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HARMONISATION OF THE EUROPEAN LEVEL CROSSINGS. IS IT POSSIBLE?

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Abstract: *The paper deals with the harmonisation of the European LC, particularly from the point of view of the road user. The variety of the LC equipment and different signalling rules, nevertheless road signs are identical, exists throughout EU countries and worldwide. A car driver can find importantly different situations particularly considering LC equipment behaviour, distances, timing etc. It may cause lower awareness and vigilance of the road user and increased number of the LC accidents. The structured approach to solve the problem is proposed in the paper.*

Key words: *railways, railway traffic, road traffic, level crossings, risk assessment, accidents*

INTRODUCTION

The international research society from several years has taken efforts to improve traffic safety situation on the railway level crossings (LC). Already 9 times, the International Level Crossing Symposiums were successfully conducted in the USA, Australia, UK and Canada. The last, 9th event subtitled: “Partners in Safety" occurred in 2006 in Montreal with a great success, as the participants reported. It is possible to find appropriate information on the following webpage: http://www.levelcrossing2006.com/. Until today, only once the LC Symposium was organised in Europe, (8th LC Symposium with subtitle: "Managing the risk", April 2004 in Sheffield). The 10th International LC Symposium is being prepared by the UIC, French Ministry of Transport, SNCF (French train operator) and RFF (French infrastructure manager) and it will take place in Paris in June 2008. The event subtitle is: “Safety and Trespass Prevention”. In spite of enthusiastic comments of some previous Symposiums’ participants, it is very hard to estimate the real impact of these events and their influence on the safety on the level crossings problem. For the outside observers, the outcome of the earlier symposiums (before the 8th) is not available, and now, even on the Internet, the information about them disappeared without trace. Fortunately, the communities of professionals interested in the increase in the safety in this dangerous, troublesome area, where two different kinds of traffic are crossing one another in one level are more and more active. One of possible and important ways is the research experience exchange. This activity manifests itself in coming into existence of the European Level Crossing Research Forum – ELCRF, the non-commercial, fully voluntary and still non-formal researchers’ organisation, actively supported by several participants with the leading role of the Rail Safety and Standards Board - RSSB from the United Kingdom.

Also, the European Commission acceptance to subsidise the 6th Framework Programme project “SELCAT” – “Safer European Level Crossing Appraisal and Technology” is a good example, that problems in these troublesome spots seem to be very important.

Level crossings are the subject of the European Railway Agency (ERA) activities, particularly from the point of view of the overall safety parameters of the railway traffic.

Unfortunately, today there is a common approach, with which I absolutely disagree, that all accidents on level crossings are treated as purely railway accidents, due to the definition that such accidents include all those, where one of the collided vehicles is the railway vehicle. Even more, in that group often we may find all such cases, where the accident victim is a road user without any railway vehicle involvement, but the accident occurred inside the dangerous area of the LC, or even generally, inside the whole crossing area. I need to express my opinion that this approach should be immediately changed. Most accidents on the level crossings are caused by road users and they may be treated exactly the same as events when the car went off track and hit a tree or went downhill to a precipice. The only reason which should be taken into account is certain danger created by the irresponsible behaviour of the road user, which may cause a dangerous situation for the rail traffic, either for passengers or for goods transportation. Obviously, when the accident caused by a road user results in railway equipment damages, passenger casualties and transported goods loss, it should be treated as a railway accident, however, road traffic participant casualties and their material losses should not be treated and counted (in the traffic statistics) as the railway accident results. Only such an accident should be considered as the railway traffic accident, when it is caused either by the failure of the level crossing protection equipment (including mistakes of the manually operated level crossing personnel) or by unauthorised approach of the train to the level crossing area.

All issues related to the level crossings, as relevant legislation, construction rules and methods, technical solutions, particularly warning and protection equipment, road signs, information and warning plates, their application, operation, sizes, shapes and colours etc. are probably the most diversified area in the whole road traffic around the world. These issues have not been included yet in Technical Specifications for Interoperability (TSIs) of the European Union railways because the only factor which may have influence on interoperability is the train "movement authority" limitation (or revoking) and possible speed restriction when the appropriate feedback (interlocking) exists and the level crossing protection equipment indicates that the level crossing is not protected, usually due to a certain failure.

