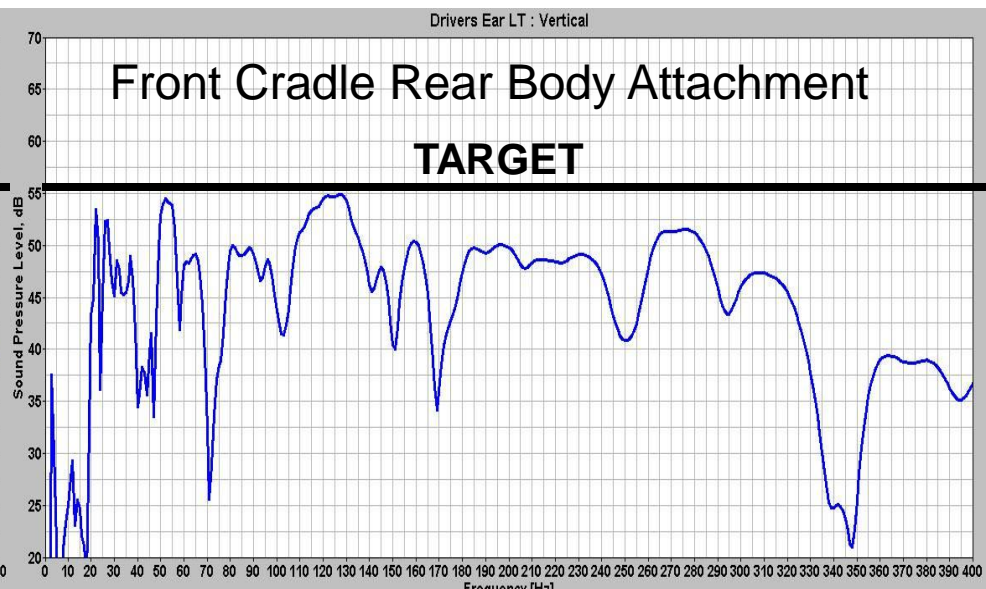
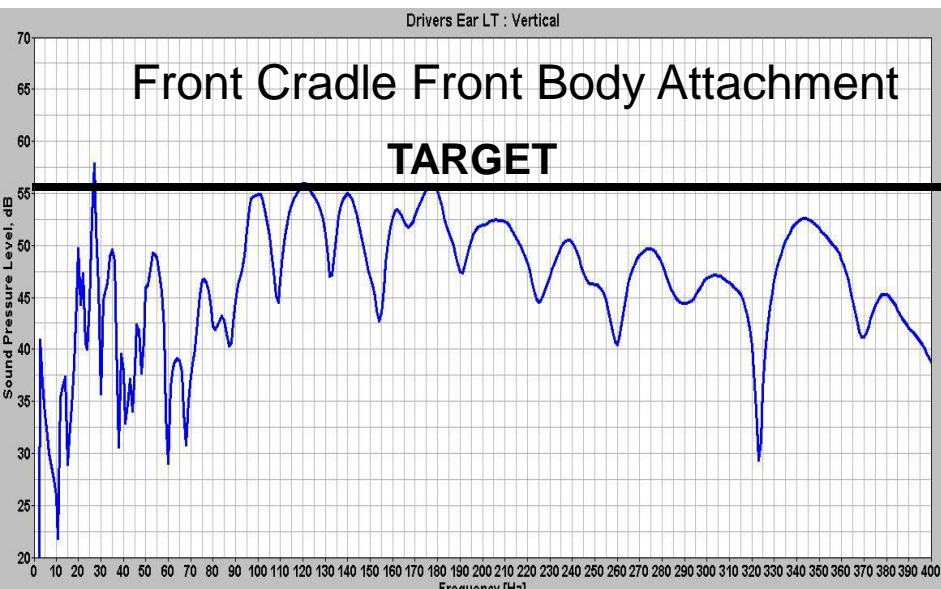
Target Met: $< 0.2 \text{ mm/sec/N}$



11WK Acoustic Responses to Input @ Body Attachment to Cradles: Driver Delight



Target Met: < 55 dB



Tow Hooks: Rugged Performance and Capability

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- **Development**
 - Tow Hook Development





Mineral Gray paint and Adaptive Cruise Control are late availability.

