

Development of 2009 Model Year U.S. FIT

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ABSTRACT

The first-generation U.S. Fit embodied a new appeal — a utility and sportiness not previously seen in the North American sub-compact car market — which gave the vehicle a unique position in the market.

The development of the second-generation U.S. FIT sought to polish and enhance the strengths of the original vehicle, while also attempting to both surprise and please North American customers.

The Fit is now a global vehicle platform, and the development of the new model focused on redesigning even small details in order to optimize the first generation Fit's "DNA," its stylish small body and spacious cabin, ease of use, safety and environmental performance, and fuel efficiency, as well as the riding and driving pleasure it offers, for the North American market.

This has advanced the appeal of the Fit beyond the previous model and resulted in the realization of a "next-generation sub-compact car" able to satisfy not only younger users, but also users seeking a smaller car as their next vehicle, a market segment expected to increase in the future.

1. Introduction

The first-generation U.S. Fit, featuring an automatic transmission and modified design, debuted in 2006, four years after the Japan domestic model.

Up to that point, the selling points of sub-compact cars in the U.S. had been their low price and fuel efficiency. The Fit added a high level of utility created from their center tank layout and a sporty feel designed exclusively for the North American market to forge a unique market position.

Market evaluation of the first generation U.S. Fit had not yet reached Japan, even when the project for the new FIT started, and the team was unsure as to whether the Fit's unique utility and sportiness had achieved significant market acceptance.

In order to obtain information in a short period, the team conducted interviews with user groups, conducted dealer surveys and design clinics, and offered test rides in sub-compact cars at various locations in the U.S. The information obtained and the impressions received at these events became the axis around which the concept for the new FIT was generated.

2. Concept

Interviews with users and surveys of dealers had indicated that the first generation U.S. Fit had been accepted in accordance with the initial goals for the design of the vehicle, and that the market was expecting a further evolution of the vehicle.

The first generation Fit's spacious cabin, roomier than it appears from the exterior, its ease of use, in particular the "Magic Seats," its nimble handling in the city, and its acceleration on freeway convergences were particularly well received.

The market in both North America and Japan also showed that there were signs of a shift away from larger vehicles, due in part to the spiraling price of gasoline.

Based on this information, the team was determined to refine the utility and sportiness that were important aspects of the appeal of the original Fit, and to increase the sense of quality of the vehicle to also satisfy customers who sought to move to a smaller car. These goals were summed up in the concept "Sport & Utility + Refinement" (Fig. 1).

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Fig. 1 Development concept

It was also decided that the design of the North American FIT would be considered during the development of the Japan domestic FIT, which would serve as its base vehicle, thus realizing an increase in the level of commonality between the vehicles. By this means, the developers sought to achieve a good balance between cost and the realization of increased commercial appeal.

3. Exterior

3.1. Design

The concept for the exterior design of the U.S. FIT was set as a “Super Forwarding Aero Form.” This design sought to incorporate an advanced cabin design in which the cabin reached far to the front of the vehicle and a dynamic forward inclination into a vehicle that gave the sense of being a single compact unit (Fig. 2).

In order to realize the Super Forwarding Aero Form and to increase up-down and left-right visibility:

- The A-pillars were moved forward (110 mm in comparison to the previous model).

- The A-pillars were reduced in width (by 10-40 mm against the previous model).
- The area of the windscreen and the front quarter windows was increased.

This design would reduce the cross-section of the framework. The response to this issue was to use stiffeners and to modify the structure of the A-pillars in order to reduce the amount of change to the framework cross-section (Fig. 3).

The front overhang was extended by 150 mm compared to the domestic FIT in order to emphasize the vehicle's sportiness, and designs developed exclusively for the North American model were used for the front bumper, front fender, and hood.

In addition, two front bumper designs were prepared for the FIT Sport and the base FIT in order to satisfy the desires of a wide range of users, from younger users to users seeking to move to a smaller vehicle.

