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Aesthetics and Safety of Road Landscape: are they Related?

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The problem of unsafe roads is very actual in Lithuania. The solution of the problem is usually found in construction of road equipment. The paper covers another solution: the authors analyze road safety through aesthetic features of landscape. The identification of relations between safety and landscape aesthetic features will enable us to enhance safety by modeling road landscape. This untypical approach would lead to both achievements: decrease of road traffic accidents and increase of visual quality of road landscape. The correlation analysis enabled us to identify weak relations between the quantity of car accidents and some aesthetic properties of road landscape. Regression analysis revealed the factors described by aesthetic properties which influence the quantity of car accidents on Lithuanian roads.

Keywords: *Road landscape, aesthetics, safety, correlation analysis, linear regression analysis.*

1. Introduction

According to Eurostat statistical findings (Transport … 2012) about road accidents in EU member countries during 2008, the highest road fatality rates were recorded in Lithuania (148), Poland (143), Romania (142), Bulgaria, Greece and Latvia (all 139) (here the values of road fatality rates are expressed as the number of deaths per million inhabitants). Though during the last decade the number of car accidents on Lithuanian roads decreased from 5972 in 2001 (1715 accidents per million inhabitants) to 3312 in 2011 (1035 accidents per million inhabitants) (Eismo … 2012) and the fatality rates also decreased from 706 in 2001 (202 accidents per million inhabitants) to 297 in 2011 (93 accidents per million inhabitants) the overall road safety in Lithuania is not high, having in mind Lithuania's position in the context of other EU member countries. For instance, road fatality rates in Sweden and the United Kingdom are both 43, in the Netherlands 41 and in Malta 37 per million inhabitants. Lithuania try to solve the problem of unsafe roads through speed restriction on dangerous segments of roads, installation of safety islands, roundabouts etc. Though many countries (USA, Germany, Great Britain, Australia etc.) involve road landscape aesthetics and design into enhancing of road safety. In these countries creation of an aesthetic road landscape is an essential part of creation a safe driving on the road.

Literature review revealed some analysis of road safety through the prism of landscape aesthetics. According to the National Association of Australian State Road Authorities (NAASRA) the main goal of road landscaping is „to produce roadways to high safety standards which will also aesthetically integrate with the environment“ (Road … 1997). Though the Road landscape manual (1997) presents the assessment of the road landscape at visual-aesthetic, ecological (environmental) and cultural heritage consideration stages, road safety aspect has to be considered at all stages, including construction, operation and maintenance of roads (Road … 1997). According to American experience billboards impact the visual quality of the highway because they obstruct the views of scenic features and the natural landscape (I-15 … 2005). Advertising can also distract drivers through messages and products which are not relevant to travelling (Road … 1997). J. Edquist (2008) analyzed the effect of visual disorder on road safety. Chaotically located road signs, advertising, buildings, electrical transmission lines etc. are called here as visual disorder. The scholar carried out the research of simulation of drivers' behavior at day time. The result of her research revealed that visual disorder in road landscape decrease drivers' attention while driving and negatively affect safety on the roads. H. Antonson with a group of researchers (2009) analyzed the reliance of drivers' behavior and safety on the road landscape type – open, woodlands or mixed. For the research they used the simulator of driving in these types of landscape. Then eighteen research participants were asked to answer the questions about their feelings while driving. The research results indicated that in the open landscape the speed of driving is faster, and that road safety depends on the landscape through which road passes. H. Drottenborg (2002) analyzed traffic safety and driving behavior in 10 beautiful and 10 ugly traffic environments. The results confirmed that "aesthetically rewarding traffic environments seem to be beneficial for traffic safety", and that driving speed is lower in beautiful rather than ugly traffic environments due to more stops in beautiful landscape. Research in Germany demonstrated that the most part (68%) of all the car accidents happen due to the wrong design of road and its landscape, and because of insufficient informativity of road and its landscape.

According to Küllers' model of the basic emotional process, "driving behavior is related to the physical environment, other road users, the driving task, the individual factors and own abilities, and to the interaction among them" (Drottenborg, 2002). Therefore, this research is concentrated on the physical environment, id est the landscape through which the road passes. Accordingly, the aim of the research is to identify if there is a relation between landscape aesthetics and safety on Lithuanian roads.

