STUDY ON THE EFFECT OF OVERLOADING ON SRI LANKAN ROADS

Liyana Arachchige Thilina Udara Liyanaarachchi

138315 L

M. Eng. in Highway and Traffic Engineering

Department of Civil Engineering

University of Moratuwa

Sri Lanka

May 2018

DECLARATION OF THE CANDIDATE AND SUPERVISOR

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any University or other institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant the University of Moratuwa the non-exclusive right to reproduce and distribute my thesis, in whole or in part in print, electronic or other medium. I also retain the right to use this content in whole or part in future works (such as articles or books).

Signature: Date:

The above candidate has carried out research for the Master thesis under my supervision.

Signature of the supervisor: Date:

ACKNOWLADGEMENT

I wish to express my sincere gratitude to University of Moratuwa, Sri Lanka, for giving me the opportunity to follow my Post Graduate program at department of civil engineering, University of Moratuwa. I would also wish to express my sincere gratitude to Prof. W.K. Mampearachchi for giving me a valuable guidance, supervision and encouragement to complete my research study. It is highly appreciated your dedication and cooperation given me to make this thesis to a success.

My sincere thanks shall go to all staff of the Department of Highway and Traffic Engineering, University of Moratuwa including Prof. J.M.S.J. Bandara, Dr. H.R Pasindu, Dr. Dimantha de Silva and Mr. Loshaka Perera for giving me a fullest corporation during the academic session and in successful completion of the Master's Degree Course during past four years period. Also thanks to all academic and nonacademic staff in Department of Civil Engineering.

My sincere gratitude should go to Project Director (NRCP Project) of RDA – Mr. A.H.M Nizar for guiding me on this research area and throughout the study. Specially thanks to the Deputy Director (Planning) of RDA - Mrs. D.A P. Padmini and staff of Planning Division for the assistance given me in collecting necessary data for the study. Also, Cooperation given by Road Development Authority staff for carrying out the studies while working on several projects is emphasized with great appreciation.

The encouragement and great support received from my friends, Mr. Asela Bambarendage, Mr. Sumedha Senarathna & Ruksala Jayarathna is appreciated and reminded.

Last but not least I extend my gratitude and appreciation to my wife and family for their support and motivation. My thanks and blessings go to everyone who supported me to complete this study, successfully.

ABSTRACT

With the increasing demand for transport means, new technological vehicles and heavy loads carrying vehicles are used by people, in order to take the financial advantage. Consequently most of the commercial vehicles plying on Sri Lankan National Highways are overloaded. Previous studies show that overloaded vehicles are carrying as much as double weights than its maximum permissible load. Limits for standard legal axel loads and gross vehicle weight have been already imposed by Minister of transport as a part of Motor Traffic Act. But, they are violated oppressively by the transporters but not enforced stringently by road agencies or Motor Traffic Department.

Designing of flexible road pavements is mostly based on the cumulative number of equivalent standard axles(CNESA) which is significantly subscribed by the heavy vehicular traffic including overloaded vehicles. Construction cost of road pavement is hence directly incurred by CNESA and it results in extensive, costly pavement designs. Furthermore the damage by overloaded vehicles to the pavement is exponential. Continuous overloading of vehicles reduces the design life of pavement resulting premature failures and induces additional cost to road agencies for maintaining them. On the other hand, limiting the carrying loads may result in multiplied number of trips and thereby cost for the user is increased.

In this study, actual axle load survey data at selected locations to cover the national road network were analyzed and assayed in different aspects. Case study was done for the axle load data in 22^{nd} km of A004 road & 196^{th} km of A006 road in such a way that transport cost for user & pavement construction cost could be evaluated at different loading scenarios, such as, at legal limit, 10%, 20%, 30% & 40% than legal limit.

Results of preliminary assessment include percentage of overloading vehicles, extent of overloading, overloading growth trend over a decade, often overloaded commodity types & significant vehicle types. Results of case study include, transport cost for the user & pavement construction cost in each loading scenario, optimum level of overloading that result in minimum pavement construction cost while user cost shall be satisfied. Further it has been evaluated simple alterations that can be practice to reduce CNESA extensively.

It was concluded that, 1.2 axle type has a significant contribution to ESA due to overloading. Further, sand, fertilizer, cement, rice & paddy are identified as often overloaded commodity types. From the case study, it was concluded that, transport cost for the user is getting reduced when more overloading occurred. But, the increased user cost lie in a large range than decreased pavement cost.

It can be recommended that, overloading up to 20% from GVW shall be an optimum level where the both parties will be satisfied. Further it could be controlled overloading extensively & reduce pavement cost by rules against 1.2 & 1.22 type vehicles which are overloaded more than 30% from GVW. Simple methods to enforce the rules are also discussed in recommendations.

Keywords: Vehicle overloading, standard legal axel loads limits, effective enforcement

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
AASHTO	American Association of State Highways and Transportation Officials
ADT	Average Daily Traffic
BBD	Benkelman Beam Deflection Test
BC	Bituminous Surfacing
BOT	Build Operate and Transfer
CBR	California Bearing Ratio
CNSA	Cumulative Number of Standard Axles
DCP	Dynamic Cone Penetration
DF	Damage Factor
DFC	Damage Factor Cost
DLL	Deficit Design Life
ESA	Equivalent Standard Axel Load
FWD	Falling Weight Deflectometer Test
GVW	Gross Vehicle Weights
LL	Liquid Limit
MAL	Maximal Axle Load
MCC	Manual Classified Count
MDD	Maximum Density
M-E	Mechanistic –Empirical
PI	Plasticity Index
RDA	Road Development Authority
SAR	Standard Axle Repetitions
TRL	Transport research Laboratory
VDF	Vehicle Damage Factor

LIST OF APPENDICES

1 INTRODUCTION

The current inland transport system in Sri Lanka is dominated by the road network. Therefore, the Government spends a substantial amount of its capital for construction & Rehabilitation of National highways network and to maintain it fulfilling the demands of increasing population and development activities. In the same manner, with the increasing demand for the transportation means, new technological vehicles and heavy loads carrying vehicles are used by people. Consequently, significant growing trend of vehicle axel loads is observed during the past few years in Sri Lankan roads. However, effective management of vehicle axel loads is important for the balance of country's economy.

1.1 Background of the Study

An overload can be defined as a load that exceeds the legal truck load limit. There are standard legal axel loads and gross vehicle weight limits imposed by Minister of transport as a part of Motor Traffic Act. It has been amended lastly by regulations published in Gazette Extraordinary No. 1847/32 of 29 January 2014 (**Appendix A**). Though there are limits for vehicles ply on roads, they are violated oppressively by the transporters but not enforced stringently by road agencies or Motor Traffic Department.

The damage by over-loaded vehicles to pavements is exponential. According to Bagui, Das and Bapanapalli (2013, 962-971), it is believed that the damage caused to a pavement by an axel load twice the standard axel is 16 times the damage incurred by the latter. Lianyu et al. (1997) revealed that the damage ratio is 384,442 to 1 when comparing a 36,288 kg heavily loaded truck on five axels with a 908 kg compact size passenger car. If the roads are designed as suit to the actual axel loads survey data including overloaded vehicles, it results in extensive, costly pavement designs. Further overloading of vehicles reduce the pavement life and induce additional cost to road agencies for maintaining them. However, now overloading has become a challenge to Road Development Authority (RDA) and other road agencies in Sri Lanka.

On the other hand, because transporters seek for their own economic profit, it is rather general that the vehicles are overloaded on roads. Limiting the carrying load per a trip results in multiplied number of trips and thereby cost for the user is increased.

Consequently, it could be directly influenced to increase the prices of commodities and other commercial products.

Currently, user charges are applied only in Expressways (E Class Roads) in Sri Lanka. All other roads including national highways (A & B class roads) are free for users. Since, road agencies are worried about overloading & road users shall be restrained by regulations against overloading, it is needed to find hoe the both parties will be consoled. For that, it is required to assess the axel load limits which optimize transportation cost for the users & pavement construction cost for road agencies. By formulating methodical values for maximum permissible axel loads or penalty limits for overloading which complied with above requirement, it could be enforced the rules against overloading in Sri Lankan roads.

1.2 Objective

The objectives of this study are;

- To estimate the effect of axle overloading on Pavement Design
- To identify the practical measures and procedures to control & manage excessive overloading
- To determine the maximum permissible legal weight limit on vehicles which optimize both Transport cost & Pavement construction cost

Identified tasks to achieve objectives are as mentioned below.

- To determine the axle loads growth trend
- To identify zones, areas that frequent overloading occur
- To identify the vehicle types and commodities which contribute more for overloading
- To assess transport cost for users at different extent of overloading
- To assess the increased pavement construction cost due to overloading at different extents
- To identify the requirements of imposing charges for overloading vehicles

2 LITERATURE SURVEY

2.1 Introduction

2.1.1 Overloading & Prevailing Regulations in Sri Lanka

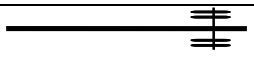
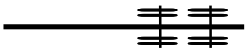
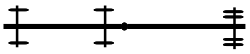
Motor Traffic Department of Sri Lanka, has stipulated maximum gross vehicle weight limits by their act published in 2004. Later it has been amended by regulations published in Gazette Extraordinary No. 1847/32 of 29 January 2014 introducing axel load limits for each type of axels whereas the Gross Vehicle Weights (GVW) are also been considered accordingly.

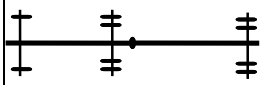
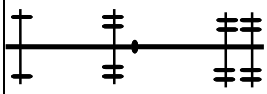
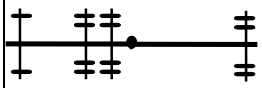
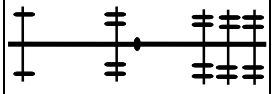
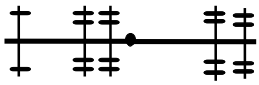
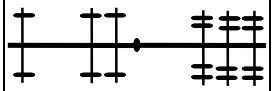
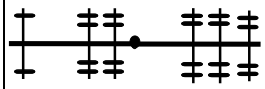
Limits for Axel Loads and Gross vehicle Weights as per the regulations in 2014 Gazette are stipulated in below table 2-1 & 2-2.

Table 2-1: Axle load of a vehicle as per 2014 Gazette

	Class or description of motor vehicles	**Kilograms**
i	Two wheeled single axle	6,000
ii	Four wheeled single axle	10,000
iii	Four wheeled dual axle	10,000
iv	Eight wheeled dual axle or any two consecutive axles with 8 wheels where the axle centers are not more than 2.45 meters apart	16,500
v	Twelve wheeled triple axel or any three consecutive axles with 12 wheels where the centers of the extreme axles are not more than 3.66 meters apart.	22,000

Table 2-2; Gross Vehicle Weight as per 2014 Gazette

	Description of motor vehicles	**Diagram**	**Kilograms**
i	Moto vehicle with a four wheeled rear axle		15,275
ii	Motor vehicles with an eight wheeled dual rear axle		21,300
iii	Articulated or combination vehicle with two wheeled front axle and two wheeled rear axle for driving unit and four wheeled axle for trailer		19,900

iv	Articulated or combination vehicle with two wheeled front axle and four- wheeled rear axle for driving unit and a four wheeled axle for trailer		23,500
V	Articulated or combination vehicle with two wheeled front axle and four- wheeled rear axle for driving unit and a eight wheeled dual axle for trailer		29,800
vi	Articulated or combination vehicle with two wheeled front axle and eight wheeled dual rear axle for driving unit and a four wheeled axle for trailer		30,400
vii	Articulated or combination vehicle with two wheeled front axle and four wheeled rear axle for driving unit and twelve wheeled triple axle for trailer		33,900
viii	Articulated or combination vehicle with two wheeled front axle and eight wheeled dual rear axle for driving unit and eight wheeled dual axle for trailer		36,700
ix	Articulated or combination vehicle with two wheeled front axle and four wheeled dual rear axle for driving unit and twelve wheeled triple axle for trailer		31,200
x	Articulated or combination vehicle with two wheeled front axle and eight wheeled dual rear axle for driving unit and twelve wheeled triple axle for trailer		42,500

Overloaded vehicles in Sri Lankan roads could be considered as the vehicles which are carrying loads violating the above mentioned Limits. As in current practice in Sri Lanka, for carrying out vehicle weighing is done by only RDA for axle load testing on National Highways. Apart from that, Department of Motor Traffic is carrying out

vehicle weighing at time of registration of vehicles, where tare of the vehicle (un laden weight) needed to be recorded.

RDA has installed weigh bridges in certain locations, and identified few other locations where stationary vehicle weighing to be done. However, still no enforcement come in to practice. Identified locations by RDA for install weigh bridges are tabulate below in Table 2-3.

Table 2-3; Identified locations by RDA for weigh bridge installation

Route No	**Road Name**	**Location**	**km**
A001	Colombo – Kandy	Warakapola	59
A002	Colombo – Galle – Hambanthota – Wellawaya	Galle	108
A003	Peliyagoda – Puttalam	Seeduwa	18
A004	Colombo – Rathnapura – Wellawaya – Batticaloa	Galagedara	33
A005	Peradeniya – Badulla – Chankaladi	Gampola	15
A006	Ambepussa – Kurunegala – Trincomalee	Gokarella	57
A009	Kandy - Jaffna	Dambulla	65
A012	Puttalam – Trincomalee	Kaluwaragaswe	20
A026	Kandy – Mahiyanganaya – Padiyathalawa	Mahiyanganaya	72
B492	Kandehandiya – Adikarigama – Randenigala - Loogaloya	Keerthi Bandarapura	26

2.1.2 Overview of Flexible Pavement Design

There are two types of highway pavements called flexible & rigid. A flexible pavement consists of a thin surfacing layer built over a base course and a subbase course resting upon a compacted subgrade. Earth and gravel roads are the preliminary forms of flexible pavements. In contrast, the rigid pavement is made of Portland cement concrete and may or may not have a subbase course underneath. However, almost all major trunk roads in Sri Lanka are of flexible type, whereas small sections are done with concrete in locations such as inundating and marshy areas.

Flexible pavements distribute loads applied on them progressively over a large areas as they transmitted through each course. The concept of the design is to adopt a

sufficient thickness of construction so that the load intensity at the subgrade level is less than its bearing capacity.

There are many factors affecting pavement design which can be recognized as traffic and loading, material characterization & environment. Amongst them traffic and loading is the important factor which includes contact pressure, wheel load, axel configuration and load repetitions as its key components. Loading and repetitions are defined in terms of standard axel loads. Total loading repetitions carried during the design life of road taken in standard axels are considered as the governing factor for the pavement design. To tolerate the load intensity, bearing capacity of subgrade soil will be the next governing factor for pavement designs which is indicated in California Bearing Ratio (CBR).

2.1.3 Equivalent Standard Axel Load (ESA)

In order to express various traffic loads and axel configurations (Single, Tandem, Tridem) in terms of a single design parameter, Equivalent Single Axle Load (ESAL) is used. Standard Axel Weight is 80KN (18,000lb) load on single axel with two wheels. Damaging effect of the passage of an axle of any mass can be represented by a number of 18-Kip equivalent single axle loads (ESALs). For example, one application of a 12-Kip single axle was found to cause damage equal to approximately 0.23 applications of an 18-Kip single axle load, and four applications of a 12-Kip single axle were required to cause the same damage (or reduction in serviceability) as one application of 18-Kip single axle. (AASHTO, 1993).

Equivalent effect of any type of axel can be evaluated as in following equation.

$$ESAL = \left(\frac{Axel\ Weight}{Standard\ Axel\ Weight}\right) \text{^} 4.5$$

Standard Axel Weight = 8.16 Ton (80 KN)

Effect of overloading can be described by use of ESA as in below figure.

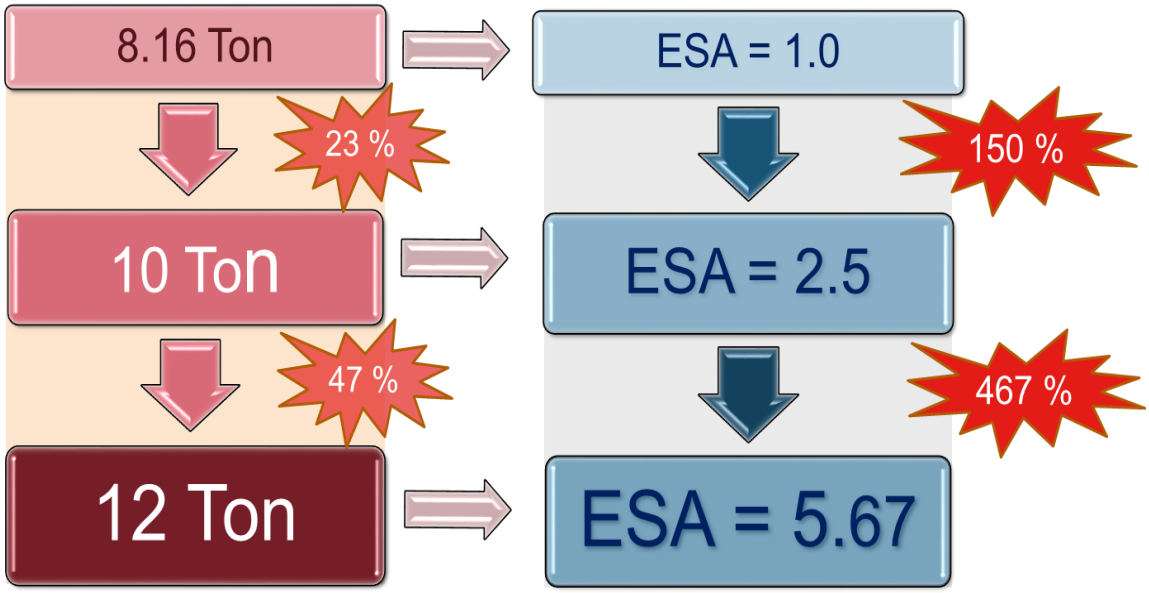


Figure 2-1; Effect of overloading in ESA values

2.1.4 Flexible Pavement Design Methods used in Sri Lanka

Design approaches of flexible pavements are come through empirical pavement design methods and later developed mechanistic –empirical (M-E) design methods. Empirical pavement design methods are based on empirical formulas or experimental studies conducted in extreme weather conditions. Due to limitations in empirical methods, mechanistic-empirical (M-E) methods were developed enabling evaluation of real time performance and calculation of pavement responses (stresses, strains and deformations) with traffic loading, material properties and environment conditions.

Till recently, almost all flexible pavement designs in Sri Lanka were carried out by using empirical methods. Those pavement designs for widening, reconstruction and overlay have been carried out from, "A Guide to the Structural Design of Roads under Sri Lankan Conditions" published by Road Development Authority (RDA) based upon the Transport research Laboratory (TRL) publication "Overseas Road Note 31 – A Guide to the Structural Design of Bituminous-surfaced Roads in Tropical and Sub-tropical Countries (1993)" and American Association of State Highways and Transportation Officials (AASHTO) 1993.

2.1.5 Estimation of Volume of Traffic & Cumulative ESA during Design Life

For estimation of design traffic, existing traffic to be taken into account by considering the anticipated new traffic, possible changes in road network and land use of the area, probable growth rates and design life of pavement.

Existing traffic is generally evaluated through field survey data carried out for 12 hours or 24 hours period. Survey is carried out for measuring the Gross Vehicle Weights (GVW), axel loads of each axel of the vehicle. All vehicles are classified in to standard classes and Manual Classified Count (MCC) data is collected along with the Average Daily Traffic (ADT) data. In addition, a set of several data is collected during the survey in both directions in order to determine average ESA through a comprehensive analysis. Axel configuration of each vehicle, Origin-Destination (O-D) data and carrying commodity type are such data collected in parallel to the axel load survey.

Collected axel loads are then converted to ESAL by using the equation mentioned in above para 2.1.3. Load on each axel is converted to ESAL and summation of ESALs of all axels of vehicle shall be considered. Total ESAL for particular type of vehicles then be divided by number of vehicles to determine the average ESAL for given type of vehicle. Sample Calculation is depicted in below Table 2-4.

Table 2-4; Sample Calculation of ESA for a vehicle

Sr NO	VEH TYPE	AXLE CONFIG	Load		Total load	ESAL		SUM ESA
			AXLE1	AXLE 2		AXLE 1	AXLE 2	
1	Large Bus	1.2	4.36	6.69	11.05	0.060	0.409	0.469
2	Large Bus	1.2	2.99	3.63	6.62	0.011	0.026	0.037
3	Large Bus	1.2	3.27	4.17	7.44	0.016	0.049	0.065
Total ESAL for 3 vehicles of Type “Large Bus”								0.571
Average ESAL for “Large Bus”								0.190

Anticipated new traffic, possible changes in road network, land use of the area and probable growth rates are some factors to be determined for realistic forecasting of traffic volumes. Nowadays, Computer models are used for traffic forecasting and determining growth rates. Generally design life of about 10-20 years is considered in

countries like Sri Lanka as the growth rates are normally high and it is rarely economical to build a road strong enough to carry traffic that will be using it for a period of more than 20 years. Cumulative ESAL for a period of the design life could be calculated with consideration of new traffic and probable growth rates by following equation.

$$CNSA = 365 \sum_{i=1}^{m} Pi\,[(1 + ri)n - 1]/ri$$

A = Cumulative number of standard axles for design life

Pi = number of standard axles per day as an average for the 1st year after construction for vehicle type i

ri = rate of growth of traffic for vehicle type i

m = number of types of vehicles

n = design life in years

2.1.6 Assessing the strength of the existing layers and sub-grade soil

Sub grade soil strength and residual strength of existing road surface including underneath soil layer are needed to be assessed for the design of new pavement structure. Test pit investigations are done for carrying out field density tests, Dynamic Cone Penetration (DCP) tests and collecting soil samples for further laboratory testing such as California Bearing Ratio (CBR), Maximum Density (MDD), Sieve Analysis Liquid Limit (LL) & Plasticity Index (PI). For the purpose of overlaying, Pavement surface deflection measurement are needed to be collected though Benkelman Beam Deflection Test (BBD) or Falling Weight Deflectometer Test (FWD) tests. Those data will be next governing factors for the design of pavement.

2.2 Literatures on Case Studies & Analysis on Overloading

Several case studies and analysis have been conducted on overloading in various dimensions. Analysis of benefits in revenue by controlling overloading in Build Operate and Transfer (BOT) projects, analysis of total loss cost of pavements due to overloading, effect on road construction & maintenance cost in Sri Lanka due to overloading and how pavement performance changes by effects of axel loads are some researches reviewed as literatures.

2.2.1 Controlling Vehicle Overloading in BOT Projects

Bagui, Das & Bapanapalli, 2013 have conducted a case study in India in order to evaluate the increase of revenue achieved by controlling overloading in a BOT project. In the case study, it has been evaluated the possible enforcement methods such as installation weigh bridges and functional viability of that.

In this study, it has been conducted an axle load survey for a real project, analyzed the axle survey data and identified overloading occurrences. Vehicle Damage Factor (VDF) and surveyed Annual Average Daily Traffic (AADT) has been adjusted considering the concept of controlling overloading. According to that concept, The Concessionaire of BOT project may control overloaded vehicle by measuring provision of weight of vehicle at roadside weigh bridge station. If overloading is controlled, number of vehicles shall be increased assuming that same weight for different goods will be transported from one place to another place to fulfil the demand and supply of these particular goods. If loading is controlled, the VDF value of each vehicle is revised or reduced. For the purpose of adjustment, a total of five scenarios have been considered. The five scenarios are (1) actual case, (2) at legal load, (3) more than 10 % legal load, (4) more than 20 % legal load (5) more than 30 % legal load.

Number of actual vehicles weighed during axle load survey and revised number considering different axle load controls have been evaluated. Then revised VDF values have been obtained. Redistribution of load is considered for vehicles carrying more than legal load. The Annual Average Daily Traffic data (AADT) surveyed on the project has been revised considering controlling overloading concept.

Pavement design has been carried out considering 20 years of design traffic for construction of 4 lanes divided new road. California Bearing Ratio (CBR) of subgrade is adopted 10 %. Initial construction cost has been calculated for different overloading scenario. As per the design guidelines of IRC: 37-2012, the thickness of WMM and GSB are constant for all cases for a given design CBR. And, for design traffic at and greater than 100 MSA, the only variant for the various traffic scenarios is the thickness of the bituminous surfacing (BC+DBM). Both BC and DBM exhibit the same elastic modulus in terms of material strength. However, keeping the economics in view, the recommended thickness of BC is 50 mm, thus keeping DBM as the only variable. In

this study, it is noticed that initial investment cost of the Concessionaire is least when commercial vehicle is allowed to carry maximum legal permitted load.

Revenue statement has been determined based on controlling overloading on vehicle with different scenarios of overloading control. It is assumed that the concession period of the project is 28 year (3 years construction period + 25 years operation period). Toll rate (vehicle mode wise) and traffic growth rate are the two important factors for toll revenue generation besides number of traffic. Toll rate per kilometer as per the regulatory authority of India has been considered. Traffic growth factor is considered as 5 % uniformly throughout for all class of vehicles. Total revenue for various cases of overloading control is evaluated. Maximum revenue has been generated when the project road is allowed to carry maximum legal load.

Further, economic viability of installing a weigh bridge is assessed in the study and proven that it is viable.

2.2.2 Effect on Cost of Road Construction & Maintenance Due to Overloading

This study has been carried out by Professor Amal S. Kumarage & Professor Saman Bandara of University of Moratuwa, Sri Lanka with Mr Gunathilake Bandara, former Deputy Director, Planning Division of Road Development Authority (RDA), Sri Lanka in order to determine the effect of overloading on construction and maintenance cost in Sri Lankan roads. By the time of study, the vehicle weights in Sri Lanka were ruled by gazette no 1270/33 dated 10.01.2003 published by Motor Traffic Department stating the allowable GVW for each type of vehicles. Authors show that, current practice in Sri Lanka for carrying out vehicle weighing is done by only RDA for axle load testing on National Highways. Apart from that, Department of Motor Traffic is carrying out vehicle weighing at time of registration of vehicles, where Tare of the vehicle (un laden weight) needed to be recorded.

This study is based on axle load data collected through a 48 hour controlled survey done on 58^{th} km (Melsiripura) of A6- Ambepussa – Kurunegala – Trincomalee Road.

Selection of Vehicles for Weighing has been carried out using sampling rates for the target vehicle categories. Midi buses and Light Lorries with 2 axle & 4 wheels have

not been weighted as their capacity is considered to be less than the allowable GVW according to the axle configuration.

Survey data has been analyzed in a way of interpreting the extent of overloading occurred, overloaded percentage from the total vehicle fleet and effect of overloading on average ESAL. Analysis has been tabulated as follows.

Table 2-5; Sample Table Format used for analysis

Description		Long Bus	Light lorry 2A/4W	3 Axle Commercial	etc
Allowable GVW in Tons					
Vehicles Overloaded less than 25% of GVW	Nos				
	Total ESA				
	Avg ESA				
	% from total				
Vehicles Overloaded 25% - 50% of GVW	Nos				
	Total ESA				
	Avg ESA				
	% from total				
Vehicles Overloaded 50% - 75% of GVW	Nos				
	Total ESA				
	Avg ESA				
	% from total				
Vehicles Overloaded 75% - 100% of GVW	Nos				
	Total ESA				
	Avg ESA				
	% from total				
Vehicles Overloaded more than 100% of GVW	Nos				
	Total ESA				
	Avg ESA				
	% from total				

Following observations made from results have been pointed out by authors.

- All loaded 6 axle commercial trucks that were weighed, were overloaded and 40 % of them were overloaded by more than 50% of the allowable GVW (i.e. a load of 150% of GVW). The average ESA value for these 6 axle loaded vehicles is around 49.4 ESAs
- Nearly 10 % of the 5 axle commercial trucks are overloaded by more than 75% of the allowable GVW and their ESA value is around 51 ESAs. Nearly 33% of these 5 axle trucks are overloaded by more than 50% of their allowable GVW. Average ESA for these vehicles are around 31 ESAs
- Around 2% of 3 axle and 4 axle trucks are overloaded more than 100 % of their allowable GVW. ESA value for these vehicles are 58.3 ESA and 66.4 ESA for 3 axle trucks and 4 axle trucks respectively.
- Considerable percentage of 3 axle and 4 axle trucks are overloaded more than 75 % of their allowable GVW

In order to estimate the cost of overloading, the reduction in life cycle cost when an overloaded vehicle travels a road section of 1 km has been calculated. This has been done for the Ambepussa- Kurunegala – Trincomalee road (A6) where the control survey was carried out. In order to estimate costs, the following different overloading scenarios have been taken in to consideration.

Scenario 1: Vehicles will carry only the allowable GVW and there will be no overloading.

Scenario 2: All Loaded vehicles will carry loads that are 25 % in excess of the GVW

Scenario 3: All Loaded vehicles will carry loads that are 50% in excess of the GVW

Scenario 4: The vehicles will carry the present observed levels of overloading

Usually the Cumulative ESAs are calculated as the estimated ESAs for a design period such as 15 years. It is necessary that on completion of the 15 years or more exactly the cumulative passes of ESA, the pavement road has to be overlaid or reconstructed depending of the residual strength of the pavement.

Here in this study, two design options have been considered for Scenario 1 and Scenario 4 assuming that the present road pavement has strength to give Benkelman Beam deflection of less than 0.77mm for overlay design as used by Road Development Authority. Accordingly overlay thicknesses for each scenario and related cost have

been calculated. Life cycle cost for difference overloading scenarios are calculated and compared. Following conclusions were extracted from the study.

I. The present legislation pertaining to vehicle weights and dimensions in Sri Lanka is from 1983. The amendment in 2003 appears to incorporate some steps in the correct direction. However, the load levels that have been specified have not been computed after research or study.