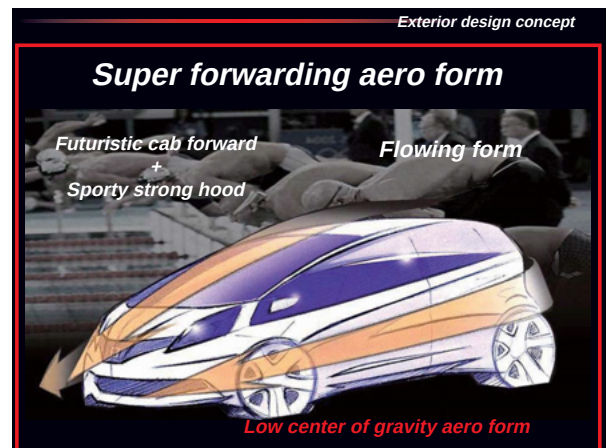


Fig. 2 Exterior design concept

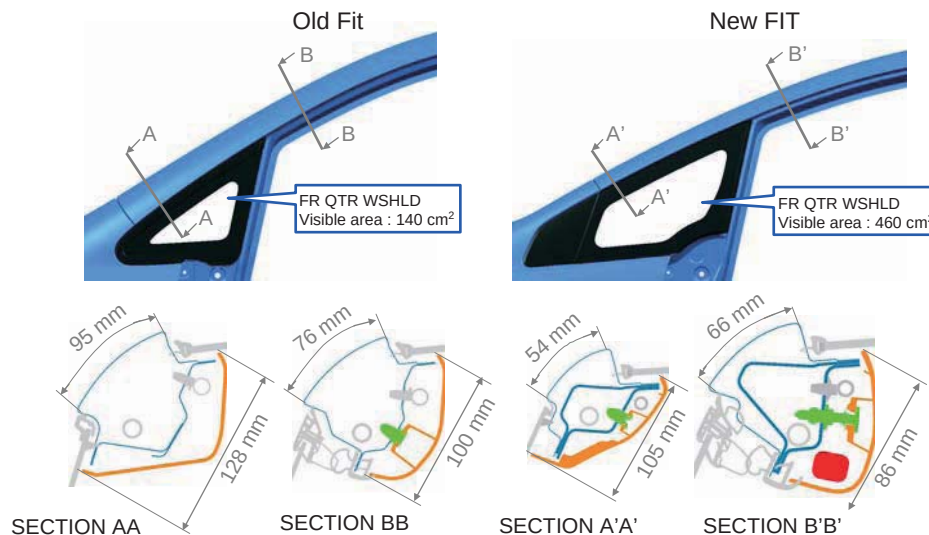


Fig. 3 Structure of front pillar

3.2. Dimensions

The wheel base of the U.S. Fit has been increased by 50 mm against the previous model to 2500 mm (the same length as the Japan domestic Fit). Ride comfort has been enhanced by extending the tandem distance and redesigning the rear suspension geometry.

In addition, structural modifications, including the expansion of the rear frame cross-section, use of a polygonal cross-section, and optimization of frame thickness, have enabled the achievement of higher

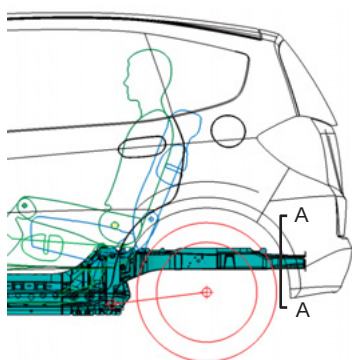


Fig. 4 Section of rear frame

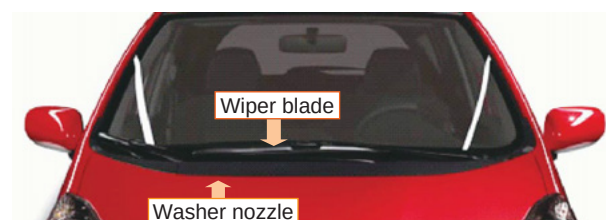


Fig. 5 Forward visibility

energy absorption performance within short strokes, which minimized the increase in total length and also enhanced the vehicle's safety performance in a rear collision (Fig. 4).

