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Motorcycle Safety Research

Part 1: Overview by Mr. T. Shigetomi

1.1. Introduction

Fig. 1:

Honda's global motorcycle sales exceeded the 10 million units mark since 2004, and further expansion is expected. As a responsibility for a company to provide mobility, Honda is focusing on motorcycle safety as top priority and has been working on various activities for both aspects of hardware and software.

1.2. Honda Safety Concept

In Fig. 2 Honda's activity for the safety technology of motorcycles is shown. At present, Honda is promoting motorcycle safety in the four themes of prevention and collision safety such as safety education, recognition assistance, accident prevention and injury reduction.

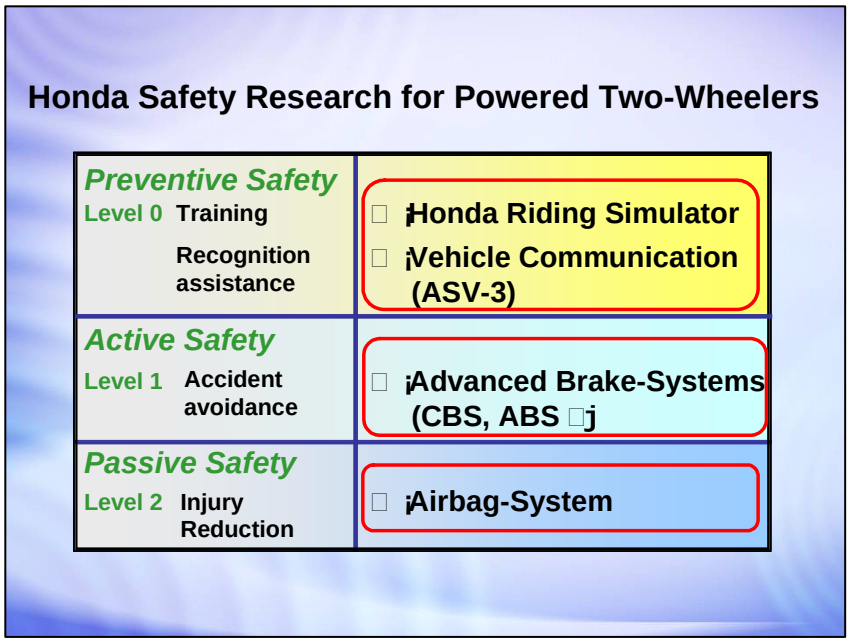


Fig. 2:

1.3. Preventive Safety

First, in the area of the safety education, the “Honda Safety Driving promotion Center” was established in 1970, and motorcycle riders and vehicle driver trainings have been organized, and such traffic training activities are used as an actual practice field not only in Japan but also in many other regions in the world.

Fig. 3:

Through our training activities, the new area of safety training with hardware assistance was developed and Honda’s unique technology was accumulated such as the riding simulator which can provide experience of potentially dangerous situations without risk.

Especially, the “riding trainer”, the popular version of the riding simulator, was introduced at several motor shows in various countries and launched in September 2005. It was distributed first in Europe and is expected to expand globally aiming at 3000 units worldwide. And in Europe, the newest version, which includes the suburban roads program, jointly developed with ADAC, will be

released in near future.

Fig. 4:

In the area of recognition assistance, “vehicle to vehicle communication technology” is under development using the advantage of being a manufacturer of both motorcycles and cars. This technology is under research as Honda “ASV-3” in Japan, and as part of C2C activity in Europe.

Fig. 5:

1.4. Active Safety

As for the accident prevention, advanced brake systems for motorcycles to assist more effective brake operation have been expanded, Honda signed the European Road Safety Charter in April 2004 with the advanced brake systems commitment and furthermore, they are expanding according to vehicle characteristics and region. Then all models above 250 cc will have a version

of the system by 2010.

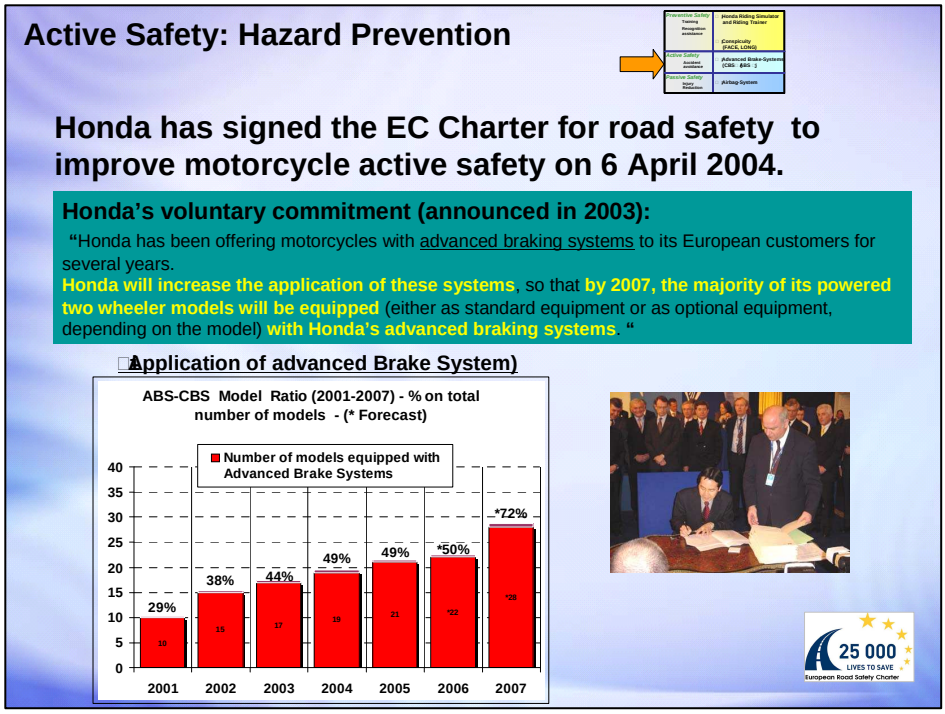


Fig. 6:

1.5. Passive Safety

And as the last theme, "motorcycle airbag system" is introduced which is equipped on a mass production motorcycle for the first time in the world. It has been researched and developed for a long time as an injury reduction technology for collision accidents.

Fig. 7:

Honda automobile technology was used for the research and development of the motorcycle

airbag, and many specific issues such as the analysis of the collision conditions particular to motorcycles have been solved to realize today's success.

Fig. 8:

It might be known that ADAC in-house crash test held in August this year confirmed the high effectiveness of the airbag system and showed a positive result.

Fig. 9:

This motorcycle airbag system is equipped to the Honda Gold Wing and launched in North

America in August, 2006. Also in Europe, it will be sold by the end of this year.

Part 2: Technology presentation by Mr. T. Yamazaki

2.1. Preventive Safety: Honda Riding Trainer

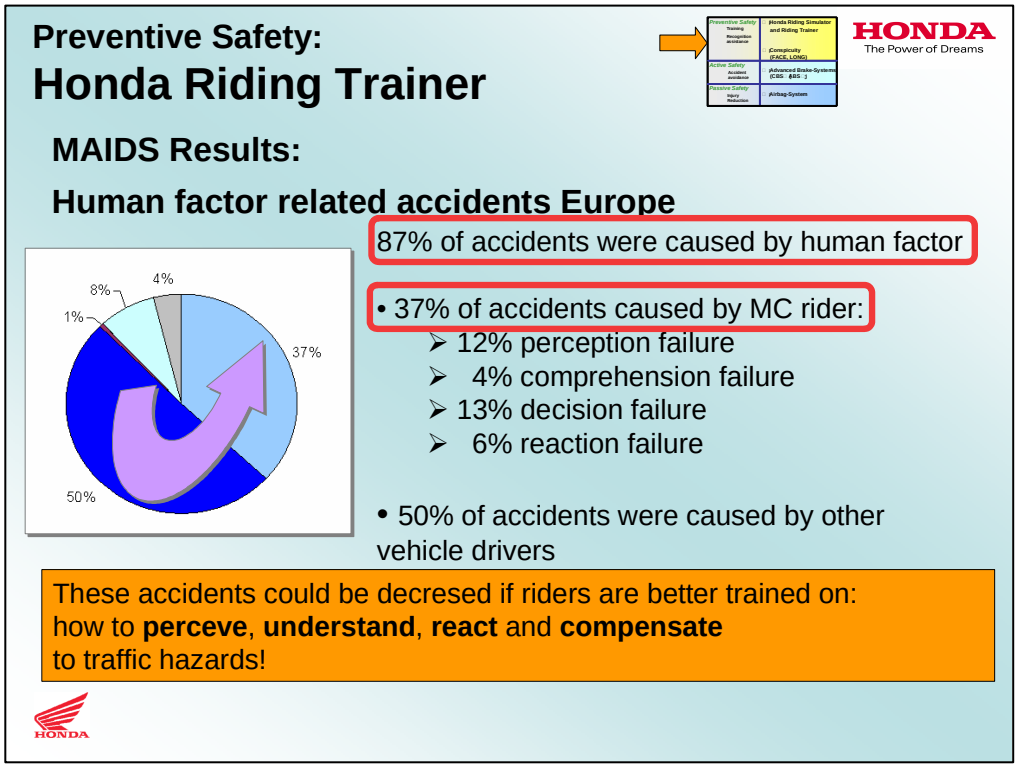


Fig. 10:

An analysis of European motorcycle accidents according to the MAIDS study (Motorcycle Accident In depth study) shows that:
- almost 90% of accidents were caused by human factor and
- almost 40% were caused by MC rider's fault

Therefore, the education for hazard detection is very important.

