Road Traffic Safety

Ghana Sustainable Change Program

The Ohio State University

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Background

Ghana is a country in sub-Saharan West Africa with a population of 26.8 million people according to the World Bank. Though it is still classified as a lower middle income country, it is also a developing nation with plenty of diverse peoples and cultures. Different sources seem to give different figures as to how many different language and ethnic groups there are, but according to the Ghanaian embassy of the US, there are about 75 different ethnic groups with about 250 different languages and dialects. With English being the inherited official language, there are also 9 other government-sponsored local languages—the most widely spoken are Ga, Dagomba, Akan, and Ewe. There are 10 regions in Ghana: Ashanti, Brong-Ahafo, Greater-Accra, Central, Eastern, Northern, Western, Upper-East, Upper-West, and Volta regions. Within these 10 regions are 216 local districts.

Transportation in Ghana is done through modes of road, rail, air, and water. Of these, the dominant mode of transportation is through the country's road network. Today, Ghana does not have a developed system of interstate highways. Ghanaian cities are more dependent on a network of trunk roads consisting of National, Regional, and Inter-regional roads. National roads are designated with the letter "N" and are tasked with connecting larger populated areas such as Accra, Cape Coast, Kumasi, and Tamale. Regional roads, designated with the letter "R", primarily serves as feeder roads to nation roads. Inter-Regional roads, designated with "IR", functions to connect major settlements across regional borders. These trunk roads are administered, developed, and maintained by the Ghana Highway Authority which was established in 1974.

Between larger cities, however, trunk roads often bisects the center of smaller towns and communities. In some cases, smaller towns and communities will build themselves around these trunk roads. They do this for reasons such as economic gain and access. While this development pattern does have its advantages, disadvantages do entail. They conquer city centers. They divided socio-economic functions. They fragment the habitats of people and animals. Consequently and ultimately, they also create immediate dangers to physical and mental safety of the people they divide.

The Offinso North District

The population of the Offinso North District is estimated to be around 55,000 people with a growth rate of about 3.1%. It is, generally, a rural district with 78% of the total population living in rural areas. Topographically, it has a slight range of hilly areas to flatter plains. Its highest elevation is about 585 meters above sea level, while having low-lying plains from Nkenkaasu to Afrancho. The land in the district is also very arable. It could support a wide range of crops, trees, and animals. The district is known for its outstanding ability to grow tomatoes and Okra. It is by no surprise that the farming and agricultural sector employs about 70% of the economically active work force. Even then, 60% of those outside the sector (outside of the 70%) still engages in farming as a subsidiary activity.

The Offinso North District of Ghana is one of 27 districts in the Ashanti region. The district is served by the larger Offinso North District Assembly ("ONDA"). They are also served by 5 smaller area and town councils. These are the Akomadan, Afrancho, Nkenkaasu, Asuoso and

Nsenua area council. It is a relatively new district that was created in 2008 by the then president, John Kufuor. Its capital is located in Akomadan, with other major settlements being Nkwakwaa, Asempanaye, Asuoso, Nkenkaasu, and Afrancho. Almost all of these major settlements reside along the Kumasi-Techiman road section of National Road 10 ("N10") that bisects through them.

Literature Review

In the past, there has been research that was done on the relationship between trunk roads, road traffic crashes ("RTC"), and pedestrian safety. For the purpose of evaluation in this paper, three papers were reviewed for background information and to create an image of the current condition. These papers were:

1. Pattern of Road Traffic Injuries in Ghana: Implications for Control
Authored by Francis K. Afukaar, Phyllis Antwi, and Samuel Ofosu-Amaah
Published in May 2003 by the International Journal of Injury Control and Safety Promotion.

This article collected police reports of years 1994-1998 (4-year interval). Data was obtained from the Building and Road Research Institute ("BRRI") and was analyzed by the Micro-computer Accident Analysis Package ("MAAP5"). MAAP5 was developed by Transport Research Laboratory (TRL), UK.

Between the years of 1994 to 1998, this article found that a total of 434,012 road traffic crashes ("RTC") were recorded. Of that, 9.2% were fatal, while 21.8% caused serious injuries. 27.1% caused slight injuries, and 41.5% were associated with only property damage. These crashes resulted in 5276 fatalities, 18812 severe injuries, and 29695 slight injuries. Altogether, they totaled 53783 casualties. There was an injury to fatality ratio of 9:1. This implied that for every 10 persons involved in a road traffic crash, 9 were injured (either severe or slightly) and 1 person who died from the accident.

The highest crash rate of 286 per 100,000 inhabitants happened in the Greater-Accra region. However, this was predominantly low-speed crashes that occur in urban environments. The Eastern and Central region has the highest recorded rates of fatal and serious injury accidents, and shares a border with the Greater-Accra region. The Northern, Upper-East, and Upper-West regions had the lowest rate of crash casualty rates. These 3 regions are located in the northern part of the country and makes up 40% of the land area while accounting for less than 20% of the population when this article was written. The authors have also mentioned that there are relatively fewer vehicles in these regions than in the Greater-Accra region. The article also found that 61.2% of road fatalities and 52.3% of road injuries occur on rural roads. Approximately 58% more people die on rural roads than in urban areas. This has been attributed to high driving speeds, poorly maintained vehicles, and the lack of the ability of emergency services.

Males were 2.73 times more likely to be involved in road traffic fatalities in Ghana, making up 73.1% of the fatalities and 68% of all casualties. This distribution is disproportionately high as males account for only 49% of the population at the time this article was written. Another alarming figure is that children ages 15 and under represent 24.7% of all road crash fatalities. This implies that one of four people killed on the road are age 15 or under. Pedestrian deaths are the largest group of fatalities on the road, accounting for 46.2% of all road crash fatalities. Although the number of pedestrian fatality on rural roads was less than in urban areas, the ratio of pedestrian fatality to injury was about 3 times that rate in urban areas. This implies that the severity of injury is generally higher in rural settings than in urban settings. In both cases, pedestrians remain the most vulnerable of road users.

2. Analysis of Fatal Road Traffic Crashes in Ghana

Authored by Williams Ackaah, and David O. Adonteng
Published in May 2010 by the International Journal of Injury Control and Safety Promotion.

This article collected police reports of years 2005-2007 (3-year interval). Data was obtained from the Building and Road Research Institute ("BRRI") and was analyzed by the Micro-computer Accident Analysis Package ("MAAP5"). MAAP5 was developed by Transport Research Laboratory (TRL), UK. This article reports that this database is subject to some measure of under-reporting and non-reporting. In the years of 2003 and 2004, the level of under-reporting was estimated to be about 37% for fatal casualties, 120% for serious injury casualties, and 199% for slight injury casualties.

In the three-year period of 2005 to 2007, there was total of 4439 fatal crashes resulting in 5637 deaths. This is higher than the four-year period of 1994-1998 analyzed in the previous article. Of the 5637 deaths, pedestrians accounted for 42% of the fatalities. Nearly three-quarters of fatalities were male (74.3%) and 61.2% were between the ages of 15 and 45 years. Contrary to the previous article reviewed, nearly two-thirds of fatalities occur in non-urban settings as opposed to 34.4% that happen in urban areas. This figure accounts for all fatalities, not just pedestrian. 54.8% of fatal pedestrian collisions occurred in non-urban settings compared to the 45.2% of urban areas. This has been attributed to high-speed. The majority of fatalities happen on weekends with the highest on Saturday at 16.8%, second highest on Sundays at 15.9%, followed by Friday at 15.6%. Fatal pedestrian crashes were more likely to occur during early night-time hours between 6:00 pm and 8:00 pm. Children ages 15 and under make up nearly 32.9% of pedestrian fatalities. The elderly (ages 55 and over) accounted for 16.3% of pedestrian fatalities.

