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# ANALYSIS OF THE RESULTS OF GENERAL TRAFFIC MEASUREMENTS IN THE WEST POMERANIAN VOIVODESHIP FROM 2005 TO 2015

**Summary**. Tools for counting traffic are not only used to obtain information about traffic conditions and necessary data in order to design new transport system infrastructure. They primarily allow for the assessment of road users' communication needs, as well as their dynamic mobility in the transport network of the analysis area. In these aspects, general traffic measurements (GTM), which, since 1965, have been performed in Poland every five years, are extremely helpful. The article presents the results of a detailed analysis of the data derived from the GTM conducted in the period 2005-2015 on voivodeship roads. The analysis was carried out using results from the West Pomeranian Voivodeship.

**Keywords:** general traffic measurements; annual average daily traffic; road traffic engineering

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## 1. INTRODUCTION

Traffic measurement tools are used exclusively to obtain information and necessary data for the design of transport infrastructure. They primarily allow for the assessment of road users' communication needs, as well as their dynamic mobility in the transport network of the area (m.in.: [1-4,10-18]). In this respect, GTM have, since 1965, been performed in Poland every five years (the first measurement in Poland took place in 1954, but it was very limited). The entity responsible for GTM implementation is the General Directorate for National Roads and Motorways (GDDKiA in Polish). Until 1980, measurements were carried out on state roads with a hard surface. After the introduction of a new national and provincial road network in 1999, measurements in subsequent years, i.e., 2000, 2005, 2010 and 2015, were performed separately for national roads and separately for voivodeship roads.

The main purpose for which the GTM are carried out is to determine, on the basis of the obtained data, the basic characteristics and traffic parameters for all sections of the roads covered by the survey. The basic measure in terms of the GTM is annual average daily traffic (AADT). This is the number of vehicles that has crossed a given road cross section in a period of 24 hours on average in one year. In addition, annual average daily summer traffic (AADST) and annual average daily winter traffic (AADWT) are also calculated for national roads. For voivodeship roads, average daily, evening and night traffic is determined on a limited basis. Another measure of traffic generated by these surveys is the average daily traffic load on roads, that is, the number of vehicles passing 1 km in a unit of time. The GTM also determine the growth rate of traffic and the structure type of traffic [15].

The article presents the results of a detailed analysis of data derived from the GTM conducted in the period 2005-2015 on voivodeship roads. The analysis was carried out using the results from the West Pomeranian Voivodeship.

## 2. CHARACTERISTICS OF THE VOIVODESHIP ROAD NETWORKS IN THE WEST POMERANIAN VOIVODESHIP

West Pomerania is located in the northern part of Poland and lies on the Baltic Sea. According to data published by the Central Statistical Office (GUS in Polish) in 2017 [9], it covers an area of about 2,289 $km^2$ and is home to a population of about 1.72 million. The capital of the West Pomeranian Voivodeship is Szczecin. In turn, the location of the regional road administration is Koszalin. The most important roads in the voivodeship are the A6 motorway and numerous express roads, such as S3, S10 and S11. Table 1 presents a list of voivodeship roads in the region as reported by GDDKiA along with their route.

