INFRASTRUKTURA I EKOLOGIA TERENÓW WIEJSKICH
INFRASTRUCTURE AND ECOLOGY OF RURAL AREAS

Nr IV/4/2015, POLSKA AKADEMIA NAUK, Oddział w Krakowie, s. 1485–1495
Komisja Technicznej Infrastruktury Wsi

DOI: http://dx.medra.org/10.14597/infraeco.2015.4.4.107

THE IMPORTANCE OF THE MEASUREMENT AND ANALYSIS OF VEHICLE TRAFFIC VOLUME FOR DESIGNING ROAD INFRASTRUCTURE. A CASE STUDY OF BYSINA

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Summary

The aim of this study is to analyse the intensity of traffic in the village of Bysina taking into account, that local municipality is planning to build ring road of Bysina nearby. Conducted traffic measurements confirmed that existing transit route – the county roadNo.K1935is characterized by allow transit traffic with a relative stabilization of its level in the various periods of the year. In addition, there is no increased arduousness at night and during all the days off from work. The discussion was also subjected to an assessment of the accuracy of the report on environmental impact of one particular road investment. Basing on authors research, there was found that the report should not be used as the ultimate document judging the road usefulness.

Keywords: car traffic analysis, environmental impact assessment, technical infrastructure, ring roads construction

INTRODUCTION

Due to a complicated procedure and wide impact, designing and implementation of road infrastructure projects is a very difficult task. Undoubtedly, there is a dependence between economic or social development of a commune and the quality and availability of technical infrastructure (Collins and Weisbrod 2000). Striving for a systemic and predicted in advance development of this infrastructure is justifiable attitude. However due to financial reasons, many local governments usually make investment outlays on the realization of projects

which should be finished much earlier. Many of them are projects scheduled for implementation as advanced processes, but actually are implemented to eliminate existing congestion on roads (Zeman-Miszewska 1996).

In extreme situation it has been assumed that construction of a new road infrastructure (e.g. ring road), which is one of the elements of technical infrastructure will be a stimulant for the development of entrepreneurship and creating new housing areas. However, without the appropriate investigations conducted at the design stage, the investment may involve a long-time freezing of capital, whereas the intended effectivity will never be achieved (Kuciński *et al.* 2002, Breheny 1992, Markowski 2011).Demarcating a roadway is often a controversial issue, particularly if it is intended to run through terrains attractive both from the environmental and farming point of view (Bloustein 2005, Hołuj 2013). Seemingly appreciated asset is the landscape itself but its protection is a difficult task. Firstly, it is difficult to indicate and appreciate the landscape values, secondly despite the amendments to the legislation made this year (so called landscape law) its application in practice may prove very difficult (Ustawa 2015). Another problem is a lack of understanding and involvement in the design works on the part of local communities and only superficially sustainable spatial policy of local government (Markowski red. 2009). Local authorities when designing roads are sometimes basing on special laws to facilitate investing in a situation where fundamental laws are not usable (so called "specustawa") (Szafranko 2010). It is not always an antidote to creating new and qualitatively desired infrastructural solutions. In this way investors can disregard the assumption of spatial policy and negative opinions of local dwellers.

It is relatively difficult to identify a universal method of providing a territorial unit with road infrastructure. The time frame should be indicated, as well the expenses resulting from the spatial and urban planning process itself. Time consumption is strictly connected with the multifaceted preparation of space for the intended investment and its realization. Development and then implementation of the documents necessary in compliance with the regulations in force (Leoński *et al.* 2012) require sound proceeding, regarded as joint effort of clerks, designers, local counsellors, investors and inhabitants at fair and square fulfilment of needs of all interested parties, particularly local communities (Kuciński *et al.* 2002, Hołuj 2013). Strongly emphasized "justice" is sometimes wrongly perceived. However, its absence may sooner or later lead to a conflict arising in the managed space. Focussing on individual interests in programming investment plans is justified only if the community participation in the investment process is equal and mutually recognized. Ambition to fulfil the needs of only selected communities may cause a chain reaction over a longer period of time leading to a division of the inhabitants for the better and worse.

Methodology of the activities should be adjusted to the key documents in the discussed process, particularly to the study of land conditions and directions

of spatial management and local space management plans of the district, as well as with the report on the environmental impact and the investment project itself. The professional quality of these documents is particularly important.