The main reason which pushed me to express my personal point of view concerning the level crossings safety issue is the wide range of substantial differences regarding the overall circumstances of passing the dangerous area of crossing the railway line as it may be seen by the road user in particular countries, railways and even particular places. Due to the permanent increase in the international road traffic, it may be suspected that these differences may become the important factor decreasing safety increasing the potential risk for foreigners passing the level crossing in other countries than their own. Despite the fact that road signs are generally standardised, there are some national differences between them, but usually only regarding their size, colour and some jointly used additional information. Unfortunately, application of the road signs that warn road users about approaching the level crossings is probably most diverse among all of standardised road signs. The road user may find vital differences between distances (even twofold) from warning tables to the level crossing, different warning sign (either with the steam engine or with the fence on the drawing) while there is nearly the same warning and protection equipment, depend on the national regulations. Moreover, there are fundamental differences among warning times, for example from the beginning of the warning to lowering of the barriers or from activation of the level crossing equipment (by the approaching train) to reaching the LC area by this train. There is also a wide range of light signals to warn road users, including among others specific solutions: single and double red lights, permanent or flashing, with additional white light (active when it is possible to pass the LC safely) additional lamps, arrows, etc. to inform about the second train approaching (on the other track of double or multiple track line). The variety of sound warning devices and their operation rules is also great.

LC UNIFICATION PROBLEMS

First of all, it is necessary to stress the basic problems that we encounter analysing the level crossings subject. The long list of problems starts with the differences in terminology used.

One of factors taken into account during analysis of accidents on level crossings is the type of the technical equipment used for warning and protection the level crossing area, mainly for the road users, to protect them while the train approaches, however, sometimes also to inform the train driver that the level crossing area is protected and safe. In the beginning, the LC classification in some countries is called as the categorisation of level crossings, while in others we are talking only about different level crossing types. This classification, from country to country and from one assembly to another is based on three specific approaches:

♦ technical approach, where the level crossing type/category is related to the set of technical equipment used for warning and protection purposes, starting from not equipped LCs, one equipped only with permanent road user warning signs (as the St. Andrew's Cross, which, by the way, also has a variety of sizes, shapes and colours), LCs with light and acoustic warning signals, up to the LCs equipped with half barriers and full barriers and with a wide range of different devices, which may be used in a certain LC equipment type;

♦ functional approach, where the basic division may be done among them to the passive and active LCs, where "passive" means that the warning and/or protection installed, if any, remains unchanged independently of the rail (and road) traffic situation and "active" LCs group includes all those, where the warning and/or protection function is activated while the train approaches the LC area; the active group is then subdivided to manually and automatically activated; this approach, is used by ERA for the "basic types" classification, which will be discussed later;

♦ application approach, where the LC classification is based on the traffic requirements to ensure the certain protection level depending on rail and road traffic density, maximum allowed train speed, visibility conditions etc.

As usual, in a number of particular cases a hybrid classification is used.

In practice, the brief phrase "level crossing type" is often identified with the level crossing protection equipment type used on the particular level crossing.

Similar range of problems occurs with the definition of:

♦ accident and rules to distinguish it from incident (for example: different border values of losses, rules of calculating proven suicides as LC accidents);

♦ accident victims – rules to calculate fatalities (depend on time from accident to death), division between groups of serious and light injuries;

The result of the country-specific LC type classification is the inconsistency of the available statistical data regarding the accidents on level crossings, which reduces the possibility of the comprehensive analysis of the relation between the warning and protection equipment types used and the quantity of the accidents. Currently, efforts are undertaken inside the European Union to unify statistical data reports on the basis of the ERA basic LC types' classification. Moreover, the data reported by countries to some international bodies and organisations as UIC, and even by EU Member States to Eurostat and ERA, are very general, without description of the particular cases and even without detailed subdivision, for example, regarding the accident causes.

It should be important to investigate if there exists any relation between the particular type of the level crossing protection equipment and the relative number of accidents. Even when the complete statistical data of level crossing accidents is available, the answer may not be immediate, because several different factors have the influence on the possible results. For example, particularly in countries, where the "application approach" is the basis of the level crossing protection equipment type selection, we encounter the influence of the average traffic volume to the particular equipment type choice and then, the eventual accidents factor (vs. the number of the particular equipment type). It means that achieving of the objective results relating to the factor of possible accidents with the particular LC protection equipment type is not an easy and immediate task.

ERA BASIC LC TYPES

Aiming to obtain accident statistics data better exposing to the comprehensive analysis and obtaining reasonable results, the ERA proposed the LC types' classification, as shown on Fig. 1.

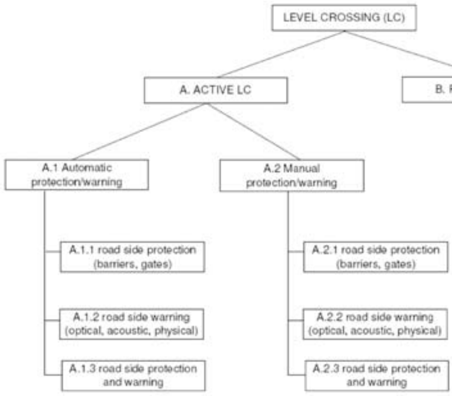

Fig.1. The ERA classification of the LC types.

