

Great Designs in

# STEEL

## 2019 Chevrolet Silverado

### Structure Review

Jeff Sulik, Engineering Group Manager

Joy Geeraerts, Senior Design Release Engineer

General Motors Company



**THE ALL-NEW 2019 SILVERADO**

# VEHICLE INTRODUCTION



- / Vehicle Overview**
- / Mass Reduction Strategy**
- / Material Utilization**
- / Frame Design Features**
- / Cab Design Features**
- / Bed Design Features**



# 2019 CHEVROLET SILVERADO



**ALL-NEW DESIGN**



# 2019 CHEVROLET SILVERADO



**BOLD SHAPE  
HIGHER AND TALLER**



# 2019 CHEVROLET SILVERADO



**WHEELS MOVED FORWARD  
SHORTER FRONT END**



# 2019 CHEVROLET SILVERADO



**4" LONGER WHEELBASE**  
**1.5" LONGER OVERALL**



# 2019 CHEVROLET SILVERADO



**MORE PASSENGER VOLUME**  
**MORE CARGO VOLUME**



# 2019 CHEVROLET SILVERADO



**LARGER CABS**

**MORE COMFORTABLE SEATING POSITIONS**



2019 CHEVROLET SILVERADO



**7% INCREASE  
IN AERODYNAMIC EFFICIENCY**







**DURAMAX**

**ALL-NEW  
DURAMAX**

**3.0L  
INLINE-SIX  
DIESEL**

**WITH 10-SPEED  
TRANSMISSION**





# SILVERADO'S UPGRADED 5.3L AND 6.2L V8

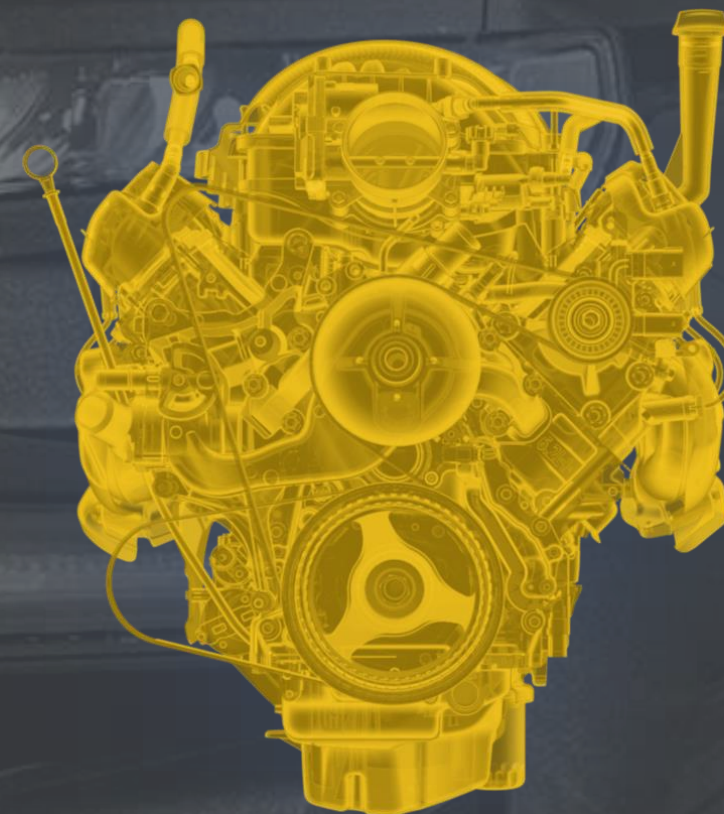
## PROGRAM OBJECTIVES

**MAINTAIN PROVEN SMALL BLOCK ARCHITECTURE**

**IMPROVE OPERATING EFFICIENCY AND FUEL ECONOMY**

**EXPAND AND IMPROVE AFM**

**MAINTAIN LEGENDARY SMALL BLOCK PERFORMANCE AND DURABILITY**







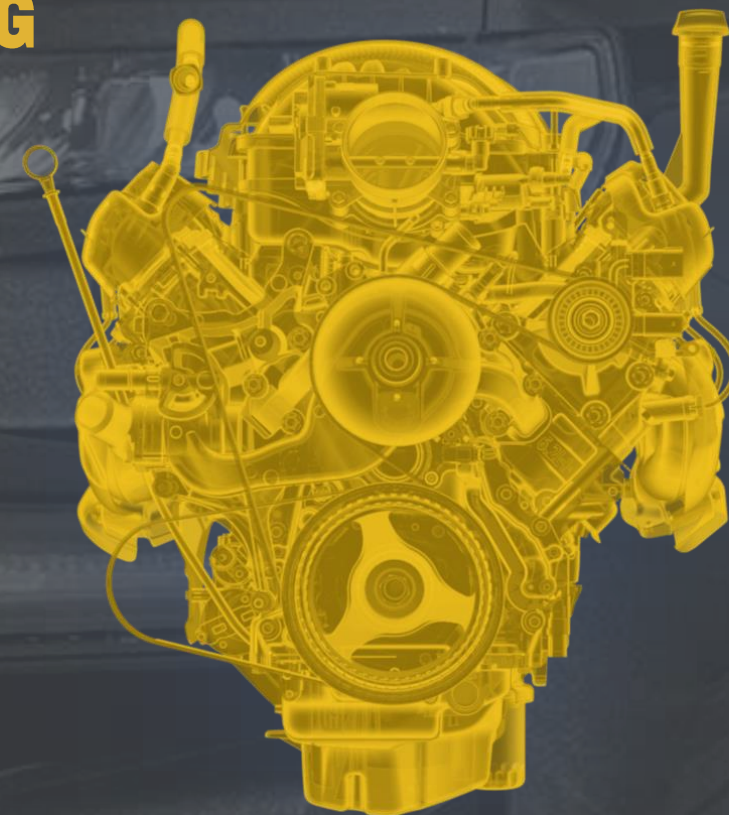
# INDUSTRY-FIRST DYNAMIC FUEL MANAGEMENT

AFM IS PROVEN METHOD TO **REDUCE PUMPING WORK & IMPROVE FUEL ECONOMY**

DFM ADDS **CYLINDER DEACTIVATION CAPABILITY ON EVERY CYLINDER**

ONLY USE THE **CYLINDERS YOU NEED**  
- OPTIMIZES EFFICIENCY

**N & V** REFINEMENT





# 2019 CHEVROLET SILVERADO MASS STRATEGY



- / Increased use of UHSS / AHSS / HSLA materials in the cab, higher HSLA grades in the bed and frame**
  - Multi-disciplinary optimization of the steel structure for the greatest possible mass reduction
  - Best balance of mass reduction and piece cost
  - Maintains the existing manufacturing base
- / Aluminum closures**
  - Easily integrated into the existing manufacturing base
  - Acceptable cost increase for mass reduction
- / Disciplined part design: scalloped flanges, lightening holes, no extra metal, etc.**
- / Integral front structure v. previous structural fender or hydroformed options**
- / Frame mount designs revised for improved NVH and durability**
- / Aggressive redesign of the upper body structure for mass reduction**



# 2019 CHEVROLET SILVERADO MASS STRATEGY



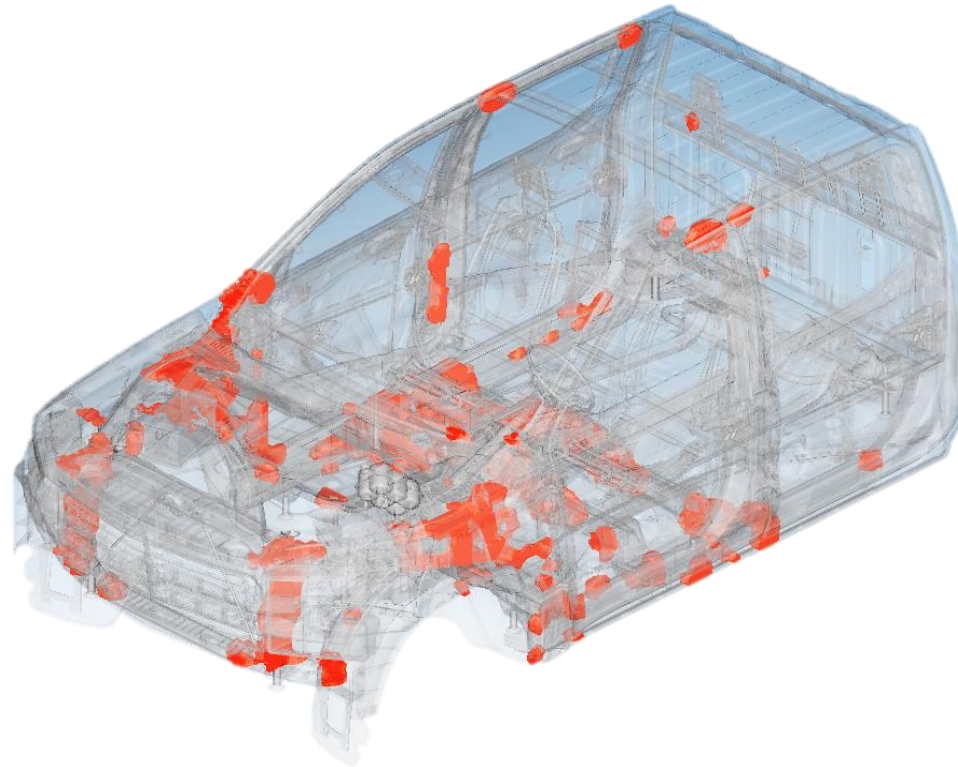
- / Multi-disciplinary optimization CAE procedures were utilized in the development of the cab and frame**
- / Three distinct cycles were completed with differing objectives:**



# 2019 CHEVROLET SILVERADO MASS STRATEGY



- / Multi-disciplinary optimization CAE procedures were utilized in the development of the cab and frame
- / Three distinct cycles were completed with differing objectives:
  - Topological to determine the best load paths

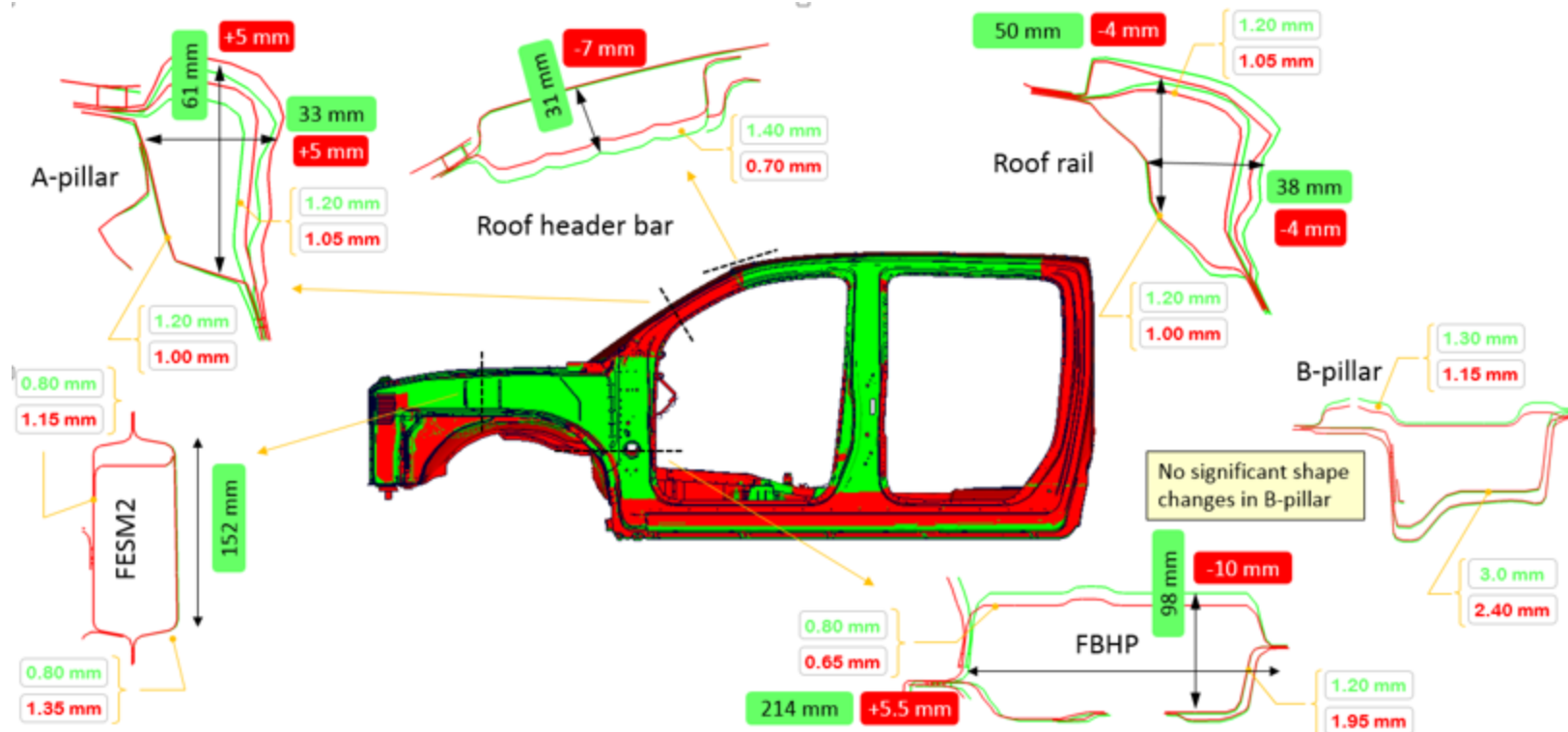




# 2019 CHEVROLET SILVERADO MASS STRATEGY



- / Multi-disciplinary optimization CAE procedures were utilized in the development of the cab and frame
- / Three distinct cycles were completed with differing objectives:
  - Shape optimization to establish the most efficient section sizes within the possible design envelopes

