

MSc Theses Abstract

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Graduation Year 2012

Thesis Title: **STUDY OF MOTORCYCLE TRAFFIC
STREAM CHARACTERISTICS IN
KATHMANDU VALLEY**

Submitted by: **Amit Kumar Shrestha**

Supervisor: **Mr. Anil Marsani, Dr. Thusitha Chandani
Shahi**

ABSTRACT

This paper mainly presents motorcycle traffic stream characteristics of Kathmandu Valley. Traffic problems are common in city areas however the type and extent of problems are diverse in developed countries and developing countries. Most of the developed countries are facing four wheelers problems whereas developing countries are facing two wheelers problems. Though much knowledge about traffic characteristics was acknowledged, very little attention has been paid regarding motorcycle. This study will address a comprehensive analysis of motorcycle behavior and operation through videotaping of some roads that have significant motorcycle proportion.

In this paper, three locations Old buspark to Bhadrakali (1), Shital Niwas to Maharajgunj (2), Kalimati to Tankeshwor (3) in

Kathmandu Valley have been used to meet criteria for data collection mixed traffic, one way roadways and two way roadways. Traffic composition, Vehicle arrival modeling, Speed modeling and time headway modeling were developed. Speed flow relationship, speed density relationship and flow density relationship were developed for all locations, in which the adjustment factor for the present of vehicles other than motorcycle was based on motorcycle equivalent unit. Statistical analyses of the empirical data were utilized to demonstrate the characteristics of motorcycle speed, time headway regarding to traffic flow. The preliminary model was developed to relate the motorcycle lane capacity with lane width.

The finding obtains from this study may be used to develop capacity and level of service model of motorcycle lane, design procedure of motorcycle lane, new procedures for Highway Capacity Manual (HCM), which adapt developing countries as well as provide the data needed to develop a motorcycle simulation model.

Keywords: Motorcycle traffic; Mixed traffic; Vehicle arrival modeling; Speed modeling; Headway modeling; Motorcycle lane; Speed - flow relationship; Traffic characteristics.

Thesis Title: **EFFECT OF FINES CONTENT ON
STRENGTH BEHAVIOR OF
PAVEMENTS BASE MATERIALS**

Submitted by: **Ashis Thapa Magar**

Supervisor: **Prof. Gautam Bir Singh Tamrakar**

ABSTRACT

The quality of a base material can significantly alter the lifespan of the pavement that it supports. Most specifications for base materials require that the plasticity index (P. I.) of the passing No. 40 portion of the mix be no greater than **6%** and that the liquid limit be no greater than 25%.

The quantity and types of fines (materials finer than 75 (μm) have major influence on performance of an unbound aggregate road base. The quality of fines is controlled by plasticity index (PI) and liquid limit LL. This thesis describes an investigation into the influence of fines content and types on the strength behavior of aggregate base. The fines investigated were 0%, 5%, 10%, 15% and 20%, the fines has PI values 0% and 19%.

The results of the investigation indicate that;

A peak value of maximum dry density was increased as the fines content of the mixture increased and maximum dry density has a

peak value at 10% fines content for stone dust and maximum dry density peaks at 5% fines content for clay.

The variation in soaked CBR with increase in fines content follows a pattern similar to that observed for maximum dry density. Mixture containing non-plastic (stone dust) fines and plastic fine (red clay) has a peak CBR value at 8% and 6.5% fines.

For the soil aggregate mix with fines 0% and 5.0%, the fines to sand ratio (i.e. $75\ \mu\text{m}/2.36\ \text{mm}$) is less than 0.20; therefore the mix is unstable and permeable. For remaining soil aggregate as the fines to sand ratio lie between 0.20 and 0.60, the mix is stable and less permeable.

Department of Roads, Nepal permits the fines content to range from 2% - 10%, the minimum soaked CBR 80%. Mixture containing 0% and 20% fines does not meet the specification. Mixture containing 2% - 15% non plastic fines and 2% - 12.5% plastic fines meet the DoR specification.