3.3. Increased Visibility

In order to increase up-down visibility and visible area on the left and right:

- An extra-large windscreen with a total length of 1076 mm (an increase of 166 mm against the previous model) has been employed.
- A new wiper blade design has been employed.
- The positioning of the wipers helps prevent them from obstructing forward visibility.
- The washer nozzle has been positioned inside the cowl top.
- Small mirror bases have been employed for a streamlined design.

These innovations have enabled the achievement of a panoramic field of vision (Fig. 5).

4. Interior

4.1. Design

In order to realize ease of use and comfort based on the concept "Advanced Personal Interior," the goal for the interior design was a sporty design that located the vehicle operating switches in the center of the driver's position and offered the pleasure of operation with instantaneous recognition and response (Fig. 6).

4.2. Package

The design of the vehicle package sought to increase cabin space and realize greater ease of use while maintaining the center tank layout.

Various modifications were made to all the fittings, such as changes to the shape of the door linings and the seats, in order to achieve increased cabin space.

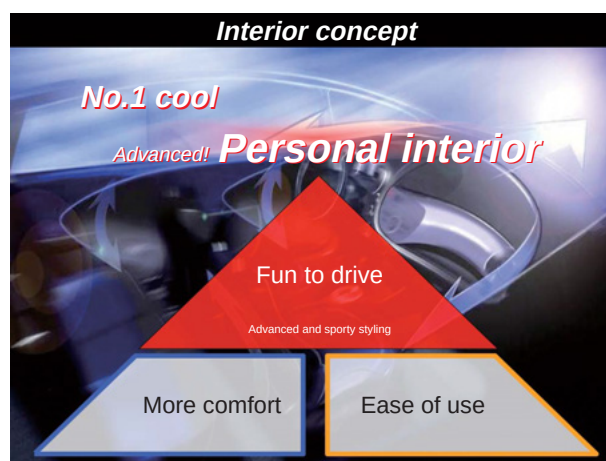


Fig. 6 Interior concept

In addition, employing a large footrest and telescopic steering mechanism and increasing the range of choice for seat adjustments has enabled each driver to find the optimum, most comfortable driving position (Fig. 7).

4.3. Instrument Panel

The heater control switches have been positioned to be within reach of the driver's hand, thus enabling them

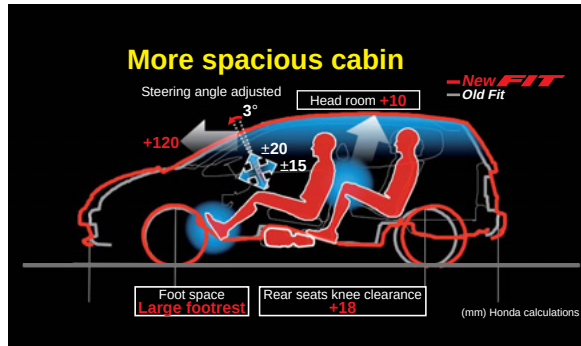


Fig. 7 Package layout

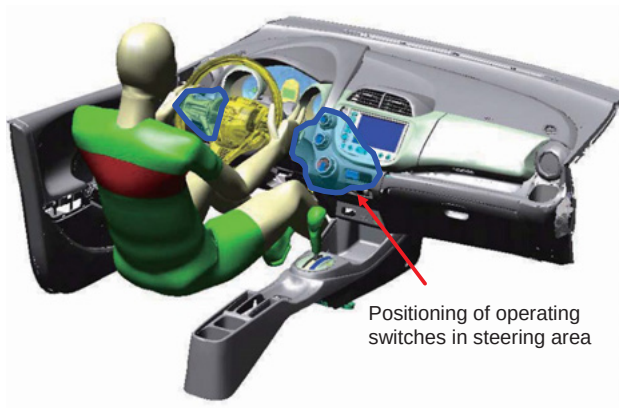


Fig. 8 Enhanced maneuverability

to be operated with the minimum change in the driver's line of sight. The use of thinner ducts in the instrument panel has enabled the top section of the instrument panel to be lowered in order to achieve increased visibility (Fig. 8).

4.4. Storage Space

Cup holders have been placed at the sides of the instrument panel in order to enhance their ease of use and to make them more accessible. Drink holders have also been fitted in 10 other locations, including the console box and door pockets (Fig. 9).