Tow Hooks: Complex and Punishing Requirements



“A Jeep Queue”

Front Tow Hooks (Two per Vehicle RT and LT) / Rear Tow Hook (one per Vehicle LT)

1. Design for Impact Requirements

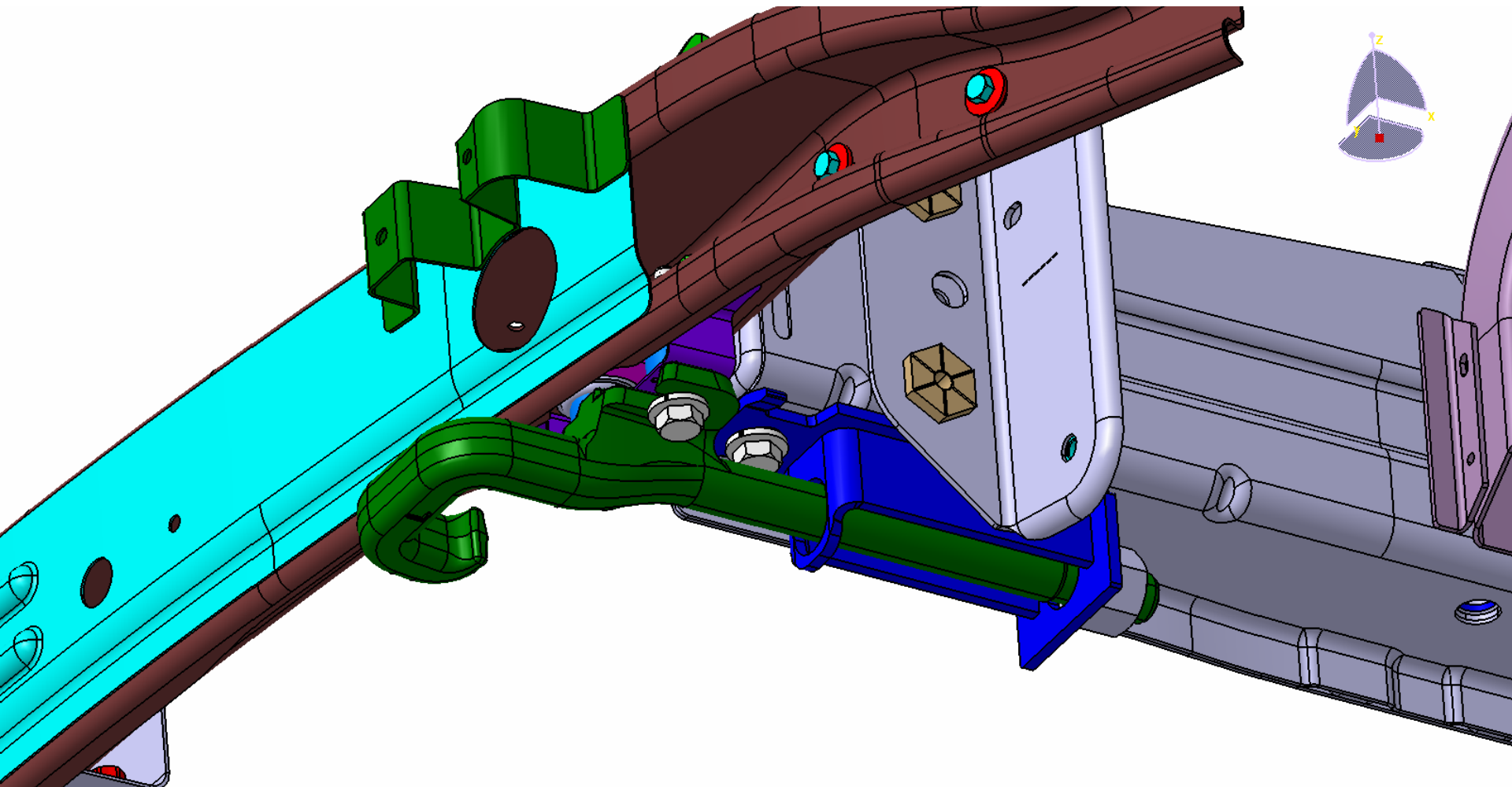
1. Requires pulse separation between low speed threshold vs. 16 FF.
2. Common calibration with and without tow hooks.

2. Design for durability Requirements

1. 1.0 /1.5 GVW pull.
2. 2.0 GVW pull with no separation.
3. 0.9 GVW 90 deg outboard pull no separation.
4. 0.5 GVW push/pull (BUX).