2. Methods

The research objects are the main Lithuanian highways which are marked as the European motorway network corridors or the European highways: A1 road Vilnius-Kaunas-Klaipėda (311.40 km), A2 road Vilnius-Panevėžys (135.92 km), A3 road Vilnius-Minsk (Belarus) (33.99 km), A5 road Kaunas-Marijampolė-Suwalki (Poland) (97.06 km), A6 road Kaunas-Zarasai-Daugavpils (Latvia) (185.40 km), A8 road Panevėžys-Aristava-Sitkūnai (87.86 km), A9 road Panevėžys-Šiauliai (78.94 km), A10 road Panevėžys-Pasvalys-Bauska (Latvia) (66.10 km), A11 road Šiauliai-Palanga (146.85 km), A12 road Riga (Latvia)-Šiauliai-Tauragė-Kaliningrad (Russia) (186.09 km), A13 road Klaipėda-Liepaja (Latvia) (45.15 km) and A16 road Vilnius-Prienai-Marijampolė (137.51 km) (Fig. 1). The total length of the researched roads is 1512.27 km. Only the road segments within the Lithuanian borders were considered.

The research of aesthetic properties of road landscape was conducted in spring 2010 by employing the photo-fixation of road landscape and the qualitative survey (Matijošaitienė 2011). Selected photos of road landscape were used for the qualitative survey. Also aesthetic properties of road landscape were used for the survey and for the analysis of aesthetics and road safety*: interesting, natural, visually safe, skittish, beautiful, outstanding, harmonious, sophisticated, relaxing, majestic, pleasant, elements match for surrounding environment, left an intense positive impression, willing to drive on this road*. These properties were measured by the 5-point semantic differential scale, where 1 meant the least acceptance and 5 meant the most acceptance (Matijošaitienė and Stankevičė 2011). Thus, the aesthetic properties of road landscape are based on respondents' emotions and their opinion about a certain road landscape. The number of respondents was N=486. PASW Statistics 17.0 software was applied for the correlation and regression analysis of the data.

Correlation analysis was applied for the identification of relations between all or separate variables, and if there was a relation this analysis will enable us to identify the strength of the relation. The variables describing demographic, financial and marital status of respondents are nominal and interval (for the measurement of respondents' income per month), the variables describing the aesthetic properties of roadscape are ordinal (rank), and the variables describing the quantity of car accidents on the researched roads are scale. Therefore, the Kendall's tau_b and Spearman's correlation coefficients were counted. Kendall's tau-b correlation coefficient is used to measure the association between two measured quantities. Kendall's tau-b, unlike tau-a, makes adjustments for ties and is suitable for square tables. In our case we have 15x15 table (according to the number of variables), thereby the table is square. Values of Kendall's

Fig. 1. *Research objects*

tau_b range from -1 to +1. Spearman's correlation coefficient (Spearman's rho) is a non-parametric measure of statistical dependence between two variables. It assesses how well the relationship between two variables can be described using a monotonic function. If there are no repeated data values, a perfect Spearman correlation of +1 or −1 occurs when each of the variables is a perfect monotone function of the other. For instance, when X was increasing Y monotonously increases (not necessarily linearly) or decreases. The Spearman correlation coefficient is defined between the ranked variables. For the both correlation coefficients the correlation can be: a) very strong when the value is -1 or +1, b) strong when the value is from -1 to -0.7 or from +1 to +0.7, c) moderate when the value is from -0.7 to -0.5 or from +0.7 to +0.5, d) weak when the value is from -0.5 to -0.2 or from +0.5 to 0.2 and e) very weak when the value is from -0.2 to 0 or from +0.2 to 0. A value of 0 indicates the absence of relation.

Multiple linear regression analysis was applied for the identification of visual characters of road landscape which influence the quantity of car accidents. Because all the variables which represents the visual character of road landscape are ordinal (rank) we make the assumption that the intervals between the ranks are equal. The biggest advantage of regression analysis is that regression model (function which connects variables) is composed. Regression model is a statistical model which let forecast the values of one variable through the values of other variables. English geneticist F. Galton used the term of regression for the first time during his research on the relation between height of children and their parents (Čekanavičius 2008).