Cars were most frequently involved in fatal crashes, making up 28.9% of the reported fatal crashes. This is followed by buses and mini-buses at 27.7%, then trucks/goods vehicles at 21.8%. This is considering all fatal crashes, not just pedestrian deaths. Cars were most likely to be involved in fatal pedestrian crashes at 36.2%, followed by buses/mini buses at 31.4%. The article also noted that *the majority of pedestrian-involved crashes occur within rural village settlements along the highways at 47.3%*

3. Characteristics of Pedestrian Accidents on Trunk Roads in Ghana
Authored by Daniel Atuah Obeng
Published in May 2013 by the International Journal of Injury Control and Safety Promotion.

This article collected police reports of years 2006-2010 (5-year interval). Data was obtained from the Building and Road Research Institute ("BRRI") and was analyzed by the Micro-computer Accident Analysis Package ("MAAP5"). MAAP5 was developed by Transport Research Laboratory (TRL), UK. This article analyzed the trunk road network totaling 13263 kilometers.

From 2006 to 2010, there were recorded 15710 pedestrian-involved accidents that occurred nationally. 10626 or 67.6% of that were of fatal or serious injury. For the non-urban environment, there was a total of 5608 accidents with 2233 or 39.8% of that being fatal and 2361 (42.1%) of it being of serious injury. This distribution of casualties is alarming as it indicates that four out of every 5 persons involved in a pedestrian accident was either killed or experienced some serious form of injury and disability. Age distribution was also compared to figures from the United States where in the U.S., 41% of pedestrian deaths were between the ages of 15 and 45. This is followed by ages 45-65 at 34% and people over the age of 65 at 19%. Children age 15 and under represents 7% of pedestrians killed in the United States. While the 15-45 age demographic figure from the U.S. shows similarities to the same age group in Ghana, other age groups differ to a varying degree. For instance, Ghanaian children age 15 and under make up 32% of pedestrians killed or sustained serious injury. This is compared to the 7% in the United States. At the time this article was written, males still constituted 48.8% of the population however still experienced 64.4% of the fatalities and 60.2% of all casualties. Light vehicles such as cars, pickups, and mini-buses accounted for 76% of pedestrian-involved accidents. The risk of pedestrian fatality when hit by a vehicle was higher at night than during the day.

In terms of location, pedestrians in the Ashanti, Eastern, and Central regions are highly at risk of being involved in a serious accident. The Greater-Accra region showed the highest risk being the region most economically active, the most vehicles registered, and the highest rate of population growth. The high rate of rural pedestrian accidents in Eastern, Central, and Ashanti is a *consequence of most settlements being extremely close to the road*. The communities are then exposed to the proximities and interactions with the road.

Commonalities

These three papers shared commonalities in many ways. Road traffic crashes remain a top cause of death in the country. Pedestrian fatalities account from 40% to 46.2% in each of the three papers. More road traffic crashes occur in large urban centers—understandably because of more vehicles, more activity, and more moving parts. However, the degree of injury is substantially more severe in rural areas and rural settlements than in urban centers. Each of the three papers obtained data from police reports that was databased at the Building and Road Research Institute of Ghana. It is also by no surprise that the variables measured in all three articles were: Crash information, location, vehicles, and casualties. None of the three papers, however, measured Speed and Velocity. A past study from Donker and Mock (2008) found that between 90% and

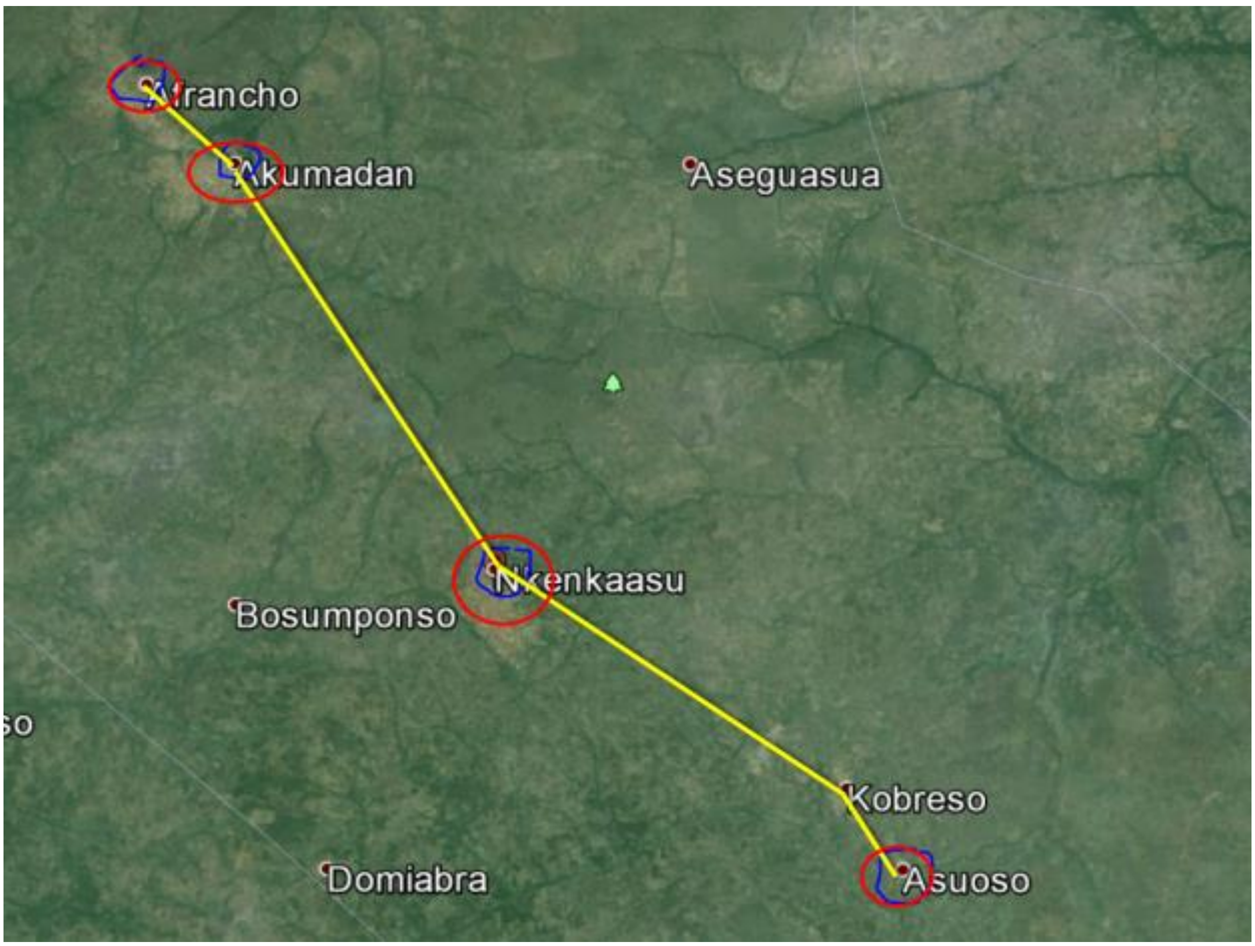
97% of vehicles exceeded the 50 km/h speed limit in rural areas on trunk roads and between 47% and 66% of vehicles exceeded the speed limit of 80 km/h on rural undivided highways in Ghana.