Preventive Safety:
Honda Riding Trainer

HONDA
The Power of Dreams

In the schools, driving schools, training centres, safety education facilities and in dealers' showrooms we can teach:

- **The basic hand and foot control co-ordination (brake, clutch, throttle)**
- **"Safely Experience hidden dangers in mixed traffic" to improve rider's ability to recognize hazard (risk awareness)**

Characteristics

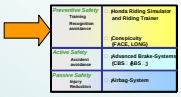
1. **Simulates risky situations in mixed traffic**
2. **Riding unit responds in real time to rider input**
3. **Lively pictures and sounds**
4. **Play back facility to improve educational effect**
5. **Printout generated of obtained result**
6. **Easy operation**
7. **Can be used with many students at once by connecting to a projector**

demonstration in Paris Salon September, 2005

Fig. 11:

The Riding Trainer can be used in various occasions. It provides the basic operation elements of a MC. It is a useful tool for the training of hazard perception without any risk. It features several characteristics such as simulated risky situations in mixed traffic, response of the riding unit which responds in real time to rider input and a printout of the result obtained.

Preventive Safety:
Honda Riding Trainer



HONDA
The Power of Dreams

Fig. 12:

During the training process, riders may experience an accident. Immediately after the accident, the Riding Trainer can replay the accident scenario. So the rider can understand what the cause was

and how to improve his behavior.

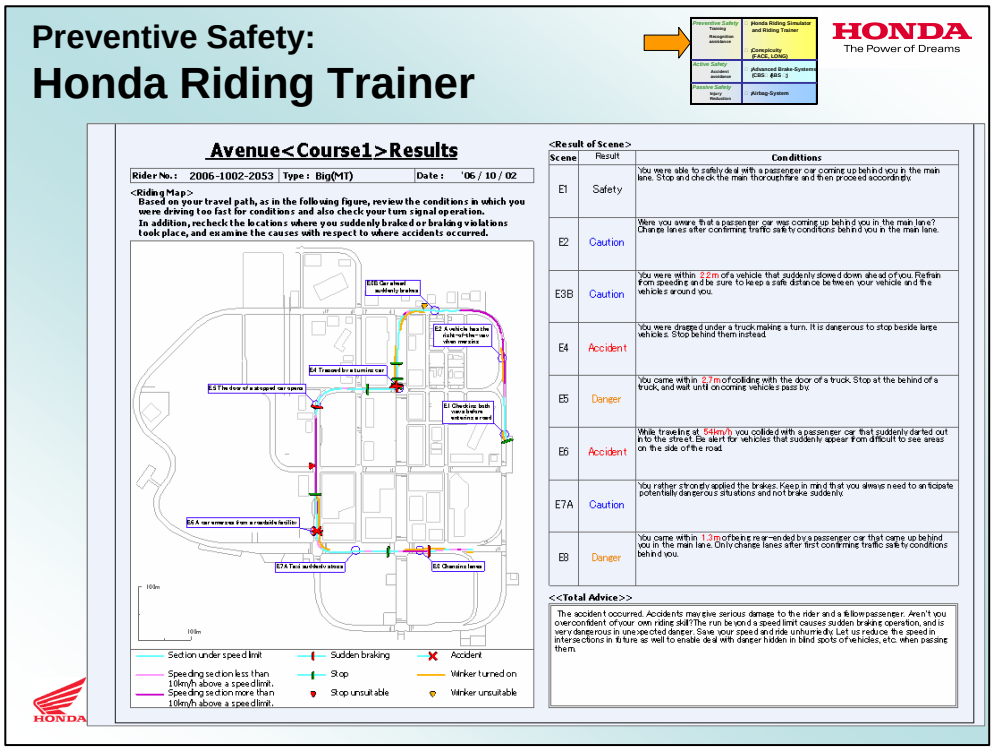


Fig. 13:

At the end of the training, the rider will receive a result sheet. This shows the result in several key points with status and explanation. And finally, he will get a comment for his whole training

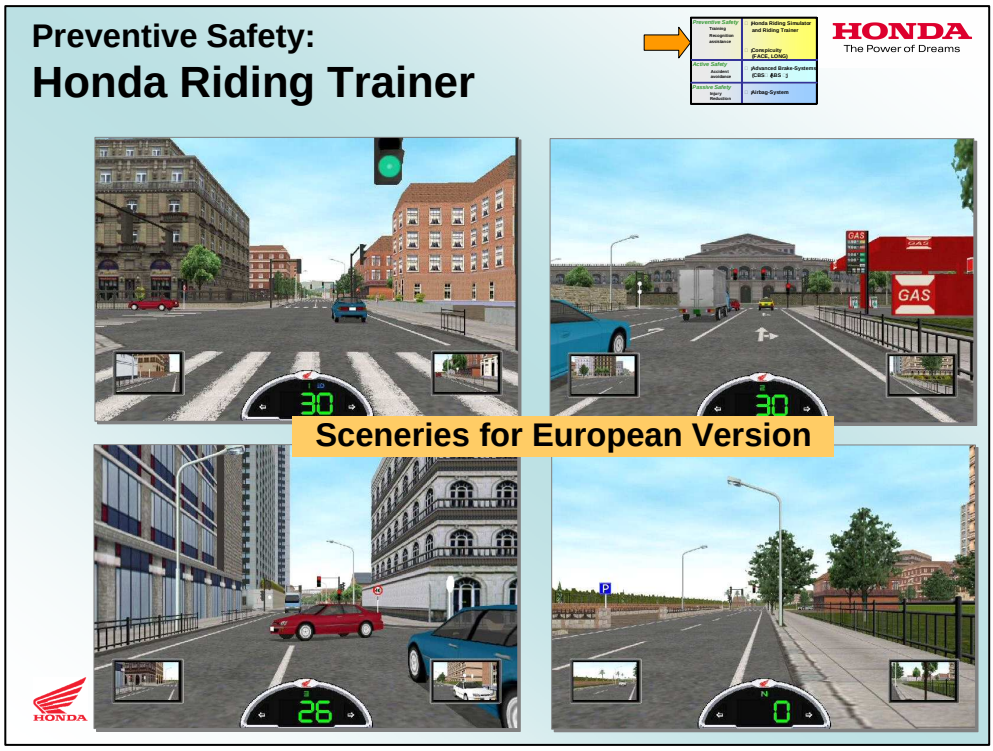


Fig. 14:

Honda is making efforts to expand the Riding Trainer e.g. by preparing various sceneries for each region. In Fig. 14 such typical scenes for European conditions are displayed.

