A STUDY ON THE IMPORTANCE OF THE DETAILS IN THE TECHNICAL EXPERTISE OF THE TRAFFIC AND AERONAUTICAL ACCIDENTS

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Abstract: *one of the aspects which are in many situations superficially treated in accidents investigations is the careful analysis of the details to be revealed by the study of the official documents folder, the place of the accident, the technical systems involved in the accident or the testimonials. There were a lot of situations when two words or a millimeter aspect from a "hidden" corner of a testimonial or a photography have changed the main direction of the accident technical expertise (investigation).*

Keywords: *accidents investigations, technical expertise, investigator, accidents details*

1. INTRODUCTION

The occurrence accidents during the exploitation of technical systems is an unwanted phenomenon but they will be permanently present regardless of the methods used to avoid them. Despite the remarkable increase in the technical equipment's reliability in modern time, the hazard and the human mistakes will continue to cause accidents.

The new concept of the hybrid engineer, which is now present in aeronautical and automotive engineering, largely influences the process of the accidents' technical expertise from these areas. That means that an aeronautical and automotive engineer must be multidisciplinary specialized (in mechanics, electronics, automatics and especially informatics) in order to understand the complex technical systems from now on. A technical investigator must respect the same thing because what we have stated in the first sentence of the paragraph has large implications onto the accidents analyses. Otherwise, the Re-engineering concept is met more and more often in the synthesis analyses of the evolution of the nowadays aeronautical and automotive engineering. That means that traditional engineering must be multidisciplinary changed.

On the one hand, this thing causes a good effect because, for example, in aeronautics the multitude and the complexity of the "black box" data compensate, to a large degree, the lack of any physical signs. Speaking about traffic accidents, while technical experts usually have a lot of physical signs (on the place of the event, the damages of the car bodies, the wounds of the human victims), unfortunately, for the moment, they do not benefit from an accidents recorder (like the "black box" type).

We have to remark that in the last years in the field of automotive engineering as well, CDR (Crash Data Retrieval) gadgets have been used more and more extensively which could be linked to the main ECU or airbag ECU of the vehicles. Therefore, they could be used as EDR (Event Data Recorder) gadgets.

Unfortunately, not all vehicles permit these data to be read despite their utility in accidents analysis. In other situations, CDR can read the data but the data provided are not complete. Until EDR becomes mandatory and until it becomes mandatory to reveal accidents data from EDR completely, traffic accidents technical analyzers will continue to study the events by using classical methods.

Therefore, one of the aspects which are in many situations superficially treated is the careful analysis of the details to be revealed by the study of the official documents folder, the place of the accident, the technical systems involved in the accident and the testimonials. There were a lot of situations when two words or a millimeter aspect from a "hidden" corner of a testimonial or a photography have changed the main direction of the accident technical expertise. Also, the presence of a magnifier into the traffic specialist pocket is absolutely necessary because this little object can find out in each moment some hair beneath of a car paint layer, some burned spots or a deep plunged rived on the ploughing where an airplane just crashed. The experts' meticulosity must be one of his basic features.

2. STATE OF ART

Despite the sometimes excessive publicity, flight is safer than it appears to be. Definitely safer than driving. It depends on the way one defines flight and driving safety. Neither flight nor driving is safe if safety means that an accident is impossible to happen. Following this logical stream, there are permanent concerns with an increase in the safety standards for flight and driving. The aim is to remove all the reasons for which accidents occur.

But hazard cannot be completely removed. For example, the impact of some flying objects with the aircraft's aerodynamic surfaces could lead to getting into the unwished "Deadly Area" of the pilot and some passengers. This term was imposed by the Paul A. Craig in The Killing Zone, How and Why Pilots Die [2001, "The McGraw-Hill Companies"]. And this accident is produced exclusively by hazard. The same thing can be said about the situation when some obstacles may suddenly appear on the road just in front of the vehicle. Unfortunately, traffic accidents are not analysed in so much detail as far as the cause of the events is concerned, or they are treated very superficial.

