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Car Following Distributions for Ankara Sakıp Sabancı Boulevard

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Abstract: Micro traffic flow parameters of section 186 and 191, established on SakıpSabancı Boulevard, are examined using City Security Management system (CSMS) with data containing records for 2010 and 2011. The existing lane traffic, recorded with associated camera numbers, is evaluated using measured or recorded time interval, space headway, and traffic distribution between vehicles. Additionally, analyses and assessments are evaluated via base maps or terrain models unlike widely-used graphics. These methods enable for a simultaneous presentation of different sections, lane, year, season, and different timeframes such as month simultaneously. Space headway and traffic distribution ratio is developed and assessed with contour lines according to 24 hours of the day and observed time intervals.

Keywords: Vehicle following models, traffic distribution ratio, time-space headway, digital terrain model

1. INTRODUCTION

To provide and monitor traffic safety, service continuity, and traffic information services within the borders of Ankara Metropolitan Municipality, the City Security Management System (CSMS) has been established on the main collector, arteries or streets, and as of today, Istanbul Secil Site, Military Airport Entrance, Mamak 19 Mayıs Boulevard, Eryaman Entrance, Eskişehir Road or Dumlupınar Boulevard, Sakıp Sabancı Boulevard, Mevlana Boulevard, Celal Bayar Boulevard and Turgut Özal Boulevard on 10 sections, is operated in both directions and all lanes. With CSMS, each section and lane are monitored separately by using camera systems, and vehicle transit dates and passing speeds are recorded in terms of year, month, day, hour, minute, and second. Vehicle speed is calculated with cameras which is based on the calculated based on the vehicle entry-exit time of a section with a certain length within the camera's view which is called the "space-mean speed", and it refers to the speed that is different from the time-mean or instantaneous speed and should be taken as a basis for the flow.[1]

Ankara SakıpSabancı Boulevard, which is a 2x3 divided highway, is the section from Ankara Intercity Bus Terminal (ASTI) to Erler interchange, on which Söğütözü, BeştepeCaddesi, and Anadolu Boulevard interchanges are crossed respectively along the way. CSMS system is located 1700 m away from Anadolu Boulevard Interchange. This section is labelled 186 in the center direction and numbered 191 in the direction of Etimesgut. 3 lanes are available in both directions; it is monitored and recorded with cameras numbered 136, 137, and 138 for section 186, and cameras numbered 139, 140, and 141 for section191.

In this study, registration information containing 27,836,240 vehicle traffic measurements of the specified boulevard for the years 2010-2011 is used.

According to the vehicle transit times, time intervals up to 30 seconds (ht: time headway) are named and classified as intervals 1-29, and intervals exceeding 30 seconds are named and classified as interval 30. The time interval between vehicles numbered “1” or class represents the interval between 00.00 and 00.99 seconds, and the time interval numbered “29” represents the interval between 28 and 28.99 seconds. With the help of the number of vehicles at these intervals and their total speeds, traffic distribution rates and weighted average speeds are obtained according to 1-30 time zones for the daily totals and 24-hour rates. Once these informations are gathered, hourly flow, weighted average speed,time interval, distance between vehicles (hs: space headway) are calculated in regular traffic with given time interval.[2]

With respect to vehicle transition dates, different time zones such as year, quarter period, season, month, week, month, weekdays and hours for each segment and lane are arranged;vehicle distribution, speed, time and space intervals according to these time zonescan be examined.[3]For this purpose, a study database in 20 columns and 268321 rows are created by deriving information such as average speed, traffic volume and average distance between vehicles according to the time interval of 1-30 seconds for the total day and 24 hours at sections 186 and 191 of SakıpSabancı Boulevard.

2. EVALUATION OF THE MODELS

Space headway and traffic distribution ratios depending on the time interval between vehicles are examined with the help of a three-dimensional digital terrain model (DTM-Digital Terrain Model) created using commercial MicroStation software. Graphic models are prepared to evaluate the existing lanes for both

directions or sections of the selected boulevard. In the models, the X (Easting) and Y (Northing) cartesian axes can be adjusted to a random initial reference coordinate. X coordinate axis; represent the time interval between vehicles (1-30) with base reference coordinate value of: "484110", whereas Y (Northing) coordinate axis; "0" refers to the sum of days and 24 hours of 1-24 days, with base the reference coordinate value of "4420850". Z or 3rd axis of the Cartesian coordinate system is the contour curves prepared at the desired intervals for the space headway or traffic distribution ratio. Space headway contours are prepared at every 60 meters and traffic distribution ratio contours are prepared at every 3% change. Results are shown in the following figures, respectively.