II. The legislation on vehicle weights has not been based on an acceptable study, comparison of limits in other countries or the extent of road damage and costs of provision of roads.

III. The present cost recovery from road haulage vehicles also seems inconsistent and does not appear to recover the true cost. Neither does it recover in the same proportion between different vehicle types. The diesel subsidy appears to be a net subsidy for all types of road haulage.

IV. The surveys show that overloading is significant and frequent. This occurs in all road haulage vehicles. The survey conducted for the study shows that:

    a. All loaded 6 axle commercial trucks that were weighed, were overloaded and 40 % of them were overloaded by more than 50% of the allowable GVW (i.e. a load of 150% of GVW).
    b. Nearly 33% of these 5 axle trucks were overloaded by more than 50% of their allowable GVW.
    c. Around 2% of 3 axle and 4 axle trucks were overloaded more than 100 % of their allowable GVW.
    d. Considerable percentage of 3 axle and 4 axle trucks were overloaded more than 75 % of their allowable GVW.

V. The general attitude of State Agencies on recovery of actual road user costs and the desire to enforce limitation on vehicle weights has been very poor. To begin with there has been very little discussion or public debate on the need to enforce vehicle weights. Secondly, there has been no awareness of the need to price use of road space. The traditional approach that the government has to finance all road provision and the maintenance of them continues to prevail. Furthermore the attitude that anything and anyone should be allowed to use the roads with as few fetters as possible is also a general public attitude.

VI. The life cycle cost for an ESA km ranges between Rs 0.45 to Rs 1.01 depending on the loading levels adopted at time of design. At current design standards, the 4 axle commercial vehicle is the most suitable vehicle for the transportation of loads up to 25% overloading level. However, beyond that the 5-axle vehicle is has the lowest life cycle cost per ESA km.

VII. It has also been shown that the optimum life cycle cost for the road design will be realized if it is assumed that in general there would be 50% overloading. Thus if indeed the roads are designed for higher loads in the future, then there would be a net reduction in life cycle cost per ESA km.

VIII. However, even if new or rehabilitated roads are thus designed the fact that the other sections of the road network which is badly deteriorated cannot take up overloading without causing severe failure is a limiting factor. The exact calculation of this scenario has not been carried out to date. Since this is beyond the scope of this study it may be recommended as a future activity.

IX. The road provision cost recovered from goods vehicles through taxes ranges between 28 cts and 43 cts per km. of this the highest collection is from the 2 axle trucks, while the larger trucks pay about 30% less.. This is below the average costs of between 45 cts and Rs 1.01 stated earlier. In addition, the diesel fuel subsidy also contributes a further Rs 1 per ESA km (approximately). Thus all forms of road freight haulage vehicles are presently receiving a net subsidy.

X. Buses on the other hand have a cost recovery of Rs 1.91 per km, via taxes and fees. In this case there is a revenue surplus with respect to road user charges. However, with the diesel subsidy buses receive a net subsidy.

2.2.3 Analysis of Loss Cost of Road Pavement Distress due to Overloading Freight Transportation

Mulyono, Parikesit, Antemeng & Rahim, 2010 has written a paper on above to Journal of the Eastern Asia Society for Transportation Studies, Volume 8, 24 December 2010, Pages 706-721

This paper explains the analysis to calculate road pavement distress loss cost resulted from overloading and therefore the amount of loss cost the overload car users shall bear can be determined. The loss cost of road pavement distress due to overloading is

calculated based on damage factor (DF) and deficit design life (DDL). Study has been conducted on following steps.

I. Compilation of field and institutional data
II. Analysis of loss cost of road pavement distress
III. Analysis of road distress betterment cost charged to overload car user

The compilation of field and institutional data has been started by classifying the road distress along with the causing factor in order to determine the type of dominant distress. In this study, if the width area of rutting is more than sixty percent of total road pavement distress per km, it has been concluded that the main reason is overloading. Additionally the percentage of operating heavy vehicle by type and by freight is calculated. If the MAL (maximal axle load) of the operating heavy vehicle is more than the standard MAL, it indicates that overloading happens in the surveyed road section.

Analysis of loss cost starts by investigating the damage factor (DF) of overloading vehicle and the deficit design life (DLL) of pavement performance of the existing road. If DF of overload vehicle is larger than DF of normal vehicle, there is pavement loss so that the analysis of damage factor cost (DFC) shall be conducted. The data of road maintenance program on normal vehicle traffic (no overloading) is investigated and therefore routing maintenance can be performed every year, periodic maintenance every 3-5 years and betterment at the end of the design life time. If overloaded vehicle traffic exist, the normal scenario will be changed as the periodic maintenance every 3-5 years, and betterment every 4years so that loss cost due to service lifetime decrease during design life time emerges.

In the conclusion followings have been presented. The presence of overloading on the surveyed road is indicated by the width area of rutting which is more than 60% of total road structural distress per km and by real maximum axle load (MAL) of the heavy vehicle which is larger than its standard MAL. The loss cost the overload car user shall bear is 60% of total DFC (Damage Factor Cost) and DDC (Deficit Design Life Cost), considering that not all pavement structural distresses are absolutely caused by overloading freight transport.

2.3 Austroads Pavement Design Guide and Design Traffic Calculation according to Ausrtroads

Austroads, A Guide to the Structural Design of Road Pavement, 1992 is widely used in Australia and New Zealand incorporating mechanistic pavement design methods. In the purpose of evaluating axle loads and total repetitions of loads in a different method, this design guide was referred in this study. It was evaluated the overload scenario for collected data sample in terms of Standard Axle Loads used in Austroads.

In Austroads, it is used, layered elastic analysis to calculate traffic-induced elastic strains in pavements. Then those critical strains are empirically related to the deterioration rate of the pavement which is calibrated against performance observed from the test pavement or in service pavement. The vertical compressive strain at the top of the subgrade level is related to the repetitions to cause surface rutting and the horizontal tensile strain at the underside of the asphalt and stabilized layers is related to the repetitions to cause cracking of those layers. These critical strains are referred to as 'pavement performance indicators' and the empirical performance relationships are called as 'failure criteria'. In Austroad guild they introduced two types of failure criteria, rutting and cracking. (Austroads, Guide to the Structural Design of Road Pavement, 2008)

CIRCLY is an integral component of Austroad Pavement Design Guide which is used as a mechanistic computer program in flexible pavement designing. It enables to use any combination of vehicle types and load configurations, use of any wheel layout, braking or vertical loads, use any damage model, any combination of layer thicknesses and elastic modulus etc.

2.3.1 Design Traffic Calculation according to Ausrtroads

The design traffic for flexible pavement design is stated in Austroad pavement design method as; the total number of Standard Axle Repetitions (SAR) during the design period which causes the same damage as the cumulative traffic. As mentioned in Austroad guide, light vehicles contribute very little to the pavement deterioration. Therefore, only heavy vehicles account for design traffic. A damage caused to a pavement by the passage of a heavy vehicle depends not only on its gross weight but also on how this weight is distributed to the pavement. Such as the number of axles on the vehicle, the manner in which these axles are grouped together – into axle groups

and the loading applied to the pavement through each of these axle groups – the axle group load. Axle group is considered where the adjacent axles are less than 2.1 m apart. By considering this scenario, all possible axle configurations are divided into six categories as follows and corresponding standard axle loads are mentioned in below Table; 2-6.

Table 2-6; Axle Group Types and Standard Axle Loads According to AUSTROADS

Axle group type	Standard axle load (kN)
Single Axle with Single Tires (SAST)	53
Single Axle with Dual tires (SADT)	80
Tandem Axle with Single Tires (TAST)	90
Tandem Axle with Dual Tires (TADT)	135
Triaxle with Dual Tires (TRDT)	181
Quad Axle with Dual Tyres (QADT)	221

The design tyre pavement contact stress for pavement analysis is taken as 750 kPa. However, the tyre inflation pressures vary widely from 500 to 1200 kPa.

Procedure of determining the design traffic in Austroad is sequenced as follows;

1. Select a design period
2. Identified the most heavily trafficked lane in the carriageway
3. Estimate the average daily number of heavy vehicles in the design lane during the first year of the project's life (Annual Average Daily Traffic - AADT)
4. Calculate the percentage of heavy vehicles (%HV) in traffic stream
5. Determine the Lane Distribution Factor (LDF)
6. Estimate heavy traffic growth throughout the design period (Cumulative Growth Factor - CGF)
7. Estimate the average number of axle groups per heavy vehicle (NHVAGs)
8. Calculate the cumulative heavy vehicle axle groups over the design period
9. Estimate the proportion of axle group types and the distribution of axle group loads
10. Calculate ESA per axle group and SAR per ESA
11. Calculate design ESA and design SARs for each distress type

The design traffic (NDT) can be calculated by Equation.

$$NDT = 365 \times AADT \times DF \times \%HV 100 \times NHVAG \times LDF \times CGF$$

Where,

NDT = cumulative number of heavy vehicle axle groups (When axles are less than 2.1 m apart they are considered as axle group)

AADT = annual average daily traffic

DF = direction factor

%HV = percentage of traffic that are heavy vehicles

NHVAG = average number of axle groups per heavy vehicle

LDF = lane distribution factor

CGF = cumulative growth factor

Cumulative Growth Factor (CGF) over the design period is calculated by using Equation;

$CGF = (1+0.01R)-10.01R \ , for \ R>0$

Where;

- R = Annual growth rate (%)
- P = Design period (years)

2.3.2 Traffic Load Distribution (TLD)

The traffic load distribution is required to calculate the design traffic loading. It provides information necessary to evaluate the pavement damage caused by the HVAG, as

- The proportions of all axle groups that are a particular axle group type
- For each axle group type, the proportion of axles applied at each load magnitude

2.3.3 Pavement Damage in Terms of Standard Axle Repetitions (SAR)

The ability of a pavement configuration to withstand the design traffic is to determine the extent of damage caused to the pavement in terms of a reference axle group called

the Standard Axle. The standard axle is a single axle dual tires (SADT) applying an axle load of 80 kN to the pavement. The allowable number of Standard Axle Repetitions (SAR) for each damage type should be determined. Then these allowable SAR need to equal or exceed the number of SAR that caused by the same damage as the design traffic. The SAR is evaluated by Equation;

$$SARij\ m=(LijSLi)m$$

Where,

- SARijm = number of standard axle repetitions which causes the same amount of type m damage as a single passage of axle group type I with load Lij
- SLi = standard load for axle group type I
- Lij = load on the axle group
- m = damage exponential which is specific to the mechanism of failure

3 METHODOLOGY

3.1 Introduction

Study is carried out based on all the available axle load survey data collected from Road Development Authority (RDA), Sri Lanka. Preparation of an Axle Load Database was done using history data and recent data collected from year 2001 to 2015. Locations for the surveys have been selected by RDA considering the different zones, geographical factors, economic activities and so on. Frequency of surveys shall be decided by RDA based on requirements of rehabilitation, maintenance or upgrading the highway network. Permeant locations are used for surveys in order to maintain the reliable database throughout.

Special apparatus is available with RDA for measuring axle loads (shown in figure 3-1). Separate team has been appointed for axle load surveys. They are involved in field surveys when data needed for new projects. Also trailer manufactures are hiring this apparatus for measuring of axle loads in special vehicles invented by them. Specially, some logistic companies are manufacturing trailers with trial axle configurations, in order to transport a maximum load while complying with regulations.

Figure 3-1; Measuring of axle weight of a vehicle

3.2 Preparation of Axle Load Survey Database

Generally, axle loads surveys are carried out as 12- hours /24 – hours surveys. Along with the axel loads, following data also shall be collected in parallel to that.

- Axel configuration of each vehicle,
- Origin-Destination (O-D) data
- Carrying commodity type
- Manual Classified Count (MCC) of vehicles

Sample Data sheet used in the survey is attached in **Appendix B.**

Proper survey records were found for few major trunk roads fallen under National Highways maintain by RDA as A & B class roads. History data from year 2001 were found for few roads. Detailed survey records with row data were available only for the surveys carried out after year 2005. For history data, average ESAL values for each vehicle types could be found.

In this study, a Database is prepared including all available survey results. A comprehensive analysis was done in various dimensions in such a way to illustrate current trends and deviations from the regulations imposed on overloading.

3.3 Road list & Location Map of Axle Load data collected

Detailed survey records were found for roads and locations mentioned in the below table 3-1. Locations are mapped so as to identify the zones where the axle loads are measured and map is shown in figure 3-2.

Table 3-1; Roads and locations where axle load surveys done

Road	Location	
A001	59km, 107km	Ambepussa, Pilimathalawe
A002	130km	Koggala
A003	36km	Negombo
A004	22km,	Homagama,
A006	57m, 193km	Malsiripura, Trinco
A009	106km, 269km	Thonigala, Kilinochchi

A026	73km	Hasalaka
Data for many other roads were available for analysis		

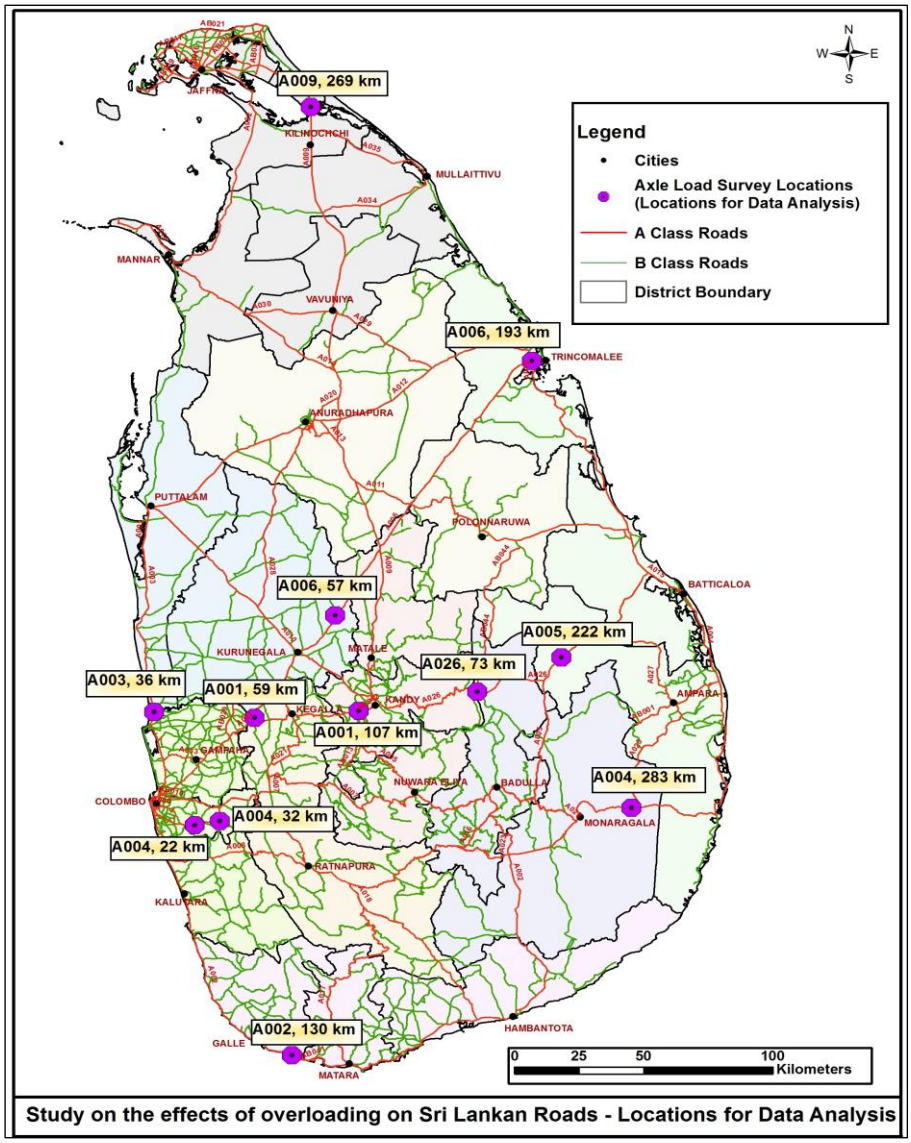


Figure 3-2; Map of few survey locations

3.4 Processing and Analyzing of data in various aspects

Row data received from Planning Division of RDA, were compiled in to a database. Processing and analyzing was done by using MS Office Excel. Data sets for more than 35 locations in A & B class National Highways were compiled. Axle load data in each location were analyzed separately in different aspects such that it will give important indicators and facts in determining the effects of overloading. Following areas were evaluated from the survey data.

1. Axle load growth trend over a period of decade using history data & recent data
2. Composition of vehicles ply on roads (Based on axle type)
3. Contribution to total ESA by each type of axle
4. Percentages of overloaded vehicles in each road
5. Often overloaded vehicle type (in terms of axle type)
6. Extent of overloaded occurred for each type of vehicle
7. Overloading was evaluated according to carrying commodity type
8. Average ESA values for overloaded vehicles, non-overloaded vehicles & vehicle mix at legal limit (LL), 10%, 20%, 30% & 40% of LL. (Case study described below in paragraph 3.5)
9. Transport cost by using commodity type & origin-destination data for different loading extents mentioned in above. (Case study described below in paragraph 3.5)
10. Effect on average ESA by replacing overloaded vehicles by vehicles with an added rear axle. (Case study described below in paragraph 3.5)

All the analyzed data in excel sheets are attached in **Appendix C.**

3.5 Case study for different overloading scenarios

A case study was done to analyze the effect of overloading on pavement construction cost & transport cost for road users. Study was carried out for the survey data collected in 193th km in A006 road (at Trinco). In this case study, different overloading scenarios were considered as below mentioned.

It was considered that transporting commodity tonnage through survey location under "actual condition" is a fixed amount and that amount shall be transported to relevant destinations in each scenarios described from 2 to 6 below. At each load case, it was considered the excess amount of commodity shall be transported to the destinations in similar type of vehicles loaded up to relevant loading limit.

1. "*Actual Condition"*- Loading is considered as represented in axle load survey data.
2. "*Legal Limit"* - All vehicles are limited to its Legal Limit for GVW and commodity tonnage calculated in actual scenario shall be transported to relevant destinations by similar type of vehicles which are also loaded up to legal limit. –

3. "*10% than LL*"- All vehicles are limited to 10% than its Legal Limit for GVW and commodity tonnage calculated in actual scenario shall be transported to relevant destinations by similar type of vehicles which are also loaded up to 10% than legal limit.
4. "*20% than LL"* - All vehicles are limited to 20% than its Legal Limit for GVW and commodity tonnage calculated in actual scenario shall be transported to relevant destinations by similar type of vehicles which are also loaded up to 20% than legal limit.
5. "*30% than LL"* - All vehicles are limited to 30% than its Legal Limit for GVW and commodity tonnage calculated in actual scenario shall be transported to relevant destinations by similar type of vehicles which are also loaded up to 30% than legal limit.
6. "4*0% than LL"* - All vehicles are limited to 40% than its Legal Limit for GVW and commodity tonnage calculated in actual scenario shall be transported to relevant destinations by similar type of vehicles which are also loaded up to 40% than legal limit.

From the case study, data sheets were analyzed and developed to derive following facts.

- Weight of load only (without tare weight) at different loading scenario stated above.
- Distance that each vehicle travelled during the trip to one direction.
- Transport cost incurred per each vehicle for the trip.
- Total Excess load and added number of trips for each vehicle type when loaded at different scenarios.
- Revised MCC and ADT data according to added number of vehicles.
- Average ESA value for a vehicle in each type at different loading scenarios.
- Average cost incurred per a vehicle in each type to travel one kilometer length.

3.5.1 Determination of transport cost for the user.

To determine transport cost for the user, it was evaluated average cost incurred per an each type of vehicle to travel one kilometer length. Assumption made here is, trip

patterns recorded during the axel load survey is similar throughout the period considered for design. Hire charges have been collected during the year of 2017. Hence average cost values were adjusted to year 2013 & 2022 with a discounting factor. Vehicle growth rates are similar to which considered in calculating CNESA.

Steps to evaluate average cost are depicted in below flow chart and described in following sub sections.

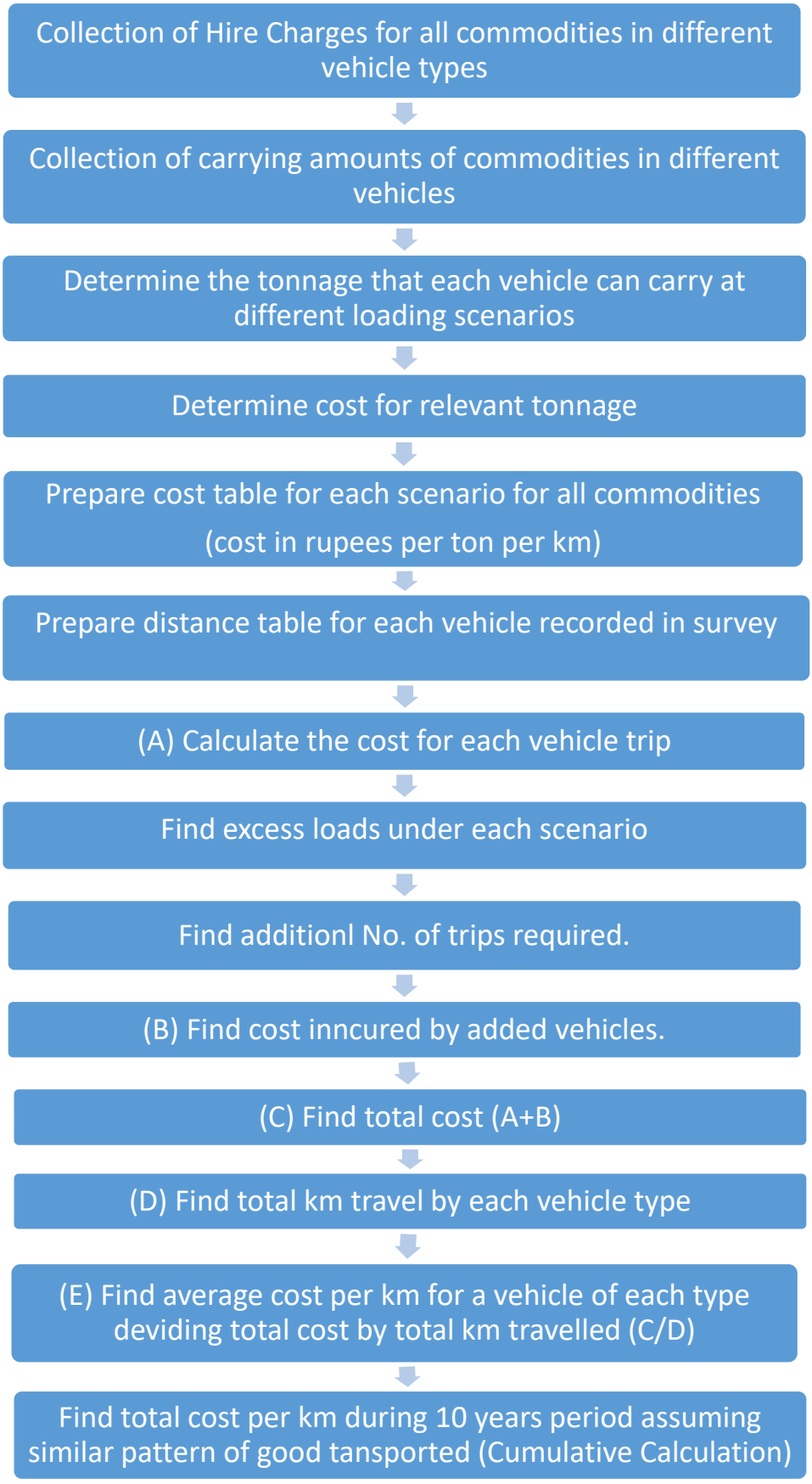


Figure 3-3; Flow chart to describe user transport cost calculation

3.5.1.1 Questionnaire Survey for collecting user cost

Questionnaire survey was carried out to collect hire charges of vehicles carrying different commodities. Following Information is gathered from the survey in order to determine cost for transporting each commodity as a rate per ton per kilometer transported by each vehicle type.

1. What is the carrying commodity in vehicle?
2. What is the vehicle type & axle type?
   (Ex: 6 Wheeled large lorry, 1.2 axle type)
3. What is the dimension of the container or body?
4. What is the maximum load it can carry & normally loaded amount in ton?
   (Ex: in 40' length container, it can carry only 15.84 Ton of Arrack bottles which is nearly 20% overloaded than legal limit)
5. What is the origin & destination?
6. What is the hire charge for normal condition & hire for lower loads?

Sample Data collection sheet used in questionnaire survey is attached as **Appendix D.** From the questionnaire survey it was determined the hire rates in rupees per ton per km at different loading scenarios mentioned in section 3.5.

Following facts were considered in order to develop more accurate cost values at each loading scenario.

- Some of the commodities could be loaded up to 40% than GVW. But some bulk commodities cannot be loaded up to some limits considered in loading scenarios. In such case, hire charge shall not be changed for total load, but cost values considered here in this study represent the correct cost relevant to its load. For an example, cement, flour, fertilizer products could be loaded upto 40% from GVW in 1.2, 1.22 & 1.2-2.2 type vehicles. But when consider arrack bottles, it could be loaded only up to 20% than GVW in 1.2 axle type vehicles, since its volume fill up the maximum container capacity.
- From questionnaire survey it was identified that hire charge of some vehicles could be reduced when it transport lower loads. However some vehicle charges remains same regardless the weight of load transported. Such differenced also were considered in deriving the cost values. For an example, arrack bottles are transported at a rate per kilometer regardless it's load.

- For the vehicles with passengers, it has been considered only a cost value per km travelled.

3.5.1.2 Calculation of hire rates for each vehicle and commodity type

Cost tables were prepared for each loading scenario including determined cost values in an array as shown in below table.

Table 3-2; Sample Cost Table for different commodities in each scenario

Commodity	**Axle type**	**Normal Condition**	**At Legal Limit (LL)**	**At 10% than LL**	**At 20% than LL**	**At 30% than LL**	**At 40% than LL**
Unit		**Rs. per ton per km**					
Arrack	1.2	17.48	17.48	17.48	17.48	N/A	N/A
	1.22	11.36	11.36	11.36	11.36	N/A	N/A
Cement	1.2	6.25	13.60	11.48	11.03	9.72	8.70
	1-22	5.00	12.18	10.32	10.12	8.93	8.00
	1.2-2.2	6.25	16.45	13.44	12.98	11.16	9.91
	1.2.2-2.2	9.74	18.94	15.90	15.41	13.54	12.07
	1.2.2-2.2.2	9.09	17.05	14.48	13.99	12.37	11.09

Prepared cost tables for different loading scenarios of A004 (22km) & A006 (196km) are attached as **Appendix E.**

3.5.1.3 Calculation of average transport cost for vehicle of each type

From the origin-destination data available in the axle load data sheet, it has been prepared the distance table including the distances for each trip. Then it was calculated the cost incurred per each trip as follows.

Cost for a Trip = *Weight of Load only* * *Travel Distance* * *Cost value for relevant commodity type in each vehicle*

Such that cost for all trips shall be calculated and travel distance of all vehicles shall be summed. In case of each loading scenario, excess weight of each trip was found. That weight shall be transported by added number of trips. Then cost incurred by added vehicles shall be calculated as follows.

Cost for added vehicles = *Excess Load* * *Travel Distance* * *Cost/ton/km*

K[illegible]relled by added vehicles shall be calculat

$$Travlled\ distance\ (km) = \int_{i=0}^{i=n} Number\ of\ trips\ required\ * Distance\ for\ each\ trip$$

i = each trip having excess weight

Then the total transport cost for all trips and total travel distance shall be calculated by adding as follow.

$$Total\ Cost\ for\ each\ vehicle\ type\ in\ data\ sheet = Cost\ for\ all\ trips + Cost\ for\ added\ number\ of\ trips \rightarrow \mathbf{A}$$

$$Total\ travel\ length(km) = km\ travelled\ by\ all\ trips + km\ travelled\ by\ added\ vehicles \rightarrow \mathbf{B}$$

Then the average cost incurred per a vehicle could be derived as follow.

$$Average\ Cost\ per\ vehicle = \frac{A}{B}$$

This average cost represent the average value of total cost encountered by each type of vehicles by transporting commodities as recorded in survey data. Here it has been assumed that the pattern of transporting goods recorded during the survey shall be repeated every day throughout the considered design life span.

3.5.1.4 Determination of user transport cost during entire design life

Average cost values were determined from the data collected from questionnaire survey carried out in year 2017. According to the pavement design, life span has been considered from year 2013 to 2022. Therefore cost values were de-escalated up to 2013 and escalated up to 2022 at an interest rate of 5% per year. (Sri Lanka Consumer Price Index Transportation 2008-2018)

In calculation of cumulative cost for entire design life, following data is required,

- Vehicle proportions from MCC data
- ADT value
- Vehicle Growth Rates

As such, in the evaluation under deferent loading cases. It is generated new trips to transport excess commodity amount to relevant destinations. Therefore MCC, ADT shall be adjusted accordingly, considering the number of trips generated for each vehicle type. Assumption made that percentage of weighted vehicles from MCC will be remain same.

Ex:

- MCC of A004 road for vehicle type 9(Large Lorries) = 434
- Number of weighted vehicles = 202 (46.54% of MCC)
- Number of added vehicles (at 10% than LL) = 29
- Total weighted vehicles = 231
- Revised MCC value = 231/46.54% = 497

Accordingly ADT data also shall be revised for each scenario.

