

Presentation of 2006 Model RC211V

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ABSTRACT

A full model change of the RC211V was performed, in order to achieve highly controllable handling and enhanced cornering performance. The engine used in the new model is based on the light, compact, and high output V-type five-cylinder engine, which is the backbone of the RC211V, and has been made more compact and lighter. The entire completed machine has been re-designed for greater mass concentration, and the frame and suspension dimensions have been modified, enabling the moment of inertia of the overall machine to be reduced. In addition, the adoption of the Honda Intelligent Throttle Control System II (HITCS II), which electronically controls the fuel supply system for only two of the five cylinders, has enhanced maximum output and increased fuel economy and throttle controllability. In addition, the side area of the fairing has been reduced, resulting in greater handling performance.

Based on these results, a stable racing machine with high potential performance has been developed.

1. Introduction

The RC211V⁽¹⁾, which entered the Moto-GP race in 2002 and held the title for two consecutive years until 2003, lost the title for two consecutive years in 2004 and 2005. A study was performed to acquire the title once again. In the case where evolution due to only detailed changes in the machines that raced until 2005 was considered, it was believed that although the various kinds of electrical control could be evolved, the potential performance was not able to be enhanced. For this reason, it was decided to simultaneously develop a model in which the dimensions of the body were changed. The 2006 race was fought with two kinds of RC211V, an enhanced version (original) of the 2005 model and a new generation model that had undergone a full model change. Set out below is a description of the technology that is applicable to the new generation RC211V.

2. Development Concept

A Moto-GP class machine consists of a 148 kg machine fitted with an engine of a maximum output

exceeding 180 kW.

Even if the maximum output of the engine is high, unless it has usable controllability, it will not have potential performance. The 2005 model RC211V was reliable in respect of total performance and had basic potential performance, however, it had insufficient stability during deceleration compared to rival machines, and because of this there were issues concerning cornering speed enhancement, and there were races in which the rider's skill could not be adequately utilized.

Based on these issues, it was decided to focus on highly controllable handling and enhanced cornering for the 2006 model. The development concept employed was the enhancement of total performance, which was intended to further controllability of the completed machine. The main three items of this concept were as follows.

- * Enhanced deceleration performance
- * Enhanced cornering performance
- * Enhanced traction performance

In order to realize these performance factors, it was necessary to newly design both the engine and the chassis, so a new generation machine was developed (Fig. 1).

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Table 1 Major specifications

Item	Specifications	
Overall length (mm)	2050	
Overall width (mm)	645	
Overall height (mm)	1130	
Wheel base (mm)	1440	
Vehicle dry mass (kg)	Over 148	
Engine type	Liquid cooled 4-stroke DOHC V-5 cylinder	
Valve train	DOHC 4-valve	
Engine displacement (cm ³)	990	
Max. power (kw/r/min)	Over 180	
Fuel supply system	PGM-FI	
Ignition system	Digital CDI	
Transmission	6-speed constant mesh	
Clutch type	Dry multi-plate type (hydraulic)	
Fuel tank capacity(Liter)	22	
Frame type	Aluminum twin tube	
Tire size	Front	16.5
	Rear	16.5
Suspension	Front	Telescopic
	Rear	Unit pro-link



Fig. 2 2006 RC211V external view

4. Engine

The engine was not based on the models of the RC211V up to 2005. Rather, all of the parts, including the crankcase, were newly designed for making a light, compact engine. Figure 3 shows a comparison of the size of the 2005 and 2006 model engines.

By redesigning the engine details, the distance between the crankshaft and the transmission countershaft was reduced by 27 mm, the front cylinder was inclined 6° to the rear, and the length of the connecting rod was reduced by 4 mm, as well as the height of the cylinder head by 6 mm, each cylinder pitch by 5 mm, and the crankshaft width by 21 mm.

As a result, the length of the engine in the front-rear direction has been reduced by 60 mm and its width by 30 mm, compared to the existing V5 engine, which is highly appraised for its potential performance, without increasing the height of the engine. Weight was reduced by 7%, which contributes to the performance of the completed machine, and friction at each part was also reduced, enhancing the maximum output and torque. The resulting engine characteristics enabled the acceleration performance to be further increased. Figure 4 shows a comparison of the output characteristics of the 2006 model and that of the 2005 model.

