Volumetric Traffic Count Survey And Statistical Analysis On Baraki Intersection Kabul Afghanistan

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Abstract: the current paper is evaluated the traffic characteristics which is vital for selecting an appropriate geometric design of pavement. The traffic data includes traffic volume, traffic speed, and the percentage of trucks or other large vehicles. Traffic volume is an important basis for determining what improvements, if any, are required on a highway or street facility. Traffic volumes can be expressed in terms of average daily traffic or design hourly volumes. These volumes must be used to calculate the service flow rate, which is typically used for evaluations of geometric design alternatives. This study was found the variability of traffic volumes by vehicle classification. It is discussed the traffic volume in terms of statistics. The purpose of this study is to demonstrate how to estimate daily traffic volumes in peak hours which is selected 3-hour-vehicles counts and also identifying, collecting the data, and analyzing it. This study has counted more than 12179 vehicles for 3 hours for each observation period is 15 min. It is distributed as follows; 9035 cars, 137 taxies, 1710 Light vehicle, 755 heavy vehicles, 86 bus, 456 minibusses. It is found the percentage of cars 75% in one location site and it is selected the highest percentage of vehicles.


1. INTRODUCTION
Transportation has been one of the essential components of the civil engineering profession since its early days. From time immemorial, the building of roads, bridges, pipelines, tunnels, canals, railroads, ports, and harbors has shaped the profession and defined much of its public image [1]. As cities grew, civil engineers became involved in developing, building, and operating transit facilities, including street railways and elevated and underground systems. Traffic counting determines the number and classifications of vehicles at specific locations and times. Based on Kinzer (1934) presented on the relationship of probability theory to highway traffic data [2]. Kinzer's paper influenced the subsequent national and international discussion of the assumption that traffic is a random series According to Albright (1991) analyzed manually collected hourly traffic flows to demonstrate that, under free-flowing conditions, traffic generally corresponds to a random series of events [3]. Shelton (1938) examined the grouping of traffic volume by the hour, day, and month at two sites in Iowa [4]. For the two sites, hourly manual traffic volume observation was conducted for one year. The analysis of variability at these sites specified that "there are no additional hours of wider variation not included." Shelton sought to identify the optimal number of manual count hours at a site. Within 3 years there was widespread development and implementation of mechanical traffic recording devices, and the urgency of Shelton's findings diminished. What did not diminish was the concern for unadjusted data sets for statistical analysis. There are two methods for counting traffic: manual and automatic. Manual counting usually refers to the practice of counting classified traffic in a "manual fashion". Some examples of traffic counting include vehicle counts at intersections, estimation of average daily traffic, and annual average daily traffic [5], [6], [7]. Manual counting and classification can be carried out on the site or from video recordings. Counting and classification are simply based on visual examination and judgments by individual observers [8]. The data is usually recorded using tally sheets or mechanical counters. After data have been collected for an interval (e.g. 1 min), totals are calculated and registered on a datasheet which can be input into the computer later [9], [10]. It is usually taken for granted that errors in manual counts are small and can be ignored [11]. However, the impacts of manual count errors are very application dependent. Under certain circumstances, they could be sensitive to the errors in manual counts. Empirical investigations may be necessary to determine whether errors in manual counts can affect traffic assessment results. For this purpose, some test manual count data was collected. Statistical analysis was applied to the data and manual count errors were quantified. The effects of manual count errors on the results of a traffic assessment schemes were also investigated to exemplify the effects of manual counting errors.

2 PROBLEM STATEMENT
Traffic organization is advanced countries is one of the major ways in which traffic is controlled and analyzed with time progression and this, in turn, proffers solution to traffic issues through the improvement of traffic engineering and forecasts as expected in the future. A common solution, in general, could range from the enhancement of intersection operation, control of signals or signal control, grade separation of junctions and all of these options form part of the associated cost. In Afghanistan, due to the development and expansion of the republic recently have undoubtedly witnessed population growth which implies more traffic and thus traffic congestion as proper traffic organization is currently not in place to control this new demands, as well as take consideration into future needs which will turn out to be a major problem if adequate plans are not currently put in place to cater to this. The problem in the city of Kabul which is a state in Afghanistan as common to most developing countries is that of congestion at peak time or hours, inadequate public transport systems like internal buses, and mainly improper functioning signals. In tackling this problem, traffic organization is key through
signalized junctions and intersection, due to these issues which are essential to be collected proper traffic data.