Then cost for all type of vehicles encountered during each year was calculated & Net Present Value were obtained to base year 2013. Total of NPV shall be the Transport cost per kilometer length encountered for all users during the design life span. NPV was evaluated using a discounting rate of -2.27% which is calculated as follows. (Mampearachchi W.K., et al., 2011)

$$Discounting\ Factor\ (i) = \frac{(1+e)}{1+d} - 1$$

Where, e – interest rate

d - inflation rate

Interest rate – 7.5% (Central Bank, Sri Lanka, 2013)

Inflation (CCIP) – 10% (Central Bank, Sri Lanka, 2013)

$$\text{Discounting Factor} = i = (1+0.075)/(1+0.1)\ -1 = -2.27\%$$

Spreadsheets for calculation of average cost values, adjustment of MCC & ADT data, calculation of cumulative transport user cost for A004 road & A006 road are attached in **Appendix F.**

3.5.2 Review of Pavement Design Reports and evaluation of pavement construction cost

In the review process, it was observed that pavement designs have been done disregarding the excessive overloading. But average ESA values are considered allowing vehicles to be overloaded up to some extent. In the design reports, average ESA values obtained from axle load survey are further compared with previous design reports and common ESA values used in RDA designs. Hence, it is determined that most of the existing pavements are designed to cater prevailing traffic volumes disregarding the GVW limits imposed by Motor Traffic Department, but not allowing excessive overloading.

Review was done for the loading scenarios as mentioned under section 3.5.1.

Further, in calculations of CNSA, it was considered the traffic growth factors as same as in the relevant design reports. The design life was considered as 10 years. To obtain the design layer thicknesses in reconstruction and widening sections, same method adopted in the design report were used in this study also by changing only the factor of CNSA. In the same manner, design approaches adopted for overlay sections were concerned. Design subgrade CBR values and strength of existing pavements are extracted from relevant design reports.

Pavement design reports for 22nd km of A004 and 196th km of A006 road were collected from the Research and Development Division of RDA and Detailed Designed Reports from relevant project unit. Those pavement designs were redone according to actual traffic condition, and traffic at several scenarios described under 3.5.

3.5.2.1 Calculation of Average ESA values

At each loading scenario, all the data separated as non-overloaded & overloaded vehicles. For ESA calculation of non-overloaded vehicles, it was considered the same axle load values recorded during the survey. Sample calculation is as follows.

$$ESAL = \left(\frac{Axel\ Weight}{Standard\ Axel\ Weight}\right) \text{^} 4.5$$

Standard Axel Weight = 8.16 Ton (80 KN

Table 3-3; Sample Calculation of Average ESA value

Sr NO	VEH TYPE	AXLE CONFIG	Load		Total load	ESAL		SUM ESA
			AXLE 1	AXLE 2		AXLE 1	AXLE 2	
1	Large Bus	1.2	4.36	6.69	11.05	0.060	0.409	0.469
2	Large Bus	1.2	2.99	3.63	6.62	0.011	0.026	0.037
3	Large Bus	1.2	3.27	4.17	7.44	0.016	0.049	0.065
Total ESAL for 3 vehicles of Type "Large Bus" [A]								0.571
Average ESAL for "Large Bus" [B= A/3]								0.190

But for overloaded vehicles calculation of ESA values was done as below mentioned.

ESA values were found for each vehicle type at each loading scenario. ESA values for Legal Limit Scenario is illustrated in below table.

Table 3-4; ESA for each vehicle type when they are loaded at legal limit

Loading Scenario – "*Legal Limit*"									
Axle Type	**Loading Limit (GVW)**		**Axle-1**	**Axle-2**	**Axle-3**	**Axle-4**	**Axle-5**	**Axle-6**	**Sum**
1.2	15.275	Weight	6	9.275					
		ESA	0.251	1.780					2.031
1.22	21.3	Weight	6	7.65	7.65				
		ESA	0.251	0.750	0.750				1.751

1.2-2.2	29.8	Weight	6	7.9	7.9	8			
		ESA	0.251	0.864	0.864	0.915			2.887
1.2.2-2.2	36.7	Weight	5.7	7.5	7.5	8	8		
		ESA	0.199	0.684	0.684	0.915	0.915		3.386
1.2.2-2.2.2	42.5	Weight	5.5	7	7.5	7.5	7.5	7.5	
		ESA	0.169	0.502	0.684	0.684	0.684	0.684	3.389

It was considered that overloaded vehicles will carry loads only up to loading limit in relevant scenario. Hence number of overloaded vehicles is counted. (n_{over}). Then total ESA for vehicles loaded up to limit of loading scenario is expressed by

$$ESA = n_{\text{over}} * Relevant\ ESA\ values$$

Then, it shall be taken summation of excess loads in each vehicle type. It has been found the maximum commodity load that can be carried in the container of each vehicle type at each loading scenario.

For an example, commodity weights carried by 1.2 axle type at each loading case is illustrated in below table.

Table 3-5; Commodity Weight that 1.2 axle vehicles can carry at each loading scenario

Loading Scenario	1.2 axle type		
	Total Weight (Ton)	Tare Weight	Commodity Weight
Legal Limit (LL)	15.275		8.525

10% from LL	16.8	6.75	10.05
20% from LL	18.33		11.58
30% from LL	19.86		13.11
40% from LL	21.36		14.61

Then the number of added trips shall be calculated as follows,

$$Number\ of\ added\ trips,$$
$$= \frac{Summation\ of\ Excess\ Loads}{Commodity\ Weight\ vehicle\ can\ carry\ at\ relevant\ loading\ scenario}$$

Then the ESA for added vehicles shall be calculated,

$$ESA\ for\ added\ vehicles = Relevant\ ESA\ value * number\ of\ added\ trips$$

Total ESA then shall be calculated as below,

$$Total\ ESA = \ ESA\ of\ non\ overloaded + ESA\ for\ vehicles\ loaded\ upto\ relevant\ limit + ESA\ for\ added\ vehicles$$

Average ESA is obtained by dividing total number of vehicles with added vehicles.

$$Average\ ESA = \frac{Total\ ESA}{Number\ of\ vehicles}$$

3.5.2.2 Calculation of CNESA & pavement designing

ADT and MCC data shall be altered accordingly as described under section 3.5.1.4, for each scenario. Then the CNESA is calculated for entire design period and divided by two if it is a two lane road.

According to the CNESA values, pavement designs were done for each loading cases. Similar soil condition data and design method used in the original pavement design were followed. Further, it is considered only annual maintenance cost for ten years period in each case.

3.5.2.3 Estimation of construction cost

Bill of quantities from relevant projects implemented for construction of 22nd km of A004 and 196th km of A006 were obtained from RDA. According to the layer

thicknesses obtained from pavement designs and cross sections obtained from drawings, cost for construction of one kilometer length is evaluated.

Maintenance cost of Rs. 120,000.00 was proposed per year starting immediately after the construction. NPV of maintenance for base year 2013 was evaluated.

Increased cost due to overloading is compared with respect to increase of user cost calculated as described under 3.5.1. Results are discussed under section 4.0.

Spreadsheets for determination of added number of vehicles, Average ESA calculation, calculation of CNESA and pavement construction cost are attached in **Appendix G.**

3.5.3 Replacement of 30% overloaded vehicles with next type of axles

In this case study, it was evaluated the change of CNESA when vehicles are replaced with next type of axle configuration, if the load is more than 30% from GVW. Worksheets are attached in **Appendix H** and results are discussed under section 4.

4 DATA ANALYSIS AND DISCUSSION

4.1 Introduction

Data analysis was done in different aspects as mentioned in Chapter 3. From several set of data sets, it can be observed a similar relationship in all results. Some of the results related to major trunk roads in Sri Lanka are discussed here in this chapter showing effect of overloading. Results are best described by use of tables and graphs.

4.2 Analysis of axle load growth trends on average ESA basis

Average ESAL values of each vehicle type is evaluated for axel load survey locations for a period of several years. By plotting those ESA values it shows the trend how axle loads change throughout a period of decade. Following graphs show how axle loads change with time in same location of the same road. Axel types donated by numbers are explicated in below table.

Table 4-1; Axle types donated by notations

Number	Vehicle Type	Axle Type Notation
1	Medium Bus (MBU)	1.2
2	Large Bus (LBU)	1.2
3	Light Good Vehicle (LGV)	1.1
4	Medium Good Vehicles (<8.5T)	1.2
5	Large Lorries (>8.5T)	1.2
6	Three Axle Vehicle Combined	1.22
7	Four Axle vehicle Articulated	1.2-2.2
8	Five Axle vehicle Articulated	1.22-2.2
9	Six Axle vehicle Articulated	1.22-2.2.2
10	Farm Vehicles	1.2

A006 – Ambepussa- Kurunegala – Trincomalee Road at 193km (Kanthale)

Below graph shows that there is a significant growth of axle loads in four axle vehicles from year 2004 to 2013. Average ESA are 20, 37 and 65 for year 2004, 2006 and 2013 respectively.

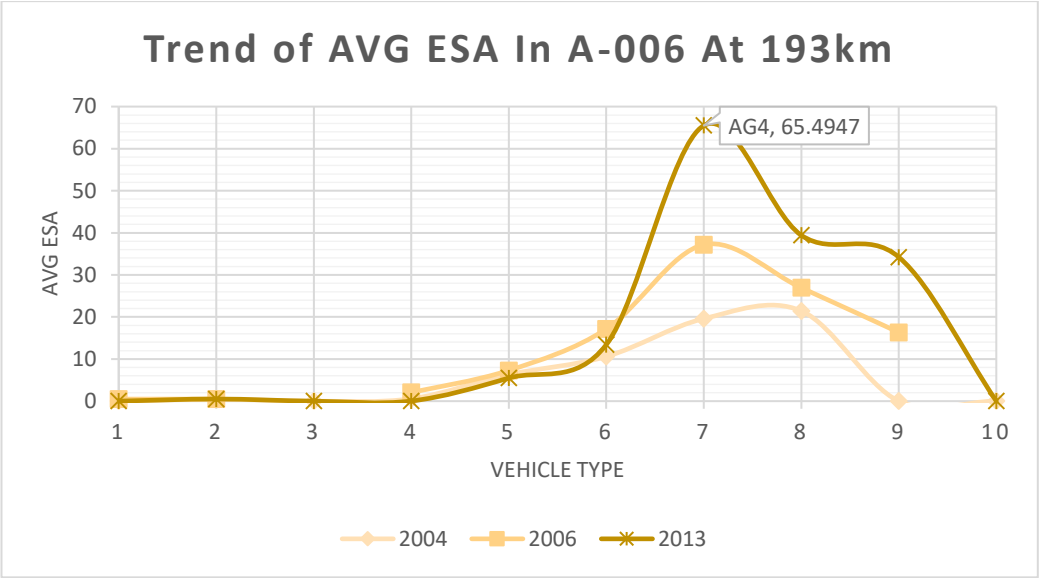


Figure 4-1; Average ESA growth trend in A006 road at 193km

A006 – Ambepussa- Kurunegala – Trincomalee Road at 114km (Habarana)

Below graph shows the average ESA trend in same A006 road at Habarana (114km). Here also, it could be observed that, significant growth is present in four axle and six axle vehicles.

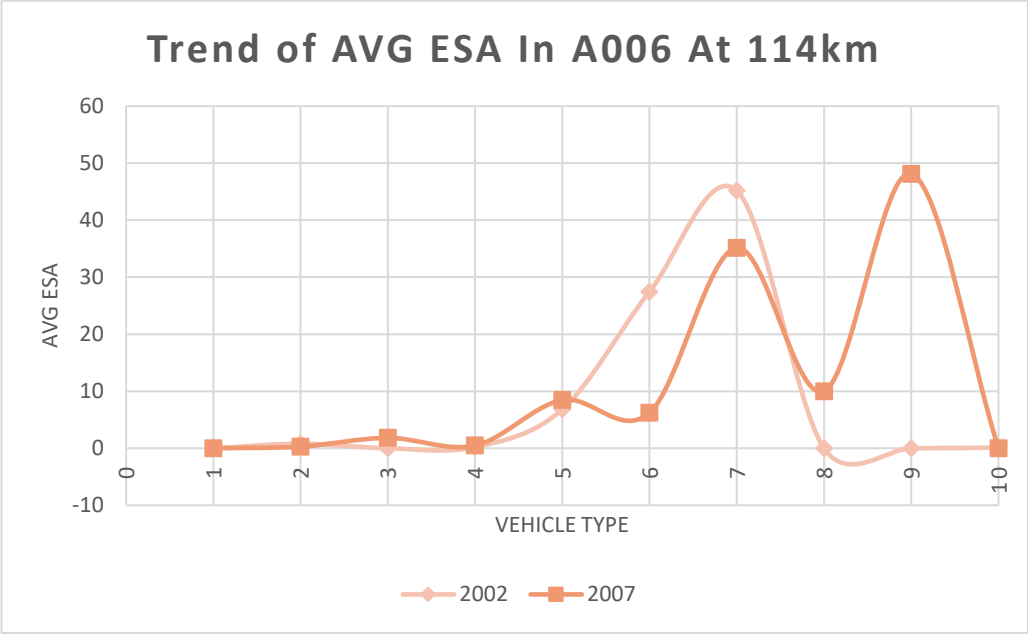


Figure 4-2; Average ESA growth trend in A006 road at 114km

A006 – Ambepussa- Kurunegala – Trincomalee Road at 57km (Malsiripura)

Same growth trend of average ESA is shown here. But for the vehicle type 7 (1.2-2.2) it is shown deviation from the normal behavior. It may be due to lack of sufficient data from 12 hours survey which does not represent the most fright transport occurred during night.

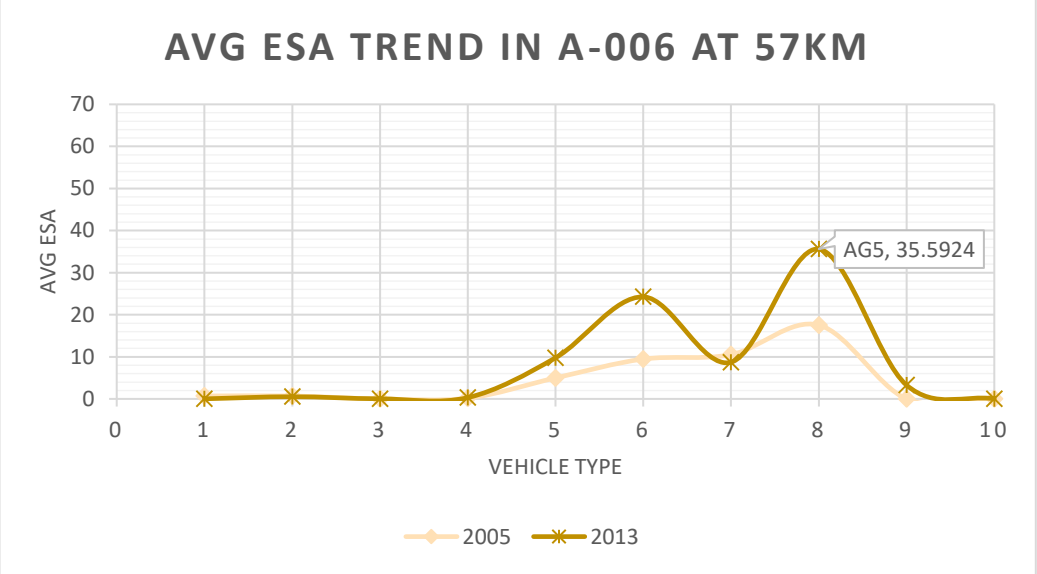


Figure 4-3; Average ESA growth trend in A006 Road at 57kn

A004 Colombo – Rathnapura – Wellawaya – Batticollo at 128km (Opanayaka)

This results in A004 road is shown a significant growth of axle loads in six axle vehicles when year 2008.

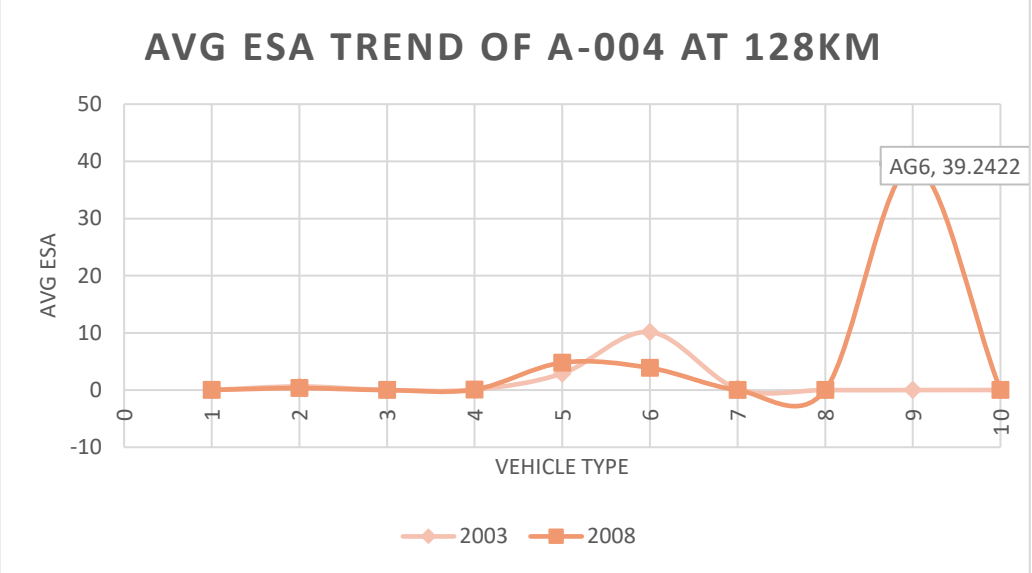


Figure 4-4Average ESA growth trend in A004 at 128km

A004 Colombo – Rathnapura – Wellawaya – Batticollo at 33km (Galagedara)

Here in A004 road near to Colombo, it shows a significant growth of axle loads in three and five axle vehicles.

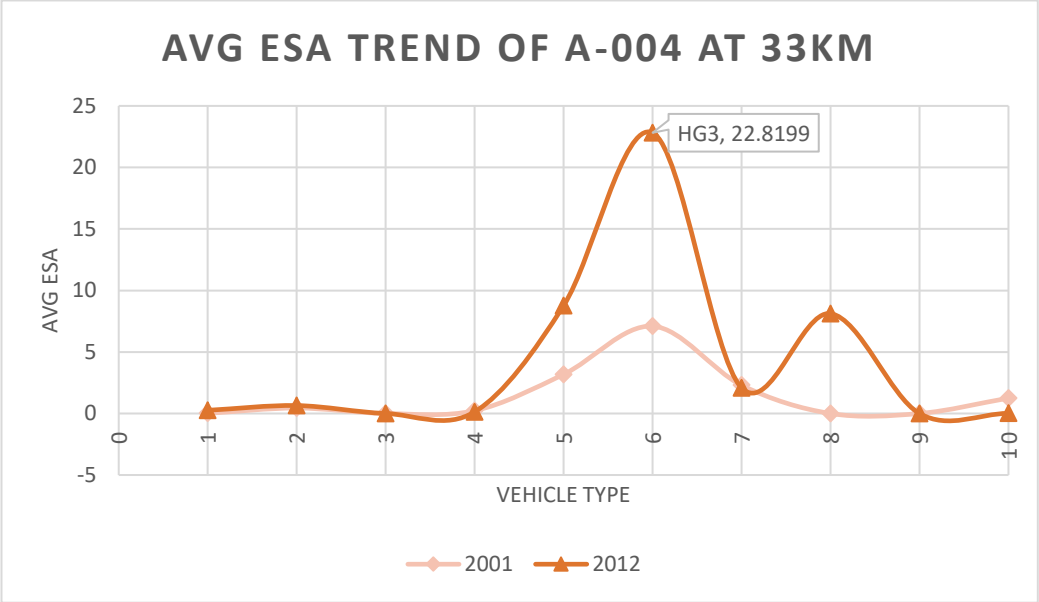


Figure 4-5; Average ESA growth trend in A004 at 33km

A001 – Colombo – Kandy Road at 107^{h} km (Pilimathalawa)

Same trend is observed in the Colombo Kandy road near to Kandy area.

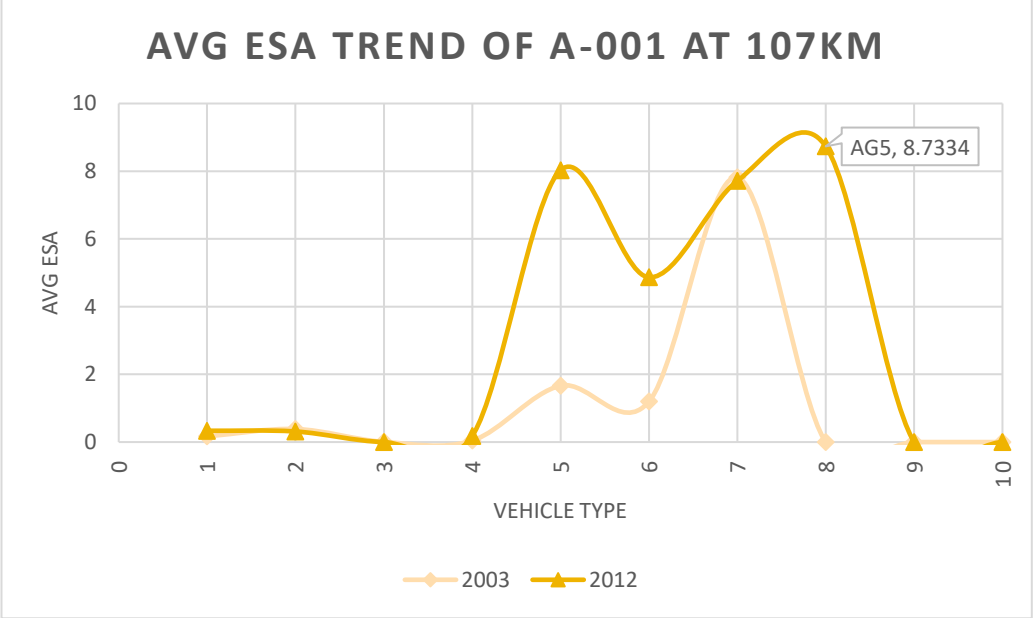


Figure 4-6; Average ESA growth trend in A001 Road at 107km

4.3 Identification of frequently overloaded areas, zones in Sri Lanka

From the collected set of axle load data, overloaded percentage of vehicles were evaluated. Disregarding the amount of total ESA, overloading was considered in terms of number of vehicles from total heavy vehicles. Below table 4-2, shows the percentage values of overloaded vehicles from total heavy vehicles. Locations were mapped showing intensity of percentage values and thereby frequent overloading zones could be identified. Map is shown in below figure 4-7.

Table 4-2; Percentage of overloaded heavy vehicles

Road & Location	**Percentage of Overloaded Vehicles**
A026 – 73km – Mahiyanganaya	17%
A012 – 133km – Horowupathana	19%
A005 – 222km - Mahaoya	20%
A004 – 32km - Galagedara	22%
A009 -106km - Thonigala	24%
A002 – 130km - Koggala	27%
A003 – 36km - Seeduwa	28%
A009 – 269km - Jaffna	29%
A001 – 59km - Warakapola	32%
A006 – 193km - Trincomalee	32%
A006 – 57km - Malsiripura	45%

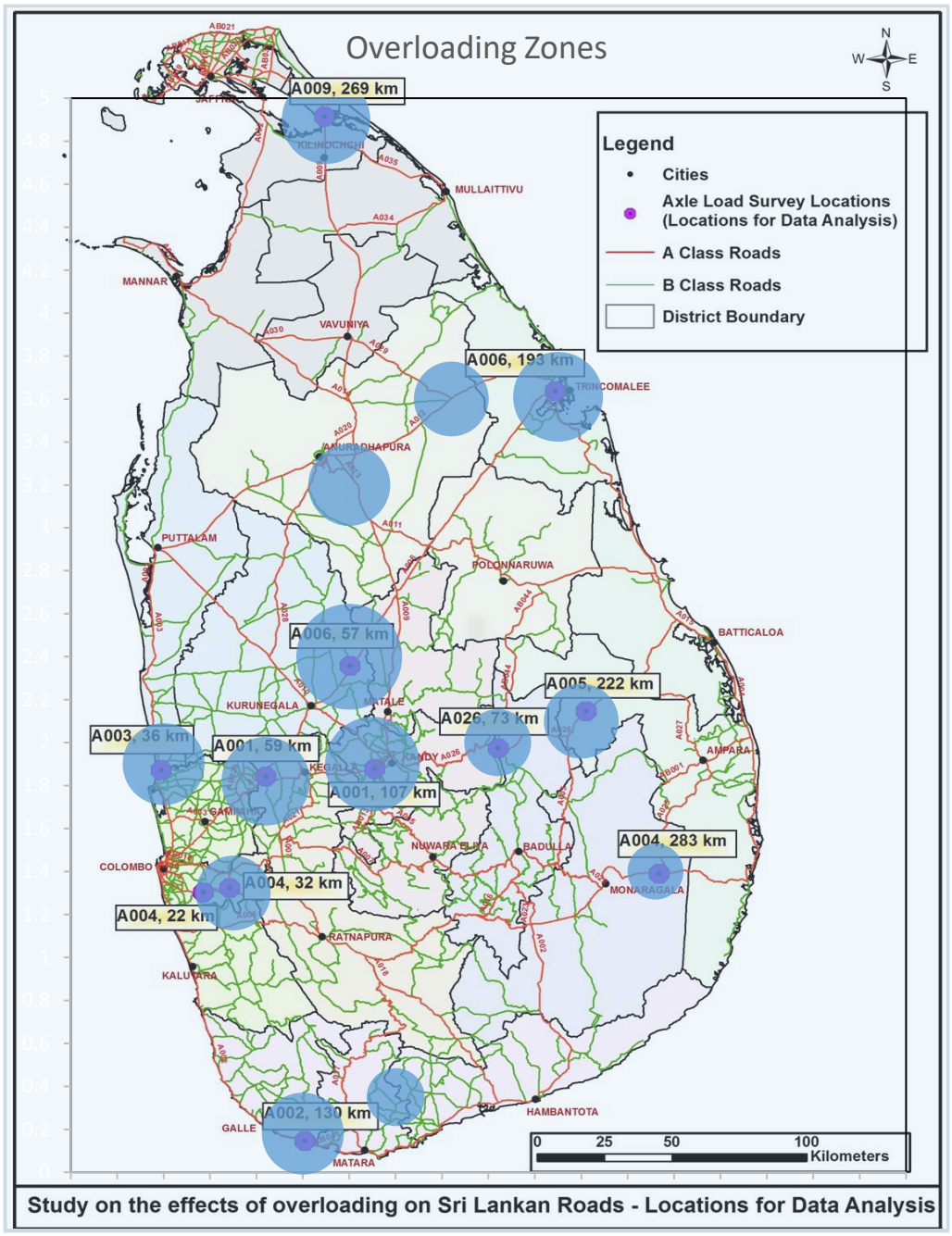


Figure 4-7; Map of most overloaded locations and overloading intensity

4.4 Analysis of axle load data in each location

Analysis is done to evaluate vehicle composition, contribution on ESA by each type of vehicle, percentage of overloaded vehicles, often overloaded vehicle types, how extent overloading occurred, often overloaded commodity type and effect on average ESA values by overloading. These factors were evaluated for the survey data collected from each location separately. Some of the results are discussed here in next paragraphs with graphs and charts.

4.4.1 Composition of vehicles based on axle type/ Contribution on ESA from each vehicle type

When categorized total vehicles plying on a road according to their axle type, following common distribution could be observed. Total ESA value considered in a particular road can be distinguished based on axle type. Then contribution for total ESA from each axle type could be identified.