Key Words: Fines, Road-base, Plasticity, CBR

Thesis Title: **NON-DESTRUCTIVE EVALUATION OF
ASPHALT CONCRETE PAVEMENT IN
AIRFIELDS: A CASE STUDY OF
TRIBHUVAN INTERNATIONAL
AIRPORT**

Submitted by: **Babu Ram Paudel**

Supervisor: **Prof. Gautam Bir Singh Tamrakar, Dr.
Biswa R. S. Shahi**

ABSTRACT

Various types of structural evaluation of the asphalt concrete pavement can be done to find the structural capacity of the pavement. These are broadly divided into two categories. The first is a destructive test (DT) and second a non-destructive test (NDT). The NDTs have become popular as a result of the recent development of sophisticated equipment for these tests. The non-destructive tests are fast, cost-effective and do not hamper the functional requirement of the pavement. On the other hand, the destructive tests are costly, time-consuming and disrupt the operational requirement of the pavement.

The widely used non-destructive test are the Benkelman Beam (BB) Deflection and the Falling Weight Deflectometer. These are used to assess the existing structural capacity and the remaining

structural fatigue life of the asphalt concrete pavement. The most suitable equipment for the asphalt concrete pavement evaluation of airports is the Falling Weight Deflectometer (FWD). The BB deflection data have been analyzed to determine the present performance of the pavement of the runway and taxiway pavements.

In this thesis, the existing condition of the pavement has been evaluated as a design review by using Federal Aviation Administration (FAA) Software FAARFIELD. The computer program KENPAVE has been used to calculate the deflections, stress and strains of the flexible pavements of the runway and taxiways. Further, the remaining structural fatigue life span of the pavement is found to be 4.7 years.

Keywords: Benkelman Beam (BB), Falling Weight Deflectometer (FWD), back calculation, KENPAVE, Pavement Structural Evaluation.

Thesis Title: ESTIMATION OF WORK TRIP MODE
CHOICE MODEL FOR PUBLIC
TRANSIT RIDES IN KATHMANDU
VALLEY

Submitted by: Binaya Rai

Supervisor: Mr. Anil Marsani, Mr, Saroj Pradhan

ABSTRACT

Kathmandu Valley is considered one of the most densely populated areas in the Nepal. The lack of efficient application of transportation planning process leads to deficiency in adopting the suitable transport policies to mitigate the transportation problems resulting from urbanization and rapid increase of population. The mode choice model is probably the most important element in transportation planning and policy making.

The aim of this study is to develop mode choice model for work trips in Kathmandu Valley and therefore investigating the factors that affect the employed people's choice for public transport modes. The revealed preference mode choice models were developed using about 400 questionnaires out of 598 valid questionnaires and rest 1/3rd of questionnaires were used to validate the chosen models.

The results of this research show that the factors that significantly affect the choice of transport modes for the model are: in vehicle travel time, waiting time, ration of total cost by personal income, age and person monthly income. The calibrated model as illustrated in the results are able to predict the choice behaviour for public transit riders who are employed people in Kathmandu valley and found to be valid at 95% confidence level.

This study can be used by transportation planners to predict the employed people's behaviour who are riders of public transit and helpful for planning public transit system of Kathmandu valley.

Keywords : Modal Spilt, Disaggregate Model, Multinomial Logit Model, Maximum Likelihood, Public Transit

**Thesis Title: MODELING PEDESTRIANS' BEHAVIOR
 AT ROAD CROSSINGS: A CASE STUDY
 IN KATHMANDU**

Submitted by: Bishnu Prasad Devkota

Supervisor: Prof. Dr. Padma Bahadur Shahi

ABSTRACT

The various pedestrian facilities provide segregation of the pedestrian traffic from the vehicular flow, thereby increasing the perceived safety. In order to provide such facilities, it is essential to know the behavior of pedestrians. It is, as a study in Kathmandu, the problems regarding behavioral aspects of pedestrians are formulated using a mathematical model.

Data are collected at eight locations in Kathmandu, including am and pm, peak hour and off-hour. These locations are selected based on the frequency of occurring accidents and having similar traffic flow characteristics. Combined survey, including observational and interview method is adopted at mid-block un-controlled crossings. Randomly selected 400 pedestrians were observed for their waiting time and he/she was asked with a set of questions including their age, gender, marital status, have children at home, crossing frequency, in group or individual during cross, access to private vehicle, destination, involve or

witness to pedestrian accidents, education level. The SDI survey was conducted for all eight locations.