Tow Hook Design: Engineered Geometry for Multi-Purpose Objectives

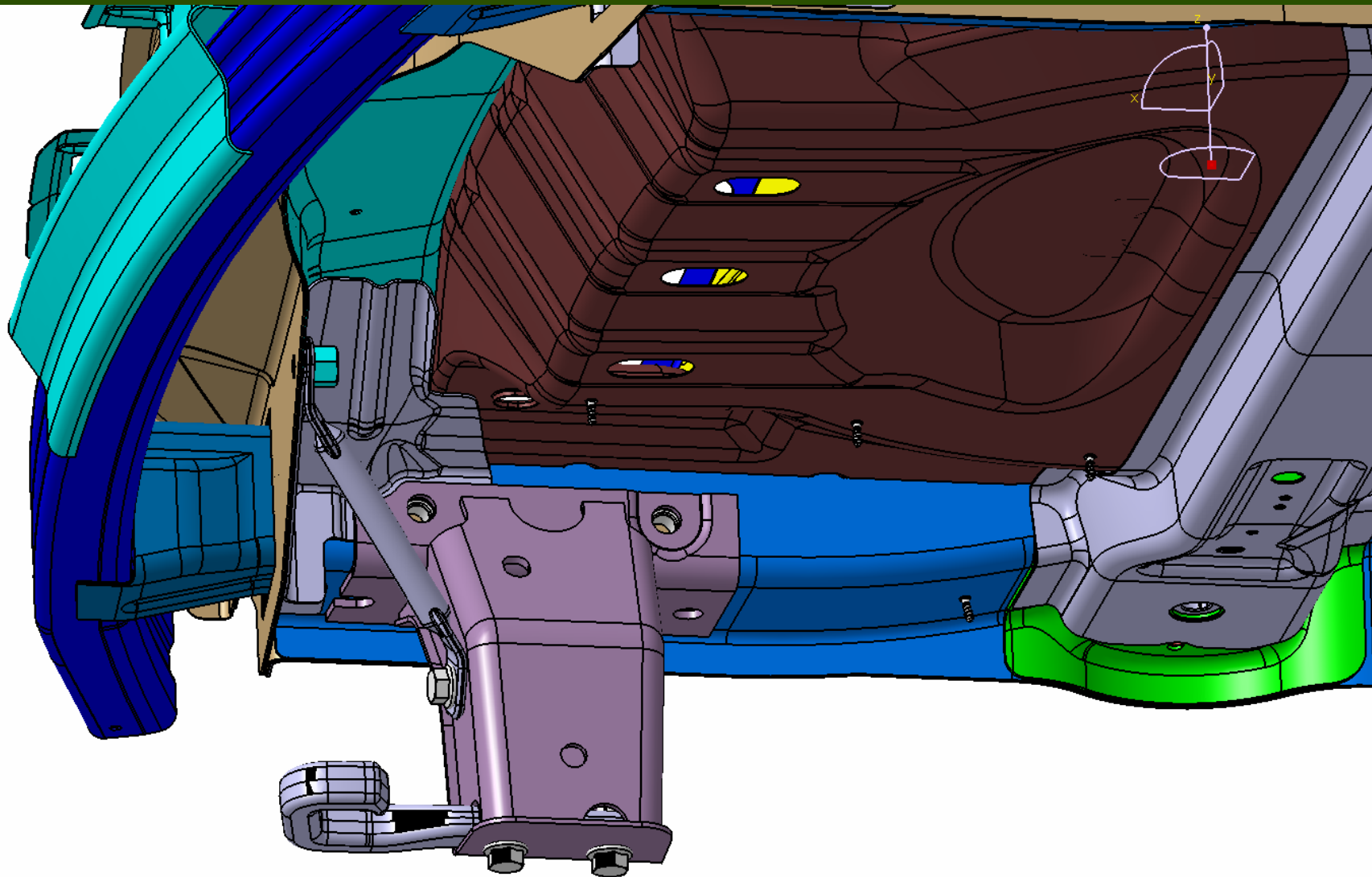
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Front Tow Hook Development: System Level Confirmation Testing

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Rear Tow Hook Development: System Level Confirmation Testing

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Water Fording: 'Trail Rated' Requirement