A006 – Ambepussa- Kurunegala – Trincomalee Road at 193km (Kanthale)

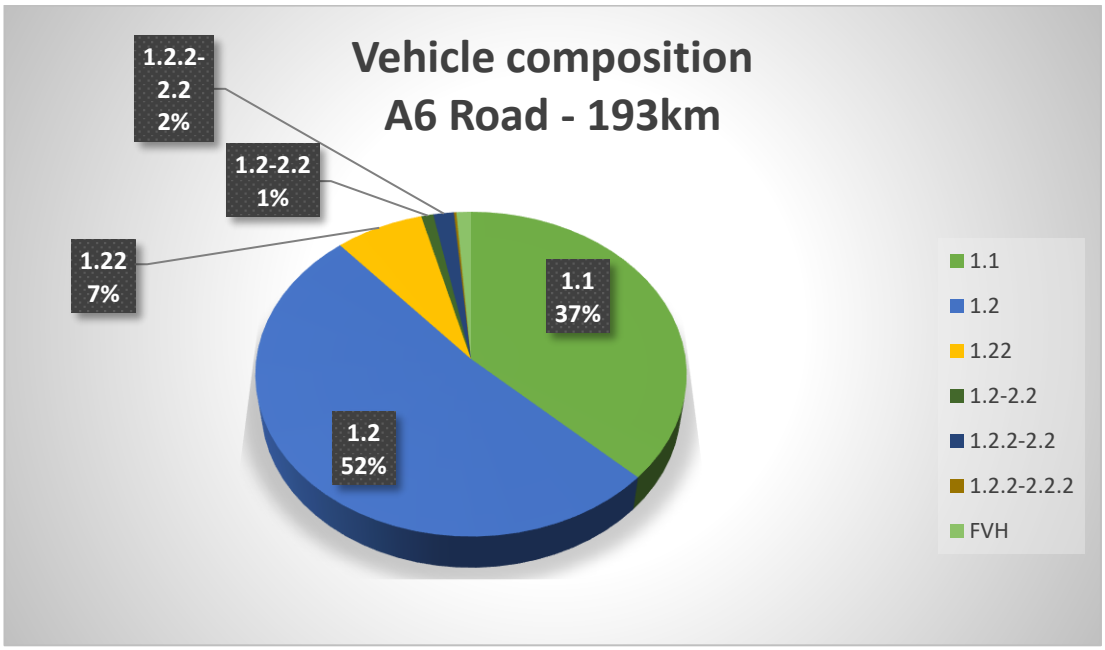


Figure 4-8; Vehicle composition of A006 Road at 193km

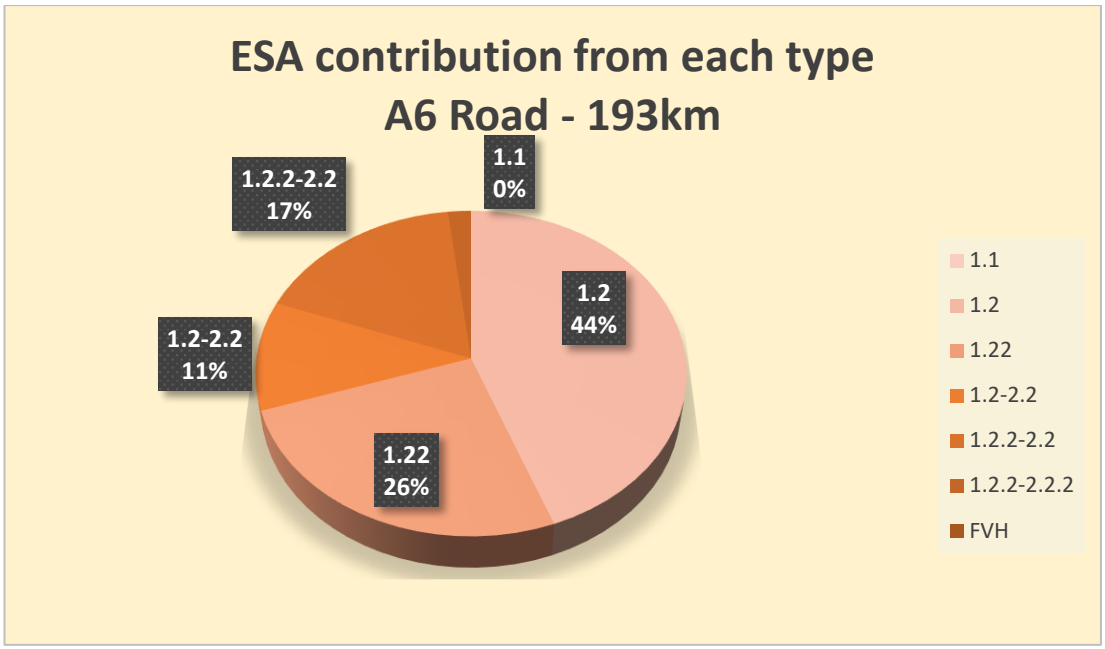


Figure 4-9; ESA contribution by each type of axles in A006 road at 193km

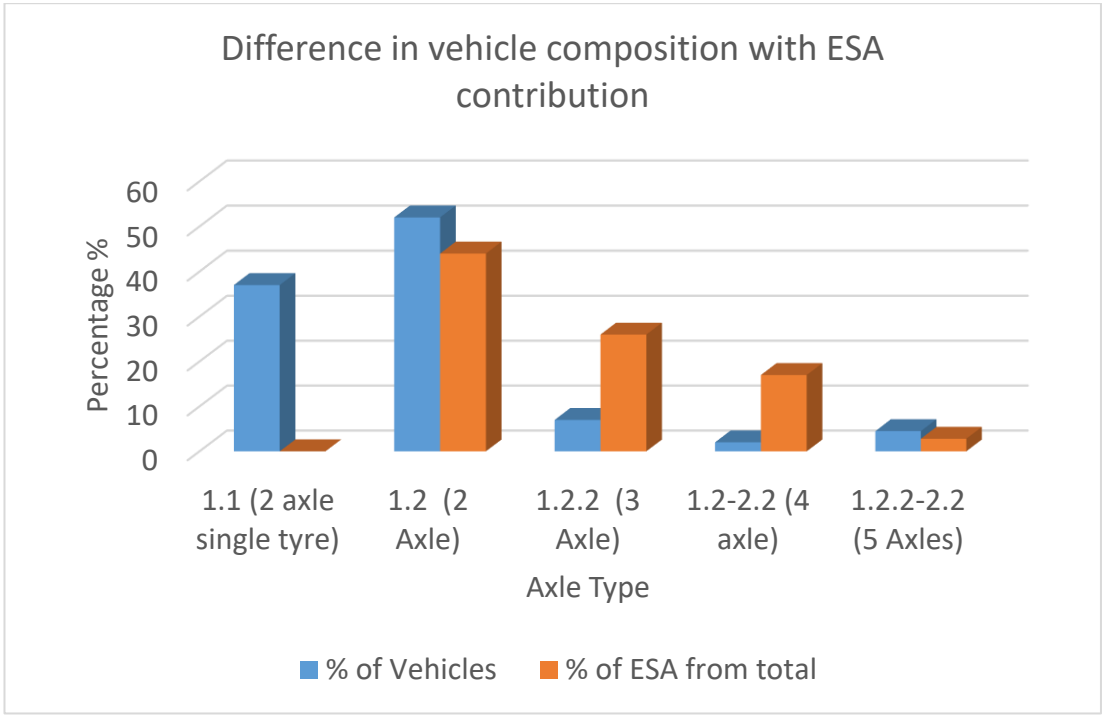


Figure 4-10; Difference in vehicle composition with ESA contribution

Figure 4.8, 4.9 & 4.10 clearly show a significant effect on CESA from the 1.2 vehicle type.

A006 – Ambepussa- Kurunegala – Trincomalee Road at 57km (Malsiripusra)

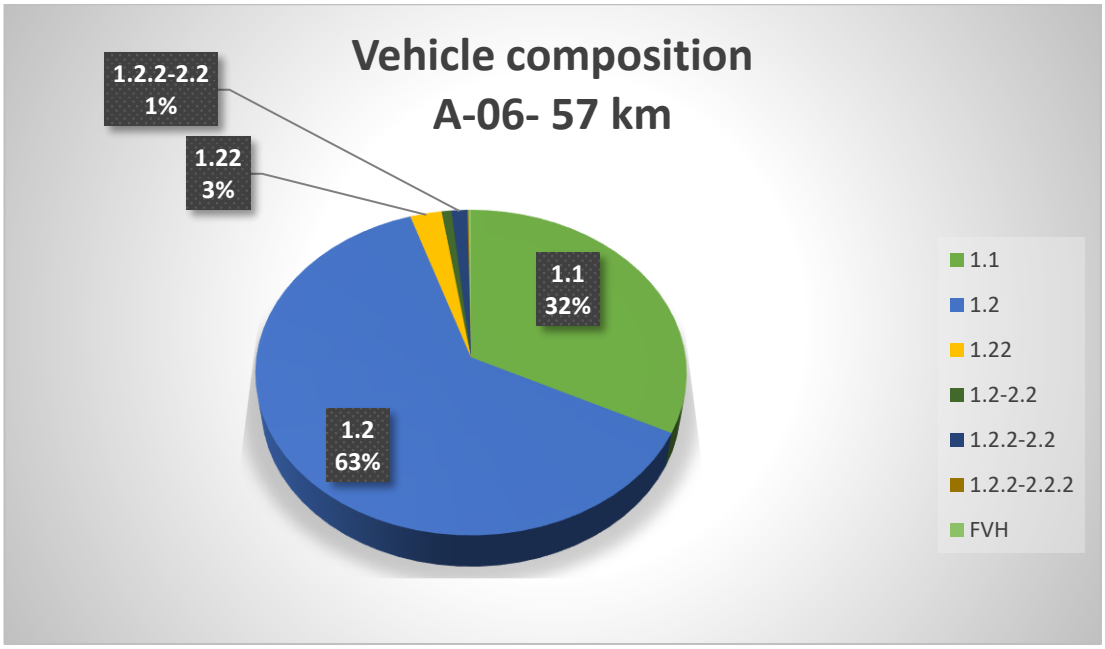


Figure 4-11; Vehicle composition in A006 road at 57km

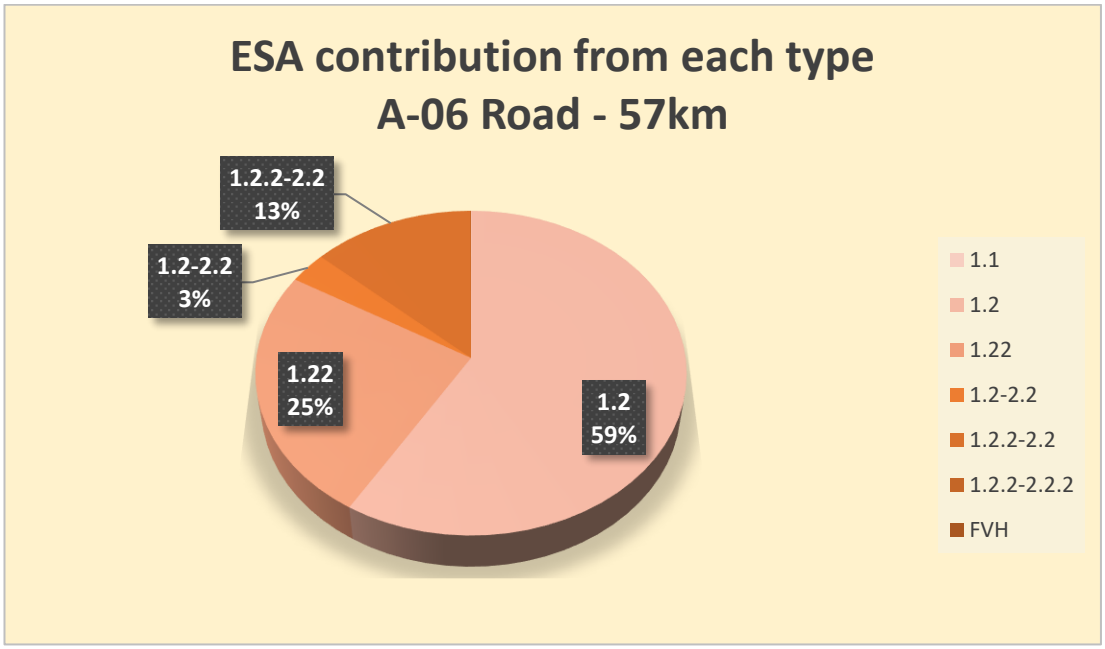


Figure 4-12; ESA contribution by each type of axle in A006 road at 57km

Figure 4-11 & 4-12 also show a similar pattern to data figure 4-8 & 4-9. More comparisons on other few roads are attached in **Appendix I.**

4.4.2 Percentage of overloaded vehicles & often overloaded vehicle type

In the analysis, it was evaluated the overloading by axel weight. Overloading of each axles reflect that its GVW limit also is exceeded. According to the axle load data, number of overloaded vehicles were considered as a percentage from total number of heavy vehicles. Here it has been considered, axle load survey data collected on and after year 2012. As per the latest records, it was determined that most of the roads are overloaded 15% - 45% than the respective GVW limits or axle load limits. Results obtained for few major trunk roads are tabulated below Table 4-3. Without considering the factor of ESA, often overloaded vehicle type is evaluated and commonly overloaded vehicle type for each road then can be identified.

Table 4-3; Overloaded Percentages

Road & Location	**Percentage of Overloaded Vehicles**
A026 – 73km	17%
A004 – 32km	22%
A009 -106km	24%
A002 – 130km	27%
A003 – 36km	28%
A001 – 59km	32%
A006 – 57km	45%

4.4.3 How extent overloading occurred

Considering the each vehicle type, it was evaluated the extent of overloading from respective GVW limits of particular vehicle type. Analysis was done for each overloaded vehicle type in each road. Results are shown in below graphs so as to identify how extent the overloading occurred and exceptional limits of carrying loads for each vehicle type.

A006 – Ambepussa- Kurunegala – Trincomalee Road at 193km (Kanthale)

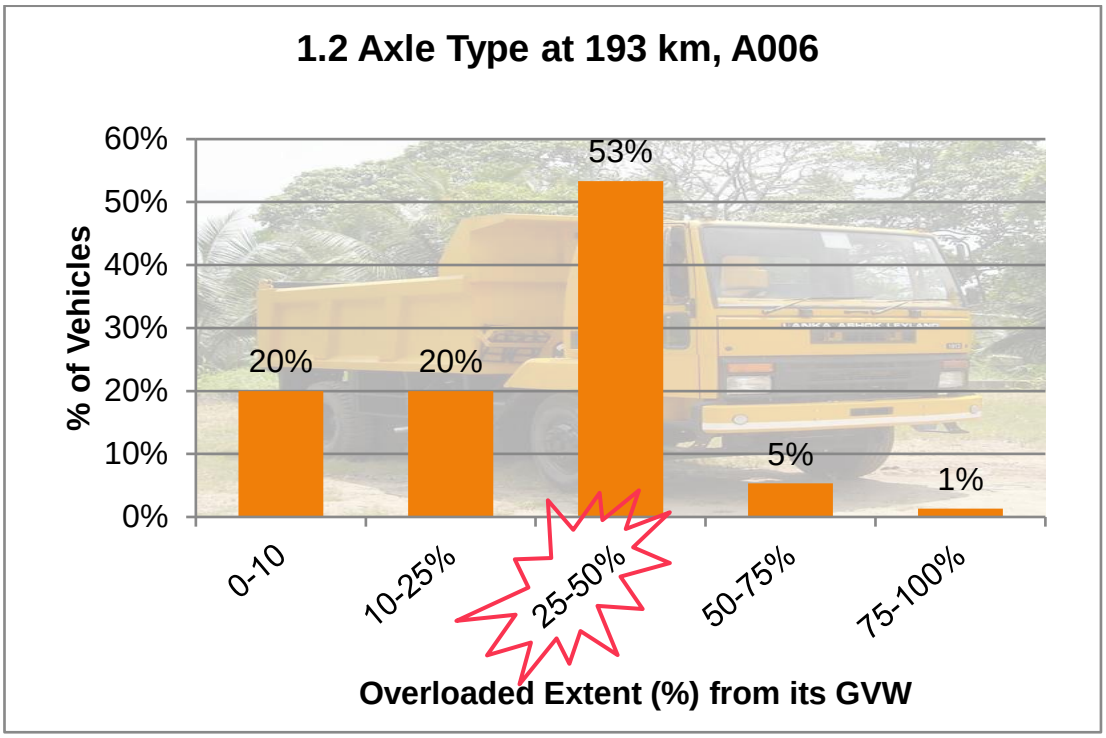


Figure 4-13; Extent of overloading in 2-axle trucks in A006 road at 193km

According to this figure 4-21, 59% of 1.2 axle vehicles are overloaded than 25% of Legal Limit. That Means though the legal limit is 15.275 Ton, almost half of vehicles are overloaded than 19 Ton.

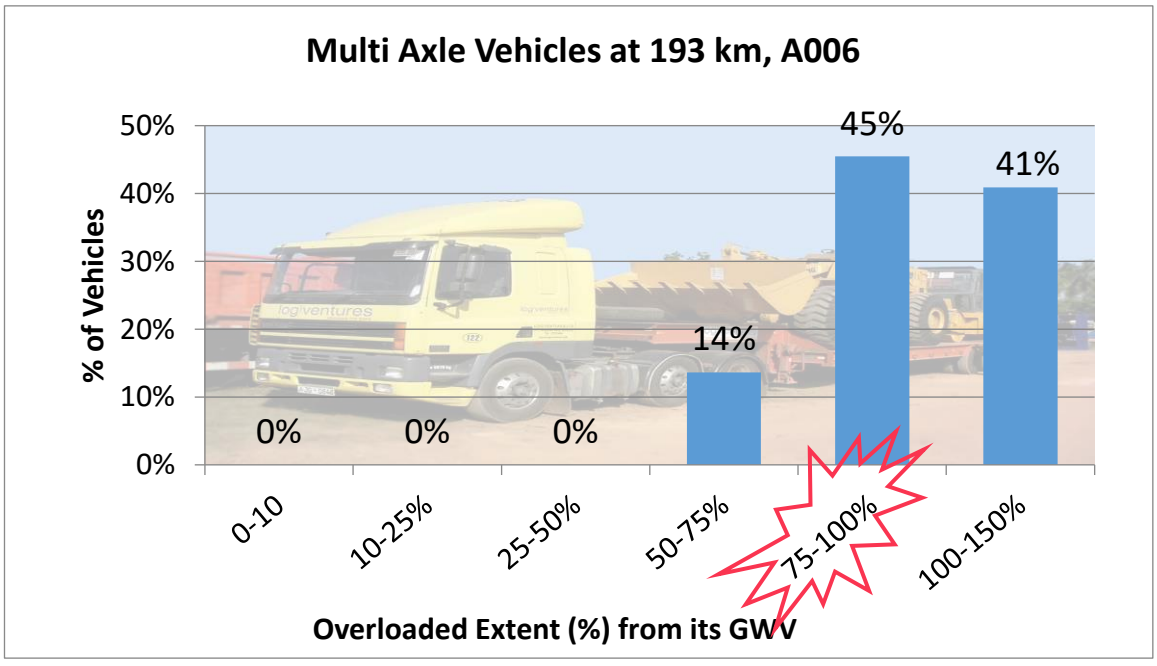


Figure 4-14; Extent of overloading of multy axle trucks in A006 road at 193km

When consider the multy axle vehicles together, almost 86% of vehicles are overloaded than 75% from its legal limit in A006 road.

A006 – Ambepussa- Kurunegala – Trincomalee Road at 57km (Malsiripura)

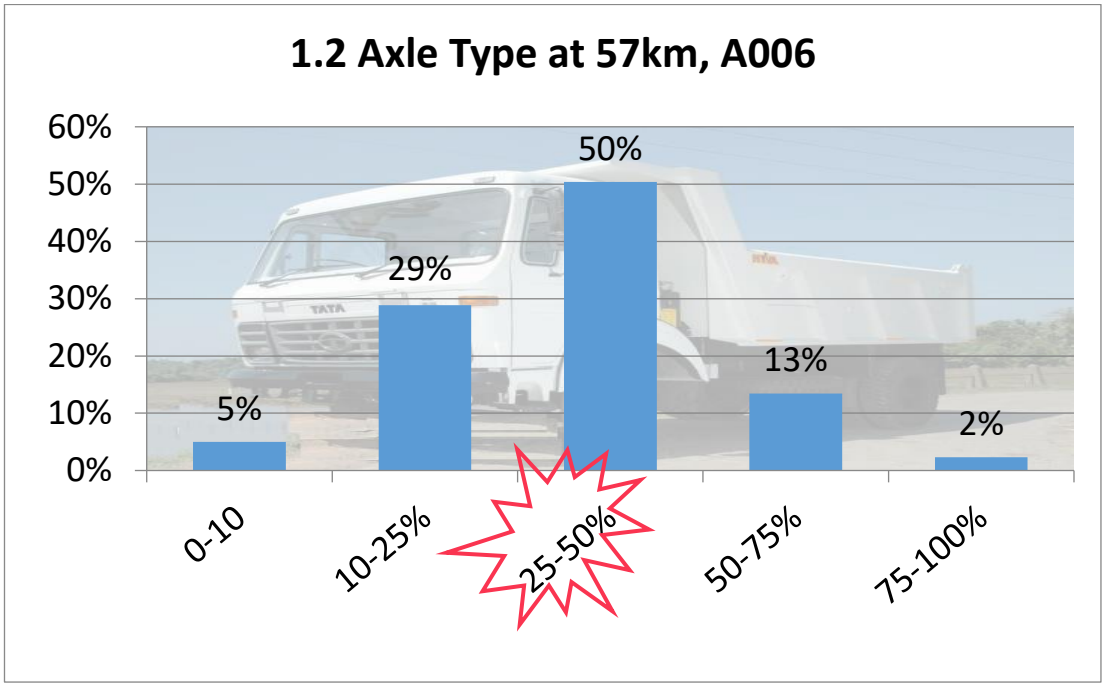


Figure 4-15; Extent of overloading of 2-axle trucks in A006 roads at 57km

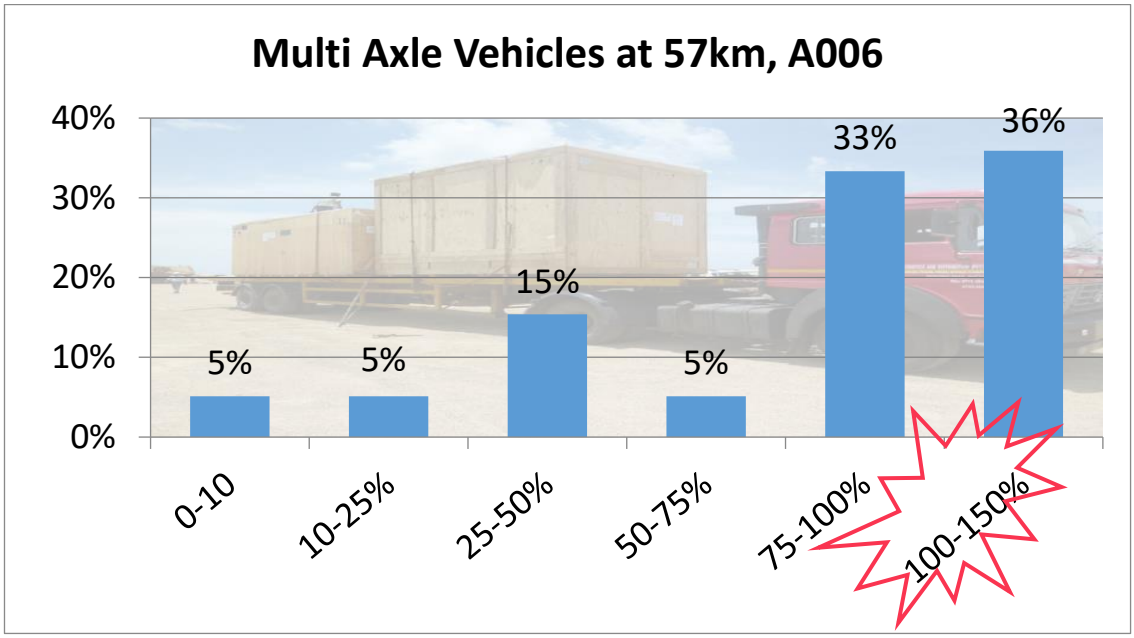


Figure 4-16; Extent of overloading of multy axle vehicles in A006 road at 57km

Similar pattern shown from these two figures also.

4.4.4 Often overloaded commodity type

It was evaluated the overloading by commodity type which are been transported in each type of vehicle. Sand is often overloading commodity observed in 1.2 axle type vehicles. According to survey results in 193th km of A006 road, 1.22 axle type vehicles are often overloaded by fertilizer products followed by petroleum, rice-paddy, cement & flour respectively. In the same location, multi axle vehicles are ofeten overloaded by petroleum products and then cements and flour. Results obtained at 193km of A006-road are shown in below charts.

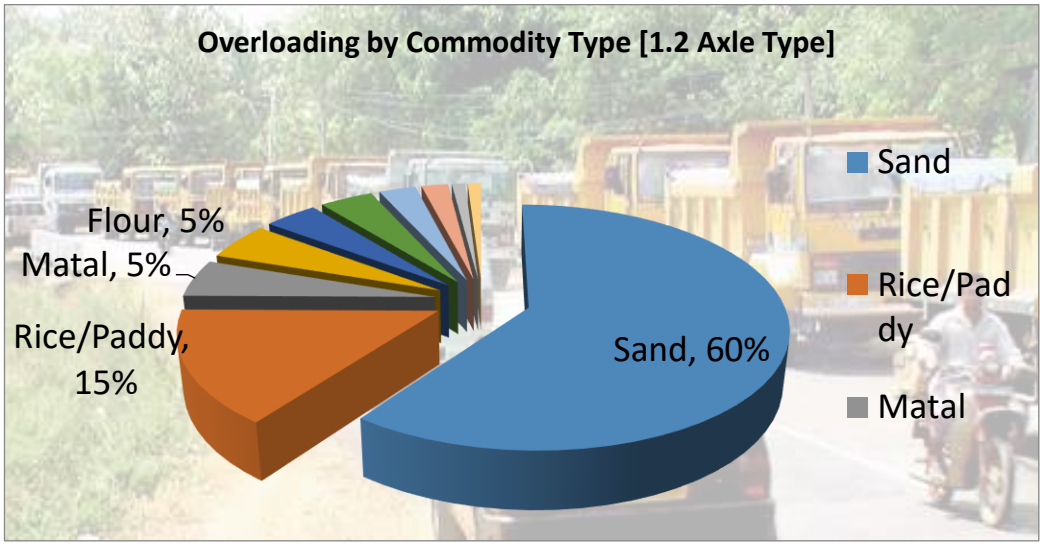


Figure 4-17; Overloading by commodity type for 2-axle trucks

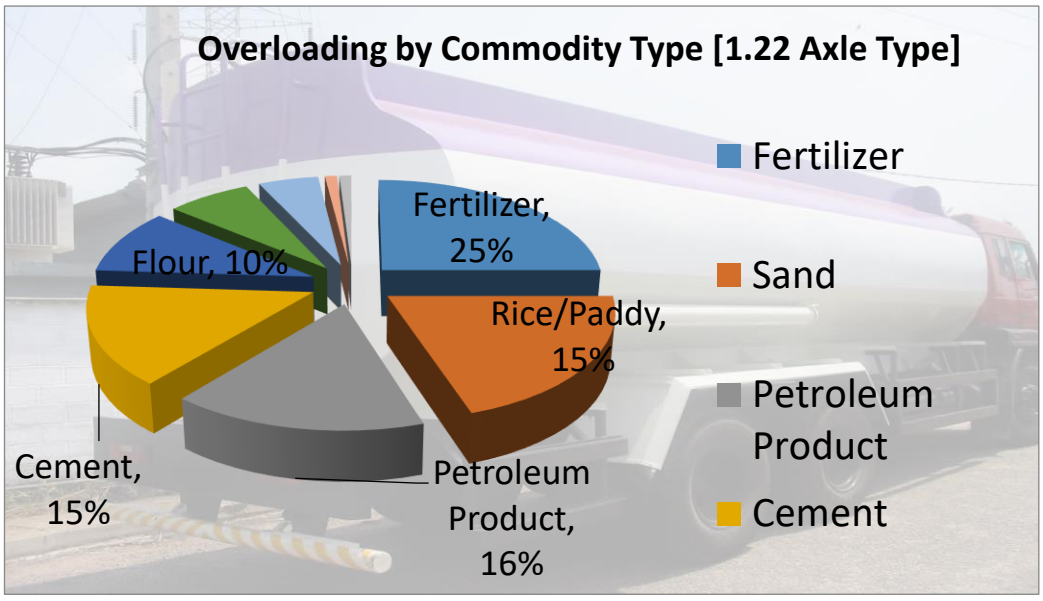


Figure 4-18; Overloading by commodity type for 3-axle trucks

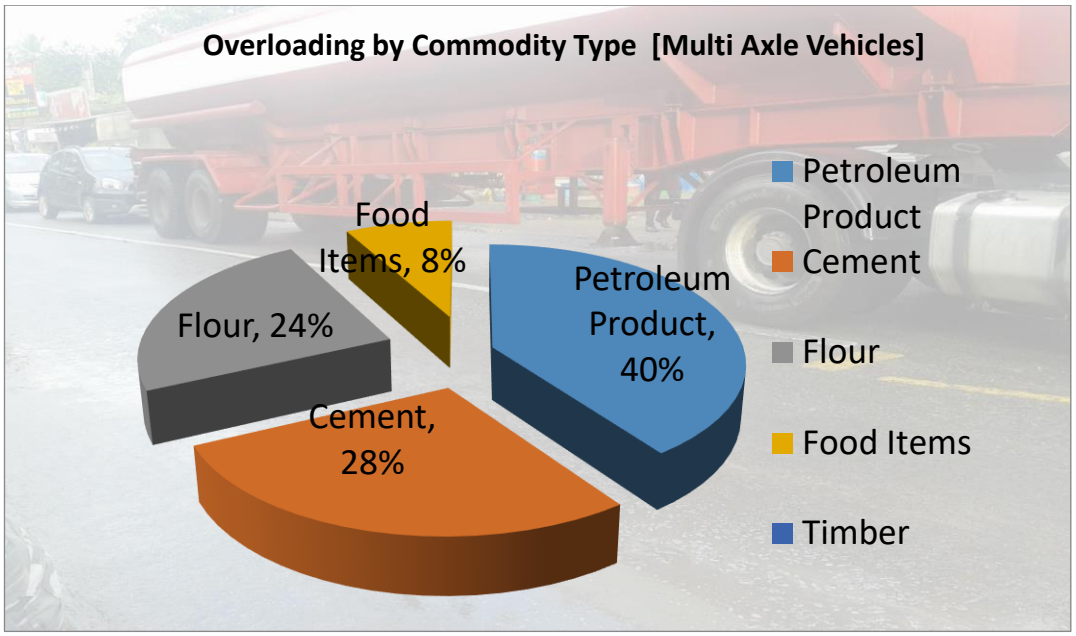


Figure 4-19; Overloading by commodity type of Multi axle vehicles

Above three figures show what commodities are often overloaded in 1.2, 1.22 & multy axle vehicles. According to the figures, its revealed that sand, rice, cement, fertilizer, flour & petroleum products are significant.

4.4.5 Calculations of Average ESA of overloaded/ non-overloaded/ all vehicles

Based on the collected axle load data, average ESA values for each type of axles were evaluated. Overloaded & non-overloaded vehicles were considered separately and average ESA values for all vehicles then be compared. Further, it was evaluated the average ESA for the vehicle loads at legal limit. Obtained values for each location are tabulated in below table 4-4 to 4-8.

