IS IT WORTH LIMITING THE TRAVEL SPEED?

JERZY WICHER[1]

Automotive Industry Institute

Summary

The paper presents a quantitative analysis of the impact of travel speed on the number of accidents and level of pedestrian safety. With the use of the calculation capabilities of the so-called "Power model", it was demonstrated that it is reasonable to introduce limited zones of max. 30 km/h in cities. The quantitative comparison of the level of risk of death and injury of pedestrians and cyclists at AIS3+ for mean speeds obtained in Poland in 2014 by vehicles in built-up areas and on expressways and motorways was presented by using the statistical relation demonstrating the dependency of risk from speed. The procedure of determining the impact of vehicle speed estimation error on the error of the determined risk was presented taking into consideration the fact that vehicle speed is one of the mostsignificant parameters.

Keywords: speed, number of accidents, risk for pedestrians and cyclists

1. Introduction

From the point of view of road traffic safety, the answer to the question specified in the paper's title seems obvious. All participants of road traffic agree with the view that speed is one of the mostsignificant parameters, which should be taken into consideration in the road traffic safety analysis (RTS). Why, therefore, do domestic and European statistics demonstrate that travelling with excessive speed is also one of the most common offences in road traffic?

Direct observation of the behaviour of drivers demonstrates that the speeds obtained by them are the result of many factors, such as good weather conditions, adequate road type, good physical and mental fitness of the driver, often haste or simply possession of a good car and satisfaction from travelling at high speeds.

Decreases in vehicle speed are the result of unfavourable weather conditions (fog, rain), high traffic intensity, low pavement condition, observation of direct accident effects, poorfitness of the driver. Furthermore, speed cameras, police checkpoints and the fear of getting penalty points or losing the driver's license.

[1] Automotive Industry Institute, Vehicle Safety Laboratory, ul. Jagiellońska 55, 03-301 Warszawa, e-mail: j.wicher@pimot.eu, +48 22 777 71 65

In the opinion of the drivers, speed limit signs are in most cases too strict or placed in locations where such a limit is not necessary. Thus, ignoring them facilitates maintaining traffic smoothness, while driving faster than the speed permitted by road signs does not automatically mean dangerous driving.

The descriptive analysis of the causes of such driver behaviours presented above may be confirmed by statistical data.

As estimated by the European Transport Safety Council (ETSC), in European Union member states that monitor the speeds on roads, 40÷50% of drivers exceed the speed limit on the relevant road section, whereas 10÷20% of these drivers exceed the limit by 10 and more km/h. In Poland, it is "socially acceptable" to exceed the speed by 20-30 km/h in relation to the speed limit set by road signs [14]. This offence regards most drivers both in cities (approx. 80%) and on roads outside of built-up areas (approx. 70%). It is only on motorways and expressways that "only" approx. 30% of the drivers exceed the acceptable speed due to obvious reasons. This proportion is higher in Poland; it amounts to approx. 55% [14].

The relation of the severity of injuries and vehicle speed immediately becomes clearly visible lear if we take into consideration the dependency between the kinetic energy which is absorbed during the accident and vehicle speed at the moment of the collision: $E = \frac{mv^2}{2}$, where m – vehicle weight, v – speed). We can see that, for example, a double increase in speed causes fourfold increase of energy, which should be absorbed. Furthermore, excessively fast driving extends the braking distance, thus there is a high probability that vehicle speed will be substantial at the moment of collision.

Neither the descriptive analysis of the phenomenon of widespread excess of acceptable speed nor the statistical information allow active forecasting of actions in the scope of road traffic safety improvement. Such possibility occurs only in the case of an attempt to create appropriate mathematical models. The aim of this paper is to present the actions taken for this purpose.

2. Power model

The concept of mean travel speed is used for project purposes and development of a proper RTS policy. This speed may vary substantially from the acceptable speed (speed limit) specified by road signs (e.g. day-time/night-time driving, dry/wet/icy pavement, etc.).

By using the principle of kinetic energy retention and empirical data, G. Nilsson from the Swedish National Road and Transport Research Institute has proposed the following formula demonstrating the impact of changing the mean travel speed on the change in the number of accidents [10]:

$$W_1 = \left(\frac{V_1}{V_0}\right)^n W_0 \tag{1}$$

In the dependency (1), the index "0" was used to mark values observed prior to the speed change, while index "1" – after the speed change. W_1 is the number of accidents after changing the mean speed from V_0 to V_1,while W_0 – number of accidents prior to the change in the mean speed. The value of the power exponent $n \geq 2$ e.g., $n=3$ in case of serious injuries; $n=4$ – in case of fatalities.