2.2. Preventive Safety: "LONG" lighting system for better conspicuity

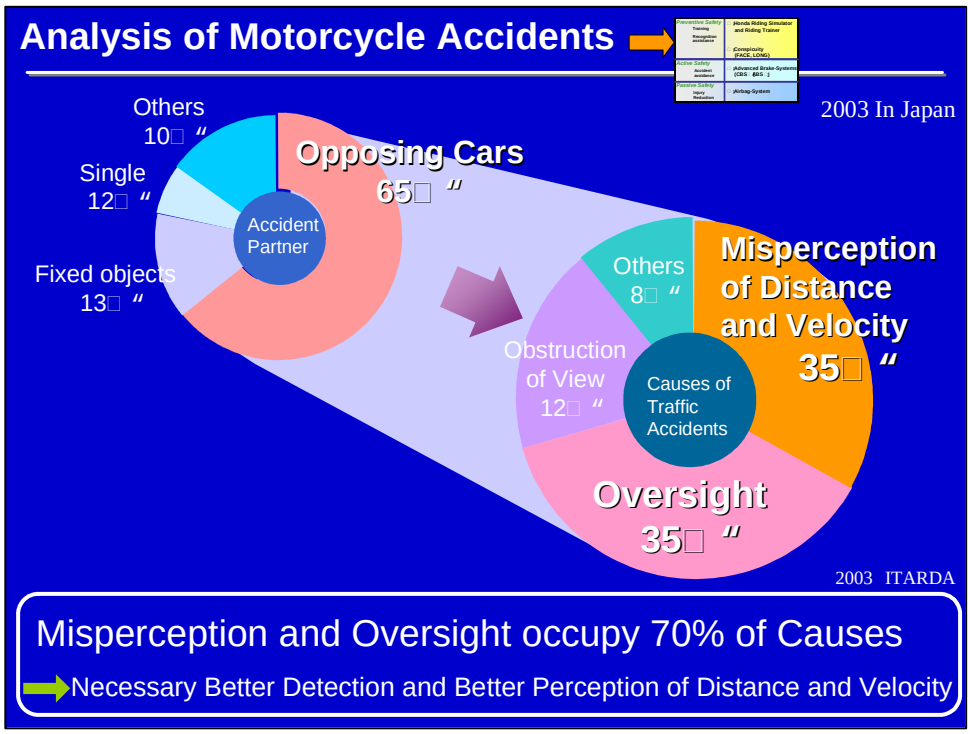


Fig. 15:

In the accident analysis, looking at the accident partners, 65% were opposing cars and most of accidents were caused by misperception of distance and velocity, and oversight. So, better detection and better perception of distance and velocity are important and necessary.

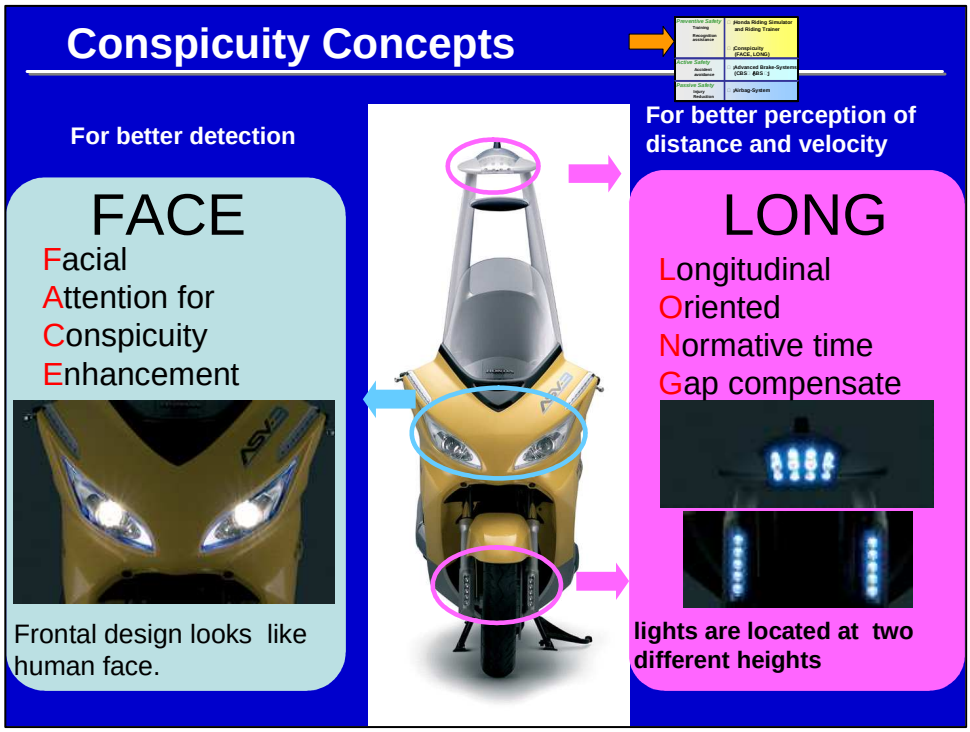


Fig. 16:

Honda is proposing two design concepts to improve motorcycle conspicuity. The left one is called “FACE”. It is a special technology for better detection reminding a face pattern. Human beings seem to have a special ability to detect face patterns and to distinguish them from others. This approach utilizes this ability. The right one is called “LONG”. With its additional lights at two different heights it supports a better perception of distance and velocity. The background is as follows.

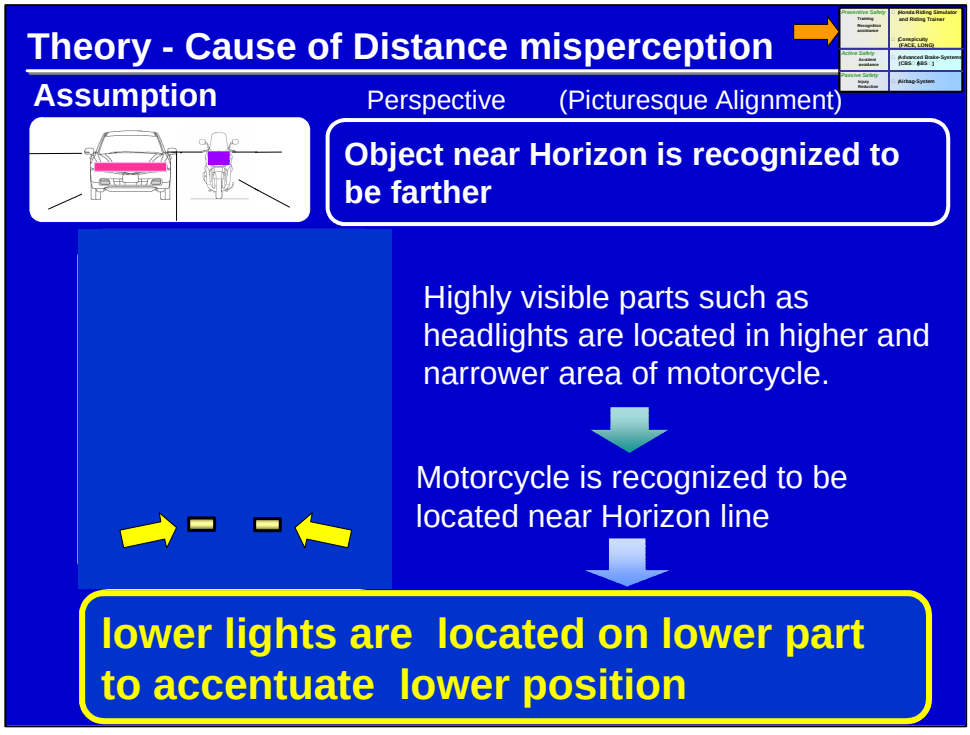


Fig. 17:

Looking at Fig. 17, which vehicle seems to be nearer? It is known that objects near the horizon are recognized as further than its actual location. In our assumption, a motorcycle's frontal lights, highly visible parts, such as a headlight are located in a higher and narrow area.

So we can say that a motorcycle is located near the horizontal line. Therefore, motorcycles may be recognized to be further than in their actual position. To accentuate the lower part of MC, we also added the lights in lower position.

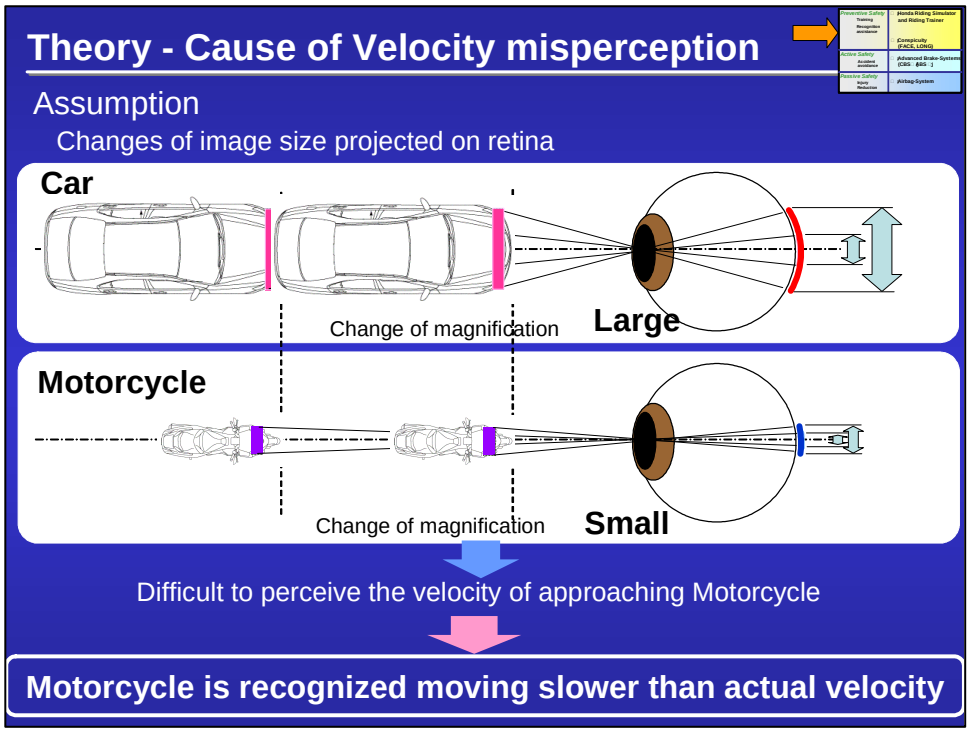


Fig. 18:

Fig. 18 shows the assumption of misperception of the velocity of a motorcycle. In case of a car, a change of the image size on the retina is large. However, in case of a motorcycle, the change is very small. So, a motorcycle may be recognized slower than its actual speed.