4.5. Seats

The use of a luxury vehicle seat frame in which the



Fig. 10 New seat frame



Fig. 11 One motion dive-down

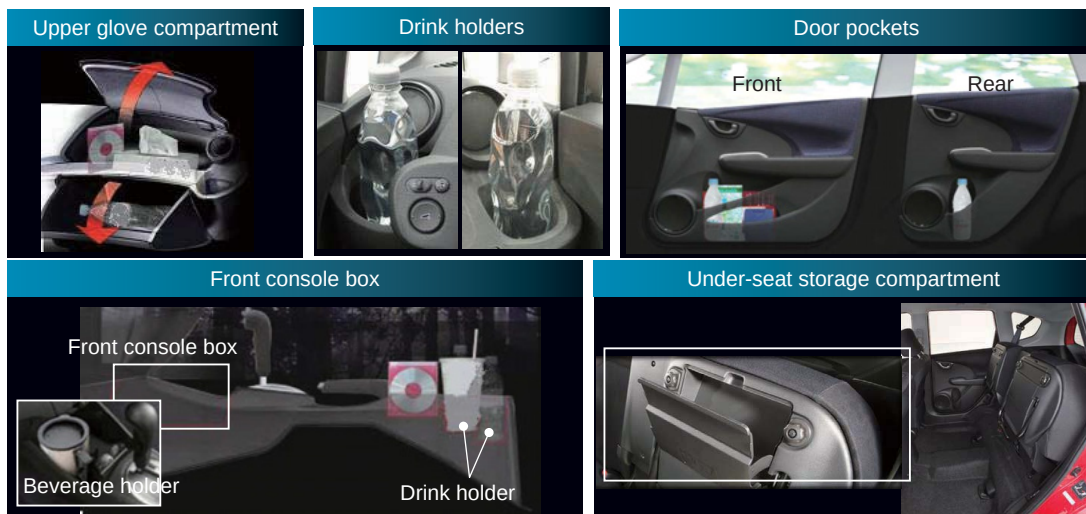


Fig. 9 Storage

cushion springs run horizontally was set as the basic specification for the seats. The seat and the side supports have been separated by deep grooves, realizing a balance between cushioning and holding performance and enabling the achievement of a “wrap-around” feel (Fig. 10).

Thicker cushions in the rear seats have enhanced ride comfort, and a lever-operated seat shift mechanism has been employed to enable one-touch operation (Fig. 11).

5. Powerplant

In order to create a powerplant suitable for the model change of the Fit as a global model, an i-VTEC engine⁽¹⁾ displaying increased power and reduced friction was developed to increase fuel efficiency and environmental performance (Fig. 12).

The replacement of the one-valve VTEC mechanism used in the previous model with a high-power VTEC mechanism that switches the two intake valves between “Lo” and “Hi” modes, has increased maximum power. Reducing knocking by means of redesigning the flow of cooling water in the engine and employing an intake manifold with a resonator enabled the achievement of increased power.

