LANCER EVOLUTION X Chassis Technologies

Masaru OHUCHI* Takeshi YAMAMURA* Hiroshi OIKAWA*

Abstract

For the kind of driving pleasure targeted by Mitsubishi Motors Corporation with the LANCER EVOLUTION X, the platform was updated and new chassis technologies were developed. The suspension was fundamentally revamped in terms of layout and structure and was combined with wider treads* and 18-inch wheels, resulting in exceptional roadholding at all four tires and in concomitantly improved cornering performance and a high-quality ride befitting the new-generation LANCER EVOLUTION. In addition, larger-diameter brakes were adopted for superior stopping power and fade resistance and a superior pedal feel.

***: 30 mm wider than LANCER EVOLUTION IX**

Key words: *Sport Car, Motor Sports, Chassis, Vehicle Dynamics, Steering System, Stability, Suspension System, Shock Absorber, Damping, Wheel Alignment, Brake, Tire, Wheel, Handling, Ride Comfort*

1. Introduction

The LANCER EVOLUTION was developed as the base vehicle for rallies and other competitions, and has continued to evolve to the present. In recent years, however, there have arisen demands not only for high driving performance, but also for high-quality riding performance as well.

This time, along with the renovation of the platform, the entire chassis has been newly developed, aiming at the simultaneous realization of enhanced handling stability and high-quality riding.

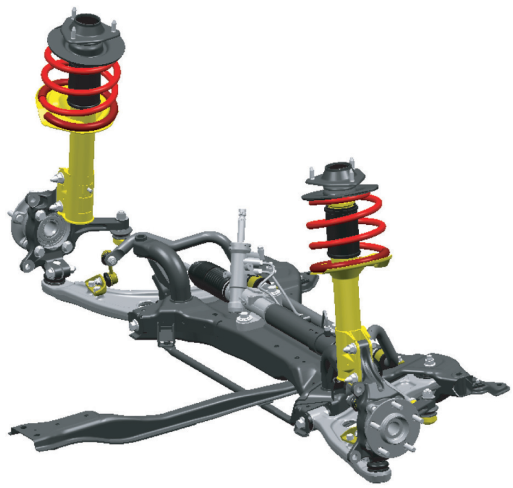

Fig. 1 Front suspension

2. Suspension

The suspension was designed with the aim of increasing the rigidity of each part and also optimizing the geometry for secure positioning of wheels. Also, a highly rigid, lightweight suspension was developed by selecting the right material for the right place and optimizing its construction. In addition, the road holding performance was increased in order to maximize the effectiveness of the Super All Wheel Control (S-AWC) integrated vehicle dynamics control system.

2.1 Front suspension

The front suspension was newly developed along with the evolution of the MacPherson strut which used the proven inverted strut (**Fig. 1**).

To cope with the increased various inputs and the improved cornering performance due to the adoption of 18-inch low-profile tires, steps were taken to increase the size of the hub unit bearings, increase the stiffness of the upper insulator that supports the strut, and also extensively increase the stiffness of the sub-members which correspond to the framework structure of the suspension (**Fig. 2** and **Fig. 3**).

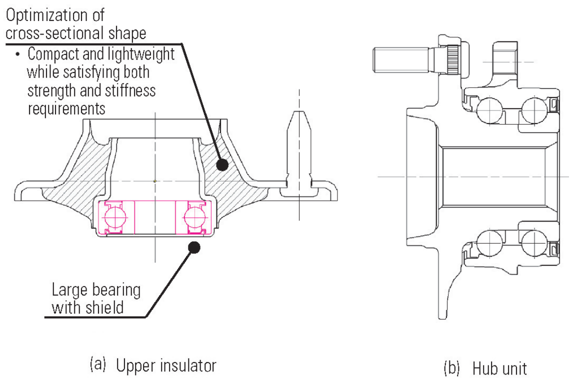

Fig. 2 Front stiffness-enhancing component

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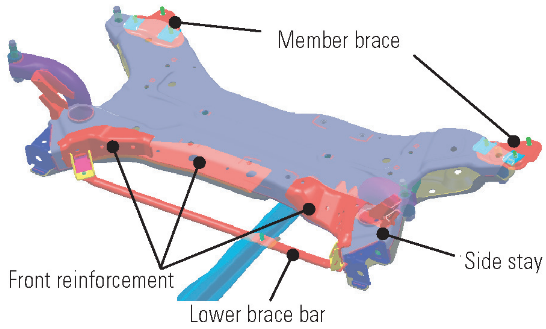

