

Development of New Model CIVIC Sedan

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Abstract

The new CIVIC was developed under the theme “a vehicle to provide unique sensations and excitement.” The developers were aiming for a completely new driving sensation and appeal. The power plant was newly developed, the platform and suspension were redesigned and the vehicle’s fundamental performance was enhanced in an innovative way. Moreover, its unique design, never before seen in the sedan concept, was combined with a people-friendly package.

Factors that are often difficult to balance – safety and novel exterior design, comfortable running performance and stability, advanced interior design and ease of use, high output and fuel economy – were mastered one by one, setting new standards and using innovative technologies to create not just a vehicle with originality, but one that is highly practical. In other words, the developers have come up with a high quality, next generation compact sedan with the never-before-seen CIVIC sensation.

1. Development Concept

The original CIVIC launched Honda’s automobile business, and people the world over see the CIVIC as a symbol of progress. Our mission is to develop that image further using the new 8th generation CIVIC. The CIVIC is currently being sold in 160 countries worldwide, and the roles it plays in each country were due for a major change.

In this Internet age, global information can be obtained quickly. People demand products (and not just vehicles) with unique design that provide innovative performance and package.

To respond to this type of customer demand, in the new CIVIC we chose the development concept, “a vehicle that provides unique sensations and excitement,” to express how its unique presence and innovative performance far surpass conventional concepts.

2. Global Formation

For the American market, the CIVIC was given a sporty appearance, to meet the needs of the market’s largest segment, Generation Y (now around 25 years old) which has replaced Generation X (now around 40 years old) and the baby boomers (now around 55 years old). For the markets in Japan and the rest of Asia, the median age of sedan buyers is slightly higher, and thus the CIVIC has been given a more luxurious feel (Fig. 1). In addition, the power plants are configured to meet regional needs, with 1.6L, 1.8L or 2.0L gasoline engines, as well as IMA and CNG (natural gas) vehicles that appeal to those who are environmentally conscious (Table 1).

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Fig. 1 Worldwide style variations

Table 1 Worldwide power plant variations

Power plant variation	North America		C., South America	Asia	EC	Japan
	CIVIC	ACURA CSX	CIVIC	CIVIC	CIVIC	CIVIC
1.8 L 140 Ps 5AT	●		●	●	●	●
1.6 L 125 Ps 6MT				1.6/1.8L	5AT 5/6MT	
2.0 L 155 Ps 5AT		●		●		
IMA 110 Ps CVT (Motor power included)	●			●	●	●
CNG 115 PS 5AT	●					

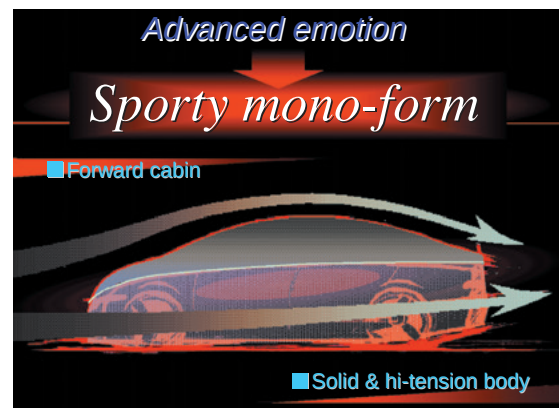


Fig. 2 Exterior design concept

3. Exterior

3.1. Design

The “sporty mono-form” exterior design concept frees the vehicle from the conventional sedan image and adds additional style. While carefully maintaining its current ergonomic features, such as head clearance, trunk room and visibility, the new CIVIC also provides best-in-class collision performance with the unique new presence of its mono-form, flowing upper body; and a solid, strong underbody (Fig. 2).

3.2. Dimensions

In the upper body, the front glass was moved forward 260 mm while compressing the overall height, creating a mono-form that also provides high-level collision performance. Changes to the body frame structure and a wider application of high tension steel both enhanced collision performance and achieved a new look. In the underbody, the wheel base was extended 80 mm, and the tread was widened. 16-inch wheels were made the standard, and the wheel arch gap was made the smallest found in a compact-class car. This produced a lower body that is strong and solid (Fig. 3).