3. EXAMPLES OF DETAILS WHICH MIGHT HAVE BEEN MISSED AND WHICH INFLUENCED THE FINAL CONCLUSIONS OF THE ACCIDENT'S TECHNICAL EXPERTISE

3.1 The observation of a photographic detail (the photo was taken immediately after the accident)

The tactical situation to be analysed: on a "T" crossroads a cyclist does not yield to a car and they impact as it is simulated in Fig. 1. The impact speed of the cyclist is requested.

When the expert analyzed the photos taken immediately after the accident he noticed a detail which had escaped the first police investigators: there was a cap on the hood of the car. He requested the police to ask the witnesses whether the cap belonged to the victim of the accident (the cyclist). The witness confirmed the suspicion of the expert: the cap belonged to the cyclist.

Returning to the aim of the investigation (the bicycle speed on the impact), statistically, the speed of the cyclist can be estimated by taking into account the age and the sex of the cyclist and the type of bicycle. In this case, the expert estimated the speed of the bicycle as approximately 13 km/h.

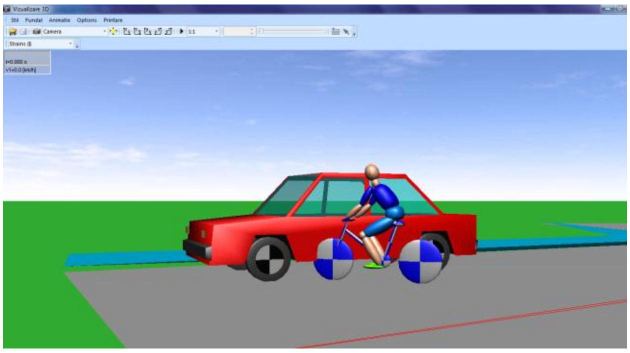

FIG. 1 The impact position

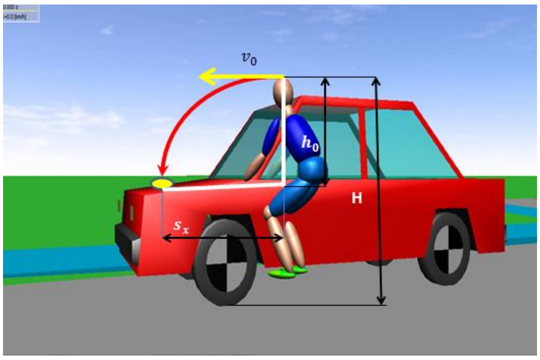

FIG. 2 The forces and the distances

Taking into account this important detail (the cyclist's cap on the car hood), the speed of the bicycle in the moment of impact can be cinematically calculated considering that the cap was a material point thrown horizontally. It was under the influence of the variable uniform moving laws. It was under the influence of the gravitational force on the vertical (Oy coordinates). So, the situation can be simulated as in Fig. 2.

In Fig. 2 one can see the PC Crash 10.1 cyclist model who is already thrown from the bicycle because of the car impact. The bicycle cap from the car hood is marked in yellow.

The others sizes from Fig. 2:

v_0 – the initial speed of the cap thrown, which is the same with contact/percussion car/bicycle speed

s_x – the maximum distance to which the cap was thrown

h_0 – the height from which the cap was thrown (related to the car hood area it finally reached)

H – the height from which the cap was thrown (related to the ground).

Simplifying assumptions:

- H is considered 1,65 m, taking into account that the cyclist's height was 1,59 m and in the moment of his being thrown he got up from the bicycle saddle; the kinetic energy due to bicycle moving dissipated in pottential energies difference due to altitudes difference (leap from the saddle of the body up and in the front);
- the difficulty of plucking the cap was not taken into account;
- the final cap sliding on the car hood was not taken into account; the last two assumptions compensate one another.

FIG. 3 h_0 measurement

FIG. 4 s_x measurement

Some measurements were made in order to find out the values of s_x and h_0. A similar vehicle was used. (look at Fig. 3 and Fig. 4).