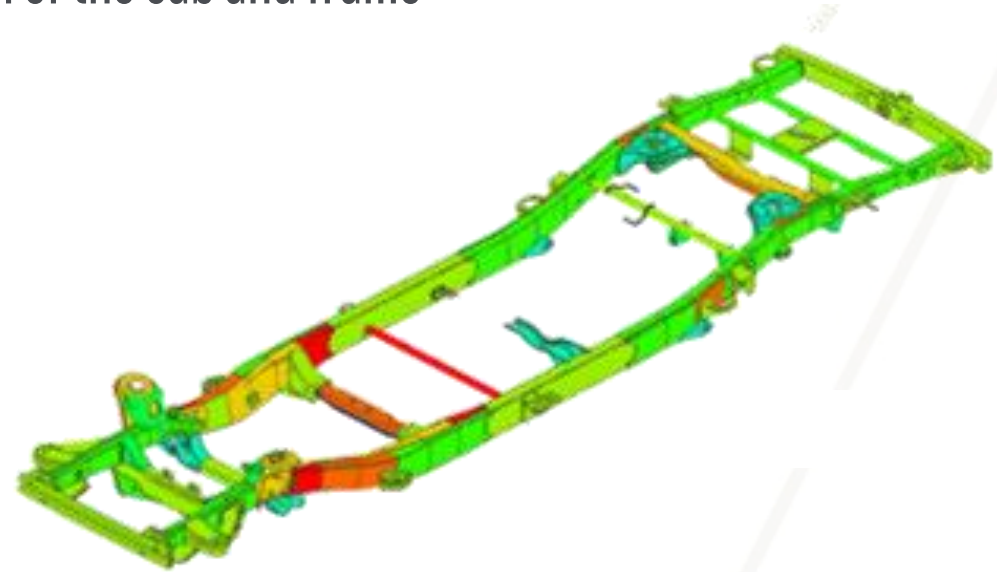
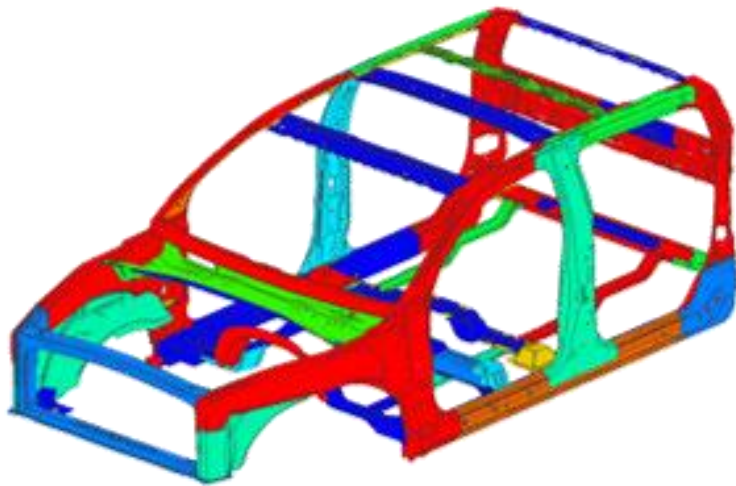




# 2019 CHEVROLET SILVERADO MASS STRATEGY



- / Multi-disciplinary optimization CAE procedures were utilized in the development of the cab and frame
- / Three distinct cycles were completed with differing objectives:
  - Part specific for gauge and material optimization of the cab and frame

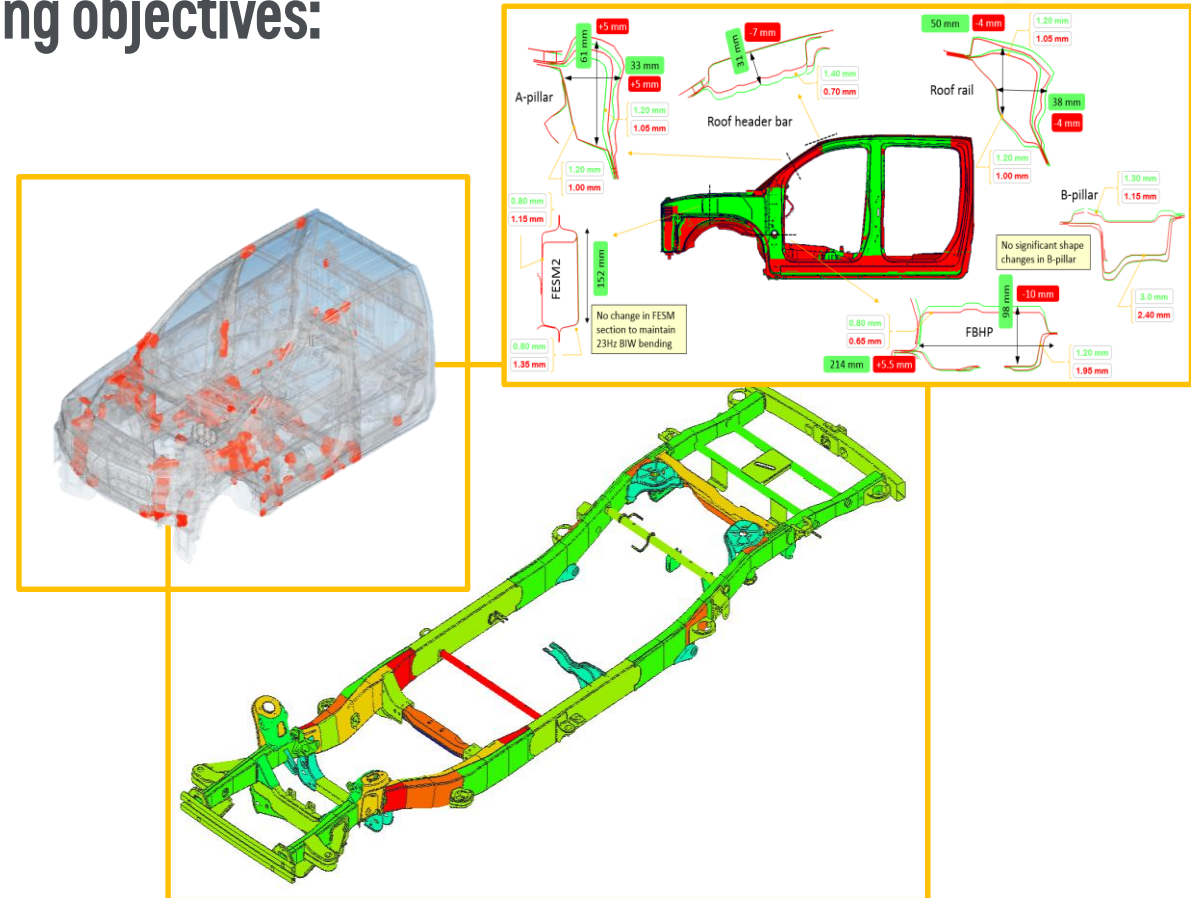




# 2019 CHEVROLET SILVERADO MASS STRATEGY



- / Multi-disciplinary optimization CAE procedures were utilized in the development of the cab and frame
- / Three distinct cycles were completed with differing objectives:
  - Topological to determine the best load paths
  - Shape optimization to establish the most efficient section sizes within the possible design envelopes
  - Part specific for gauge and material optimization of the cab and frame
- / Smaller optimizations conducted on many specific components: grille, door, prop shaft, door mirror patch, rear bumper bracket, etc.



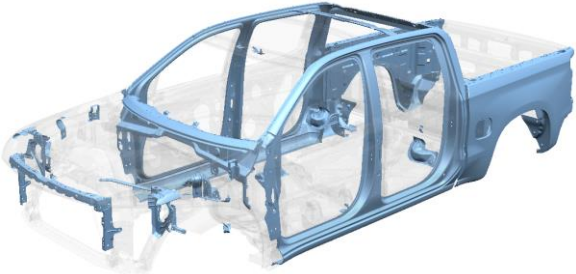
# 2019 CHEVROLET SILVERADO MASS REDUCTION



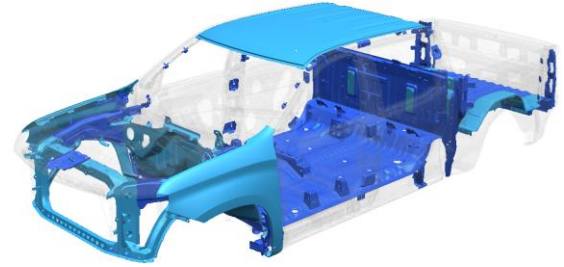
- / Vehicle level mass reduction of 204.5 kg (crew cab)**
- / Painted cab structure mass reduced by 27.2 kg**
  - Cab structure mass reduced by 35.6 kg
  - Aluminum plenum reduced mass by 6.6 kg
  - Liquid applied sound deadener reduced by 1.3 kg
  - Increased sealing for corrosion protection and noise control added 8.9 kg
- / Aluminum closures reduced mass by 42.0 kg**
  - Doors: 31.9 kg
  - Hood : 0.6 kg
  - Tailgate: 9.5 kg
- / Box mass increased less than 1 kg despite size increase.**
- / Frame mass reduced 40 kg**