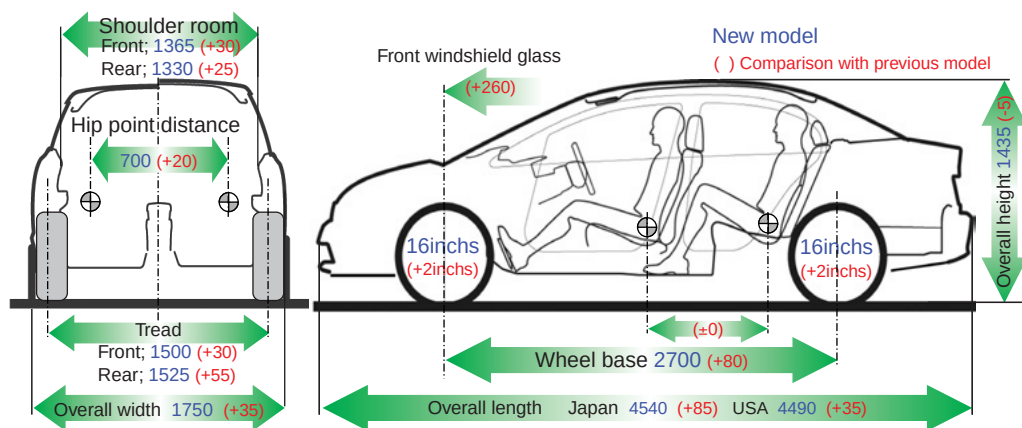


Fig. 3 Basic dimensions (mm)

To highlight the underbody's solidity and sporty high-quality feel, high caster front suspension geometry was used to increase steering camber, and the tire was offset from the wheel arch (Fig. 4).

Vehicle stability was enhanced by implementing such measures as bending the outer panel's rear wheel arch flange (Fig. 5), and the gap between the wheel arch and upper edge of the front and rear tires was narrowed to 50 mm, the smallest in the global compact-car class.

3.3. New Link Mechanism Flat Wiper

The front window was moved forward to achieve the mono-form design, expanding the window glass surface. To ensure adequate wiper coverage as well as to enhance the wipers appearance and quality, a new style of wiper, linked opposite-type flat wipers, was developed (Fig. 6).

Conventionally, opposite-type wipers either have a large gap between the stationary positions of the left and right wipers, or have pantograph links to avoid interference during operation. The wipers developed during this project combine a proximity pivot, output link and connection link to create a system that controls the speed of the wiper on the front passenger seat side. This achieves a low stationary position and an elegant appearance.

The design arm and flat blade were used to enhance the wipers elegant appearance with an integrated feel. In consideration of maintenance costs, the wiper blade was made a single replaceable structure (Fig. 6).

