2015 Acura TLX Body Structure Review

Aron Madsen
Principal Engineer
Cabin Technical Expert
Upper Body Design

Honda R&D Americas, Inc.
History of the Acura TL Sedan

1st Gen - 1996

2nd Gen - 2000

3rd Gen - 2004

4th Gen - 2009
History of the Acura TL Sedan

Honda R&D Americas, Inc.
Concept, Package & Styling
Torrance, California

Honda R&D Americas, Inc.
Design, Development & Testing
Raymond, Ohio

Honda of America Manufacturing, Inc.
Vehicle Production
Marysville, Ohio

Since 1998
Concept and Package

2015 TLX
Acura Dynamic Concept

SYNERGY

MAN

MACHINE

work → response

feedback ←

input →
2015 Acura TLX Concept

Balance of Performance and Luxury

Magnetic
Dynamic Design

Engaging Driving Experience

Intuitive Interactive Experience

RED CARPET ATHLETE

Balance of Performance and Luxury

Magnetic
Dynamic Design

Engaging Driving Experience

Intuitive Interactive Experience

RED CARPET ATHLETE
2015 Acura TLX Concept

PROPORTION

PRESTIGE

PERFORMANCE
Acura Sedan Proportion Hierarchy

PROPORTIONS that Offer an *Invitation*

to Acura Performance & Prestige

(Widener)

(ILX)

(TSX)

(TL)

(Discontinued)

(RLX)

(179.1 185.6 190.3 194.0 196.1)

(inches)

Steel Matters - Demand Nothing Less

www.autosteel.org
Proportion Changes

“Right Size” Package

Dynamic Proportion

- 0.5 inch*

-1.0 inch*

(Width = 73 inches)

* Compared to Outgoing TL
Proportion Changes

“Right Size” Package

- 1.1 inches*

Dynamic Proportion

- 2.7 inches*

* Compared to Outgoing TL
Proportion Changes

NO Sacrifice to Luxury Space

Outgoing TL
(Outgoing TSX + 2.8 Inches)

Outgoing TL
(Outgoing TSX + 1.8 Inches)
Proportions for Performance

Low Wide Stance
Sloping Low Hood
Proportions for Performance

Fast Rearward Cabin
Short Rear Deck

Pushing Through Fenders
Aerodynamic Design

Designed Using CFD, Scale Tunnel & Real-world Coast-down

Best in Class $C_D^*A$

Frontal Area*

$-1.5\%$

15% Lower $C_D^*A$
Compared to 12M TL

* Compared to Outgoing TL

[ Acura Internal Data ]
Clean Appearance, Aero Benefit

SECTION AA

Roller Hem Wheel Arch

Visible Welds
Forward Edge
Flange Not Constant

12 TL

Rearward Edge
Visible Welds
Flange Not Constant

15 TLX

Constant Curve
No Welds

Spot weld
Large Flange

SECTION AA

TLX 1st
Small Hem
Smooth Transition to Bpr

SECTION AA

Forward Edge
Rearward Edge
Intuitive Cargo Loading

Opening Width

• Increased cargo capacity/usability
• Improved lift-over height

Floor Length

Lift Over Height

User Friendly Cargo Area

+14%

+12%

-15%
THREE Levels of Performance

2.4L 2WD
P-AWS*

3.5L 2WD
P-AWS

3.5L
SH-AWD**

* Precision All-Wheel Steer
** Super Handling All-Wheel Drive
Body Concept & Materials

2015 TLX
**Body Concept & Development**

**Solid Platform**
- Improve Mount Point Stiffness

**Optimized Body**
- Apply High Tech Materials Where Most Needed

**Acoustic Spray Foam**
- Enables a Quiet Cabin

**Hemmed RR Wheel Arch**
- Promotes Clean Appearance, Quality & Aero

**Manage Crash Performance**

**SMART**

**Intuitive Cargo Loading**

**ENGAGING**

- Improve Ride and Handling Feel
- Improve NV and Appearance Quality

**MAGNETIC**

- Achieve Top Safety Pick+
- Improve User Experience

**INTUITIVE**

- WIDE / LOW Opening

**RED CARPET ATHLETE**
Body Component Commonality

- Upperbody is completely exclusive

- Safety: HSS590

- Rigidity: Cast Mg

- Styling & Package

- Styling

- Exclusive Components
- Common Components
- Modified Components

30% Common
Body Construction Strategy

Optimized Body Structure for Performance

① Next Gen ACE Body Construction for Crash Compatibility and Handling
② Reinforced cabin for SICE / SOT
③ Rigid IP Frame and SUS Mounting Points for Handling and NVH
④ 4X Roof Crush and NVH
### Material Type Application

#### 52% Advanced High Strength Materials

- **LSS 270**: 41%
- **HSS 340**: 3%
- **HSS 440**: 5%
- **HSS 590**: 35%
- **HSS 780**: 2%
- **HSS 980**: 2%
- **USIBOR 1500**: 5%