2.1Evaluation of the space headway and traffic distribution for Section-186

Figure 1 shows the total value of the day with respect to hours. Space headway intervals are observed according to the time intervals between vehicles, for 186 section strips that represent the central direction of SakıpSabancı Boulevard.

- When examined, the space headway (contour) curves prepared for the three lanes in the section up to the 4th time intervalshows closer values to each other at all hours of the day compared to other time intervals.
- At 5th time interval, regular situation deteriorates and the distance between vehicles increases between 01:00 and 05:00 due to low number of vehicles.
- The space headway curves of the 138 and leftmost lane, where higher average vehicle speeds are observed, reach higher spatial interval values in shorter time intervals compared to the other two lanes.
- Space headway values in 24th time intervalfor 02:00 point are 376 meters in camera number 136, 422 meters in camera number 137 and 688 meters in camera number 138. In this case, it is understood that camera numbered 138 measured the left lane, camera numbered 137 measured the middle lane and camera numbered 136 measured the right lane.
- The differences between the space headway of the lanes between 01:00 and 07:00 arereduced remarkably and the curves converge considerably when it comes to the 08:00-10:00 interval. This similarity between the curves; shows that the average speeds of the lanes are close to each other and the traffic density is high. When compared with other times of the day, this time interval can be considered as the peak hour period.
- When service levels of all-timeintervals are determined with the help of space headway values, it is seen that the acceptable service level, that is, class D service level and above, is achieved as of the 4th time interval within the 3 lanes of this section. When it comes to the 9th time interval, it is seen that the service levels reach the highest level and the lanes serve in Class A. The service levels obtained until the 4th time interval are E and Flevels. When traffic flow at the capacity limit or exceeding the capacity is observed; vehicle travel times are high,resulting in a very low level of comfort and convenience.