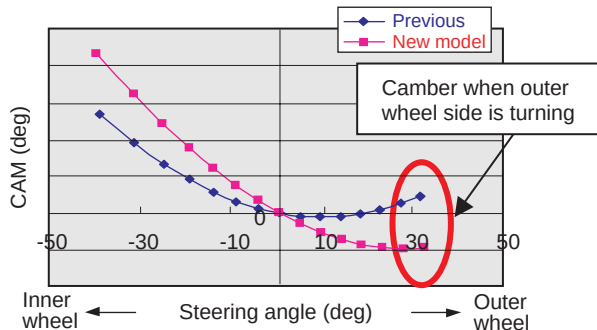


Fig. 4 High caster front suspension geometry

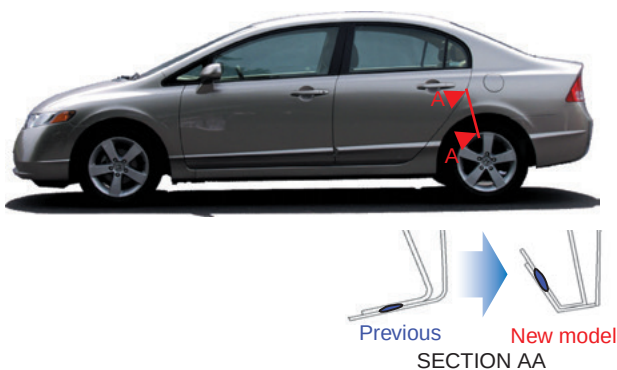


Fig. 5 Rear wheel arch bend

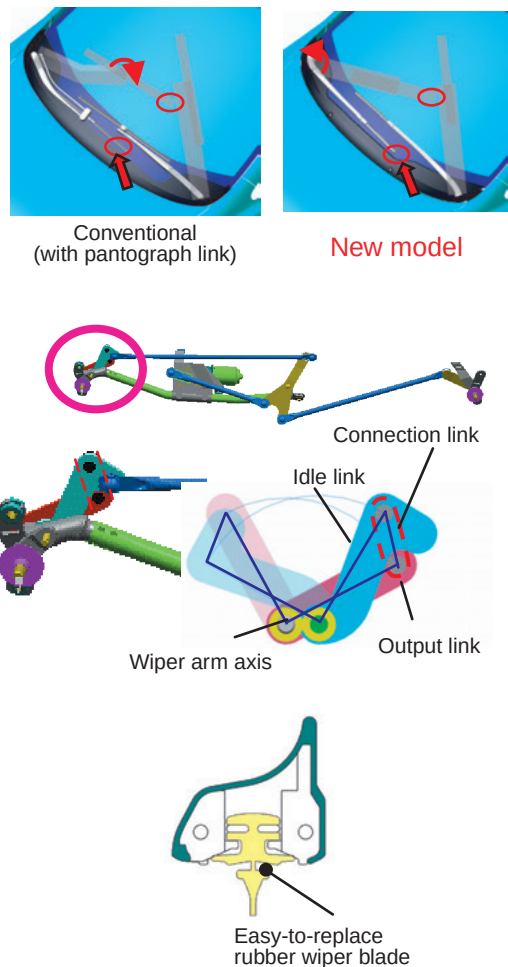


Fig. 6 Flat wiper with new linked system

4. Interior

4.1. Design

To realize the concept of a "multiplex cockpit", a user-friendly interface with separate functions was required. To achieve this, driving, ease of operation and ease of use were studied, focusing on the driver's needs, and a comfortable, functional cabin space with a new sense was created (Fig. 7).



Fig. 7 Interior design concept

4.2. Meters

When designing the meter area, the features of the mono-form exterior were put to practical use. Meter functions are divided between information that is a priority during driving (the speedometer) and other information. After analyzing the location of monitors that are easy to see lettering size and colors, it was decided to create a dual-layer configuration to provide enhanced visibility and a futuristic look (Fig. 8).

4.3. Control System

The elliptical and compact steering wheel, modularized new compact shift lever and Z-arm hand brake are all located in close proximity. This layout provides for smooth and user-friendly operation (Fig. 9).

4.4. Console

Because the control system was centralized, it was possible to provide large, easily accessible console storage and door pockets, which are especially useful since these are usually accessed blindly while driving. The center console includes a cup holder that can hold two large travel mugs, and large storage areas both in front of and behind the gear shift lever that do not interfere with shifting. In addition, below the sliding armrest there is a storage space that can hold 25 CDs (Fig. 10).

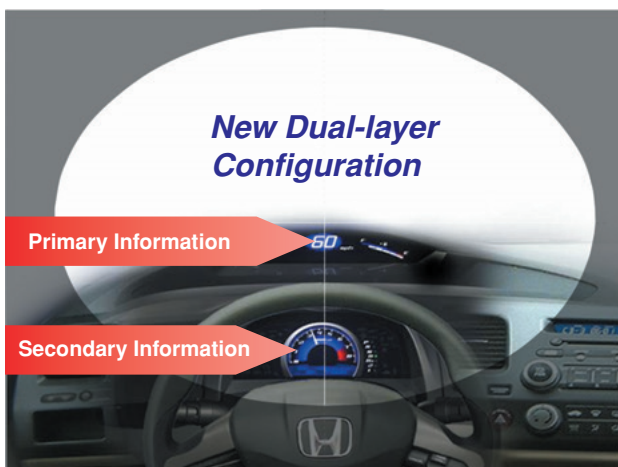


Fig. 8 Meter arrangement



Fig. 9 Control package

4.5. Seat

The seats provide the feeling of being enveloped “in the seat,” rather than just sitting “on the seat.” A dual layer structure increases the “soft solid” portion of the seat that comes in contact with the passenger, while the “hard solid” under layer provides support. This dual solid structure provides high quality and a sporty feel. The internal structure comprises a new highly rigid frame and a plastic self-adjusting plate that fits to the body. This structure makes it possible to drive for long periods without feeling fatigued (Fig. 11).