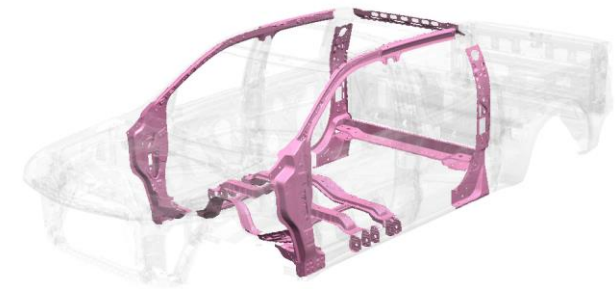
# MATERIAL STRATEGY – CAB WITH CLOSURES AND BOX



Mild Steel



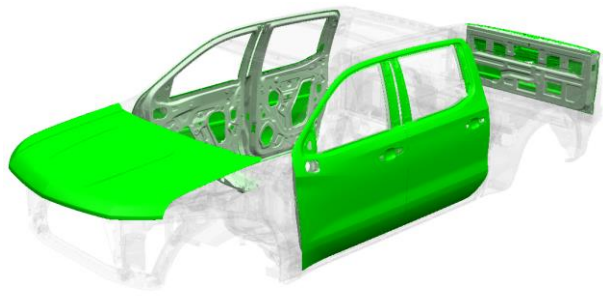
HSLA and Bake Hardenable



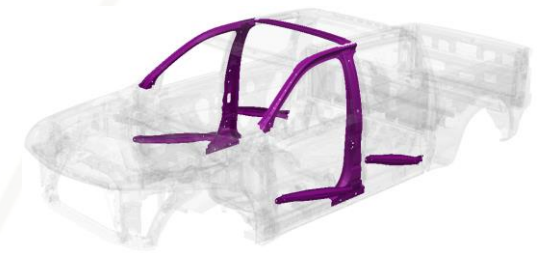
AHSS



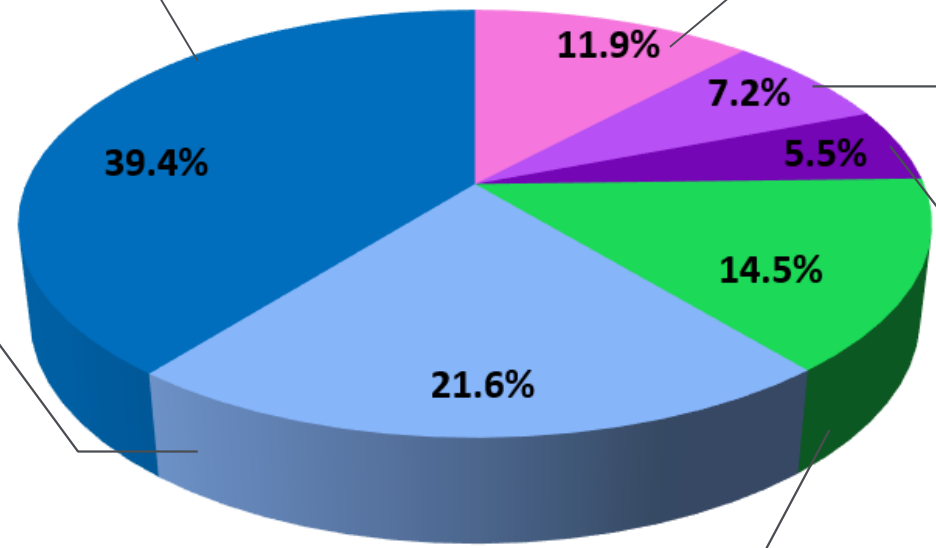
UHSS



Aluminum



PHS







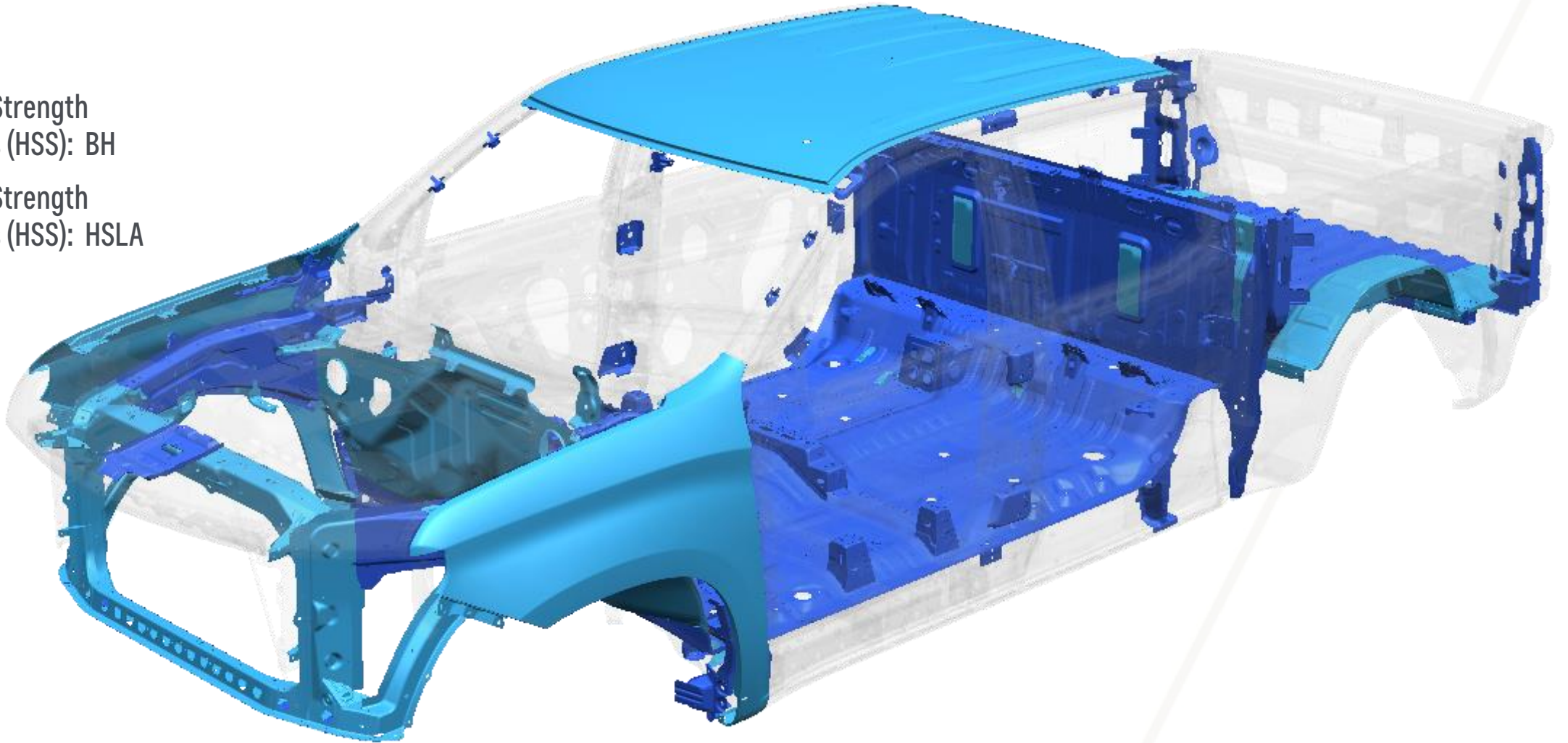


# CAB AND BOX MATERIAL DISTRIBUTION

## 39.4% HSS




-  High Strength Steels (HSS): BH
-  High Strength Steels (HSS): HSLA

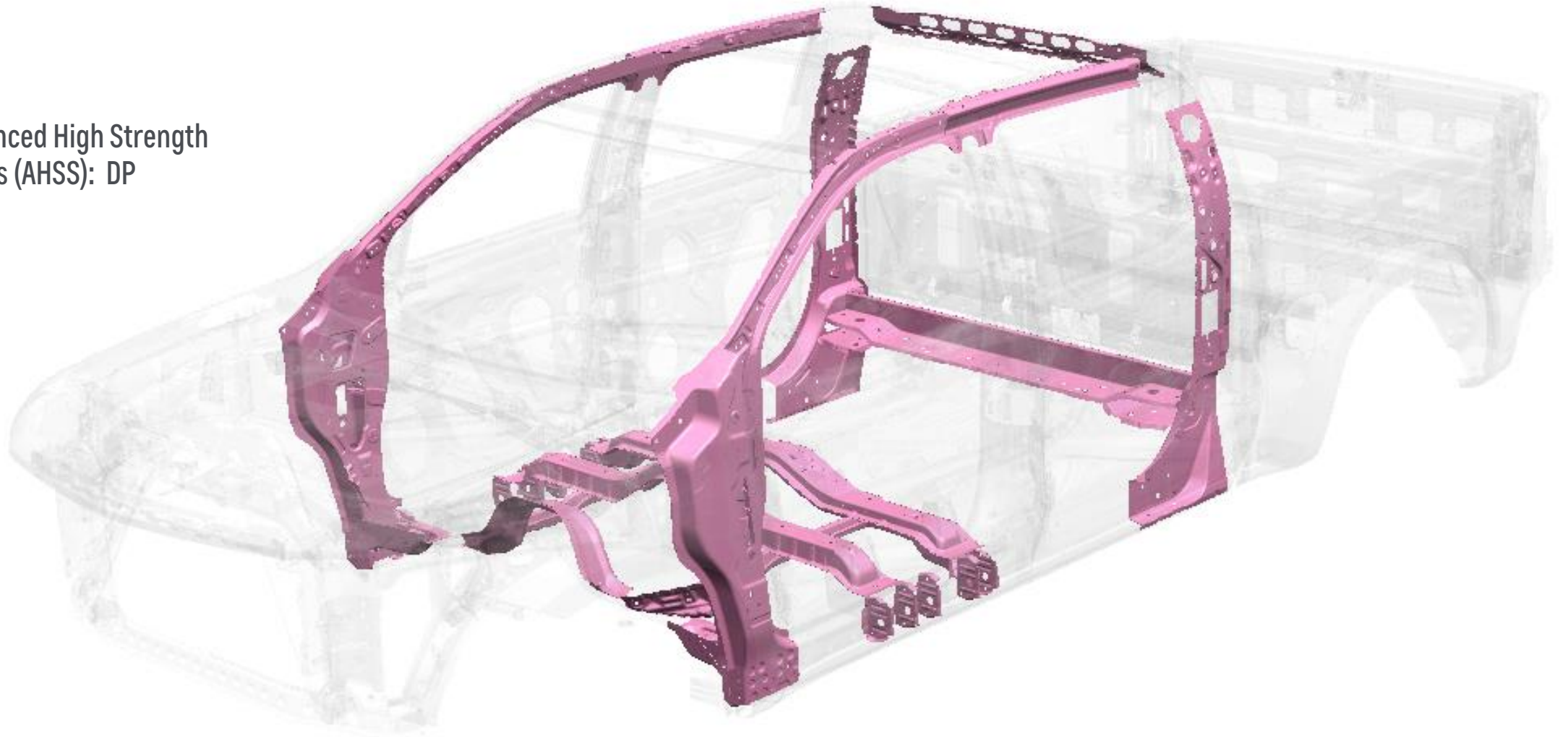


# CAB AND BOX MATERIAL DISTRIBUTION

## 11.9% AHSS



 Advanced High Strength Steels (AHSS): DP







# CAB AND BOX MATERIAL DISTRIBUTION

## 7.2% UHSS



-  Ultra High Strength Steels (UHSS): MP
-  Ultra High Strength Steels (UHSS): MS

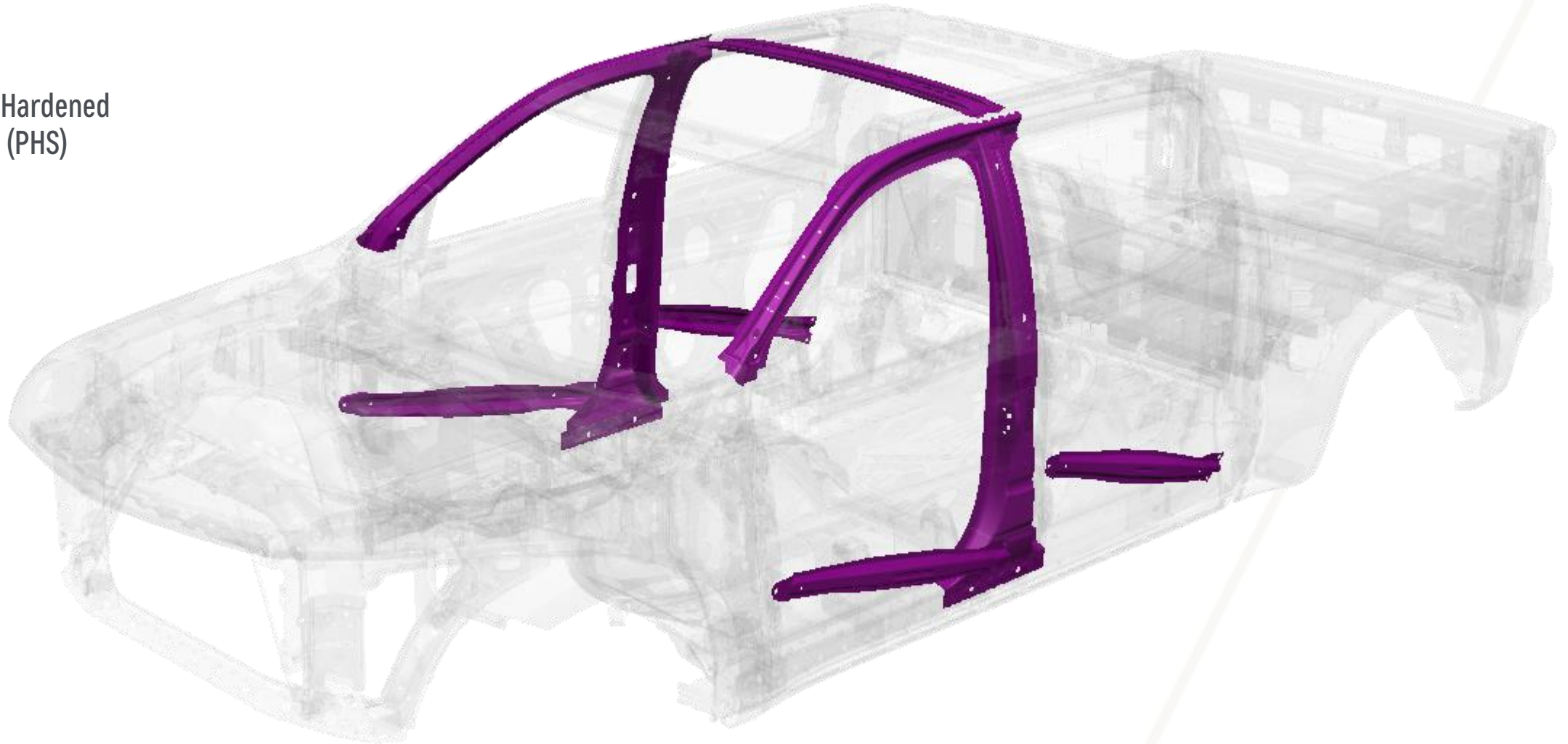


# CAB AND BOX MATERIAL DISTRIBUTION

## 5.5% PHS



 Press Hardened Steels (PHS)





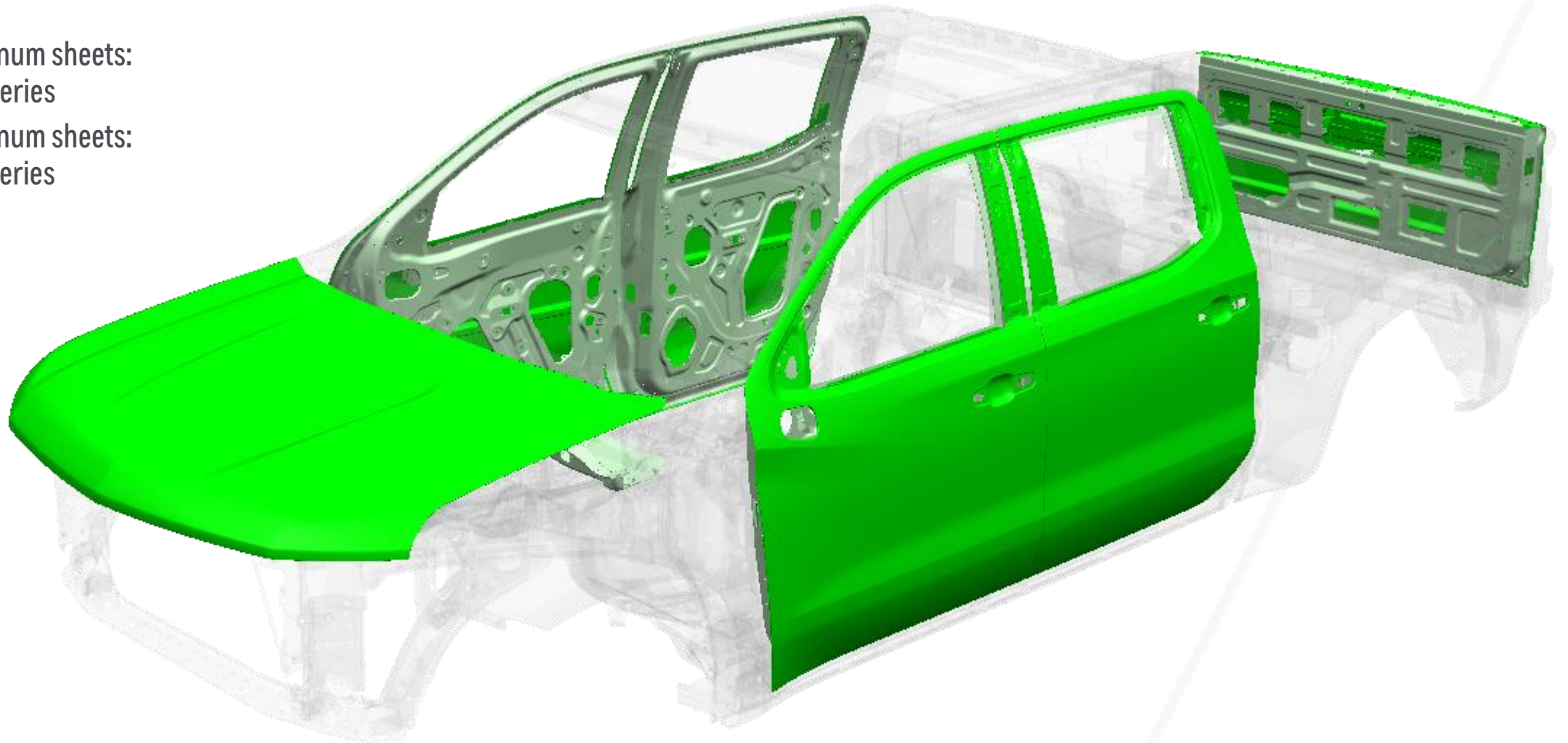


# CAB AND BOX MATERIAL DISTRIBUTION

## 14.5% AL



-  Aluminum sheets:  
6xxx series
-  Aluminum sheets:  
5xxx series



# 2019 CHEVROLET SILVERADO – FRAME MASS STRATEGY



## CAE OPTIMIZATION

### / Mixed materials:

- Higher strength steel grades
- Aluminum for the rear lower control arm cross member