This paper will evaluating the speeds and velocities of vehicles in the Offinso North District, Ghana using data collected for 4 days from March 14, 2016 to March 17, 2016.

Methods and Procedures

Data was obtained by conducting traffic observations in four towns and settlements in the Offinso North District of Ghana. Each of these four towns were bisected by Kumasi-Techiman road segment of the National Road 10 (“N10”). N10 is a two lane road for the entirety of the observed area. The speed limit for each of our study areas is 50 kilometers an hour. The study areas from North to South:

- Afrancho
- Akomadan- District Capital
- Nkenkaasu
- Asuoso- Permanent speed tables installed



Observations were conducted by standing roadside using radar speed guns and measured incoming traffic from both directions of a two-lane road. These were 1-hour long observations, with 2 observations per day—once in the morning (around 10:30 am) and once in the afternoon (around 2:30 pm). An effort was made to have each observation conducted at the same time for each area conducted. However due to limitations on transportation, timing of each observation may vary up to 30 minutes depending on location. Each area, therefore, was observed twice a day for an hour at a time. Data obtained was Cross Sectional. Multiple communities are being compared. One community had speed calming measured installed. None were observed at the exact same time.

It is important to note that Asuoso was only observed for the afternoon. Asuoso also has permanent speed tables installed where the other three observed areas did not. Implementation of speed tables stopped at Asuoso by the GHA (Ghana Highway Authority) before they could have been implemented in the other 3 communities.

These observations measured four categories of vehicles and their velocities.

1. Cars, pickups, and mini-buses
2. Large Trucks
3. Large Buses
4. Motorcycles

The first category are cars, pickups, and minibuses. These are light vehicles. Mini-buses, however, are vans that has been retrofitted to fit as many people as possible. They go up and down trunk roads to drop off and pick up passengers for economic gain. The second category are large trucks. Large trucks carry goods and commodities from one area to another. The third category are large buses. These buses carry a large number of people. The final category are motorcycles—two wheeled vehicles that carry optimally up to two people.

Other variables that were measured include

- Time of Day– When were the vehicles observed
- Location – Environmental variable
- Speed calming measure installed

Since observations were made once during morning and once during afternoon times, the time of day was noted to document differences in observations and to strengthen the project design. Using G.P.S. devices, location was also documented. An analysis of environment will attempt to explain discrepancies in data between different locations and times. Finally, in Asuoso, speed tables were installed and have made a great difference in the observed data.

Locational Analysis

General: Can be hilly up to Asuoso. Northward from Nkenkaasu up to Afrancho is typically flatter featuring plains. All four towns resides along the Kumasi-Techiman road segment of National Road 10 ("N10"). This road eventually travels northward to the city of Techiman which is outside of the Offinso North District and approximately 25.5 kilometers from Akomadan.

Afrancho: 1 day prior to arrival in Ghana and 3 days before observations began, there was an unfortunate accident where a truck was going downhill experienced brake-failure. Consequently, the truck drove through a building and caused 1 pedestrian fatality. The truck remained flipped on site for the duration of the project observations. During the morning observation in Afrancho, workers who were cleaning up the accident had placed large branches on the road to stop vehicles from speeding by the work scene. The branches could cause physical damage to the vehicle if it was to not reduce speed. Additionally, local goats will occasionally come out to the road to eat the leaves on the branches.

The immediate to the southern part of town where National Road 10 enters is a curve where vehicles would also slow down or else risk the possibly of dropping off a 5-10 meter cliff.

Akomadan: Akomadan is the district capital that is south and very close to the borders of Afrancho. The location of observation had not been in the center of town, but slightly to the outskirts where the Offinso North District Assembly ("ONDA") and the location of multiple primary and senior high schools.

Nkenkaasu: Slight bend in N10 when approaching the outskirts of town. Segment through town is straight and visible. Slight upward grade when traveling northward on N10.

Asuoso- Generally hillier than compared to the other three areas of observation. Was the last location where speed tables were installed traveling northward before reaching the city of Techiman, outside of the Offinso North District. Three speed tables were installed in the center of the town. Was seen to be 150 meters, and 120 meters apart from one another.

Data

Akomadan morning: 10:10 am to 11:10 am, speed limit: 50 kilometers per hour (km/h)

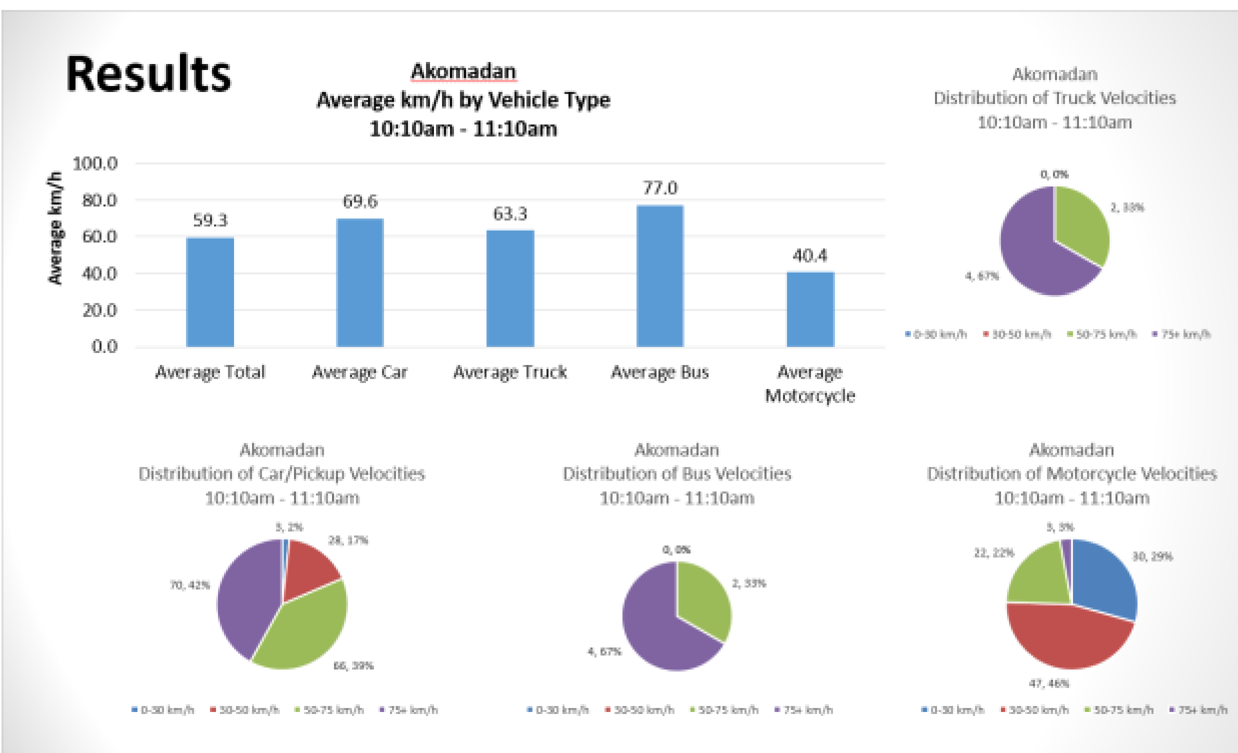
The morning observation in Akomadan recorded 298 vehicles. The average velocity recorded for all vehicles in this observation is at 59.3 km/h.