4.6. Driving Position

One aim in developing the new CIVIC was to create the “best (driving) position for everyone.” A comfortable driving position was achieved by standardizing the tilt-telescoping steering wheel, a sliding armrest, easy-to-use lever seat height adjuster and organ-type acceleration pedal, features available for all grades (Fig. 12).



Fig. 10 Center console storage

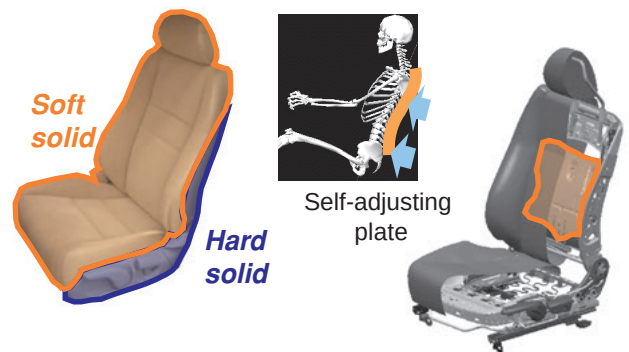


Fig. 11 Dual solid sheet

Best position for everyone

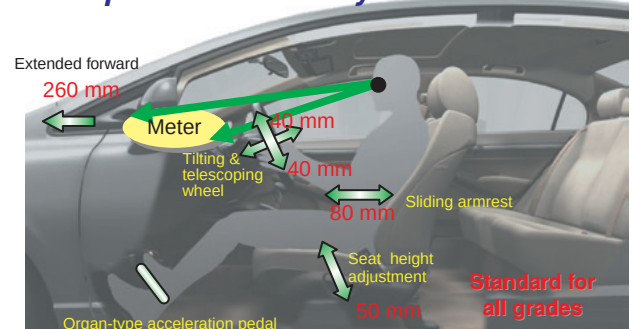


Fig. 12 Mechanics of driving position

5. Power Plant

A new 1.8L (for some regions, 1.6L) i-VTEC engine equal to the high output of engines one class above while having best-in-class fuel economy was developed⁽¹⁾ along with an ultra-compact 5AT, and 5MT (6MT) transmissions, all with enhanced drive feel.

By combining these features with the newly adopted drive-by-wire control, a sporty driving feel was developed, with good acceleration feel and a quick accelerator response (Fig. 13).

The 2.0L i-VTEC engine installed in the Accord has been used for some regional needs. An IMA vehicle with enhanced fuel efficiency and battery performance, and a CNG vehicle that uses natural gas for fuel were prepared to demonstrate environmental performance and innovative technology. These various uses were further proof of their strength and versatility (Fig. 14).

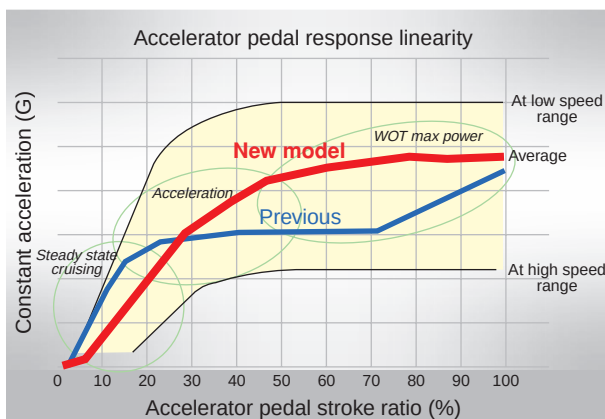


Fig. 13 Accelerator pedal response

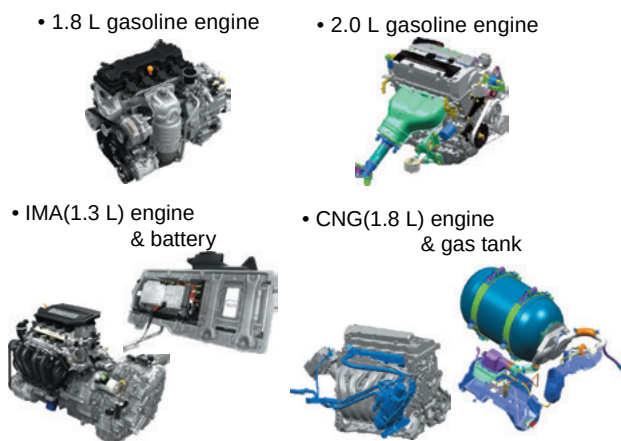


Fig. 14 Worldwide power plant variations

6. Ride and Handling

To produce the CIVIC's distinctive ride and handling, the developers wanted to come up with both linear and direct handling that were compatible with a smooth ride. Many thorough simulations and tests were carried out concerning the body that supports the suspension, and the results showed a 35% increase over the previous model in torsion rigidity, enhancing the suspension performance (Fig. 15).