### / Advanced manufacturing technologies:

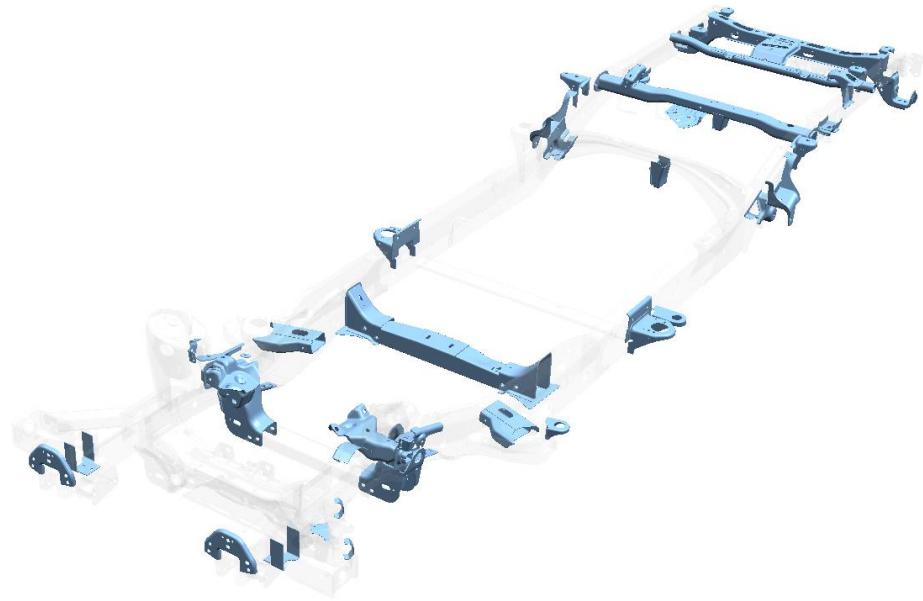
- Allow the use of the advanced steel grades
- Increase part optimization opportunities
  - / Tailor rolled blanks for the rear frame side members
  - / Roll formed front and rear rail tips and mid-rails

### / Design improvements:

- Spare tire support structure
- 2 piece clamshell front rail for better material optimization
- Mid bay cross member
- Improved integration of crash reinforcements



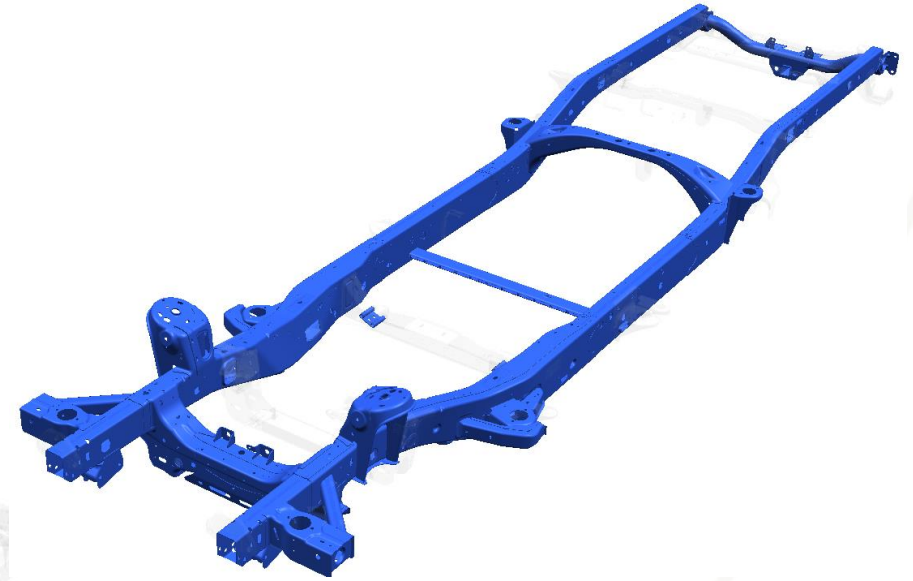
# FRAME MATERIAL UTILIZATION



**Mild Steel**



**Aluminum**

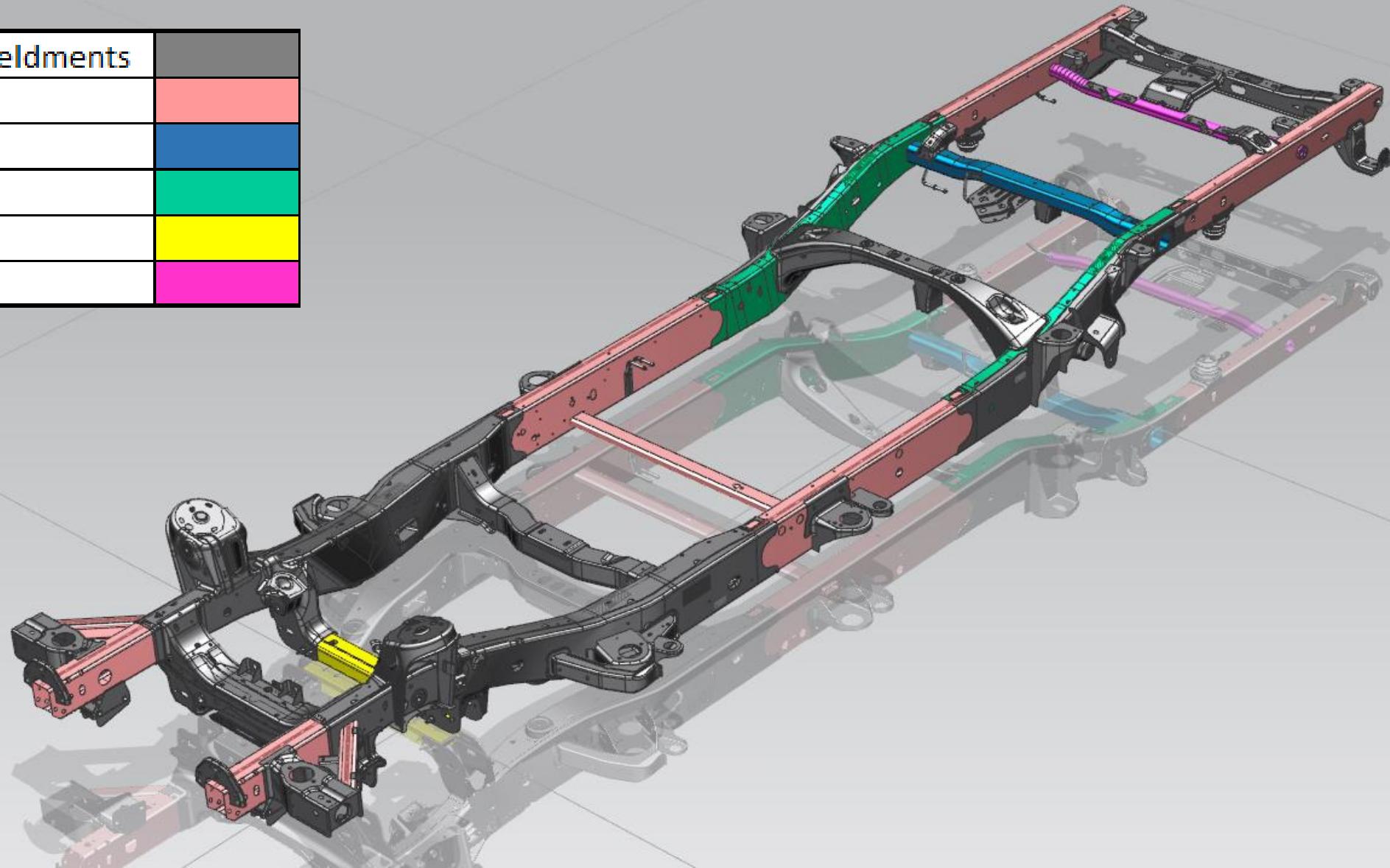


**HSLA**

# FRAME MANUFACTURING PROCESSES



Clamshell Bracketry & Weldments	Grey
Roll Form	Red
Hydroform	Blue
Tailor Rolled Part	Green
Aluminum Extrusion	Yellow
Formed Tubing	Magenta

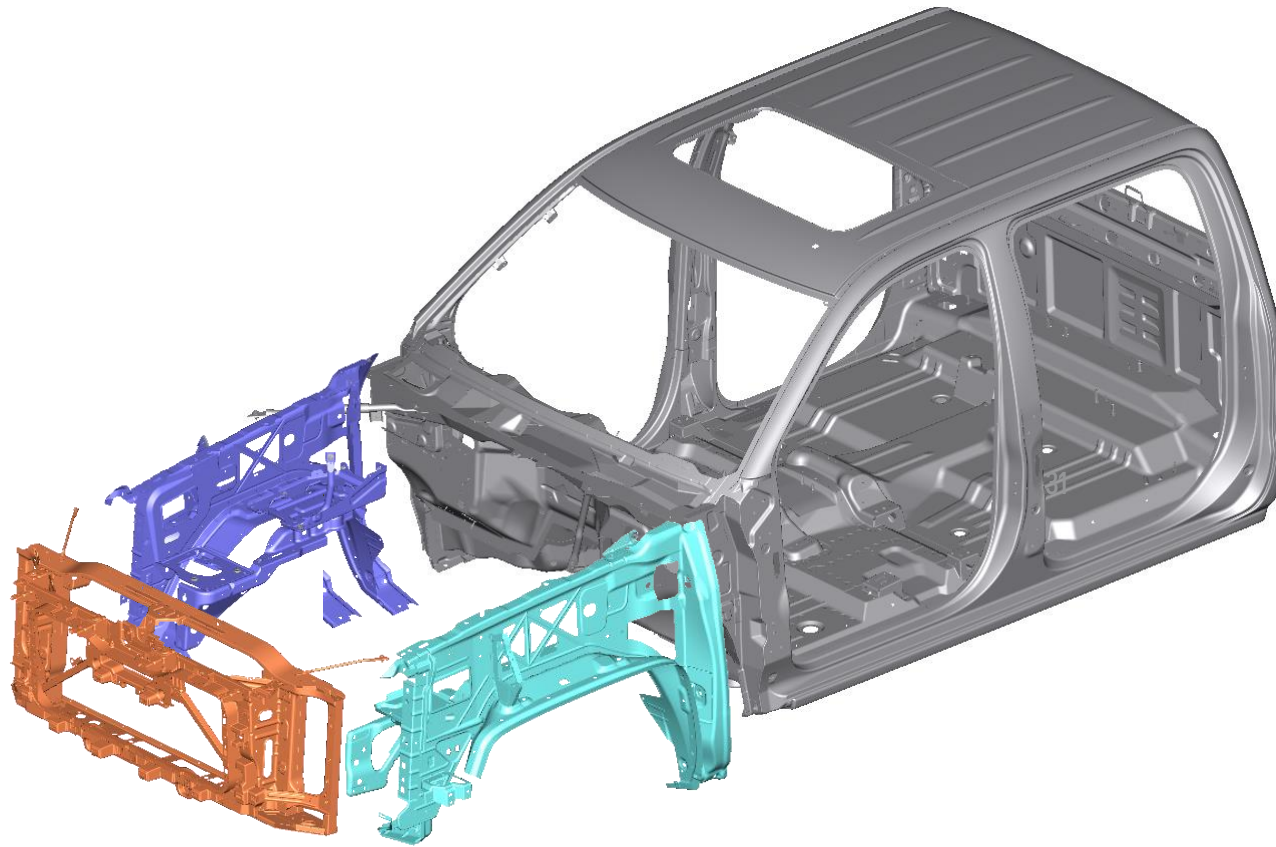




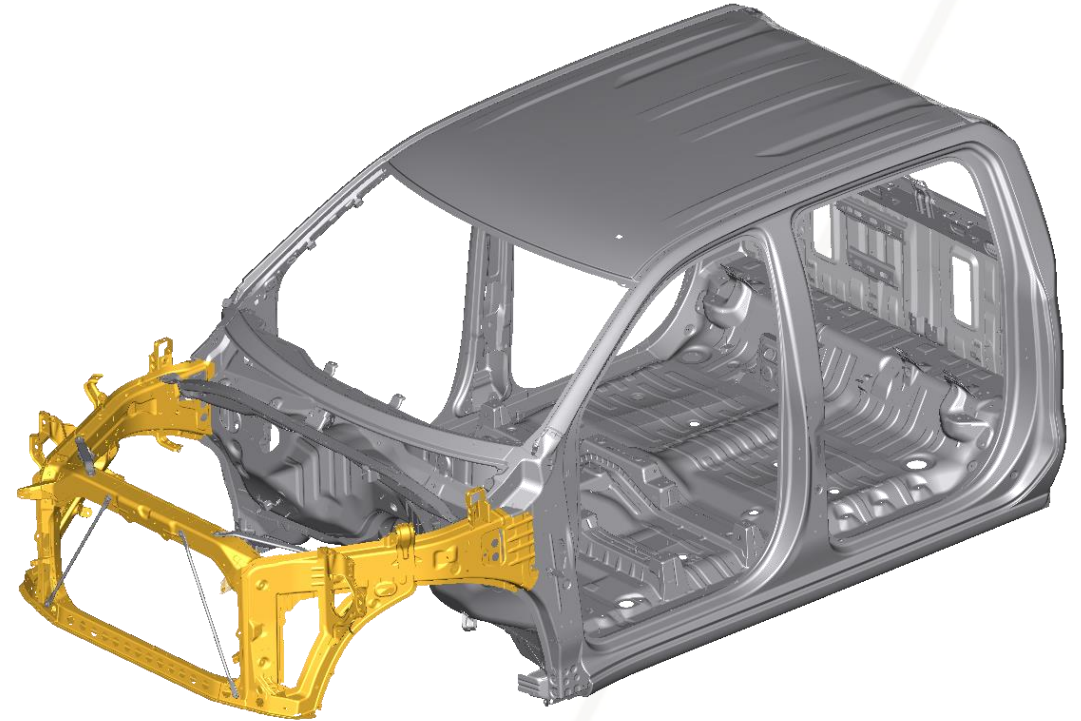
# 2019 CHEVROLET SILVERADO – INTEGRAL FRONT END



