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Methodology for Determining the Traffic Volumes on Urban Roads in the Czech Republic

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Abstract

This paper discusses the methodology for determination of traffic volumes on roads in the Czech Republic. The current methodology does not reflect some of the specific characters of traffic on urban roads and the unified set of expansion factors to determine the final intensities (and AADT) is used regardless of the specific purposes of individual urban roads. The paper outlines the possibilities for improving the methodology for determining the traffic intensity on these types of urban roads.
KEY WORDS: *traffic volumes, transportation planning, AADT, average daily traffic, urban roads, expansion factors*

1. Introduction

The traffic volume is one of the main materials for transportation planning and a measure of road capacity. Mostly, it is given by daily traffic intensity, which represents the number of vehicles that will pass through one point of the road in both directions for 24 hours (in one day). Another important indicator of the traffic volume is Annual Average Daily Traffic (AADT) for particular section of a road, which is the average of 24-hour counts of the vehicles collected every day of the year [cars / 24h].

The regular observation of traffic volumes over the years has identified certain characteristics showing that although traffic volume at a section of a road varies from time to time, this variation is repetitive and rhythmic. These characteristics of traffic volumes are usually taken into consideration when traffic counts are being planned so that volumes collected at a particular time or place can be related to volumes collected at other times and places [1].

In the Czech Republic, these hourly, daily, monthly and annual variations are taken into consideration by expansion factors, which were statistically calculated from the long-term measurements of traffic volumes. The expansion factors were determined for categories of vehicles, types of road, each day of a week and seasons. These expansion factors appear to be an inefficient tool for calculation of intensity in the category of local roads, where the actual traffic character of a particular urban road is significantly different according to the usage of the surrounding urban area.

The problems of conducting the surveys, the evaluation of surveys, AADT determination, daily intensities or hourly peak intensities are described in more detail in the document of Technical condition no. 189 (TP 189) entitled "Determination of traffic volumes on the roads." with the help of conversion coefficients. Another important document is the technical conditions no. 225 (TP 225) entitled "Prognosis of the intensity of car traffic", which were analyzed as part of the project as well [2,3].

In the following chapters, the main results from the traffic survey are concisely described. The traffic survey was held on the urban roads in the city of České Budějovice (Czech Republic) in November 2014 and it was supported from the research grant program at the Institute of Technology and Business in České Budějovice.

2. Determination of Expansion Factors

A traffic survey was conducted to determine the traffic volumes on urban roads. The aim of the survey was also to determine the types of urban roads according to the difference in the hourly variations of their traffic (different traffic characters).

Daily traffic intensity is determined for each type of vehicle (or vehicles in total) using the formula [2,5]:

$$I_d = I_m * K_{m,d} , \quad (1)$$

where I_d - daily traffic volume in the day of the survey [cars/day]; I_m - the traffic volume gained at the time of the survey [cars/time period]; $K_{m,d}$ - expansion factor of traffic volume at the time of the survey on a total daily traffic volume (taking into account the daily variations in traffic according to TP 189).

From the measurement results (the intensity gained at the relevant time measurement - I_m), tables showing the frequency of vehicles in hourly intervals were compiled. According to the type of communication, day hour of measurement and season, the values of the shares of intensities for exact hour for vehicles in total were used (according to TP 189). Using equation (2), the values of conversion factors for each type of local roads were determined and the

daily traffic volume was then for the "total vehicle" determined according to formula (1). These formulas can be found in TP 189, which directly regulates the calculation methodology for all roads. The values of conversion coefficients $k_{m,d}$ for any selected time period of the survey are determined by the relationship [2,5]:

$$K_{m,d} = \frac{100\%}{\sum p_i^d} \ , \tag{2}$$

where $\sum p_i^d$ - the sum of the shares of hourly traffic volumes during the survey on a daily traffic volume [%]. Recommended values p_i^d are determined for each type of vehicles and traffic characters in annexes of TP 189, where the expansion factors $k_{m,d}$ for the recommended time of the survey may also be found.

From the mutual comparison of the results of daily intensities for specific time intervals according to TP 189, it can be concluded that these values are significantly different. It can be noted that the recommended values p_i^d of TP 189 (ratio of intensity of each hour i on a daily traffic volume) cannot be applied to certain types of local roads with a specific traffic. This observed deviation may also be caused by several factors, but mainly by the small sample of input data. It will be necessary to repeat the measurements several times and measure the passing vehicles for at least 24 hours at each station to have the opportunity to work with a more representative sample of data. Then the measurement results would have a greater explanatory power and would be more objective for the partial conclusions or for further work with the data [4,5].