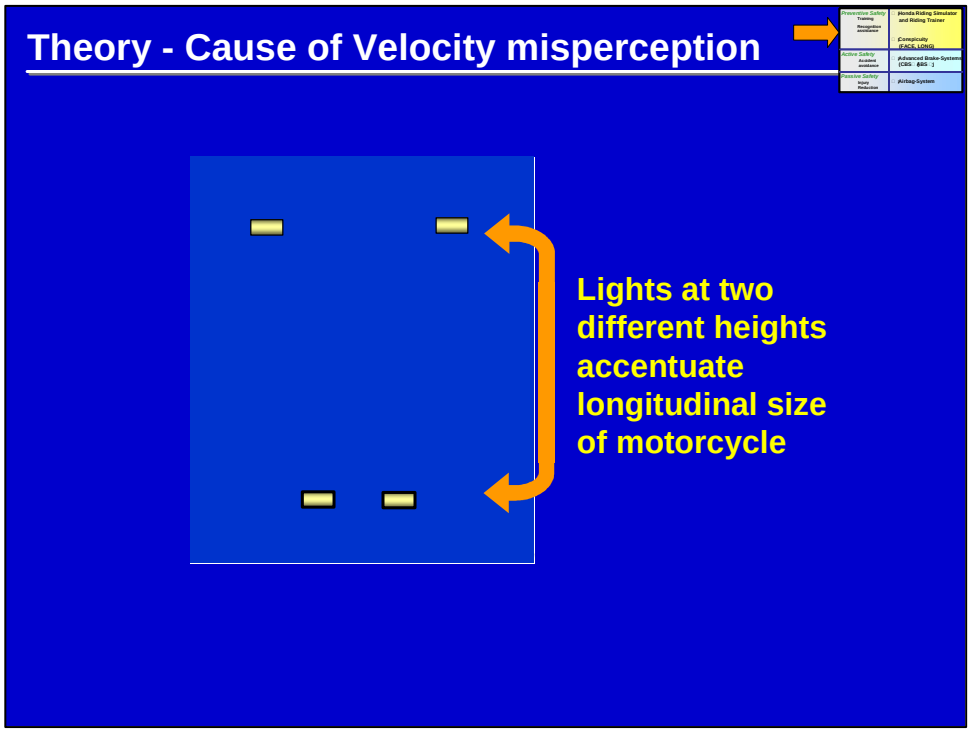

Theory - Cause of Velocity misperception
Lights at two different heights accentuate longitudinal size of motorcycle

Fig. 19:

So we locate additional lights at different height position to accentuate the longitudinal size of a motorcycle.

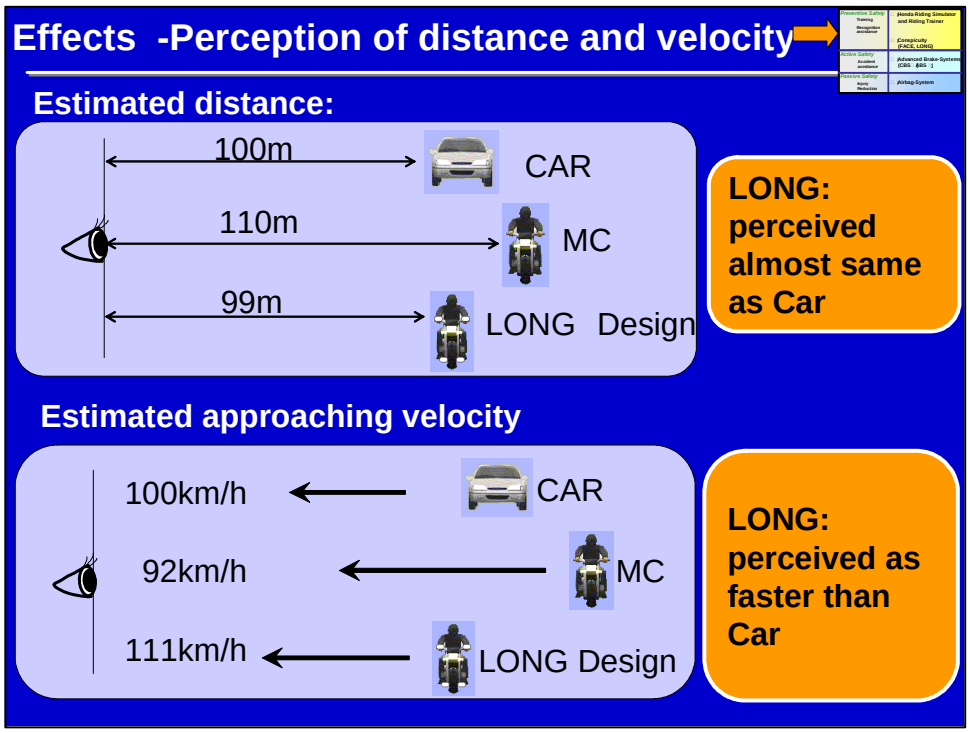


Fig. 20:

Fig. 20 demonstrates the effect of LONG. According to subjective perception the MC is almost 10% behind the car, but the LONG MC is perceived in a similar position as the car.

For the velocity, the MC was perceived 10% slower than car, but the LONG MC 10% faster.

Fig. 21:

Fig. 21 shows a comparison of an ordinary MC (left) and a LONG MC (right) approaching in the darkness. Actually both MCs are at the same position, but the LONG MC appears nearer. Honda is investigating the potential of LONG for production models. There is no homologation problem of this technology, except in Europe. In Europe, at this moment it is not possible to utilize this technology for production models because of a homologation barrier.

2.3. Active Safety: Advanced Brake Systems

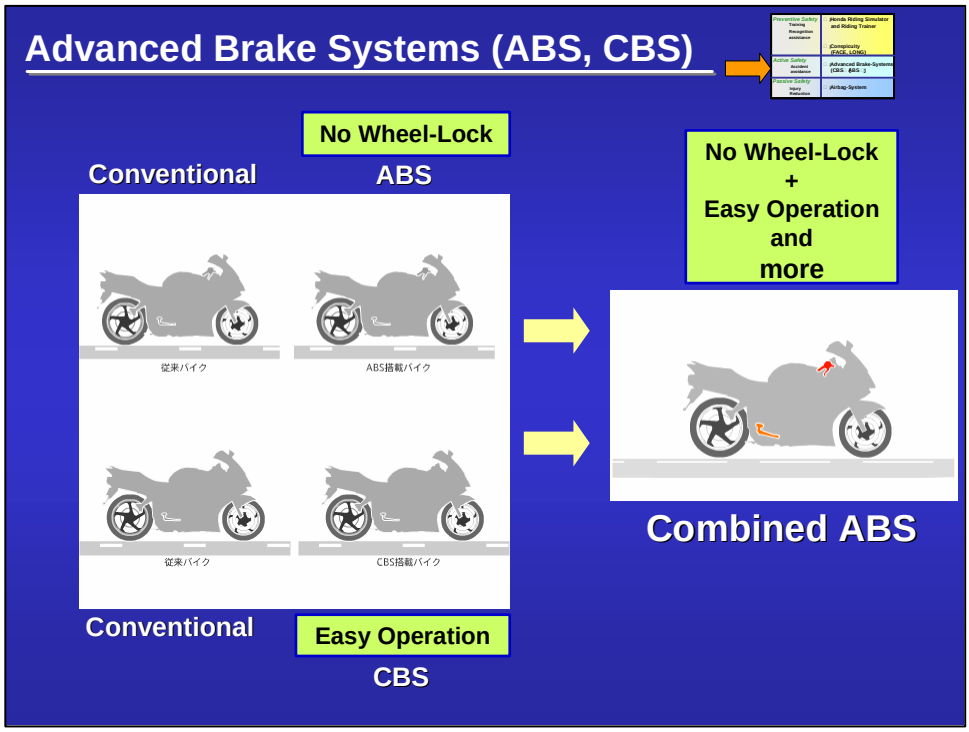


Fig. 22:

Honda has developed several kinds of advanced brake systems. There is ABS for “No Wheel-lock” and we are offering combined brake systems for “Easy operation”. Furthermore we are expanding Combined ABS, which consists of ABS and CBS, and performs “No Wheel-lock”, “Easy operation” and more.