- **Development**
 - Body Sealing - 20" Water Fording – Define P1/P2 Sealing

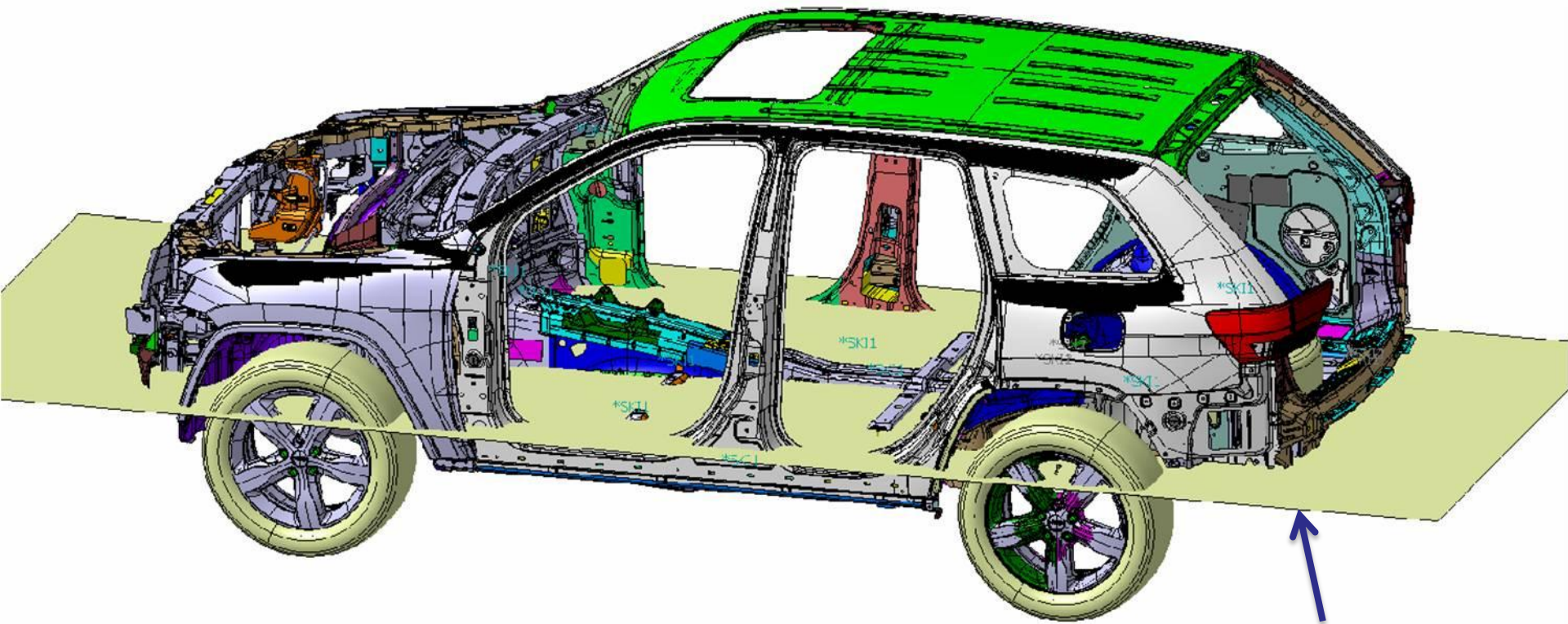




Overland model shown with optional features. Mineral Gray paint is late availability.

Water Fording Requirements: 20 inches of Water Submersion Performance

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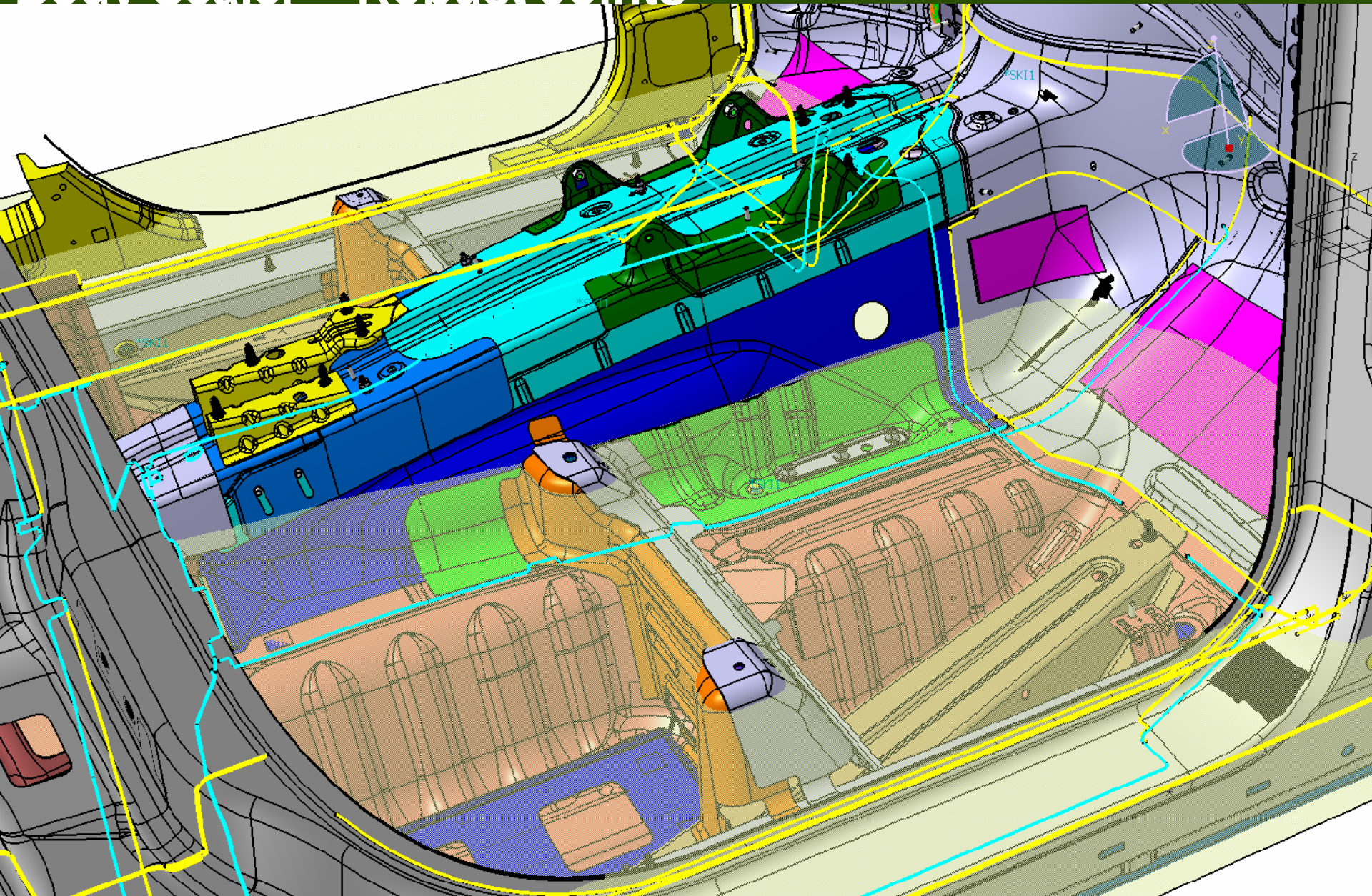