3. The Analysis of Traffic Characteristics on Urban Roads

The realized measurements were subjected in all points of measurement to a detailed analysis of the actual values of the re-counted expansion factors and the factors determined in TP 189. The results show that there is indeed a significant difference especially in measurements on local roads in cities. A very important factor is the definition of the final destinations of the population mobility and reason for using the local roads. The graphs indicating numbers of passing vehicles in dependence on time were created from the data obtained during the traffic surveys (measured values). The traffic characteristics specific to the selected roads in the city can be seen in Fig. 1 [2,5].

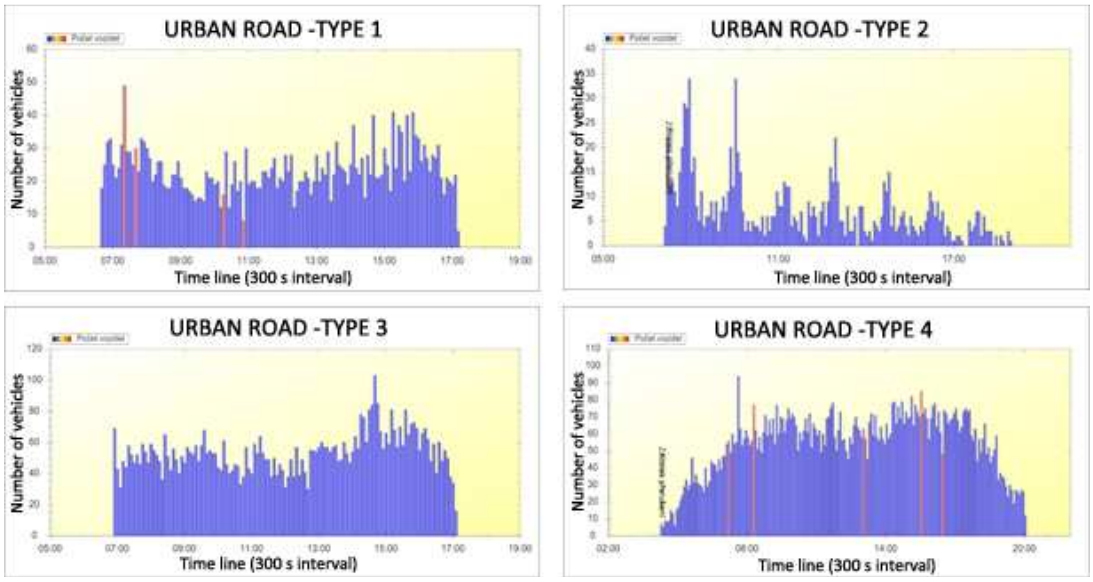

Fig. 1 Graphical output of measurements in the profiles of local roads with different specific characters traffic. Source: Authors

Based on the determination of new values of p_i^d it is necessary to determine new expansion factors, which will reflect the values relevant to expansion factors according to the actual character of the traffic on the road and it is possible to determine them according to the daily variation of traffic intensity (weekly variations, yearly variations, etc.). The current methodology works with the expansion factors set for these categories of roads (TP 189) [4-6]:

1) D – Highways,
2) R – Fast roads of I. Class,
3) E – Fast roads of I.Class with the status of International road („E“),
4) I – Other roads of I. Class,
5) II – Roads of II. And III. class with more subcategories regarding other characteristics,
6) M – Urban roads.

It should be noted that the set of expansion factors for the category of urban roads is only for the urban roads not included in the above mentioned categories. Some of the main urban roads (for example fast roads going through the city) are counted as the category D, R, E, I or II and the sets of expansion factors for each category are used. But the

influence of the city life on the daily variations on these roads is quite visible from measurement as well. According to the methodology, the expansion factors should be set from the long-term measurement when the more precise factors are needed on the rest of urban roads (for example the access roads to the commercial zones where the traffic is more specific). The aim of the authors' project is to determine the types of urban roads and set the expansion factors which can be used on the basis of short-term measurement [7,8].