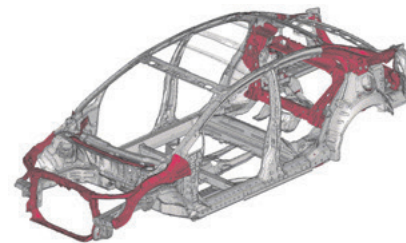
6.1. Front Suspension

Increasing the caster angle and caster trail amounts enhanced turning stability, linear toe compliance performance and straight-line stability (Fig. 16). A linear and direct steering feel was obtained by reducing the center offset amount and optimizing characteristic damper, spring and bush settings, thereby suppressing kickback and torque steer.

6.2. Rear Suspension

An enhanced damper lever ratio with separately located suspension springs, a reduced damping force and optimized bush characteristics increased ride comfort. A longer upper arm length, rear tilt and deviation against rear knuckle bush rotation axis, etc. (Fig. 17) raised the linear characteristics of camber changes against bump toe change, and raised lateral ground contact rigidity, thereby enhancing turning performance.

Furthermore, a comprehensive review of detailed parts, including the use of a damper valve for steering kickback, changes to hydraulic controls, and rigidity increases were made, producing a stable feeling as well as exhilarating handling with a linear and direct feel (Fig. 18).



Reinforced body parts

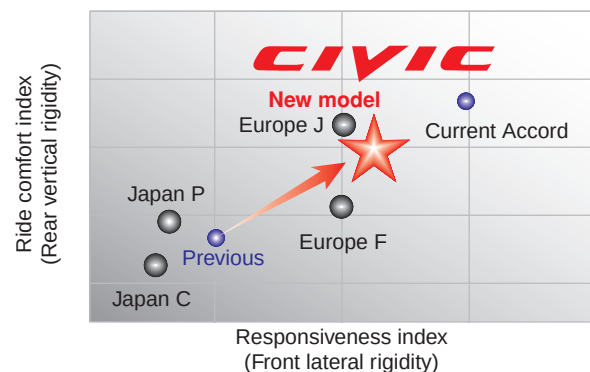


Fig. 15 Body rigidity

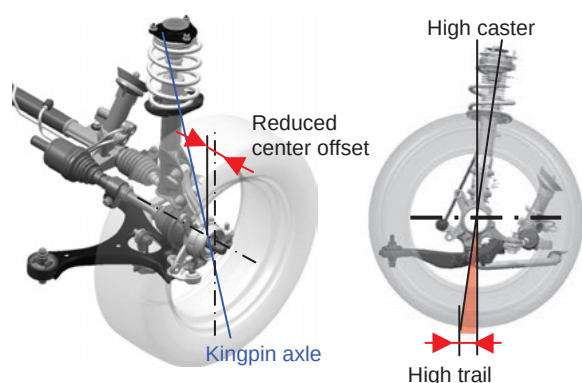


Fig. 16 Front suspension

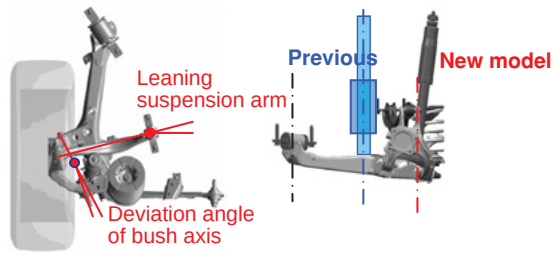


Fig. 17 Rear suspension

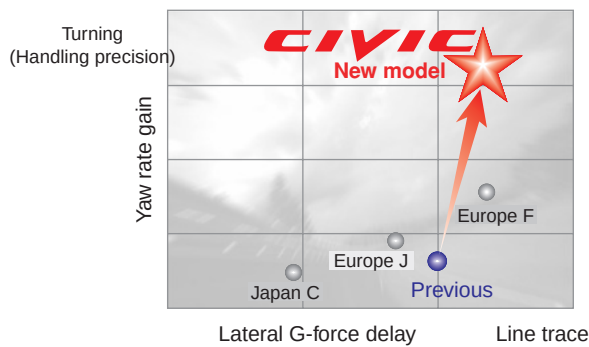


Fig. 18 Handling

7. Engine Sound Creation

To express the sporty and comfortable feel of the CIVIC, developers aimed “to create an engine sound that was integrated with acceleration.” This was achieved by reducing 2nd order booming noise and creating sound using 4th order intake noise, which rises linearly with acceleration (Fig. 19).