20 inches water
fording line

69.4 meters of sealer on BIW
76.4 meters including closures and hem sealing

Water Fording: Body Sealer – Robust Joints

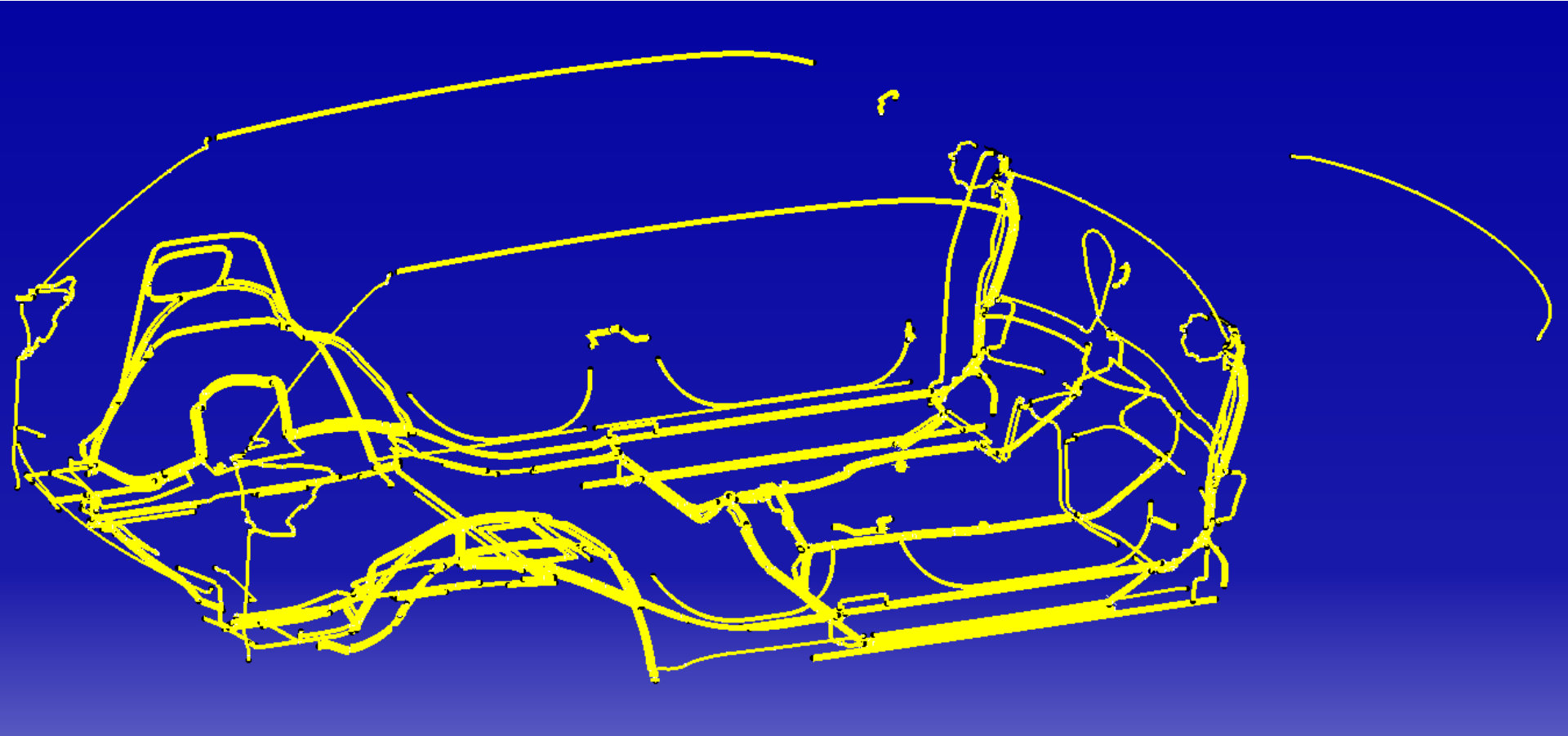
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Water Fording: Body Sealer – Robust Joints