Fig. 3　Front stiffness-enhancing component

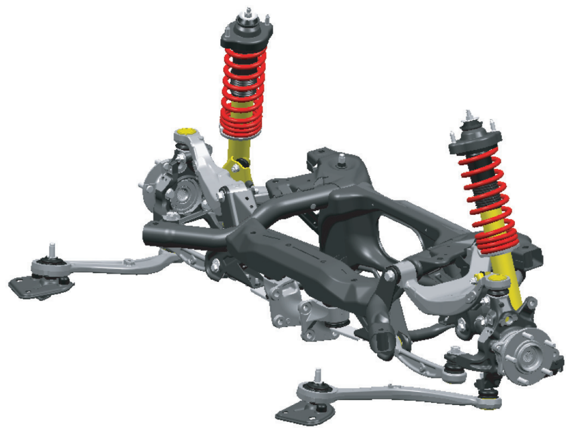

Fig. 4　Rear suspension

2.2　Rear suspension

A completely new suspension was developed which has a sub-member conforming to the new platform while following the design of the proven multi-link type used on the LANCER EVOLUTION IX.

The sub-member was connected securely to the body at six points, and the sub-member itself was also of a high-stiffness construction (**Fig. 4**).

Regarding the suspension arms, the support span between each arm was enlarged, the length and layout of the arms were made appropriate, and the high stiffness and change of alignment were optimized (**Fig. 5** and **Fig. 6**). The hub unit bearing was also enlarged, resulting in greater stiffness (**Fig. 7**).

Excellent road holding performance was realized by increasing the number of places where pillow balls were used and also by changing the mounting position of the rear damper from the lower arm to the knuckle (**Fig. 4** and **Fig. 7**).

By thus optimizing the construction of the suspension and increasing its stiffness, the handling stability - consisting of cornering limit, response and so on - and the riding performance - consisting of straight stability, riding comfort and so on - were simultaneously realized with relatively little compromise.

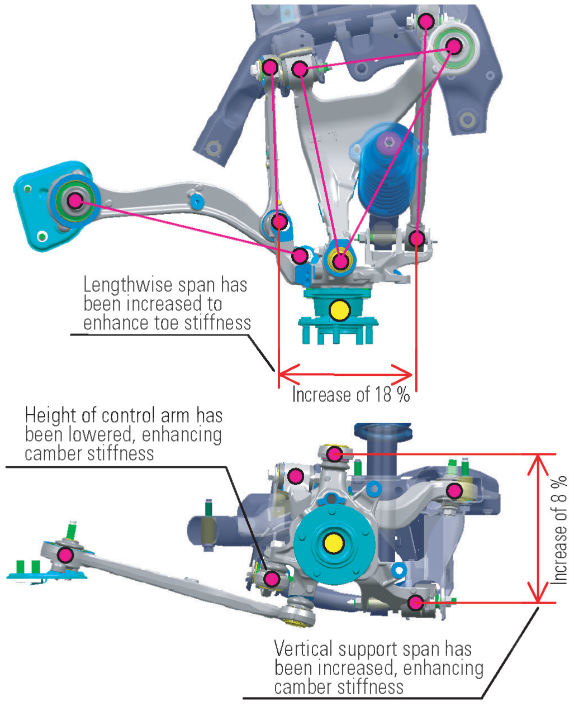

Fig. 5　Rear arm layout

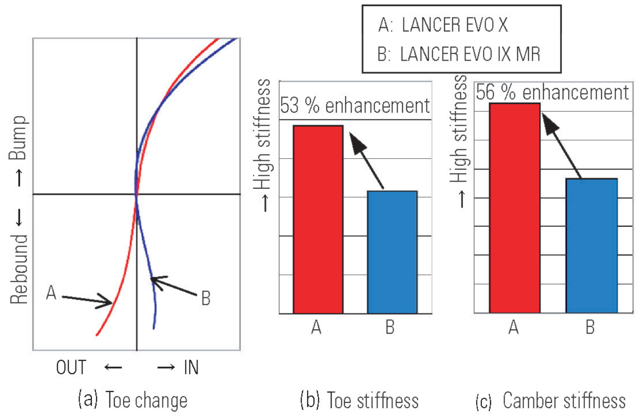

Fig. 6　Rear suspension characteristics

2.3　Power steering system

A hydraulic assist system was employed. By optimizing the assist characteristics and the steering gear ratio, a quick and high quality steering feeling was realized.

3.　Tires and wheels

3.1　Tires

245/40R18 low-profile wide tires were used. The necessary performance factors for high performance tires, consisting of handling stability, braking performance, wet performance, and quietness, were well-balanced against each other due to the newly developed asymmetrical tread pattern and the optimized inner structure.