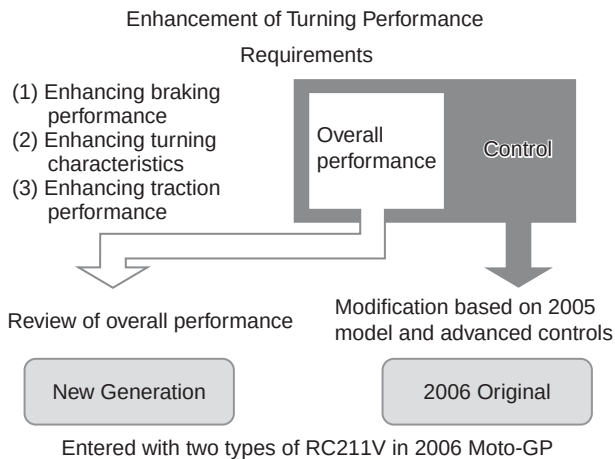


Fig. 1 Development concept

3. Model Outline

Table 1 shows the main specifications of the RC211V and Fig. 2 shows the exterior.

In order to enhance the deceleration performance, cornering performance, and traction performance, it is necessary to reduce the moment of inertia of the completed machine. To this end, it is necessary to concentrate the mass and change the frame and suspension dimensions. The most effective way of achieving this, while keeping the wheel base within that of the 2005 model, was to redesign the engine, which is the heaviest part of the machine and is located at the center of the chassis. This was an important point concerning the performance of the completed machine.

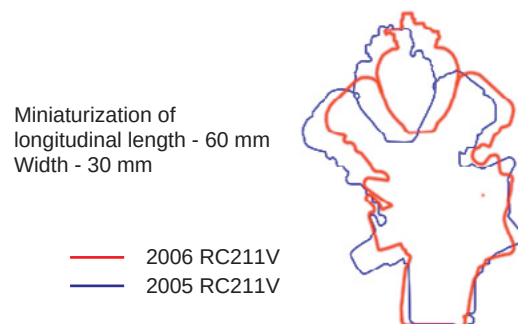


Fig. 3 Comparison of engine size

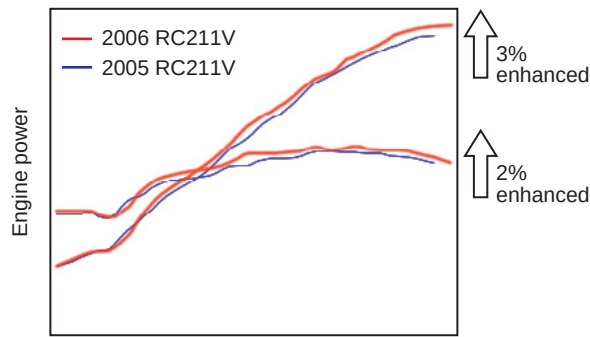


Fig. 4 Engine performance curve

5. Fuel Supply System

Fuel economy and throttle controllability are important items, and efforts were made to enhance both features. In order to achieve higher throttle controllability, it is necessary to perform finer throttle control.

In contrast to the uniform control of all cylinders (variable relaxation control) employed in conventional models, the Honda Intelligent Throttle Control System II (HITCS II), which controls the throttle of the front and rear banks independently, was newly adopted. In order to independently control the front bank, the HITCS II controls the three cylinders of the front bank by conventional throttle control (variable relaxation control), and controls the two cylinders of the rear bank by full electric control (motor drive). Compared to uniform throttle control of all five cylinders (variable relaxation control), control that conforms to the demands of the rider

in situations where fine throttle control is required at the commencement of the opening of the throttle can now be performed, for example.

As a result, even though the maximum output of the engine was enhanced, the fuel economy was the same as that of the 2005 RC211V. The structure of HITCS II is shown in Fig. 5, and the throttle control of the front bank and rear bank is shown in Fig. 6. In the region where the engine speed in 1st to 3rd gears is lower, the throttle opening of the rear bank is limited. Figure 7 shows the operating situation of the throttle opening and the increase in speed of the wheels. It indicates that by controlling the front and rear banks separately, the rotational speed of the rear wheel increases smoothly.