Robotically Applied Sealants - 76.4m total length



WK Water Fording: Capable Results Achieved!

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Performance Confirmation: Legendary Jeep Performance



- **Confirmation**

- Road Test Simulator (RTS) Validation
- Proving Grounds Duty Cycles
- Impact Performance:
- 3rd Party Rating→ including Top Safety Pick (4x SWR Roof Crush)
- 'Trail Rated' and Rubicon Performance



WK Road Test Simulator Testing: Accelerated Discovery and Durability Results

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2011 WK on Road Test Simulator Rig

- SUV Body/Chassis PG Durability Duty Cycle
- Represents 95th Percentile Usage Customer
- 150K Customer Equivalent Miles
- Testing Performed to 2x Life



WK Proving Grounds Testing

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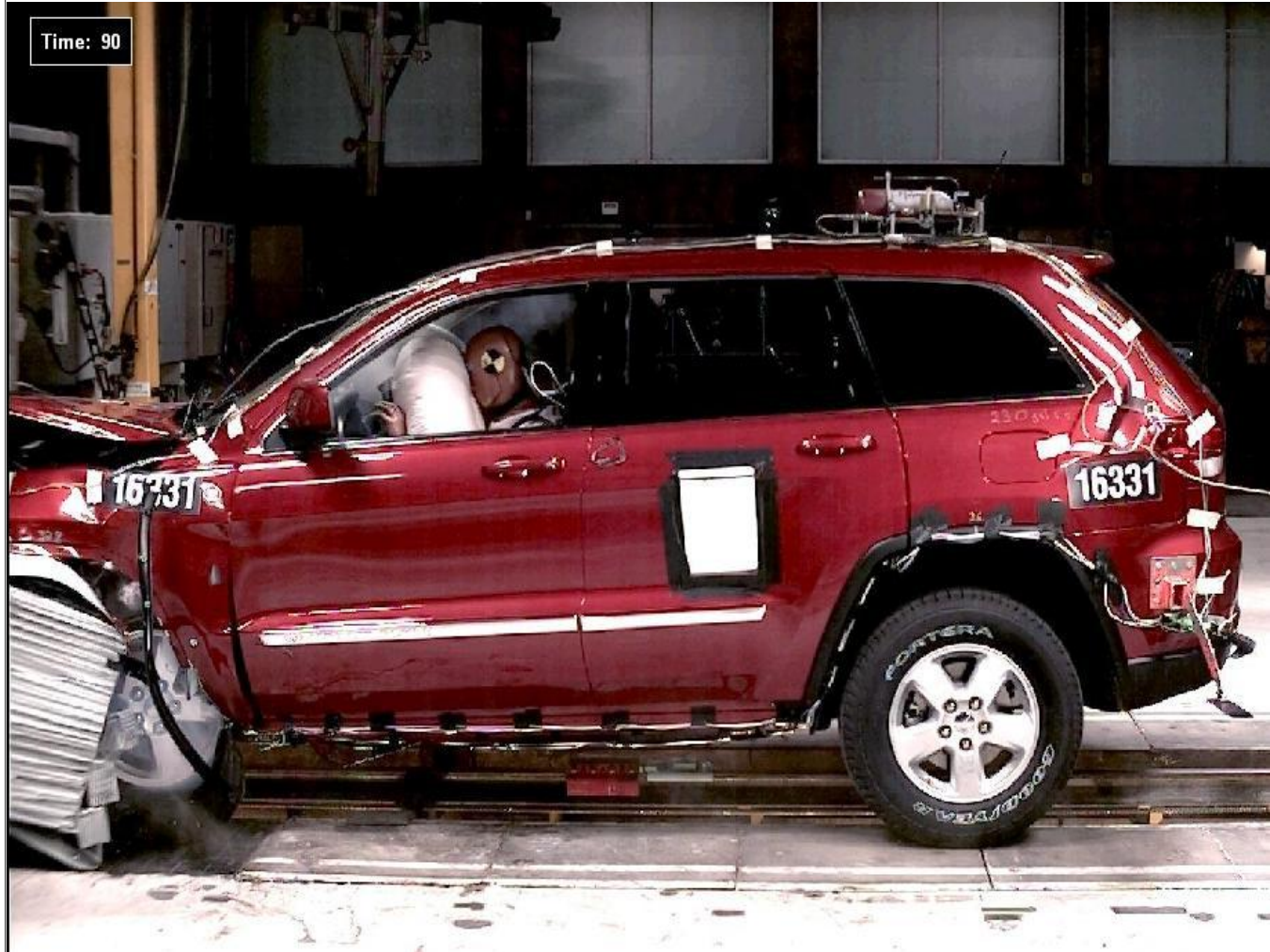
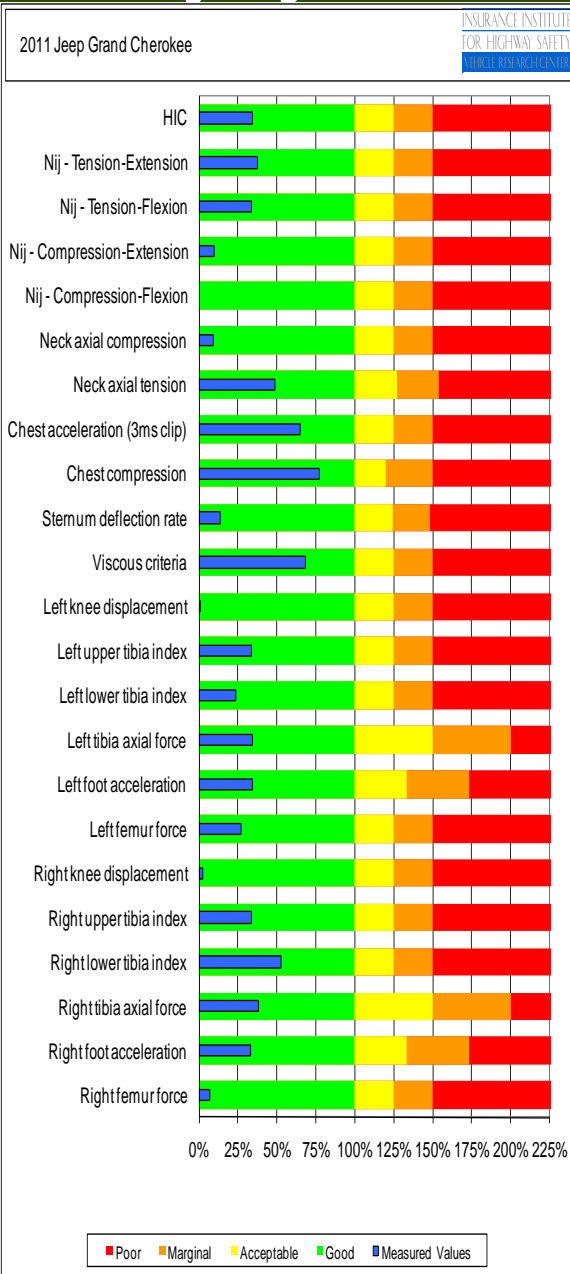
2011 WK NEW US NCAP RATINGS

New NCAP Mode		Mode Rating
Frontal	Driver	★★★★
	Passenger	
Side	Front MDB	★★★★★
	Rear MDB	
	Front Pole	
Rollover		★★★
Overall Vehicle Rating		★★★★