Category 1 (cars/pickups/mini-buses): 169, or 56.7%, the 298 vehicles recorded during the morning observation in Akomadan was of Category 1. The average category 1 vehicle was going at 69.6 km/h. Distribution shows that 66 (39%) of category 1 vehicles were going from 50 to 75 km/h. 70 (42%) of category 1 vehicles were going 75+ km/h.

Category 2 (Large Trucks): 23, or 7.72%, the 298 vehicles recorded during the morning observation in Akomadan was of Category 2. The average category 2 vehicle was going at 63.3 km/h. Distribution shows that 12 (52%) of category 2 vehicles were going from 50 to 75 km/h. 7 (31%) of category 2 vehicles were going 75+ km/h.

Category 3 (Large buses): 6, or 2.01%, the 298 vehicles recorded during the morning observation in Akomadan was of Category 3. The average category 3 vehicle was going at 77.0 km/h. Distribution shows that 2 (33.3%) of category 3 vehicles were going from 50 to 75 km/h. 4 (66.3%) of category 3 vehicles were going 75+ km/h.

Category 4 (Motorcycles): 102, or 34.2%, the 298 vehicles recorded during the morning observation in Akomadan was of Category 4. The average category 4 vehicle was going at 40.4 km/h. Distribution shows that 22 (22%) of category 4 vehicles were going from 50 to 75 km/h. 3 (3.0%) of category 4 vehicles were going 75+ km/h.



Akomadan afternoon: 2:35 pm to 3:35 pm, speed limit: 50 kilometers per hour (km/h)

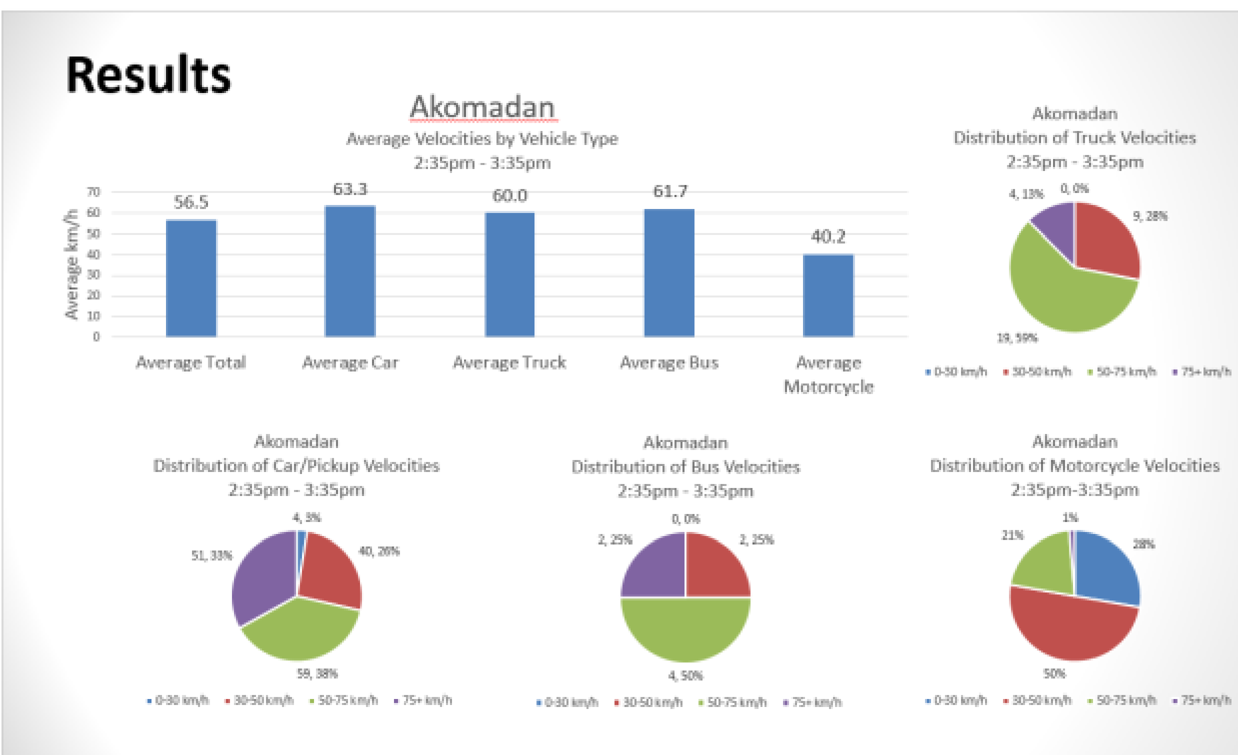
The afternoon observation in Akomadan recorded 267 vehicles. The average velocity recorded for all vehicles in this observation is at 56.5 km/h.

Category 1 (cars/pickups/mini-buses): 154, or 57.6%, the 267 vehicles recorded during the afternoon observation in Akomadan was of Category 1. The average category 1 vehicle was going at 63.3 km/h. Distribution shows that 59 (38%) of category 1 vehicles were going from 50 to 75 km/h. 51 (33%) of category 1 vehicles were going 75+ km/h.

Category 2 (Large Trucks): 32, or 11.9%, the 267 vehicles recorded during the afternoon observation in Akomadan was of Category 2. The average category 2 vehicle was going at 60.0 km/h. Distribution shows that 19 (54%) of category 2 vehicles were going from 50 to 75 km/h. 4 (13%) of category 2 vehicles were going 75+ km/h.

Category 3 (Large buses): 8, or 3%, the 267 vehicles recorded during the morning observation in Akomadan was of Category 3. The average category 3 vehicle was going at 61.7 km/h. Distribution shows that 4 (50%) of category 3 vehicles were going from 50 to 75 km/h. 2 (25%) of category 3 vehicles were going 75+ km/h.

Category 4 (Motorcycles): 73, or 27.3%, the 267 vehicles recorded during the morning observation in Akomadan was of Category 4. The average category 4 vehicle was going at 40.2 km/h. Distribution shows that 15 (21%) of category 4 vehicles were going from 50 to 75 km/h. 1 (<1.0%) of category 4 vehicles were going 75+ km/h.



Nkenkaasu morning: 10:10 am to 11:10 am, speed limit: 50 kilometers per hour (km/h)