The first objective of this paper was the analysis of vehicle traffic volume in the area of Bysina village. Discussed was also the reliability of the report of the environmental impact of the road project. The exploration and theoretical inference were preceded by the analysis of the spatial structures in the area and investigations of the Myślenice and Bysina areas where the ring road was planned. Vehicle traffic was analysed in detail for the county road K1935 in Bysina village area.

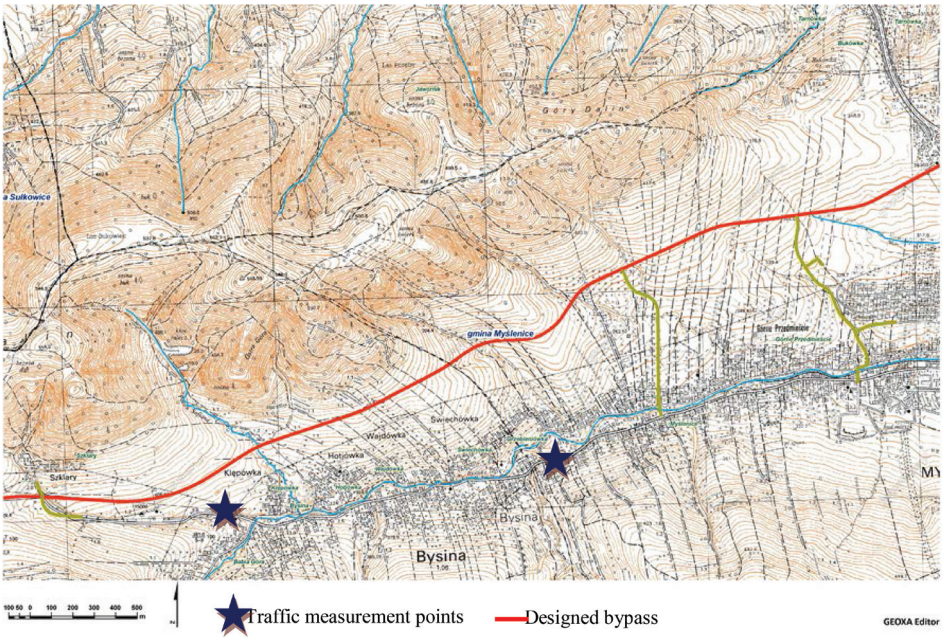
Because of the research subject discussed in this paper, the authors will focus on a fragment of the report on the environmental impact (Rakoczy 2010), the analysis of methodology of forecasting the traffic volume and principles of traffic design used in practice (Rolla *et al.* 1988, Handy *et al*. 2002). This issue is very important, even crucial because it allows for a reliable statement whether traffic congestion is present, so if designing a new road is necessary.

CHARACTERISTICS OF THE RESEARCHED AREA

The subject matter of the discussion and analyses is a designed road located in the area of Małopolskie voivodship, in Myślenice county, in the area of Myślenice city and Bysina village. The project document is entitled: "*Complex improvement of safety and transport in the city and commune of Myślenice – Construction of the western bypass of Myślenice and Bysina"*. According to the assumptions the road is to function as a transit road between Bysina village (quarry) and the national road No.7 – Myślenice ring road bypassing the built-up areas in the Bysina area and 3Maja and Średniawskiego streets in Myślenice. It is also assumed to be the new course of county road (K1935). In Fig.1 a possible course of the designed ring road was marked red. Besides, the points were marked where the measurements of vehicle traffic volume were conducted for the needs of the presented research.

It should be considered that analysed space is characterized by a diversity of terrain, which in the case of the project realization may be associated with some technical difficulties. Moreover, the course of the ring road will interfere mainly in green areas, arable fields, terrains covered by trees and shrubs, and in meadows and pastures. Planned road will cross eight streams, whereas a part of construction works will be conducted in inundation areas. Moreover, an important feature of the area is apparent "strip shape" of arable fields which are considerably long but relatively not wide. In these conditions, construction of a roadway crossing agricultural lands may negatively affect their accessibility. As has been mentioned before, from the environmental point of view, also the

surroundings are very important, which in this case are covered by rich vegetation and situated close to forested areas. Forecasted traffic on the designed bypass is presented in Raport (2011,pp.85-86). However, there is no information about the basis on which the forecasts for the years 2025-2030 were calculated (i.e. when the investigations were conducted and what were the results of field trials). Precision of the calculations is important for predicting spatial distribution of air pollution, equipollent sound level or rainwater pollution in surface runoff.