In terms of environmental performance, high-

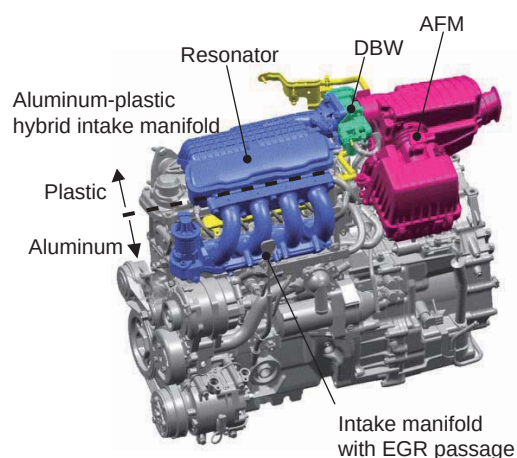


Fig. 12 2009 Model engine

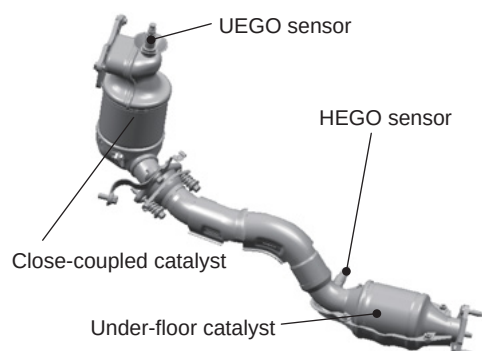


Fig. 13 Configuration of exhaust system

precision A/F control using an airflow meter and LAF sensors, integration of the cylinder heads with the exhaust manifold, and the use of a close-coupled catalyst for enhanced cleaning performance have enabled the new FIT to meet the California LEV II ULEV regulations (Fig. 13).

In order to increase commercial appeal, the characteristic of the DBW (electric throttle) control, which is a factor in the vehicle’s drive feel, has been set to suit modes of use in the North American market, in particular city driving, enabling the achievement of a rapid acceleration feeling.

6. Electrical Equipment

6.1. Meters

The use of dials with a three-dimensional hairline finish and acrylic calibrations on the speedometer, tachometer, and fuel gauge has increased the three-dimensionality of the meters. To increase visibility, the

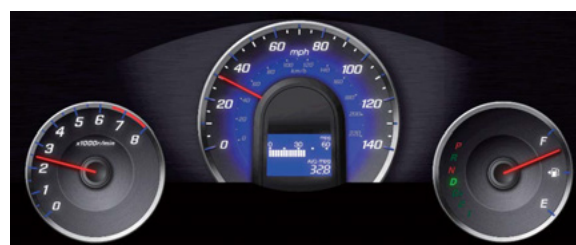


Fig. 14 Meters



Fig. 15 Audio



Fig. 16 Navigation system

meters are constantly lit, and the use of blue illumination imparts a sense of sophistication and refined quality. In addition, the information display located in the center of the panel matches the meters with a blue backlight, and includes constantly displayed instantaneous and average fuel consumption meters, providing support for eco-driving (Fig. 14).

6.2. Audio

Provided with its own face panel, the audio system is MP3/WMA-compliant, and a volume adjustment in relation to vehicle speed is standard. In order to respond to the need to connect portable audio players, and the like, an external input jack has been provided as standard in the front of the audio panel. The FIT Sport features a USB interface that enables an iPod to be operated through the audio as standard (Fig. 15).

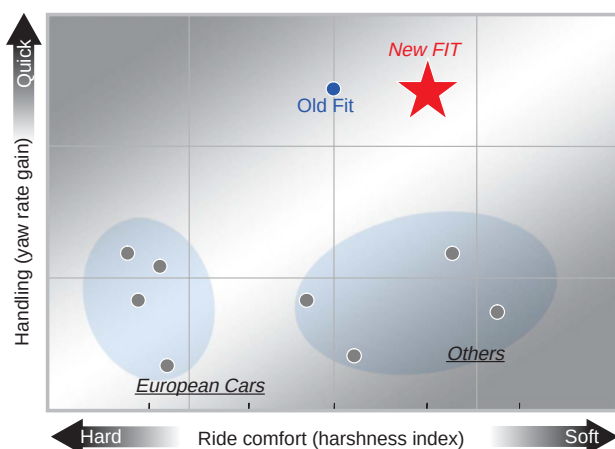


Fig. 17 Handling

6.3. Navigation System

The FIT Sport offers a DVD navigation system as an option for the first time in the U.S. Fit. The system features a 6.5-inch-wide touch screen display and voice recognition function (Fig. 16).

7. Handling / Ride Comfort / NV Performance

With regard to handling and ride comfort, the development of the new FIT maintained the “Fun to Drive” experience that was a strength of the previous model in the North American Market, while also working to realize the concept of solidifying the Fit’s position as the “Sporty No. 1.”

In order to bring this concept to fruition, the rigidity of the new vehicle’s body was increased against the first-generation U.S. Fit, and the steering system and front and rear suspension systems were redesigned.

In addition, the steering and suspension settings were established exclusively for North America. Testing was done continuously based on North American road conditions in an attempt to realize both nimble handling and a level of ride comfort in which there would be minimal shock even on rough roads (Fig. 17).