In order to study the behavior of pedestrians, 'Cox Proportional Hazards Model' was calibrated. The significance variables have selected based on Likelihood Ratios and theory of Probability. The research was concluded with two set of predictors. One suggests pedestrians are likely to accept higher risk and cease their waiting time (male pedestrians, pedestrians crossing in group, pedestrians going to work and well educated pedestrians) and another suggests lowering the risk and extending their waiting (older pedestrians, past involvement or witness in pedestrian accidents, access to private vehicles) at pedestrian crossings. Pedestrian oriented training classes along with enforcement by traffic law to the drivers on public vehicles and educational programs for pedestrians through mass media are recommended as policy implications.

Keywords: Pedestrians; Road Crossings; Safety; Cox Proportional Hazard Model; Policy Implications

**Thesis Title: ANALYSIS OF MOTORCYCLE
ACCIDENT COST BY WILLINGNESS
TO PAY METHOD - A CASE STUDY
FOR KATHMANDU VALLEY**

Submitted by: Buddha Maharjan

Supervisor: Mr. Anil Marsani, Mr. Saroj Pradhan

ABSTRACT

In fiscal year 2010/11 the 8656 number of vehicles involved in accident with 171 number of fatalities, 553 number of the severe injury and 3632 number of minor injuries in Kathmandu Valley. Out of this 77 fatalities are of the motorcycle users and involvement of motorcycle on crash is about 45% out of total crash. Besides that 75% of Registered vehicle in the Kathmandu valley is Motorcycle which also tends to increase the probability of motorcycle accident. To address the road safety problem, it is essential to understand accident costs which is related to motivation and awareness. If the cost can be visualized in some ways, it would provide motivation to handle the question in an adequate manner that is by the provision of the necessary legislation, organization, funding etc.

In this study Willingness-to-Pay method (WTP) is applied to evaluate the motorcycle accident cost. Willingness-to-Pay

method (WTP) method or the value of risk change is used to estimate the value that individuals would pay for reducing the risk of loss of life. The Contingent Valuation (CV) approach is adopted in this study to determine the WTP. The questionnaire survey was designed to determine the amount of money that each motorcycle user would pay to reduce the risk of loss of life from motorcycle accident. In this study, a total of 400 motorcycle users in Kathmandu valley were interviewed. Besides that the study also evaluates how socio-economic characteristics and Riding behavior affects the willing to pay of motorcyclist to avoid crash involvement and risk of death.

The result shows that the gender, occupation, household income, household number, Riding Frequency, Riding against traffic, accident experience and the behavior of alcohol-impaired riding are the significant factors affecting the willingness to pay of motorcycle riders to reduce the fatality risk. The gender, Education, occupation, income, household number, accident experience and the behavior of alcohol-impaired riding are the significant factors affecting the willingness to pay of motorcycle users to reduce the severe injury risk.

Thesis Title: MINIMUM TRAFFIC THRESHOLD FOR
RURAL ROAD UPGRADATION: A CASE
STUDY OF TERAJ ROAD

Submitted by: Sagar Ram Nepal

Supervisor: Prof. Dr. Rabindra Nath Shrestha, Mr.
Kamal Raj Shrestha

ABSTRACT

Road infrastructure is an important sector of economic activity for the development of a country. The road infrastructure is required to be maintained in proper condition to ensure its continuous utilization in proper manner. By proper maintenance of roads continuous acceptability is achieved but also at the same time a higher economy, safety and serviceability is gained. The decision-making process for the development and maintenance of low-volume rural roads suffers from the lack of an economic evaluation tool customized for this type of roads. For the optimum resource allocation in rural road by local government agency, traffic threshold is very important indicator for decision maker in policy level. The main objective of this study is to ascertain the traffic threshold for rural road upgradation. By using Road Economic Design (RED) model the traffic threshold is ascertained for upgrading rural road in Teria region. Study has shown that traffic threshold for rural road upgradation in Nepal

from earthen to bituminous premix carpet is 369 AADT with traffic composition of Motorcycle (59%), Car (5%), Utility Vehicle (14%), Bus Medium (7%), Truck Light (5%) and Truck Medium (10%).