An expansion of the above formula is the so called "Power model" consisting of 6 equations presenting the relations between the change in the number of accidents W or number of road traffic fatalities Z and the change in the mean travel speed V. The Power model may be presented in the following form [10]:

Number of accidents with fatalities

$$W_1 = \left(\frac{V_1}{V_0}\right)^4 W_0 \tag{2}$$

Number of accidents with serious injuries

$$W_1 = \left(\frac{V_1}{V_0}\right)^3 W_0 \tag{3}$$

Number of accidents with wounded (total)

$$W_1 = \left(\frac{V_1}{V_0}\right)^2 W_0 \tag{4}$$

Number of fatalities

$$Z_1 = \left(\frac{V_1}{V_0}\right)^4 W_0 + \left(\frac{V_1}{V_0}\right)^8 (Z_0 - W_0) \tag{5}$$

Number of fatalities or serious injuries

$$Z_1 = \left(\frac{V_1}{V_0}\right)^3 W_0 + \left(\frac{V_1}{V_0}\right)^6 (Z_0 - W_0) \tag{6}$$

Number of road traffic victims (total)

$$Z_1 = \left(\frac{V_1}{V_0}\right)^2 W_0 + \left(\frac{V_1}{V_0}\right)^4 (Z_0 - W_0) \tag{7}$$

If the mean speed is decreased (i.e. $V_1<V_0$.), then according to formulas (2), (3), (4) the number of accidents W_1 will always be smaller after changing the speed than the number of accidents W_0 ($W_1<W_0$). In the case of the number of victims, the aim is for $Z_1<Z_0$. This condition will be met for the number of fatalities (formula (5)) if

$$\left(\frac{V_1}{V_0}\right)^4 \frac{W_0}{Z_0} + \left(\frac{V_1}{V_0}\right)^8 \left(1 - \frac{W_0}{Z_0}\right) < 1$$

Similarly, for formulas (6) and (7), this results in:

$$\left(\frac{V_1}{V_0}\right)^3 \frac{W_0}{Z_0} + \left(\frac{V_1}{V_0}\right)^6 \left(1 - \frac{W_0}{Z_0}\right) < 1$$

$$\left(\frac{V_1}{V_0}\right)^2 \frac{W_0}{Z_0} + \left(\frac{V_1}{V_0}\right)^4 \left(1 - \frac{W_0}{Z_0}\right) < 1$$

Formulas (4-7) demonstrate that the relation between the mean speed V and the number of accidents W or the number of road traffic victims Z is exponential in these equations. This means that lowering the mean vehicle speed has substantial impact on the number of accidents and victims of road traffic. The European Transport Safety Council (ETSC) estimates [6] that lowering the mean actual speed by all drivers in Europe would result in the reduction of fatalities by 2200 persons within a year (1100 fatalities less on the streets of cities, 1000 – on roads outside urban areas and 100 – on motorways).

According to the studies of G. Nilsson from Sweden [10], the change in the mean speed by 1 km/h causes a change in the number of accidents in the range of 2% (for the range of up to 120 km/h) to 4% (in the range of up to 50 km/h). This observation was confirmed in many other studies conducted in Scandinavia, the Netherlands and Australia. Similar relations are presented in the work of M. Taylor and others [17], [18], [19], in which it is specified that the change in mean vehicle speed by 1 km/h results in the change of the number of accidents of 1÷4% on urban roads and of 2.5÷5.5% on extra-urban roads (lower values regard higher quality roads).

The extension of the Power model as well as example of in-depth analyses using the model can be found in the publication [11].

It is worth to notice the fact that the impact of mean speed V depends on the value of the power exponent n in the formula (1). The value of the exponent should be verified based on the current set of data about the road traffic, which comprise the basis for statistical approximation. In-depth information on this subject can be found in the publication of R. Elvik [4] who demonstrated that, for example, the values of some of the exponents proposed by G. Nilsson for the Power model published in 2004 [11] depend on the observations of road traffic in subsequent decades (tab. 1). The variable values also depend on the location, type and scope of traffic moderation means as well as the demographic profile of the community.