7.1. Noise Cleaning

7.1.1. Use of a torque rod mount method

For the engine mount system, a torque rod mount method⁽²⁾ was used in which the torque rod receives driving reaction force in the longitudinal direction.

The torque fluctuation vibration which operates in the rotational direction around the crankshaft is received longitudinally. This reduces idle vibration and booming noise at low engine speeds, e.g. when taking off. With the torque rod’s double vibration-prevention effect, booming noise inside the vehicle and engine noise are both reduced (Fig. 20).

7.1.2. Application of light-weight sound absorbing material

Reviewing a layered structure of the conventional noise insulation material and applying materials with advanced sound absorbing performance both enhanced body quietness and reduced body weight⁽³⁾ (Fig. 21).

7.1.3. Structure preventing sound penetration

A structure preventing noise penetration from the outside was created by using a sound-absorbing door hole seal (Fig. 22) and a double door seal, by reducing body plate joint clearances and the number of holes, and by applying urethane foam inside each pillar.

7.2. Sound Creation

In addition to implementing the measures outlined above, the intake system’s silencer device was used to create an engine sound that matches the acceleration.

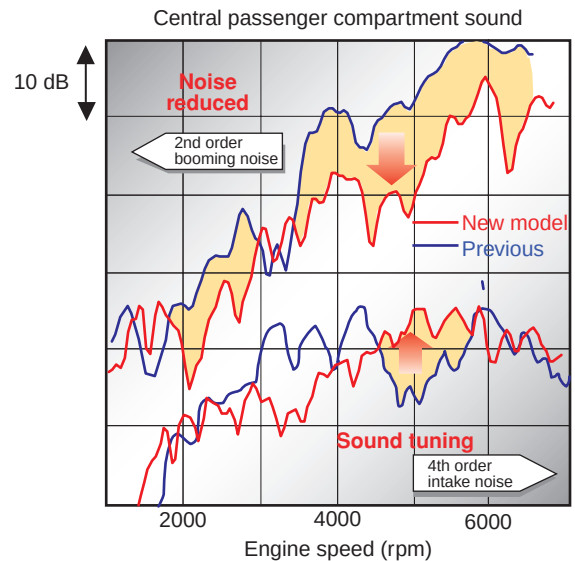


Fig. 19 Engine sound creation

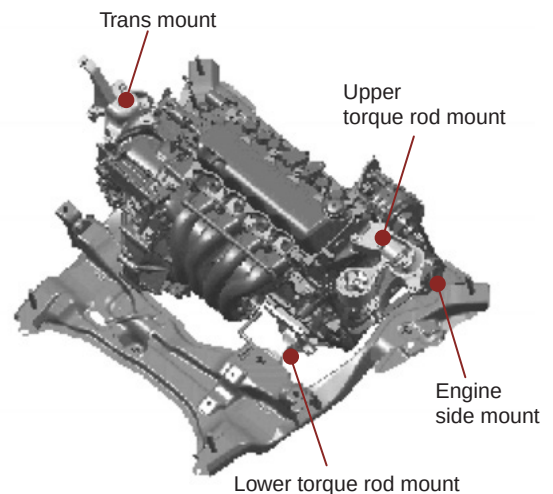


Fig. 20 Torque rod mount system

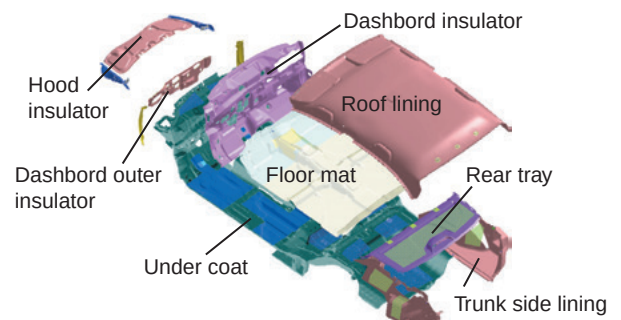


Fig. 21 Use of sound-absorbing materials

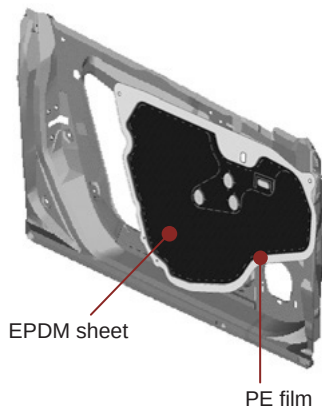


Fig. 22 Sound-absorbing door hole seal

8. Collision Safety Performance

In collision safety evaluations carried out according to J-NCAP, US-NCAP, EURO-NCAP, and IIHS standards, top performance was achieved. Furthermore, the target was not only reducing damage to the CIVIC and its occupants when struck by other vehicles, but also to reduce damage inflicted on the other vehicle. An Advanced Compatibility Engineering (ACE) body⁽⁴⁾ (Fig. 23) was used, along with tailored blank welding on the side frame, which helps control the deformation mode during a collision. This produced a structure that is highly efficient in impact energy distribution and absorption.