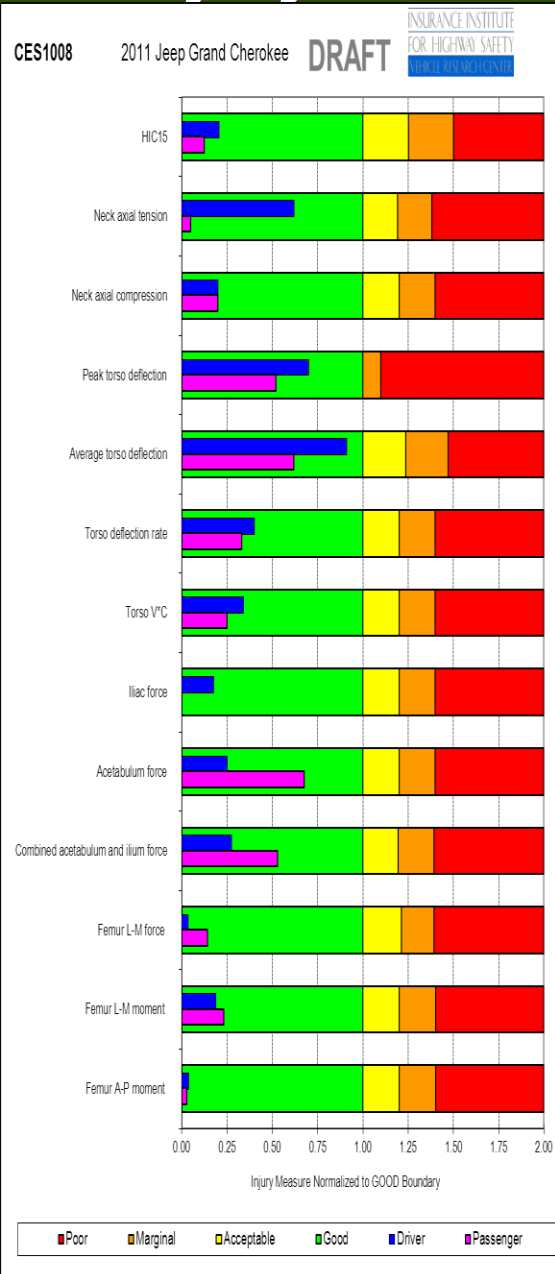
WK IIHS Offset: All Injury Criteria in 'Green Zone'

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IIHS Side Impact: All Injury Criteria in 'Green Zone'

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WK IIHS Side Crush: After-test Geometry in 'Green Zone'

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CES1008 2011 Jeep Grand Cherokee

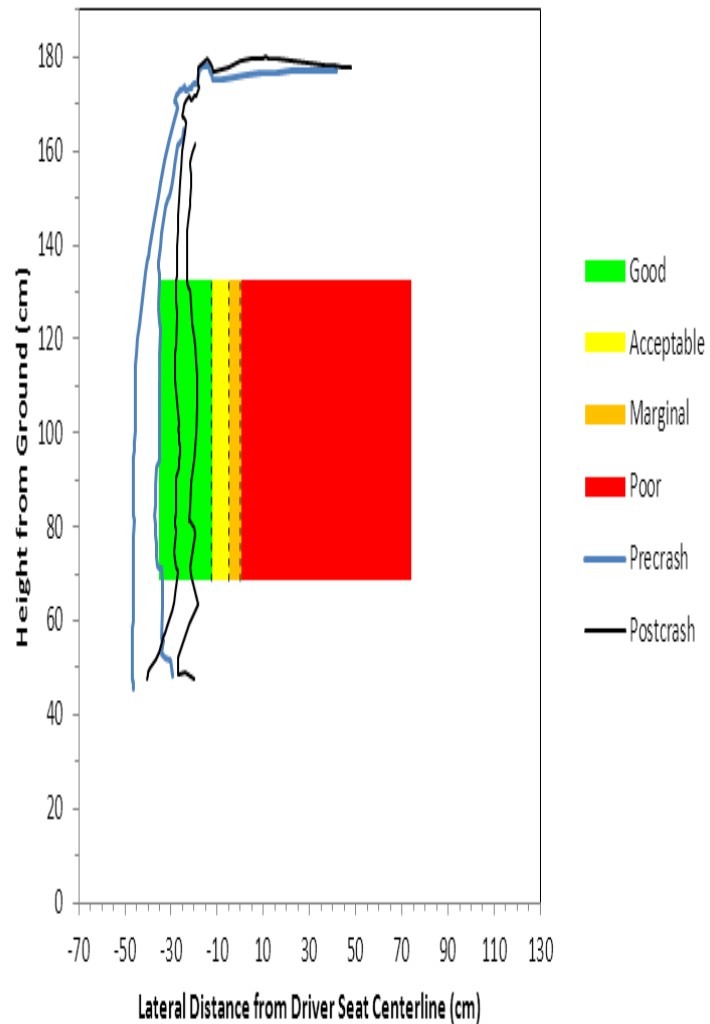


Table From IIHS website:

IIHS Classification: Roof Crush Rating “Good”



G Good

A Acceptable

M Marginal

P Poor

| Vehicles are listed in order of performance

Model	Overall rating	Curb weight (lb)	Peak force (lb)	Strength-to-weight ratio
Jeep Liberty 2008-10 models	G	4,245	21,073	4.96
Dodge Nitro 2007-10 models				
Toyota Highlander 2008-10 models	G	4,325	20,511	4.74
Toyota Venza 2009-10 models	G	4,037	18,977	4.70
Jeep Grand Cherokee 2011 models	G	4,655	21,545	4.63
Dodge Journey 2009-10 models	G	4,318	19,649	4.55

Roof Crush Rating : Good

2011 Jeep Grand Cherokee: 'Trail Rated' Performance

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Q & A



Thank You for Your Attention!