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ROAD TRAFFIC PROTECTION IN POLAND

OCHRONA RUCHU DROGOWEGO W POLSCE

***Summary**: Road traffic safety is all about the ability of a human-vehicle-road system to have collision-free functioning, and a separate discipline dealing with the organisation and monitoring of road traffic. The level of road safety is measured by the number of traffic incidents. These incidents can involve a single vehicle, or traffic collisions resulting in damage to property, or traffic accidents with fatalities. The favourable geographical location of Poland, coupled with the widespread availability of storage space, generates heavy traffic. As a result, there are many domestic and transit carriers, as well as private, vehicle road users. Regardless of the efforts of the Polish government aimed at improving safety standards and road traffic, many road accidents still occur, which negatively impact on the attractiveness of the country and generate great costs. Social campaigns concerning the consequences of traffic incidents launched in the media are slowly beginning to yield the desired results. Nonetheless, investment in equipment ensuring road safety and systems improving road traffic on European roads appears to be a more effective way of improving the standards of Polish roads. The paper, based on available literature on the subject, addresses the measures which are undertaken in the field of road infrastructure and which contribute to road traffic safety.*

***Keywords**: transport, car, road, safety measures, road traffic*

***Streszczenie**: Bezpieczeństwo ruchu drogowego to przede wszystkim bezkolizyjne funkcjonowanie układu człowiek-pojazd-droga oraz odrębna dyscyplina zajmująca się organizacją i monitorowaniem ruchu drogowego. Poziom bezpieczeństwa ruchu drogowego mierzony jest liczbą zdarzeń drogowych. Zdarzenia te mogą dotyczyć pojedynczego pojazdu lub kolizji drogowych skutkujących uszkodzeniem mienia lub wypadków drogowych z ofiarami śmiertelnymi. Korzystne położenie geograficzne Polski w połączeniu z powszechną dostępnością powierzchni magazynowych generuje duży ruch. W efekcie istnieje wielu przewoźników krajowych i tranzytowych, a także prywatnych użytkowników dróg samochodowych. Mimo wysiłków polskiego rządu zmierzających do poprawy standardów bezpieczeństwa i ruchu drogowego, wciąż dochodzi do wielu wypadków drogowych, które negatywnie wpływają na atrakcyjność kraju i generują ogromne koszty. Rozpoczęte w mediach kampanie społeczne dotyczące skutków zdarzeń drogowych powoli zaczynają przynosić pożądane rezultaty. Niemniej inwestycje w urządzenia zapewniające bezpieczeństwo ruchu drogowego i systemy poprawiające ruch drogowy na europejskich drogach wydają się być skuteczniejszym sposobem na poprawę standardów polskich dróg. Artykuł, oparty na dostępnej literaturze przedmiotu, dotyczy działań podejmowanych w zakresie infrastruktury drogowej, które przyczyniają się do bezpieczeństwa ruchu drogowego.*

***Słowa kluczowe**: transport, samochód, droga, środki bezpieczeństwa, ruch drogowy*

Introduction

Over the recent years, we have observed a rapid increase in the number of road users and, consequently, in the proportional growth of traffic volume. This translates into more accidents, the vast majority of which was caused by the improper and insufficient road infrastructure. Systems supporting safe journeys, although simple, are based on a number of algorithms which are used for collecting, analysing and transferring data. Among other things, Road Traffic Safety devices (RTS) are used with a view to making roads safer. Their task is to carry out optics-based management of road traffic (the systems notify of bad weather conditions, and drivers can read the notices, generated real-time, on electronic display boards placed along numerous routes), mark any objects on the edge of the road and secure vehicle and pedestrian traffic. The safety of drivers, pedestrians and cyclists is also improved by appropriate lighting of the road and the surrounding areas. Transport is responsible for 29 % of CO_2 emission; this is the reason why cities with substantial traffic congestion are no longer attractive places to live and work in.

Road transport safety programmes

Analysis is the main source for creating action plans, and the priority is protecting the lives and health of road traffic participants. Most road accidents result from errors made by road users, despite good road conditions. Road factors account for only 2–4% of the incidents. Detailed research results show that improper road infrastructure indirectly and directly contributes to approximately 30 % of accidents, with around 70.9 % of the events taking place in built-up areas.