3 PURPOSE OF STUDY
The main purpose of this research is to study the Vehicular Traffic Congestion in urban areas of Kabul Baraki to help alleviate traffic congestion.

- To demonstrate how to estimate daily traffic volumes from 3-h vehicles counts, and also it is including identify, collect, and data analysis.
- It will be selected zone the Traffic Congested areas for analysis to identify which zone has the highest Vehicular traffic during the peak hours (11:00 AM-12:00 AM -and 1:00 PM-2:00 PM).
- To evaluate some planning options to ease Vehicular Traffic congestion in Baraki –Kabul Afghanistan.

4. LITERATURE REVIEW
It is essential to know the magnitude of traffic data required or to be collected, which will then determine its quality and type of vehicle classification to be adopted. Traffic counting falls in two main categories, namely; manual counts and automatic counts. There is no distinct difference between the two methods however, the economic use or selection of an appropriate method of traffic counting is a function of the level of traffic flow and the required data quality [12].

4.1 Selection of Suitable Observer location
A vantage point should be selected where the observers are strategically positioned in other to have an unhindered view of the traffic flow. Safety is also a major consideration when selecting a location and as such should be well-positioned away from the edge of the motorway. In a situation where an observer is positioned high above ground level free from obstruction usually gives the best location or vantage point. Also in scenarios where there are multiple observers on-site, visual contact must be kept constant. Observers can also count from a vehicle as long as the views are unhindered or blocked.

4.2 Manual Counts
The most common method of collecting traffic flow data is the manual method, which consists of assigning a person to record traffic as it passes. This method of data collection can be expensive in terms of manpower, but it is nonetheless necessary in most cases where vehicles are to be classified with several movements recorded separately, such as at intersections. Intersection sites, the traffic on each arm should be counted and recorded separately for each movement. It is of paramount importance that traffic on roads with more than one lane is counted and classified by the direction of traffic flow [13]. Permanent traffic-counting teams are normally set up to carry out the counting at the various locations throughout the road network at a set interval. The duration of the count is determined before the commencement of traffic counting and it is dictated by the end-use of data. The teams are managed and supervised by the technical staff to ensure efficient and proper collection of data [14]. As shown in manual traffic count in Fig 1.

4.3 Automatic Counts
The detection of vehicular presence and road occupancies has historically been performed primarily on or near the surface of the road. The exploitation of new electromagnetic spectra and wireless communication media in recent years has allowed traffic detection to occur in a non-intrusive fashion, at locations above or to the side of the roadway. Pavement-based traffic detection currently relatively inexpensive, will be met with fierce competition in the coming years from detectors that are liberated from the road surface [15]. The most commonly used detector types are:

4.3.1 Pneumatic Tubes
These are tubes placed on the top of road surfaces at locations where traffic counting is required. As vehicles pass over the tube, the resulting compression sends a burst of air to an air switch, which can be installed in any type of traffic counting devices. Air switches can provide accurate axle counts even when compressions occur more than 30 m from the traffic counter. Although the life of the pneumatic tubes is traffic dependent as they directly drive over it, it is used worldwide for speed measurement and vehicle classification for any level of traffic [16]. Care should be exercised in placing and operating the system, to ensure its efficient operation and minimize any potential error in the data. As shown Pneumatic tubes traffic count in Figure 2.
4.3.2 Inductive Loops
An inductive loop detector consists of embedded turned wire from which it gets its name. It includes an oscillator, and a cable, which allows signals to pass from the loop to the traffic counting device. The counting device is activated by the change in the magnetic field when a vehicle passes over the loop. Inductive loops are cheap, almost maintenance-free, and are currently the most widely used equipment for vehicle counting and detection [17]. As shown in Figure 3.

4.3.3 Weigh-in-Motion Sensor Types
A variety of traffic sensors and loops are used world-wide to count, weigh, and classify vehicles while in motion, and these are collectively known as Weigh in Motion (WIM) sensor systems. Whereas sensor pads can be used on their traffic speed and axle weighing equipment, they are trigged by “leading” inductive loops placed before them on the roadbed. This scenario is adopted where axles, speed, and statistical data are required [18]. As shown in Figure 4 Weigh-in-Motion Sensor. Some notable traffic sensors are: Bending Plates which contains strain gauges that weigh the axles of passing vehicles. Continuous electric signals are sent to the strain gauges, and these signals are altered as the plates are deflected by dynamic vehicular weight and measure the axle of the passing vehicles. Capacitive Strip is a thin and long extruded metal used to detect passing axles. The force of vertical pressure applied to this strip by a wheel alters its capacitance, which can be converted to a wheel-weight measure when related to the speed of the vehicle. Capacitive strips can be used for both statistical data and axle configuration. Capacitive Mat functions similarly as the capacitive strip but it is designed to be mobile and used temporarily only. Piezo-electric Cable is a sensing strip of a metallic cable that responds to vertical loading from vehicle wheels passing over it by producing a corresponding voltage. The cable is very good for speed measurement and axle-space registration and is relatively cheap and maintenance-free like an inductive loop if installed correctly.