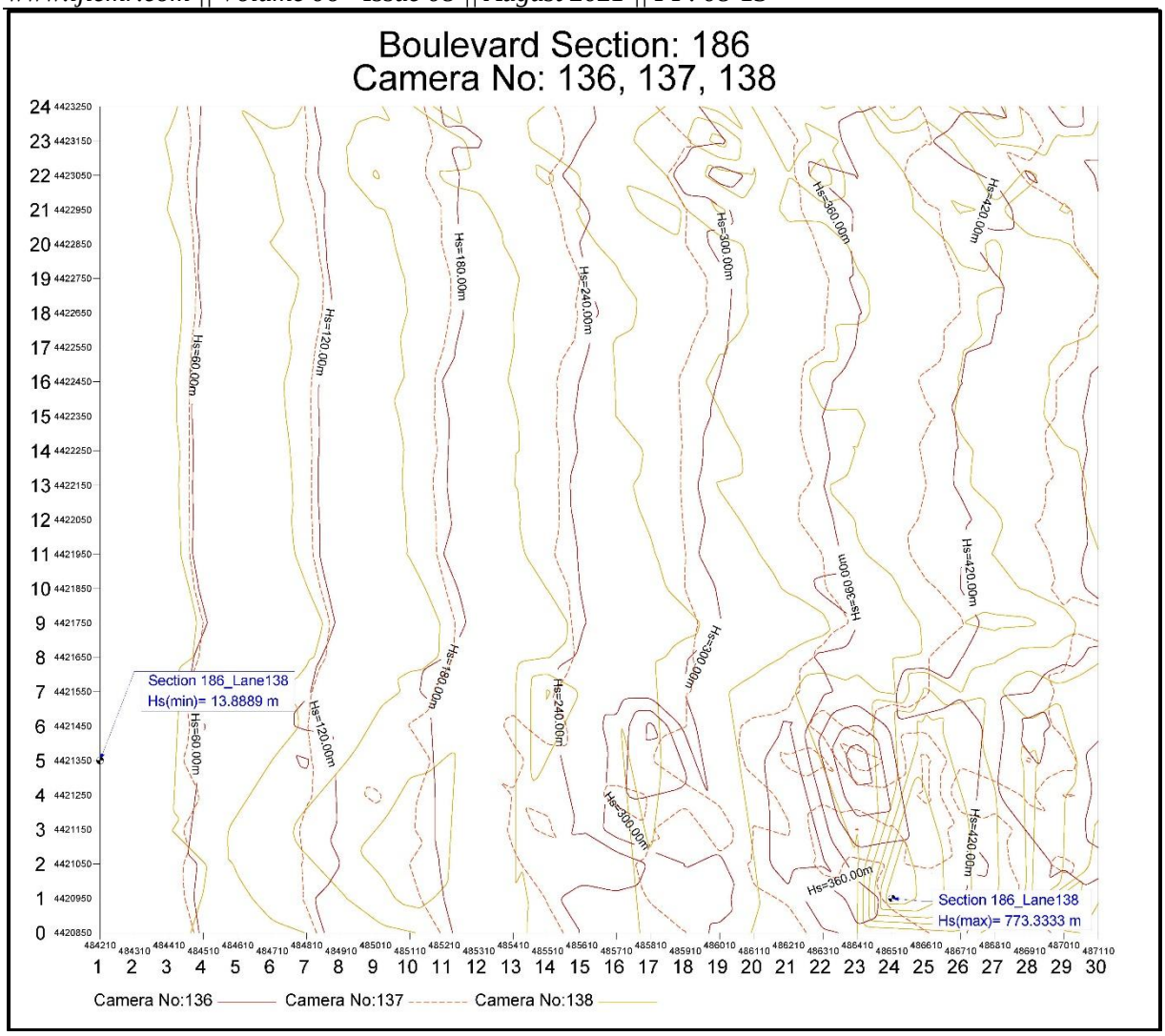

Fig.1 SakıpSabancı Boulevard section 186 space headway terrain model

The terrain model expressing the traffic distribution ratios of the 186 section is given in Figure 2.

- Considering the contours, the first thing that stands out is that the traffic distribution ratios in all three lanes are below 1% between 01:00 and 07:00. With this observation, it can be said that the traffic flow and density are low at night.
- In the peak hour interval, the contours become quite frequent and form the peaks of the pattern. Highest distribution rates are observed in peak hour along with the 2, and3 time intervals.
- In this section,peak value for all lanes belong to lane 138, which is the leftmost lane with a distribution ratio of 53.04%. A similar 45.30% distribution ratio is observed at lane 136 which resembles a left lane. On the middle lane however, a 25.09% distribution ratio is seen.
- From 10:00 onwards, distribution ratios tend to decrease continuously until night hours.