2018 Silverado  
Bolted Front Structure



2019 Silverado  
Integral, Welded Structure



# 2019 CHEVROLET SILVERADO – INTEGRAL FRONT END

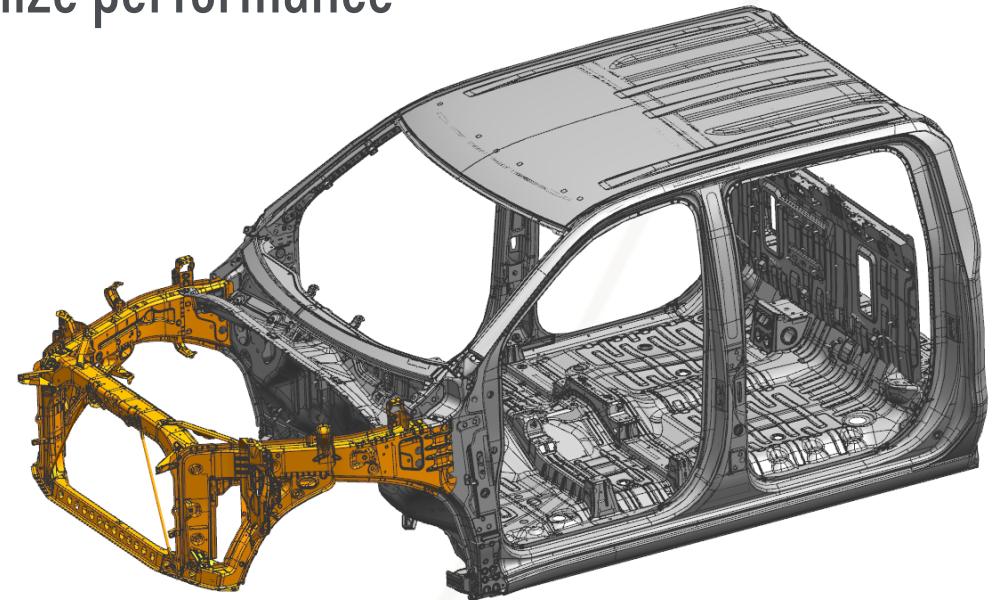


## / Mass savings >15% v. previous generation

- Use of stamped/welded structure v. competitors' tubular hydro-form
- Utilization of thin gauges
  - / Robust sealing strategy for corrosion protection
  - / Extensive use of structural adhesive to maximize performance
- Geometry optimized for ideal load paths

## / Enabled many styling opportunities

## / Strong dimensional capability





# 2019 CHEVROLET SILVERADO – INTEGRAL FRONT END



Metric	Welded Aluminum Front Structure (Alternate solution)	Integral, Welded Steel Front Structure	Bolted Structural Fenders (Current production)
Mass, kg	+	+	Baseline
Piece Cost, \$	+	++	Baseline
Labor / Vehicle, \$	+	+	Baseline
Cost of Mass Reduction, \$	+	+	Baseline
Vendor Tooling, \$ Millions	+	+	Baseline
Manufacturing*, \$ Millions	--	-	Baseline

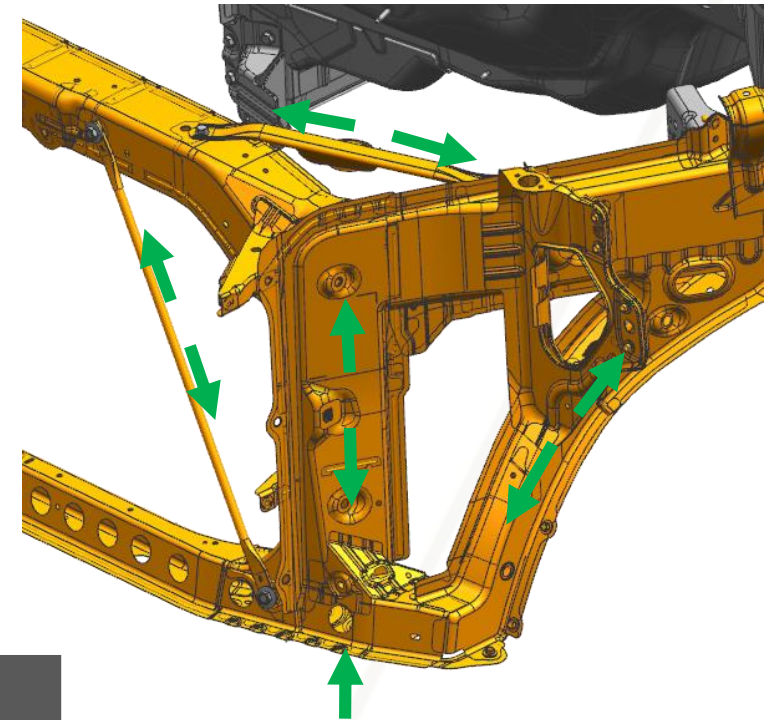
\* Includes Die & Press, Assembly Plant, Containers

# 2019 CHEVROLET SILVERADO – INTEGRAL FRONT END



## Improved dynamic stiffness

- / Out performed competitive benchmark data
- / Allows increased tuning in mount stiffness for better ride and handling
- / Helps to maintain quiet interior cabin



## CAB DYNAMIC PERFORMANCE

	Competitor A (Hz)	Competitor B (Hz)	2019 Silverado (Hz)
FESM Lateral	20.8	19.4	21.8
Global Vertical Bending	15.8	18.4	20.9
Global Torsion	28.5	27.1	29.8



## THE LONGEST LASTING FULL SIZE TRUCK ON THE ROAD

### / Corrosion prevention

- Extensive use of weld through sealer as well as paint shop applied sealer
- Double sealed flanges to prevent water and contaminants from entering either side of the flange
- Areas of high exposure have triple sealing to prevent edge corrosion
- In total, cab sealer and adhesive was increased by 8.9 kg compared prior year
- Significant addition of structural adhesive for sealing and durability improvement: ~34 m

### / Improved cab sealing enhances corrosion resistance and reduces airborne noise

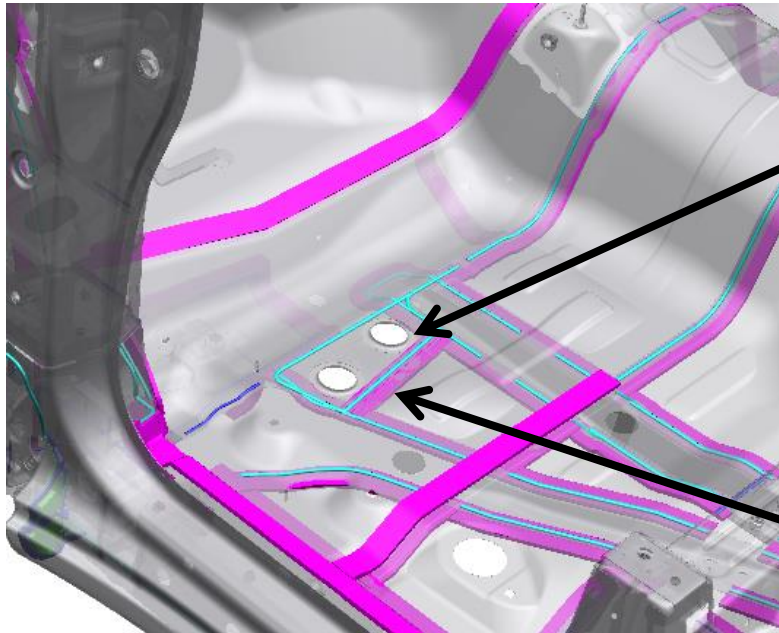
# 2019 CHEVROLET SILVERADO – SEALING STRATEGY



## / Motor-compartment is double sealed

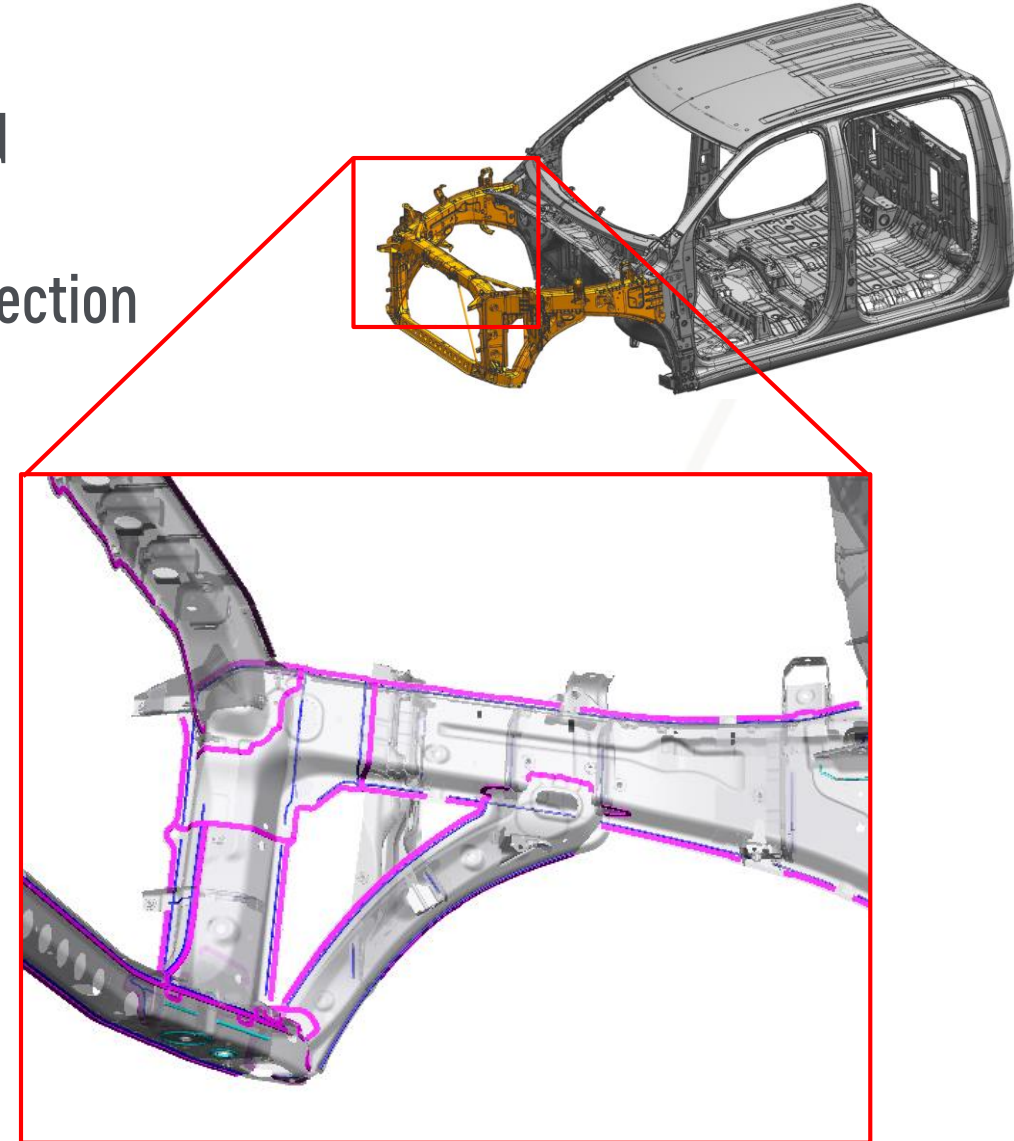
- Adhesive in weld flanges for corrosion protection and increased stiffness
- Increased paint shop sealer for added corrosion protection

## / Fully boxed out panel overlaps



Surface boxed out with weld through sealer

Paint shop sealer to protect from water intrusion into flange

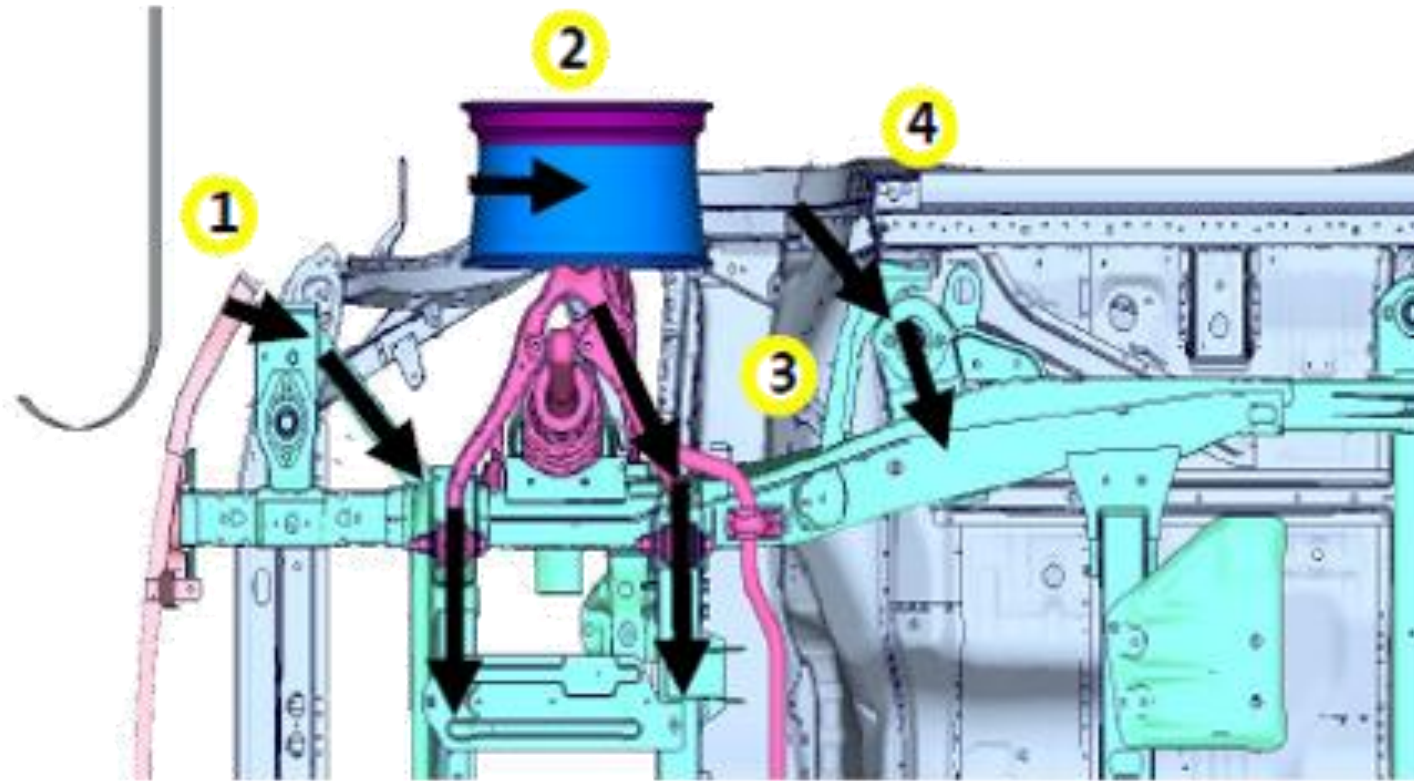




# 2019 CHEVROLET SILVERADO – SMALL OFFSET CRASH STRATEGY



1. Early engagement of the barrier by frame components to absorb energy and begin to deflect the vehicle away from the barrier
2. Control wheel kinematics with chassis tuning and body and frame blockers
3. Absorb energy through the frame to body mount
4. Provide strong back up structure in the cab to reduce intrusion