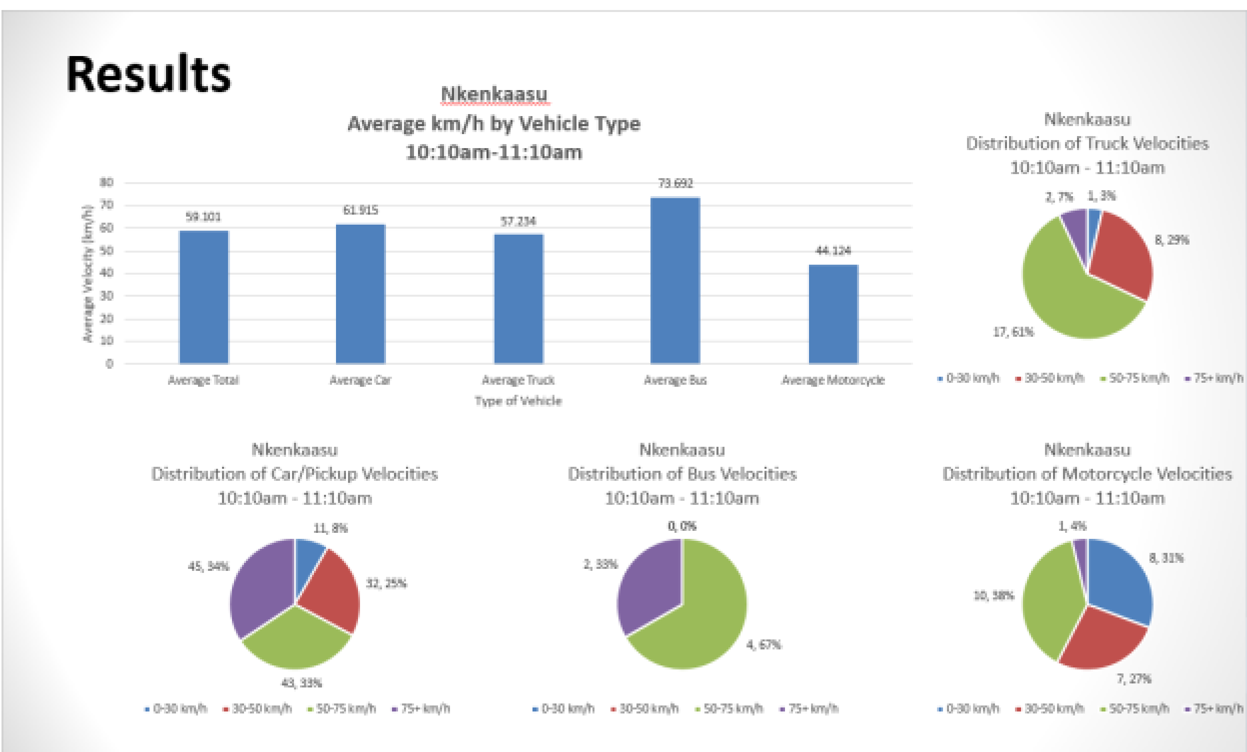
The morning observation in Nkenkaasu recorded 190 vehicles. The average velocity recorded for all vehicles in this observation is at 59.1 km/h.

Category 1 (cars/pickups/mini-buses): 133, or 70%, the 190 vehicles recorded during the morning observation in Nkenkaasu was of Category 1. The average category 1 vehicle was going at 61.9 km/h. Distribution shows that 33 (33%) of category 1 vehicles were going from 50 to 75 km/h. 45 (34%) of category 1 vehicles were going 75+ km/h.

Category 2 (Large Trucks): 28, or 14.7%, the 190 vehicles recorded during the morning observation in Nkenkaasu was of Category 2. The average category 2 vehicle was going at 57.2 km/h. Distribution shows that 17 (61%) of category 2 vehicles were going from 50 to 75 km/h. 2 (7%) of category 2 vehicles were going 75+ km/h.

Category 3 (Large buses): 5, or 2.63%, the 190 vehicles recorded during the morning observation in Nkenkaasu was of Category 3. The average category 3 vehicle was going at 73.7 km/h. Distribution shows that 4 (67%) of category 3 vehicles were going from 50 to 75 km/h. 2 (33%) of category 3 vehicles were going 75+ km/h.

Category 4 (Motorcycles): 26, or 13.6%, the 190 vehicles recorded during the morning observation in Nkenkaasu was of Category 4. The average category 4 vehicle was going at 44.1 km/h. Distribution shows that 10 (38%) of category 4 vehicles were going from 50 to 75 km/h. 1 (4.0%) of category 4 vehicles were going 75+ km/h.



Nkenkaasu afternoon: 2:45 pm to 3:45 pm, speed limit: 50 kilometers per hour (km/h)

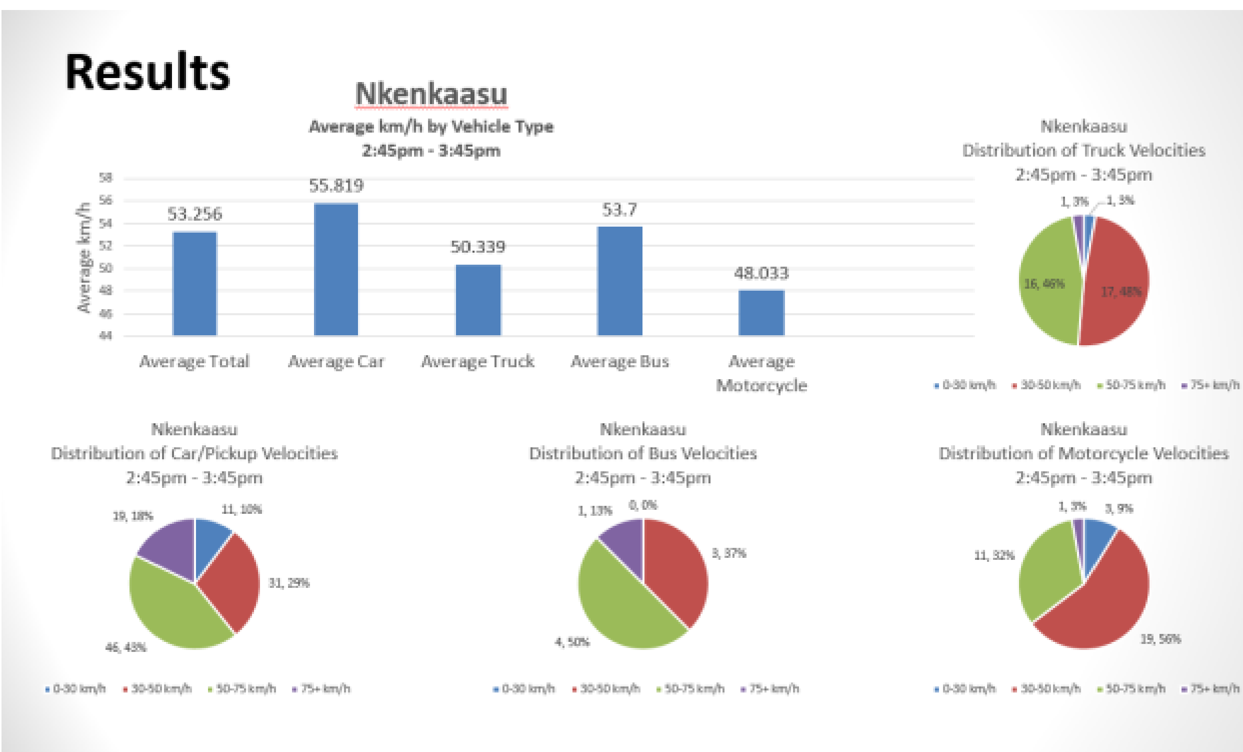
The afternoon observation in Nkenkaasu recorded 184 vehicles. The average velocity recorded for all vehicles in this observation is at 53.2 km/h.

Category 1 (cars/pickups/mini-buses): 107, or 58.1%, the 184 vehicles recorded during the afternoon observation in Nkenkaasu was of Category 1. The average category 1 vehicle was going at 55.8 km/h. Distribution shows that 46 (43%) of category 1 vehicles were going from 50 to 75 km/h. 19 (18%) of category 1 vehicles were going 75+ km/h.

Category 2 (Large Trucks): 35, or 19.0%, the 184 vehicles recorded during the afternoon observation in Nkenkaasu was of Category 2. The average category 2 vehicle was going at 50.3 km/h. Distribution shows that 16 (46%) of category 2 vehicles were going from 50 to 75 km/h. 1 (3%) of category 2 vehicles were going 75+ km/h.