- **Magnesium**: 2%
- **Aluminum**: 6%
- **Magnesium**: 2%

---

#### Durability

- Safety: SOT, SICE, Frontal

#### Safety and Durability

- Safety: SOT, SICE, Frontal

#### Light Weight

- Safety: SOT, Frontal

#### Safety and Rigidity

- Safety: SOT, Frontal

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**Steel Matters**

[www.autosteel.org](http://www.autosteel.org)
Body Construction Strategy

Key Improvements in Body Structure, NVH, Crash Safety

- **Safety and Dynamic Performance**
  - Optimized Body

- **Hot Stamp Stiff Ring**

- **Manage Crash Performance**
  - Targeted Stiffness
  - Cast Mg IP Frame
  - Acoustic Spray Foam
Body Construction Strategy

Optimized Global Midsize Platform

- **Body Rigidity**
- **Body Rigidity + Road Noise**
- **Road Noise**

(Targeted Stiffness Regions)
Performance Achievement

Key Body Stiffness Improvements

Body Rigidity

Body Rigidity + Road Noise

Road Noise

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<tr>
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<th>Road Noise</th>
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<tr>
<td>Z</td>
<td>+46%</td>
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<tr>
<td>Z</td>
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<tr>
<td>Z</td>
<td>+31%</td>
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<td>+24%</td>
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<tr>
<td>Y</td>
<td>+45%</td>
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<tr>
<td>Z</td>
<td>+15%</td>
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</table>
Performance Achievement

Body Rigidity for Static/Dynamic Performance

15M TLX
12M TL

Mount Point Static Stiffness

Ave = ↑ 27%

Acoustic Sensitivity (20~300 Hz)

Ave = ↓ 8dB
Performance Achievement

Body Rigidity for Static/Dynamic Performance

Global Bending

Global Torsion

Global Modes

Eigen Frequency (Hz)

+5

15M TLX

White Body
Mass:

12M TL

Global Torsion

Static Torsion

21%

100N

- 25kg

(-55.1lbs)
Performance Achievement

Body Rigidity for Passenger Comfort Level

FR Seat Mount Points

Dyn Stiffness (N/mm)

Front

Rear

15M TLX

12M TL

+31%

+44%

Seat Mount Stiffness

Front

Rear

15M TLX

12M TL

+31%

+44%
Body Construction Strategy

Hot Stamp Door Ring Stiffener

Stiff Ring Benefits

① Improved energy management by uninterrupted joints that transfers load more efficiently.

② Improved door fit & finish by controlling front and rear door hinges on one part.

③ 4.1 kg (9lbs) weight down by overall strength increase and eliminating weld flange overlaps.

12M TL = 4 Separate Welded Pieces

15M TLX = 1 Piece, 1.4mm Thick
Body Construction Strategy

Cast Magnesium IP Frame

12M TL
Aluminum/Steel Hybrid

15M TLX
Cast Magnesium

26 different parts:
Extrusions and stampings

- Difficult accuracy control
- High investment
- Moderate Mass [7kg]
- ‘Acceptable’ steering frequency

One tool casts three parts

- Higher accuracy control
- High investment
- Mass savings [6kg]
- Improved steering frequency

Slip joint for stable vehicle impact performance
Performance Achievement

Cast Magnesium IP Frame Performance

Strng Wheel Frequency

Transfer Function

Idle / Cylinder Mgt Zone

Frequency [Hz]

15M TLX
12M TL

Better

+4Hz

More [m/s^2/N]

Frequency [Hz]

[dB/N]

-1dB

-1.3dB

-2.7dB

Better

Idle / Cylinder Mgt Zone

Steel Matters Demand Nothing Less
www.autosteel.org
Performance Achievement

Optimized Body and Subframe Improve Driver Comfort

Front Axle Vibration as Felt by Driver

- Vertical G
- Fore/Aft G

Good

- TL

- JP

- EU

- TLX

Improvement:

- 61%

Rear Axle Vibration as Felt by Driver

- Vertical G
- Fore/Aft G

Good

- TP

- EU

- TLX

Improvement:

- 31%

- 33%

High Level Static and Dynamic Optimization provide ideal ride and handling properties
Optimized Body, NV & Subframe Improve Driver Comfort

Best-in-Class Road Noise
Cabin NV Levels
- Easy To Hear
- Reduced
- Low Frequency Drumming
  - Torsional Rigidity Improved by 21%
  - Chassis Mounting Point Improved by 25%
  - Body Leak Improved by 50%

Best-in-Class Wind Noise
Wind Noise
- Quieter
- Mid Frequency dBA
- Quieter

A Stiffer Body, with Higher Isolation & Sealing, was Required to Balance TLX’s NVH
Crash Safety Performance

Complete Vehicle Safety Design

Highest achievements in both consumer information testing & Honda requirements for vehicle-to-vehicle compatibility & pedestrian safety

**Consumer Information Testing**
- IIHS SOT -- 64 km/h (& SICE)
- US NCAP -- Front 56 km/h (& SINCAP)
- IIHS ODB -- 64 km/h
- IIHS 4x Roof Crush
- IIHS Rear Impact Neck Injury
- IIHS Side MDB
- IIHS SUV