# 2019 CHEVROLET SILVERADO – SMALL OFFSET CRASH COUNTER MEASURES



**/ Frame reinforced and braced to increase energy absorption early in the event and create lateral velocity**



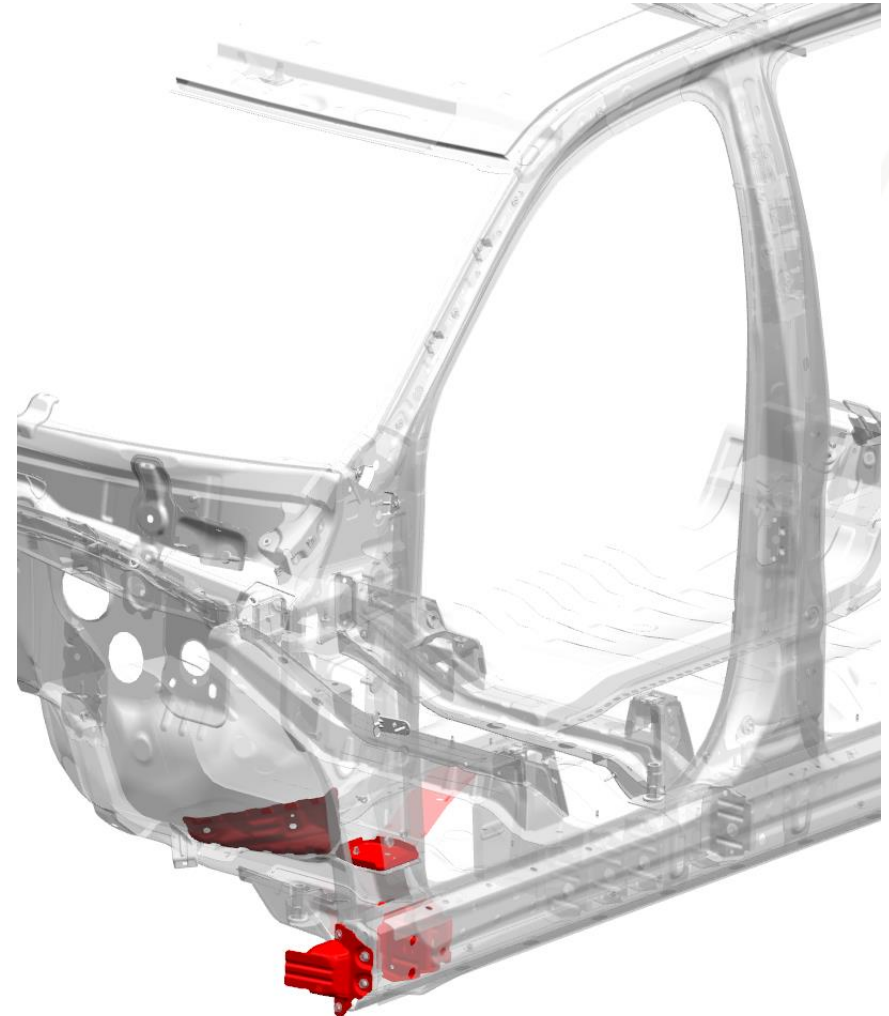
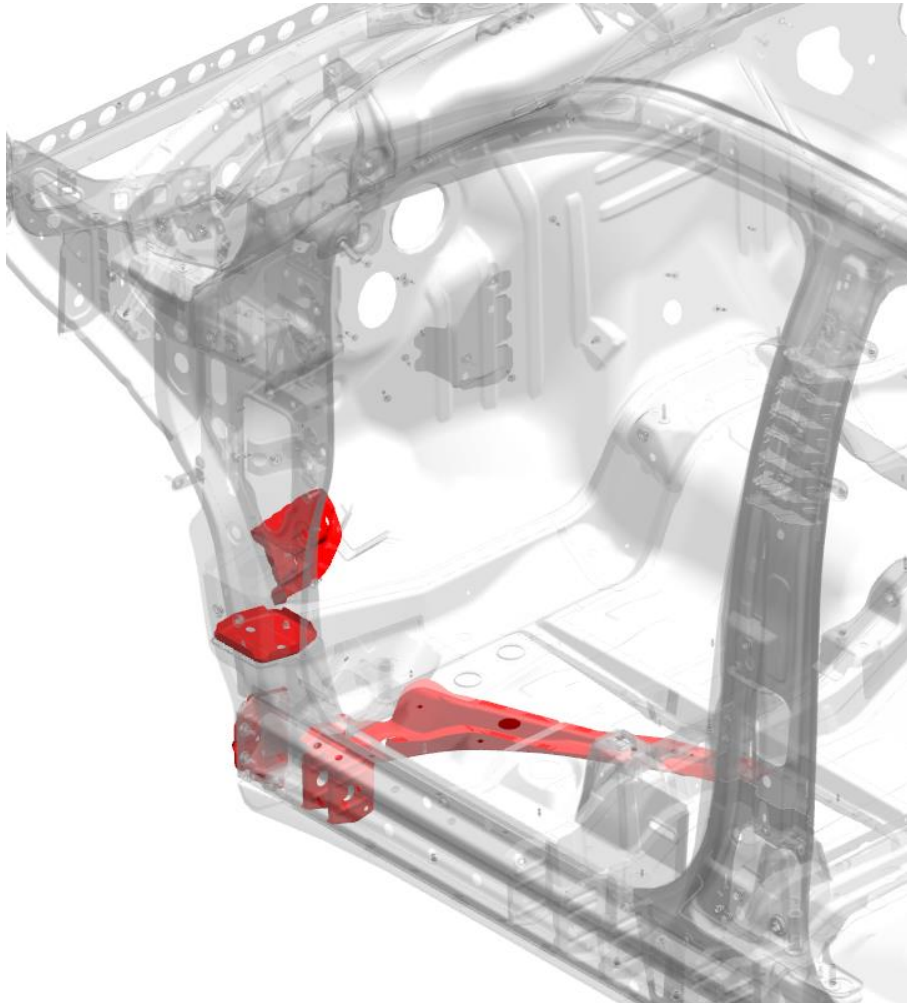
**/ Frame and body mount structure designed to allow tire rotation and absorb energy**



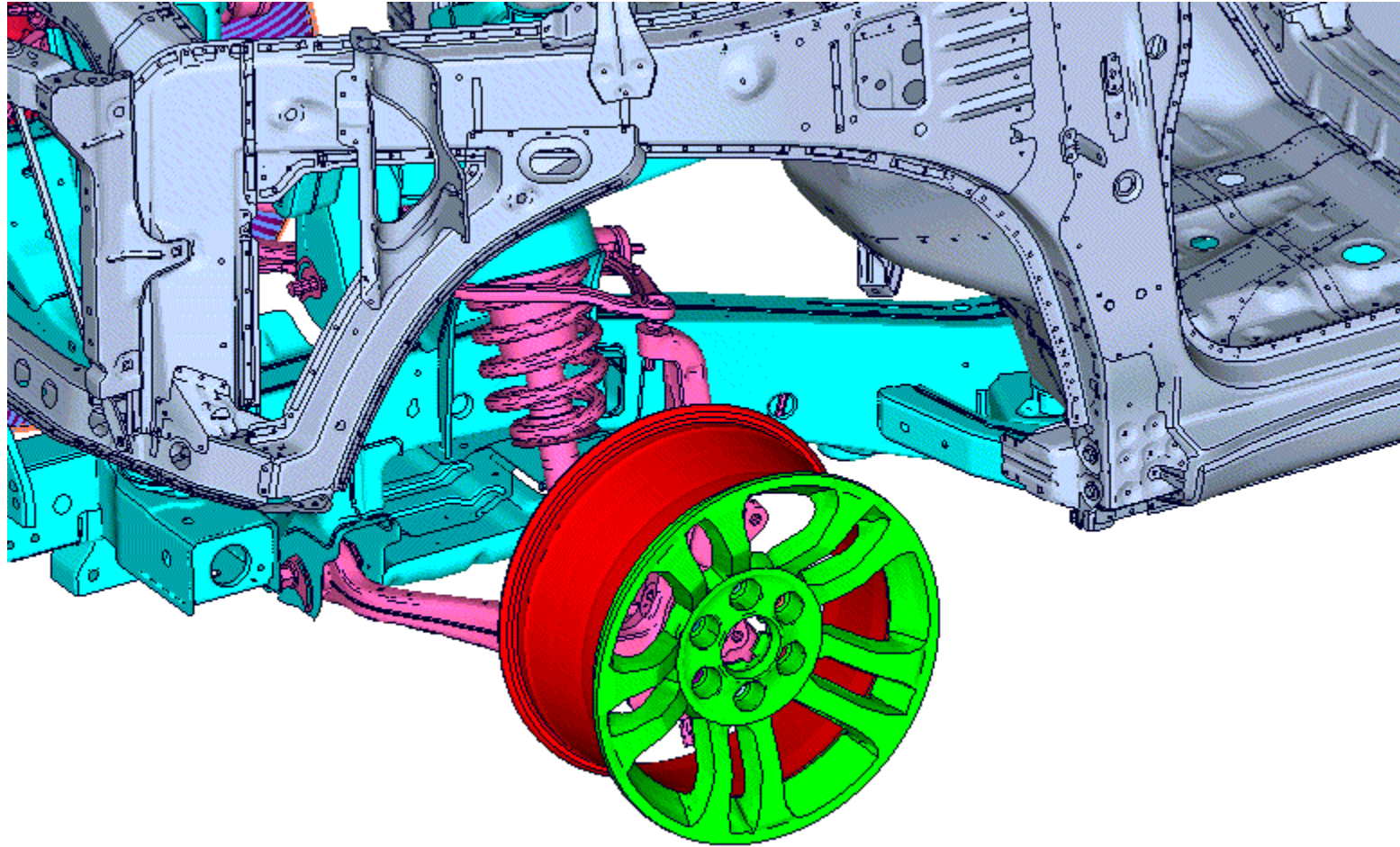
# 2019 CHEVROLET SILVERADO – SMALL OFFSET CRASH COUNTER MEASURES



/ Cab structure reinforced to control deformation in the toe pan and rocker area.