Tab.1. Variation of the exponent n in the power model

Type of accidents	1970-79	1980-89	1990-99	2000-09
Fatal accidents n=	4.57	4.21	3.50	3.53
Accidents with injuries n=	2.64	1.72	2.28	2.01

3. Zone with the speed limit of 30 km/h

Non-observance of the safe vehicle speed is related to the increased probability of accident occurrence and more serious injuries, especially in the grouped of unprotected road traffic participants (pedestrians, cyclists). Thus, more common is the opinion about the purposefulness of higher protection of this group of road traffic participants by radical limitation of the speed of motor vehicles and introduction of zones with the speed limit of 30 km/h in the cities. Currently, for example, 47% of the road network is covered with such zones in Gdańsk [June 2015] [5]. Additionally, this results in lowering the noise level and smaller emission of exhaust fumes into the atmosphere. Such action is one of the elements of the traffic moderation strategy, especially in city centres, mainly in the areas of common intersections and near schools and residential areas. The dominating element of traffic organisation in a 30 km/h zone is the prioritisation of pedestrians, preference of uncontrolled intersections, which utilise the principle of priority to the right and guarantee visibility at least 50 km in front of the pedestrian crossing.

By using the Power model, it is possible to attempt evaluating the projected effects of introducing such zones in areas currently subject to the speed limit of 50 km/h.

The data collected in the publication [5] demonstrates that the mean speed of vehicles amounted in 2014 to 49 km/h on single-lane streets of provincial capitals, on which the speed is limited to 50 km/h. If the substitute in the Power model equations respectively V_1= 30 km/h and V_0= 49 km/h, we will obtain the index $\frac{V_1}{V_0} = \frac{30\ km/h}{49\ km/h}$=0.61. If we assume that the number of accidents with fatalities for streets prior to the change in speed amounts to W_0 = 100%, based on the formula (2), we will obtain the number of accidents with fatalities for the 30 km/h zone: W_1=0.61^4·100%=13.8%, i.e. the number of accidents with fatalities after introducing the 30 km/h speed limit will comprise only 13.8% of the number of such accidents which could have happened when the speed limit was 50 km/h.

We may estimate the decrease in the number of accidents with fatalities and serious injuries (formula (3)) in a similar manner: W_1=0.61^3·100%=22.7%. The number of all accidents with wounded (formula (4)) will amount to respectively: W_1=0.61^2·100%=37.2%.

The presented estimations demonstrate that the introduction of a 30 km/h zone should substantially decrease the number of victims in traffic accidents. There is no point in discussing about the qualitative assessment of the advantages. However, quantitative results also depend on many other factors, which are not included in the Power model. This mainly regards the 30 km/h zone, the type and scope of the applied means of traffic moderation and the demographic profile of road traffic participants in this zone. Thus, the reliability of the applied model should be verified by its adaptation to appropriate statistical observations. According to Swedish data from 2004-2008 [7], accidents with fatalities occur relatively rarely as result of a car-pedestrian collision at impact speeds below 40 km/h, while serious injuries – below 25 km/h. Indeed, the number of such accidents is highest at speeds below 35 km/h, but the speed limit of 30 km/h does not necessarily result in substantial improvement of pedestrian safety. According to French data [20], the best effects may be obtained in the areas of intersections.

4. Statistical models

In many studies, analyses are conducted using the notion of impact speed. It is the speed of the car at the moment of impact with a pedestrian, which determines the severity of the pedestrian's injuries. This is confirmed, for example, by the results of studies presented by W.A. Leaf and D.F. Preusser [8].

Statistical observations demonstrate that the mathematical relation between the risk $R(V)$ (of death or injuries of a road traffic participant and the impact speed V (in km/h) may have the following form [16]:

$$R(V) = \frac{1}{1+\exp(a-bV)} \tag{8}$$

The values of parameters a and b may be estimated using the method of the highest reliability based on statistical data. The list of the values of those parameters for pedestrians and cyclists is presented in table 2.

Tab.2. Values of the model parameters (8)

$R(V) = \frac{1}{1+\exp(a-bV)}$	Pedestrians		Cyclists	
	a	**b**	**a**	**B**
Fatalities [16]	6.9	0.090	-	-
Fatalities [9]	5.549	0.105	8.706	0.124
Injuries AIS3+[2] [4]	4.894	0.092	5.826	0.093

G. A Davis [2] developed the following dependency between the risk of fatality $R(V)$ and the impact speed V (in km/h)

$$R(V) = \frac{\exp(x)}{1+\exp(x)} \tag{9}$$

with division to children (age of 0-14), adults (age of 15-59) and elderly people (age of 60+).

The values of the parameter x are presented in table 3.