Primary consideration for selecting urban roads for measuring the traffic intensity was the fact that the roads in the city each have different specific traffic character according to the town planning and economic character of the surrounding buildings - for example, daily variations of traffic intensity will be different for special urban roads and urban roads with mixed traffic, daily variation of traffic intensity will also vary with the local road linking the industrial zones of the city (due to the shift operation) or for local access roads to schools, student dormitories, administrative institutions etc. We can identify different specific traffic on urban roads, of which for the initial phase of measurement and subsequent analysis were the following:

1) The access roads for shopping centers,
2) Local roads in residential areas,
3) Local roads with administrative centers,
4) Fast local roads,
5) Local roads linking industrial zones.

For the purposes of the analysis of methodology for determining the daily variation of intensities, the shares of cars in total course of the reporting period were determined (measurements were carried out according to each hour of the day). These shares indicate the conversion coefficients, thanks to which the daily variation of traffic from the data obtained during the measurement can be determined.

The following Fig. 2 shows the comparison of converted coefficients from measured data and expansion factors set by current methodology (TP 189) for calculating the daily volumes generally on all roads, both in urban and rural areas. The scheme demonstrates the significant deviation of the set out coefficients and the converted coefficients at the measuring points, in this case on an urban road in the residential area [5-7].

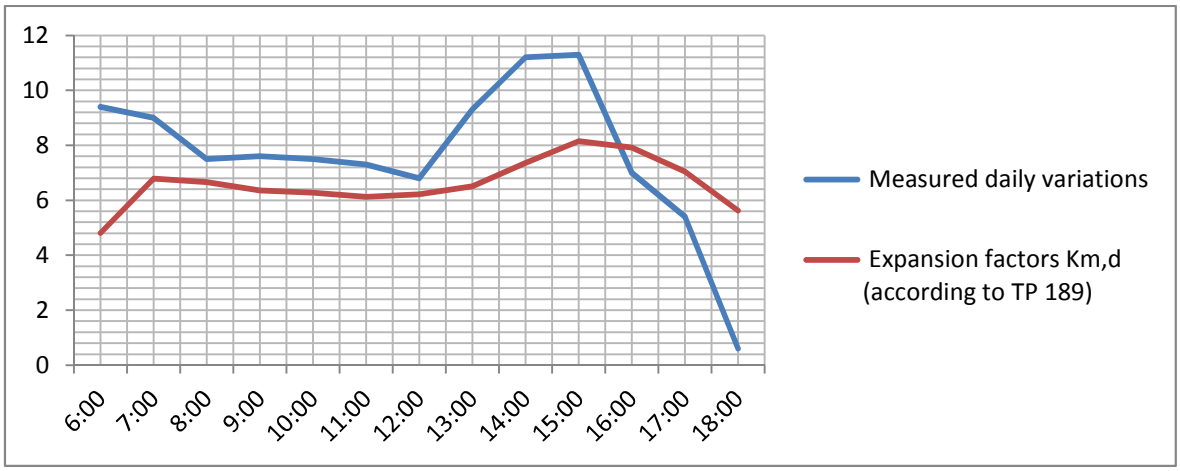

Fig. 2 Graph comparing the coefficients of Daily variation and the expansion factors according to TP 189 methodology at Jírovcova street in České Budějovice. Source: Authors

Other relevant information resulting from the graph 2 is the fact that when using the expansion factors (according to the current methodology) to determine the AADT on the specific segment of urban road, the final AADT value is significantly different than using the expansion factors re-counted from the measurements. From the above mentioned example (urban road in residential area) the difference in the AADT value is more than 2000 vehicles/day. This fact supports the idea of the significance of right set values of expansion factors on the urban roads [7].

4. Conclusions

The authors of the contribution analyzed existing TP 189 and TP 225. These technical guidelines are the basis for determination and calculation of Annual Average Daily Traffic (AADT). The basic tool is a set of expansion factors that are derived from practical measurements. It is true that actuality of some values (on which the model of AADT is assembled) does not reflect reality and actually measured traffic volumes, especially in the context of calculations of AADT on urban roads.

It was found out that both intensities are different for each local communication with the specific character of traffic, and are significantly different even over the day compared to the intensities in rural roads. It is all about the intensity of the morning and afternoon intensity. The aim of the project was not to make judgments about the values of hourly coefficients of intensity (set by TP 189), but the investigators show that the update of TP 189 will be required in the future [2,8].

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