The literature review revealed many cases of application correlation and regression analyses for the research of landscape. For instance, T. Daniel (1976) applied correlation analysis for the research of Arizona (USA) woodlands. Regression analysis is often used for the practical research: for the forecast of election winners for the political purposes, for the identification of consumer opinion about a product or a service, for the research of landscape. P. Cook (1995) applied multiple regression and correlation analyses for the analysis of landscape scenery of Great Plains in the USA, R. Clay (2004, 2000) applied correlation, regression and factor analyses for the research of factors which describe Californian road scenery.

3. Results

The characteristics of demographic, financial and marital status of respondents correlate with variables describing road landscape very weakly: the highest correlation coefficients are r_{tau_b}=0.178 (p=0.000<α=0.05) and r_s=0.190 (p=0.000<α=0.05) at the significance level of 0.01. These correlations are between the variable *outstanding* road landscape and the marital status of respondents. Therefore, the conclusion is that demographic and financial characteristics of respondents as well as their marital status do not affect respondents' opinion and assessment of road landscape views.

The analysis of the Kendall's tau_b correlations between road landscape describing variables demonstrate that almost all the describing variables correlate to each other. The exception is the variables *beautiful* and *sophisticated* – these variables do not correlate at all r_{tau_b}=0.000 (p=0.000<α=0.05). The most of the correlations are moderate, weak and very weak. The strongest correlation (though it is just a strong correlation) is between the variables *interesting* and *skittish* r_{tau_b}=0.848 (p=0.000<α=0.05), *majestic* and *left an intense positive impression* r_{tau_b}=0.818 (p=0.000<α=0.05), *relaxing* and *willing to drive* r_{tau_b}=0.758 (p=0.000<α=0.05), *interesting* and *left an intense positive impression* r_{tau_b}=0.727 (p=0.000<α=0.05) all at the significance level of 0.01. There are some opposite very weak correlations between the variables *visually safe* and *elements match for surrounding environment, visually safe* and *beautiful, outstanding* and *elements match for surrounding environment, harmonious* and *sophisticated, sophisticated* and *elements match for surrounding environment*: the better assessment is for one variable the worse assessment is for another variable in the pair (table 1).

The higher quantity of car accidents on the road correlates weakly with *relaxation* r_{tau_b}=-0.303 (p=0.000<α=0.05), *visual safety* r_{tau_b}=-0.212 (p=0.000<α=0.05), *beauty* r_{tau_b}=0.364 (p=0.000<α=0.05), *sophistication* r_{tau_b}=-0.333 (p=0.000<α=0.05) and *elements match for surrounding environment* r_{tau_b}=0.273 (p=0.000<α=0.05) (table 1). It is interesting that the more road landscape is relaxing, visually safe and sophisticated the less car accidents happen.

The analysis of the Spearman's rho correlations between road landscape describing variables demonstrate that almost all the describing variables correlate to each other. The most of the correlations are strong, moderate, weak and very weak. The strong correlation is between the variables *skittish* and *interesting* r_s=0.951 (p=0.000<α=0.05), *majestic* and *left an intense positive impression* r_{tau_b}=0.930 (p=0.000<α=0.05), *relaxing* and *willing to drive* r_s=0.888 (p=0.000<α=0.05), *interesting* and *left an intense positive impression* r_{tau_b}=0.881 (p=0.000<α=0.05), *skittish* and *left an intense positive impression* r_{tau_b}=0.853 (p=0.000<α=0.05), *skittish* and *outstanding* r_{tau_b}=0.846 (p=0.000<α=0.05), *outstanding* and *left an intense positive impression* r_{tau_b}=0.839 (p=0.000<α=0.05), *pleasant* and *beautiful* r_{tau_b}=0.813 (p=0.000<α=0.05), *interesting* and *outstanding* r_{tau_b}=0.811 (p=0.000<α=0.05), *harmonious* and *elements match for surrounding environment* r_{tau_b}=0.804 (p=0.000<α=0.05), *beautiful* and *elements match for surrounding environment* r_{tau_b}=0.776 (p=0.000<α=0.05), *majestic* and *willing to drive* r_{tau_b}=0.762 (p=0.000<α=0.05), *pleasant* and *skittish* r_{tau_b}=0.760 (p=0.000<α=0.05), *pleasant* and *interesting* r_{tau_b}=0.760 (p=0.000<α=0.05), *majestic* and *interesting* r_{tau_b}=0.741 (p=0.000<α=0.05), *majestic* and *skittish* r_{tau_b}=0.734 (p=0.000<α=0.05), *relaxing* and *visually safe* r_{tau_b}=0.720 (p=0.000<α=0.05), *pleasant* and *willing to drive* r_{tau_b}=0.718 (p=0.000<α=0.05) all at the significance level of 0.01, *left an intense positive impression* and *willing to drive* r_{tau_b}=0.706 (p=0.000=α=0.05) at the significance level of 0.05.