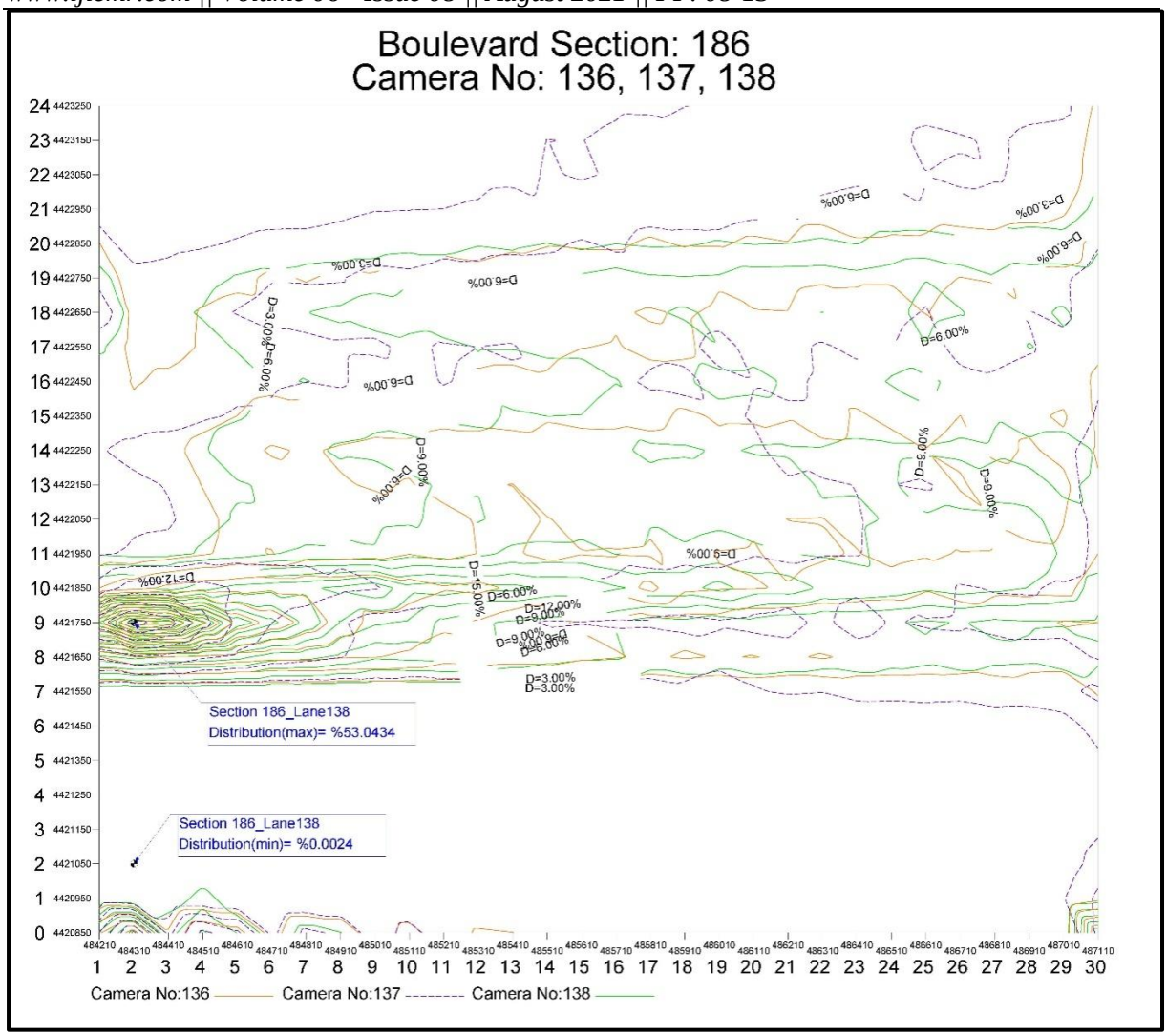

Fig.2 SakıpSabancı Boulevard section 186 traffic distribution ratios terrain model

2.2 Evaluation of the space headway and traffic distribution for Section-191

The micro flow model showing the space headway of section 191 representing the SakıpSabancı Boulevard Etimesgut direction is given in Figure 3.

- Similar to section 186, the 4th time interval can be evaluated as the time interval in which the differences between the space headways of the strips start to increase.
- Due to the fact that there is very little vehicle movement00:00 (night) and 08:00 (morning) and the data being independent from each other, the values of the space headway between the vehicles are quite high.
- The situation in section 186, which characterizes the curves in the morning hours as converging and having a high traffic flow, cannot be observed so clearly in this section. The most striking point in the model is that the space headways observed at 08:00 and 19:00 are very close to each other until the 22nd time zone. Based on this, it can be said that the traffic flow characteristics of section 191 at the mentioned times are similar to each other.
- The space headway values in lane 142 are obtained at lower time intervals compared to other lanes, which indicates that the average vehicle speeds of the lane are higher. In this context; Lane 142 can be considered as the left lane, lane 141 as the middle lane and lane 140 as the right lane.
- The highest space headway is seen in lane 142 with 630.00 meters, and the lowest space headway is observed in lane 140 with 13.45 m.
- When the service levels are determined with the help of the space headway values, it is seen that the acceptable service level, that is, the D class service level and above, has been reached at the 3rd time interval for the lanes of section 191. As for the 8th and 9th time intervals, it is seen that the service levels

reach the highest level and the lanes serve in class A. The service level obtained for each hour until the 3rd time where traffic flow exceeding its capacity is observed service level is considered to be F.