**Honda Internal Testing**
- Pedestrian Protection
- Next Gen ACE™ Structure

ACE™
[ Advanced Compatibility Engineering ]
Crash Safety Performance

IIHS SICE Crash Achievement

<table>
<thead>
<tr>
<th>Result</th>
<th>Judge</th>
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<tbody>
<tr>
<td>Survival Space</td>
<td>180mm</td>
</tr>
<tr>
<td>Injury Measures</td>
<td>FR / RR</td>
</tr>
</tbody>
</table>

Actual Result

CAE Prediction

SICE Survival Space
- Seat Center
- Top of Measurement Zone
- CAE Pre
- CAE Post (164 mm)
- Pre Test
- Post Test (55:183 mm)
IIHS 4X Roof Crush Achievement

Peak Load = 90.8 kN
@ Plate Stroke = 76 mm
SWR = 5.67

<table>
<thead>
<tr>
<th>Result</th>
<th>Judge</th>
</tr>
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<tbody>
<tr>
<td>SWR (Peak Force)</td>
<td>5.67 * (90797)</td>
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<tr>
<td>Stroke</td>
<td>76 mm</td>
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* Benefit of SOT Pillar Structure creates large strength margin
Crash Safety Performance

IIHS Small Overlap Crash Management

Zone 1: Control G-Loading into body
Zone 2: Passenger Protection

25% Overlap @ 40mph

Energy Absorption
Cabin Stiffness
Passenger Protection with strong cabin
Crash Safety Performance

Door Ring Crash Management

Balanced blend of **Very Rigid** and **Semi Rigid** components improve crash energy management through the cabin opening.

- **USIBOR 1500**
- **HSS 590**
- **HSS 980**
- **HSS 780**
The Door Ring components with the Floor components better balance and distribute crash energy in a **controlled** manner.
IIHS Small Overlap Test

IIHS Small Overlap Achievement

[ Crash Video ]
IIHS Small Overlap Test

IIHS Official SOT Achievement

IIHS Acceptable

**Dummy Injury ratings**
- Head/neck: GOOD
- Chest: GOOD
- Hip/thigh: GOOD
- Lower leg/foot: MARGINAL
- Restraints/dummy kinematics rating: GOOD
- Vehicle structure rating: ACCEPTABLE

**Rating**
- Overall evaluation: Acceptable

**Structure = Acceptable**

IIHS Small Overlap Safety Cage Evaluation

- Measured Intrusion (cm)
- Lower Hinge Pillar
- Footrest
- Left Toepan
- Brake Pedal
- Rocker Panel (lat)
- Steering Column (long)
- Upper Hinge Pillar
- Upper Dash
- Left IP

10/9/2014

Different wheel fracture mode and fracture timing
IIHS Small Overlap Test

2015 Acura TLX
Midsize luxury/near luxury car

CRASHWORTHINESS

Small overlap front  A
Moderate overlap front  G
Side  G
Roof strength  G
Head restraints & seats  G

FRONT CRASH PREVENTION
SUPERIOR
with optional equipment

PRINT FULL REPORT FOR THIS VEHICLE
# Overall Crash Safety Performance

<table>
<thead>
<tr>
<th>Item</th>
<th>Mode</th>
<th>14M TL</th>
<th>15M TLX</th>
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<tbody>
<tr>
<td><strong>NHTSA</strong></td>
<td>NCAP</td>
<td>Overall 4-Star</td>
<td>Overall 5-Star</td>
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<tr>
<td>IIHS Top Safety Pick</td>
<td>4 X Roof Crush</td>
<td>Good</td>
<td>Good</td>
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<tr>
<td></td>
<td>Side Impact</td>
<td>Good</td>
<td>Good</td>
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<tr>
<td></td>
<td>SICE</td>
<td>Good</td>
<td>Good</td>
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<tr>
<td></td>
<td>Rear Crash Protection</td>
<td>Good</td>
<td>Good</td>
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<tr>
<td></td>
<td>(whiplash)</td>
<td>Small Overlap Test</td>
<td>Small Overlap Test</td>
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<td></td>
<td>Front Crash</td>
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<tr>
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<td>• Small Overlap Test</td>
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<td>• 40% ODB</td>
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<td>Crash Avoidance</td>
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<td>Pedestrian Protection</td>
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<td></td>
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<td>HIC ≤ 1700 100%</td>
<td>HIC ≤ 1700 100%</td>
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15M TLX: ADV: CMBS Tech: FCW

Crash Avoidance
2015 TLX Vehicle Design adapts “Smart Proportions” to absorb outgoing packages of the TSX & TL

Body Concept and Structure significantly improved global and local stiffness and isolation to deliver high performance targets for:

- Capable Dynamic Response for the demands of three powertrain / drivetrain packages
- Significant NVH Achievement for a best in class balanced cabin environment

Body Structure applies 60% AHSS in targeted areas to achieve Acura crash safety goal of Top Safety Pick while also shaving 25kg (55lbs)
THANK YOU FOR YOUR ATTENTION