This classification will be called further as the basic one.

In the first step, the ERA basic classification distinguishes between active (group A) and passive (group B) level crossings. The simplest explanation of the passive type of the LC may be such, that in this group we combine all level crossings equipped with any warning signs, plates, devices or any other protection equipment, which state is permanent and totally not dependent on any traffic situation. This group includes also non-protected level crossings.

In opposite, the level crossings protection equipment on any active level crossing reacts somehow by changing the state (warnings and/or protection) when the train approaches to the level crossing area. In the second step of the ERA basic classification, the main difference between two subgroups of the active level crossings is the activation method of the warning and protection equipment on the level crossing. If the process, starting from the approaching train detection up to the state change of the protection and warning equipment happens without any manual intervention (by the level crossing keeper or any other personnel), the group is called as the "Automatic protection/warning LC" (group A.1). If anywhere in the process, the man activity is needed (usually to operate locally the position of barriers), such level crossing is classified to the group called "Manual protection/warning" (ERA group A.2). Each of these two groups is then divided into three identical subgroups, depend on the road side equipment used: road side protection, as barriers, gates (groups A.1.1 and A.2.1, respectively), road side warning – optical, acoustic, physical (groups A.1.2 and A.2.2) and road side protection and warning (group A.1.3 and A.2.3).

It is a very general and relatively simple classification, however, the theoretical completeness and symmetry of the structure is not fully compatible with the practical solutions. One of the SELCAT project activities was to build the database of the level crossing types used in countries of the project participants. Nevertheless, the database is not giving the complete picture of all LC equipment configurations, which may be found in Europe, in that database, and in real installations, it is rather impossible to find, for example, the automatically operated LC with road side protection (as barriers) and without warning lights the same time. So, the group A.1.1 is empty in practice. A similar situation occurs with groups A.2.1 and A.2.2.

This classification may be used only as the first step to unify the reporting rules for the EU Member States and to obtain the general overview of the safety parameters of the particular LC type groups. This classification will be used by the ERA as the element of the Common Safety Indicators in order to estimate the required Common Safety Targets.

STRUCTURAL APPROACH

The final, structural approach, which I need to present in this paper, shall consist of the series of subsequent phases. The first one shall result in the common definition of the LC classes.

Let us introduce the term "class" to incorporate all LC protection equipment types (LC types), which all behave the same from the road user's point of view. It means that all LC types in one class have exactly identical timing, the set of warning and protection devices as well as all road signs used including their shapes, sizes, possibly colours and exact rules of their application. What is the most important, this classification should be based on the road user's side view, i.e. all, may be various solutions regarding the technology or additional subsystems applied, shall be seen the same by the road user for the whole particular LC class.

Each particular class shall guarantee a certain, minimal protection level. The classification shall not reduce the possible innovation and equipping the certain level crossing equipment type with any new subsystem which increases the protection, however, in the particular defined class, any system development should not influence the warning and protection equipment behaviour as visible for the road user. Obviously, it is possible and even recommended, that several classes ensuring different minimal protection level will be not distinguishable by the road used.

First of all, there should be decided how many different level crossing equipment classes will be used on the whole railway network. I suppose that the reasonable number of different LC equipment classes shall include from 5 to 9 guaranteed protection levels, however, the number of different level crossing types visible for the road user shall be reduced probably to not more than four.

The second and probably the most important step in the structural approach proposed here shall unify the method used for the selection of the required protection level for the particular level crossing. The current situation varies substantially from country to country. The introduction of common rules usually will require changes of the local regulations, sometimes also in the national legislation. So it is possible to imagine, that the first area, if applied anywhere, would be possible in the European Union. Today particular countries, and sometimes even particular railways (their Infrastructure Managers) or administrative areas use different rules to organise safe railway and road traffic on level crossings. The wide range of rules and methods to define certain safety protection requirements for the particular level crossing is applied. It starts from very simple rules, as the calculation of the "traffic product", which combines the volume of rail and road traffic on the basis of the traffic flow measurements performed in the well-defined manner. The achieved result is translated to the certain LC type required. For example, such an approach is defined in the current regulations being in force in Poland. This method is relatively simple and effective, however, it has several weak points. First of all, the "traffic product" may be exactly the same in each of three very importantly different situations from the traffic safety point of view, i.e. when:

- ♦ the railway traffic is very low and the road traffic is relatively dense;
- ♦ the railway and road traffic flows are on average;
- ♦ the railway traffic is high, but the road traffic there is relatively low.

