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The development of motorcycles in terms of passive safety in traffic[1]

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***Abstract**: This paper points to the importance of the application of passive safety elements in series production of modern motorcycles. Nowadays, the need for further development of safety motorcycle is increasingly emphasized, because of the motorcyclists. Factual situation is evident from the analyses and statistics on traffic accidents involving motorcyclists.*

***Keywords**: passive safety, development, safety*

1. INTRODUCTION

Offers and constructive solutionsof safety elements of motorcycles should find their own application in practice with a wider number of producers of motorcycles. It is important that these new safety solutions be esthetically acceptable of very finicky young customers, owners and drivers of motorcycle. The point of this paper is to launch a new debate, which would generate new initiatives for the producers of motorcycles and
equipment for modern development in this neglected area. It is necessary to introduce elements of passive safety for motorcycles, and equipment for motorcycle riders, as well as it is necessary to introduce legal norms of their implementation on the roads.Nowadays civilization is unimaginable without modern transport, this extreme characteristics of our time. Traffic affects our lives and it is closely linked with the human psyche, and a vehicle has been given the status, a member of family".
Nowadays, motorcycles have become one of the most massive and interesting participants in everyday traffic. There are a lot of reasons of this use, for example, traffic jams on the roads, as well as economy, and ecological aspects. Motorcycle is subject of the satisfaction in the hands of young people, who do not have experience at all. Because of this, motorcycles often cause accidents.
Today's motorcycleshave high constructive and technical characteristics of dynamic capabilities. Because of that, this means of transportattracts young people, and a lot of people considered it the first means of transport, because it is still the cheapest.[1].

[1] *Work was developed in the framework of the doctoral thesis " The impact of passive safety of drivers and passengers using the vehicle - Disabled in traffic "*

1.1. Motorcycle Development Directions

Today's motorcycle is set to manage the city traffic and it is practical for longer and shorter trips, it is fast and economical, and because of this, it has become a favorite means of transport, and every day it has more and more supporters in those countries where so far only ruled cars. The problem of parking vehicles in urban areas should be added to this. It is believed that in the future, the motorbike will provide more pleasure to the man in his needs in the fields of movement, recreation, sports and tourism.
Therefore, world motorcycle industry obviously has set its future development of the motorcycle. However, today there are many types of motorcycle which are produced as a function of their utilization. Motorcycle with a driver could be mild and relatively harmless to the traffic, in the case of the bicycle with an auxiliary motor, or fast and aggressive when it comes to motorcycles that are driven by powerful engines working volume over 1000 (ccm), which have over 100 power (kW) with a mass of about 500 (kg) including the driver. It's all led by the world industry of motorcycle, to do more engagement to increase active and passive safety, which include big capital in those countries, which have developed the technical world.
The main reason of this is the fact motorcycles killing mostly young people, who seldom become disabled people for life time, which is a huge burden on society.

2. CONSTRUCTION OF MOTORCYCLE BASED ON ASPECTS OF PASSIVE SAFETY

Increased safety of motorcyclists in traffic is based on quality constructions of motorcycles and good roads on which they drive, to the versatile education and training.
This includes basic vocational training and exploring the possibilities and dangers of riding on two wheels it carries and what she hides followed by many and frequent traffic hazards of other participants and traffic traps.The same feel the legislators and producers, many of them are already fully or partially realized, and some new laws were foreshadowed.
At the same time the automotive industry much earlier responded to the increase in the number of accidents in traffic, by undertaking intensive efforts and costs in the development of vehicles using modern structures in order to achieve the greatest possible passive safety[2]. Exactly the same situation exists today in the construction of the motorcycle. The enormous technical and optical - designed solutions with attractive production models are directed against number of traffic accidents, which are somewhat stagnant, but are still at a certain level unacceptable. Now it should be as well as in the field of automotive, considered fundamental for safety and with the further development of the motorcycle. This applies particularly to the area of passive safety in accidents that do not yet take into account and do not handle many motorcycle manufacturers. Reasons should be found in the fact, that in this area, only occasional information on the potential improvements of passive safety at the motorcycle have been achieved , but it lacks a comprehensive research and complete treatment of this complex issue.