A006 – Ambepussa- Kurunegala – Trincomalee Road at 193km (Kanthale)

Table 4-4; Average ESA representation for different axle types in A006 road at 193km

Axle Type	Average ESA for Overloaded & Non-Overloaded Vehicles	Average ESA for all vehicles	Average ESA for vehicle loads at legal limit
1.2 (2-Axle)	Overloaded - 12.51 Non- Overloaded – 0.07	3.2	0.825
1.22 (3-Axle)	Overloaded - 27.82	13.4	2.52

	Non- Overloaded – 0.07		
1.2-2.2 (4-Axle)	Overloaded - 65.49	65.5	8.03
	Non- Overloaded – 0		
1.2.2-2.2 (5-Axle)	Overloaded - 55.09	41.4	6.66
	Non- Overloaded – 0.1934		
1.2.2-2.2.2 (6-Axle)	Overloaded - 102.7	34.2	3.67
	Non- Overloaded – 0.23		

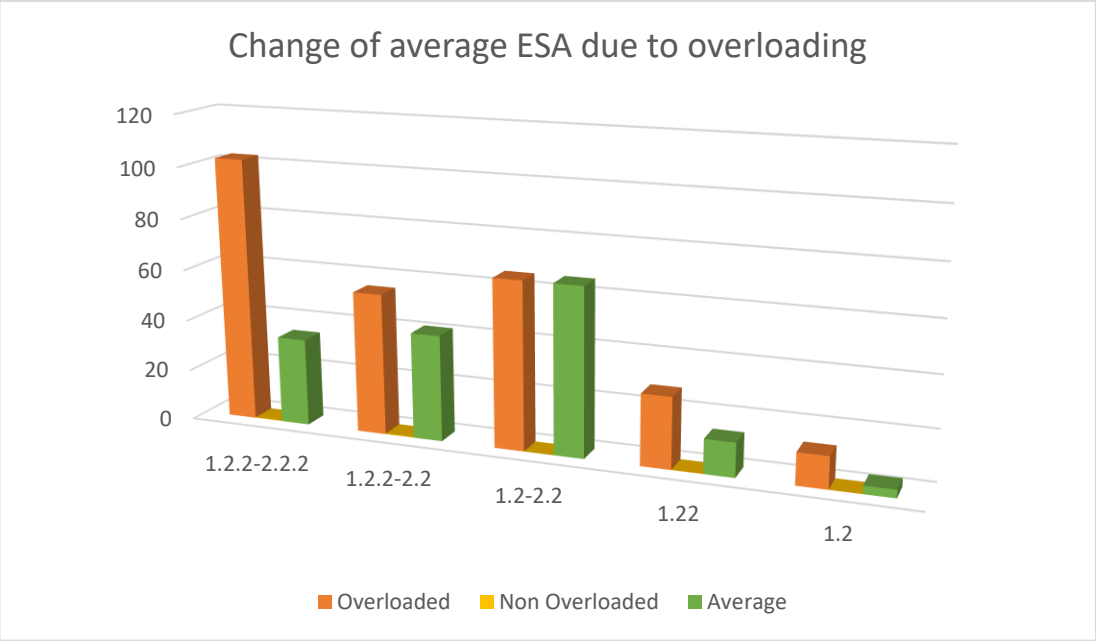


Figure 4-20; Change of average ESA due to overloading

Here this figure shows that the average ESA values are increased significantly only due to overloaded vehicles.

A004 Colombo – Rathnapura – Wellawaya – Batticollo at 32km (Galagedara)

Table 4-5; Average ESA representation for different axle types in A004 road at 32km

Axle Type	**Average ESA for Overloaded & Non-Overloaded Vehicles**	**Average ESA for all vehicles**	**Average ESA for vehicle loads at legal limit**
1.2 (2-Axle)	Overloaded - 24.24	5.69	0.77
	Non- Overloaded – 0.25		
1.22 (3-Axle)	Overloaded - 34.94	22.8	3.5

	Non- Overloaded – 0.22		
1.2-2.2 (4-Axle)	Overloaded - 20.4	16.5	1.87
	Non- Overloaded – 0.65		
1.2.2-2.2 (5-Axle)	Overloaded - 38.78	25.15	4.62
	Non- Overloaded – 0.45		

4.5 Evaluation of damaging effect of 1.2 & 1.22 axle types

Table 4-6; ESA values for 1.2 & 1.22 axle vehicles at each loading scenario

Loading Scenario	**1.2 Axle Type**		**1.22 Axle Type**	
	Load	**ESA**	**Load**	**ESA**
Legal Limit	15.275	2.7	21.3	1.97
10% than LL	16.8	5.5	24.3	2.78
20% than LL	18.3	6.5	25.56	5.09
30% than LL	19.9	10.6	27.69	7.65
40% than LL	21.4	14.48	29.82	10.2

When replace all 1.2 axles which are overloaded than 20 Tons by 1.22 Axles reduced CNESA in two roads are tabulated below.

Table 4-7; ESA reduction when replaced 30% or more overloaded vehicles with next type of axle vehicle

Road	**As designed (Mn ESA)**	**When Replace with 1.22 axles (Mn ESA)**	**% Reduction**
A 006 – 193km	22.36	18.7	16.4 %
A 004 – 19km	18.21	6.33	65.2 %

4.6 Analysis of unit cost for users encountered in 1.2 & 1.22 axle vehicles

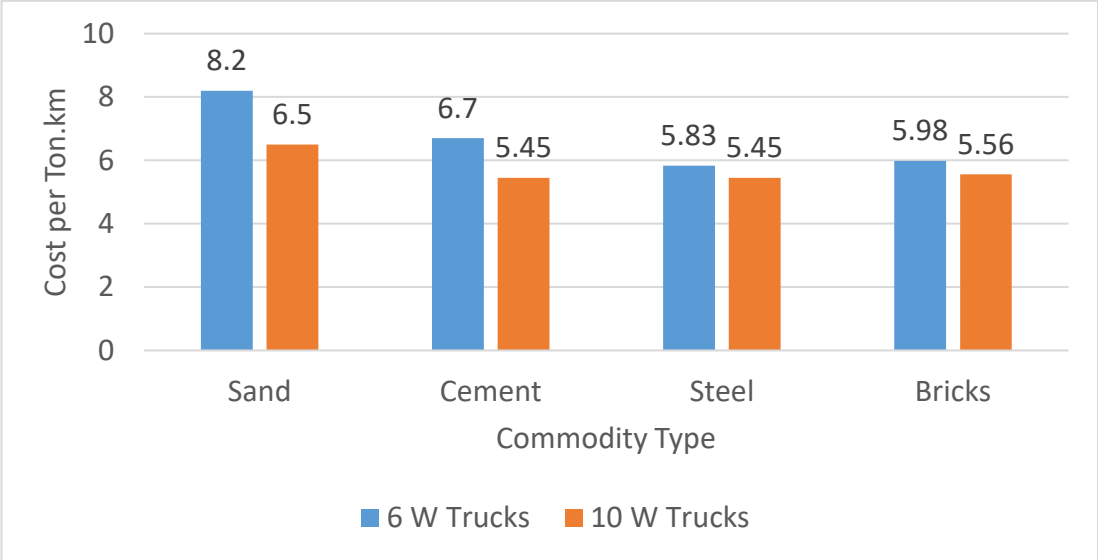


Figure 4-21; Unit transport cost analysis of 1.2 & 1.22 axle vehicles for different commodities

This figure shows that transport cost is lesser for all commodities when it is in 1.22 axle type ten wheeled trucks.

4.7 User cost calculation for different loading scenarios

User cost for different loading scenarios in A004 road and A006 road can be illustrated in following terms.

01. Cost incurred by all vehicles during 10 years period to transport the commodity through one kilometer length
02. Total Transport cost encountered by the vehicles passing particular location with similar trip patterns throughout 10 years period.

Table 4 8; Net Present Value of User cost for one km length incurred by all vehicles passed through 22nd km in A004 road

Loading Scenario	User Cost Rs. Mn/km	Cost Increase than Actual (Rs. Mn)
LL	2,651.02	119.5
10%	2,636.80	105.3
20%	2,626.07	94.57
30%	2,626.79	95.29
40%	2,621.18	89.68

Actual	2,531.50	0

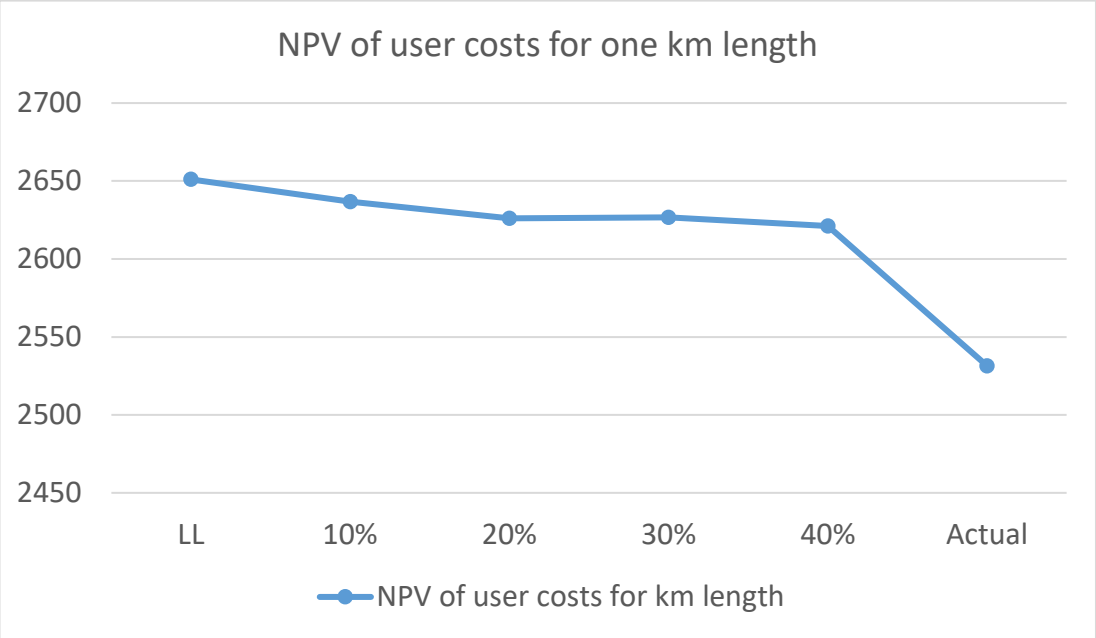


Figure 4-22 Change of User cost with each loading scenario A004 Road

According to this graph, there is no significant change of user cost when it is loaded up to 30% & 40%.

Table 4 9; Net Present Value of User cost for one km length incurred by all vehicles passed through 193 km in A006 road

Loading Scenario	**User Cost Rs. Mn/km**	**Cost Increase than Actual (Rs. Mn)**
LL	789.78	175.73
10%	771.71	157.66
20%	678.41	64.36
30%	650.00	35.95
40%	645.97	31.92
Actual	614.05	0

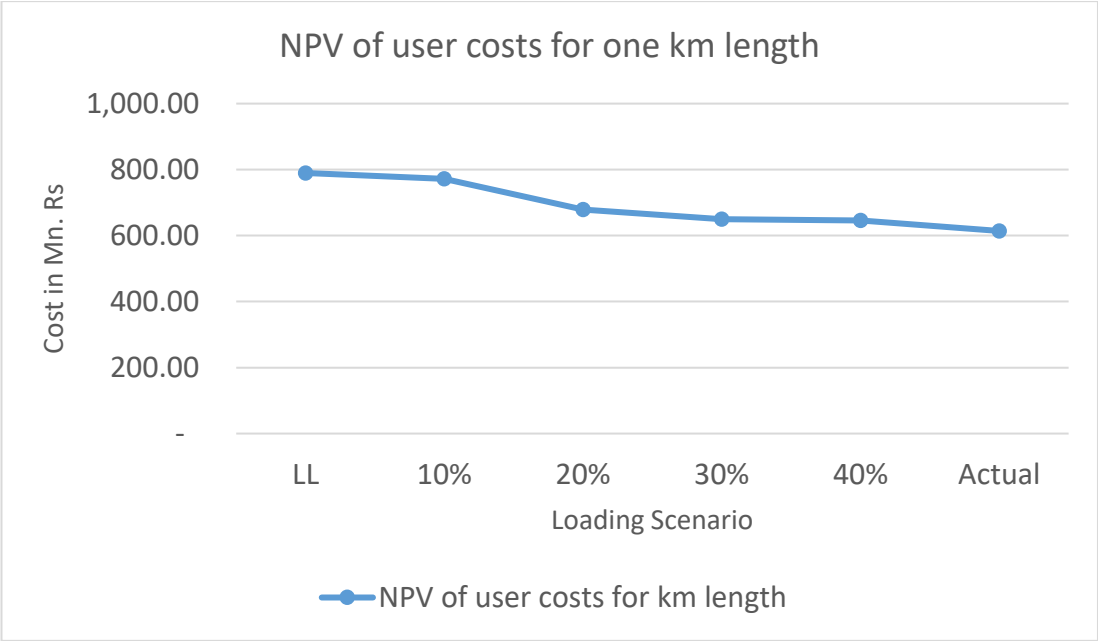


Figure 4-23 Change of User cost for each loading scenario A006 Road

Total transport cost for the user encountered for all the trips of vehicles passed through particular locations are varied as in following graphs.

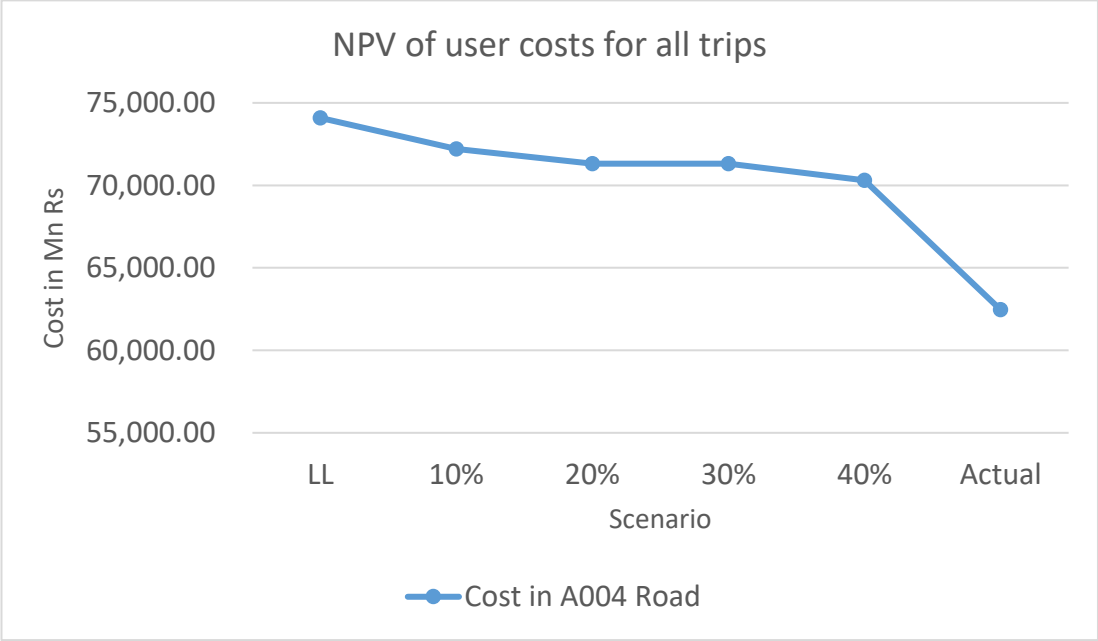


Figure 4-24; Total Transport Cost for user encountered during 10 years period – A004 Road Vehicles Passed 22 km

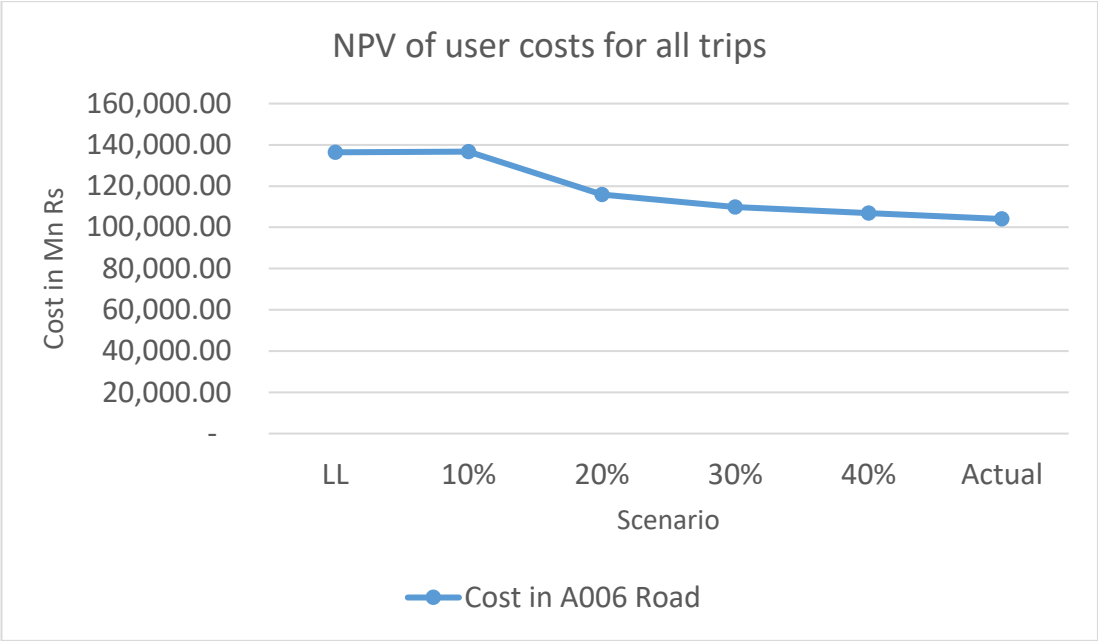


Figure 4-25; Total Transport Cost for user encountered during 10 years period – A006 Road Vehicles Passed 193 km

4.8 Review of Pavement Designs

In the review process, it was observed that pavement designs have been done disregarding the excessive overloading. But average ESA values are considered allowing vehicles to be overloaded up to some extent. In the design reports, average ESA values obtained from axle load survey are further compared with previous design reports and common ESA values used in RDA designs. Hence, it is determined that most of the existing pavements are designed to cater prevailing traffic volumes disregarding the GVW limits imposed by Motor Traffic Department, but not allowing excessive overloading.

Review was done for the loading scenarios as mentioned under section 3.5.1. Calculation of CNESA was done as described in section 3.5.2.2 and results are illustrated below.

Variation of CNESA values for both roads are plotted against each scenario in below graphs.

Table 4 10; CNESA of A004 & A006 at each loading scenario

Loading Scenario	CNESA – A004	CNESA – A006
LL	6.36	4.7
10%	6.88	6.03
20%	8.38	6.25
30%	10.93	11.8
40%	14.51	13.1
Actual	28.5	21.5

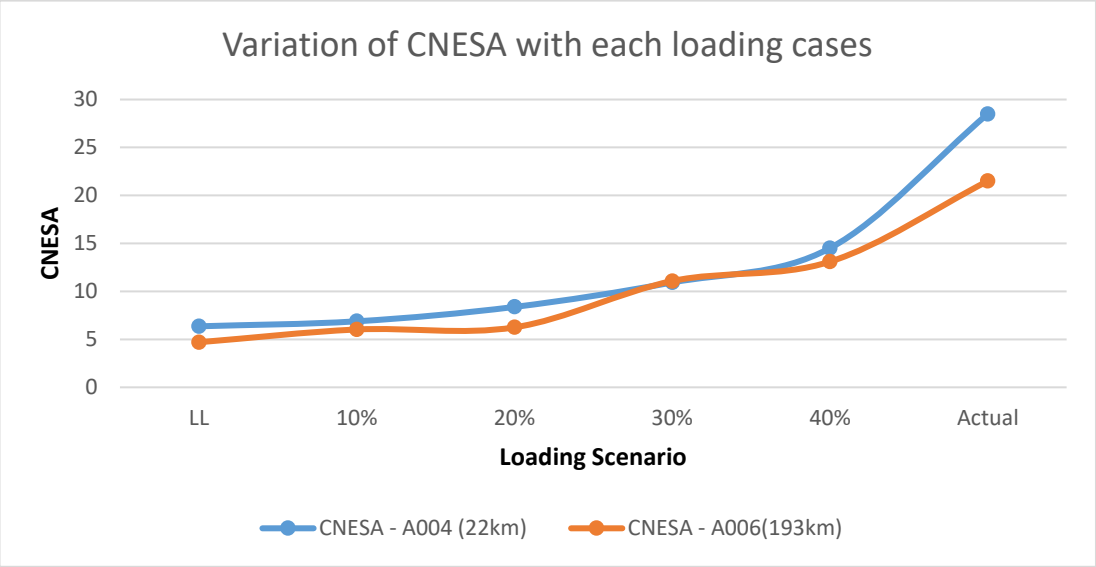


Figure 4-26; Variation of CNESA with each loading cases

4.9 Evaluation of pavement construction cost

According to the pavement designs done for each scenario described in above para 4.6, Unit cost calculation was considered to reflect cost per kilometer only for construction of road pavement. Relevant cross sections were also collected from design drawings in order to identify the lane arrangement and width.

Cost for construction of kilometer length of pavement is then compared for different loading scenarios. Obtained results for A004 road and A006 road are tabulated in below Tables 4-11 to 4-14 and graph 4-30.

A004 Colombo – Rathnapura – Wellawaya – Batticollo Road at 22km (Homagama)

Table 4 11; cost comparison for each scenario in A004 road at 19km

Loading Scenario	Construction Cost Rs. Mn	Cost variation than Actual (Rs. Mn)
Legal Limit (LL)	40.29	-8.8
10%	40.29	-8.8
20%	40.29	-8.8
30%	42.79	-6.3
40%	42.79	-6.3
Actual	49.09	-

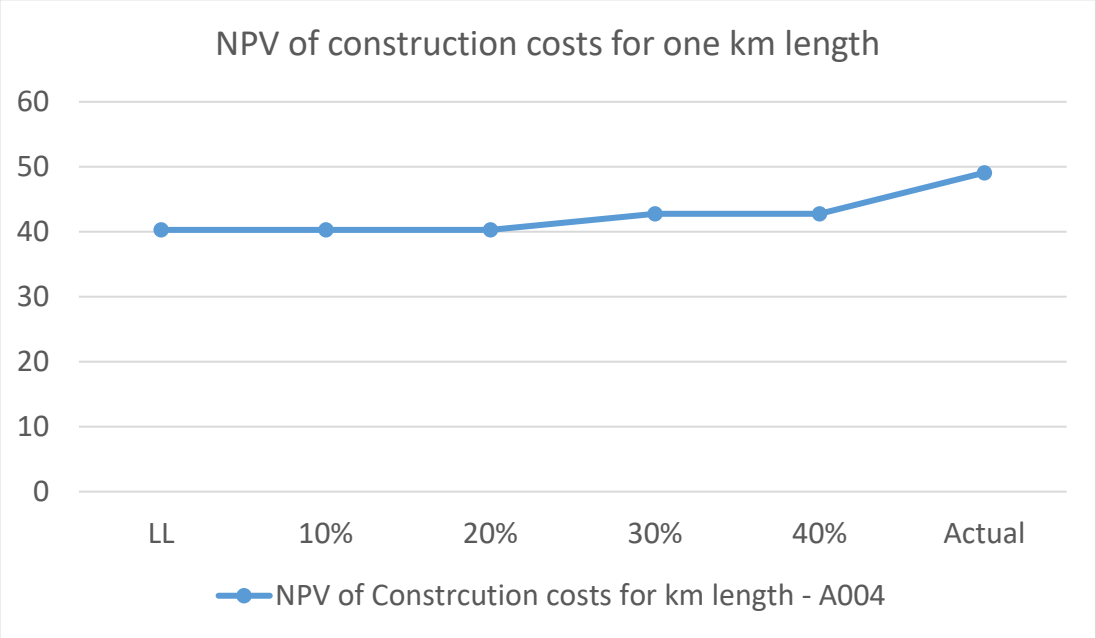


Figure 4-27; Change of construction cost for km length

Here in this graph there is no significant increase of cost for loading limits at 30% & 40%, but it results in higher thicknesses of pavement designs.

A006 – Ambepussa- Kurunegala – Trincomalee Road at 193km (Trinco)

Table 4-12; cost comparison for each scenario in A006 road at 193km

Loading Scenario	Construction Cost Rs. Mn	Cost variation than Actual (Rs. Mn)
Legal Limit (LL)	22.19	-21.1
10%	27.48	-15.81
20%	27.48	-15.81
30%	34.51	-8.78
40%	35.74	-7.55
Actual	43.29	0

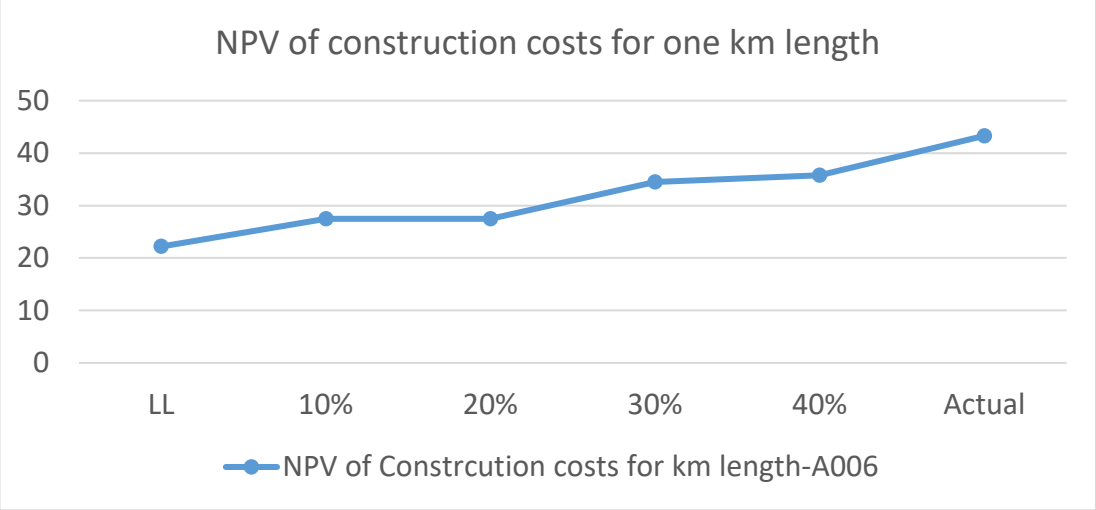


Figure 4-28; Change of construction cost for km length A006

Increase of user cost and decrease of agency cost is tabulated below for A004 road.

Table 4-13; Increased & decreased amount of cost values A004 Road

Loading Scenario	Construction Cost Decrease* Rs. Mn	User Cost Increase* Rs. Mn
Legal Limit (LL)	8.8	65.87
10%	8.8	57.47
20%	8.8	51.6
30%	6.3	49.86

40%	6.3	48.91

* - Here decrease & increase considered with respect to the actual loading scenario

Variation of User cost and Agency cost can be illustrated as in below Table for A006 road.

Table 4-14; Increased & decreased amount of cost values A006 Road

Loading Scenario	**Construction Cost Decrease Rs. Mn**	**User Cost Increase Rs. Mn**
Legal Limit (LL)	21.1	175.73
10%	15.81	157.66
20%	15.81	64.36
30%	8.78	35.95
40%	7.55	31.92

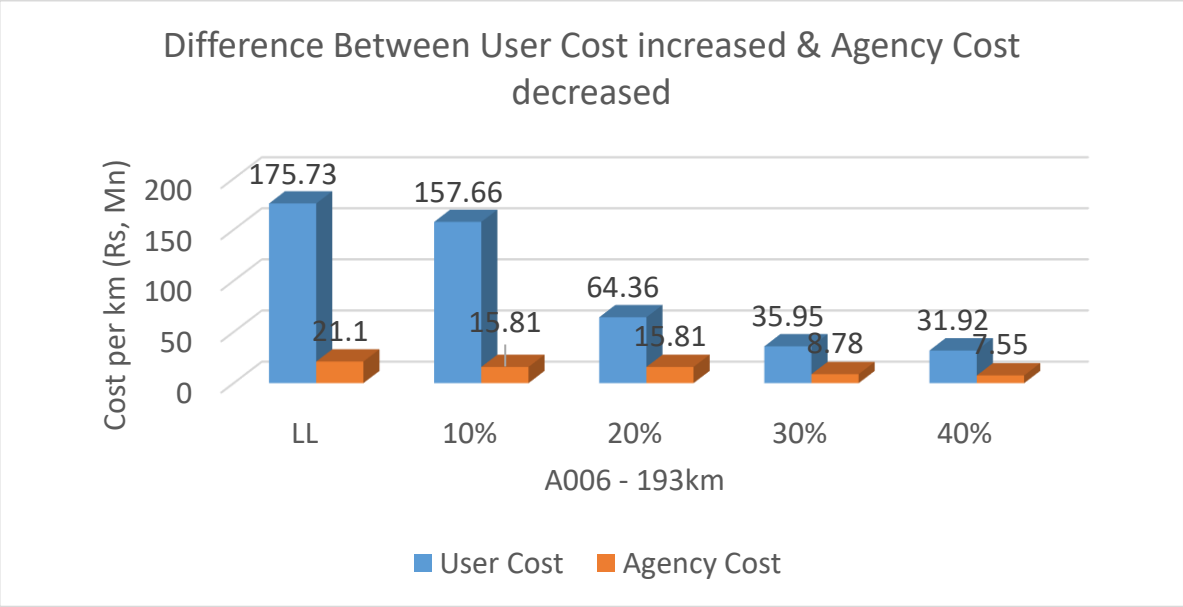


Figure 4-29; Change of cost for construction of 1km length in each scenario

5 CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

According to the literature survey & data analysis, following conclusions could be made.

Legislations pertaining to vehicle weights have been updated recently in 2014, but analysis reflects that load levels specified in the act are not rely with the current loading capacities when consider the frequent overloading and overloaded extent.