In each of the mentioned cases, the accident danger is different due to such reasons, as for example the different time of road traffic breaks required separating both traffic flows. In fact, much higher probability of the accident emerges in case of the bigger railway traffic density.

The set of important weak points of such deterministic method as the "traffic product" calculation includes for example the following:

- ♦ the random structure of the traffic flows, particularly in the case of the road traffic;
- ♦ the length of the road vehicles queue awaiting for the rail vehicle pass through the level crossing area and the influence of these queues for the traffic in the neighbouring area (particularly in cities);
- ♦ the impact of the particular objects in the service area of the road passing through the level crossing on the volume and the distribution in time of the road traffic;
- ♦ the rail and road infrastructure state in the level crossing area, including distances from the level crossing, which has influence on the traffic through the level crossing.

The road traffic in most European Union regions, particularly in the new member states, increases relatively fast. The deterministic method, based mainly on the traffic flow measurements is probably outdated. Thus, the second step suggested in this paper should result as a target in the introduction of the probabilistic method of the certain safety protection requirements definition for the particular level crossing, possibly and eventually in all countries. This method is generally called as the risk assessment of the accident occurrence on the certain level crossing.

The traffic flow across the level crossing is significantly different during the separate time intervals, for example in the separate 2-hours portions of each twenty-four hours period (day).

Instead of the simple traffic volume measurement, the traffic model should be built for the particular level crossing taking into account the results of traffic flow measurements in the 2-hours (or other duration) time intervals. The LC traffic model shall allow for estimation of the peak-hour traffic density and its relation to the average daily traffic volume, simulation of the road traffic in the neighbouring area and the accident risk assessment. The achieved results will be the basis of the LC protection equipment class selection, however, they shall not be directly applied for that purpose.

In each particular case, the results obtained using the traffic simulation on the certain level crossing shall be analysed and possibly corrected by the appropriate panel of experts. The expert group shall be selected using the criteria well-defined in the relevant regulations.

The experts' panel shall consist of:

♦ railway authority (usually the infrastructure manager) representatives;

♦ road authority representatives;

♦ necessarily, local authority representatives;

♦ other experts depending on the local geographical and economic structure.

The experts' panel correction shall consider the local circumstances having influence on the possible accident risk. Such circumstances shall include the location of such objects generating the traffic flow on the level crossing as for example: schools, hospitals, big industrial plants, commercial centres, sport facilities etc.

The possible range of accident risk values, i.e. the probability of the accident, shall be divided into several subsequent intervals, which number should be the same as previously defined number of the LC equipment classes. In the intermediate step, it shall be defined the direct relation between the accident risk assessment result (the certain accident probability interval) and the particular LC class.

It should not be forgotten that one of the most important factor which has the direct influence on the number of accidents is the road users' awareness. All available measures shall be applied to increase it. One of possible methods is a wide advertisement campaign. It shall include all well-known advertisement techniques. Such a European-wide (or worldwide) campaign shall be the necessary element of the structured approach implementation to the level crossing protection equipment type selection on the basis of the accident risk assessment.

CONCLUSIONS

In conclusion, the paper presents a structured approach to the issue of supplying level crossings with warning and protection equipment which should be as a target applied widely all over the world as soon as possible to reduce the number of level crossing accidents taking also into consideration people's increasing international mobility.

The level crossing warning and protection equipment, called briefly the level crossing type (or class) shall be selected on the basis of the unified approach, by the accident risk assessment.

The minimal protection level of the particular LC class shall directly correspond to the estimated accident risk there.

The overall level crossing warning and protection equipment application and behaviour, as seen from the road user point of view, shall be identical for at least one from the possible LC types and it shall be unified eventually for all countries, starting possibly from the whole European Union.

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ХАРМОНИЗИРАНЕ НА ЕВРОПЕЙСКИТЕ ПРЕЛЕЗИ. ВЪЗМОЖНО ЛИ Е ТОВА?

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Резюме: *Докладът разглежда хармонизирането на европейските прелези, специално от гледна точка на използващите пътищата. Въпреки че пътните знаци са идентични, в европейските страни и по света съществува разнообразие на прелезните съоръжения и различните правила за сигнализиране. Шофьорът може да открие различни ситуации по отношение на поведението на прелезните съоръжения, разстоянията, времевите интервали и т.н.Това може да причини по-ниска степен на осъзнаване и бдителност на използващия пътя и увеличен брой на произшествия при прелезите. В доклада се предлага структурен подход за решаване на проблема.*

Ключови думи: *железници, железопътен трафик, прелез, оценка на риска, произшествия.*