**Thesis Title: AIR TRAVEL DEMAND MODELING
FOR NEPAL**

Submitted by: Satya Ram Duwal

**Supervisor: Dr. Purushotam Dangol, Prof. Padma
Bahadur Khadka**

ABSTRACT

Air transport in Nepal remains the most reliable means for domestic and international linkage given the geographical location and topography of the country. This requires large infrastructural facilities like airports. Modeling air travel demand has rapidly emerged as a major issue in view of the mammoth growth in air travel in Nepal. The importance of air travel demand and its variation with time, together with the emergence of new policies, emphasize the need to develop accurate air travel demand models. This present study is undertaken to develop an air travel demand model for Nepal. Different Modeling techniques like Econometric modeling, Time series modeling and a combination of both have been used to forecast the air travel demand. In view of the large demand of air transport in Nepal and the congestion at existing Kathmandu TIA airport, there has been a proposal for second international airport in Pokhara, Kaski district. At this juncture the traveler would have an option to choose between two airports, assuming that

similar airlines fly from both the airports. An airport choice model has been developed to study the behaviour of international air travelers, with regard to different attributes like access time to the airport, announced delay at the airport and new airport charges. The data required for the airport choice model has been obtained by conducting a Stated Preference (SP) survey at the existing international airport. The SP experiment will be a choice experiment and Regression technique will be used to evaluate the parameters of the model. It was observed that Double Exponential Smoothing model was the best in terms of forecasting air travel demand. The Airport choice model indicated that the access time to airport and delay at airport play a significant role in airport choice and the travelers are willing to pay more money in the form of new airport charges if these two parameters are improved.

Keywords: Air Travel Demand Model, Airport choice model, Stated Preference (SP), Multinomial Logit, Exploded Logit.

Thesis Title: **SIGNAL OPTIMIZATION AT ISOLATED
INTERSECTION BY USING PRE-
SIGNAL: A CASE STUDY ON KESHAR
MAHAL INTERSECTION**

Submitted by: **Sunil Khyaju**

Supervisor: **Mr. Anil Marsani**

ABSTRACT

This paper proposes a new signal operation strategy aimed at efficient utilization of green time by cutting down on the start up and response time. The idea is to have a "pre-signal" on main approach a few meters upstream of the intersection in addition to the main intersection signal, which is coordinated with pre-signal. The offset between the main and pre-signal ensures that the majority of startup losses does not occur at the main signal. The benefit of the system under various traffic compositions were evaluated based on the control delay and VIS SIM simulation Study.

Keshar Mahal Intersection, the central heart core of the Kathmandu City is selected as the study area of my thesis. The detail directional traffic flow was counted with the help of Video Footage provided by Prahari Aayukta Kaaryalaya, Ranipokhari and Aviyaan Consulting Pvt. Ltd, Mid-Banesor. The detail study

is based on the same video footage recorded on 6th and 29th July 2012 for the traffic count as well as evaluating the present condition. The vehicle count has clarified that the peak flow time of 17 PM to 18 PM with the peak flow of first 15 min flow of 1677 vehicles through Jamal Leg, first 15 min flow of 165 vehicles through Thamel Leg, first 15 min flow of 997 vehicles through Lainchaur Leg and second 15 min flow of 808 vehicles through Royal Palace Leg. The level of service is found to be F. The saturated headway for all vehicles is measured to 1 sec and saturated flow speed with maximum 65 kmph for motorbike and minimum 40 kmph for three wheel vehicles.

The classified vehicles as car, light vehicle, heavy vehicle, motorbike and cycle, signal timing, speed proportion of vehicle share and driving behavior are the most parameter for the VISSIM. VISSIM 5.40 is calibrated used as the base model for the application of pre-signal.

By eliminating only start up loss time i.e. increasing the green time by corresponding eliminated start up time the control delay has reduced from total 204 sec to 87 sec.

Keywords: VISSIM, HCM, pre-signal, control delay, peak flow.

Thesis Title: ESTIMATION OF PAVEMENT LAYER
MODULI AND DISPLACEMENTS
BASED ON OPTIMIZATION
TECHNIQUES USING NON-
DESTRUCTIVE TEST DATA

Submitted by: Sushil Babu Dhakal

Supervisor: Prof. Gautam Bir Singh Tamrakar, Dr.
Rajat Raj Bhandari

ABSTRACT

Good estimation of layer Moduli from nondestructive methods is an important tool for scheduling and designing rehabilitation projects in pavement engineering. The Benkelman beam for deflection test is the most commonly used nondestructive method for the evaluation of the structural performance of pavement systems. Thickness of pavement layers obtained from dynamic cone penetration (DCP) test and surface deflection obtained from Benkelman beam were used for the study. The back calculation approach recommended by the American Association of State Highway and Transportation Officials (AASHTO) guidelines for design of Pavement Structures 1993 was also adopted.

