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Development of Active Aero Devices for Efficient Wind Tunnel Tests

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As fuel and electricity consumption increase further in the times ahead, it will be necessary to enhance the aerodynamic performance of vehicle bodies. To that end, it is important to enhance the efficiency of wind tunnel testing to enable more aerodynamic validations to be performed within limited development periods. Wind tunnel testing repeatedly goes through the procedure from (1) starting the fan and standing by until the wind speed becomes stable, then on to (2) making aerodynamic measurements using balances, (3) stopping the fan, and (4) making appropriate changes to the vehicle body shape. The time taken in (4) can be shortened by mounting mechanical devices in a mockup and changing the shape by remote operation. With this approach, stop the wind also becomes unnecessary since the workers no longer need to enter the wind path, so the processes of (1) and (3) can be reduced and testing can be made more efficient. In this research, mechanisms for changing the shapes of the front (Fr) strake and rear (Rr) spoiler were developed.

For the mechanism of the variable Fr strake device, the multiple moving strip structure (Fig. 1) and the X-direction moving mechanism (Fig. 2) were developed. The former changes the strake width in the Y direction, its height in the Z direction, and its position in the Y direction. The latter changes its position in the X direction. When the developed devices were used in a wind tunnel to measure the aerodynamics of 39 shapes, the time taken was approximately equal to the time taken to measure four shapes by the conventional method.

For the mechanism of the variable Rr spoiler device, the spring-coupled underactuated beam structure (Fig. 3 a) and the split skin (Fig. 3 b) were developed. The former device becomes the internal frame structure for the spoiler shape when the length and angle are changed by the device. The latter device is the skin structure that maintains rigidity while allowing expansion and contraction. By being fixed over the internal frame of the former device, it can generate the surface shape of the spoiler. The developed device was used in a wind tunnel to measure 11 shapes, and the time taken was equal to the time taken to measure about one shape by the conventional method.

It was confirmed that, compared to the conventional method, it was possible to measure 10 times the number of proposed shapes within the same period of time(Fig.4).

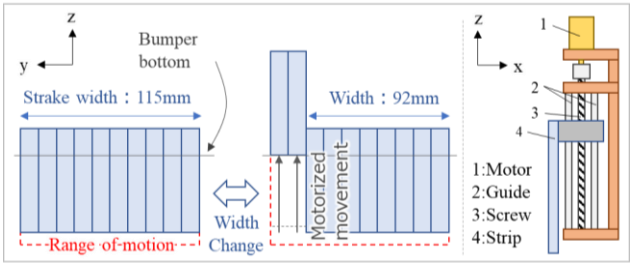


Fig.1 Moving strip mechanism

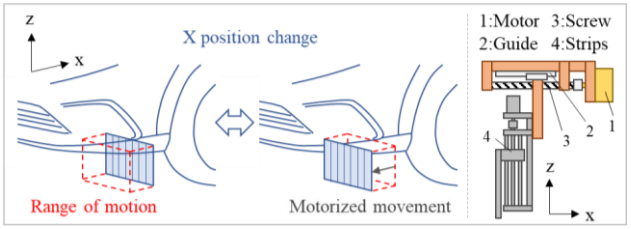


Fig.2 X-direction moving mechanism

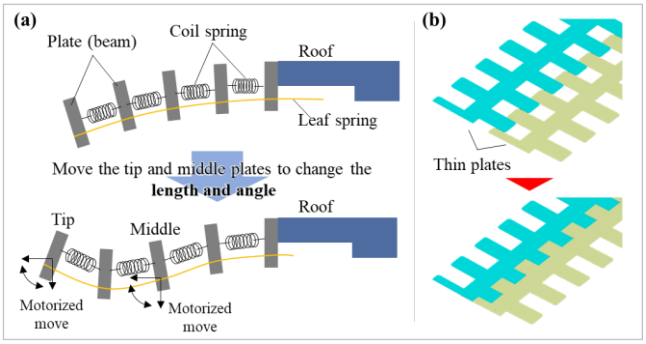
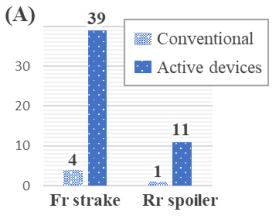


Fig. 3 (a) Underactuated beam structure
(b) Split skin structure



(B)

	Conventional	Active devices
①Blower start	12	0
②Measurement	5	5
③Blower stop	12	0
④Shape change	71	4.5
Total	100	9.5

Fig.4 (A) Number of tests within same period of time
(B) Time for each test process when the total time for the conventional method is 100