2.4. Passive Safety: Motorcycle Airbag System

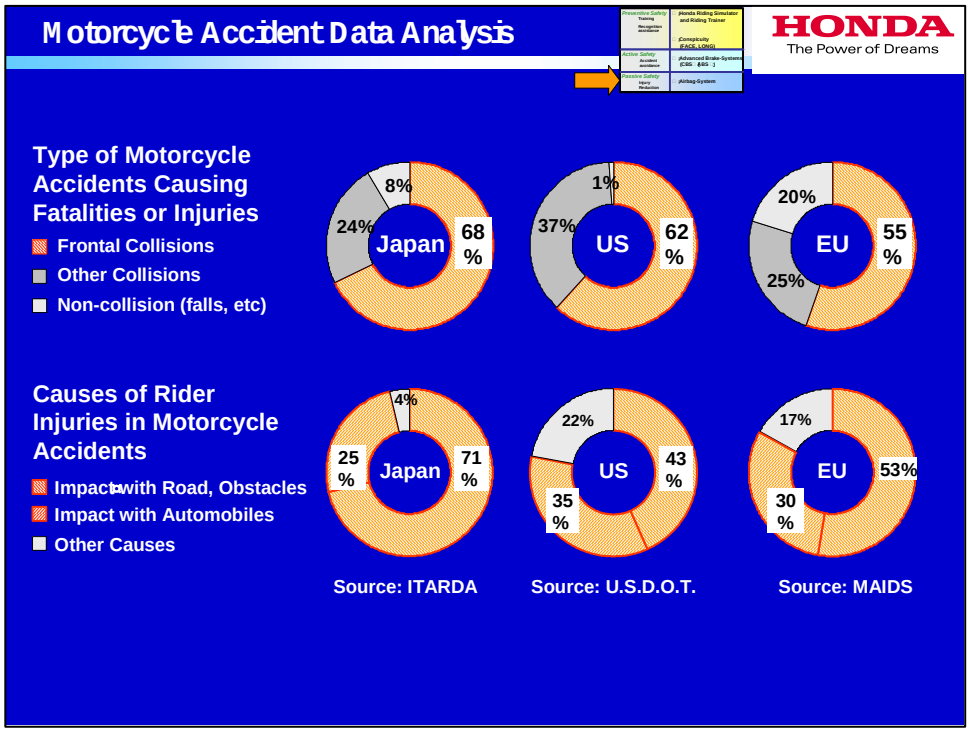


Fig. 23:

The accident data in Fig. 23 show casualties of motorcycle riders. In Japan, United States and Europe, there is very high percentage of frontal collisions, and most of injuries are caused by opposing vehicles and road obstacles. Therefore it is recognized that the typical rider injury occurs by the impact after separating from motorcycle in the frontal collision.

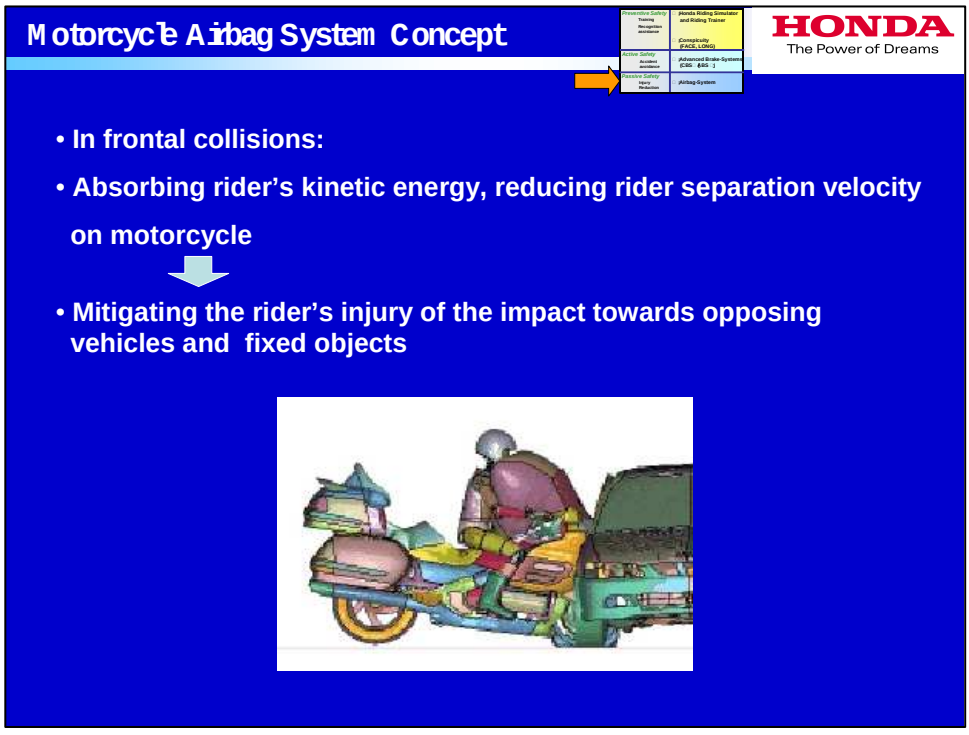


Fig. 24:

Then, we focused and started the research of the airbag as a technology for rider injury mitigation. Our airbag concept is: for frontal collision, holding on the motorcycle, absorbing the rider's kinetic energy, reducing the rider separation and/ or reducing the separation velocity. This helps to mitigate the rider's injuries towards the opposing vehicles etc.

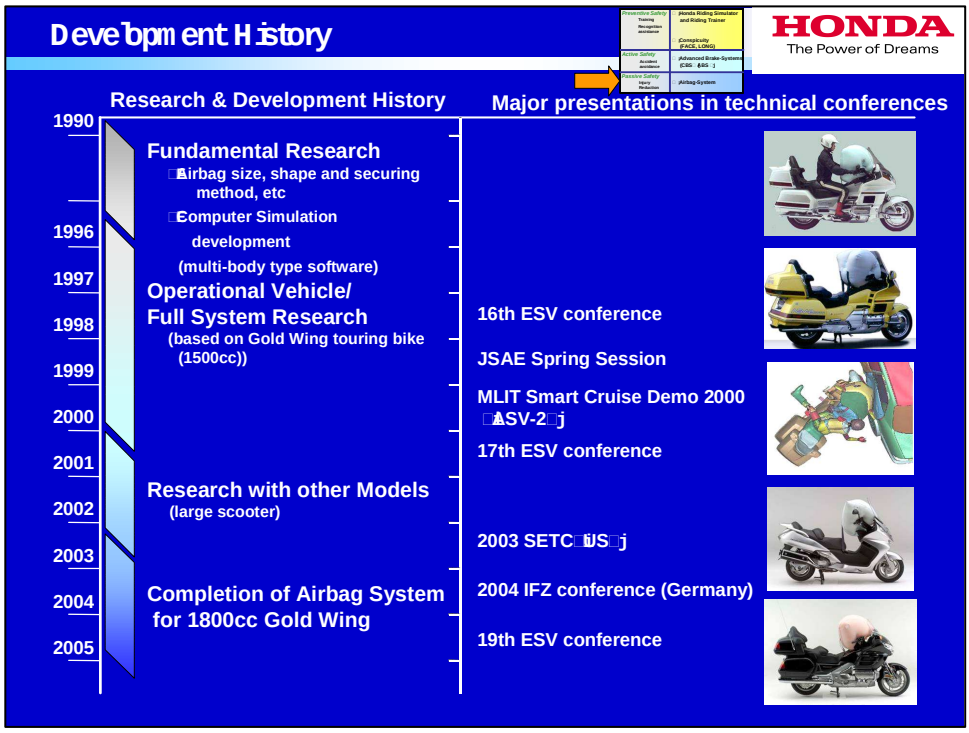


Fig. 25:

Fig. 25 shows the development history of the MC AB system. Parallel from the early stage Honda has presented airbag studies at international technical conferences (such as ESV, JSAE and ifz) aiming to exchange opinions with worldwide researchers on a broad basis and to promote researches by other manufacturers. In the 2005 ESV conference, we introduced the potential of production model.