2.1. Proposals for motorcycle safety

In order to complete such a research project set up and processed,the special development groups and institutes for the safety of two-wheelers have been established in Germany, Japan, Italy. In this very complex and responsible task, apart from technicians, designers, medical doctors, psychologists and other professions have also been involved. The focus of this preliminary development work is based on the following areas:

- There were taken into account and examined all categories of statistics on motorcycle accidents
- Individual accidentwere analyzed and processed
- The causes of and collision flows between personal vehicles and motorcycles were analyzed
- Encounters of motorcycle on pedestrians were analyzed
- Collisions between a motorcycle and other stronger traffic participants: trucks, buses, tractors, trams etc have been investigated.
- We analyzed mutual collisionstwo motorcycles.

Based on the above and executed tests, we made a detailed expert analysis of individual cases and all the results are systematized and largely disclosed in professional journals and books. The data obtained by testing on the basis of the analysis are constructively worked out, but on the basis of them, we made drawings and models of constructive project motorcycle safety. In doing so, the authors' main task was to cooperate with designers preparing the project (sketch - model), which will integrate safety equipment motorcycle and central security clothes of its driver. Therefore, the design of most commercially attractive motorcycle with a basic concept design and craftsmanship of real motorcycle safety should have been accepted.

2.2. Examples of the kind of injuries

Based on the kind of injury that happens on motorcycles, according to the data fromthe investigations and analysis of accidents in which motorcycles take part, it was established that two types of injuries happen mostly:

1. Injuries of the bottom limbs, because for majorityof motorcycles, the feet of the driver are the most vulnerable spot of the system driver-motorcycle. Namely, it is found that all of the lateral contact and collision between the legs of the driver and passenger get the most damage and receive the primary injury.

Illustration 1. [7]

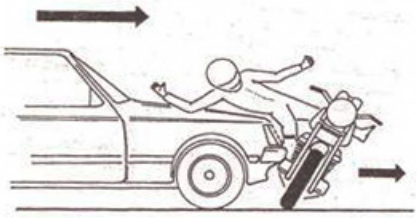

Illustration 2. [7]

Figures no. 1 and 2 show cases of lateral contact of motorcycles and cars. In both cases the side exposed to the injuries of the motorcycle is the lateral side in relation to thecar in the picture no. 1 has a lateral contact with the motorcycle. Figure no .2 shows contact of the car again with the lateral side of the motorcycle.Lateral side of themotorcycle is more vulnerable and exposed to contact, because it is dimensionally longer and has a larger contact area. In general, it can be added that almost any form of accident threatens every motorcycle driver, as well as compression of the body between a car and a motorcycle. If the motorcycle driver fails to separate and free himself from the motorcycle during a

collision, a rule will be another leg that does not move, trapped or pinched between the motorcycle and the medium on which it fell. The consequences are first, that will get your foot in the true sense of word peel or scrape, and second, the driver will go through such a critical situation and violations, seized from every opportunity to actively influence the process of further uncontrolled glideon the surface or the environment.

2. **Injuries of the upper extremities and the body of driver** are shown in the cases of the Figure no. 3 and 4. [7].

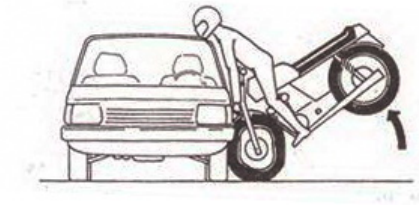

Illustration 3. [7]

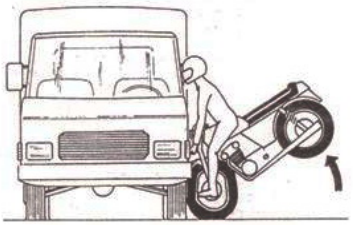

Illustration 4.

Figure no. 3 shows an example of a collision between a motorcycle and a passenger car, and the picture no. 4 collision with a freight car. The main cause for very frequent cases of frontal collisions, the driver of the motorcycle causing injury is a separation of body and motorcyclists collision with a higher hurdle: personal vehicle, truck, bus, tractor or a stationary obstacle. Figure no. 3 is an example of ways to crash on the side of the passenger compartment with personal vehicles, and in the event of collision with a motor or the tailgate is part of the vehicle body kinematics clash is even more complex due to the flight of the body through the vehicle body.