Tab. 1

Voivodeship roads in West Pomerania along with their route

| Voivodeship road | The course of the road | | |
|---|---|---|---|
| | Starting point | Intermediate points | End point |
| 102 | Międzyzdroje | Dziwnówek - Pobierowo - Rewal - Trzebiatów | Kołobrzeg |
| 103 | K. Pomorski | Mokrawica - Świerzno - Ciećmierz - Paprotno - Cerkwica - Chomętowo | Trzebiatów |
| 105 | Świerzno | Gryfice - Brojce | Rzesznikowo |
| 106 | Rzewnowo | Golczewo - Nowogard - Maszewo - Łęczyca - St. Szczeciński | Pyrzyce |
| 107 | Dziwnówek | Kamień Pomorski | Parłówko |
| 108 | Parłówko | Golczewo | Płoty |
| 109 | Mrzeżyno | Trzebiatów - Gryfice | Płoty |
| 110 | Lędzin | Karnice - Cerkwica | Gryfice |
| 111 | Recław | Droga 3-Racimierz - Stepnica - Krępsko - Modrzewie | Droga 3 |
| 113 | Żółwia Błoć | Żółwia - Mosty - Jarosławki | Maszewo |
| 114 | Nowe Warpno | Trzebież - Police | Tanowo |
| 115 | Szczecin | Tanowo - Dobieszczyn | Granica Państwa |
| 119 | Radziszewo | Chlebowo | Gardno |
| 120 | Granica Państwa | Gryfino - Stare Czarnowo - Kołbacz | Kobylanka |
| 121 | Pniewo | Banie | Rów |
| 122 | Krajnik Dolny | Krzywin - Banie - Pyrzyce | Piasecznik |
| 124 | Granica Państwa | Cedynia | Chojna |
| 125 | Granica Państwa | Cedynia - Golice - Moryń | Wierzchlas |
| 126 | Osinów Dolny | Siekierki - Mieszkowice - Smolnica | Dębno |
| 127 | Granica Państwa | Porzecze - Namyślin - Chwarszczany | Dębno |
| 128 | Rów | Kierzków - Otanów - Myślibórz | Ławy |
| 129 | Sarbinowo | - | Dąbroszyn |
| 130 | Barnówko | Tarnów | Baczyna |
| 141 | Sowno | Przemocze | Darż |
| 142 | Szczecin | Łęczyca | Lisowo |
| 144 | Nowogard | Dobra | Chociwel |
| 146 | Jenikowo | Dobra | Strzmiele |
| 147 | Wierzbięcin | Troszczyno - Wołkowo | Łobez |
| 148 | St. Łobeski | Łobez | Dr. Pomorskie |
| 151 | Świdwin | Łobez - Węgorzyno - Recz - Barlinek | G. Wielkopolski |
| 152 | Płoty | Resko - Świdwin | Buślary |
| 156 | Lipiany | Barlinek - Strzelce Krajeńskie - Zwierzyn | Klesno |
| 160 | Suchań | Piasecznik - Choszczno - Drezdenko - Międzychód - Gorzyń - Lewice | Miedzichowo |
| 162 | Rościęcino | Świdwin | Zarańsko |
| 163 | Kołobrzeg | Białogard - Połczyn - Zdrój - Czaplinek | Wałcz |
| 165 | Mielno | - | Mścice |
| 166 | Gdaniec | Lulewice | Białogard |
| 167 | Koszalin | Tychowo | Ogartowo |
| 168 | Niedalino | Zegrze Pomorskie - Wyszewo - Mostowo | Drzewiany |
| 169 | Byszyno | Tychowo | Głodowa |
| 171 | Bobolice | Barwice | Czaplinek |
| 173 | Połczyn - Zdrój | Drawsko Pomorskie | Droga 20 |
| 175 | D. Pomorskie | Kalisz Pomorski | Choszczno |

| Voivodeship road | The course of the road | | |
|---|---|---|---|
| | Starting point | Intermediate points | End point |
| 177 | Czaplinek | Mirosławiec - Człopa | Wieleń |
| 178 | Wałcz | Trzcianka - Czarnków | Oborniki |
| 179 | Rusinowo | Dzikowo - Gostomia - Jaraczewo - Szydłowo - Dolaszewo | Piła |
| 201 | Gwda Mała | Czarne | Barkowo |
| 203 | Koszalin | Darłowo - Postomino | Ustka |
| 205 | Darłówko | Darłowo - Krupy - Sławno - Polanów | Bobolice |
| 206 | Koszalin | Polanów | Miastko |
| 208 | Barcino | Kępice - Warcino - Mzdowo | Wielin |
| 209 | Warszkowo | Suchorze | Bytów |

Source: authors' own based on [5-8]

## 3. ANALYSIS OF THE RESULTS OF GENERAL TRAFFIC MEASUREMENTS FROM 2005 TO 2015 IN THE WEST POMERANIAN VOIVODESHIP

All voivodeship roads located in West Pomerania where GTM were performed have been analysed. Changes in the AADT value on voivodeship roads in the region from 2005 to 2015 are presented in Fig. 1. As can be noted for the 2010 GTM, there was a significant increase in AADT value on voivodeship roads (by 18%). In another study conducted in 2015, the result was identical to that obtained with regard to the 2010 GTM, i.e., 2,358 vehicles/day.