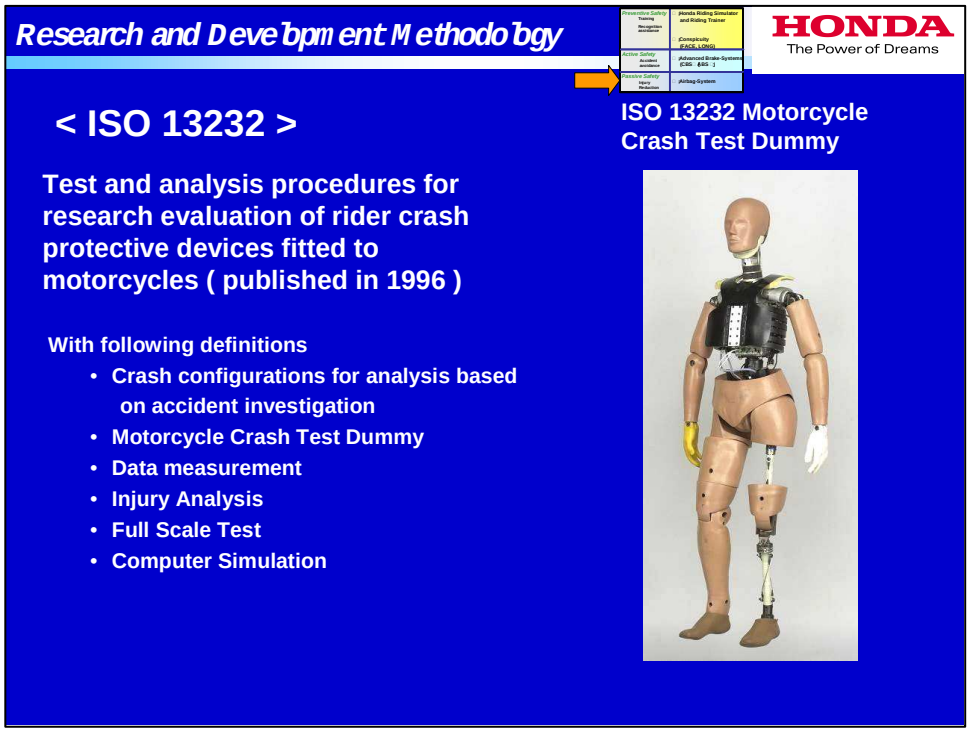


Fig. 26:

Next, as summarized in Fig. 26 these were the topics in the research and development process. In case of a motorcycle collision, the maneuver of the motorcycle varies by the differences of the crash conditions. Therefore it is necessary to take various crash conditions into account. Honda utilized the ISO 13232 world standard which was established on this kind of philosophy. In this ISO, the dummy for Full Scale testing is defined as well as these 7 test configurations. Those were performed and Honda also conducted additional crash tests to investigate special conditions.

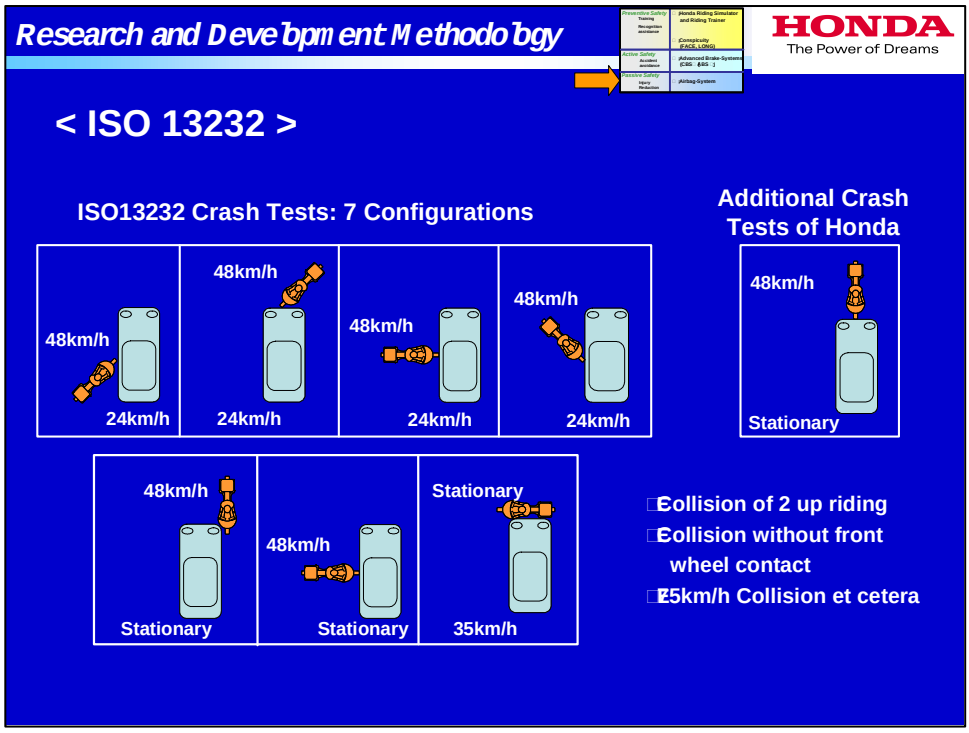


Fig. 27:

For example, a crash test with 75 km/h was conducted as higher energy collision.

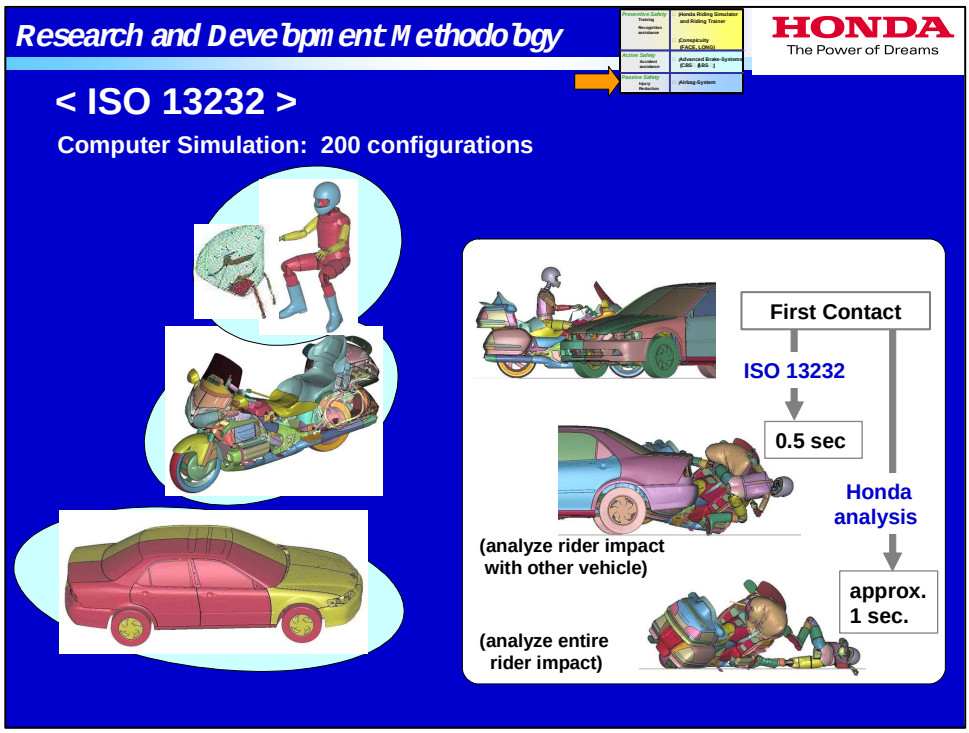


Fig. 28:

For many crash configurations in addition to the ones mentioned before, computer simulations were carried out covering the evaluation of 200 configurations. Although ISO defined just 0.5 second of computer simulation, we calculated up to the time when the rider contacted towards the ground. This technology plays an important role for higher efficiency of the research and development.