The measured values were:

s_x = 1,38 m;

$h_0 = H - 0{,}94m = 1{,}65\text{-}0{,}94 = 0{,}7\ m.$

So, we now have all the necessary values to calculate v_0 using the formula:

$$v_0 = \frac{s_x}{\sqrt{\frac{2h_0}{g}}} = \frac{1{,}38}{\sqrt{\frac{2 \cdot 0{,}7}{9{,}81}}} = 3{,}65\, {}^{m}/_{s} = 13{,}15\, {}^{km}/_{h} \qquad (1)$$

So, it means that the bicycle speed in the impact moment was 13,15 km/h.

This value is approximately the same with the speed statistically established (13 km/h). That means that the calculus is correct! The technical expertise will continue using the value of the impact bicycle speed 13,15 km/h (3,65 m/s).

3.2 The detailed analyzing of the physical evidence on an overturned vehicle

The tactical situation to be analysed: a Dacia Logan vehicle tries to overtake two other vehicles when a hollow appears in front of it unexpectedly. The driver violently braked before passing it until after passing it. After some distance, the control of the vehicle is lost, in first instance the car turns sharply to the right, hits the left rear part of the the second overtaken vehicle body, turns again more sharply to the left. Because of these sharp changes of directions the vehicle overturned.

The reason for the loss of vehicle control is requested.

As an initially unremarked detail, the expert found out on the right front wheel two damages (bends) of the rim edge (look at Fig. 5).

Thus, the film of evolution for the Dacia Logan involved in the accident can be re-enacted: the driver tried to overtake two other vehicles from one maneuver, he saw the cavity from Fig. 6 and he sharply and unjustifiedly braked till the right front wheel of his car went into this cavity (the brake pedal is used). In this moment the wheel rim edge suffered first damage (it is marked in red in Fig. 5) and it suddenly lost the pressure. This thing caused losing the steering stabilization of the vehicle. The vehicle skidded and in first instance went sharply to the right.

FIG. 5 The damages of the right front wheel

In this moment the vehicle could not be controlled by the driver and it hit the left behind part of the Audi vehicle (the second overtaken vehicle) as it can be seen in Fig. 8 and Fig. 9. On the impact with the Audi body the right front wheel of the Dacia Logan suffered the second damages (yellow marked in Fig. 5).

FIG. 6 The cavity which caused the loss of steering stability)

FIG. 7 Skid evidence after the loss of pressure from the wheel

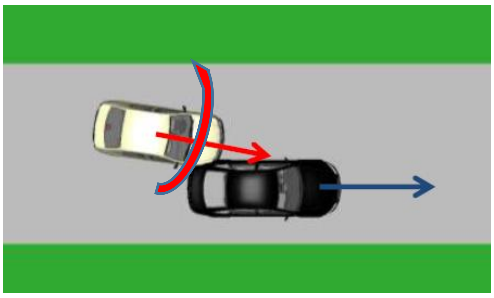

FIG. 8 The act direction forces outline

FIG. 9 The impact

Due to impact with a heavier vehicle, the Dacia Logan car is violently thrown to the left until the front part of the body reached the grass from the left part of the road. This caused the overturning of the vehicle.

CONCLUSIONS

In this paper we presented only two examples of details which were initially missed. One of them was observed on one picture taken immediately after the accident and the second was seen on one of the wheels which were damaged after the event.

Other possible places where this kind of the details can be seen could be the medical certificates of the victims (or autopsy certificates) or the spots-evidence which can be detected using the magnifier on the place of accidents, body of technical equipment, or on the material or humans scraps.

Here is how the analysis of apparently unimportant details, which can be missed by the first investigators, can bring clear evidence about the film of the accidents and they can be first importance factors in order to discover the real causes of the accidents. Establishing these real accident causes should be materialized in “lessons learned” which can lead to the disappearance of many accidents and to an increase in the safety of flight and road traffic.

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