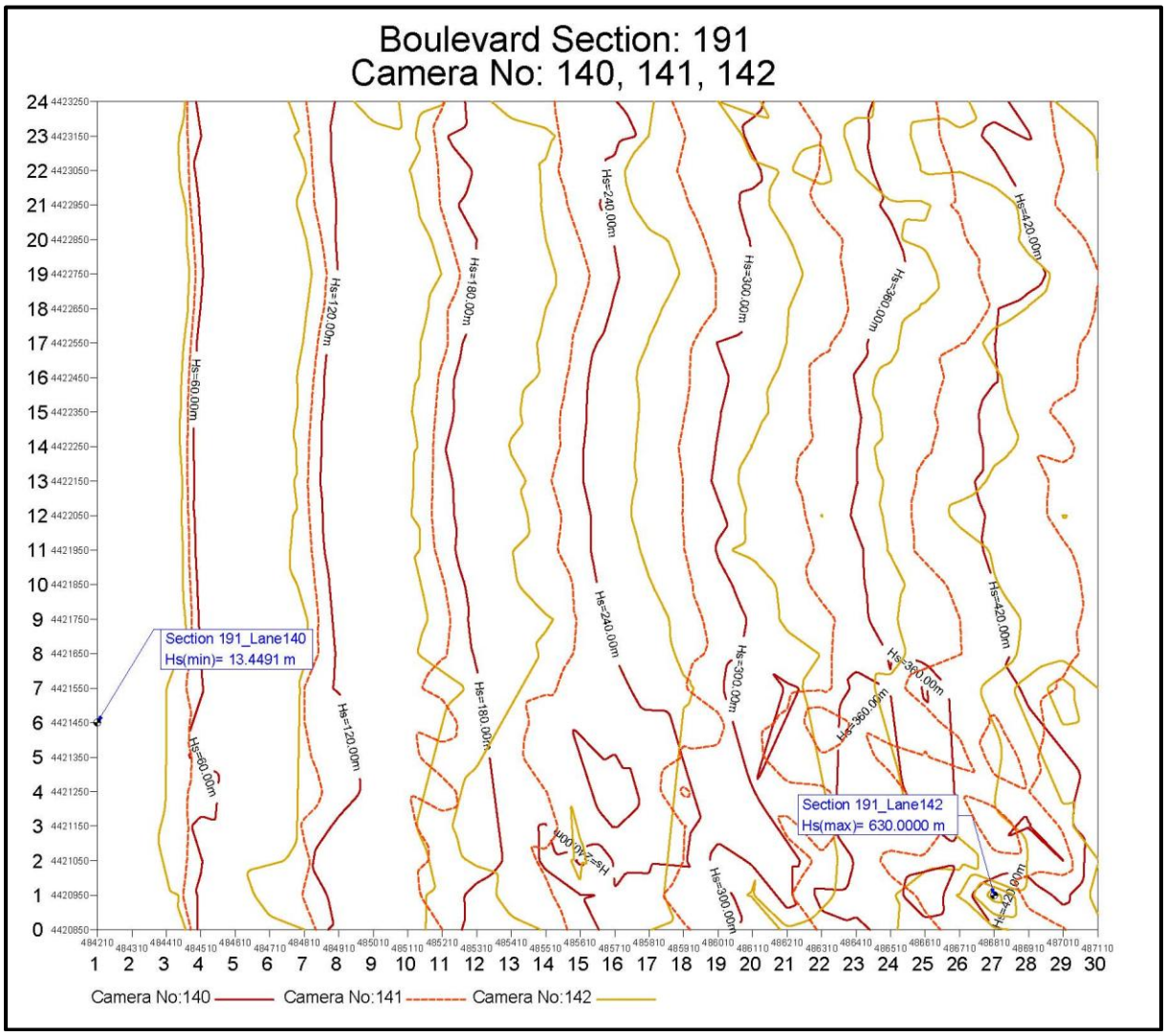

Fig.3 SakıpSabancı Boulevard section 191 space headway terrain model

The vehicle traffic distribution ratio model for the Etimesgut direction is given in Figure 4.

- Between 01:00 and 07:00, the traffic distribution rates in all three lanes are below 1%, which can be said that the traffic flow is quite low in this hour range compared to other times of the day, similar to other section.
- Contrary to section 186, the distribution ratio model peaks are seen at 19:00. From this point of view, the peak period of the traffic and the peak period of the flow can be determined as this hour.
- In this section with closed contours, a maximum vehicle distribution ratio of 24.32% in lane 140, 13.84% in lane 141, and 32.68% in lane 142 are observed.