Category 3 (Large buses): 8, or 4.3%, the 184 vehicles recorded during the morning observation in Nkenkaasu was of Category 3. The average category 3 vehicle was going at 53.7 km/h. Distribution shows that 4 (50%) of category 3 vehicles were going from 50 to 75 km/h. 1 (13%) of category 3 vehicles were going 75+ km/h.

Category 4 (Motorcycles): 34, or 18.4%, the 184 vehicles recorded during the morning observation in Nkenkaasu was of Category 4. The average category 4 vehicle was going at 48 km/h. Distribution shows that 11 (32%) of category 4 vehicles were going from 50 to 75 km/h. 1 (3.0%) of category 4 vehicles were going 75+ km/h.



Afrancho morning: 10:10 am to 11:10 am, speed limit: 50 kilometers per hour (km/h)

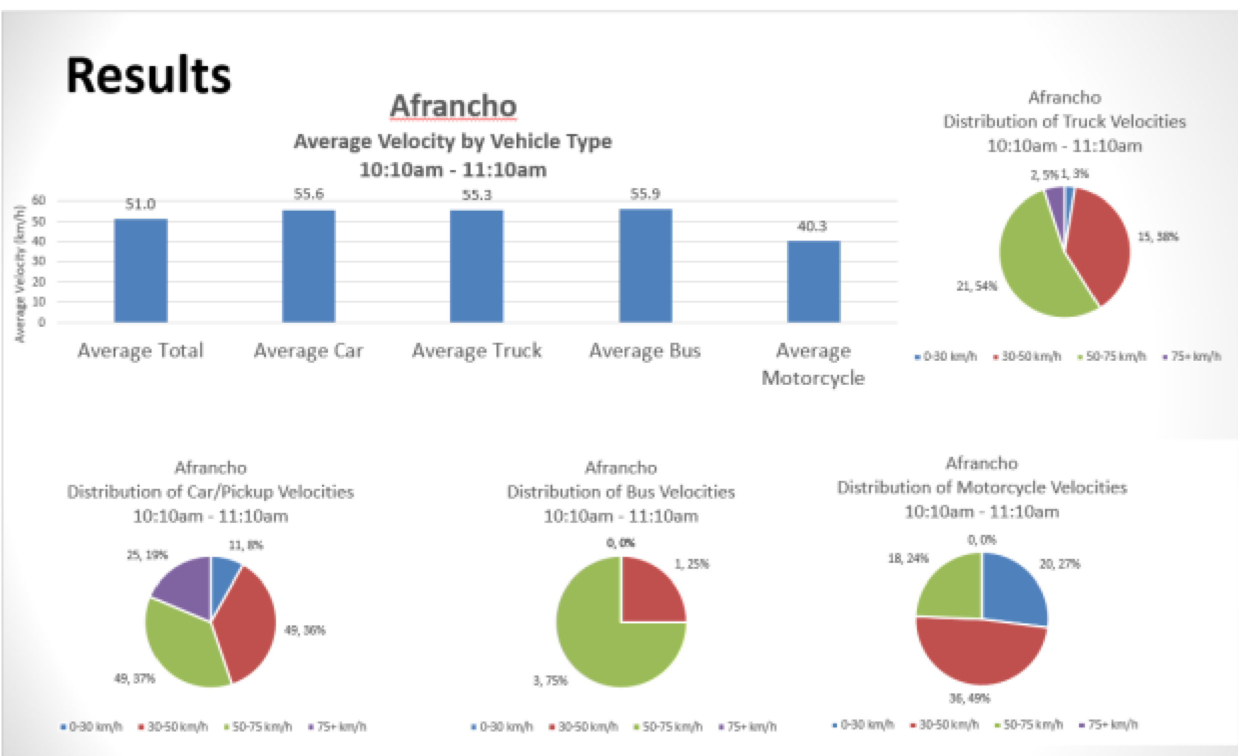
The morning observation in Afrancho recorded 251 vehicles. The average velocity recorded for all vehicles in this observation is at 51.0 km/h.

Category 1 (cars/pickups/mini-buses): 134, or 53.3%, the 251 vehicles recorded during the morning observation in Afrancho was of Category 1. The average category 1 vehicle was going at 55.6 km/h. Distribution shows that 38 (37%) of category 1 vehicles were going from 50 to 75 km/h. 29 (19%) of category 1 vehicles were going 75+ km/h.

Category 2 (Large Trucks): 38, or 15.1%, the 251 vehicles recorded during the morning observation in Afrancho was of Category 2. The average category 2 vehicle was going at 55.3 km/h. Distribution shows that 21 (54%) of category 2 vehicles were going from 50 to 75 km/h. 2 (5%) of category 2 vehicles were going 75+ km/h.

Category 3 (Large buses): 5, or 2%, the 251 vehicles recorded during the morning observation in Afrancho was of Category 3. The average category 3 vehicle was going at 55.9 km/h. Distribution shows that 3 (75%) of category 3 vehicles were going from 50 to 75 km/h. None of category 4 vehicles were going 75+ km/h.

Category 4 (Motorcycles): 74, or 129.4%, the 251 vehicles recorded during the morning observation in Afrancho was of Category 4. The average category 4 vehicle was going at 40.3 km/h. Distribution shows that 18 (24%) of category 4 vehicles were going from 50 to 75 km/h. None of category 4 vehicles were going 75+ km/h.



Afrancho afternoon: 2:28 pm to 3:28 pm, speed limit: 50 kilometers per hour (km/h)

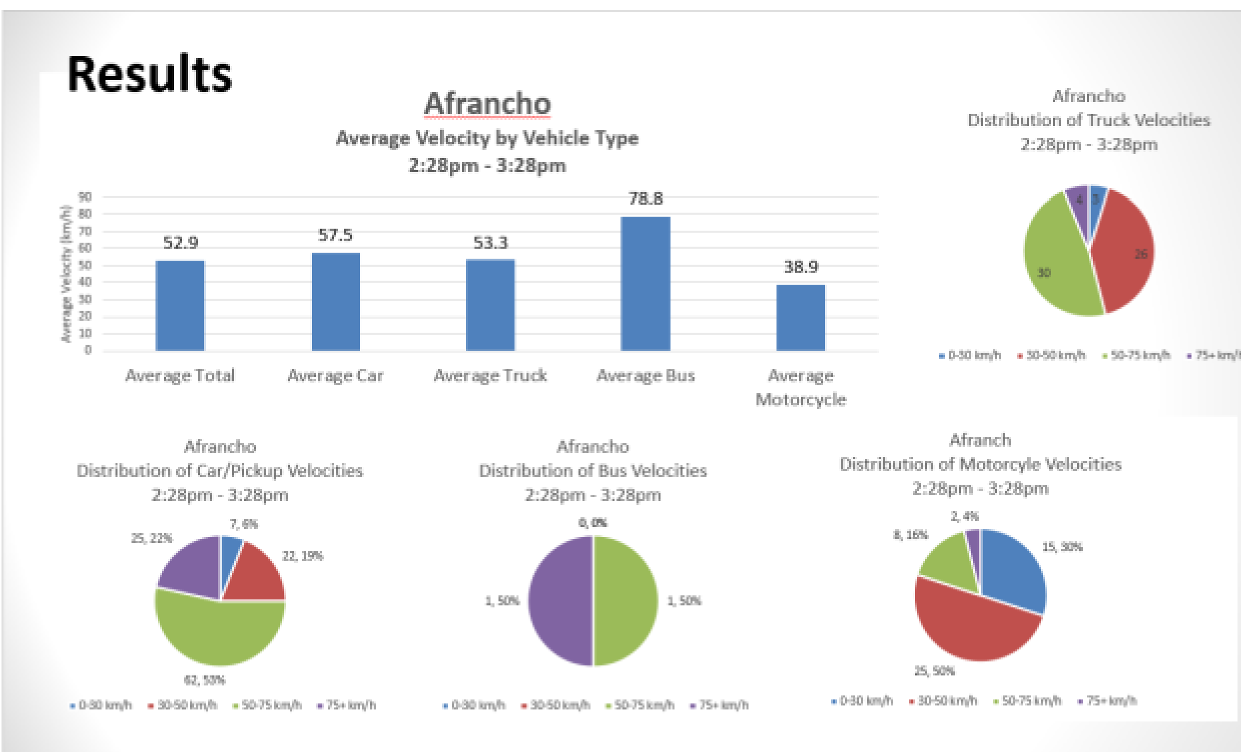
The afternoon observation in Afrancho recorded 253 vehicles. The average velocity recorded for all vehicles in this observation is at 52.9 km/h.