In turn, Fig. 2 shows the AADT broken down into the different generic groups. In the case of AADT cars, it can be stated that, concerning the 2010 GTM, their value increased by 20%. In the next measurements carried out in 2015, the maximum value of this indicator was recorded for the whole analysed period (i.e., 2,012 vehicles/day). During the period analysed, the AADT value for passenger cars increased by 23%.

In the case of motorcycle AADT, it can be said that the 2010 GTM recorded a significant increase in its value compared to the previous measurement (by about 54%). On the other hand, no further increase was recorded in the next measurement, as the motorcycle AADT increased by 3% compared to the previous measurement.

Changes in the AADT of light trucks were irregular. In the 2010 GTM, the maximum value of this indicator was 178 vehicles/day. This figure was higher than that obtained in 2005 by 8%. The largest change in the AADT of light trucks was observed in the 2015 GTM. This study reported a decrease of approximately 14%.

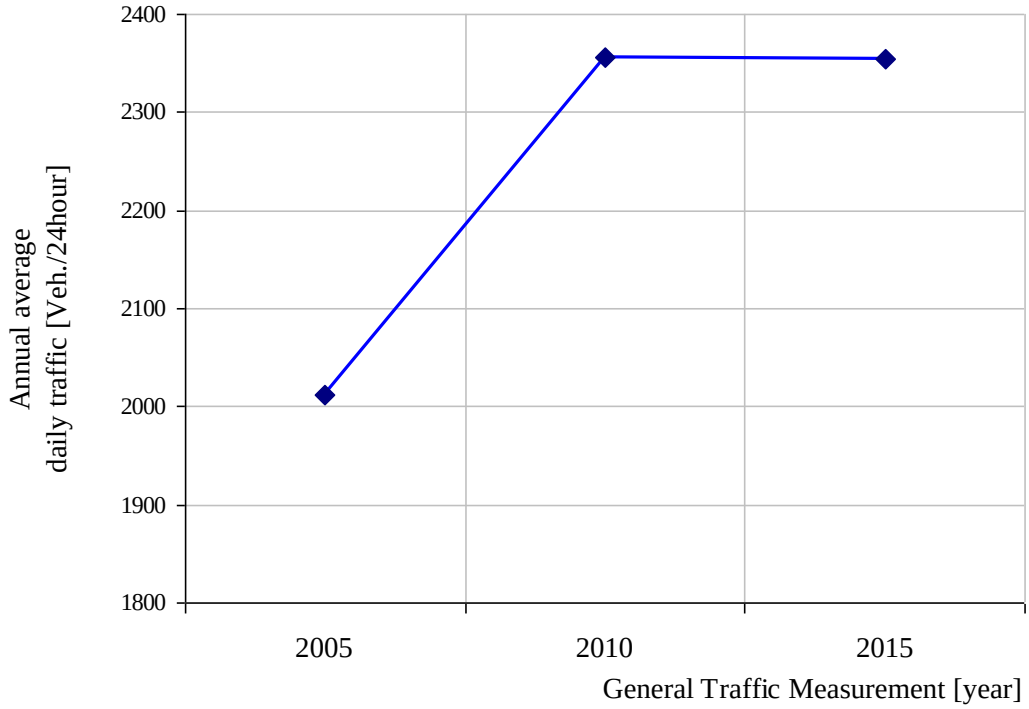


Fig. 1. Changes in the AADT value on voivodeship roads in West Pomerania from 2005 to 2015

In turn, the value of the AADT for trucks without a trailer systematically decreased. In the 2005 GTM, the maximum value of this indicator was 64 vehicles/day. In subsequent GTM surveys, only the AADT for those with no trailers was obtained. The GTM for 2015 reported a minimum of 45 vehicles/day for the entire period analysed. During the whole analysis period, the AADT value of trucks without trailers fell by approximately 29%.