7.1. Body Rigidity

The body of the new FIT, the basis of the vehicle’s dynamic performance, was redesigned from the ground up (Fig. 18).

However, no increases in weight were permissible in achieving enhanced performance. To help prevent weight increases, CAE was employed at every step of the body design process. The shapes and thicknesses of plates were optimized and the efficiency of couplings was increased

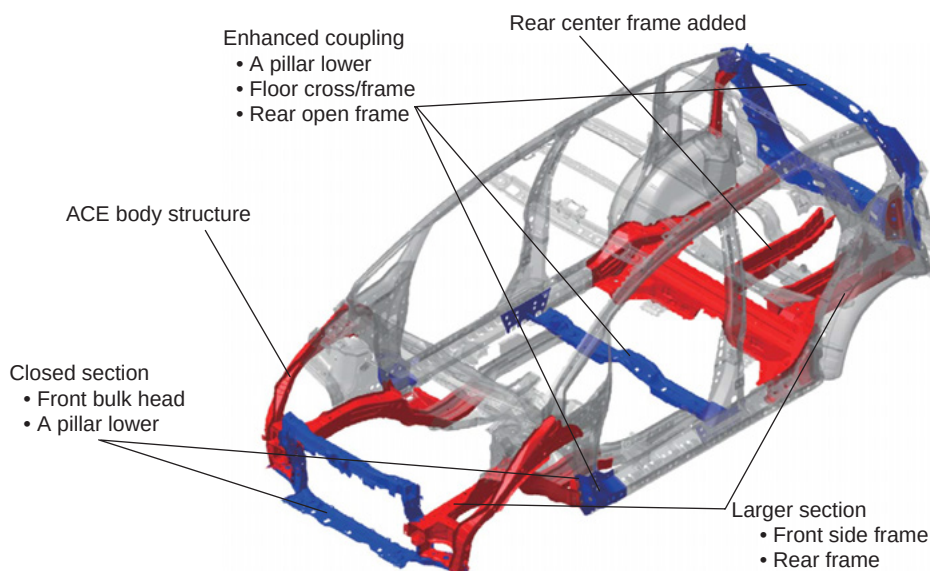


Fig. 18 High-rigidity body structure

in a continuing process aimed at achieving weight savings in units of grams.

The main points in this process were:

- 1) Realization of a larger cross-section for the body framework
- 2) Employment of an ACE (Advanced Compatibility Engineering) body framework
- 3) Addition of a rear center frame
- 4) Achievement of increased coupling efficiency
- 5) The use of a closed cross-section

In terms of dynamic performance, the use of an ACE framework and other measures employed have increased body rigidity by 164% against the previous model.

In addition, the rigidity of the rear suspension mounting has been increased by 27% (Fig. 19), resulting in the achievement of a level of body rigidity that rivals that of the CIVIC, a vehicle one class higher.

7.2. Steering System

In order to provide highly responsive steering, a high-capacity EPS system has been used exclusively for the North American model, and a quick ratio has been set. The rigidity of the gear box has also been increased, and a redesigned mounting method helps to ensure high support rigidity (Fig. 20).