There are some opposite weak and very weak correlations between the variables *visually safe* and *beautiful*, *visually safe* and *elements match for surrounding environment, outstanding* and *elements match for*

Table 1. *Kendall's tau_b correlation coefficient values*

	Kendall's tau_b correlation coefficient values														
	pleasant	relax-ing	safe	skittish	interes-tin	outstandi	harmo-niou	majestic	natural	beauti-ful	sophis-ticat	left posit impr	elemen mat	willin to drive	car ac-cidents
pleasant	1.00	.351	.076	.595**	.626**	.382	.473*	.473*	.504*	.687*	.137	.473*	.534*	.595**	.168
relaxing	.351	1.00	.545*	.152	.303	.242	.394	.515*	.030	.091	.364	.394	.242	.758**	-.303
safe	.076	.545*	1.00	.121	.212	.030	.182	.364	.121	-.182	.394	.364	-.030	.485*	-.212
skittish	.595**	.152	.121	1.00	.848**	.667**	.091	.576**	.455*	.394	.424	.697**	.121	.394	.061
interestin	.626**	.303	.212	.848**	1.00	.636**	.182	.606**	.545*	.364	.394	.727**	.152	.424	-.030
outstandi	.382	.242	.030	.667**	.636**	1.00	.061	.545*	.182	.303	.394	.667**	-.030	.364	.091
harmonio	.473*	.394	.182	.091	.182	.061	1.00	.091	.273	.394	-.061	.152	.667**	.394	.121
majestic	.473*	.515*	.364	.576**	.606**	.545*	.091	1.000	.273	.273	.364	.818**	.061	.576**	.000
natural	.504*	.030	.121	.455*	.545*	.182	.273	.273	1.00	.576**	.182	.394	.303	.212	.121
beautiful	.687**	.091	-.182	.394	.364	.303	.394	.273	.576**	1.00	.000	.273	.606**	.333	.364
sophisticat	.137	.364	.394	.424	.394	.394	-.061	.364	.182	.000	1.00	.424	-.152	.364	-.333
left posit impr	.473*	.394	.364	.697**	.727**	.667**	.152	.818**	.394	.273	.424	1.00	.061	.576**	.000
elements matc	.534*	.242	-.030	.121	.152	-.030	.667**	.061	.303	.606**	-.152	.061	1.00	.364	.273
willing to drive	.595**	.758**	.485*	.394	.424	.364	.394	.576**	.212	.333	.364	.576**	.364	1.00	-.061
car accidents	.168	-.303	-.212	.061	-.030	.091	.121	.000	.121	.364	-.333	.000	.273	-.061	1.00

**. Correlation is significant at the 0.01 level
*. Correlation is significant at the 0.05 level

Strong relation | Moderate relation | Weak relation | Very weak relation

surrounding environment, harmonious and *sophisticated, beautiful* and *sophisticated, sophisticated* and *elements match for surrounding environment*: the better assessment is for one variable the worse assessment is for another variable in the pair (table 2).

The hihger quantity of car accidents on the road correlates weakly with *pleasure* r_{tau_b}=0.214 (p=0.00<α=0.05), *relaxation* r_{tau_b}=-0.406 (p=0.00<α=0.05), *visual safety* r_{tau_b}=-0.315 (p=0.00<α=0.05), *harmony* r_{tau_b}=0.217 (p=0.00<α=0.05), *naturalness*