Referring to the axle load growth trend discussed in this study, it is revealed that, axle loads in heavy vehicles have been considerably increased with new technological trucks having high horse power capacities over a period of decade.

From the analysis of composition of vehicles ply on the roads & their contribution to total ESA, following observations could be made.

- It is observed that highest percentage of vehicle type that use the road is two axle trucks with Four wheeled single rear axle-1.2. including Medium Busses, Large Busses, Medium Good Vehicles(<8.5T) & Large Lorries(>8.5T). In same manner, highest contribution to ESA is given by the same which is about 75% from CNESA.
- Also it was observed that from the lesser number of 3-axle trucks, ESA contribution is much higher compared with other vehicles (Nearly 10% from CNESA)

Therefore more concern should be paid on 1.2 and 1.22 axle types in controlling of overloading in roads.

When consider the heavy vehicle component, it was determined that more than 10% of vehicles are overloaded in most of the road in Sri Lanka. However, according to the analysis done on several roads, overloaded vehicle percentage goes up to maximum of 45%. Hence, it is revealed that overloading is significant and frequent.

In the analysis of extent of overloading, it is concluded that, almost 50% of 2-axle trucks are overloaded more than 25 % up to 50 % from its GVW limit. Also, it was revealed that, 40% multi axle vehicles are almost overloaded by 100% from its GVW limit.

From the analysis, it was identified that sand, fertilizer, cement, flour and rice are often overloaded commodity type.

Considering the often overloaded commodity type, best appropriate axle configuration for transportation of them could be determined such that it does not lead to excessive overloading. In the analysis, it was replaced all 1.2 axle type vehicles which are overloaded than 30%, with 1.22 axle type vehicles. It is revealed that 16.4% reduction & 65.2% reduction of CNESA in A006 & A004 road respectively. Further it has been analyzed and proven that the unit cost for transporting by 1.22 axle types is lesser than 1.2 axle type of vehicles.

From the review of pavement designs, it was determined that the, current pavement construction are done considering the average ESA values disregarding excessive overloading occurred in actual case. Further, it was observed that CNESA values for 20 % overloaded scenario is about one third from the CNESA of actual traffic.

From the cost analysis done to determine user cost & construction cost for one km length, it is revealed that user cost is varied within a large range where the construction cost is varied in small amount. Hence, controlling of overloading become very difficult due to increase of user cost.

5.2 Recommendation

Both user cost and construction cost shall be optimized when at the 20% of overloading than current maximum permissible limit for GVW under due consideration of following facts,

- To avoid extensive pavement designs thus construction cost of roads shall not be an overburden to the government.
- Layer thicknesses of pavement are not much higher when at 20% overloading scenario. Thereby more practicable pavement design could be delivered.
- Extensive pavement designs cannot be applied only for few roads in the road network where the other roads may not structurally sound for higher loadings.

Particularly for sand, fertilizer paddy/rice, flour & cement, transported by 1.2 & 1.22 axle vehicles, restrictions shall be imposed to control the loads than 20% from GVW. Such loads shall be transported by vehicles with one more rare axle. (Ex: 1.2 into 1.22, 1.22 in to 1.2-2.2)

Enforcement should be done since overloading is alarming now. Since 75% & 10% of CNESA are possessed by 1.2 & 1.22 type axles respectively, it is advisable to enforce weight limits especially on those two types of vehicles. To make enforcement more easy, economical and viable, it could be proposed the methods to weigh the loads by counting number of commodity packs or measuring the volume of container etc. (Ex: it could be measured the nu of cement bags in a load, volume of sand in the container)

Following norms could be recommended to practice enforcement of rules against overloading with no weighbridges.

Loading Patterns which contravene Legal Limits extensively		
Carrying Commodity	**Vehicle Type**	**Recommended Bunches/Volume**
Cement, Fertilizer, Rice, Flour (50kg Bags)	1.2 Axles – 6 Wheeled	250 Bunches only
	1.22 Axle – 10 Wheeled	400 Bunches only
Sand, ABC, Metal, Quarry Dust	1.2 Axles – 6 Wheeled	Prohibit raising the bucket size. Up to 3.5 cubes
	1.22 Axle – 10 Wheeled	No action required
Petroleum	1.22 Axle - 10 Wheeled	16000 Liters only

6 REFERENCES

AASHTO. (1993). *ASSHTO Guide for Design of Pavement Structures.* Washington: Ammerican Assoociation of State Highway and Transportation Officials.

Austroads. (2008). *A guide to the Structural Design of Road Pavement.* Sydney: Austroads.

Bagui, S., Das, A., & Bapanapalli, C. (2013). Controlling Vehicle Overloading in BOT Projects. *Procedia - Social and Behavioral Sciencies 104*, 962-971.

Kumarage, A., Bandara, S., & Bandara, G. (2006). Effect on Cost of Road Construction & Maintenance Due to Overloading. *International Workshop on Assessing the need for the management of axle loads in developing countries* (pp. 1-14). Colombo: University of Moratuwa.

Lanka, S. L. (2014, 01 29). *Department of Government Printing.* Retrieved from Department of Government Printing website: http://documents.gov.lk/en/home.php

Mulyono, A. T., Parikesit, D., Antameng, M., & Rahim, R. (2010). Analysis of Loss Cost of Road Pavement Distress due to Overloading Freight Transportation. *Jouranal of the Eastern Asia Society for Transportation Studies, Vol. 8*, 706-721.

Quintero, E. M., Fowkes, T., & Watling, D. (2013). Modelling Planner - Carrier interaction in road freight transport:Optimisation of road maintenance costs via overloading control. *Transport Research Part E 50*, 68-83.

Sharma, B., Sitaramanjaneyula, K., & Kanchan, P. K. (1995). Effect of Vehicle axle Loads on pavement performance. *Road Transport Technology-4. University of Michigan Transporation Research Institute, Ann Arbor*, 263-272.

Mampearachchi, W. K., Kosgolla, J.V, Nanayakkara, S. M. A., (2011). Development of an Economic High Early Strength concrete mix for paving of provincial roads in Sri Lanka. *Engineer, vol XXXXIV, No. 02,pp [1-9], Institute of Engineers, Sri Lanka*

APPENDIX – A: Gazette Notification on axle weight regulations

ශ්‍රී ලංකා ප්‍රජාතාන්ත්‍රික සමාජවාදී ජනරජයේ ගැසට් පත්‍රය

අති විශෙෂ

The Gazette of the Democratic Socialist Republic of Sri Lanka

EXTRAORDINARY

අංක 1847/32 - 2014 ජනවාරි මස 29 වැනි බදාදා - 2014.01.29

No. 1847/32 - WEDNESDAY, JANUARY 29, 2014

(Published by Authority)

PART I : SECTION (I) — GENERAL

Government Notifications

L.D.B 24/51 (vi).

THE MOTOR TRAFFIC ACT (CHAPTER 203)

REGULATIONS made by the Minister of Transport under Section 237 read with Section 19 of the Motor Traffic Act, (Chapter 203).

KUMARA WELGAMA,
Minister of Transport.

Colombo,
21st January, 2014.

Regulation

1. The Motor Traffic (Construction of Vehicles) Regulations 1983 published in the *Gazette Extraoridnary* No. 248 of June, 3, 1983, as amended from time to time and last amended by regulation published in *Gazette Extraodinary* No. 1805/34 of April 11, 2013 are hereby further amended by the repeal of regulation 2 and substitution therefore of the following :-

"2. (1) The dimensions of any motor vehicle shall not exceed the dimensions specified in Column II below in respect of motor vehicles of the class or description specified in the corresponding entry in Column I :-

LENGTH, WIDTH AND HEIGHT

Column I *Class or description of motor vehicles*	*Column II* *millimeters*
(*a*) Overall width of the motor vehicle (other than a motor coach)	2,500
(*b*) Overall width of the motor coach	2,600
(*c*) Height of motor vehicle (other than a double decked motor coach)	3,800
(*d*) Height of a double decked motor coach	4,600
(*e*) Overall length of motor vehicle with two axles other than a motor coach	10,000
(*f*) Overall length of motor vehicle with more than two axles	11,000
(*g*) Overall length of motor coach (other than a heavy motor coach)	12,000
(*h*) Overall length of an articulated vehicle	16,000
(*i*) Overall length of combination vehicle with one trailer	17,000
(*j*) Overall length of a heavy motor coach	24,000

SCHEDULE (*Contd.*)

(2) The height of any motor vehicle shall not exceed One Hundred and Sixty Five per cent (165%) of the width.

(3) (*a*) the axle load of the any motor vehicle shall not exceed the axle load specified in Column II below, in respect of motor vehicles of the class or description specified in the corresponding entry in Column I :-

AXLE LOAD OF A VEHICLE

	Column I *Class or description of motor vehicles*	*Column II* *Kilogrammes*
(i)	Two wheeled single axle	6,000
(ii)	Four wheeled single axle	10,000
(iii)	Four wheeled dual axle	10,000
(iv)	Eight wheeled dual axle or any two consecutive axles with 8 wheels where the axle centers are not more than 2.45 metres apart	16,500
(v)	Twelve wheeled triple axle or any three consecutive axles with 12 wheels where the centers of the extreme axles are not more than 3.66 metres apart	22,000

(*b*) The Gross Vehicle Weight of any motor vehicle shall not exceed the Gross Vehicle Weight specified in Column II below in respect of motor vehicles of the description specified in the corresponding entry in Column I :-

GROSS VEHICLE WEIGHT

	Column I *Description of motor vehicles*	*Column II* *Kilogrammes*
(i)	Motor vehicle with a four wheeled rear axle	15,275
(ii)	Motor vehicle with an eight wheeled dual rear axle	21,300
(iii)	Articulated or combination vehicle with two wheeled front axle and two wheeled rear axle for driving unit and four wheeled axle for trailer	19,900
(iv)	Articulated or combination vehicle with two wheeled front axle and four-wheeled rear axle for driving unit and a four wheeled axle for trailer	23,500
(v)	Articulated or combination vehicle with two wheeled front axle and four wheeled rear axle for driving unit and eight wheeled dual axle for trailer	29,800
(vi)	Articulated or combination vehicle with two wheeled front axle and eight wheeled dual rear axle for driving unit and four wheeled axle for trailer	30,400
(vii)	Articulated or combination vehicle with two wheeled front axle and four wheeled rear axle for driving unit and twelve wheeled triple axle for trailer	33,900
(viii)	Articulated or combination vehicle with two wheeled front axle and eight wheeled dual rear axle for driving unit and eight wheeled dual axle for trailer	36,700
(ix)	Articulated or combination vehicle with two wheeled front axle and four wheeled dual rear axle for driving unit and twelve wheeled triple axle for trailer	31,200
(x)	Articulated or combination vehicle with two wheeled front axle and eight wheeled dual rear axle for driving unit and twelve wheeled triple axle for trailer	42,500"

(2) The regulations published in *Gazette Extraordinary* No. 1380/14 of February 16, 2005 and No. 1726/12 of October 5, 2011 are hereby rescined.

02 - 309

PRINTED AT THE DEPARTMENT OF GOVERNMENT PRINTING, SRI LANKA.

APPENDIX – B: SAMPLE DATA SHEET USED IN AXLE LOAD SURVEY

AXLE LOAD SURVEY

Name of Rd : Colombo-Ratnapura-Wellawaya-Batticaloa (A004)
Location : 22km
Date : 11/09/2013

Directon 1 : Homagama
Direction 2 : Kottawa

S/No	Direction	Vehicle Type	Axle conf	Vehicle bucket size				Filling Type	Load Type		Origin		Distination		Axle1	Axle2	Axle3	Axle4	Axle5	Axle6
				Length	Width	Height	Load height		Code	Name	Code	Name	Code	Name						
1	1	6	1.2						50	Passengers	1100	Colombo	8103	Badulla	4.47	6.87				
2	1	9	1.2						20	Empty	1154	Kottawa	1133	Godagama	3.63	3.23				
3	1	8	1.2						20	Empty	1154	Kottawa	1139	Homagama	1.56	1.25				
4	1	6	1.2						50	Passengers	1158	Maharagama	1121	Avissawella	3.47	5.74				
5	1	7	1.1						20	Empty	1122	Battaramulla	1139	Homagama	1.36	0.69				
6	1	6	1.2						50	Passengers	1100	Colombo	1174	Padukka	4.81	6.38				
7	1	9	1.2						20	Empty	3116	Galle	1139	Homagama	3.22	3.83				
8	1	8	1.2						26	Fertiliser	3116	Galle	1121	Avissawella	2.53	4.07				
9	1	6	1.2						50	Passengers	1100	Colombo	1139	Homagama	3.31	4.43				
10	1	9	1.2						20	Empty	1100	Colombo	9103	Balangoda	3.62	3.47				
11	1	8	1.2						20	Empty	1172	Nugegoda	1139	Homagama	1.52	1.41				
12	1	6	1.2						50	Passengers	1178	Pannipitiya	1139	Homagama	2.46	2.27				
13	1	6	1.2						50	Passengers	1158	Maharagama	1162	Meepe	3.62	4.97				
14	1	8	1.2						20	Empty	1158	Maharagama	1136	Hanwella	1.33	1.08				
15	1	9	1.2						20	Empty	1154	Kottawa	9212	Hettipola (Keg	3.60	3.28				
16	1	5	1.2						50	Passengers	1100	Colombo	2222	Matale	2.17	3.13				
17	1	8	1.2						71	Vegetables	1157	Madiwela	1136	Hanwella	2.23	1.75				
18	1	6	1.2						50	Passengers	1158	Maharagama	1162	Meepe	4.07	5.37				
19	1	9	1.2						20	Empty	1100	Colombo	1139	Homagama	3.61	5.80				
20	1	6	1.2						50	Passengers	1158	Maharagama	1121	Avissawella	2.99	3.49				
21	1	8	1.2						20	Empty	1154	Kottawa	9103	Balangoda	1.69	1.48				
22	1	5	1.2						50	Passengers	1154	Kottawa	1139	Homagama	1.56	1.98				
23	1	6	1.2						50	Passengers	1100	Colombo	1174	Padukka	4.35	5.60				
24	1	8	1.2						9	Charcoal/Coal	1154	Kottawa	1139	Homagama	1.29	2.28				
25	1	8	1.2						68	Tile	1154	Kottawa	1326	Kalutara North	2.01	1.35				
26	1	7	1.1						50	Passengers	1100	Colombo	1325	Ingiriya	4.16	3.52				
27	1	9	1.2						57	Rubber/Rubbe	1154	Kottawa	2122	Kandy	3.69	4.12				
28	1	8	1.2						20	Empty	1154	Kottawa	1139	Homagama	1.63	1.35				
29	1	6	1.2						50	Passengers	1158	Maharagama	1121	Avissawella	2.74	5.17				
30	1	5	1.2						50	Passengers	1165	Moratuwa	2122	Kandy	2.15	2.26				
31	1	7	1.1						67	Textiles	1158	Maharagama	1133	Godagama	0.65	0.43				
32	1	9	1.2						28	Flour	1178	Pannipitiya	1139	Homagama	4.24	7.19				
33	1	9	1.2						29	Food Items	1154	Kottawa	6127	Kurunegala	4.97	6.50				
34	1	6	1.2						50	Passengers	1100	Colombo	8211	Kataragama	3.81	6.65				
35	1	9	1.2						10	Chemicals	1158	Maharagama	8103	Badulla	2.56	8.31				
36	1	9	1.2						20	Empty	1165	Moratuwa	1139	Homagama	3.55	3.60				
37	1	8	1.2						73	Woodden Proc	1154	Kottawa	6127	Kurunegala	2.01	2.51				
38	1	7	1.1						20	Empty	1154	Kottawa	1139	Homagama	0.68	0.47				
39	1	5	1.2						50	Passengers	1172	Nugegoda	1139	Homagama	1.90	2.07				
40	1	6	1.2						50	Passengers	1122	Battaramulla	1139	Homagama	3.69	2.91				
41	1	9	1.2						29	Food Items	1154	Kottawa	6127	Kurunegala	4.92	7.10				
42	1	7	1.1						48	Non Durable I	1154	Kottawa	1139	Homagama	0.62	0.54				
43	1	8	1.2						39	Machines	1154	Kottawa	1139	Homagama	1.54	1.72				
44	1	7	1.1						54	Pvc Prod	1126	Dehiwala	1136	Hanwella	1.35	1.30				
45	1	6	1.2						50	Passengers	1154	Kottawa	1139	Homagama	4.21	4.53				

AXLE LOAD SURVEY

Name of Rd : Colombo-Ratnapura-Wellawaya-Batticaloa (A004)
Location : 22km
Date : 11/09/2013

Directon 1 : Homagama
Direction 2 : Kottawa

S/No	Direction	Vehicle Type	Axle conf	Vehicle bucket size				Filling Type	Load Type		Origin		Distination		Axle1	Axle2	Axle3	Axle4	Axle5	Axle6
				Length	Width	Height	Load height		Code	Name	Code	Name	Code	Name						
46	1	9	1.2						20	Empty	1100	Colombo	1139	Homagama	2.94	3.27				
47	1	5	1.2						50	Passengers	1100	Colombo	8103	Badulla	2.07	3.15				
48	1	6	1.2						50	Passengers	1100	Colombo	9144	Ratnapura	4.35	5.95				
49	1	7	1.1						55	Rice/Paddy	1154	Kottawa	1139	Homagama	1.15	1.36				
50	1	9	1.2						20	Empty	1154	Kottawa	1139	Homagama	3.65	3.34				
51	1	8	1.2						29	Food Items	1154	Kottawa	1133	Godagama	1.74	2.20				
52	1	9	1.2						20	Empty	1158	Maharagama	7214	Manampitiya	3.32	3.51				
53	1	9	1.2						20	Empty	1165	Moratuwa	9215	Kegalle	3.49	3.49				
54	1	6	1.2						50	Passengers	1100	Colombo	1121	Avissawella	4.49	6.22				
55	1	8	1.2						34	Groceries	1158	Maharagama	1133	Godagama	1.10	1.97				
56	1	7	1.1						20	Empty	1280	Wattala	1139	Homagama	0.71	0.40				
57	1	9	1.2						20	Empty	1178	Pannipitiya	1136	Hanwella	3.51	3.22				
58	1	9	1.2						20	Empty	1179	Piliyandala	7219	Polonnaruwa	2.37	2.08				
59	1	8	1.2						20	Empty	1179	Piliyandala	1139	Homagama	1.12	0.78				
60	1	6	1.2						50	Passengers	1100	Colombo	1139	Homagama	4.38	5.39				
61	1	8	1.2						20	Empty	1100	Colombo	1139	Homagama	1.18	0.69				
62	1	9	1.2						29	Food Items	1154	Kottawa	6127	Kurunegala	4.58	7.81				
63	1	6	1.2						50	Passengers	1303	Aluthgama(Ka	1139	Homagama	2.59	6.46				
64	1	9	1.2						29	Food Items	1154	Kottawa	6127	Kurunegala	4.37	7.13				
65	1	9	1.2						20	Empty	1154	Kottawa	1139	Homagama	3.65	3.56				
66	1	10	1.22						20	Empty	1158	Maharagama	1139	Homagama	3.79	4.17	3.84			
67	1	6	1.2						50	Passengers	1100	Colombo	1139	Homagama	3.99	5.09				
68	1	7	1.1						71	Vegetables	1100	Colombo	1139	Homagama	1.03	1.99				
69	1	8	1.2						72	Water	1154	Kottawa	1139	Homagama	2.36	4.02				
70	1	6	1.2						50	Passengers	1126	Dehiwala	1139	Homagama	4.26	5.27				
71	1	9	1.2						62	Steel Prod	1154	Kottawa	4108	Jaffna	3.69	5.33				
72	1	8	1.2						39	Machines	1179	Piliyandala	7130	Tambuthegama	2.41	4.68				
73	1	8	1.2						57	Rubber/Rubbe	1179	Piliyandala	7102	Anuradhapura	1.99	2.70				
74	1	7	1.1						67	Textiles	1185	Ratmalana	1174	Padukka	0.68	0.42				
75	1	7	1.1						35	Hardwere Iten	1154	Kottawa	1139	Homagama	0.68	0.54				
76	1	8	1.2						20	Empty	1158	Maharagama	1139	Homagama	1.87	1.72				
77	1	8	1.2						29	Food Items	1154	Kottawa	1136	Hanwella	2.05	3.86				
78	1	10	1.22						52	Petroleum Pro	1150	Kolonnawa	1325	Ingiriya	7.60	7.70	7.40			
79	1	8	1.2						39	Machines	1179	Piliyandala	6127	Kurunegala	2.41	4.85				
80	1	6	1.2						50	Passengers	1100	Colombo	1139	Homagama	4.07	5.41				
81	1	7	1.1						20	Empty	1154	Kottawa	1139	Homagama	0.74	0.73				
82	1	10	1.22						57	Rubber/Rubbe	1312	Dodangoda	1207	Biyagama	5.85	11.58	11.56			
83	1	8	1.2						57	Rubber/Rubbe	1179	Piliyandala	1139	Homagama	2.39	3.68				
84	1	8	1.2						20	Empty	1172	Nugegoda	1121	Avissawella	1.63	1.18				
85	1	6	1.2						50	Passengers	1100	Colombo	1162	Meepe	3.82	4.68				
86	1	10	1.22						20	Empty	1165	Moratuwa	1121	Avissawella	3.71	2.84	2.80			
87	1	7	1.1						20	Empty	3222	Matara	1139	Homagama	0.71	0.68				
88	1	8	1.2						71	Vegetables	1100	Colombo	1139	Homagama	2.60	6.58				
89	1	6	1.2						50	Passengers	1100	Colombo	1139	Homagama	4.25	5.92				
90	1	9	1.2						20	Empty	1154	Kottawa	7219	Polonnaruwa	3.36	4.23				

APPENDIX – C: AXLE LOAD DATA ANALYSIS SHEETS

APPENDIX – C 1: Analysis of axle load growth trend

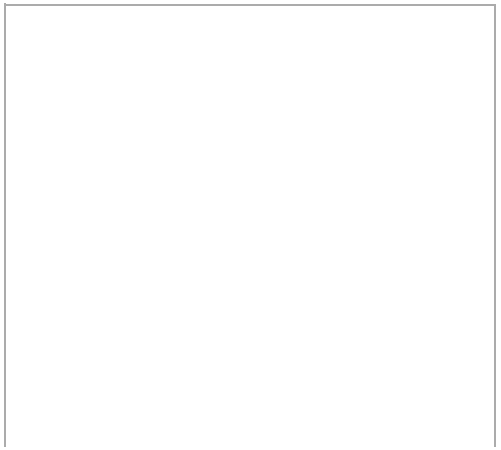
APPENDIX – C 2: Vehicle & ESA composition

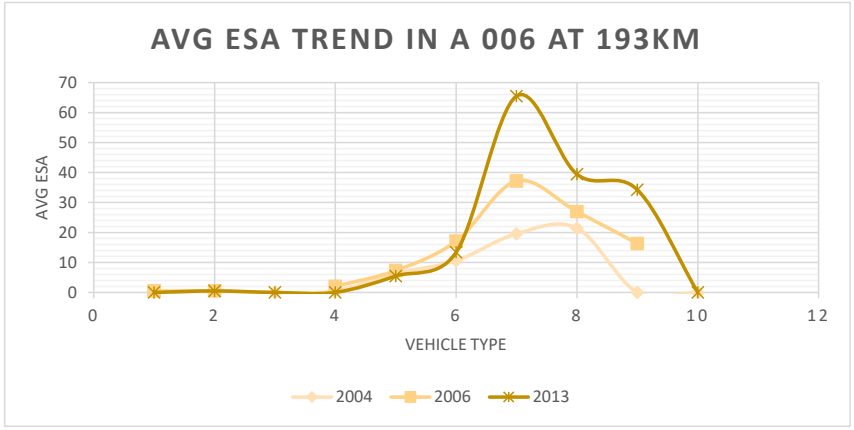
APPENDIX – C 3: Overloaded vehicle percentage, overloaded extent in each road

APPENDIX – C 4: Tables of cost values for each scenario in A004(18km) & A006

Road A006 Ambepussa - Kurunegala - Trincomalee Road
Location 193km

Vehicle Type		Medium Bus (MBU)	Large Bus (LBU)	Light Good Vehicle (LGV)	MG1	MG2	HG3	AG4	AG5	AG6	FVH
Axle Notation											
Year	2004	0.0021	0.455	0.0013	0.5604	6.3004	10.5943	19.5978	21.4378	0	0.0188
	2006	0.49	0.49		2.07	7.29	17.13	37.18	26.94	16.34	
	2009		0.8671		0.0801	9.5934	28.4511	4.6455	12.0713	46.3522	0.0328
	2013	0.0053	0.5029	0.004	0.0294	5.4831	13.4101	65.4947	39.4211	34.2229	0.0145
	2014	0.0162	0.2342	0.1361	0.0106	4.6016	9.8096	57.1707	29.6966	0.3896	0.0007

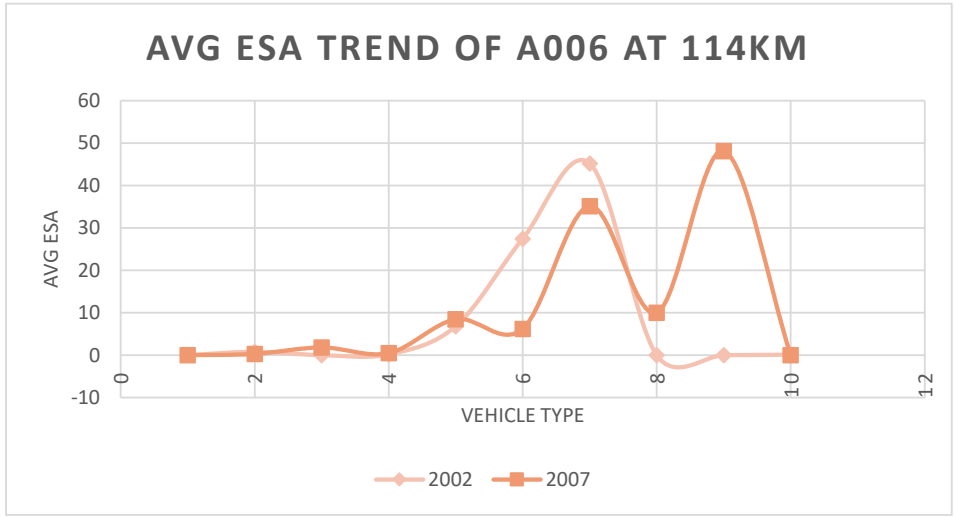




Road A006 Ambepussa - Kurunegala - Trincomalee Road

Location 114km

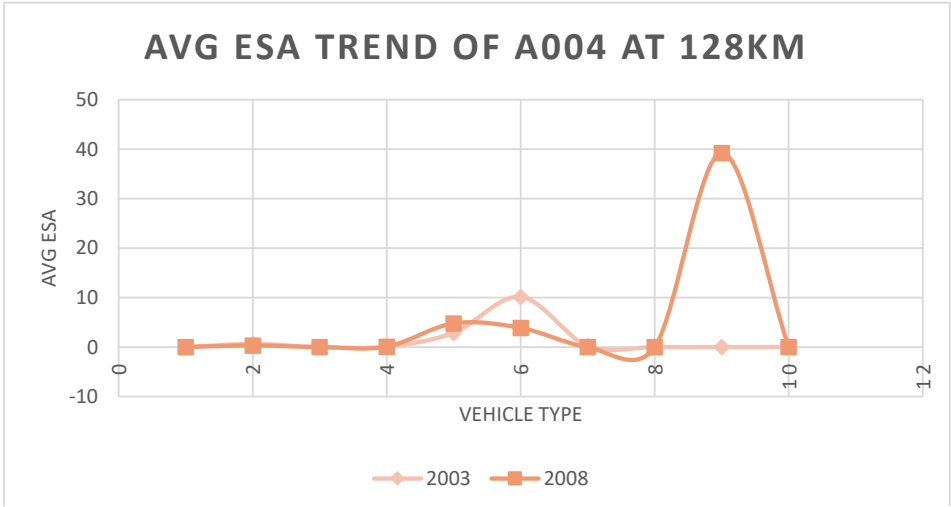
Vehicle Type / Axle Notation / Year	Medium Bus (MBU)	Large Bus (LBU)	Light Good Vehicle (LGV)	MG1	MG2	HG3	AG4	AG5	AG6	FVH
2002	0	0.79	0	0.1959	6.8121	27.4458	45.1946	0	0	0.1159
2007	0.0003	0.2846	1.8197	0.4682	8.4668	6.2086	35.1606	10	48.1146	0
2012										
2013										



Road A004 Colombo - Rathnapura - Wellawaya - Chenkaladi Road

Location 128km

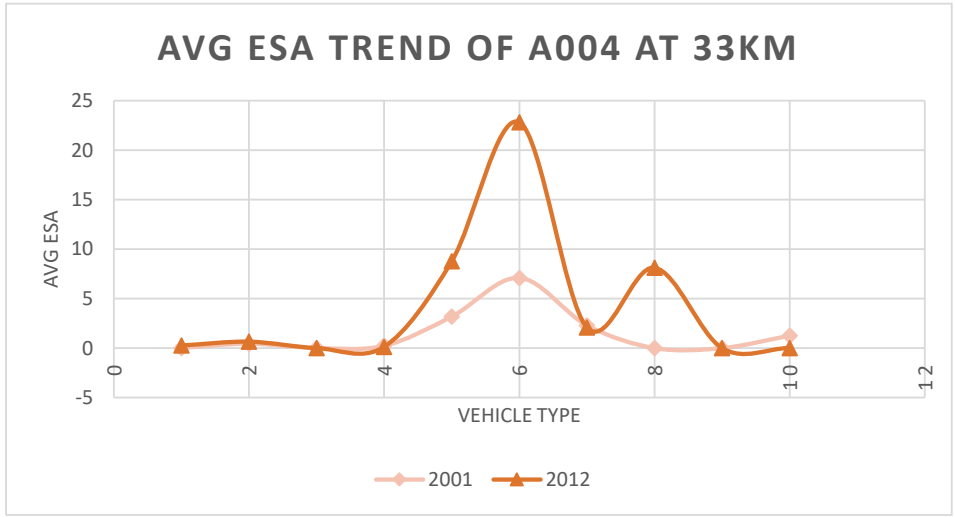
Vehicle Type / Axle Notation		Medium Bus (MBU)	Large Bus (LBU)	Light Good Vehicle (LGV)	MG1	MG2	HG3	AG4	AG5	AG6	FVH
Year	2003	0.0066	0.6336	0.0027	0.085	2.8964	10.1531	0.2189	0	0	0.0139
	2008	0.0175	0.3354	0.0021	0.0877	4.7961	3.8817	0	0	39.2422	0
	2012										
	2013										