Tab.3. Values of the model parameters (9)

$R(V) = \frac{\exp(x)}{1+\exp(x)}$	x		
	Children	**Adults**	**Elderly 60+**
	8.85-0.12v	8.87-0.13v	9.73-0.20v

The speed of V km/h in the above presented models signifies the impact speed. The impact speed varies both from the acceptable speed specified for the given type of road and from the mean speed of vehicles travelling on this road.

[2] According to the Abbreviated injury scale (AIS), the symbol AIS3+ signifies at least serious injuries.

The difference between the impact speed and the mean travel speed for the risk of fatalities is presented in fig. 1. It demonstrates that at a speed below 50÷60 km/h, this difference may practically be omitted, whereas at speeds of 100 km/h, the risk of fatalities is approx. 30% higher for impact speeds in relation to mean speeds. This is probably due to the fact that drivers travelling at higher speeds are more often able to decrease the speed prior to collision.

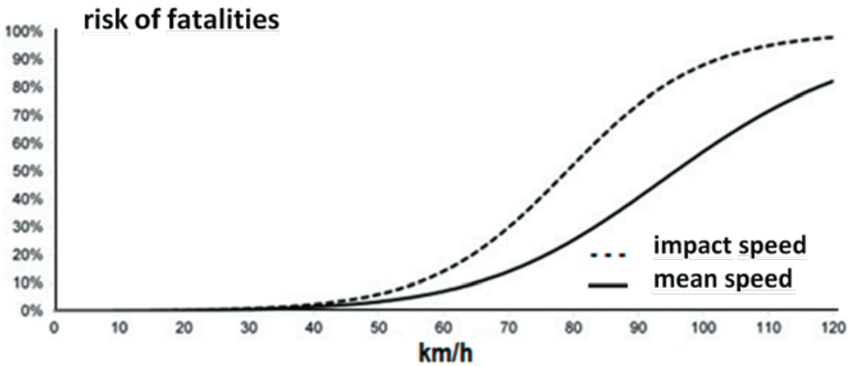

Fig. 1. Comparison of the curves of risk of fatalities among pedestrians for the impact speed and mean travel speed [2]. These curves were developed based on the model presented in publication [16]

According to the report [13] from 2014, the mean vehicle speed in built-up areas, on roads with a speed limit of 50 km/h, amounted to 49÷56 km/h, whereas on expressways – 104 km/h, and motorways – 113 km/h. This information and fig. 1 were used to estimate the value of the impact speed V and specify the risk $R(V)$ of fatalities and AIS3+ injuries for pedestrians and cyclists according to the model (8) as well as the values of parameters a and b taken from the publication [9] (see tab. 2). Table 4 presents the results of the estimations.

Tab.4. Risk for pedestrians and cyclists

Type of road	Risk R(V)			
	Pedestrians		Cyclists	
	Fatalities	AIS3+	Fatalities	AIS3+
Built-up area V=30 km/h	8.0%	10.6%	0.6%	4.6%
Built-up area V=50 km/h	41.0%	42.6%	7.0%	23.8%
Expressway V=104 km/h	99.5%	99.1%	99.2%	98.0%
Motorway V=113 km/h	99.8%	99.6%	99.4%	99.1%

The following conclusions may be formulated based on the results presented in tab. 4:

- Both in built-up areas and extra-urban roads, pedestrians are at a higher risk of fatalities and serious injuries in comparison to cyclists, however the differences in the risk in the groups of pedestrians and cyclists in case of speeds exceeding 100 km/h are within the boundaries of the statistical observation error.

- On roads on which vehicles travel with speeds exceeding 100 km/h, the risk of fatalities and serious injuries is at least twice as high both for pedestrians and cyclists than on urban roads with the speed limit of 50 km/h.
- A clear improvement of pedestrian and cyclist safety takes place, if the speed limit is lowered from 50 to 30 km/h. (4÷5 times lower risk for pedestrians and 5÷10 times lower risk for cyclists).

5. Risk specification error

The presented mathematical models depend on several parameters, e.g. the risk described with the mathematical model (8) is a function of three parameters: $R(V,a,b)$ (impact speed V as well as parameters a and b). The error[3] of specifying the impact speed V depends on the applied method of road accident reconstruction. The values of parameters a and b are chosen in a manner that enables the result of the calculations to best "match" the results of statistical observations. Due to the fact that both the estimation of the impact speed V and specification of the parameters a,b are encumbered with errors, there arises the question about the impact of these errors on the risk specification error $\Delta R(V,a,b)$.