4.3.4 Micro-Millimeter Wave Radar Detectors
Radar detectors actively emit radioactive signals at frequencies ranging from the ultra-high frequencies (UHF) of 100 MHz, to 100 GHz, and can register vehicular presence and speed depending upon signals returned upon reflection from the vehicle. They are also used to determine vehicular volumes and classifications in both traffic directions. Radar detectors are very little susceptible to adverse weather conditions and can operate day and night. However, they require comparatively high levels of computing power to analyses the quality of signals [19].

4.3.5 Video Camera
The video image processing system utilizes machine vision technology to detect vehicles and capture details about individual vehicles when necessary. A video processing system usually monitors multiple lanes simultaneously, and therefore it requires a high level of computing power [20]. Typically, the operator can interactively set the desired traffic detection points anywhere within the systems view area. Algorithms are used to extract data required for the detection of the raw data feeds. Due to the complexity of the images, it is not recommended that they should be processed outdoors as this can give poor results. The system is useful for traffic counting and give a +/- 3% tolerance, and is not appropriate for vehicular speed and their classification. As shown in Video Camera in Figure 5.
4.3 Intersection
In today’s transportation system, the major bottleneck and determinant for traffic congestion are not the links but intersections where conflicting demand for traffic movement needs to be managed [8]. These profoundly aim to smooth operations and provide sufficient and safe operations for conflicting movements. The urban intersections can be found in the form of roundabouts where movements are avoided head-to-head interaction but at an angle; signals where head-to-head movements are separated in time; priority/stop junctions where lowest demand movements provide priority to major demand; and grade-separation of movements to improve capacity and uninterrupted flow for major demand. As shown in Figure 6 the intersection [20].

Fig-6: Sample Form of Intersection [20].

5. METHODOLOGY
The methodology used to study the Vehicular Traffic congestion in the Kabul Afghanistan is described in the following sections. The study is based on one parameter that is; traffic congestion. The parameter would be estimated or computed and interpreted to determine the severity or otherwise of the current traffic situation in the Baraki-Kabul city and offer some planning advice to urban planners to help alleviate the traffic congestion problem. The steps which would be involved in the study are:

- Selection of study area.
- Zoning of the study area which includes wards within the Kabul for effective analysis of the traffic situation.
- Data on type of vehicular count (i.e. Master Station Classification Count, Screen Line Classification Count, Turning Movements Counts, and Saturation flow studies) based on the link volume count, intersection volume count, link width and intersection dimension would be obtained from the Kabul Afghanistan for the study.

5.1 Study Area
This study was conducted in the Baraki area, part of the Kabul city. It is an excellent location for this study due to near Parwan-e-dow junction which is a link between (Baraki) and (Saray-shamali) junction in Kabul Afghanistan. There is also the presence of university (Rana University) hotels (Taj continental) hospital (prof. Musa Wardak Hospital) and other shops and the number of people which in and out in this junction is high. There are also other intersections known of prawn-e-do, Parwan 3, traffic junction, etc. all these centers take a high place or area and the biggest place which is taken by a hotel as known as (Taj continental). Figure 7 shows the study locations.

Fig-7: Shows the study location

5.2. Source of Errors
Vehicles are counted and classified during the manual counting process. Two types of errors may occur, and can be categorizing as following; Counting Errors: can be defined as the difference between the number of vehicles counted and the true number of vehicles in the same time interval. Classification Errors: can be defined as the number of vehicles that have been classified in the wrong classes [8].