AADT values for trucks with trailers throughout the analysis period increased by 32%. Between 2010 and 2015, this value stabilized, with the GTM for 2015 being very similar to the previous survey, i.e., 83 vehicles/day.

In turn, the AADT for buses systematically decreased. In 2005, the highest value was recorded for the whole analysed period, which was 42 vehicles/day. In turn, the minimum value was obtained during the GTM 2015 survey, which was 23 vehicles/day. Throughout the analysis period, the AADT of buses dropped by almost half, i.e., by 47%.

The GTM have shown that the AADT of agricultural tractors is the lowest among all analysed groups of vehicle type. The largest change in AADT was recorded in the GTM for 2010. In this study, the value of this index decreased by 28% compared to the previous study. In addition, throughout the analysis period, the AADT of farm tractors decreased by 39%.

In Fig. 3, the changes in the road network of AADT voivodeship roads in the area from 2005 to 2015 are presented. Based on the data presented in Fig. 3, it can be stated that, according to the GTM for 2010, there was a significant increase in the road load of the West Pomeranian Voivodeship AADT. The maximum reported value for this indicator was 1.14, which is an increase of 19% compared to the 2005 GTM. In the last GTM carried out in 2015, a slight decrease in the AADT load was recorded of less than 1% compared to 2010.

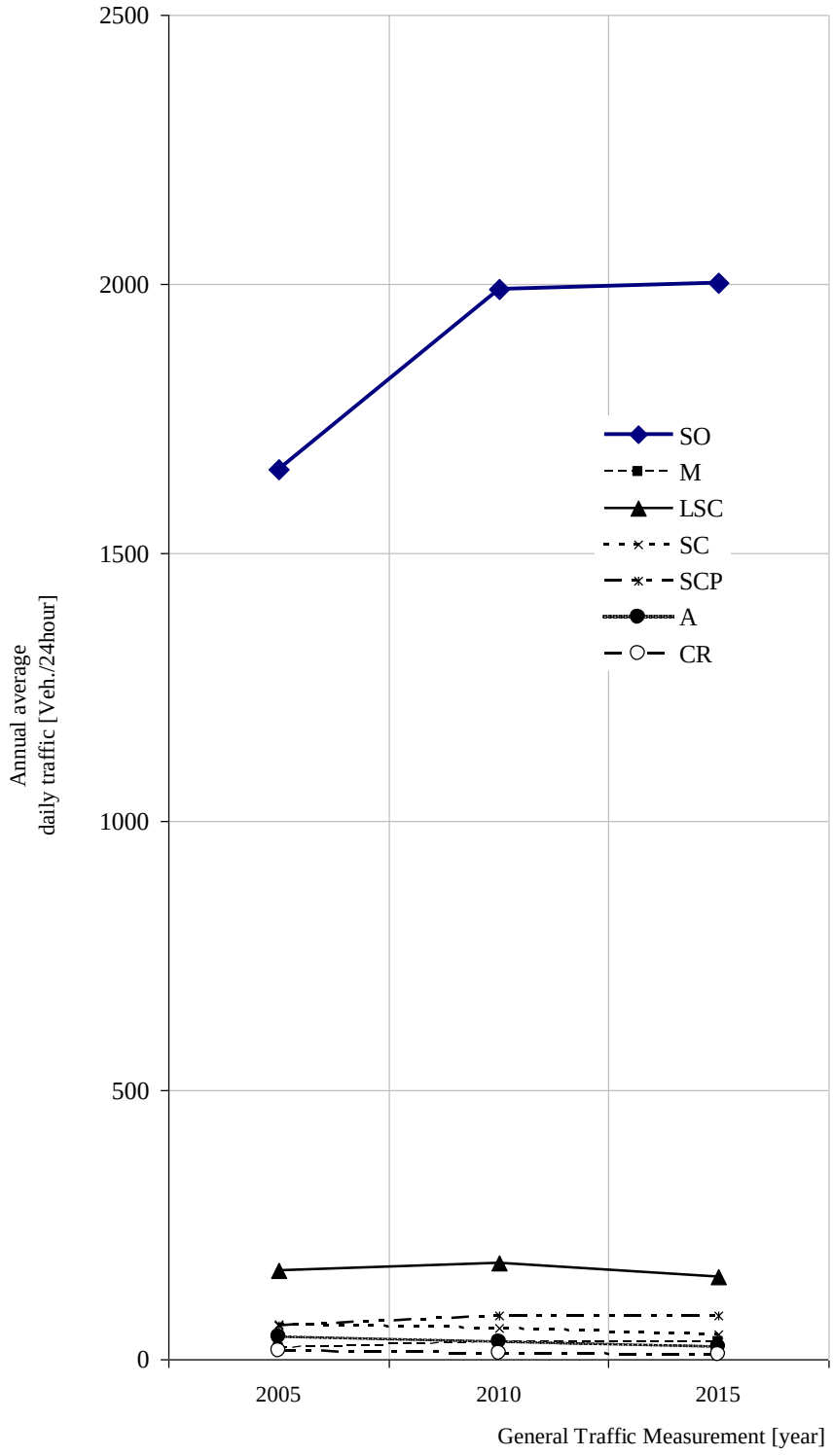


Fig. 2. Changes in the AADT value on voivodeship roads in West Pomerania according to vehicle type groups in the period 2005-2015
(where: SO - passenger cars and vans, M - motorcycles, LSC - light trucks, SC - lorries, SCP - lorries with trailers, A - buses, CR - agricultural tractors)

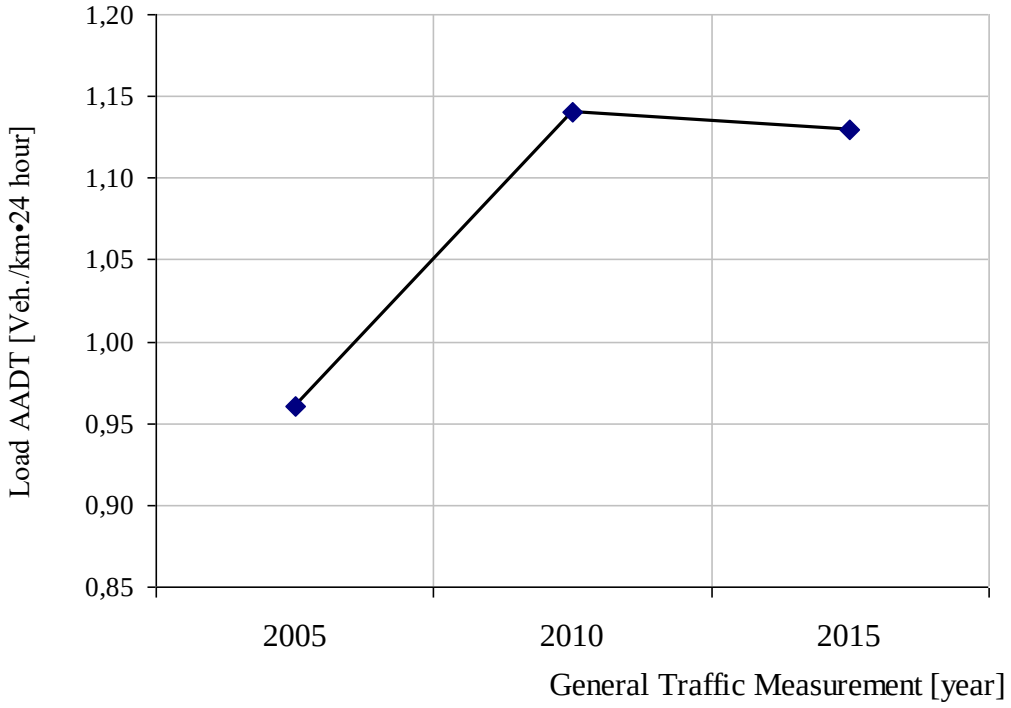


Fig. 3. The AADT load in the regional road network of the West Pomeranian Voivodeship from 2005 to 2015

In Fig. 4, the changes in the load of the regional road network in the West Pomeranian Voivodeship AADT in the period 2005-2015 are broken down into particular groups. In the case of passenger cars, it can be stated that the highest growth of this indicator was recorded in the GTM for 2010, i.e., by about 22% compared to the previous survey. The maximum AADT value for passenger cars was recorded in the GTM for 2015 and amounted to 0.96 vehicles/km·day (an increase of less than 2% compared to the previous study).