According to these examples, the most common motorcycle crash to conclude that the passive safety system motorbike-driver should not be limited to a motorcycle, but must be and collision-collision opponents (traffic participants) included in this sense should be field shaping and construction. In particular, attention should be paid to passenger cars as the most massive traffic participants.This is shown in current tests and analyses of case studies, as well as analyses of typical collision zone on vehicles which should be constructive and implemented and made from such materials to absorb as much energy collision.

Certainly, the quality of the road surface, as well as protective clothing and footwear, the motorcycle riders influence the outcome of motorcycling injuries.

3. NEW MOTORCYCLE MODELS

Based on past practices and analysis of traffic safety of motorcyclists, and achieved constructive and technological solutions, a model of motorcycle safety has been builttoday. The model of such a motorcycle is shown in figure no. 5. As you can see in the figure following safety elements of a motorcycle are represented:

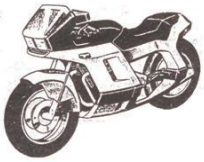

Illustration 5. *Proposal model motorcycle safety*

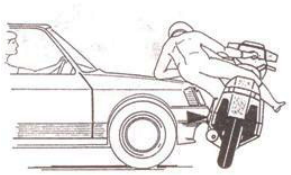

Illustration 6. Collision position of the front bumper of a car and motorcycle side reinforcements to protect the driver's leg

1. Double-front full of light, for better lighting times for night driving, because they are at the same time during their development cars the intense halogen lightsare already secured. That is why during the night driving a motorcycle, the driver in traffic is handicapped. In order to monitor the footprint of small motorcycle traffic in some European countries adopted a law that that during the day, the driversturn onthe long or beam light. As is well known, light motorcycles sold in a wide retail network from various manufacturers, are of different quality and lifetime. Light is often used for better visibility at night, and is subjected to the intense action of the vibration of the vehicle and the ground on which the motorcycle is moving. Therefore, it happens that at nighttime driving the motorcycle, sometimes a sudden and unexpected failures or cracking incandescent lamps, which can lead to serious accidents, as this in practice by examining was found. This danger can be eliminated by installing double headlights or spare beacon, which would automatically beintegrated with burnout light bulbs in the main beacon - travel light. On this basis, today more and more motorcycles on the roads meet the double road lights, and included one beacon per day. [6].
2. Second side rails are installed for the driver and passenger legs in order to protect the clash. Older types of motorcycles need to specially install these protective elements of the motorcycle, in order to protect the lower limbs. For new construction of modern motorcycle these protective bumpers are more constructively built and integrated together with the frame, i.e. motorcycle frame. In fact, in about half of all accidents in which motorcycles participate, or are going to participate, contractures and is not damaged the side of the motorcycle. Therefore, based on the study because of higher safety, built a strong, stable and tightly framed side bumpers should be built in. Because of almost the same height all the front bumper above the road, on personal cars was determined and constructive position and height of a lateral bumper protection on a motorcycle. Its width is so designed that the driver and passenger pass a safe space for their feet, which should be protected, as shown in figure no. 6. In order to such collision situations experienced by motorcyclists need to side with reinforced bumpers to predict a motorcycle and side armor. Side armor has multiple purposes, ranging from the protection of the rain, aesthetic design, streamlined shape and reduce drag, and to protection from side impacts. Side armor belongs to one of the elements of safety equipment motorcycle, which is taken from the racing motorcycle, because the racetracks in cases of falls drivers proved their quality. Appearance model motorcycle safety with side armor and the side guard is shown in Figure no. 7. In order to protect your hand motorcycle driver in the area of control, it is intended lining the front of the motorcycle as part of the shield or as a separatist protection arm. The shield is designed so wide that, looking from the front, the whole driver is protected. Regarding the

protection of the leg motorcyclists, performed side protective frame smooth surface, which is aimed to remove and prevent dangerous cuts in side contact with the motorcycle obstacle[6].