6 DATA ANALYSIS
6.1 Traffic Flow Measurement
Flow is defined as the rate at which vehicles travel through a particular point or highway segment. Flow is expressed in units of traffic per unit of time, typically Vehicles per Hour (VPH). In practice, we often measure volume in 15-min intervals. Then, within the hour of analysis, we identify the 15-min interval with the highest volume, we extrapolate to flow (e.g., we multiply the 15-min peak volume by 3 to obtain the hourly rate) Elefteriadou (2014) evaluated traffic volume studies are usually conducted when certain volume characteristics are needed, some of which follow [21]:

- Peak Hour Volume (PHV) is the maximum number of vehicles that pass a point on a highway during 60 consecutive minutes.
- Vehicle Classification (VC) records volume to the type of vehicles

6.2. Measures of Central Tendency
Quartiles and percentiles are measures of the relative positions of points within a given data set [22]. The median constitutes a useful point because it lies in the center of the data, with half of the data points lying above and half below the median. The median constitutes a measure of the “centrality” of the observations, or central tendency. The sample mean is another statistical term that measures the central tendency, or average, of a sample of observations. The mode (or modes because it is possible to have more than one)
of a set of observations is the value that occurs most frequently, or the most commonly occurring outcome, and strictly applies to discrete variables (nominal and ordinal scale variables) as well as count data. It can be defined these measures in the following Table 1.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentiles</td>
<td>((n+1)p/100)</td>
<td>-</td>
</tr>
<tr>
<td>Median</td>
<td>(\sum x/n)</td>
<td>Balance point</td>
</tr>
<tr>
<td>Mean</td>
<td>(n+1/100)</td>
<td>Middle value when ordered</td>
</tr>
<tr>
<td>Mode</td>
<td>None</td>
<td>Most frequent</td>
</tr>
</tbody>
</table>

Where: \(n\) is the sample size and \(x\) sum of all Val

6.3. Measures of Dispersion
The descriptive statistics that measure the quality of scattering are called measures of dispersion. When added to the measures of central tendency discussed previously, measures of dispersion give a more complete picture of the data set. We will discuss three such measurements: the range, the variance, and the standard deviation.

6.4. Network Terminology
A transport network maybe formally as a set of links and a set of nodes. A link connects two nodes and a node connects two or more as shown in Figure 8. A link may be regarded as a conduit for flow whose units of measurement will depend on the application [23]. For example, in this study can be used vehicles per hour but in this study that it has only one site.

7. RESULT AND DISCUSSION
The researcher has counted 12179 vehicles for 3 hours for each observation period was 15 min. It is distributed as follows; 9035 cars, 137 taxies, 1710 Light vehicle, 755 heavy vehicles, 86 bus, 456 minibusses. Table 2 shown a summary of the data from Baraki Intersection. This study identified the group of traffic characteristics and classifications on Baraki Intersection. It was found that the percentage of cars 75% and on one site. It’s got the highest percentage of vehicles in the study. Chart 1 has shown the traffic composition of one site or one location.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Formula</th>
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<tr>
<td>Percentiles</td>
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<td>(n+1/100)</td>
<td>Middle value when ordered</td>
</tr>
<tr>
<td>Mode</td>
<td>None</td>
<td>Most frequent</td>
</tr>
</tbody>
</table>

Where: \(n\) is the sample size and \(x\) sum of all Val

Fig-8: Network terminology [23]
This study is calculated for three main events of central tendency: The Mean, the Median, and the Mode. Each of these events defines a different suggestion of the typical or central value in the distribution. Besides, it is summarized the major measures of dispersion. Another important quality to measure is the “spread” of a data set: Range, and Standard Deviation. For example, The Mean is 268.82 for East-Out (Baraki Road) and the Mode of this direction is (no number occurs more than once). A group of data can have mode at all, looking at the East-In data distribution (which has 40 observations), the median is 43.5 and The range of the data in East-In side is Max-Min=228-108=116. And the other related measure of distribution is Standard Deviation 29.16 and also it was compared this value with the Standard deviation of the West-In 272 the larger data is the data set in South-Out additional proves of the data set in the South-Out is more distributed then the data set in the North-Out as shown in Table 3.