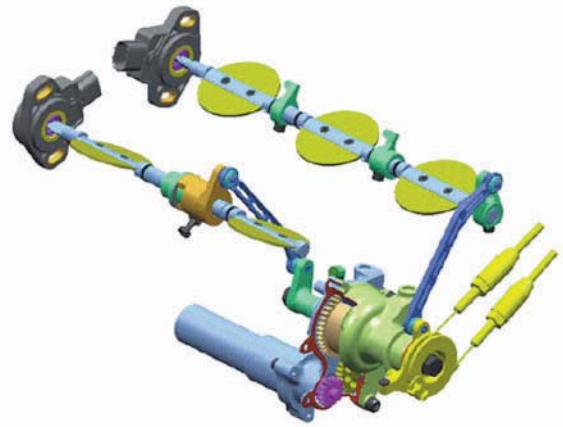


Fig. 5 Structure of HITCS II

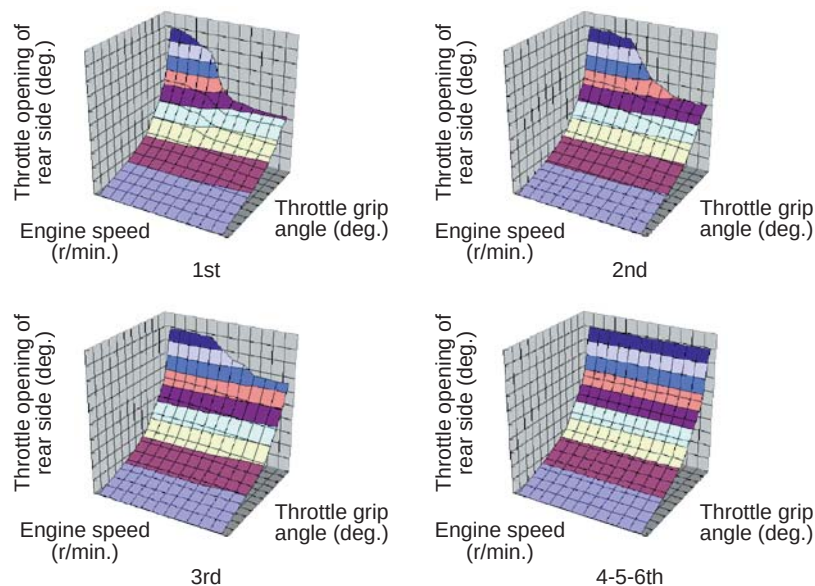


Fig. 6 Maps of front and rear throttle valve control

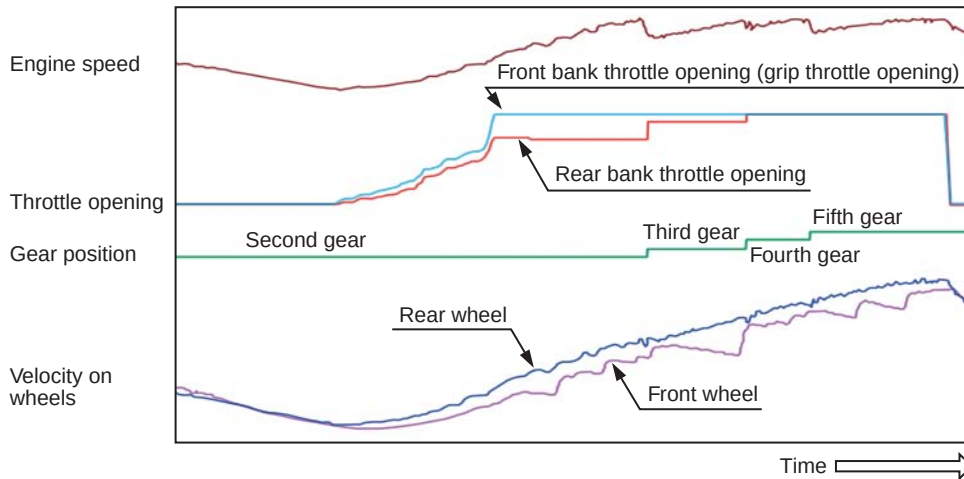


Fig. 7 Controlled throttle opening and wheel rotations

6. Frame

The compact, lightweight engine is mounted on a newly designed frame.

The dimensions of the frame were determined with the objective of enhancing the traction performance from deceleration to acceleration while enhancing the stability during deceleration. The greatest feature of the frame is the long swing arm fitted inside the wheel base, which is the same as that of the 2005 RC211V.

In general, when the wheel base is longer, the traction is enhanced, but the cornering performance decreases. When the wheel base is shorter, the cornering performance increases, but the traction performance decreases. In order to obtain dimensions that satisfy both of these characteristics, the reduced engine size was effectively utilized in the body design. Figure 8 shows a schematic diagram of the overall body.