Source: own studies based on data from geoportal.gov.pl

Figure 1. Designed course of the western bypass in the area of Bysina village

ANALYSIS OF THE TRAFFIC VOLUME IN THE AREA OF BYSINA VILLAGE

The documents available from the Myślenice local government office include not fully reliable (professionally prepared) information which would allow to accept current traffic volume and traffic forecast included in the above mentioned in Raport (2011).

Field investigations were conducted in three rounds for the necessary assessment of project documentation prepared by the local authorities. It was decided that multiple and diversified sample of traffic measurement may be used

for determining the period of time for which the trend lines will precisely describe the specificity of process of traffic development. The measurements were carried out separately for the following categories: passenger cars, trucks with total weight over 3.5 t and buses (descriptive analysis included also motorcycles and tractors). The measurements were conducted cyclically3 days per week including holidays.

The first round of traffic volume tests was conducted in 2012 during June-July period and in November, the second in June, 2013 and the third in May, 2014.The measurements were conducted for twenty-four-hours and registered the structure of traffic. Identified were passing passenger cars, trucks (also with trailers and semitrailers) and buses (including all means of paid public transport with at least 9 seats and at this point it must be added that minibuses dominated). In Figures 2-7 no other vehicles were identified in the description directly due to their small number and mainly local range (a total of 126 motorcycles were counted going to Myślenice and 114 to Jasienica), a total of 397 farm vehicles were counted in Bysina (tractors and other amateur vehicles).

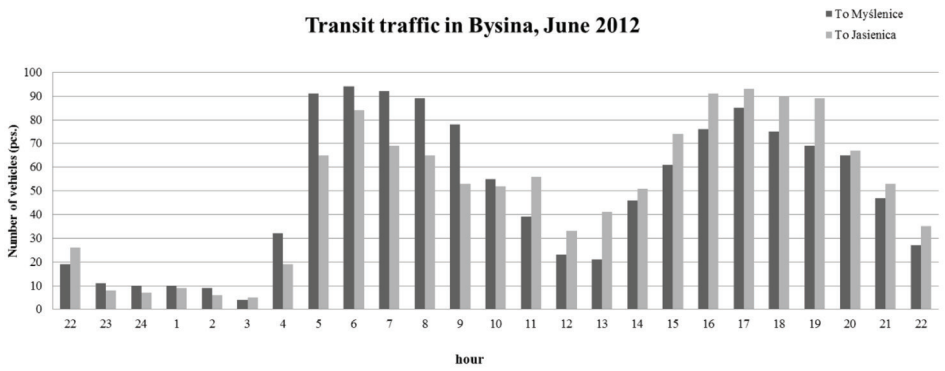


Figure 2. Average daily traffic volume in June 2012, authors' elaboration of own results

The process of vehicle counting was conducted on the border of Bysina and Myślenice or Bysina and Jasienica, whereas at night the measurements were made exclusively in the central part of Bysina village on country road no. K1935. Final presented results demonstrate vehicle transit traffic, because the designed ring road does not assume joining both roads (the existing country road with the designed road) in the centre of Bysina. In June 2012, on average 1228 vehicles (including 109 trucks and 98 buses) passed daily towards Myślenice and 1241 towards Jasienica (including 121 trucks and 95 buses).In July 2012, on average 1049 vehicles (including 80 trucks and 81buses) passed daily towards

Myślenice and 1096 (including 81 trucks and 86 buses). Detailed data for both measurement periods were shown in Figs. 2 and 3.