Similar trends can also be identified in the group for motorcycles, as in the case of passenger cars, the largest increase in the road network volume was reported in the GTM for 2010. This increase was 55%, compared to the previous traffic measurement. In another study, a very small change in the value of the indicator was noted, with an increase of only by 3%.

In turn, the changes in the value of the road load of voivodeship roads with regard to AADT light trucks were irregular. The maximum value for the whole period analysed was recorded in the GTM for 2010, which was 0.086 vehicles/km·day, indicating an increase of approximately 9% compared to the previous study. The minimum figure was reported in the GTM for 2015, which was 0.073 vehicles/km·day, in turn representing a decrease of about 15%, compared to the 2010 GTM.

On the other hand, the AADT load for trucks without a trailer steadily decreased. The maximum value for the whole period analysed was reported in the GTM for 2005, which was 0.031 vehicles/km·day. The minimum value was recorded in the GTM for 2015, which was 0.022 vehicles/km·day. Throughout the analysis period, the AADT load for trucks without a trailer was reduced by 29%.

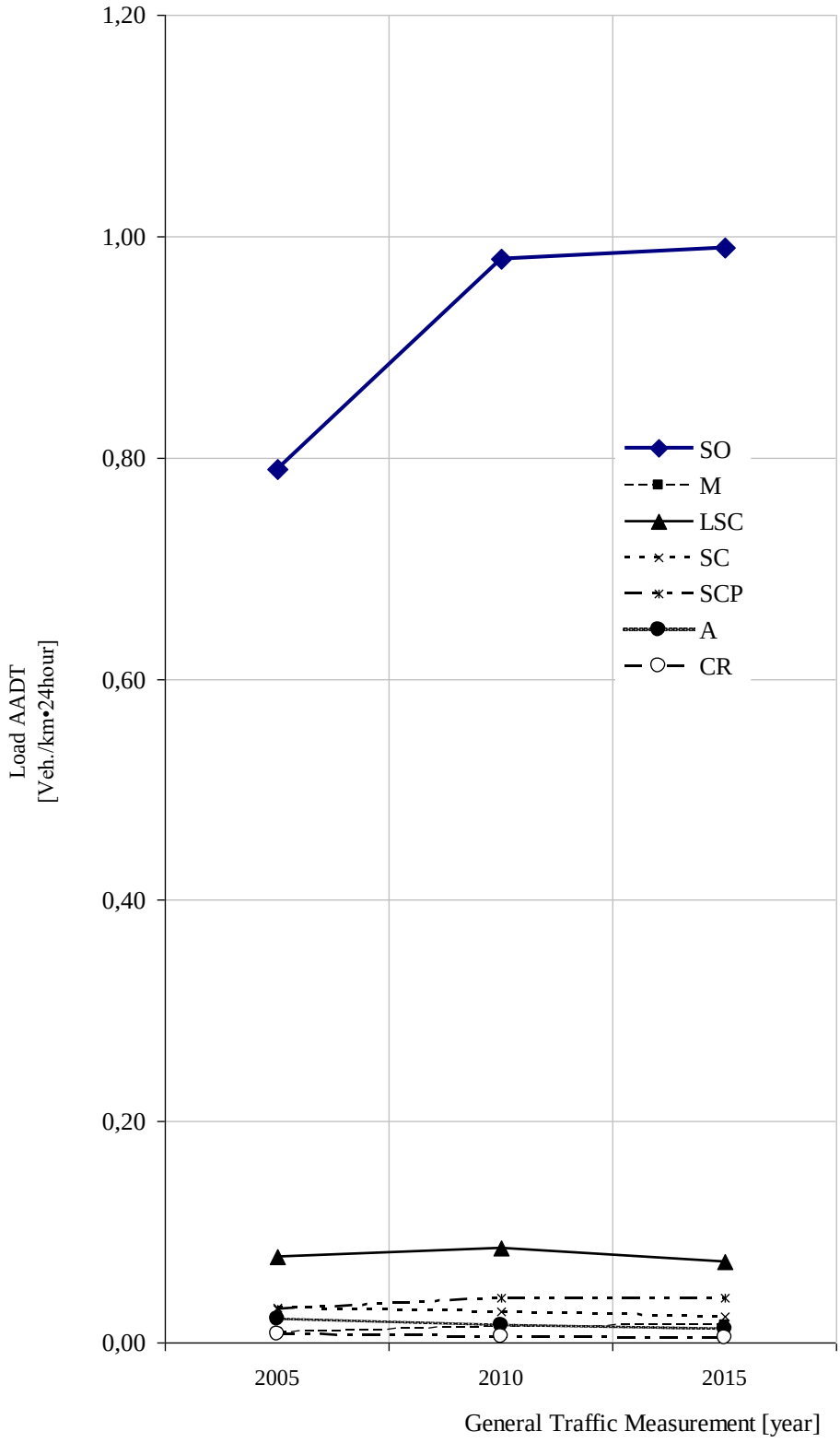


Fig. 4. Changes in the road network load of the West Pomeranian Voivodeship AADT, especially for groups, in the period 2005-2015 (where: SO - passenger cars and vans, M - motorcycles, LSC - light trucks, SC - lorries, SCP - lorries with trailers, A - buses, CR - agricultural tractors)

On the other hand, the highest increase in the AADT of trailer trucks was recorded in the GTM for 2010 (by about 34%, compared to the measurements made in 2005). In the next traffic measurement, a value was noted that was very similar to that reported in the GTM for 2010.