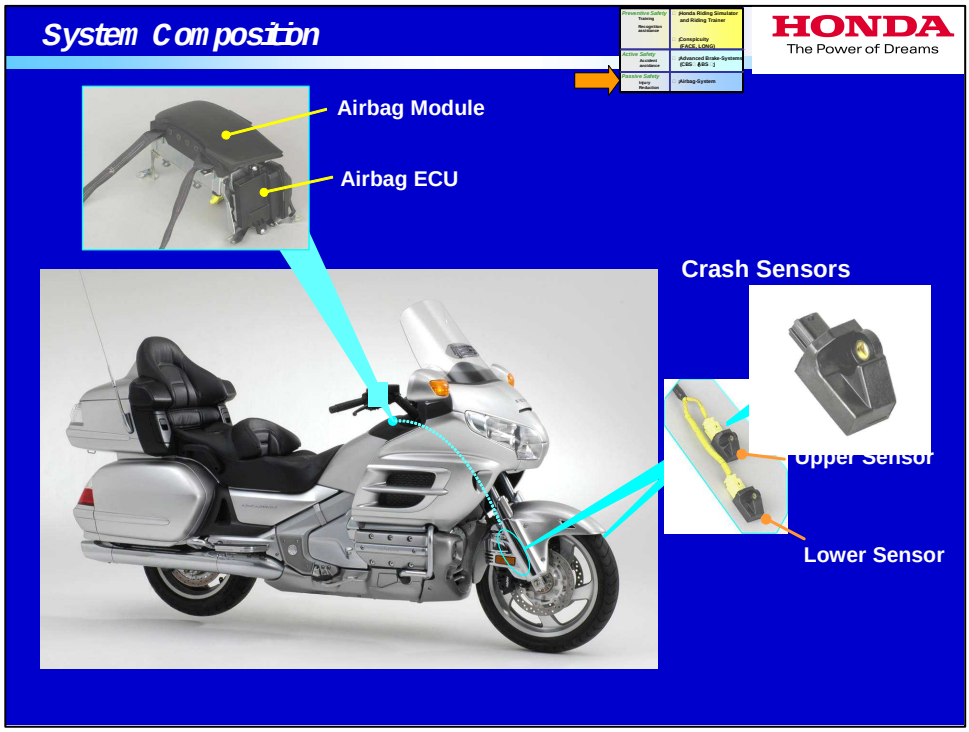


Fig. 29:

Fig. 29 shows the outline of the system and the elements of the motorcycle airbag system: the “airbag module”, as the most important element, the “airbag ECU”, which determines that a collision is occurring and the “crash sensors”, which detect the acceleration on the front fork.

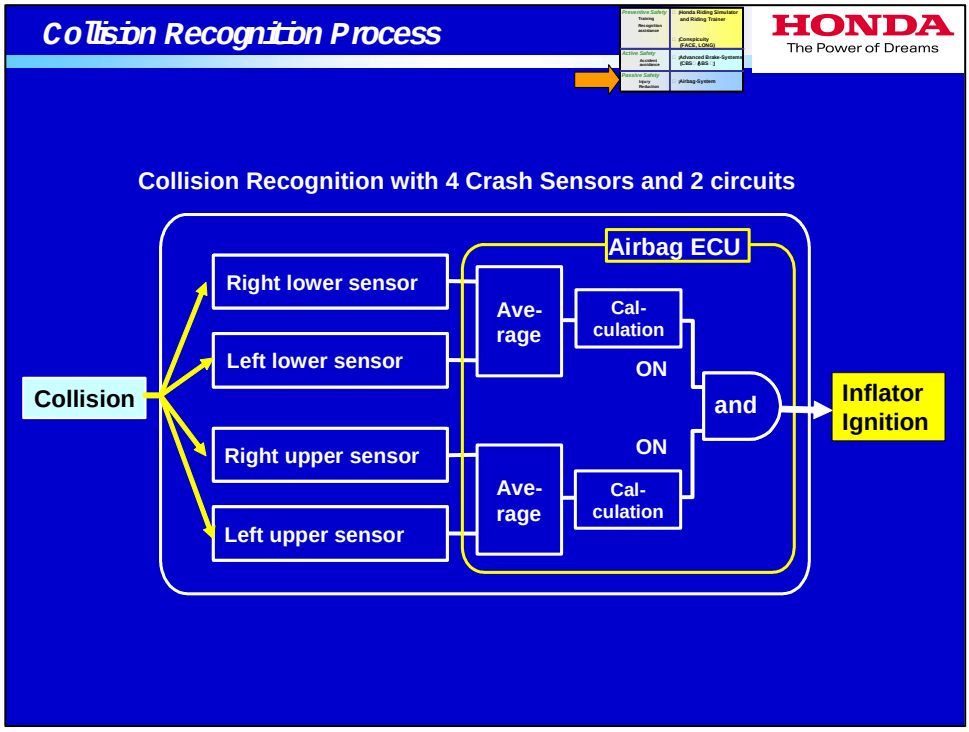


Fig. 30:

For recognition of a collision, reliability is achieved by using 4 crash sensors in 2 circuits.

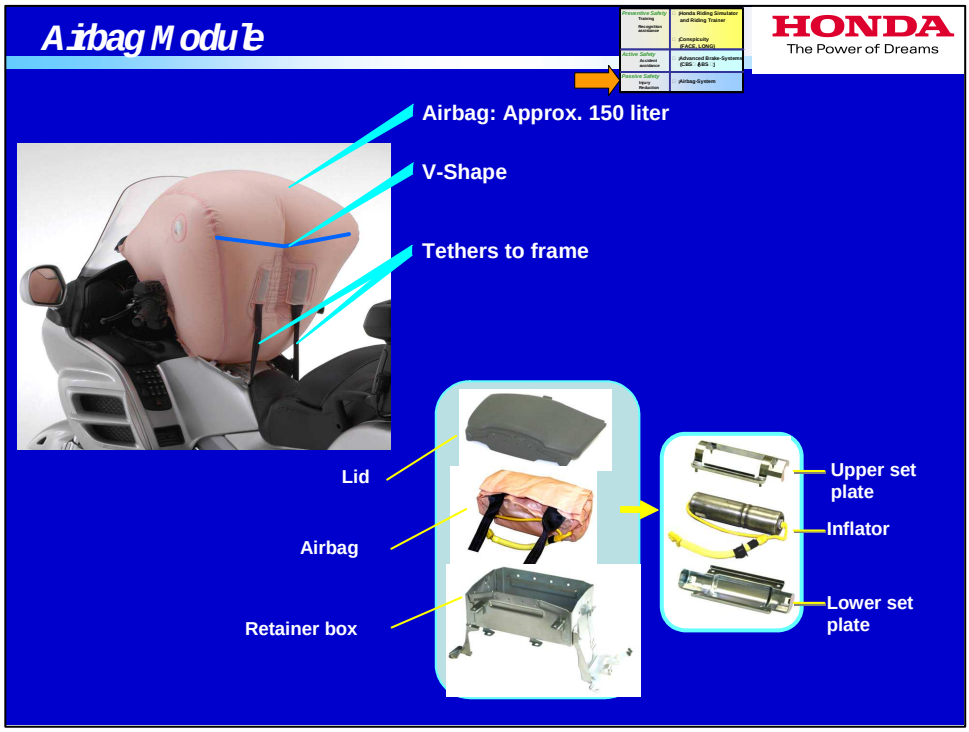


Fig. 31:

Several special features are provided for the motorcycle airbag, such as a large airbag volume, almost same as the maximum size of passenger airbags for automobiles, v-shape on the airbag panel facing to the rider to catch the rider, connection belts to the frame and so on. Each element is installed in the same way as in an automobile, in principle.

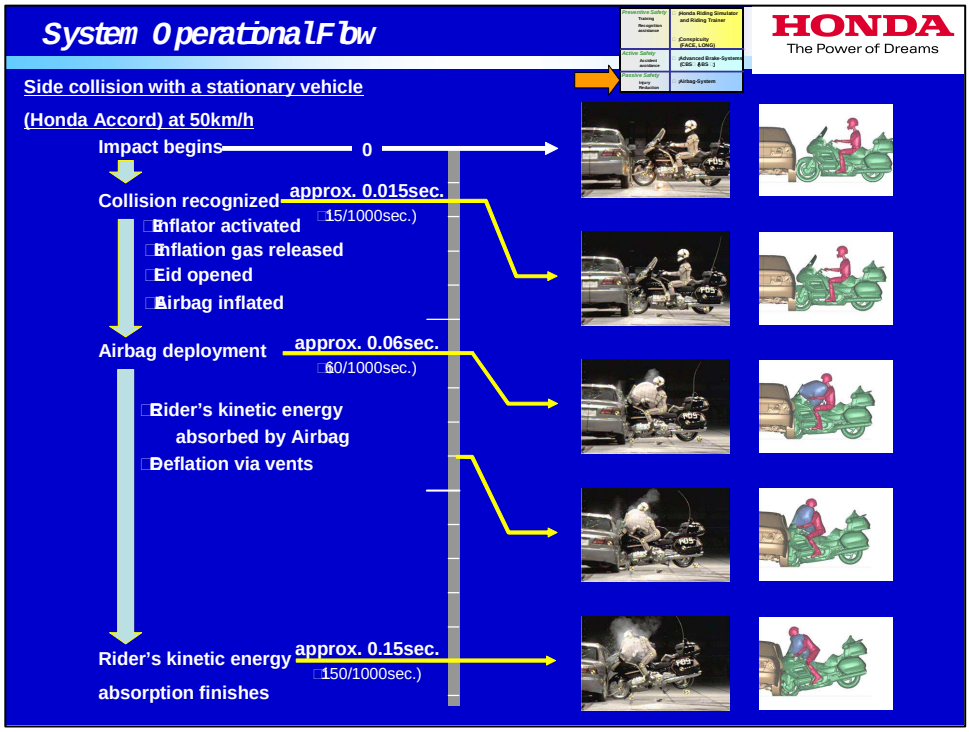


Fig. 32:

Fig. 32 demonstrates the system's operational flow in a 50km/h collision. The collision detection needs approximately 15 milliseconds. The airbag deployment completes within approximately 60

milliseconds. Then, the absorbing of the rider's kinetic energy is completed in approximately 0.15 second.