Road safety devices can be divided into four categories. The first category includes road traffic safety signalling equipment which is used for providing information to drivers and other road users in the form of prohibition, mandatory and warning signs, and any other information on road traffic. The second category comprises protection devices, used in order to prevent accidents or minimise their outcomes. The next category includes anti-destructive equipment, aimed at mitigating the outcomes of an accident or, to a smaller extent, reducing the risk of the incidents (e.g. speed bumps). The task of equipment included in the last category is to counteract breaches and ensure smooth traffic

flow and order. The devices used in high-risk areas include equipment restraining vehicle traffic, inter alia, traffic barriers, together with transitions, barrier terminals, initial sections, and crash cushions. Devices restraining pedestrian traffic include safety barriers and pedestrian safety fences. In terms of the produced effects, RTS devices can be divided into active and passive. Passive devices do not come in the direct contact with vehicles during impact, an accident or a collision. Their task is to organise and control road traffic, provide information on potential threats and dangerous spots. Road signs, light signal devices and anti-glare screen systems are also classified in this category. On the other hand, active road traffic safety devices include those devices which come in direct contact with vehicles during an accident or collision – traffic barriers, bridge rails, energy-absorbing barriers – referred to as safety design structures, adjusted to withstand a potential contact with vehicles.

Traffic barriers

Traffic barriers are designed in such a way as to mitigate the outcomes of being forced into driving off a lane or the road crown, protect the vehicle from hitting a permanent obstacle within the road crown, and protect the vehicle from being directed into an opposite lane. Barrier functions have a significant impact on the safety, as over 15% of passenger cars going out of the road lane hit the protective barriers. The impact angle usually does not exceed 10 degrees [6].

Depending on the material used, barriers can be divided into steel, concrete, aluminium or cable barriers. Safety barriers, which are properly used, should create a mutually complementary system. Modern concrete barriers make a complex of interconnected segments. Individual segments are rigid but their connection is a joint of a limited mobility. In Poland, full concrete barriers with "F" type side wall profile have been introduced. They are safer for passenger cars than New Jersey profile used in some other countries [7].

Signage

RTS devices, which include road signs, are aimed at providing specific information in a manner understandable to every traffic participant. They can assume the form of a plate or a board. Their task is also to warn traffic participants of the existing traffic disruptions and situations which might impact traffic flow and safety. Road signs within the road area are made of special-purpose retro-reflective material which is to increase the signs' visibility to drivers. Traffic is a dynamic process, so it is crucial that the distance from which drivers are able to read the signs is appropriate.

We can often encounter non-standard road marking, which includes increased vertical signs or signs having higher retro-reflective parameters of the sheeting applied, e.g. "black spot" signs aimed at affecting drivers' frame of mind, acting on their imagination, and making them act reasonably behind the wheel. Non-standard signage also covers active road signs, additionally equipped in beacon lamps which can effectively attract drivers' attention to the message of the road sign. The warnings mainly notify of a nearby pedestrian crossing or sharp curve. They provide information on traffic jams or other types of hazards in motorways and expressways. Such lamps require relevant road traffic instructions, information management system, and power supply. They also must undergo regular technical inspections. Horizontal signage is also of substantial significance for traffic safety. The currently available thermo-hardening and chemical hardening technologies allow for high quality signage. Moreover, acoustic elements are also introduced. They allow the driver to sense the approaching obstacle by hearing.

Speed-reduction infrastructure

Devices which enforce a reduction in speed include speed cushions and speed bumps. Speed cushions are basically devices in the form of a hump to be placed on a local or access road within a built-up area. In addition to public roads, speed bumps can be used in housing-estate areas, on plant premises, or car parks, where the driver must slow down to 5–8 km/h, or if gates are present in access areas. As regards agglomerations, where the number of vehicles is constantly growing, the authorities are planning to introduce the so-called ITS (*Intelligent Transport System*). The most important task of the systems is speed management which should bring about an optimised traffic flow. The ITS system sensors, placed in the area of a given city, define the optimum speed of a vehicle in order to provide a smooth and safe journey. Excessive speed will result in the need to stop at the nearest traffic lights. Retaining the indicated speed will affect the number of stops, reduce traffic jams, and the number of car accidents and their gravity. The ITS can also manage street lighting, adapting it to current weather conditions. This will improve safety of vulnerable traffic participants.

Street lighting

State-of-the-art street lighting can also be of great support for pedestrians and cyclists. The human factor" is a crucial factor in night-time traffic accidents. And the reason for it is the hampered perception of the situation, which could be prevented with suitable lighting [8].