The values of the provincial roads' AADT for buses have been systematically decreasing. The maximum value of this indicator was recorded in the GTM for 2005, which was 0.020 vehicles/km·day. The minimum value was obtained in the traffic measurement carried out in 2015, amounting to 0.011 vehicles/km·day. Throughout the analysis period, the AADT bus load was reduced by 46%.

As can be seen in Fig. 4, agricultural tractors among all types of vehicles are the least loaded by the AADT regional road network. The value of the indicator in their case does not exceed 0.008 vehicles/km·day. In addition, during the entire period of analysis, the load of the road network with regard to agricultural tractors, in the context of the West Pomeranian Voivodeship AADT, decreased by 39%.

The next stage of analysis for West Pomerania considered voivodeship roads, which, in the most recent GTM surveys in 2015, were characterized by the highest values of AADT. These are: DW 102, DW 107 and DW 165. Fig. 5 shows changes in the AADT value between 2005 and 2015 for these three routes.

On the basis of Fig. 5, it can be stated that the changes in AADT values on DW 102 were irregular. In the GTM for 2015, the AADT was 4,671 vehicles/day, the third largest result on all regional roads in the region. In the 2005 measurements, the results were in third place, and in fifth place in 2010. In the GTM for 2010, the AADT decreased by 11% compared to the previous study, while, in the next measurement, the increase was 14%. Comparing the results from the GTM in 2005 and 2015, the AADT for DW 102 was slightly altered (up 1%).