Category 1 (cars/pickups/mini-buses): 138, or 54.5%, the 253 vehicles recorded during the afternoon observation in Afrancho was of Category 1. The average category 1 vehicle was going at 57.5 km/h. Distribution shows that 62 (53%) of category 1 vehicles were going from 50 to 75 km/h. 25 (22%) of category 1 vehicles were going 75+ km/h.

Category 2 (Large Trucks): 63, or 24.9%, the 253 vehicles recorded during the afternoon observation in Afrancho was of Category 2. The average category 2 vehicle was going at 53.3 km/h. Distribution shows that 30 (48%) of category 2 vehicles were going from 50 to 75 km/h. 4 (6%) of category 2 vehicles were going 75+ km/h.

Category 3 (Large buses): 2, or <1%, the 253 vehicles recorded during the morning observation in Afrancho was of Category 3. The average category 3 vehicle was going at 78.8 km/h. Distribution shows that 1 (50%) of category 3 vehicles were going from 50 to 75 km/h. 1 (50%) of category 3 vehicles were going 75+ km/h.

Category 4 (Motorcycles): 50, or 19.7%, the 253 vehicles recorded during the morning observation in Afrancho was of Category 4. The average category 4 vehicle was going at 38.9 km/h. Distribution shows that 8 (16%) of category 4 vehicles were going from 50 to 75 km/h. 2 (4.0%) of category 4 vehicles were going 75+ km/h.



Asuoso afternoon: 3:00 pm to 4:00 pm, speed limit: 50 kilometers per hour (km/h)

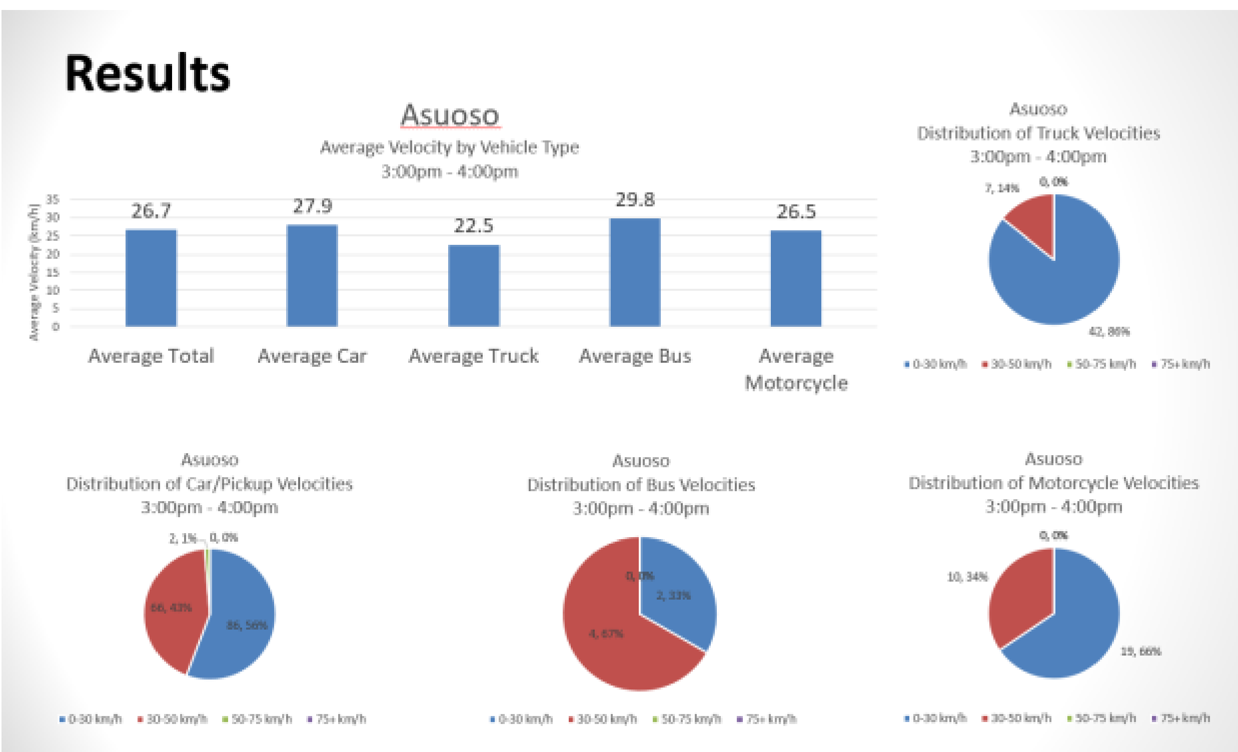
The afternoon observation in Asuoso recorded 238 vehicles. The average velocity recorded for all vehicles in this observation is at 26.7 km/h.

Category 1 (cars/pickups/mini-buses): 154, or 64.7%, the 238 vehicles recorded during the afternoon observation in Asuoso was of Category 1. The average category 1 vehicle was going at 27.9 km/h. Distribution shows that 2 (<1%) of category 1 vehicles were going from 50 to 75 km/h. None of category 1 vehicles were going 75+ km/h.

Category 2 (Large Trucks): 49, or 20.5%, the 238 vehicles recorded during the afternoon observation in Asuoso was of Category 2. The average category 2 vehicle was going at 22.5 km/h. Distribution shows that none of category 2 vehicles were going from 50 to 75 km/h. None of category 2 vehicles were going 75+ km/h.

Category 3 (Large buses): 6, or 2.5%, the 238 vehicles recorded during the morning observation in Asuoso was of Category 3. The average category 3 vehicle was going at 29.8 km/h. Distribution shows that none of category 3 vehicles were going from 50 to 75 km/h. None of category 3 vehicles were going 75+ km/h.

Category 4 (Motorcycles): 29, or 12.1%, the 238 vehicles recorded during the morning observation in Asuoso was of Category 4. The average category 4 vehicle was going at 26.5 km/h. Distribution shows that none of category 4 vehicles were going from 50 to 75 km/h. None of category 4 vehicles were going 75+ km/h.



Recommendations

Traffic Calming

Speed Humps/Tables

Definition: Speed humps/tables are traffic calming devices that use vertical deflection to slow motor-vehicle traffic in order to improve safety conditions.