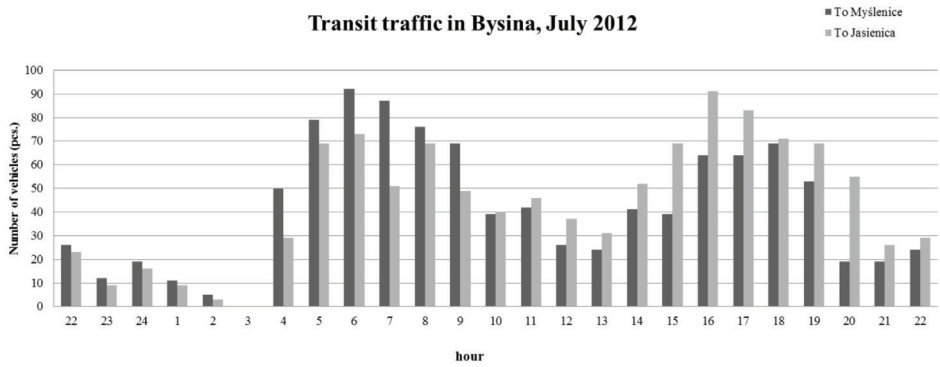


Figure 3. Average daily traffic volume in July 2012, authors' elaboration of own results

In November, 2012 two time intervals were identified during which intensified maximum traffic per hour was noticeable (Fig. 4). These were hours between 5:00 and 10:00 when vehicles going to Myślenice dominated and 13:00-20:30 (intensified stream towards Jasienica village). In July the maximum hourly traffic was noticed in the time interval between 5:30 and 19:00.

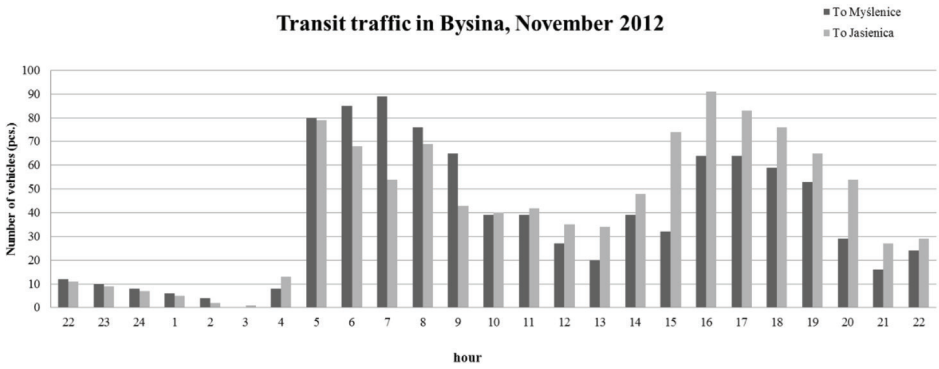


Figure 4. Average daily traffic volume in November 2012, authors' elaboration of own results

In June, 2013 on average 966 vehicles per day passed through Bysina (including 48 trucks and 107 buses) and 983 (including 59 trucks and 91 buses) went towards Jasienica. This value is lower in comparison with the previous year, which is difficult to interpret unanimously. It may be supposed that it is

somehow connected with lower demand for products and services provided by enterprises located in Jasienica and Bysina. Moreover, the share of buses increased in the analysed structure, which may evidence a change in preferences of Bysina and Jasienica village dwellers. Increased maximum hourly vehicle traffic was registered between 6:00 and 7:00 in both directions (morning peak hours 4:30 – 8:30), unlike in June, July and November, 2012 when at that time car traffic towards Myślenice dominated. In case of travellers to Jasienica, the afternoon rush hours may be treated as normal (empirical) distribution.

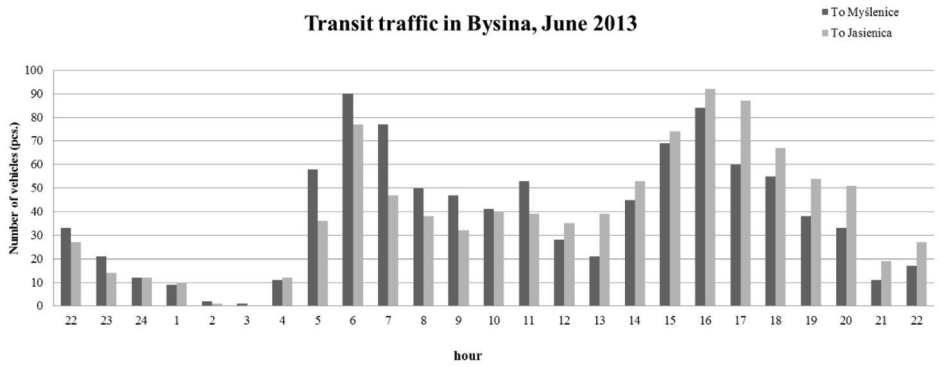


Figure 5. Average daily traffic volume in June 2013, authors' elaboration of own results