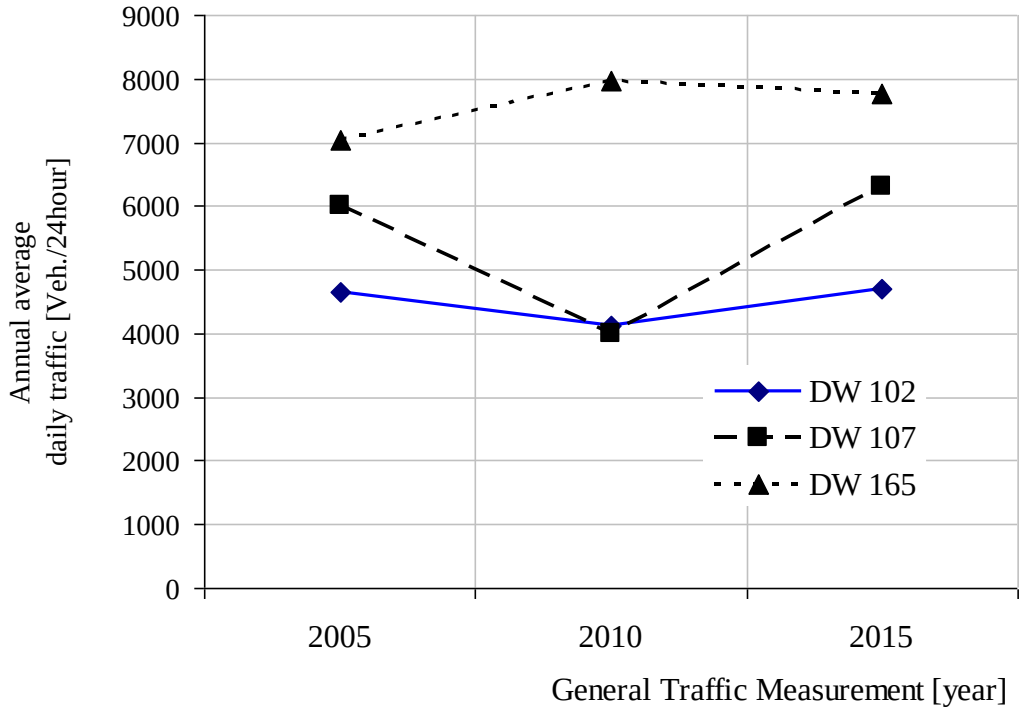


Fig. 5. Changes in AADT values for DW 102, DW 107 and DW 165 in 2005-2015

Changes in AADT values on DW 107 were also irregular. In the GTM for 2015, the AADT value was 6,374 vehicles/day, which was the second highest result on all voivodeship roads in West Pomerania. In previous studies, the results for these roads ranked second in 2005 and sixth in 2010. In the GTM for 2010, a 33% decrease in AADT was observed, compared to the previous study, while, in the next measurement, a 61% increase in AADT was found. By comparing the results with the GTM in 2005 and 2015, the AADT of DW107 has been slightly altered, i.e., increased by about 8%.

In turn, the AADT of DW 165, as measured in 2015, slightly decreased compared to the previous study (by about 3%). In all traffic measurements made in 2005, 2010 and 2015, the recorded results were the first among all the voivodeship roads in the region.

## 4. CONCLUSIONS

Based on results of the analyses addressing the GTM in the West Pomeranian Voivodeship in the period 2005-2015, one can formulate the following conclusions:

- The three most heavily loaded AADT voivodeship roads reported in the last measurement, carried out in 2015, are DW 102, DW 107 and DW 165.
- According to the GTM for 2010, the AADT on voivodeship roads increased by 18% compared to 2005. The study conducted in 2015 reported the same result as the GTM for 2010, i.e., 2,358 vehicles/day.
- The highest increase in the AADT value of passenger cars on voivodeship roads was recorded in the GTM for 2010 (by about 20%). Throughout the analysis period, the value of this indicator increased by 23%.
- AADT values of light trucks were irregular. In the GTM for 2010, this indicator saw an increase of 8%, while, in the 2015 study, the light truck AADT decreased by 14%.
- The AADT value of trucks without a trailer has been steadily decreasing. This indicator, over the entire analysis period, has decreased by 29%.
- In 2010, the AADT value of trucks with a trailer on voivodeship roads increased by 32%. In subsequent years, this value stabilized. Indeed, the finding of the GTM for 2015 was very similar to that of the previous survey, i.e., 83 vehicles/day.
- The AADT value of buses systematically decreased. In the analysed period, the value of this indicator decreased by 47%.
- Agricultural tractors are characterized by the lowest AADT value on voivodeship roads among all types of vehicles. In addition, throughout the analysis period, the AADT of agricultural tractors decreased by 39%.

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