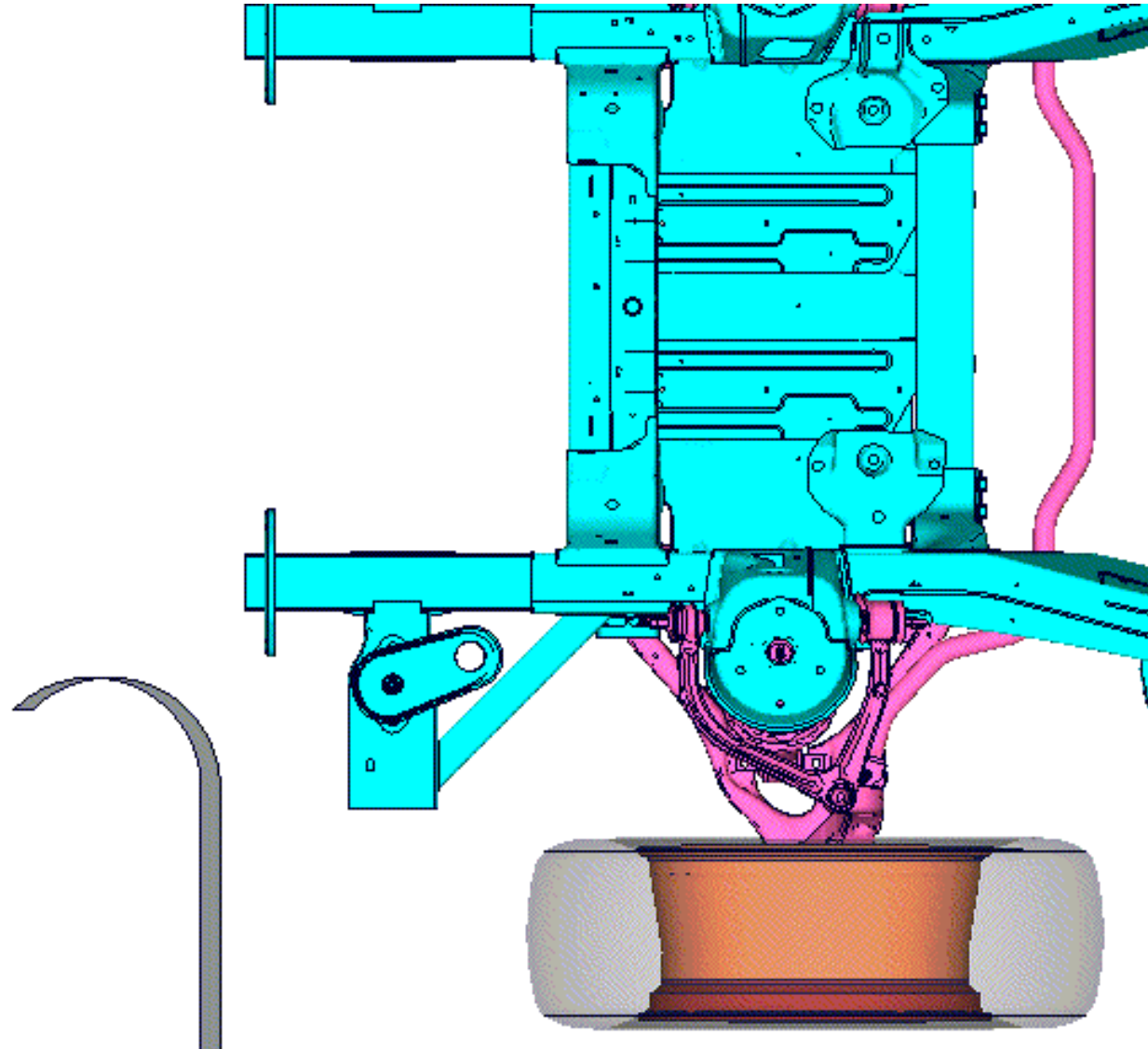


# 2019 CHEVROLET SILVERADO – SMALL OFFSET CRASH COUNTER MEASURES





# 2019 CHEVROLET SILVERADO – SMALL OFFSET CRASH COUNTER MEASURES



# 2019 CHEVROLET SILVERADO – UPPER BODY STRUCTURE MASS REDUCTION

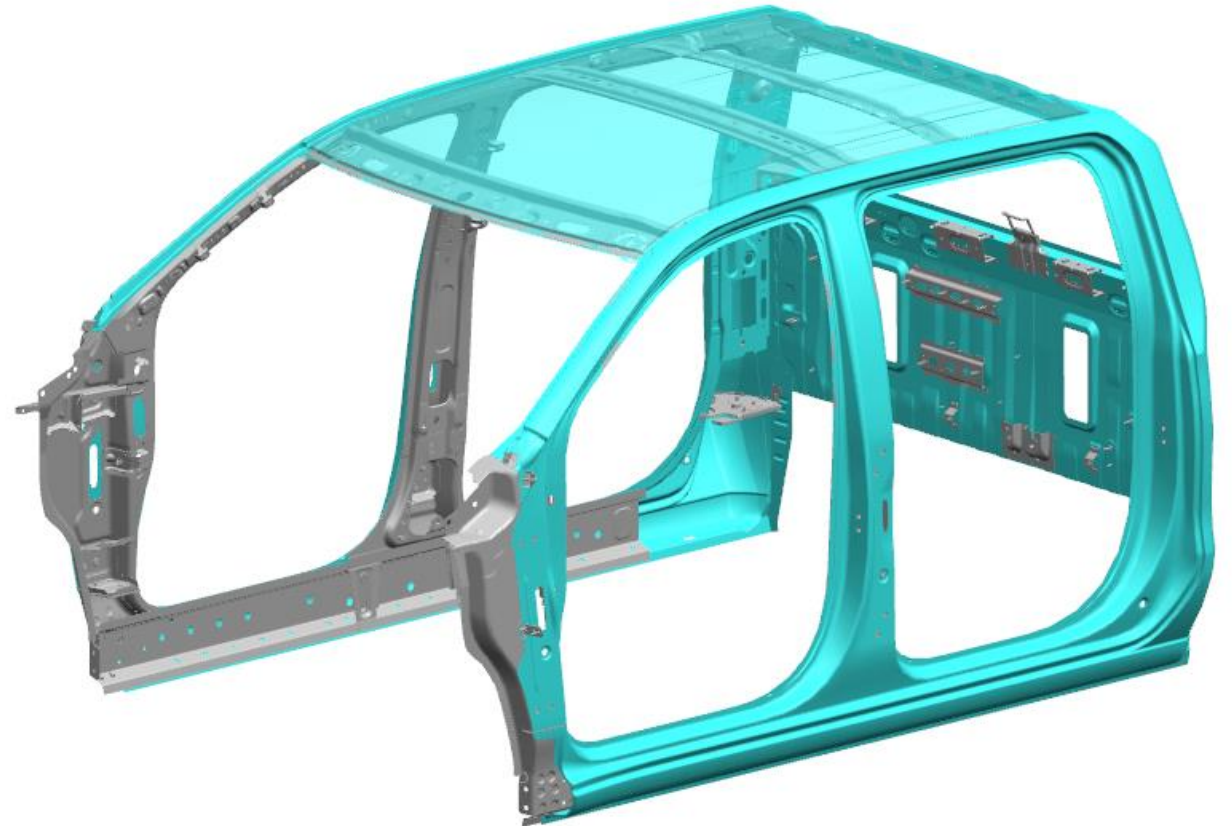


**GAUGE REDUCTIONS: 4.4 kg**

**/ All cab outer panels**

**/ Enabled by:**

- Panel shape optimization
- Bake hardenable roof
- HSLA cab back
- Increased experience with thin materials



**NOTE**

2019 Bodyside panel:  
56 mm longer  
75mm taller

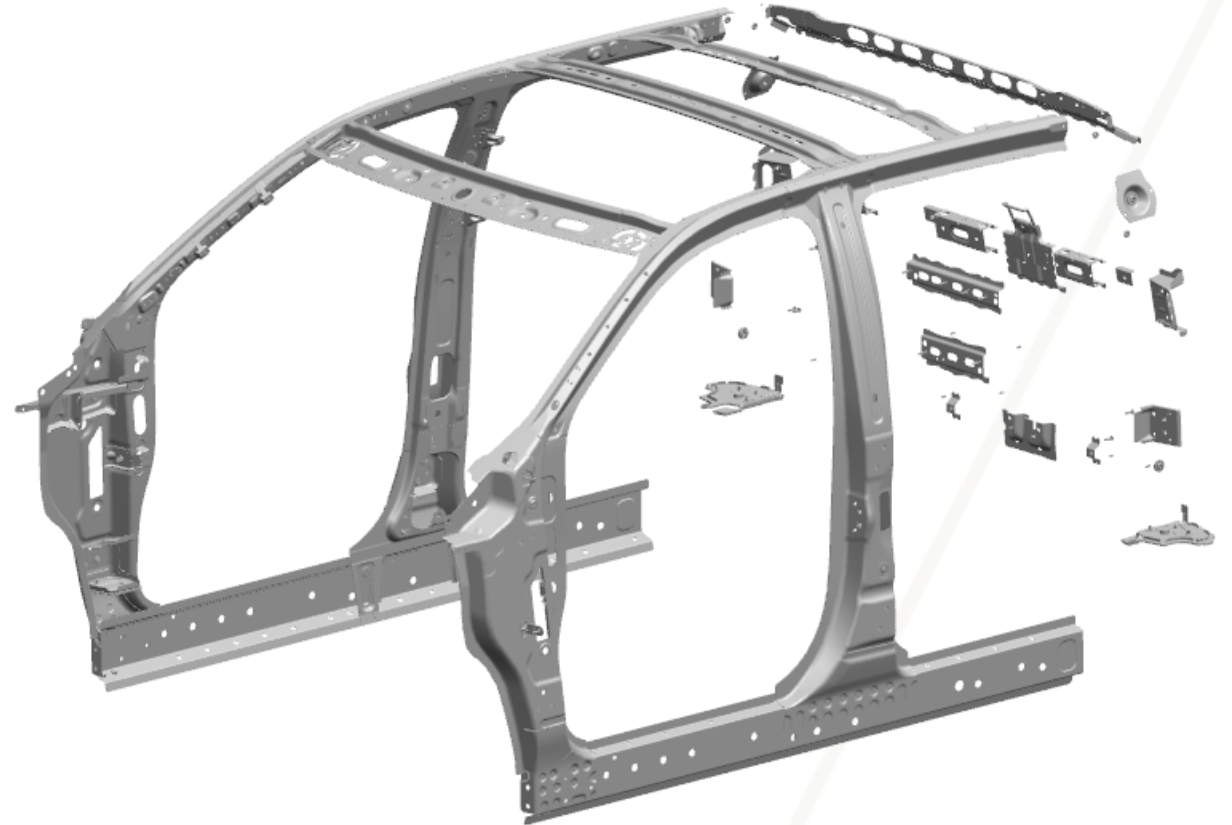


# 2019 CHEVROLET SILVERADO – UPPER BODY STRUCTURE MASS REDUCTION



## DESIGN OPTIMIZATION: 16.6 kg

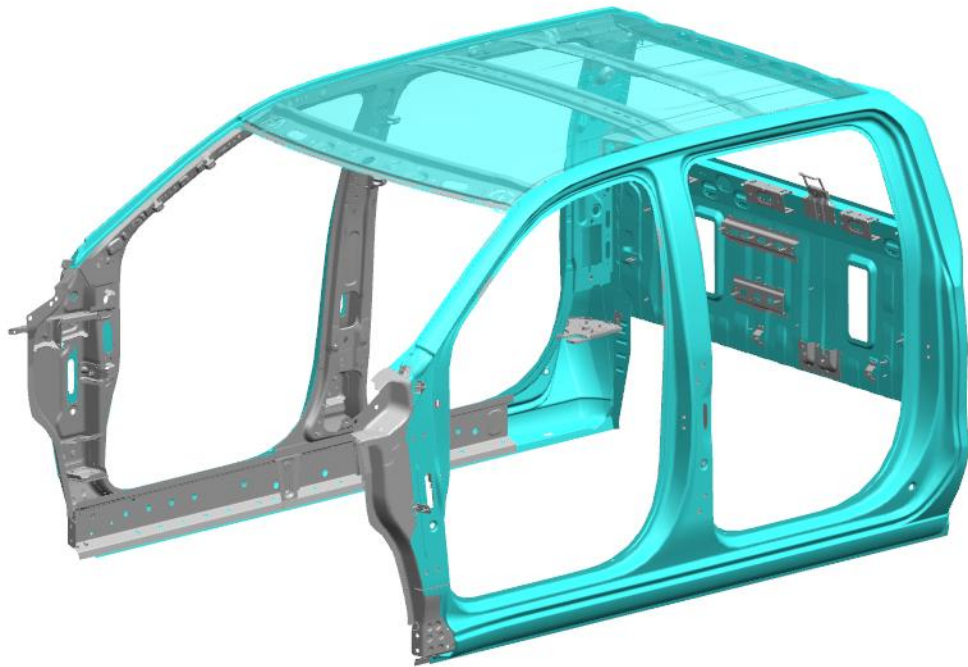
- / Expanded use of AHSS
  - MP 1180 rocker outer
  - MS 1500 rocker reinforcements
- / More efficient rocker and A-pillar designs
- / Tailor rolled center pillar reinforcement
- / Mass efficient cabin boom mitigation