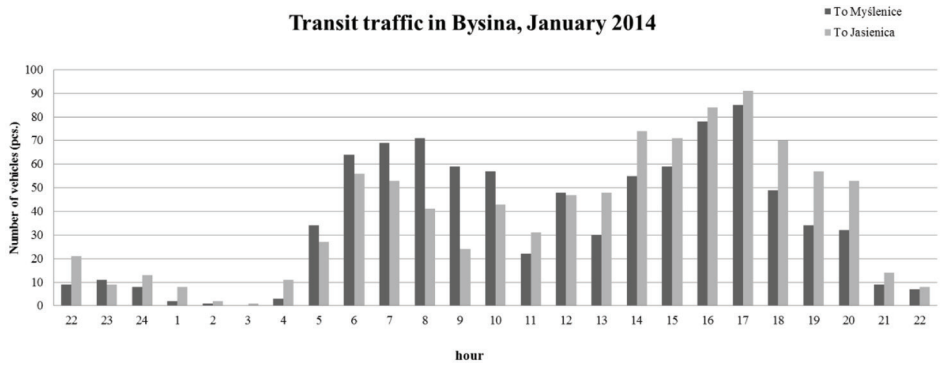


Figure 6. Average daily traffic volume in January 2014, authors' elaboration of own results

In January, 2014 on average 896 vehicles daily (39 trucks and 111 buses) went towards Myślenice and 957 to Jasienica (49 trucks and 97 buses). During the winter period the demand for products from the sawmill, concrete plant or the

plant manufacturing bituminous mastics decreases, which translates itself into the number of passing trucks. The atmospheric conditions may be also regarded as factors conditioning traffic volume. Despite a relatively low snowfall, part of the cars were unable to move owing to a drop of the air temperature below 0°C. During the afternoon rush hours between 17:00 and 18:00 the graph is approaching its maximum point (compare Fig. 6). This may be considerably affected by the length of the day, when darkness falls already after 15:00-15:30.

Fig.7 only confirms, that the investigations and analysed course of the county road show a classical distribution of traffic volume. Two peak hours occur: the morning and afternoon, when the most numerous are passenger cars. The afternoon rush hours reach maximum traffic value between 15:00 and 17:30. In May 2014, on average 1010 vehicles (including 78 trucks and 90 buses) passed towards Myślenice and 1101 towards Jasienica (88 trucks and 90 buses). These values are comparable with the test conducted in July, 2012.

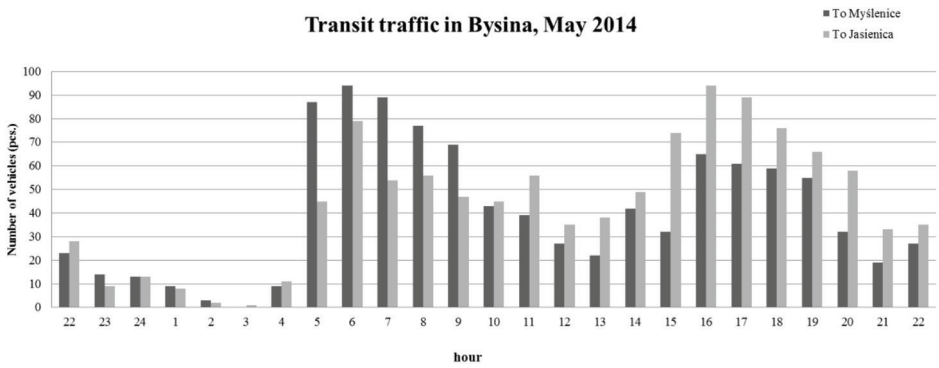


Figure 7. Average daily traffic volume in May 2014, authors' elaboration of own results

No increase in the traffic volume was noticed in relation to a comparable period in the previous years, which also evidences a necessity to conduct further investigations to prepare a credible forecast based on reliable measurement data for many years. Research extended in a greater number of regions has been suggested, preferably a full series in the chain of activities, in this case comprising Myślenice, Bysina, Jasienica and Sułkowice.