Table 2. *Spearman's rho correlation coefficient values*

	Spearman's rho correlation coefficient values														
	pleas-ant	relax-ing	safe	skittish	interes-tin	out-standi	harmo-niou	majes-tic	natu-ral	beauti-ful	sophisti-cat	left posit impr	elemen mat	willin to drive	car ac-cidents
pleasant	1.00	.410	.175	.760**	.760**	.504	.609*	.616*	.623*	.813**	.203	.669*	.687*	.718**	.214
relaxing	.410	1.00	.720**	.259	.399	.308	.455	.615*	.126	.077	.497	.531	.203	.888**	-.406
safe	.175	.720**	1.00	.140	.308	.098	.301	.483	.161	-.203	.573	.510	-.126	.595*	-.315
skittish	.760**	.259	.140	1.00	.951**	.,846**	.140	.734**	.545	.559	.552	.853**	.126	.510	.098
interestin	.760**	.399	.308	.951**	1.00	.811**	.294	.741**	.615*	.510	.594*	.881**	.168	.573	-.056
outstandi	.504	.308	.098	.846**	.811**	1.00	.077	.727**	.266	.385	.476	.839**	-.021	.483	.147
harmonio	.609*	.455	.301	.140	.294	.077	1.00	.091	.399	.455	-.189	.224	.804**	.531	.217
majestic	.616*	.615*	.483	.734**	.741**	.727**	.091	1.000	.385	.399	.559	.930**	.056	.762**	-.063
natural	.623*	.126	.161	.545	.615*	.266	.399	.385	1.00	.685*	.245	.476	.448	.266	.238
beautiful	.813**	.077	-.203	.559	.510	.385	.455	.399	.685*	1.00	-.014	.406	.776**	.399	.476
sophisticat	.203	.497	.573	.552	.594*	.476	-.189	.559	.245	-.014	1.00	.587*	-.378	.448	-.413
left posit impr	.669*	.531	.510	.853**	.881**	.839**	.224	.930**	.476	.406	.587*	1.00	.056	.706*	.056
elements matc	.687*	.203	-.126	.126	.168	-.021	.804**	.056	.448	.776**	-.378	.056	1.00	.399	.357
willing to drive	.718**	.888**	.594*	.510	.573	.483	.531	.762**	.266	.399	.448	.706*	.399	1.00	-.098
car accidents	.214	-.406	-.315	.098	-.056	.147	.217	-.063	.238	.476	-.413	.056	.357	-.098	1.00

**. Correlation is significant at the 0.01 level
*. Correlation is significant at the 0.05 level

Strong relation | Moderate relation | Weak relation | Very weak relation

r_{tau_b}=0.238 (p=0.00<α=0.05), *beauty* r_{tau_b}=0.476 (p=0.00<α=0.05), *sophistication* r_{tau_b}=-0.413 (p=0.00<α=0.05), and *elements match for surrounding environment* r_{tau_b}=0.357 (p=0.00<α=0.05). It is also interesting that according to the Spearman's rho correlation coefficient values we got the same result as according to the Kendall's tau_b correlation coefficient values: the more road landscape is *relaxing*, *visually safe* and *sophisticated* the less car accidents happen.

The application of the multiple linear regression analysis leads to one regression model. The quantity of car accidents is the dependent variable. According to the ANOVA and Coefficients tables prepared by the PASW Statistics software we find the point estimates for the regression equation. The statistical acceptance of the coefficients of the model (p-value shall not have to exceed α=0.05) was estimated. Then the unstandardized coefficient B as well as the variables, which influence the quantity of car accidents were identified.

$$\begin{aligned}&\text{Quantity of car accidents} = -33.93 + \\ &+ 40.98*\text{Beautiful} - 33.05*\text{Interesting} + \\ &+ 32.78 * \text{Willing to drive} - \\ &- 29.97 * \text{Elements match for surrounding environment} - \\ &- 19.11*\text{Relaxing} + 14.8*\text{Natural} + 8.27*\text{Harmonious} - \\ &- 8.2*\text{Sophisticated} + 7.11*\text{Majestic} - 1*\text{Visually safe}\end{aligned} \quad (1)$$

The linearity of the regression equation is approved (according to ANOVA p=0.000<0.05). The hypothesis that the coefficients are equal to zero was rejected (p=0.000<0.05), it means that the regression lines are suitable for making predictions.

4. Discussion

Values of the both Kendall's tau_b and Spearman's correlation coefficients demonstrate weak or very weak relations between the variable *Quantity of car accidents* and other variables describing aesthetics of road landscape. This could happen due to not very detailed information about aesthetic properties of each road landscape. The collected data on aesthetic properties describe the landscape of the whole road instead of description of separate sections of each road. More over the regression equation explains only 50.3% of the dispersion of all the variables. Whereas the other very important factors which influence the quantity of car accidents remain unknown. On other hand, the regression equation contains too many independent variables (10 of 14), and the constant is very high (-33.93). In consideration of these facts, more detailed analysis should be carried out. The landscape of each road has to be divided into separate segments according to the landscape type. Then for each segment more detailed aesthetic properties has to be evaluated. Finally the data on landscape aesthetics has to be compared with the number and types of car accidents for each segment of the road. Also more detailed data on road landscape aesthetic properties will let us create the guidelines for the design of an aesthetic and safe road landscape, and to forecast potentially dangerous (unsafe) places of road landscape.