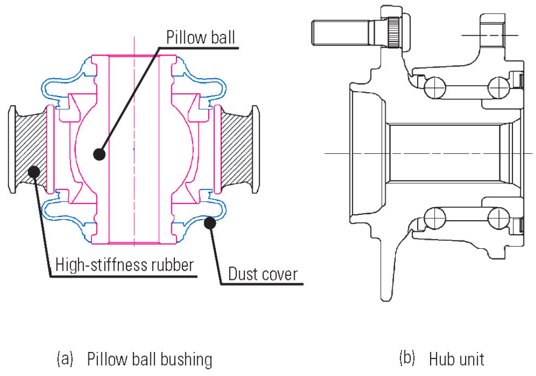

Fig. 7 Rear stiffness-enhancing component

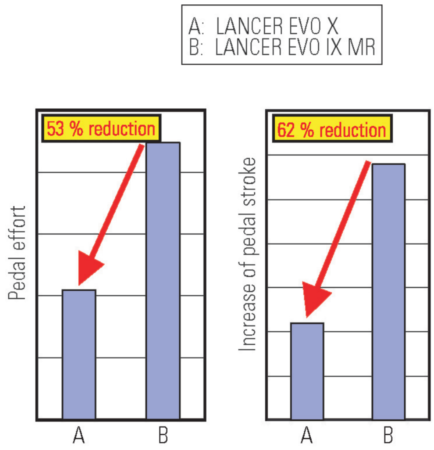

Fig. 8 Fade resistance during sport driving

3.2 Aluminum wheels

The rims of the aluminum wheels were processed by spinning process for increased material strength while reducing their thickness and weight. In addition, the rim shape and location of the spokes were optimized for highly rigid and lightweight wheels.

4. Brakes

4.1 Wheel brakes

The front brakes were 18 inches and the rear brakes were 17 inches, 1 inch larger than those for the LANCER EVOLUTION IX. The outer diameter of the rotor was set to ϕ 350 mm for the front brakes, and ϕ 330 mm for the rear brakes, thus increasing the fading resistance and effectiveness of brakes (**Fig. 8**). In addition, the caliper mounting rigidity and the characteristics and shapes of the pad and rotor were optimized for the reduction of squealing and judder (**Fig. 8**).

4.2 Highly rigid vacuum booster

Aiming at improving biting feeling at the initial braking stage, a linear increase in braking force, and enabling of an increase in the braking force when the brake pedal is depressed further in the high G deceleration zone, a through-bolt type 10-inch vacuum booster was adopted together with improving the wheel brake performance. By reducing the internal sliding resistance due to the adoption of a single booster and by suppressing the shell deformation due to the use of a through-bolt, reduced friction feel, reduced pedal effort at high fluid pressure, and higher rigidity were realized, enhancing the braking control performance (**Fig. 9**).

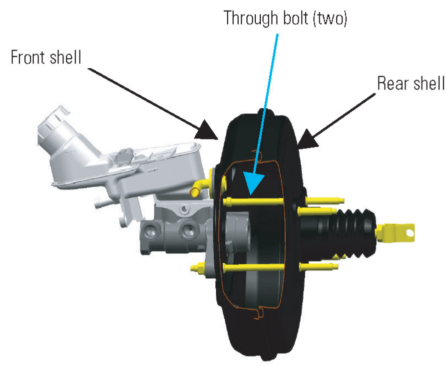

Fig. 9 High-rigidity vacuum booster

5. High performance items for MR grade

In order to realize higher performance, Bilstein dampers, Eibach coil springs, and 18-inch two-piece front disc rotors, were made available as MR grade.

5.1 Bilstein dampers and eibach coil springs

The reputable Bilstein monotube permits fine tuning of damping characteristics from the ultra-low speed range. Furthermore, coupled with the Eibach coil spring, it realizes a pliable suspension with good road holding performance (**Fig. 10**).

5.2 Two-piece disc rotor

It is a two-piece construction consisting of a separate friction rotor and hub mounting bell. Compared to a single piece construction, the weight of each rotor has been reduced by 1.3 kg. A floating construction in which the rotor and the bell are bolted together via a spacer is employed, and also the shape has been optimized, minimizing coning angle of the friction surface at high temperature and realizing good braking stability (**Fig. 11**).

6. Summary

It is expected that in the future demands will continue to be made for further increases in the level of chassis technology for the LANCER EVOLUTION, concerning which high targets have been set and realized for each generation.

Fig. 10 Bilstein damper, Eibach coil spring

Fig. 11 Two-piece disc brake rotor

The LANCER EVOLUTION is Mitsubishi Motors' leading car. To ensure that it also remains a leading car in the automobile industry, efforts aimed at technical innovation will continue to be made in the future.

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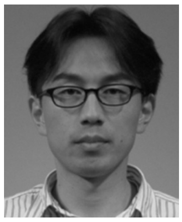

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