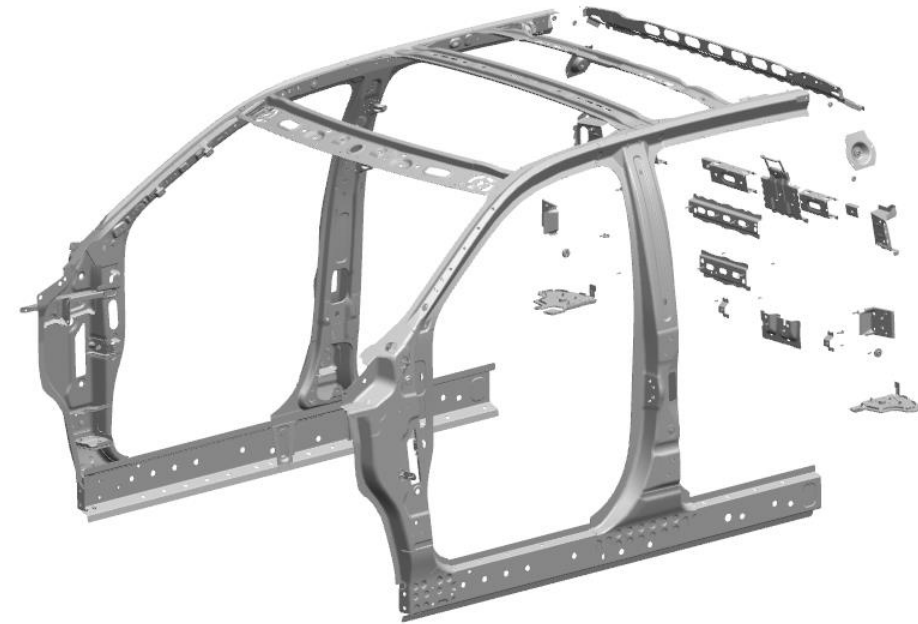
# 2019 CHEVROLET SILVERADO – UPPER BODY STRUCTURE MASS REDUCTION



GAUGE REDUCTIONS: 4.4 kg



DESIGN OPTIMIZATION: 16.6 kg



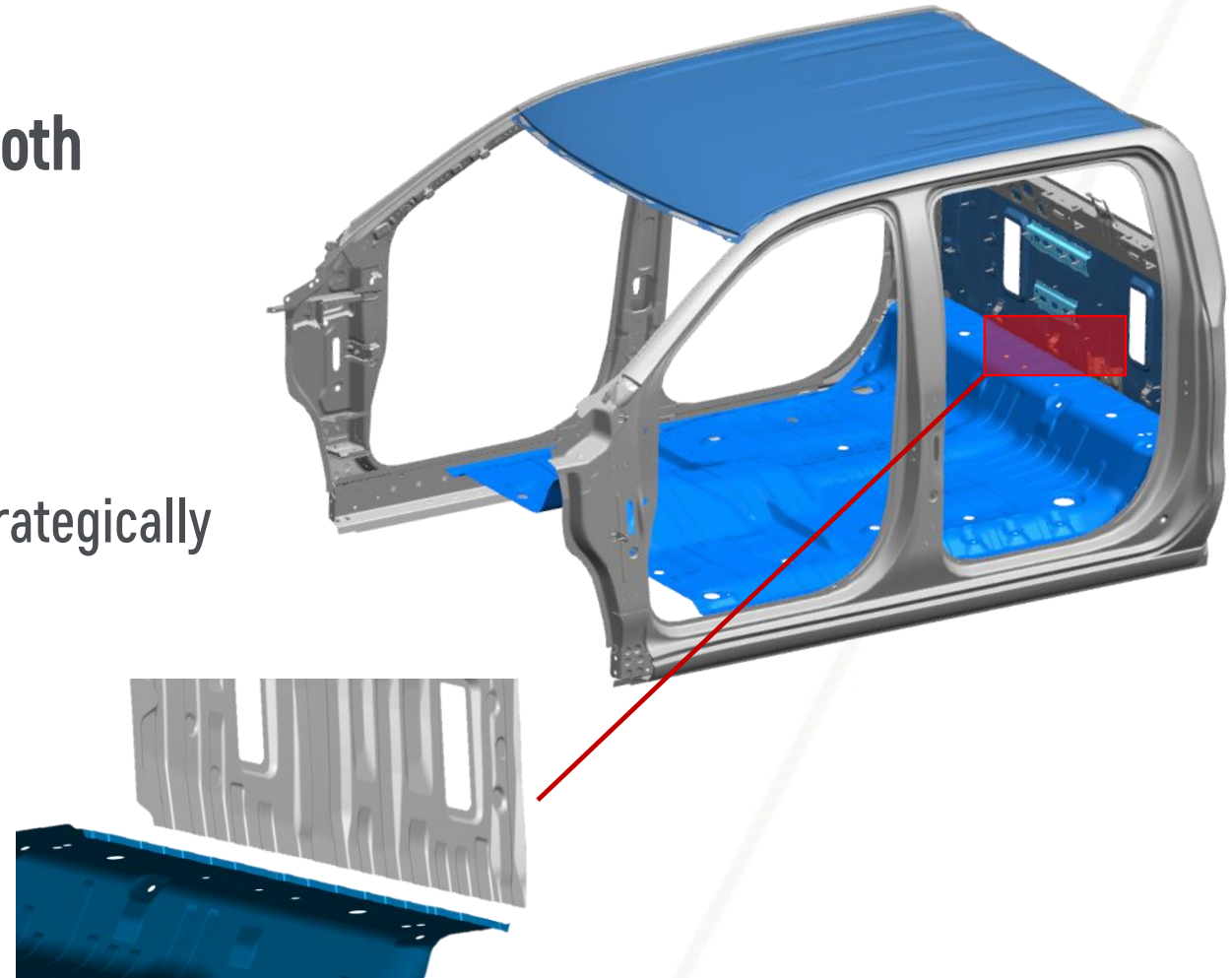
**TOTAL MASS SAVINGS : 21 Kgs**

# 2019 CHEVROLET SILVERADO – UPPER BODY STRUCTURE MASS REDUCTION



## CABIN BOOM

- / Developed new analytical tools to assess both powertrain and road induced boom
- / Modeling identified the need for:
  - Optimized roof, cab back and floor shapes
  - Interlocked floor to cab panel beading
  - Multi-functional cab back reinforcements strategically located and designed for boom reduction
- / No tuned absorbers or header masses required
- / Liquid applied sound deadener reduced

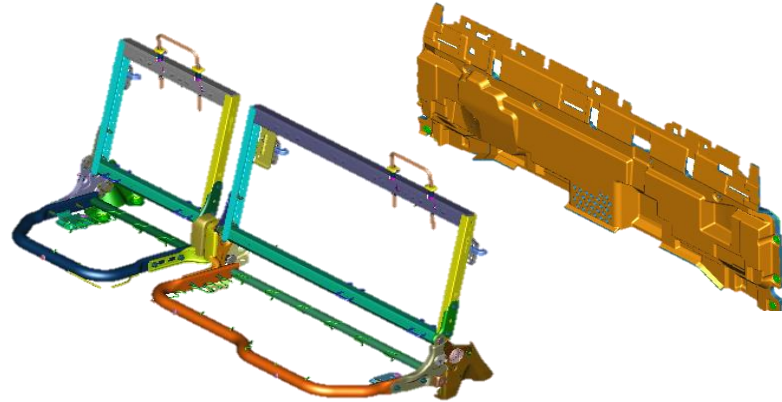




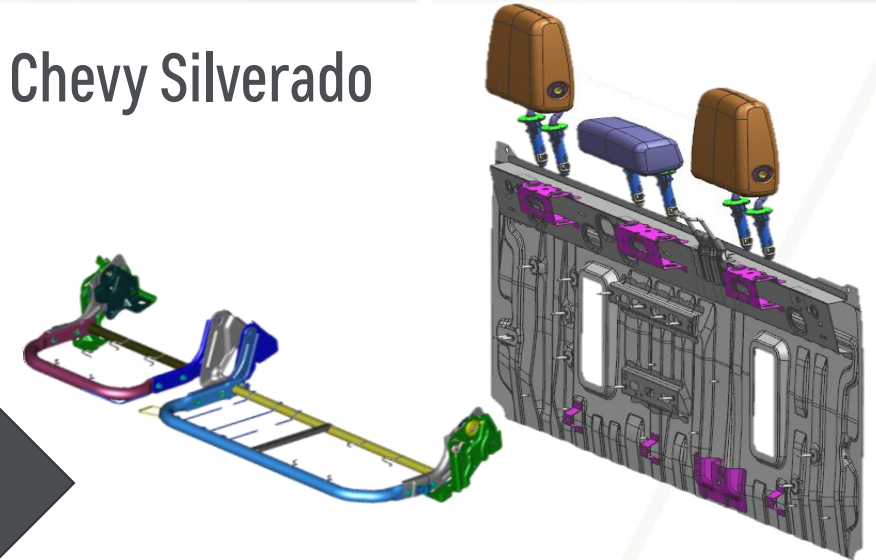
# 2019 CHEVROLET SILVERADO – INTEGRATED SEAT BACK STRUCTURE



2018 Chevy Silverado



2019 Chevy Silverado



Integrated seat back  
structure into BIW

- / Child seat anchor and head rest loads carried by seat structure
- / Separate acoustic panel for NVH performance

- / Child seat anchor and head rest loads carried by body structure
- / NVH performance managed by seat foam

**SYSTEM MASS SAVINGS : 16 Kgs**



# 2019 CHEVROLET SILVERADO PICK UP BED



**THE MOST  
FUNCTIONAL BED  
OF ANY FULL-SIZE  
TRUCK**



# 2019 CHEVROLET SILVERADO – INCREASED BED FUNCTIONALITY



- / 23% more storage space:  
63 cu ft., Best-In-Class short bed
- / Bed is 2" taller, 1" longer and  
6.75" wider
- / 21 fixed tie downs: 8 more than  
in 2018, pullout force doubled



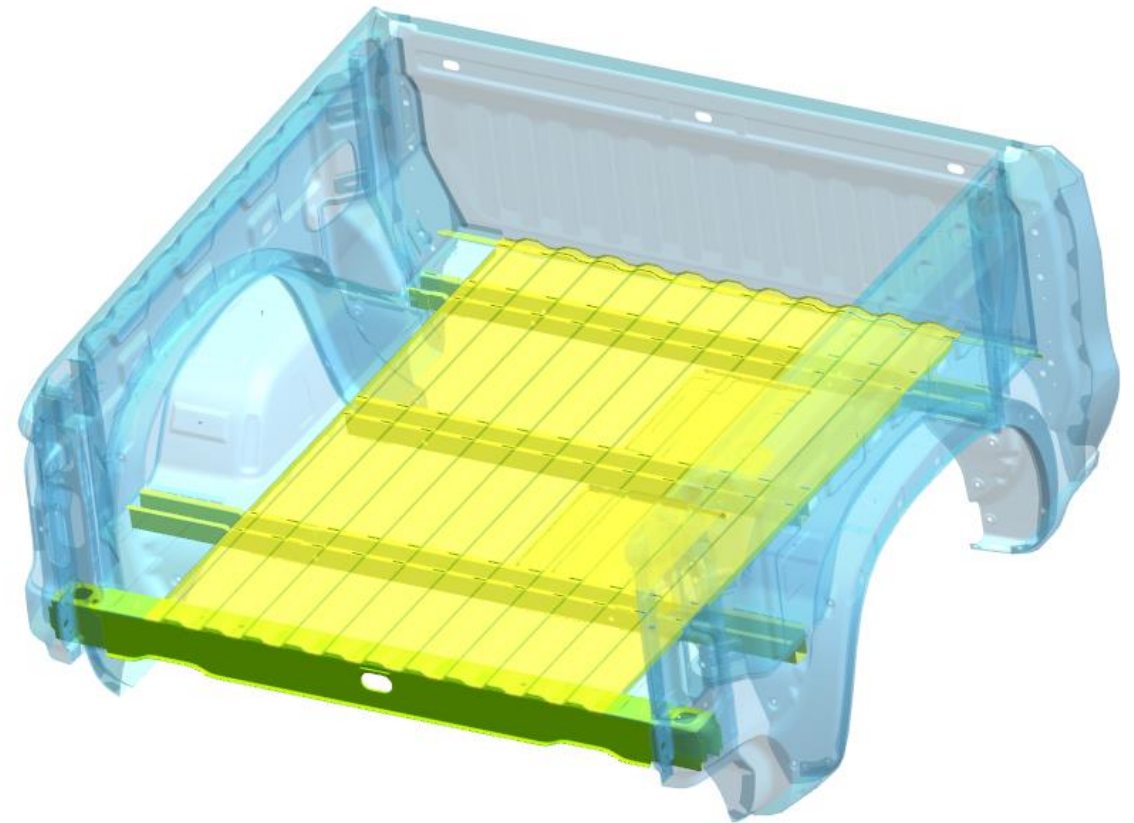


# PLATFORM OPTIMIZATION



Mass increase less than 1 kg  
with larger bed

- / Platform gauge reduced from .95 to .85 mm
- / Material strength increased: HSLA 500
- / Corrugation geometry improved
- / Sill section shape optimized



# 2019 CHEVROLET SILVERADO BED PERFORMANCE



**PUNCTURE AND IMPACT PERFORMANCE  
EQUIVALENT TO THE 2018 SILVERADO!**





# SILVERADO PICK UP BED – ADDITIONAL FEATURES

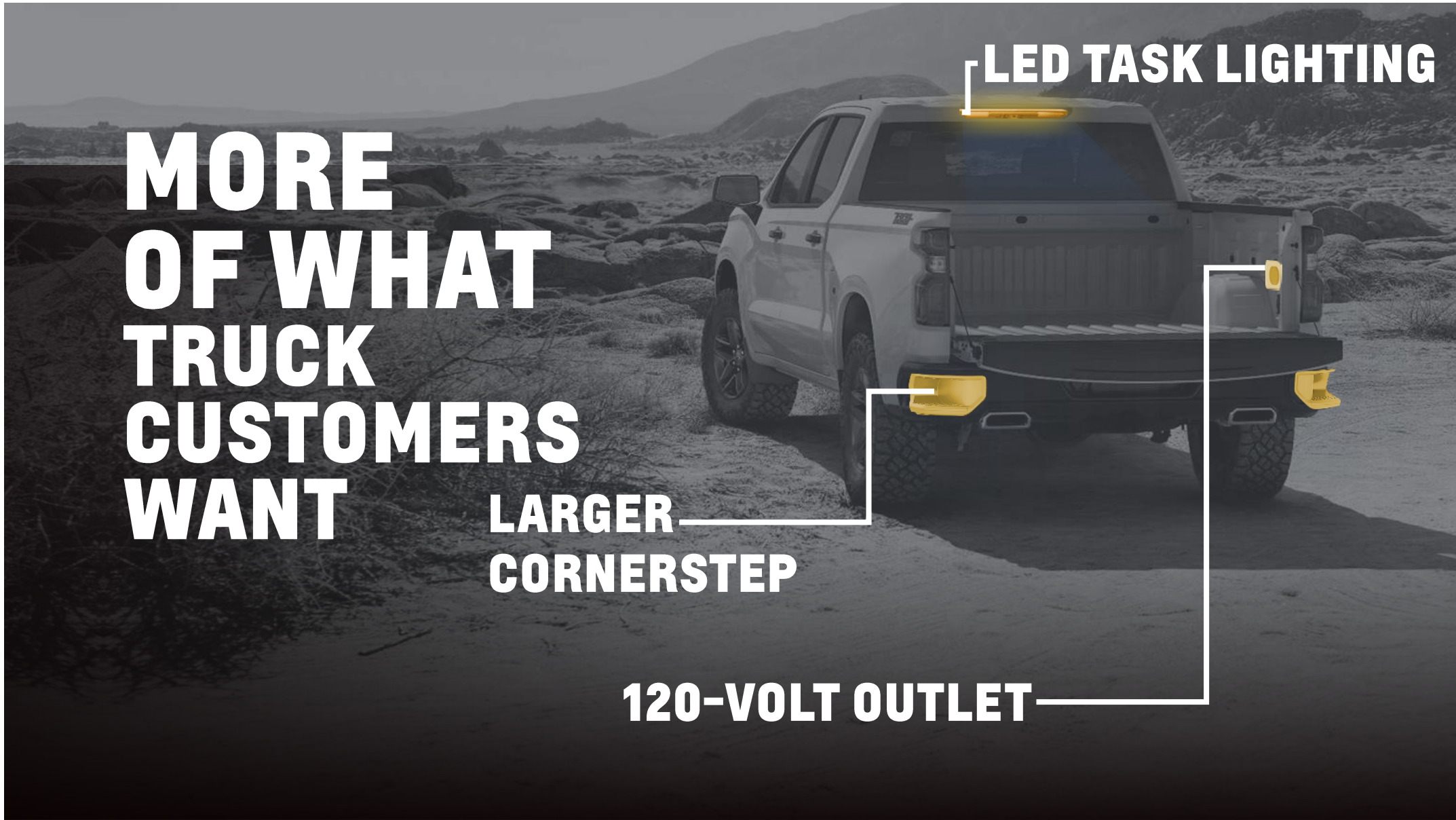


**MORE  
OF WHAT  
TRUCK  
CUSTOMERS  
WANT**

**LED TASK LIGHTING**

**LARGER  
CORNERSTEP**

**120-VOLT OUTLET**







# INDUSTRY-FIRST POWER TAILGATE





# THE ALL-NEW 2019 SILVERADO



*THANK YOU FOR YOUR ATTENTION!*