Road A004 Colombo - Rathnapura - Wellawaya - Chenkaladi Road

Location 35km

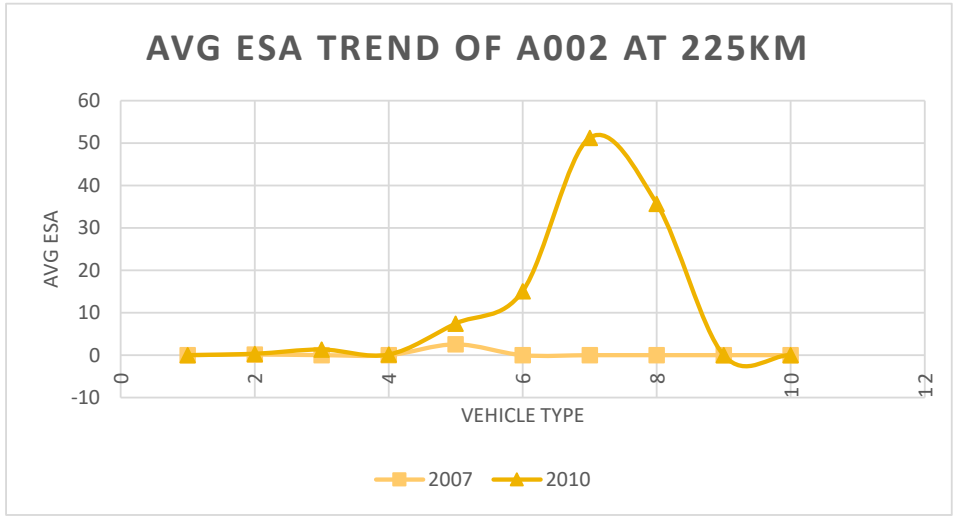
Vehicle Type		Medium Bus (MBU)	Large Bus (LBU)	Light Good Vehicle (LGV)	MG1	MG2	HG3	AG4	AG5	AG6	FVH
Axle Notation											
Year	2001	0.0131	0.4442	0.0033	0.2298	3.1816	7.0962	2.3003	0	0	1.249
	2010	0.0616	0.5068	0.0005	0.1878	5.8564	4.2597	0.2027	0.2088	0.1067	0
	2012	0.2608	0.6472	0.0038	0.1328	8.7692	22.8199	2.084	8.1201	0	0.013
	2013	0.0091	0.2863	0.002	0.06	8.8673	12.3317	0.5161	15.8308	5.8701	0



Road A002 Colombo - Galle - Hambanthota - Wellawaya

Location 225 Boossa

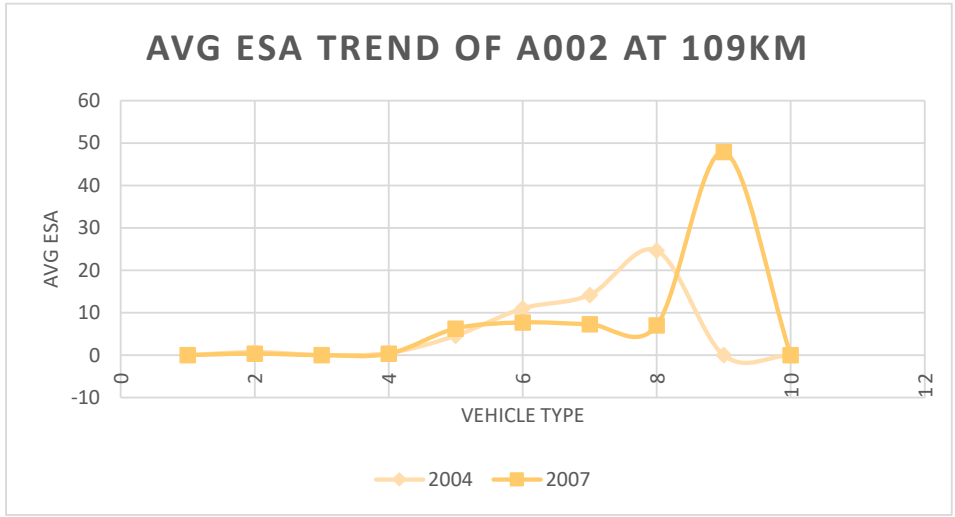
Vehicle Type / Axle Notation / Year	Medium Bus (MBU)	Large Bus (LBU)	Light Good Vehicle (LGV)	MG1	MG2	HG3	AG4	AG5	AG6	FVH
2004										
2007	0.0091	0.16	0.0018	0.0058	2.5516	0	0	0	0	0.0021
2010	0.0018	0.3261	1.3364	0.1486	7.4537	15.10013	51.2635	35.7176	0	0.0454
2014	0.0099	0.448	0.0006	0.1296	9.9269	3.9134	8.7454	5.8554	0	0.0071



Road A002 Colombo - Galle - Hambanthota - Wellawaya

Location 109km Boossa

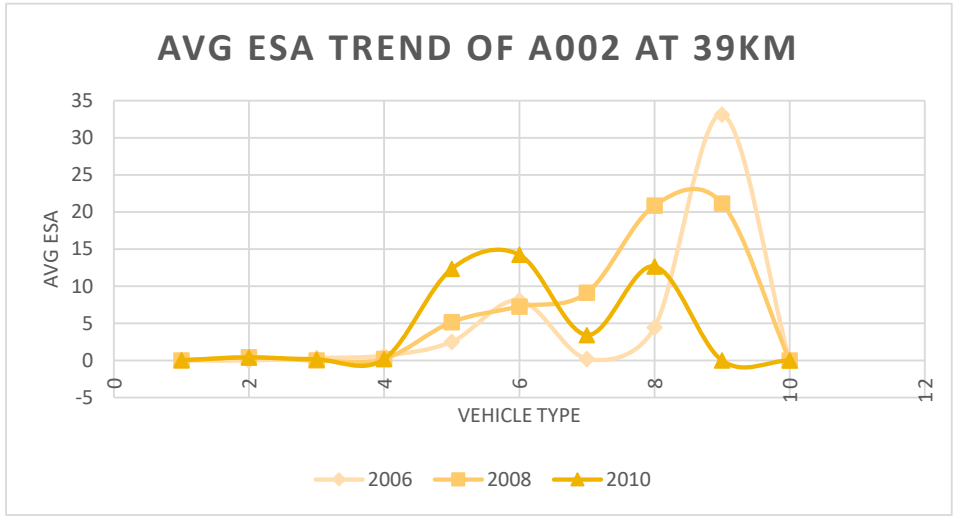
Vehicle Type / Axle Notation		Medium Bus (MBU)	Large Bus (LBU)	Light Good Vehicle (LGV)	MG1	MG2	HG3	AG4	AG5	AG6	FVH
Year	2004	0	0.7296	0.0414	0.5095	4.5983	11.0214	14.2081	24.6524	0	0
	2007	0.0173	0.3757	0.0005	0.336	6.2851	7.7141	7.2975	7	47.899	0.0006
	2010	0.0518	0.414	0.0026	0.0547	7.8548	22.3686	6.2211	14.533	0	0.0002
	2013										



Road A002 Colombo - Galle - Hambanthota - Wellawaya

Location 39km Payagala

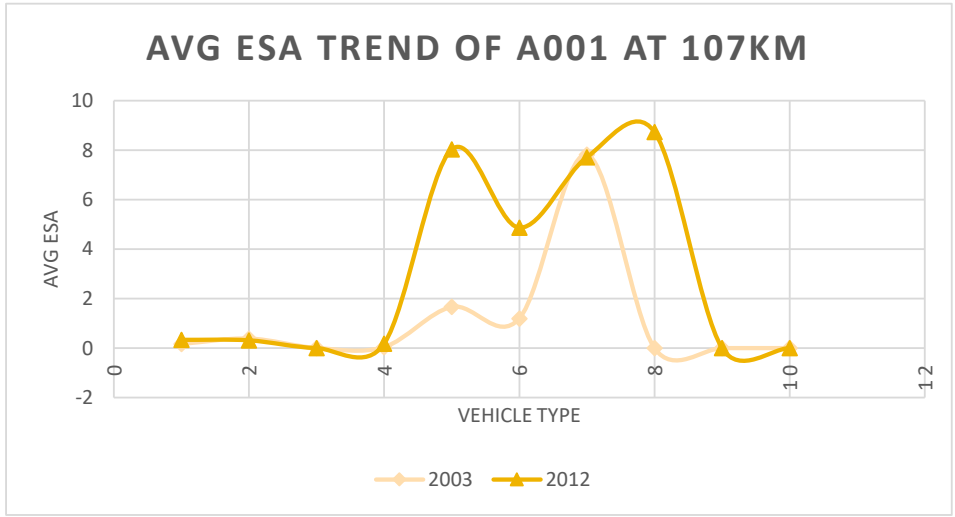
Vehicle Type / Axle Notation		Medium Bus (MBU)	Large Bus (LBU)	Light Good Vehicle (LGV)	MG1	MG2	HG3	AG4	AG5	AG6	FVH
Year	2006	0	0..4	0.32	0.65	2.51	8.09	0.2189	4.44	33.12	0
	2008	0.0202	0.4377	0	0.2223	5.1631	7.2501	9.1358	20.8892	21.1411	0
	2010	0.0326	0.409	0.1418	0.1899	12.3399	14.2385	3.4306	12.6723	0	0
	2013										



Road A001

Location 107km Pilimathalawa

Vehicle Type / Axle Notation / Year	Medium Bus (MBU)	Large Bus (LBU)	Light Good Vehicle (LGV)	MG1	MG2	HG3	AG4	AG5	AG6	FVH
2003	0.169	0.3856	0.0053	0.0425	1.6645	1.1958	7.8155	0	0	0
2006										
2012	0.334	0.3128	0.0016	0.1792	8.0311	4.8664	7.7156	8.7334	0	0
2013										



Road Name Colombo-Ratnapura-Wellawaya-Batticaloa (A004)
Location Name 22km
Survey Date : 11.09.2013
Period of Survey : 12hrs

1 Homagama 2 Kottawa

Sr NO	DIR	VEH TYPE	AXLE CONFIG	LOAD		ORIG		DISTI		Distance	Tare Weight	Weight of Load Only	Cost/Ton.km	Cost incurred for a trip	Measured – Axle Load AXLE1	AXLE2	AXLE3	AXLE4	AXLE5	AXLE6	Total load	Alo.GVW	Excess Weight	Overloaded	ESA AXLE1	AXLE2	AXLE3	AXLE4	AXLE5	AXLE6	SUM ESA	AVE ESA	Adjusted – Limited axle load AXLE1	AXLE2	AXLE3	AXLE4	AXLE5	AXLE6	ESA AXLE1	AXLE2	AXLE3	AXLE4	AXLE5	AXLE6	SUM ESA	AVE ESA
1	1	6	1.2	50	Passengers	1100	Colombo	8103	Badulla	224	5.25	6.090	75.00	16,800.00	4.47	6.87					11.34	15.275		No	0.065	0.457	-	-	-	-	0.522		4.47	6.87					0.065	0.457	-	-	-	-	0.522	
2	1	9	1.2	20	Empty	1154	Kottawa	1133	Godagama	10	6.75			-	3.63	3.23					6.86	15.275		No	0.025	0.015	-	-	-	-	0.040		3.63	3.23					0.025	0.015	-	-	-	-	0.040	
3	1	8	1.2	20	Empty	1154	Kottawa	1139	Homagama	5	3.00			-	1.56	1.25					2.81	15.275		No	0.001	0.000	-	-	-	-	0.001		1.56	1.25					0.001	0.000	-	-	-	-	0.001	
4	1	6	1.2	50	Passengers	1158	Maharagama	1121	Avissawella	36	5.25	3.960	75.00	2,700.00	3.47	5.74					9.21	15.275		No	0.020	0.202	-	-	-	-	0.222		3.47	5.74					0.020	0.202	-	-	-	-	0.222	
5	1	7	1.1	20	Empty	1122	Battaramulla	1139	Homagama	15	1.10			-	1.36	0.69					2.05	15.275		No	0.000	0.000	-	-	-	-	0.000		1.36	0.69					0.000	0.000	-	-	-	-	0.000	
6	1	6	1.2	50	Passengers	1100	Colombo	1174	Padukka	25	5.25	5.940	75.00	1,875.00	4.81	6.38					11.19	15.275		No	0.090	0.326	-	-	-	-	0.417		4.81	6.38					0.090	0.326	-	-	-	-	0.417	
7	1	9	1.2	20	Empty	3116	Galle	1139	Homagama	105	6.75			-	3.22	3.83					7.05	15.275		No	0.015	0.032	-	-	-	-	0.047		3.22	3.83					0.015	0.032	-	-	-	-	0.047	
8	1	8	1.2	26	Fertiliser	3116	Galle	1121	Avissawella	135	3.00	3.600	8.13	3,951.18	2.53	4.07					6.6	15.275		No	0.005	0.042	-	-	-	-	0.047		2.53	4.07					0.005	0.042	-	-	-	-	0.047	
9	1	6	1.2	50	Passengers	1100	Colombo	1139	Homagama	20	5.25	2.490	75.00	1,500.00	3.31	4.43					7.74	15.275		No	0.016	0.062	-	-	-	-	0.079		3.31	4.43					0.016	0.062	-	-	-	-	0.079	
10	1	9	1.2	20	Empty	1100	Colombo	9103	Balangoda	143	6.75			-	3.62	3.47					7.09	15.275		No	0.025	0.020	-	-	-	-	0.045		3.62	3.47					0.025	0.020	-	-	-	-	0.045	
11	1	8	1.2	20	Empty	1172	Nugegoda	1139	Homagama	15	3.00			-	1.52	1.41					2.93	15.275		No	0.000	0.000	-	-	-	-	0.001		1.52	1.41					0.000	0.000	-	-	-	-	0.001	
12	1	6	1.2	50	Passengers	1178	Pannipitiya	1139	Homagama	10	5.25		75.00	750.00	2.46	2.27					4.73	15.275		No	0.004	0.003	-	-	-	-	0.007		2.46	2.27					0.004	0.003	-	-	-	-	0.007	
13	1	6	1.2	50	Passengers	1158	Maharagama	1162	Meepe	20	5.25	3.340	75.00	1,500.00	3.62	4.97					8.59	15.275		No	0.025	0.105	-	-	-	-	0.130		3.62	4.97					0.025	0.105	-	-	-	-	0.130	
14	1	8	1.2	20	Empty	1158	Maharagama	1136	Hanwella	25	3.00			-	1.33	1.08					2.41	15.275		No	0.000	0.000	-	-	-	-	0.000		1.33	1.08					0.000	0.000	-	-	-	-	0.000	
15	1	9	1.2	20	Empty	1154	Kottawa	9212	Hettipola (Keg)	95	6.75			-	3.60	3.28					6.88	15.275		No	0.024	0.016	-	-	-	-	0.040		3.60	3.28					0.024	0.016	-	-	-	-	0.040	
16	1	5	1.2	50	Passengers	1100	Colombo	2222	Matale	155	3.50	1.800	65.00	10,075.00	2.17	3.13					5.3	15.275		No	0.002	0.013	-	-	-	-	0.015		2.17	3.13					0.002	0.013	-	-	-	-	0.015	
17	1	8	1.2	71	Vegetables	1157	Madiwela	1136	Hanwella	44	3.00	0.980	25.50	1,099.56	2.23	1.75					3.98	15.275		No	0.003	0.001	-	-	-	-	0.004		2.23	1.75					0.003	0.001	-	-	-	-	0.004	
18	1	6	1.2	50	Passengers	1158	Maharagama	1162	Meepe	20	5.25	4.190	75.00	1,500.00	4.07	5.37					9.44	15.275		No	0.042	0.149	-	-	-	-	0.191		4.07	5.37					0.042	0.149	-	-	-	-	0.191	
19	1	9	1.2	20	Empty	1100	Colombo	1139	Homagama	20	6.75			-	3.61	5.80					9.41	15.275		No	0.024	0.212	-	-	-	-	0.236		3.61	5.80					0.024	0.212	-	-	-	-	0.236	
20	1	6	1.2	50	Passengers	1158	Maharagama	1121	Avissawella	36	5.25	1.230	75.00	2,700.00	2.99	3.49					6.48	15.275		No	0.010	0.021	-	-	-	-	0.031		2.99	3.49					0.010	0.021	-	-	-	-	0.031	
21	1	8	1.2	20	Empty	1154	Kottawa	9103	Balangoda	130	3.00			-	1.69	1.48					3.17	15.275		No	0.001	0.000	-	-	-	-	0.001		1.69	1.48					0.001	0.000	-	-	-	-	0.001	
22	1	5	1.2	50	Passengers	1154	Kottawa	1139	Homagama	10	3.50	0.040	65.00	650.00	1.56	1.98					3.54	15.275		No	0.001	0.002	-	-	-	-	0.002		1.56	1.98					0.001	0.002	-	-	-	-	0.002	
23	1	6	1.2	50	Passengers	1100	Colombo	1174	Padukka	25	5.25	4.700	75.00	1,875.00	4.35	5.60					9.95	15.275		No	0.057	0.180	-	-	-	-	0.237		4.35	5.60					0.057	0.180	-	-	-	-	0.237	
24	1	8	1.2	9	Charcoal/Coal	1154	Kottawa	1139	Homagama	5	3.00	0.570	18.75	53.44	1.29	2.28					3.57	15.275		No	0.000	0.003	-	-	-	-	0.003		1.29	2.28					0.000	0.003	-	-	-	-	0.003	
25	1	8	1.2	68	Tile	1154	Kottawa	1326	Kalutara North	40	3.00	0.360	18.75	270.00	2.01	1.35					3.36	15.275		No	0.002	0.000	-	-	-	-	0.002		2.01	1.35					0.002	0.000	-	-	-	-	0.002	
26	1	7	1.1	50	Passengers	1100	Colombo	1325	Ingiriya	60	1.10	6.580	75.00	4,500.00	4.16	3.52					7.68	15.275		No	0.047	0.022	-	-	-	-	0.068		4.16	3.52					0.047	0.022	-	-	-	-	0.068	
27	1	9	1.2	57	Rubber/Rubber Prod	1154	Kottawa	2122	Kandy	121	6.75	1.060	16.29	2,089.36	3.69	4.12					7.81	15.275		No	0.027	0.045	-	-	-	-	0.072		3.69	4.12					0.027	0.045	-	-	-	-	0.072	
28	1	8	1.2	20	Empty	1154	Kottawa	1139	Homagama	5	3.00			-	1.63	1.35					2.98	15.275		No	0.001	0.000	-	-	-	-	0.001		1.63	1.35					0.001	0.000	-	-	-	-	0.001	
29	1	6	1.2	50	Passengers	1158	Maharagama	1121	Avissawella	36	5.25	2.660	75.00	2,700.00	2.74	5.17					7.91	15.275		No	0.007	0.125	-	-	-	-	0.132		2.74	5.17					0.007	0.125	-	-	-	-	0.132	
30	1	5	1.2	50	Passengers	1165	Moratuwa	2122	Kandy	135	3.50	0.910	65.00	8,775.00	2.15	2.26					4.41	15.275		No	0.002	0.003	-	-	-	-	0.005		2.15	2.26					0.002	0.003	-	-	-	-	0.005	
31	1	7	1.1	67	Textiles	1158	Maharagama	1133	Godagama	15	1.10	1.000	43.14	647.10	0.65	0.43					1.08	15.275		No	0.000	0.000	-	-	-	-	0.000		0.65	0.43					0.000	0.000	-	-	-	-	0.000	
32	1	9	1.2	28	Flour	1178	Pannipitiya	1139	Homagama	7	6.75	4.680	6.25	204.75	4.24	7.19					11.43	15.275		No	0.051	0.562	-	-	-	-	0.613		4.24	7.19					0.051	0.562	-	-	-	-	0.613	
33	1	9	1.2	29	Food Items	1154	Kottawa	6127	Kurunegala	98	6.75	4.720	13.50	6,244.56	4.97	6.50					11.47	15.275		No	0.105	0.355	-	-	-	-	0.460		4.97	6.50					0.105	0.355	-	-	-	-	0.460	
34	1	6	1.2	50	Passengers	1100	Colombo	8211	Kataragama	280	5.25	5.210	75.00	21,000.00	3.81	6.65					10.46	15.275		No	0.031	0.394	-	-	-	-	0.425		3.81	6.65					0.031	0.394	-	-	-	-	0.425	
35	1	9	1.2	10	Chemicals	1158	Maharagama	8103	Badulla	206	6.75	4.120	13.50	11,457.72	2.56	8.31					10.87	15.275		No	0.005	1.086	-	-	-	-	1.092		2.56	8.31					0.005	1.086	-	-	-	-	1.092	
36	1	9	1.2	20	Empty	1165	Moratuwa	1139	Homagama	10	6.75			-	3.55	3.60					7.15	15.275		No	0.023	0.024	-	-	-	-	0.047		3.55	3.60					0.023	0.024	-	-	-	-	0.047	
37	1	8	1.2	73	Wooden Prod	1154	Kottawa	6127	Kurunegala	98	3.00	1.520	18.75	2,793.00	2.01	2.51					4.52	15.275		No	0.002	0.005	-	-	-	-	0.006		2.01	2.51					0.002	0.005	-	-	-	-	0.006	
38	1	7	1.1	20	Empty	1154	Kottawa	1139	Homagama	5	1.10			-	0.68	0.47					1.15	15.275		No	0.000	0.000	-	-	-	-	0.000		0.68	0.47					0.000	0.000	-	-	-	-	0.000	
39	1	5	1.2	50	Passengers	1172	Nugegoda	1139	Homagama	15	3.50	0.470	65.00	975.00	1.90	2.07					3.97	15.275		No	0.001	0.002	-	-	-	-	0.003		1.90	2.07					0.001	0.002	-	-	-	-	0.003	
40	1	6	1.2	50	Passengers	1122	Battaramulla	1139	Homagama	30	5.25	1.350	75.00	2,250.00	3.69	2.91					6.6	15.275		No	0.027	0.009	-	-	-	-	0.036		3.69	2.91					0.027	0.009	-	-	-	-	0.036	
41	1	9	1.2	29	Food Items	1154	Kottawa	6127	Kurunegala	98	6.75	5.270	13.50	6,972.21	4.92	7.10					12.02	15.275		No	0.100	0.531	-	-	-	-	0.631		4.92	7.10					0.100	0.531	-	-	-	-	0.631	
42	1	7	1.1	48	Non Durable Items	1154	Kottawa	1139	Homagama	5	1.10	0.060	22.00	6.60	0.62	0.54					1.16	15.275		No	0.000	0.000	-	-	-	-	0.000		0.62	0.54					0.000	0.000	-	-	-	-	0.000	
43	1	8	1.2	39	Machines	1154	Kottawa	1139	Homagama	5	3.00	0.260	16.25	21.13	1.54	1.72					3.26	15.275		No	0.001	0.001	-	-	-	-	0.001		1.54	1.72					0.001	0.001	-	-	-	-	0.001	
44	1	7	1.1	54	PVC Product	1126	Dehiwala	1136	Hanwella	31	1.10	1.550	47.00	2,258.35	1.35	1.30					2.65	15.275		No	0.000	0.000	-	-	-	-	0.001		1.35	1.30					0.000	0.000	-	-	-	-	0.001	
45	1	6	1.2	50	Passengers	1154	Kottawa	1139	Homagama	5	5.25	3.490	75.00	375.00	4.21	4.53					8.74	15.275		No	0.049	0.069	-	-	-	-	0.118		4.21	4.53					0.049	0.069	-	-	-	-	0.118	
46	1	9	1.2	20	Empty	1100	Colombo	1139	Homagama	20	6.75			-	2.94	3.27					6.21	15.275		No	0.010	0.016	-	-	-	-	0.025		2.94	3.27					0.010	0.016	-	-	-	-	0.025	
47	1	5	1.2	50	Passengers	1100	Colombo	8103	Badulla	224	3.50	1.720	65.00	14,560.00	2.07	3.15					5.22	15.275		No	0.002	0.013	-	-	-	-	0.015		2.07	3.15					0.002	0.013	-	-	-	-	0.015	
48	1	6	1.2	50	Passengers	1100	Colombo	9144	Ratnapura	100	5.25	5.050	75.00	7,500.00	4.35	5.95					10.3	15.275		No	0.057	0.238	-	-	-	-	0.295		4.35	5.95					0.057	0.238	-	-	-	-	0.295	
49	1	7	1.1	55	Rice/Paddy	1154	Kottawa	1139	Homagama	5	1.10	1.410	16.88	118.97	1.15	1.36					2.51	15.275		No	0.000	0.000	-	-	-	-	0.000		1.15	1.36					0.000	0.000	-	-	-	-	0.000	
50	1	9	1.2	20	Empty	1154	Kottawa	1139	Homagama	5	6.75			-	3.65	3.34					6.99	15.275		No	0.026	0.017	-	-	-	-	0.043		3.65	3.34					0.026	0.017	-	-	-	-	0.043	
51	1	8	1.2	29	Food Items	1154	Kottawa	1133	Godagama	10	3.00	0.940	18.75	176.25	1.74	2.20					3.94	15.275		No	0.001	0.003	-	-	-	-	0.003		1.74	2.20					0.001	0.003	-	-	-	-	0.003	
52	1	9	1.2	20	Empty	1158	Maharagama	7214	Manampitiya	225	6.75			-	3.32	3.51					6.83	15.275		No	0.017	0.022	-	-	-	-	0.038		3.32	3.51					0.017	0.022	-	-	-	-	0.038	
53	1	9	1.2	20	Empty	1165	Moratuwa	9215	Kegalle	98	6.75			-	3.49	3.49					6.98	15.275		No	0.021	0.021	-	-	-	-	0.042		3.49	3.49					0.021	0.021	-	-	-	-	0.042	
54	1	6	1.2	50	Passengers	1100	Colombo	1121	Avissawella	46	5.25	5.460	75.00	3,450.00	4.49	6.22					10.71	15.275		No	0.066	0.291	-	-	-	-	0.357		4.49	6.22					0.066	0.291	-	-	-	-	0.357	
55	1	8	1.2	34	Groceries	1158	Maharagama	1133	Godagama	15	3.00	0.070	18.75	19.69	1.10	1.97					3.07	15.275		No	0.000	0.002	-	-	-	-	0.002		1.10	1.97					0.000	0.002	-	-	-	-	0.002	
56	1	7	1.1	20	Empty	1280	Wattala	1139	Homagama	30	1.10			-	0.71	0.40					1.11	15.275		No	0.000	0.000	-	-	-	-	0.000		0.71	0.40					0.000	0.000	-	-	-	-	0.000	
57	1	9	1.2	20	Empty	1178	Pannipitiya	1136	Hanwella	30	6.75			-	3.51	3.22					6.73	15.275		No	0.022	0.015	-	-	-	-	0.036		3.51	3.22					0.022	0.015	-	-	-	-	0.036	
58	1	9	1.2	20	Empty	1179	Piliyandala	7219	Polonnaruwa	234	6.75			-	2.37	2.08					4.45	15.275		No	0.004	0.002	-	-	-	-	0.006		2.37	2.08					0.004	0.002	-	-	-	-	0.006	
59	1	8	1.2	20	Empty	1179	Piliyandala	1139	Homagama	10	3.00			-	1.12	0.78					1.9	15.275		No	0.000	0.000	-	-	-	-	0.000		1.12	0.78					0.000	0.000	-	-	-	-	0.000	
60	1	6	1.2	50	Passengers	1100	Colombo	1139	Homagama	20	5.25	4.520	75.00	1,500.00	4.38	5.39					9.77	15.275		No	0.059	0.152	-	-	-	-	0.210		4.38	5.39					0.059	0.152	-	-	-	-	0.210	
61	1	8	1.2	20	Empty	1100	Colombo	1139	Homagama	20	3.00			-	1.18	0.69					1.87	15.275		No	0.000	0.000	-	-	-	-	0.000		1.18	0.69					0.000	0.000	-	-	-	-	0.000	
62	1	9	1.2	29	Food Items	1154	Kottawa	6127	Kurunegala	98	6.75	5.640	13.50	7,461.72	4.58	7.81					12.39	15.275		No	0.072	0.819	-	-	-	-	0.891		4.58	7.81					0.072	0.819	-	-	-	-	0.891	
63	1	6	1.2	50	Passengers	1303	Aluthgama(Kal)	1139	Homagama	70	5.25	3.800	75.00	5,250.00	2.59	6.46					9.05	15.275		No	0.005	0.345	-	-	-	-	0.351		2.59	6.46					0.005	0.345	-	-	-	-	0.351	
64	1	9	1.2	29	Food Items	1154	Kottawa	6127	Kurunegala	98	6.75	4.750	13.50	6,284.25	4.37	7.13					11.5	15.275		No	0.058	0.541	-	-	-	-	0.600		4.37	7.13					0.058	0.541	-	-	-	-	0.600	
65	1	9	1.2	20	Empty	1154	Kottawa	1139	Homagama	5	6.75			-	3.65	3.56					7.21	15.275		No	0.026	0.023	-	-	-	-	0.049		3.65	3.56					0.026	0.023	-	-	-	-	0.049	
66	1	10	1.22	20	Empty	1158	Maharagama	1139	Homagama	10	9.00			-	3.79	4.17	3.84				11.8	21.300		No	0.031	0.047	0.032	-	-	-	0.110		3.79	4.17	3.84				0.031	0.047	0.032	-	-	-	0.110	
67	1	6	1.2	50	Passengers	1100	Colombo	1139	Homagama	20	5.25	3.830	75.00	1,500.00	3.99	5.09					9.08	15.275		No	0.039	0.117	-	-	-	-	0.155		3.99	5.09					0.039	0.117	-	-	-	-	0.155	
68	1	7	1.1	71	Vegetables	1100	Colombo	1139	Homagama	23	1.10	1.920	43.14	1,905.06	1.03	1.99					3.02	15.275		No	0.000	0.002	-	-	-	-	0.002		1.03	1.99					0.000	0.002	-	-	-	-	0.002	
69	1	8	1.2	72	Water	1154	Kottawa	1139	Homagama	5	3.00	3.380	33.50	566.15	2.36	4.02					6.38	15.275		No	0.004	0.040	-	-	-	-	0.043		2.36	4.02					0.004	0.040	-	-	-	-	0.043	
70	1	6	1.2	50	Passengers	1126	Dehiwala	1139	Homagama	30	5.25	4.280	75.00	2,250.00	4.26	5.27					9.53	15.275		No	0.052	0.137	-	-	-	-	0.189		4.26	5.27					0.052	0.137	-	-	-	-	0.189	
71	1	9	1.2	62	Steel Prod	1154	Kottawa	4108	Jaffna	400	6.75	2.270	16.29	14,791.32	3.69	5.33					9.02	15.275		No	0.027	0.144	-	-	-	-	0.171		3.69	5.33					0.027	0.144	-	-	-	-	0.171	
72	1	8	1.2	39	Machines	1179	Piliyandala	7130	Tambuthegama	192	3.00	4.090	16.25	12,760.80	2.41	4.68					7.09	15.275		No	0.004	0.080	-	-	-	-	0.084		2.41	4.68					0.004	0.080	-	-	-	-	0.084	
73	1	8	1.2	57	Rubber/Rubber Prod	1179	Piliyandala	7102	Anuradhapura	215	3.00	1.690	18.75	6,812.81	1.99	2.70					4.69	15.275		No	0.002	0.007	-	-	-	-	0.008		1.99	2.70					0.002	0.007	-	-	-	-	0.008	
74	1	7	1.1	67	Textiles	1185	Ratmalana	1174	Padukka	31	1.10	1.000	43.14	1,337.34	0.68	0.42					1.1	15.275		No	0.000	0.000	-	-	-	-	0.000		0.68	0.42					0.000	0.000	-	-	-	-	0.000	
75	1	7	1.1	35	Hardwere Items	1154	Kottawa	1139	Homagama	5	1.10	0.120	29.15	17.49	0.68	0.54					1.22	15.275		No	0.000	0.000	-	-	-	-	0.000		0.68	0.54					0.000	0.000	-	-	-	-	0.000	
76	1	8	1.2	20	Empty	1158	Maharagama	1139	Homagama	10	3.00			-	1.87	1.72					3.59	15.275		No	0.001	0.001	-	-	-	-	0.002		1.87	1.72					0.001	0.001	-	-	-	-	0.002	
77	1	8	1.2	29	Food Items	1154	Kottawa	1136	Hanwella	21	3.00	2.910	18.75	1,145.81	2.05	3.86					5.91	15.275		No	0.002	0.033	-	-	-	-	0.035		2.05	3.86					0.002	0.033	-	-	-	-	0.035	
78	1	10	1.22	52	Petroleum Product	1150	Kolonnawa	1325	Ingiriya	23	9.00	12.300	10.25	2,899.73	7.60	7.70	7.40				22.7	21.300	1.400	Yes	0.724	0.768	0.641	-	-	-	2.133		5.05	7.70	7.40				0.113	0.768	0.641	-	-	-	1.522	
79	1	8	1.2	39	Machines	1179	Piliyandala	6127	Kurunegala	109	3.00	4.260	16.25	7,545.53	2.41	4.85					7.26	15.275		No	0.004	0.094	-	-	-	-	0.098		2.41	4.85					0.004	0.094	-	-	-	-	0.098	
80	1	6	1.2	50	Passengers	1100	Colombo	1139	Homagama	20	5.25	4.230	75.00	1,500.00	4.07	5.41					9.48	15.275		No	0.042	0.154	-	-	-	-	0.196		4.07	5.41					0.042	0.154	-	-	-	-	0.196	
81	1	7	1.1	20	Empty	1154	Kottawa	1139	Homagama	5	1.10			-	0.74	0.73					1.47	15.275		No	0.000	0.000	-	-	-	-	0.000		0.74	0.73					0.000	0.000	-	-	-	-	0.000	
82	1	10	1.22	57	Rubber/Rubber Prod	1312	Dodangoda	1207	Biyagama	57	9.00	12.300	12.00	8,413.20	5.85	11.58	11.56				28.99	21.300	7.690	Yes	0.220	4.917	4.878	-	-	-	10.015		5.05	10.10	10.10				0.113	2.639	2.639	-	-	-	5.391	
83	1	8	1.2	57	Rubber/Rubber Prod	1179	Piliyandala	1139	Homagama	11	3.00	3.070	18.75	633.19	2.39	3.68					6.07	15.275		No	0.004	0.027	-	-	-	-	0.030		2.39	3.68					0.004	0.027	-	-	-	-	0.030	
84	1	8	1.2	20	Empty	1172	Nugegoda	1121	Avissawella	33	3.00			-	1.63	1.18					2.81	15.275		No	0.001	0.000	-	-	-	-	0.001		1.63	1.18					0.001	0.000	-	-	-	-	0.001	
85	1	6	1.2	50	Passengers	1100	Colombo	1162	Meepe	28	5.25	3.250	75.00	2,100.00	3.82	4.68					8.5	15.275		No	0.032	0.080	-	-	-	-	0.111		3.82	4.68					0.032	0.080	-	-	-	-	0.111	
86	1	10	1.22	20	Empty	1165	Moratuwa	1121	Avissawella	30	9.00			-	3.71	2.84	2.80				9.35	21.300		No	0.028	0.008	0.008	-	-	-	0.044		3.71	2.84	2.80				0.028	0.008	0.008	-	-	-	0.044	
87	1	7	1.1	20	Empty	3222	Matara	1139	Homagama	145	1.10			-	0.71	0.68					1.39	15.275		No	0.000	0.000	-	-	-	-	0.000		0.71	0.68					0.000	0.000	-	-	-	-	0.000	
88	1	8	1.2	71	Vegetables	1100	Colombo	1139	Homagama	23	3.00	6.180	25.50	3,624.57	2.60	6.58					9.18	15.275		No	0.005	0.376	-	-	-	-	0.381		2.60	6.58					0.005	0.376	-	-	-	-	0.381	
89	1	6	1.2	50	Passengers	1100	Colombo	1139	Homagama	20	5.25	4.920	75.00	1,500.00	4.25	5.92					10.17	15.275		No	0.051	0.232	-	-	-	-	0.284		4.25	5.92					0.051	0.232	-	-	-	-	0.284	
90	1	9	1.2	20	Empty	1154	Kottawa	7219	Polonnaruwa	225	6.75			-	3.36	4.23					7.59	15.275		No	0.018	0.050	-	-	-	-	0.068		3.36	4.23					0.018	0.050	-	-	-	-	0.068	
91	1	9	1.2	41	Matal	1103	Col-3 Kollupitiya	1161	Meegoda	27	6.75	8.525	9.25	2,129.12	6.04	14.40					20.44	15.275	5.165	Yes	0.254	13.254	-	-	-	-	13.509		5.05	10.10					0.113	2.639	-	-	-	-	2.752	
92	1	9	1.2	20	Empty	1335	Mathugama	1139	Homagama	48	6.75			-	2.89	2.83					5.72	15.275		No	0.009	0.008	-	-	-	-	0.017		2.89	2.83					0.009	0.008	-	-	-	-	0.017	
93	1	7	1.1	20	Empty	1120	Aturugiriya	1133	Godagama	10	1.10			-	0.67	0.35					1.02	15.275		No	0.000	0.000	-	-	-	-	0.000		0.67	0.35					0.000	0.000	-	-	-	-	0.000	
94	1	9	1.2	51	Faultry Foods	3130	Kottawa	1136	Hanwella	15	6.75	5.180	16.29	1,265.73	4.04	7.89					11.93	15.275		No	0.041	0.858	-	-	-	-	0.899		4.04	7.89					0.041	0.858	-	-	-	-	0.899	