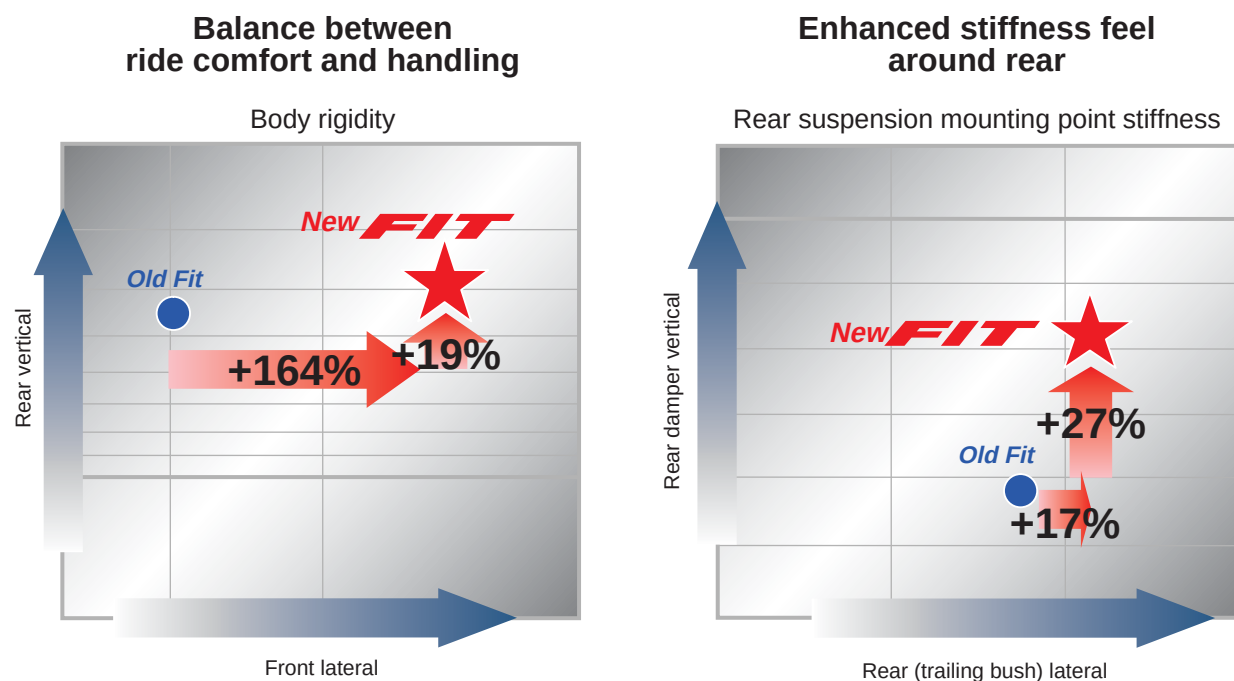


Fig. 19 Body rigidity

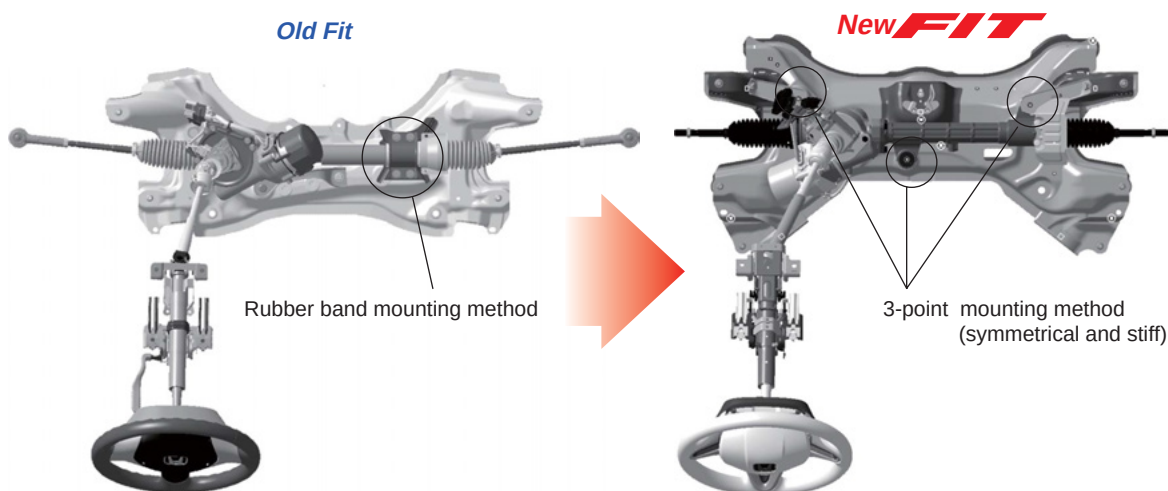


Fig. 20 Steering system

7.3. Suspension

The coaxial configuration of the compliance bushing axes with the supporting section of lower arm has reduced precession of the axes in the front suspension during the stroke, resulting in increased ride comfort (Fig. 21).