A model based on optimization has been developed to find different pavement layer modulus of elasticity. Pavement layer

characteristics were then expressed in form of regression equations, which were used to estimate the modulus of elasticity of pavement layers. These regression equations showed statistically significant relationship between Benkelman beam rebound deflection and pavement layer characteristics.

Moduli of pavement layers so obtained from the optimization model was used to calculate the surface deflection as well as deflection at the top of each pavement layers using KENPAVE software. The obtained surface deflections were compared with field-measured deflections. The error associated with calculated and measured deflection was found to be statistically insignificant.

Keywords: Flexible pavements, Benkelman beam, Layer moduli, Optimization, Rebound deflection, Non destructive test.

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**Thesis Title: COBBLE PAVEMENT AN
 ALTERNATIVE PAVEMENT OPTION
 FOR RURAL ROAD IN NEPAL**

Submitted by: Bikash Maharjan

Supervisor: Prof. Gautam Bir Singh Tamrakar

ABSTRACT

This thesis report reviews basic concepts and parameters involved in the design of cobble pavements. The basic requirements for the pavement are evaluated with study of existing pavement conducting different tests. Cobble pavement is appropriate pavement option for rural road in comparisons of other pavement. Cobble pavements designed with conventional flexible pavement concepts. This requires use of an equivalent thickness or equivalent modulus for the block surfacing, and current recommendations for both are examined. Special cobble characteristics such as effect of laying pattern on performance must be considered, but two widely debated aspects (cobble shape and lock up) probably have relatively minor effects on thickness design. The design of cobble pavement is based on flexible pavement design concept. This thesis report focus on

technical requirement for cobble pavement however, it is one of sustainable pavement for rural road in Nepal.

Keywords: Cobblestones, block pavement, CBR, Modulus of Elasticity, LCC, Pavement Thickness

**Thesis Title: DEVELOPMENT OF TRIP
GENERATION MODEL: A CASE STUDY
OF ZONES INSIDE THE RING ROAD**

Submitted by: Laxmi Dhakal

Supervisor: Er. Anil Marsani

ABSTRACT

Trip generation model is the fundamental tool for traffic How analysis and management in transportation system. The purpose of this study is to develop a trip generation model for zone inside the ring roads of Kathmandu valley.

A trip generation model was developed by using multiple linear regression analysis with the help of statistical package of social science and Micro soft Excel, which established the relationship between trip number and characteristics of household of different zone. These regression equations showed statistically significant relationship between trip and independent variables of corresponding zone.

The data consist of secondary data, collected by conducting household survey by JICA survey team (2011/2012), through household interview survey and traffic flow survey and national population census (2012).

This study gives following information of our study area:

Trip generation model used in this research is found to be appropriate for urban area like Kathmandu

Mobility of medium class family is high as compared with low class and high class family.

Mobility of family with vehicle ownership is higher than family having no vehicle.

Average household trip rate of Ring Road area is 5.72 and average person trip rate is 2.10

Keywords: Multiple linear regressions, socioeconomic characteristics, Trip generation.

**Thesis Title: PREDICTION OF PERIODIC
 MAINTENANCE OF BITUMINOUS
 ROADS**

Submitted by: Mahesh Maharjan

Supervisor: Prof. Gautam Bir Singh Tamrakar

ABSTRACT

For the effective road maintenance management the performance of the existing pavement conditions and predictions of their future conditions are the most essential. To determine the resealing, rehabilitation or/reconstruction needs, the distress survey need to be done every year in all the road sections, which is very time consuming and costly. Department of Roads (DoR), Nepal conducts the Surface Distress Index (SDI) survey of the Strategic Road Network (SRN) each year. Therefore, this study's objective is to formulate the pavement prediction models from the available SDI and other information at the DoR. Model formulation is limited only to the pavements prior to the resealing.