The lack of proper lighting is one of the factors which contribute to the occurrence of accidents involving pedestrians, especially in the evening and at night. The proper direction of luminous flux is strictly connected to the choice of appropriate light fitting with energy-efficient light sources. A substantial characteristic of the light fitting is its tightness, which should ensure protection against dirt gathering on the reflector and the source of light, resulting in lower efficiency. LED lights are characterised by high durability, a wide range of operating temperatures, high luminous efficacy, measured in lumens per wat, high reliability, and resistance to shock, impact and vibrations. The operation of road lighting results in great energy

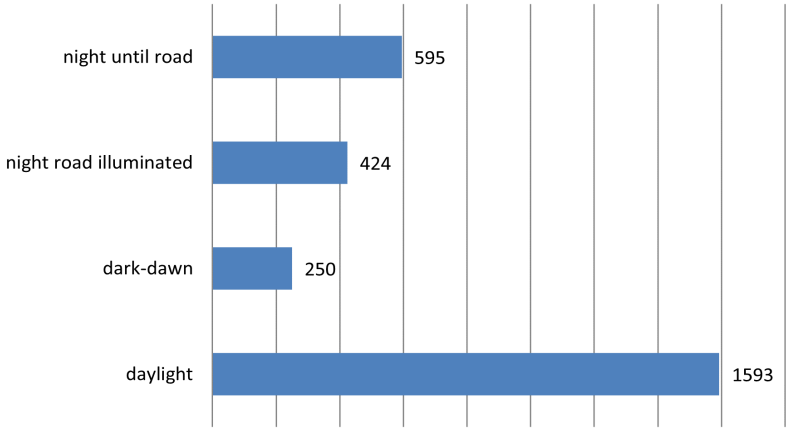

Fig. 1. Lighting impact on accidents in Poland, 2021 (statistical in thousand)
Source: the author (own study based based on police statistic)

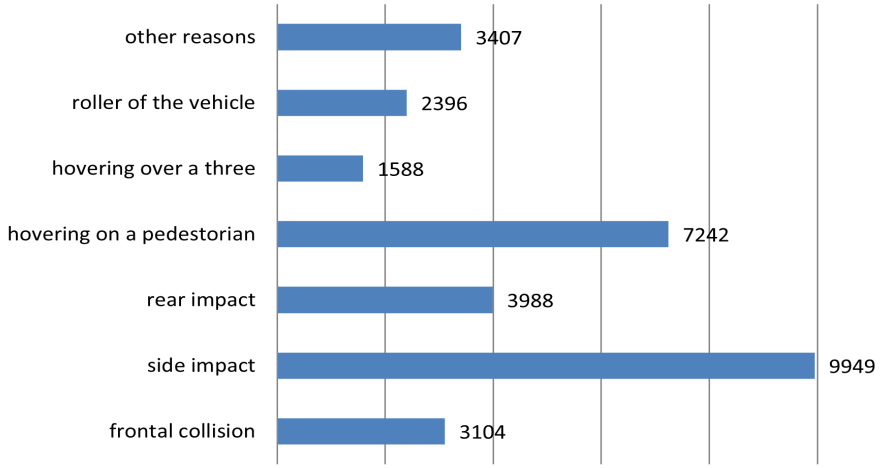

Fig. 2. Types of accidents in Poland, 2021 (statistical in thousand)
Source: the author (own study based on police statistic)

consumption at the level of 114 TWh, which corresponds to 4.3% of global energy consumption [1].

Street-lighting remote control systems are also available, making it possible to automatically change parameters by adjusting them to current conditions. The systems contribute to reducing energy consumption and lighting costs. The system can be managed via a website or a text message. Another available option is the possibility to archive and display alert and measurement data. Study results show that artificial road lighting reduces the number of road traffic fatalities by nearly 65%, the number of injuries by approx. 30%, and the number of road collisions by more than 15% [2].

Concluding remarks

The described concept of a proconsumer small hydropower unit is characterized by simple design and reduced investment costs thanks to the use of largely recycled components.

The design of a small hydropower unit can be implemented with a large participation of direct users of the generated electricity. The system enables to achieve high technical and economic effects in the form of network energy savings. It is especially designed for the applications where the availability of energy is limited. Hybrid bearing of the main shaft of the unit ensures easy start-up and high-energy efficiency with a particularly long service life.

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