In the rear suspension, enhanced ride comfort has been achieved by increasing the length of the trailing arm by 40 mm and reducing the spring lever ratio by 10% (Fig. 22). The FIT Sport uses a $\phi 17$ rear stabilizer and sportier suspension settings. The capacity of the bushes has been increased in both the front and rear suspensions, and detailed attention has been paid to optimizing settings for the damping force of the dampers, and the like, resulting in the realization of sporty and responsive driving performance.

7.4. NV Performance

The targeted characteristic in the new model U.S. FIT was that of a “sporty feel in city driving,” and engine noise in various scenarios, for example when stopping and starting at traffic lights, would have an effect on the realization of this attribute.

In addition, in the North American market, the Fit, a vehicle falling into the low-displacement vehicle category, would often be called upon to operate at wide-open throttle, for example at highway convergences. Engine noise during acceleration at wide-open throttle was

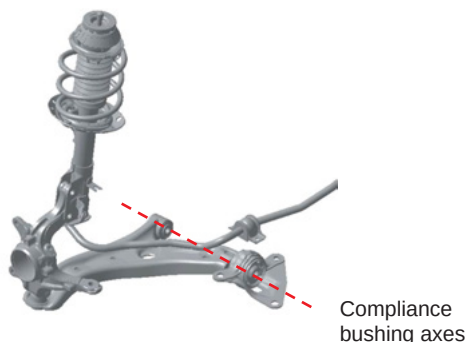


Fig. 21 Front suspension



Fig. 22 Rear suspension

therefore focused on in order to increase quietness.

Both methods of reducing input and of increasing vehicle body performance were employed in order to increase quietness. A torque rod engine mount that reduces radiated engine noise⁽¹⁾ was employed as a method of reducing input (Fig. 23).

As a method of increasing vehicle body performance, the previous sound-proofing materials were replaced by sound-absorbing materials, enabling quietness to be increased while achieving a 6.3 kg weight saving.

As a result, middle-frequency engine noise during acceleration in the frequently-used 3000-6000 rpm range has been reduced by approximately 5 dB (Fig. 24).

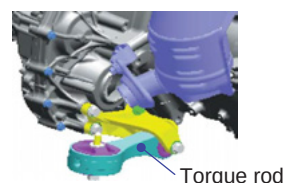


Fig. 23 Torque rod-type engine mount

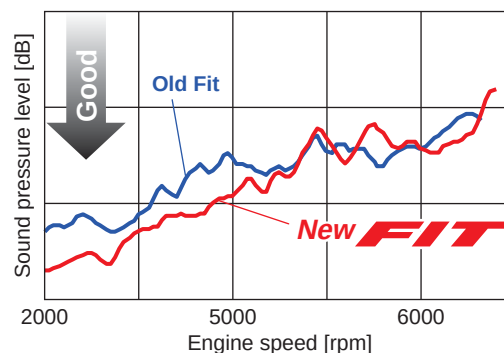


Fig. 24 Middle-frequency engine noise

8. Conclusion

During the period of development of the 2009 model year U.S. FIT, the level of changes in the global environment, users' awareness, and price of gasoline exceeded previous expectations, and the sub-compact car class came to assume a more important position, even in the North American market.

This is, of course, in line with the trend towards more economical and environmentally-friendlier vehicles. However, the development team also received the impression from numerous sources that these were not the only desires for the sub-compact class.

In order to respond to those desires, while maintaining the level of fuel efficiency and environmental performance that are basic factors in the appeal of the class, the development of the new FIT focused on fine details to

achieve a design and drive feel specifically tailored to the North American market, adding to basic performance parameters the achievement of a level of “Fun to Drive” and sense of quality that sets the FIT apart from competitors’ sub-compacts.

Honda is confident that the freshness of the new FIT will both surprise and please an increasing number of North American customers who have previously preferred larger, higher-displacement cars.

Reference

- (1) Tagishi, R., Sato, T., Kawaguchi, H., Hagiwara, Y.: Development of i-VTEC Gasoline Engine for 2008 Model Year FIT, Honda R&D Technical Review, April, 2008, p. 6-14

■ Author ■



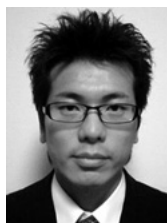
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