Like the compact engine, the main frame was also made compact. At the same time, stiffness analysis using CAE was performed in order to clarify the parts of the frame that affected steering stability, and actual running tests were performed to determine the optimum stiffness balance. Figure 9 shows a comparison of the frame layout, and a comparison of stiffness between the 2006 and 2005 models.

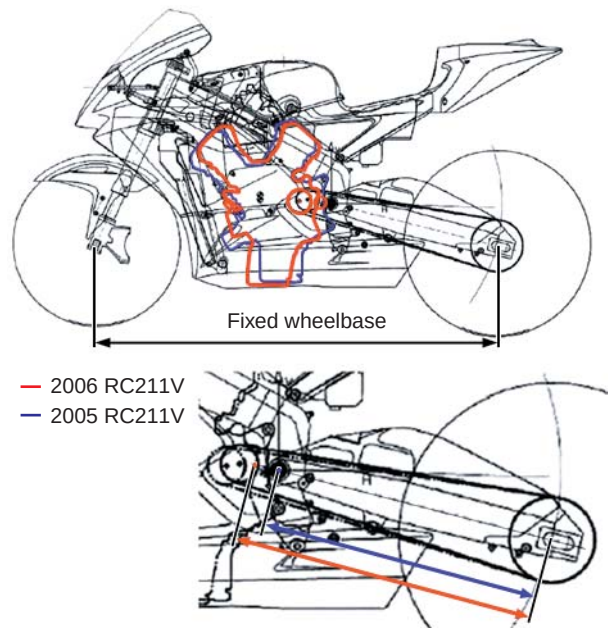


Fig. 8 Engine position and swing arm length

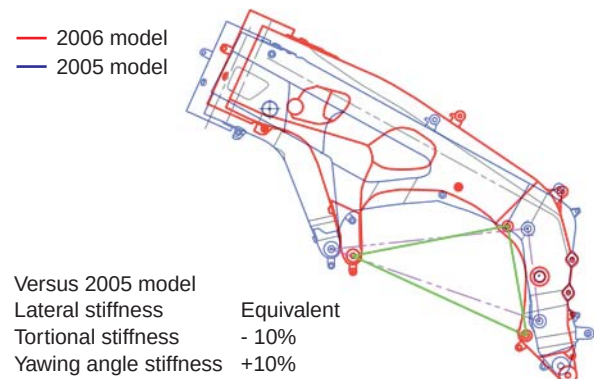


Fig. 9 Frame body

In order to transmit the drive force from the engine to the ground, and enhance the cornering performance, the rear suspension and the swing arm were also newly designed. The objectives of this were to increase the stability when the machine was decelerating due to reduction of friction, and to enhance traction performance.

The rear cushion was located in the downward direction of the body, and the installation point at the top

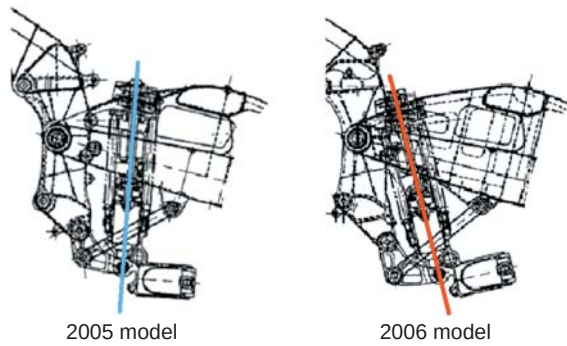


Fig. 10 Comparison of unit pro-link

of the rear cushion was brought near the pivot. In the design, the distance between the pivot and the link mounting part was increased, and the load at the link portion was reduced by at least 10% in order to reduce friction. Figure 10 shows a comparison of the unit pro-link mechanism of the 2006 model and that of the 2005 model.

8. Aerodynamic Performance

In the 2005 model, the side face area was reduced to enhance cornering performance. In the case of the 2006 model, many wind tunnel experiments were performed with a view to optimizing the profile, and light handling, stability in crosswinds, low air resistance, and wind protection were all satisfied. As a result, enhanced handling performance was realized while the same air resistance value as those of the 2005 RC211V were attained. Figure 11 shows a comparison of the side area of the fairing.