The notion of limit error, i.e. maximum expected (in the scope of possessed knowledge) error value is often used in practice. It may be designated as a total differential

$$\Delta R(V,a,b) = \left|\frac{\partial R(V,a,b)}{\partial V}\Delta V\right| + \left|\frac{\partial R(V,a,b)}{\partial a}\Delta a\right| + \left|\frac{\partial R(V,a,b)}{\partial b}\Delta b\right| \quad (10)$$

i.e. as the sum of absolute values of the partial derivative's ratio in the function $R(V,a,b)$in relation to parameters V,a,b and errors ΔV, Δa, Δb.

Real risk value

$$R_0(V,a,b) = R(V,a,b) \pm 0{,}5\Delta R(V,a,b)$$

i.e. it is in the range of

$$R_0(V,a,b)\epsilon[R(V,a,b) - 0{,}5\Delta R(V,a,b); R(V,a,b) + 0{,}5\Delta R(V,a,b)].$$

The relative error$\left[\frac{\Delta R(V,a,b)}{R(V,a,b)}\right]$or relative error expressed in %:$\left[\frac{\Delta R(V,a,b)}{R(V,a,b)}\right]\cdot 100\%$ is useful for comparing the accuracy of various models.

For model (8), the partial derivatives in relation to parameters V,a,b have the following form:

[3] The often used notions of "error" and "uncertainty" are sometimes incorrectly used. An error is the difference between the measured value and the actual value. An uncertainty is defined as a parameter related to the measurement result; characteristic spread of the analysed results.

$$\frac{\partial R(V,a,b)}{\partial V} = \frac{b \cdot \exp\,(a-b \cdot V)}{[1+\exp\,(a-b \cdot V)]^2} \tag{11}$$

$$\frac{\partial R(V,a,b)}{\partial a} = \frac{-\exp\,(a-b \cdot V)}{[1+\exp\,(a-b \cdot V)]^2} \tag{12}$$

$$\frac{\partial R(V,a,b)}{\partial b} = \frac{V \cdot \exp\,(a-b \cdot V)}{[1+\exp\,(a-b \cdot V)]^2} \tag{13}$$

If we adopt a 10% error of estimating the parameters V,a,b, we will receive:

$$\Delta V = 0.1V, \qquad \Delta a = 0.1a, \qquad \Delta b = 0.1b \tag{14}$$

Finally, the error of the specification of risk $R(V,a,b)$ after substituting (12), (13), (14), (15) in (11) will have the following form:

$$\Delta R(V,a,b) = \left|\frac{b \cdot \exp\,(a-b \cdot V)}{[1+\exp\,(a-b \cdot V)]^2} \cdot 0.1V\right| + \left|\frac{-\exp\,(a-b \cdot V)}{[1+\exp\,(a-b \cdot V)]^2} \cdot 0.1a\right| + \left|\frac{V \cdot \exp\,(a-b \cdot V)}{[1+\exp\,(a-b \cdot V)]^2} \cdot 0.1b\right| \tag{15}$$

Example. The risk of occurrence of pedestrian injuries at the level of AIS3+ in a built-up area with a speed limit of V = 50 km/h (a = 4.8964; b = 0.092 – see tab. 1) amounts to $R(V,a,b)$ = 0.426 (42.6%) (see tab. 2). After substituting the necessary values to (14), the error of the risk of occurrence of pedestrian injuries will amount to $\Delta R(V,a,b)$ = 0.345. Thus, the actual value of the risk of injuries of pedestrians is within the range of $0.25 \leq R_0 \leq 0.6$, whereas the relative error amounts to $\Delta R/R$=0.81 (81%).

6. Summary

Travelling at excessive speeds is one of the most common offences in road traffic. Therefore, it is worth to increase the knowledge about the effects of exceeding the speed limit. The mathematical models presented in the paper, as well as their use in the road traffic safety analysis, allow formulating a general conclusion that lowering the acceptable vehicle speed may radically lower the number of victims in the group of unprotected participants of road traffic. It is especially worth emphasising if we take into account the fact that the costs of such an action are relatively low.

Of course, lowering the speed limit should embrace many aspects, which are not considered in the presented mathematical models. First of all, speed limits should not hinder the smoothness of road traffic, they should be adapted to the current infrastructure and acceptable by the majority of reasonable drivers.