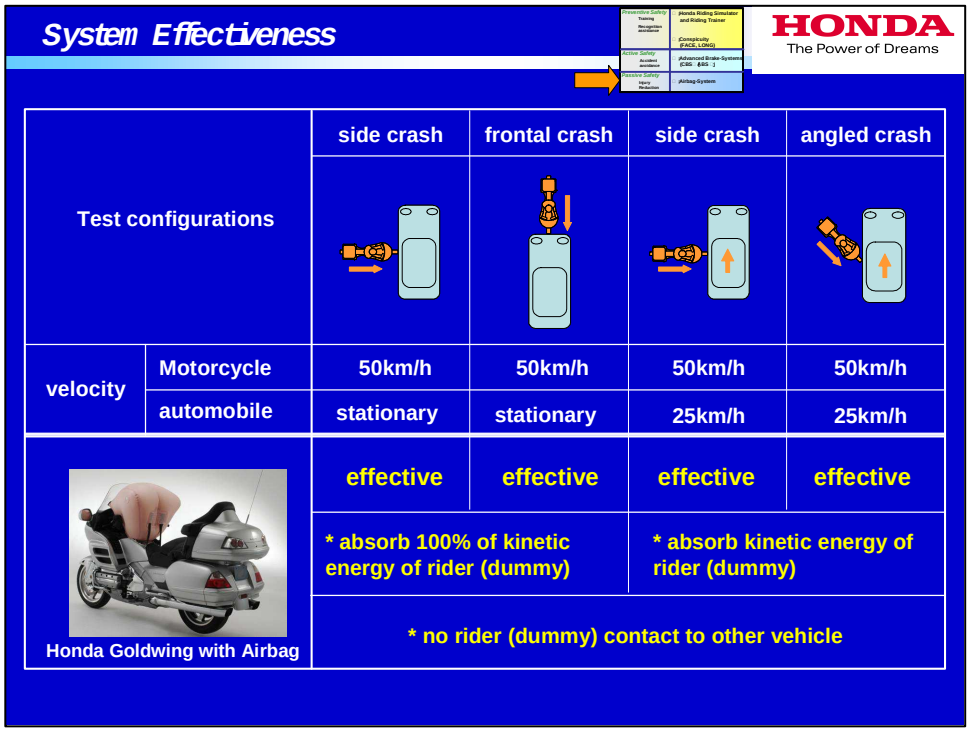


Fig. 33:

Fig. 33 shows crash configurations in which the motorcycle airbag is effective. In these crash configurations, there is no contact or impact between dummy and opposing vehicle.

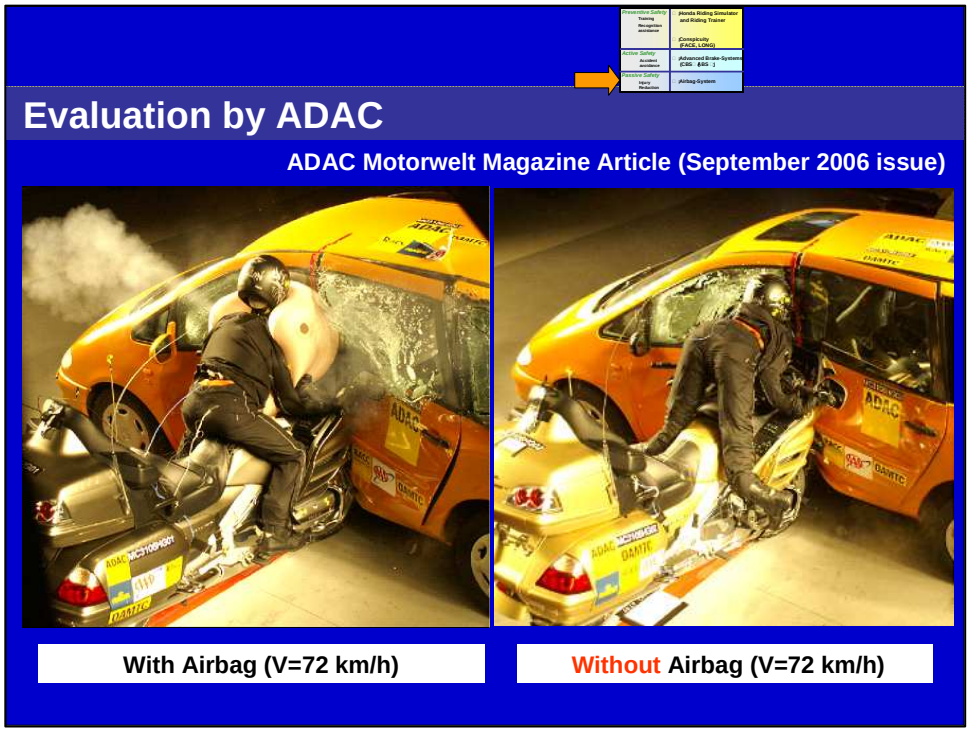


Fig. 34:

Recently, the ADAC published their evaluation result of the motorcycle airbag on the Honda Goldwing. Collision tests with and without airbag were conducted at a velocity of 72 km/h.

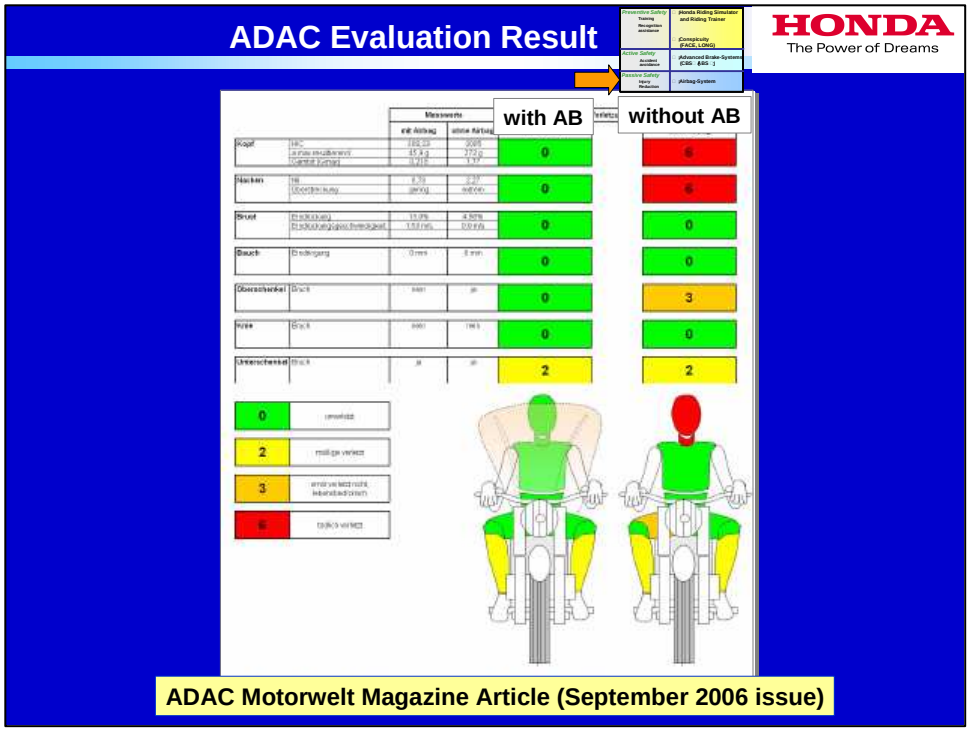


Fig. 35:

As reported in the ADAC Motorwelt Magazine (Sep. 2006) the results show that the airbag could avoid fatal injuries of head and neck. A femur fracture is also prevented.

2.5. Outlook

In conclusion we would like to point out that Powered Two Wheelers are enjoyable and convenient means of mobility. Honda is acting to assure the future of motorcycling by providing safe and environment friendly vehicles. Therefore we will continue our efforts to improve motorcycle safety.