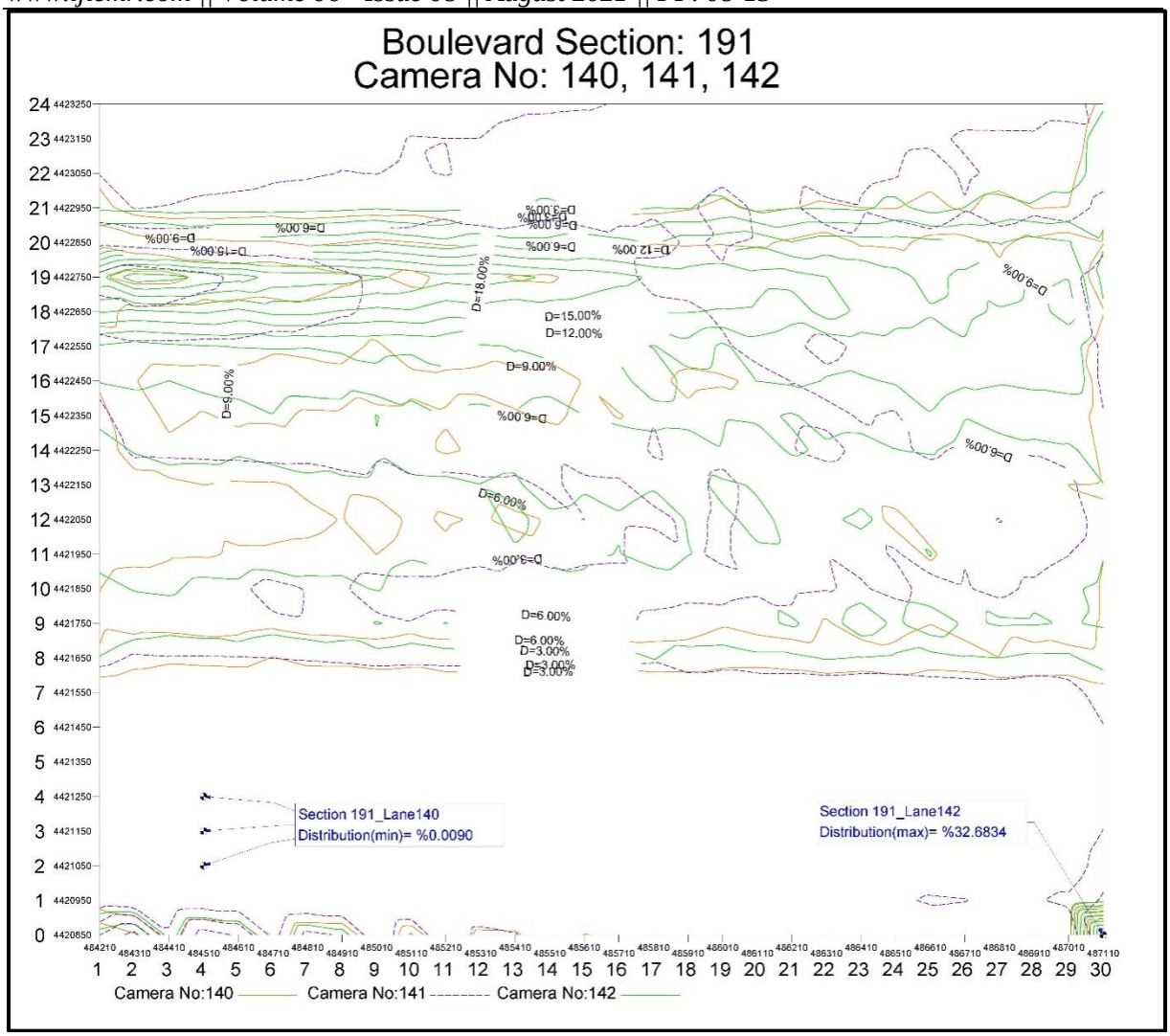

Fig.4 SakıpSabancı Boulevard section 191 traffic distribution ratios terrain model

3. CONCLUSION

This study, which evaluates the space headway and vehicle distribution ratios obtained from the section data recorded on SakıpSabancı Boulevard, is of great importance to evaluate all traffic parameters with a different approach and method. If desired, it is possible to work in coordination with the programs in which these terrain models are created. The triangular models created with the data transferred to the program are obtained by the program algorithm and give the contour curves as result. After the algorithm, the model curves can be interfered with from the outside. Model outputs expressing space headways and distribution ratios can be developed according to each requested interval value by adding inter-contours. In other words, the contours of the model can be adjusted in any format according to the details of the evaluation and analysis process.

Digital terrain models created from traffic parameters offer the analyst; a wide working area with the opportunity to obtain information by reading the values at every point of the surface without interfering with the actual data, preparing detailed range values, and intervening in the triangular models created.

REFERENCES

[1] Transportation Research Board, National Research Council. (2010) *Highway Capacity Manual (2010)*. Washington, DC, 1207.

[2] Kraft, W. H., Homburger, W.S., Pline, J. L. (2009). *Traffic engineering handbook.* Washington, DC United States.

[3] Aydın, M., Macro Traffic Flow Models for Ankara Main Collectors: Eskişehir Road and SakıpSabancı Boulevard, Master's Thesis, Gazi University Graduate School of Natural and Applied Sciences, Ankara, 2018.