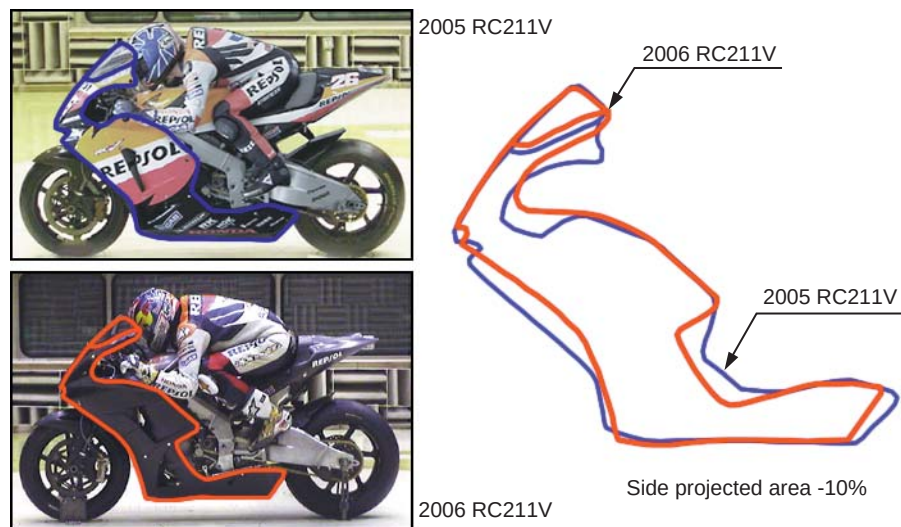


Fig. 11 Comparison of fairing

9. Results Achieved

The moment of inertia of the entire machine was reduced by 0.9% in the roll direction, 0.5% in the yaw direction, and 3.4% in the pitch direction. Also, the stability during deceleration, cornering performance, and traction performance were enhanced (Fig. 12).

The enhanced running stability during deceleration appears in the running data as a fluctuation of the engine speed or rear wheel speed. The 2006 RC211V exhibits less fluctuation of engine speed during deceleration, compared to the 2005 RC211V. The subsequent throttle opening has also increased, and the cornering speed has increased. These results are shown in Figs. 13 and 14, which show the running measurement data.



Fig. 12 Result of moment of inertia

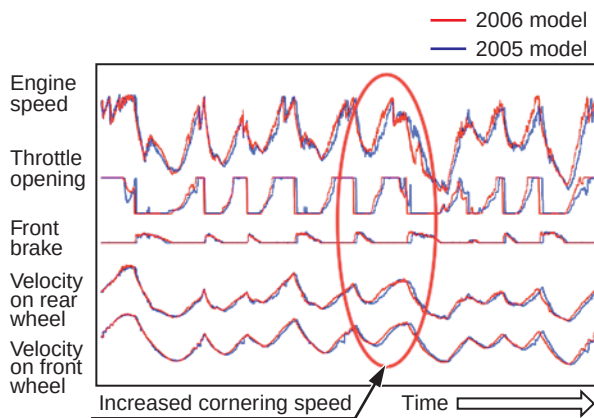


Fig. 13 Comparison of engine speed and wheel speed fluctuations in actual race

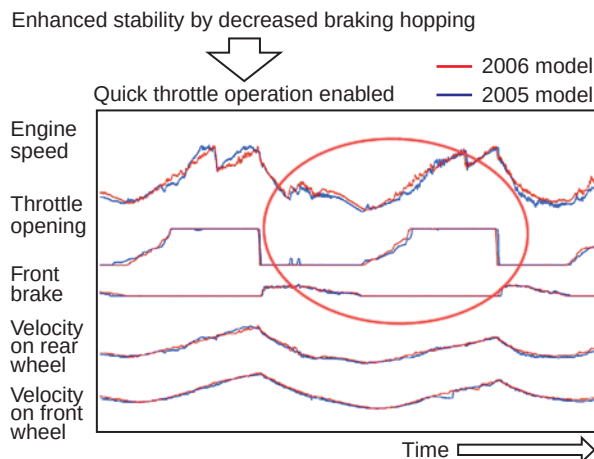


Fig. 14 Comparison of engine speed and wheel speed fluctuations in actual race (Enlarged detail)

10. Conclusion

The 2006 RC211V has achieved reduced moment of inertia of the entire machine due to the larger changes in the dimensions of the frame and suspension. The changes made to the electronic control of the fuel supply system have enhanced the maximum output, and enhanced fuel economy and throttle controllability. Also, deceleration performance, cornering performance, and traction performance, which were issues, have been enhanced in accordance with these objectives. As a result, this machine successfully regained the 2006 Moto-GP class rider's and manufacturer's titles.

Along with the change in the regulations in 2007, the RC211V will no longer be eligible to race, however the RC series will continue to take up technical challenges as an image leader of Honda super sports and as a symbol of challenging spirits.

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Reference

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