Since the rate of pavement deterioration is affected by many factors, the pavement sections are grouped into six pavement families depending on the topography, pavement types, and the traffic levels. This grouping is essential for generating effective

model. For each pavement family, regression with four forms of the deterioration functions is performed. The model selection is based on the coefficient of determination (R^2), and the significance of the parameter estimates are ascertained through the t- statistic and the associated p-values. SDI as the function of the previous year's SDI yields the best model for the pavement families. The result also shows that the periodic maintenance of Bituminous Roads is affected by terrain and environment rather than by the traffic.

The currently developed models seem to be fairly accurate and therefore, could be very useful in the management of the pavements.

**Thesis Title: SUITABLE TEST OF COARSE
 AGGREGATES FOR PAVEMENT
 CONSTRUCTION FROM TWENTY-FIVE
 QUARRIES OF CENTRAL REGION OF
 NEPAL**

Submitted by: Rishab Khanal

Supervisor: Prof. Padma Khadka

ABSTRACT

Aggregates are important constituents of the pavement structures. Performance of aggregate layers depends on particle shape, grading, composition, and their physical, mechanical and chemical properties. Careful study of these properties allows evaluation of aggregates according to the international norms. There are huge rock outcrops surrounding the Kathmandu Valley. With growing construction in and around the Kathmandu Valley, demand of the aggregates has become so high that limited quarry site within the valley are not sufficient to meet the requirements. Therefore, the search of the outcrops from which aggregates may be quarried is sought to meet the current and future demands of aggregates suitable for the roads or for the transport network in the country. This study aims in exploring and evaluating suitability of natural crushed rock aggregates in the Central Development Region of Nepal.

Data are collected at Twenty-five locations in Central Development Region of Nepal. The investigation and study of quarry materials required for major activities in road construction such as for Earth works, Pavement works and the Structural works were focused on the sources from the Dolkha-Ramechhap, Narayanghat-Kathmandu, Rasuwa-Nuwakot, Kamala-Narayani Basin and Tikabhairab.

In order to determine the suitability of the rocks obtained from these quarries, different laboratory tests i.e. Flakiness Index Test, Los Angeles Abrasion Value Test, Aggregate Crushing Value Test, Aggregate Impact Value Tests and Water Absorption tests on the bulk samples taken from the different quarries are carried out according to the relevant AASHTO/ASTM/IS Code standards and are compared with the Standard Specifications for Road and Bridge Works for the construction of Asphalt Concrete, Penetration Macadam, Surface Dressing, Graded Crushed Stone Base and Sub-base and Concrete for structures. According to the tests performed the construction materials from the different sources are decided whether they can be used or not for the construction of the different pavement layer of the roads.

Keywords: Quarry; Pavement Works; Structural Works; Laboratory Tests

Thesis Title: **ECONOMIC ANALYSIS OF LOW
VOLUME ROAD: A CASE STUDY OF
KALANKI GHYAMPEDOL
BADVANGYANG ROAD**

Submitted by: **Shaligram Devkota**

Supervisor: **Prof. Dr. Rabindra Nath Shrestha**

ABSTRACT

Road infrastructure is an important sector of economic activity for the development of a country. The road infrastructure is required to be maintained in proper condition to ensure its continuous utilization in proper manner. By proper maintenance of roads, continuous acceptability, a higher economy, safety and serviceability is gained. The decision-making process for the development and maintenance of low-volume rural roads suffers from the lack of an economic evaluation tool customized for this type of roads. For the optimum resource allocation in rural road by local government agency, traffic threshold is very important indicator for decision maker in policy level. The main objective of this study is to analyze the road for economic feasibility by using 'Road Economic Decision (RED)' model. If the road is economically feasible and then finds out the minimum traffic threshold for that rural road to be economically available NPV value is almost zero and IRR value is 12%. By using 'Road

Economic Decision (RED)' model, the rural road 'Kalanki-Ghyampedol-Badhbhanjang' is feasible because of its NPV 0.016 million US dollar and IRR 13% with traffic composition of Motorcycle (54%), Car (27%), Utility Vehicle (8%), Mini Bus (4%), and Micro Bus (8%), total existing AADT 223. The minimum Traffic threshold for rural road up gradation from earthen to bituminous premix carpet is 133 AADT with traffic composition of Car (68%), Utility Vehicle (13%), Mini Bus (7%), and Micro Bus (13%) where motorcycle is not considered. The increased cost of up gradation also increased the AADT.