**Table 3**

<table>
<thead>
<tr>
<th>Direction</th>
<th>Total</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Max</th>
<th>Min</th>
<th>Range</th>
<th>STDV</th>
<th>85th P</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-in</td>
<td>499</td>
<td>49.9</td>
<td>48.5</td>
<td>45</td>
<td>72</td>
<td>34</td>
<td>39</td>
<td>11.47</td>
<td>59</td>
</tr>
<tr>
<td>N-out</td>
<td>277</td>
<td>25.16</td>
<td>27</td>
<td>24</td>
<td>35</td>
<td>19</td>
<td>16</td>
<td>5.14</td>
<td>34</td>
</tr>
<tr>
<td>S-in</td>
<td>733</td>
<td>66.64</td>
<td>60</td>
<td>57.79</td>
<td>113</td>
<td>45</td>
<td>68</td>
<td>19.88</td>
<td>79</td>
</tr>
<tr>
<td>S-out</td>
<td>630</td>
<td>57.27</td>
<td>58</td>
<td>None</td>
<td>69</td>
<td>42</td>
<td>27</td>
<td>8.63</td>
<td>68</td>
</tr>
<tr>
<td>E-in</td>
<td>1906</td>
<td>173.27</td>
<td>18</td>
<td>None</td>
<td>224</td>
<td>108</td>
<td>116</td>
<td>29.16</td>
<td>182</td>
</tr>
<tr>
<td>E-out</td>
<td>2057</td>
<td>253.62</td>
<td>228</td>
<td>None</td>
<td>551</td>
<td>193</td>
<td>358</td>
<td>118.39</td>
<td>264</td>
</tr>
<tr>
<td>W-in</td>
<td>2804</td>
<td>254.9</td>
<td>239</td>
<td>None</td>
<td>368</td>
<td>188</td>
<td>168</td>
<td>49.11</td>
<td>272</td>
</tr>
<tr>
<td>W-out</td>
<td>2373</td>
<td>215.72</td>
<td>210</td>
<td>210</td>
<td>253</td>
<td>139</td>
<td>123</td>
<td>32.22</td>
<td>234</td>
</tr>
</tbody>
</table>

The variation of the one hour in the traffic volume is shown below, a volume for each hour of the day is represented as a volume per 15min. It can be seen that there is countless fitting between the values of the volume and also there is a peak hour between 1:00 PM and 1:45 PM so it can be referred that the work trips are responsible although it was Saturday that the private sectors are working on half-day that is the reason caused for 1:00 to 1:45 to be the peak hours. The peak hour volume (PHV) for the site of the survey. We multiply 15 minutes the PHV by 4 to get the hourly rate [24]. If data is collected on the normal working days for a week the variation that happens in an hour is higher and the actual volume did not be the same from each day. As shown in Chart 2.
After us, the extent, the error, the miscalculation section with an amount method was relatively small. As shown in Table 4 at bellow.

### Table 4
Reliability Data

<table>
<thead>
<tr>
<th>Direction</th>
<th>IN</th>
<th>OUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORTH</td>
<td>499</td>
<td>277</td>
</tr>
<tr>
<td>SOUTH</td>
<td>733</td>
<td>630</td>
</tr>
<tr>
<td>EAST</td>
<td>1906</td>
<td>2957</td>
</tr>
<tr>
<td>WEST</td>
<td>2804</td>
<td>2373</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5942</td>
<td>6237</td>
</tr>
<tr>
<td>DIFFERENCES</td>
<td>295</td>
<td>4.73%</td>
</tr>
<tr>
<td>LOSSES</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \sum \text{IN} = 5942 \]
\[ \sum \text{OUT} = 6237 \]
\[ \sum \text{OUT} = \sum \text{IN} + X \]
\[ X = \sum \text{OUT} - \sum \text{IN} = 6237 - 5942 = 295 \]
\[ \text{Error} = \frac{X}{\sum \text{OUT}} = \frac{295}{6237} = 0.0473 \]
\[ \text{Error} = 0.0473 \times 100 = 4.73\% \]

### 7. CONCLUSIONS

The highway facility during a specified period. Two methods are available for conducting traffic volume counts (1) manual and (2) automatic. The quality of manual counts is a function of the quality of the staff performing those counts and the ability of those staff to see the traffic stream. Two types of errors may occur and can be categorizing as following; counting errors, classification errors. The study identifies the group of traffic characteristics and classifications for one site. It was found that the percentage of cars 75% accounted for and got the percentage of vehicles in the study. All the private areas are working on a half-day, and it's the reason that causes the peak hour between 1:00 and 1:45. So if the survey was done on normal days for one week the variation will be higher than the weekend of Saturday. The error component within the measurement procedure is fairly small.

### REFERENCES


[17]. Oh S, Ritchie SG, Oh C. Real-time traffic measurement from single loop inductive signatures. Transportation Research Record. 2002; 1804(1):98-106