Illustration 7. Model security motorcycle equipped with side guard (metalbumper) to protect the lower limbs [6]

If the motorcycle is viewed from above, as seen in figure no. 8, we can see the V- shape, because in this way avoid the collision by cut at an angle, as in the frontal and side impacts

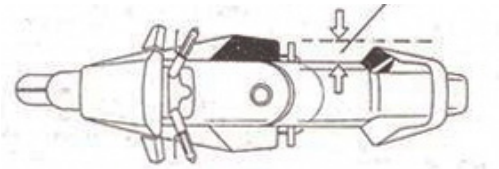

Illustration 8. Model security motorcycle seen from above

3. Antidive system is one of the elements according to the improvement of passive safety of modern motorcycle, which is built into the front wheel fork. The task of this system is to prevent the immersion of the very front of the motorcycle when braking. In particular, it distorts and disrupts the dynamic stability of the system driver-motorcycle in cases of stronger or extreme braking as it comes to the appearance of up and down driver's seating position and center of gravity system disorders. The front of the new security motorcycle is meant to be made of easily deformable plastic, especially in the area of the lining of road lights (headlights). This is sufficiently absorbing plastic material thatin deformation does not break, does not create debris such as glass, plastic or a classic sharp cutting edges as is the case with metal surface collisions of vehicles. Modern plastic materials allow the rear of the motorcycle to rise during a collision.
   In addition to this,such a softer front of the motorcycle to be in a collision with a pedestrian reduces injuries.
4. Discharge pipe, with the silencer while driving, can be heated up to 600 ° C, and is intended to be covered with a protective sheet, which acts as a thermal insulator in the event of contact of body parts of the motorcyclists with these hot parts of the motorcycle, creating burns they touch. Risk of burns, which are quite frequent in individual accidents and motorcycle collisions with pedestrians in this way is significantly reduced.
5. In various studies, the optimal passive safety of modern motorcycle is today proposing a constructive combination of safety elements and one of those is also a possibility to

move in a collision combined with an airbag and driver's seat. In this way direct contact between the driver's body to the surface on which slides is avoided. Fig. 9 shows the effect of one such motorcycle safety equipment collision with a car in the stages of "A" to "D ".

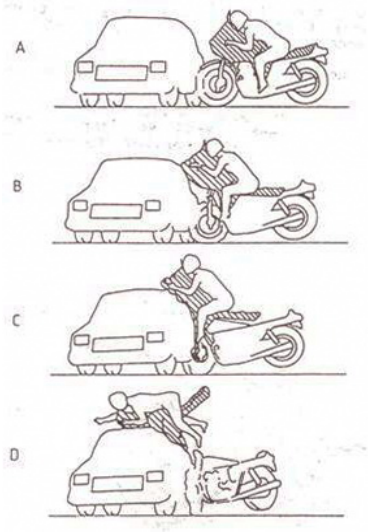

Illustration 9.

6. Finally it is necessary to mention the fact that today many serial motorcycles are equipped with "ABS" braking system. Some manufacturers of motorcycles installed at the customer's request "ABS" braking system as an option that is paid specially. The world market offers colorful serial motorcycles when buying a motorcycle, automatic transmission can be ordered separately as an option. The electric motor that drives the study C1-E is designed for exploitation in urban conditions and is based on components developed by Vetrix. Because of the higher performance, all in order to reduce the mass of the vehicle, BMW has incorporated lithium-ion batteries that are easier with a conventional metal hydride units. In addition to electric plants, the company BMW leaves the possibility of a petrol engine with low emissions. Outrank transportation on two wheels it goes without saying - both in terms of traffic flow, and in terms of the quantity of exhaust gas. However, 80 percent of road accidents occur in cities, which are the cities of Paris, Rome, Barcelona and London launched Esum project. This is one of the main reasons why the BMW put emphasis on safety. Otherwise, the BMW in the middle of last year produced the millionth motorcycle equipped with ABS system. This means of transport has arisen as a result of the BMW and the contribution of the European project for the security of which is called Esum. People in the BMW claim that the C1-E provides excellent protection to the driver. Unlike motorcycles and scooters this model despite the large windscreen has a safety cell or the roll-over bar and two bands - similar to a car. Also, the front and rear elements are "body" that absorb the forces resulting from a collision or contact. In addition to improving the active and passive safety of drivers, C1-E has better protection from inclement weather, and this model can be proud of the fact that this is the only two-wheeler driver where in most European countries is not required to wear a helmet.

Illustration 10. *Model of a safe motorcycle with elements of passive safety*

4. CONCLUSION

Central member of the family of motorcycles "the motorcycle" today, after a century of existence and development, study designed and guided by the idea of simple standby motorcycle became a model with somewhat "phantom appearance". New safety model of the motorcycle shows new elements constructively different from the previous execution of serial motorcycles. Finally, we attach a realistic model of a modern motorcycle with elements of passive safety, which is now installed at the serial motorcycles, as seen in the figure no. 10

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