References

[1] Cuerden R., Richards D., Hill J.: *Pedestrians and their survivability at different impact speeds*, United Kingdom, Paper Number 07-0440 http://www.nrd.nhtsa.dot.gov/pdf/esv/esv20/07-0440-W.pdf

[2] Davis G. A.: *Relating severity of pedestrian injury to impact speed in vehicle pedestrian crashes,* Transportation Research Record, 1773, 2001.

[3] Elvik R.: *Area-wide urban traffic calming schemes; a meta-analysis of safety effects*, Accident Analysis and Prevention, 33, 2001.

[4] Elvik R.: *The Power Model of the relationship between speed and road safety, Update and new analyses,* TOI report 1034, Institute of Transport Economics, Norwegian Centre for Transport Research, 2009.

[5] http://forsal.pl/artykuly/877485,miasta-tylko-dla-pieszych-samochodem-pojedziemy-maksymalnie-30-km-h.html

[6] http://www.obserwatoriumbrd.pl/pl/analizy_brd/problemy_brd/predkosc/predkosc-a-ryzyko-wypadku/

[7] Kröyer Höskuldur R.G.: *Is 30 km/h a 'safe' speed? Injury severity of pedestrians struck by a vehicle and the relation to travel speed and age*, IATSS Research. http://www.sciencedirect.com/science/article/pii/S0386111214000235

[8] Leaf W.A., Preusser D.F.: *Literature Review on Vehicle Travel Speed and Pedestrian Injuries,* Final Report, NHTSA, DOT HS 809 021 October, 1999. http://www.nhtsa.gov/people/injury/research/pub/HS809012.html

[9] Nie Jin, Li Guibing, Yang Jikuang, Zhou Xuenong, Zhang Chao, Yu Xiaoping, Li Weiqiang, Wang Meichuan: *A Study of Injury Risk of Bicyclist and Pedestrian in Traffic Accidents in Changsha of China,* Proc. of 5th International Conference on ESAR, 2012 http://bast.opus.hbz-nrw.de/volltexte/2013/689/pdf/38_Nie.pdf-proszę napisać tylko pierwszą literę imienia autorów

[10] Nilsson G.: *The effects of speed limits on traffic crashes in Sweden. In: Proceedings of the international symposium on the effects of speed limits on traffic crashes and fuel consumption,* Dublin. Organization for Economy, Co-operation, and Development (OECD), Paris 1982.

[11] Nilsson G.:*Traffic safety dimensions and the power model to describe the effect of speed on safety.* Bulletin 221, Lund Institute of Technology, Lund 2004.

[12] Pasanen E.: *Driving Speeds and Pedestrian Safety, A Mathematical Model,* Publication 77, Helsinki University of Technology, Transport Engineering, 1992.

[13] *Prędkość pojazdów w Polsce w 2014 r.,* Ministry of Infrastructure and Development, National Board of Road Traffic , Car Transport Institute. Collective work under the guidance of: Maria Dąbrowska-Loranc and Tomasz Wojsza.

[14] *Raport z badań ilościowych dla Ministra Infrastruktury Rzeczypospolitej Polskiej,* published by „Legend Group", Sp. z o.o., Consortium with MEC Sp. z o.o. and „On Board Public Relations" Sp. z o.o., 15-04-2011.

[15] Richards D. C.: *Relationship between Speed and Risk of Fatal Injury: Pedestrians and Car Occupants,* Road Safety Web Publication, No.16, Transport Research Laboratory, Department for Transport, London 2010.

[16] Rosén E., Sander U.: *Pedestrian fatality risk as a function of car impact speed;* Preprint of article published in Accident Analysis and Prevention 41, 2009. http://dx.doi.org/10.1016/j.aap.2009.02.002

[17] Taylor M., Baruya A., Kennedy J.V.: *The relationship between speed and accidents on rural single carriageway roads.* TRL Report TRL511. Transport Research Laboratory, Crowthorne, 2002. http://www.safespeed.org.uk/TRL511.pdf

[18] Taylor M., Lynam D.A., Baruya A.: *The effect of drivers' speed on the frequency of accidents.* TRL Report TRL421. Transport Research Laboratory, Crowthorne 2000. http://www.20splentyforus.org.uk/UsefulReports/TRLREports/trl421SpeedAccidents.pdf

[19] Taylor M., Wheeler A., *Accidents reductions resulting from village traffic calming.* In: Demand management and safety systems; Proceedings of seminar J. Cambridge 11-13 September 2000, p. 165-174. http://abstracts.aetransport.org/paper/download/id/1054

[20] *Ville plus sure, Quartiers sans accidents,* Realisations, evaluations, CETUR, 1994.