5. Conclusions

The results of the correlation analysis (both Kendall's tau_b and Spearman's correlation coefficients evaluated) revealed that the road safety described through the quantity of car accidents is weakly related with some aesthetic properties of road landscape. Actually, the more landscape is *pleasant*, *beautiful, harmonious, natural* and *elements match for surrounding environment* the more car accidents happen, and the more road landscape is *relaxing, visually safe and sophisticated* the less car accidents happen. These aesthetic properties have to be considered by the planners while designing and creation of safe road landscape.

According to the multiple linear regression analysis the more landscape is *beautiful, willing to drive, natural, harmonious* and *majestic* the more car accidents happen on the road, and the more road landscape is *interesting, elements match for surrounding environment, relaxing, sophisticated* and *visually safe* the less car accidents happen on the road. Still, the coefficients of the independent variables and the constant are too high, therefore the equation need to be revised in further research.

(I. Gurauskiene, 2006, Eco-design methodology for electrical and electronic equipment industry)

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References

Antonson H., Mardch S., Wiklund M., Blomqvist G. 2009. Effect of surrounding landscape on driving behavior: A driving simulator study. Journal of Environmental Psychology, 29 (4), 493-502.

Clay G. R., Smidt R. K. 2004. Assessing the validity and reliability of descriptor variables used in scenic highway analysis. Landscape and Urban Planning, 66 (4), 239-255.

Clay G. R., Daniel T. C. 2000. Scenic landscape assessment: the effects of land management jurisdiction on public perception of scenic beauty. Landscape and urban planning, 49 (1-2), 1-13.

Cook P. S., Cable T. T. 1995. The scenic beauty of shelterbelts on the Great Plains. Landscape and Urban Planning, 32 (1), 63-69.

Čekanavičius V., Murauskas G. 2008. Statistika ir jos taikymai 2 [Statistics and its application 2]. Vilnius, TEV.

Daniel T. C., Boster R. S. 1976. Measuring Landscape Esthetics: The Scenic Beauty Estimation Method. USDA Forest.

Service, Rocky Mountain Forest and Range Experiment Station, Research Paper RM-167, Fort Collins.

Drottenborg H. 2002. Are beautiful traffic environments safer than ugly traffic environments? Doctoral thesis. Lund University: Studentlitteratur. Available at: http://www.getcited.org/pub/103430785 (accessed 16 May 2012).

Edquist, J. 2008. The effects of visual clutter on driving performance. Doctoral thesis. Monash University. Available at: http://www.tml.org/legal_pdf/Billboard-study-article.pdf (accessed 16 May 2012).

Eismo įvykių statistika [Transport accident statistics], 2012. Lietuvos automobilių kelių direkcija prie Susisiekimo ministerijos. Available at: http://www.lra.lt/lt.php/eismo_saugumas/eismo_ivykiu_statistika/27 (accessed 16 May 2012).

I-15 landscape and aesthetics corridor plan. 2005. Nevada DOT. Available at: http://www.ndotprojectneon.com/FEIS/I-15_Landscape_Corridor_Plan.pdf. (accessed 16 May 2012).

Matijošaitienė, I. 2011. Automobilių kelių hedonomiško kraštovaizdžio formavimo principai. Daktaro disertacija [The principles of formation of hedonomic road landscape. Doctoral thesis]. Kaunas: Technologija.

Matijošaitienė, I., Stankevičė, I. 2011. Hedonomic Roadscapes in the Context of Urban Sprawl. The Scientific Journal of Riga Technical University, 5, 70-76.

Road Landscape Manual. Version 1. 1997. Queensland Government, Department of Main Roads. Available at: http://www.tmr.qld.gov.au/Business-and-industry/Technical-standards-and-publications/Road-landscape-manual.aspx. (accessed 16 May 2012).

Transport accident statistics, 2012. European Commision Eurostat. Available at: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Transport_accident_statistics. (accessed 16 May 2012).

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