Speed Humps and Tables (Source: Traffic Calming: State of the Practice, Institute of Transportation Engineers/FHWA, August 1999)

Speed humps are rounded raised areas placed across the road. The Institute of Transportation Engineers guidelines specify a speed hump that is 12 feet long (in the direction of travel), 3 to 4 inches high, and parabolic in shape, and that has a design speed of 15 to 20 mph. It is usually constructed with a taper on each side to allow unimpeded drainage between the hump and curb. In some European countries, the space between the hump and curb is wide enough to accommodate bicycles. In the United States, this space is typically kept narrower to discourage motorists from crossing a hump with one wheel on the hump and the other in the gutter. The 12-foot hump is one of many hump profiles, varying in height, length, and shape.

Speed tables are flat-topped speed humps often constructed with brick or other textured materials on the flat section. They are also called trapezoidal humps, speed platforms, and, if marked for pedestrian crossing, raised crosswalks or raised crossings. Speed tables are typically long enough for the entire wheelbase of a passenger car to rest on top. Their long flat fields, plus ramps that are sometimes more gently sloped than speed humps, give speed tables higher design speeds than humps. The brick or other textured materials improve the appearance of speed tables, draw attention to them, and may enhance safety and speed reduction. A typical speed table is 3 to 4 inches high and 22 feet long in the direction of travel, with 6-foot ramps at the ends and a 10-foot field on top.

Benefits: Reduction in traffic speeds; reduction in traffic volumes; reduction in collisions

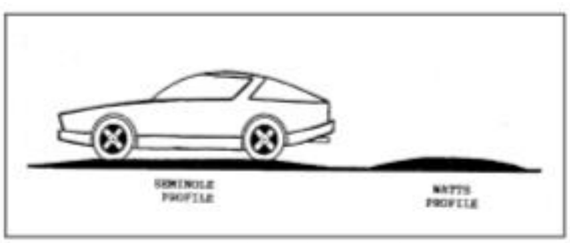


Figure 3.12. Seminole 22-foot Speed Table versus Watts 12-foot Speed Hump.

Source: D.A. Nicodemus, "Safe and Effective Roadway Humps —The Seminole County Profile," *Compendium of Technical Papers 61st Annual Meeting*, Institute of Transportation Engineers, Washington, DC, 1991, pp. 102-105.

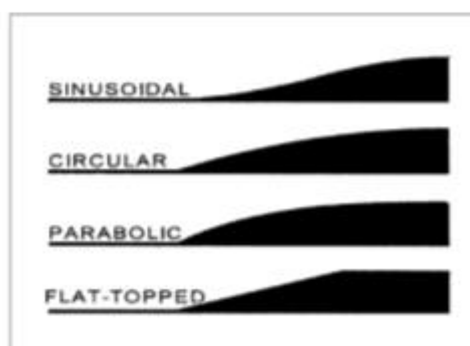


Figure 3.11. Different Hump Profiles.

Source: City of Toronto, "Installation of Speed Humps on City Streets," Toronto, ON, Canada, July 1997.

Speed Hump

Speed Table

Road Diet

Definition: A road diet, also called a lane reduction is a transportation planning technique whereby the number of travel lanes and/or effective width of the road is reduced in order to achieve systematic safety and mobility improvements

Benefits: Low cost; enhanced safety, mobility and access for all road users; ability to accommodate a variety of transportation modes

Chicanes

Definition: A chicane is an artificial feature creating extra turns in a road to slow traffic for safety.

Benefits: Encourage motorists to drive more slowly and carefully; enhance the appearance and function of a street; creates parking options; forces cars to maintain speed around bends

Roundabouts/Traffic Circles

Definition: A traffic circle is a type of intersection that directs both turning and through traffic onto a one-way circular roadway, usually built for the purposes of traffic calming or aesthetics.

Benefits: Slows traffic; reduces number of collisions; less expensive than a signalized intersection; reduces delays; improves traffic flow

Rumble Strips

Definition: Rumble strips are applied along the direction of travel following an edgeline or centerline, to alert drivers when they drift from their lane. Rumble strips may also be installed in a series across the direction of travel, to warn drivers of a stop or slow down ahead, or of an approaching danger spot. Need to extend across full width of the roadway.

Benefits: Increased driver awareness; reduction in collisions

Raised Crosswalks

Definition: Raised crosswalks serve as traffic calming measures by extending the sidewalk across the road and bringing motor vehicles to the pedestrian level.

Benefits: Improve accessibility by allowing a pedestrian to cross at nearly a constant grade; makes pedestrians more visible to approaching motorists; reduces vehicle speeds at pedestrian crossings

Gateways

Definition: A gateway is an indication to motorists that they are entering a populated area.

Benefits: Creates sense of identity/place; indication of the necessity to slow down; higher presence of pedestrians, bicycles, and other slow-moving traffic

Traffic Safety

Intersection Traffic Control

The use of traffic control methods will allow for motorists, pedestrians, bicyclists, and other roadway users to travel through intersections in a safe and organized manner. Some examples include stop signs, traffic signals, roundabouts, and traffic circles.

Geometric Improvements

Horizontal Curves and vertical grade treatments are the two important transition elements in geometric design for highways. A horizontal curve provides a transition between two tangent strips of roadway, allowing a vehicle to negotiate a turn at a gradual rate rather than a sharp cut. A vertical grade treatment provides a transition between two sloped roadways, allowing a vehicle to negotiate the elevation rate change at a gradual rate rather than a sharp cut.

Edge of Pavement Protection

Edge of pavement protections, such as guardrails, are designed to keep people or vehicles from (in most cases unintentionally) straying into dangerous or off-limits areas. Guardrails are very effective in protecting motorists from driving off the road and falling over ditches, bridges, etc.

Roadway Lighting

Roadway lighting increases visibility, which in turn enhances safety for motorists, pedestrians, bicyclists, and other roadway users.

Pavement Markings/Signage

Pavement markings and signage warn motorists of upcoming conflict points or potentially dangerous obstacles in the road. Examples include crosswalks, warning signs, and speed signs.

Shoulders

Shoulder treatments, such as widening and/or paving, provides bicyclists, pedestrians, and other roadway users a separate space for travel, away from motorists.

Education and Enforcement

Speed Enforcement

Enforcing speed limits will create incentive for motorists to travel at the roadway's intended speed, which will make travel conditions safer for themselves and all roadway users, including fellow motorists, pedestrians, and bicyclists.

Vehicle Maintenance Standards

Creating and enforcing vehicle maintenance standards will ensure the vehicles traveling on roadways are safe to do so, which will reduce the number of breakdowns on the roadway.

Vehicle Overloading

Creating and enforcing maximum vehicle load standards will ensure the vehicles traveling on roadways are not overloaded, reducing the risk of vehicle turnover and/or items falling off vehicles and colliding with other vehicles.

Works Cited

Ackaah, Williams, and David O. Adonteng. "Analysis of Fatal Road Traffic Crashes in Ghana." International Journal of Injury Control and Safety Promotion, May 2010. Web. Apr. 2016.

Afukaar, Francis K., Phyllis Antwi, and Samuel Ofosu-Amaah. *Pattern of Road Traffic Injuries in Ghana: Implications for Control*. International Journal of Injury Control and Safety Promotion, 2003. Web. Apr. 2016.

Obeng, Daniel Atuah. "Characteristics of Pedestrian Accidents on Trunk Roads in Ghana." International Referenced Journal of Engineering and Science, May 2013. Web. Apr. 2016.

"Offinso North." *Ministry of Food and Agricultre*. Republic of Ghana, n.d. Web. Apr. 2016.