As a result, the structure increases the efficiency of the occupant restraint system, reduces vehicle body deformation and enhances occupant restraint performance, thus achieving best-in-class collision safety performance.

In addition, the active headrest, a Honda first, is a standard specification on front seats (Fig. 24). The structure harnesses the force of the occupant hitting the seat back during a rear-end collision. If the force is great, a link mechanism inside the seat back goes into operation, the headrest is raised and moved into an

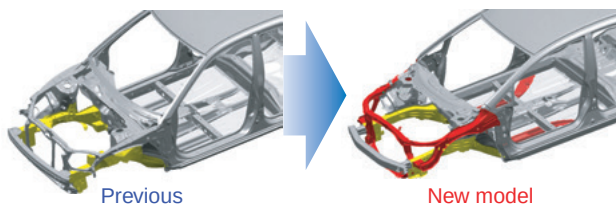


Fig. 23 Advanced compatibility engineering body

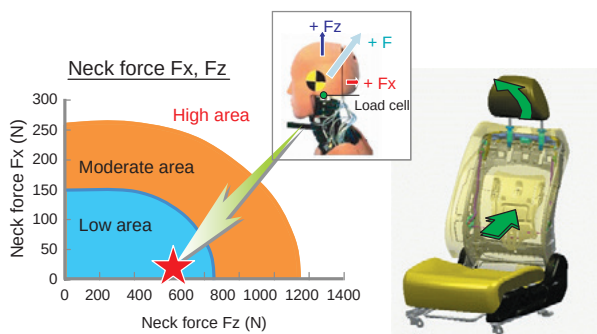


Fig. 24 Active headrest

appropriate forward tilt. By adopting an inertial lock to maintain the headrest position, the head's rear movement is kept to a minimum, thereby mitigating shock to the neck.

9. Conclusion

We have paid close attention to the development of even the smallest details, working to create a vehicle with the unique CIVIC sensation and excitement.

We are confident that we have created a next generation compact sedan that combines a "One of a kind" feeling of unique distinction, with being "Number one" in innovative performance.

References

- (1) Seko, K., Taga, W., Torii, K., Nakamura, S., Akima, K., Sekiya, N.: Development of 1.8L i-VTEC Gasoline Engine for 2006 Model Year Honda CIVIC, Honda R&D Technical Review, Vol. 18, No. 1, p. 8-15
- (2) Yanagase, H., Tamura, T., Takabayashi, H., Ikebata, S.: Reduction of Noise and Vibration in Compact Car Engine Mount System, Honda R&D Technical Review, Vol. 17, No. 2, p. 90-95
- (3) Noguchi, Y., Doi, T., Tada, H., Misaji, K.: Selection Technique of Sound Absorption Type Acoustic Insulation Material by Applying SEA Modeling Method, Honda R&D Technical Review, Vol. 18, No. 1, p. 149-153
- (4) Yoshimoto, T., Taguchi, Y.: Innovative Body Structure for Compatibility, 2004 JSAE Annual Congress Proceedings, No. 45-04, p. 11-14 (2004)

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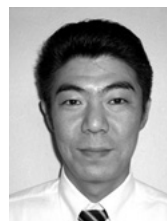
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