Additional analysis was conducted to supplement the information about the analysed stretch of country road K1935. Classification of the state of cracks and road surface for the measurement section in Bysina involved its visual inventory including: patches, potholes, spire web cracks, longitudinal and transverse cracks. Few small spider web cracks without crumbling were identified along the 1000m measurement section (Myślenice-Bysina border towards Jasienica). Analysed stretch has a relatively new wearing course made of mineral and bitumi-

nous mixture. The road stretch by the end of the village towards Jasienica (west of Myślenice) is in a definitely worse condition. The carpet of mineral-asphalt mass has big spider web cracks with considerable crumbling and loose pieces of road surface. Losses of binder and grains in the wearing course were identified and disturbance of the lower situated layer. Moreover, longitudinal and transverse humps occur affecting the comfort of car passengers travelling along this road. The road was repaired in many places, the losses were filled in, some road surface was replaced and depressions and potholes were mended.

CONCLUSION AND SUMMARY

Analysing the presented graphs and accumulated statistical data it may be concluded that the Report (Raport 2011)is burdened with an error in its final deduction concerning the predicted car traffic volume in the area of designed ring road. The Report claimed to possess the knowledge about traffic volume (the share of vehicles of various groups at night and during the day). However, the municipal office in Myślenice refused the authors to share the knowledge on the method of data collecting. Therefore no comparative analysis is possible.

The authors of the Report stated also that "*we are using the forecasts prepared by the Designer using the appropriate formulas and the results of this analysis of traffic volume are burdened with a considerable error. We are unable to foresee in 100%, for the needs of a 10year forecast the share of heavy vehicles in the traffic structure, particularly at night, but we may suppose that it will remain on the same level. This is the gravest mistake we can make, affecting all qualitative and quantitative analyses on which the range of the analysed effect depends. In the first place it is crucial for acoustic analysis, which depends mainly on the traffic volume and share of various vehicle groups.*"

In view of the above, the existing knowledge need supplementation because designing any kind of investments cannot be based on assumptions. In the first place a relatively small transit traffic in Bysina area in 2012-2014 is visible. Average daily traffic volume (ADTV) in 2012 was only 2300 vehicles (the kind structure of vehicles emphasizes a considerable share of passenger cars – over 84% followed by trucks almost 9% and buses, about 8%). ADTV level in 2013 was less than 2000 vehicles, whereas in 2014 there were about 2100 vehicles. It indicated the stability of traffic volume on the county road K1935. The report authors used some data concerning road leading from Bysina to Jasienica and Sułkowice. It should be pointed out, however, that it is not an alternative road route, frequented chosen by drivers. The author of the article also noticed, that no increased arduousness has been noticed in analysed area at night. Moreover, on all holidays vehicle traffic volume is very low. Passenger cars generate traffic volume when ceremonies are held in the church in Bysina. Apart from these time

buses pass very rarely (not always on time), there are a dozen or so during the day, whereas cars pass only sporadically. The Report forecasts that vehicle traffic volume will increase considerably on the analysed stretch in 2023, however it has been recommended to conduct investigations on the interest in construction projects or small and medium-size enterprises development (and traffic volume analysis) before any final assessment is made. For instance, only several building permits are issued per year for family housing in Bysina.

Summing up, it may be said that the Report (Raport 2011)is burdened with a significant misstatement and should not provide a basis for further proceeding of the ring road project. It has been pointed out in literature that designing a ring road is well grounded only if transit traffic at peak hour exceeds 300 vehicles and participation of transit traffic in the whole traffic structure is no less than 30-35%. Measurement and analysis of traffic volume play an important role in designing space management with road projects. Presented paper accentuates on one hand the complex character of the procedures, on the other the inadequacies of the analyses conducted for the needs of environmental reports, which may affect development and realisation of spatial policy and therefore the local inhabitants life quality.

ACKNOWLEDGEMENTS

This Research was financed by the Ministry of Science and Higher Education of the Republic of Poland.

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Received: 11. 10. 2015
Accepted: 11.12.2015