Road Name : Ambepussa-Kurunegala-Trincomalee(A006)
Location Name : 193km(4th Mile post)
Survey Date : 12.12.2013
Period of Survey : 12hrs

1 Kanthale 2 Trincomalee

72.00 72.00

Measured

Sr NO	DIR	VEH TYPE	AXLE CONFIG	LOAD		ORIG		DISTI		Distance	Tare Weight	Weight of Load only	Cost/Ton.km	Cost incurred for trip	Axle Load AXLE1	AXLE2	AXLE3	AXLE4	AXLE5	AXLE6	Total load	Alo.GVW	Excess Weight	Overloaded
1	2	9	1.2	20	Empty	5306	Kantale	5318	Trincomalee	38	6.75			-	3.53	3.02					6.55	16.803		No
2	2	10	1.22	20	Empty	5306	Kantale	5318	Trincomalee	38	9.00			-	3.86	2.44	2.63				8.93	23.430		No
3	2	7	1.1	74	Plants	5306	Kantale	5314	Pulmoddai	89	1.10	0.42	29	1,089.63	0.68	0.84					1.52	16.803		No
4	2	10	1.22	24	Empty Containers	5306	Kantale	5318	Trincomalee	39	9.00	0.84		-	3.22	3.29	3.33				9.84	23.430		No
5	2	9	1.2	7	Cement Prod/Terras	1100	Colombo	5318	Trincomalee	266	6.75	3.10	15	12,616.38	4.59	5.26					9.85	16.803		No
6	1	9	1.2	20	Empty	5318	Trincomalee	5306	Kantale	39	6.75			-	3.49	3.21					6.7	16.803		No
7	1	7	1.1	10	Chemicals	5304	China Bay	5306	Kantale	39	1.10	1.34	29	1,523.38	1.30	1.14					2.44	16.803		No
8	1	10	1.22	7	Cement Prod/Terras	5318	Trincomalee	5306	Kantale	39	9.00	1.41	13	714.87	3.29	3.62	3.50				10.41	23.430		No
9	1	10	1.22	6	Cement	5318	Trincomalee	7102	Anuradhapura	108	9.00	14.43	13	20,259.72	6.52	9.75	9.75				26.02	23.430	2.590	Yes
10	1	6	1.2	50	Passengers	5318	Trincomalee	5306	Kantale	39	5.25	5.45	75	2,925.00	4.35	6.35					10.7	16.803		No
11	2	8	1.2	50	Passengers	5306	Kantale	5318	Trincomalee	39	3.00	0.45	75	2,925.00	1.82	1.63					3.45	16.803		No
12	2	9	1.2	22	Empty Bowser	1100	Colombo	5304	China Bay	260	6.75	1.01		-	3.53	4.23					7.76	16.803		No
13	1	9	1.2	20	Empty	4213	Vavuniya	5306	Kantale	126	6.75			-	3.38	3.30					6.68	16.803		No
14	2	9	1.2	22	Empty Bowser	5306	Kantale	5304	China Bay	41	6.75	0.92		-	3.91	3.76					7.67	16.803		No
15	2	8	1.2	20	Empty	5306	Kantale	5318	Trincomalee	39	3.00			-	0.88	0.98					1.86	16.803		No
16	1	9	1.2	20	Empty	5318	Trincomalee	5306	Kantale	39	6.75			-	3.45	3.30					6.75	16.803		No
17	2	6	1.2	50	Passengers	2122	Kandy	5318	Trincomalee	180	5.25	5.80	75	13,500.00	4.79	6.26					11.05	16.803		No
18	2	9	1.2	41	Matal	5306	Kantale	5318	Trincomalee	39	6.75	10.05	12	4,798.90	6.50	12.66					19.16	16.803	2.357	Yes
19	1	10	1.22	28	Flour	5318	Trincomalee	2122	Kandy	180	9.00	11.79	15	30,984.12	5.09	7.85	7.85				20.79	23.430		No
20	1	7	1.1	20	Empty	5318	Trincomalee	5306	Kantale	39	1.10	0.13		-	0.69	0.54					1.23	16.803		No
21	2	8	1.2	35	Hardwere Items	1179	Piliyandala	5318	Trincomalee	272	3.00	1.77	19	9,027.00	2.18	2.59					4.77	16.803		No
22	1	9	1.2	20	Empty	5318	Trincomalee	1272	Seeduwa	240	6.75			-	3.12	3.45					6.57	16.803		No
23	1	10	1.22	6	Cement	5318	Trincomalee	6139	Melsiripura	137	9.00	14.43	13	25,699.83	5.69	17.33	18.46				41.48	23.430	18.050	Yes
24	2	10	1.22	20	Empty	5306	Kantale	5318	Trincomalee	39	9.00	1.08		-	3.89	3.12	3.07				10.08	23.430		No
25	2	9	1.2	55	Rice/Paddy	2205	Galewela	5318	Trincomalee	86	6.75	6.95	16	9,754.46	4.65	9.05					13.7	16.803		No
26	1	10	1.22	41	Matal	5318	Trincomalee	5306	Kantale	39	9.00	14.43	13	7,231.59	5.77	13.29	13.72				32.78	23.430	9.350	Yes
27	1	8	1.2	29	Food Items	5318	Trincomalee	5306	Kantale	39	3.00	0.04	19	29.25	1.35	1.69					3.04	16.803		No
28	2	9	1.2	41	Matal	1100	Colombo	5318	Trincomalee	255	6.75	10.05	12	31,377.42	5.87	13.09					18.96	16.803	2.157	Yes
29	1	12	1.2-22	6	Cement	5318	Trincomalee	1100	Colombo	255	13.30	19.48	15	73,020.78	6.16	16.13	18.76	15.19			56.24	32.780	23.460	Yes
30	2	7	1.1	34	Groceries	6127	Kurunegala	5318	Trincomalee	165	1.10	2.94	29	14,140.67	1.61	2.43					4.04	16.803		No
31	1	6	1.2	50	Passengers	5318	Trincomalee	1100	Colombo	255	5.25	5.59	75	19,125.00	4.55	6.29					10.84	16.803		No
32	1	9	1.2	52	Petroleum Product	5318	Trincomalee	4108	Jaffna	240	6.75	10.05	14	34,912.06	4.91	12.73					17.64	16.803	0.837	Yes
33	1	10	1.22	24	Empty Containers	7102	Anuradhapura	5306	Kantale	106	9.00	3.88		-	4.01	4.32	4.55				12.88	23.430		No
34	2	9	1.2	20	Empty	1100	Colombo	5318	Trincomalee	255	6.75	0.84		-	3.69	3.90					7.59	16.803		No
35	2	10	1.22	22	Empty Bowser	6127	Kurunegala	5318	Trincomalee	165	9.00	1.59		-	3.93	3.47	3.19				10.59	23.430		No
36	2	10	1.22	22	Empty Bowser	6127	Kurunegala	5318	Trincomalee	165	9.00	1.50		-	3.75	3.40	3.35				10.5	23.430		No
37	1	12	1.2-22	7	Cement Prod/Terras	5318	Trincomalee	1100	Colombo	255	13.30	19.48	18	89,413.20	6.22	15.67	17.66	15.22			54.77	32.780	21.990	Yes
38	1	8	1.2	57	Rubber/Rubber Prod	5318	Trincomalee	5306	Kantale	39	3.00	2.40	19	1,755.00	2.15	3.25					5.4	16.803		No
39	1	9	1.2	20	Empty	5318	Trincomalee	1100	Colombo	255	6.75			-	3.01	3.00					6.01	16.803		No
40	1	10	1.22	20	Empty	5318	Trincomalee	1100	Colombo	255	9.00	2.83		-	4.75	4.35	2.73				11.83	23.430		No
41	1	9	1.2	52	Petroleum Product	5318	Trincomalee	1121	Avissawella	300	6.75	10.05	14	43,640.07	4.15	12.96					17.11	16.803	0.307	Yes
42	1	8	1.2	34	Groceries	5306	Kantale	5318	Trincomalee	39	3.00	7.14	19	5,221.13	2.88	7.26					10.14	16.803		No
43	1	9	1.2	1	Arrack/Beer	7102	Anuradhapura	5318	Trincomalee	114	6.75	4.34	15	7,569.83	4.20	6.89					11.09	16.803		No
44	1	5	1.2	50	Passengers	1259	Negombo	5318	Trincomalee	235	3.50	1.21	65	15,275.00	2.16	2.55					4.71	16.803		No
45	2	9	1.2	20	Empty	5318	Trincomalee	7219	Polonnaruwa	108	6.75			-	2.67	2.98					5.65	16.803		No
46	2	13	1.22-22	6	Cement	5318	Trincomalee	1100	Colombo	255	16.50	23.87	16	94,954.86	5.48	7.87	12.45	14.69	15.67		56.16	40.370	15.790	Yes
47	2	13	1.22-22	6	Cement	5318	Trincomalee	1100	Colombo	255	16.50	23.87	16	94,954.86	5.73	6.87	12.82	17.62	15.12		58.16	40.370	17.790	Yes
48	2	7	1.1	48	Non Durable Items	5318	Trincomalee	7219	Polonnaruwa	108	1.10	0.84	22	1,995.84	0.82	1.12					1.94	16.803		No
49	1	7	1.1	20	Empty	5306	Kantale	5318	Trincomalee	39	1.10	0.26		-	0.89	0.47					1.36	16.803		No
50	2	13	1.2-222	24	Empty Containers	1100	Colombo	5318	Trincomalee	255	16.50	7.22		-	5.77	5.37	5.70	3.00	3.88		23.72	40.370		No
51	1	12	1.2-22	22	Empty Bowser	5318	Trincomalee	1100	Colombo	255	13.30	19.48		-	6.72	18.87	18.46	11.55			55.6	32.780	22.820	Yes
52	2	9	1.2	22	Empty Bowser	5306	Kantale	5318	Trincomalee	39	6.75	0.86		-	3.60	4.01					7.61	16.803		No
53	1	10	1.22	52	Petroleum Product	5318	Trincomalee	1100	Colombo	255	9.00	14.43	14	50,227.22	5.01	10.46	10.60				26.07	23.430	2.640	Yes
54	1	9	1.2	52	Petroleum Product	5318	Trincomalee	1100	Colombo	255	6.75	10.05	14	37,094.06	5.27	13.40					18.67	16.803	1.867	Yes
55	1	10	1.22	52	Petroleum Product	5318	Trincomalee	8125	Mahiyangana	211	9.00	14.43	14	41,560.56	6.24	11.48	9.67				27.39	23.430	3.960	Yes
56	1	8	1.2	29	Food Items	5318	Trincomalee	5306	Kantale	39	3.00	1.76	19	1,287.00	1.93	2.83					4.76	16.803		No
57	2	9	1.2	39	Machines	1285	Welisara	5318	Trincomalee	245	6.75	4.22	11	11,372.90	3.92	7.05					10.97	16.803		No
58	2	10	1.22	28	Flour	7219	Polonnaruwa	5318	Trincomalee	108	9.00	0.69	15	1,087.99	3.17	3.23	3.29				9.69	23.430		No
59	1	9	1.2	52	Petroleum Product	5318	Trincomalee	1260	Nittambuwa	280	6.75	10.05	14	40,730.73	5.05	12.18					17.23	16.803	0.427	Yes
60	2	10	1.22	26	Fertiliser	1100	Colombo	5308	Kinniyai	250	9.00	14.43	15	52,669.50	7.49	8.40	8.40				24.29	23.430	0.860	Yes
61	1	10	1.22	6	Cement	5318	Trincomalee	5306	Kantale	39	9.00	12.52	13	6,347.64	6.72	7.40	7.40				21.52	23.430		No
62	2	9	1.2	20	Empty	5306	Kantale	5318	Trincomalee	39	6.75			-	3.28	3.17					6.45	16.803		No
63	2	10	1.22	20	Empty	6112	Galgamuwa	5318	Trincomalee	155	9.00	1.21		-	3.69	3.23	3.29				10.21	23.430		No
64	1	12	1.2-22	6	Cement	5318	Trincomalee	1100	Colombo	255	13.30	19.48	15	73,020.78	5.93	15.48	17.48	14.10			52.99	32.780	20.210	Yes
65	1	9	1.2	20	Empty	5318	Trincomalee	5306	Kantale	39	6.75	0.08		-	3.68	3.15					6.83	16.803		No
66	2	7	1.1	34	Groceries	7117	Kekirawa	5318	Trincomalee	108	1.10	2.10	29	6,611.22	1.10	2.10					3.2	16.803		No
67	2	9	1.2	41	Matal	7117	Kekirawa	5318	Trincomalee	108	6.75	3.24	12	4,283.02	3.40	6.59					9.99	16.803		No
68	1	12	1.2-22	6	Cement	5304	China Bay	2201	Dambulla	95	13.30	19.48	15	27,203.82	6.32	15.61	17.84	14.80			54.57	32.780	21.790	Yes
69	2	8	1.2	9	Charcoal/Coal	9219	Mawanella	5318	Trincomalee	200	3.00	2.28	19	8,550.00	2.35	2.93					5.28	16.803		No
70	2	6	1.2	50	Passengers	5306	Kantale	5318	Trincomalee	39	5.25	3.21	75	2,925.00	3.36	5.10					8.46	16.803		No
71	2	10	1.22	22	Empty Bowser	1100	Colombo	5304	China Bay	255	9.00	1.81		-	3.80	3.66	3.35				10.81	23.430		No
72	1	6	1.2	50	Passengers	5318	Trincomalee	5306	Kantale	39	5.25	2.65	75	2,925.00	4.08	3.82					7.9	16.803		No
73	2	13	1.22-22	24	Empty Containers	5306	Kantale	5318	Trincomalee	39	16.50	0.99		-	5.17		5.17	3.96	3.19		17.49	40.370		No
74	1	12	1.2-22	52	Petroleum Product	5304	China Bay	1100	Colombo	255	13.30	19.48	15	73,517.52	6.09	13.75	11.16	11.52			42.52	32.780	9.740	Yes
75	2	8	1.2	35	Hardwere Items	1100	Colombo	5318	Trincomalee	255	3.00	0.05	19	239.06	1.49	1.56					3.05	16.803		No
76	1	9	1.2	20	Empty	5318	Trincomalee	5306	Kantale	39	6.75			-	3.37	2.74					6.11	16.803		No
77	1	9	1.2	24	Empty Containers	5318	Trincomalee	5306	Kantale	39	6.75	0.59		-	3.43	3.91					7.34	16.803		No
78	1	10	1.22	9	Charcoal/Coal	5304	China Bay	1120	Aturugiriya	275	9.00	14.43	16	62,698.35	5.06	9.55	9.20				23.81	23.430	0.380	Yes
79	1	13	1.22-22	6	Cement	5304	China Bay	1233	Ja-Ela	240	16.50	23.87	16	89,369.28	6.60	8.99	13.52	15.50	15.20		59.81	40.370	19.440	Yes
80	1	8	1.2	20	Empty	5318	Trincomalee	1172	Nugegoda	282	3.00	0.61		-	1.97	1.64					3.61	16.803		No
81	2	10	1.22	41	Matal	5306	Kantale	5318	Trincomalee	39	9.00	11.29	13	5,657.98	6.09	7.10	7.10				20.29	23.430		No
82	2	9	1.2	9	Charcoal/Coal	5304	China Bay	5318	Trincomalee	6	6.75	4.85	18	534.28	4.46	7.14					11.6	16.803		No
83	1	9	1.2	52	Petroleum Product	5304	China Bay	2325	Nuwara Eliya	305	6.75	10.05	14	44,367.41	5.10	13.42					18.52	16.803	1.717	Yes
84	2	7	1.1	55	Rice/Paddy	5306	Kantale	5318	Trincomalee	39	1.10	0.77	17	506.76	0.87	1.00					1.87	16.803		No
85	1	10	1.22	9	Charcoal/Coal	5304	China Bay	1141	Kaduwela	260	9.00	14.43	16	59,278.44	5.10	9.43	10.40				24.93	23.430	1.500	Yes
86	1	8	1.2	58	Salt Bags	5318	Trincomalee	5306	Kantale	39	3.00	1.88	19	1,374.75	1.90	2.98					4.88	16.803		No
87	2	9	1.2	17	Earth/Soil/Clay	5306	Kantale	5318	Trincomalee	39	6.75	10.05	11	4,312.74	6.46	10.40					16.86	16.803	0.057	Yes
88	2	7	1.1	20	Empty	5318	Trincomalee	5306	Kantale	39	1.10	0.22		-	0.75	0.57					1.32	16.803		No
89	1	13	1.22-22	6	Cement	5304	China Bay	1233	Ja-Ela	240	16.50	23.87	16	89,369.28	6.01	7.80	12.43	14.25	15.29		55.78	40.370	15.410	Yes
90	2	8	1.2	62	Steel Prod	1260	Nittambuwa	5311	Nilaveli	227	3.00		13	-	1.13	0.93					2.06	16.803		No
91	1	10	1.22	28	Flour	5304	China Bay	3104	Aluthgama (Gal	316	9.00	14.43	15	66,574.25	5.26	15.05	16.90				37.21	23.430	13.780	Yes
92	1	9	1.2	20	Empty	5318	Trincomalee	5306	Kantale	39	6.75			-	3.56	3.00					6.56	16.803		No
93	2	8	1.2	20	Empty	5306	Kantale	5308	Kinniyai	34	3.00			-	1.18	1.34					2.52	16.803		No
94	1	9	1.2	52	Petroleum Product	5304	China Bay	1150	Kolonnawa	265	6.75	10.05	14	38,548.73	5.21	11.67					16.88	16.803	0.077	Yes
95	1	6	1.2	50	Passengers	5318	Trincomalee	1100	Colombo	255	5.25	4.97	75	19,125.00	4.16	6.06					10.22	16.803		No
96	2	9	1.2	73	Wooden Prod	6127	Kurunegala	5318	Trincomalee	165	6.75	6.84	11	12,414.60	4.50	9.09					13.59	16.803		No
97	2	7	1.1	20	Empty	5306	Kantale	5318	Trincomalee	39	1.10			-	0.65	0.34					0.99	16.803		No
98	2	7	1.1	52	Petroleum Product	7219	Polonnaruwa	5318	Trincomalee	108	1.10	2.21	22	5,250.96	1.67	1.64					3.31	16.803		No
99	1	8	1.2	20	Empty	5318	Trincomalee	5306	Kantale	39	3.00	0.72		-	1.91	1.81					3.72	16.803		No

Sr NO	Measured ESA AXLE1	AXLE2	AXLE3	AXLE4	AXLE5	AXLE6	SUM ESA	AVE ESA	Adjusted: Limited axle load AXLE1	AXLE2	AXLE3	AXLE4	AXLE5	AXLE6	Adjusted ESA AXLE1	AXLE2	AXLE3	AXLE4	AXLE5	AXLE6	SUM ESA	AVE ESA
1	0.022	0.011	-	-	-	-	0.033		3.53	3.02					0.022	0.011	-	-	-	-	0.033	
2	0.033	0.004	0.006	-	-	-	0.043		3.86	2.44	2.63				0.033	0.004	0.006	-	-	-	0.043	
3	0.000	0.000	-	-	-	-	0.000		0.68	0.84					0.000	0.000	-	-	-	-	0.000	
4	0.015	0.016	0.017	-	-	-	0.048		3.22	3.29	3.33				0.015	0.016	0.017	-	-	-	0.048	
5	0.073	0.136	-	-	-	-	0.209		4.59	5.26					0.073	0.136	-	-	-	-	0.209	
6	0.021	0.014	-	-	-	-	0.035		3.49	3.21					0.021	0.014	-	-	-	-	0.035	
7	0.000	0.000	-	-	-	-	0.000		1.30	1.14					0.000	0.000	-	-	-	-	0.000	
8	0.016	0.025	0.021	-	-	-	0.062		3.29	3.62	3.50				0.016	0.025	0.021	-	-	-	0.062	
9	0.360	2.248	2.248	-	-	-	4.856		5.05	9.75	9.75				0.113	2.248	2.248	-	-	-	4.609	
10	0.057	0.319	-	-	-	-	0.377		4.35	6.35					0.057	0.319	-	-	-	-	0.377	
11	0.001	0.001	-	-	-	-	0.002		1.82	1.63					0.001	0.001	-	-	-	-	0.002	
12	0.022	0.050	-	-	-	-	0.072		3.53	4.23					0.022	0.050	-	-	-	-	0.072	
13	0.018	0.016	-	-	-	-	0.034		3.38	3.30					0.018	0.016	-	-	-	-	0.034	
14	0.035	0.029	-	-	-	-	0.065		3.91	3.76					0.035	0.029	-	-	-	-	0.065	
15	0.000	0.000	-	-	-	-	0.000		0.88	0.98					0.000	0.000	-	-	-	-	0.000	
16	0.020	0.016	-	-	-	-	0.036		3.45	3.30					0.020	0.016	-	-	-	-	0.036	
17	0.089	0.299	-	-	-	-	0.388		4.79	6.26					0.089	0.299	-	-	-	-	0.388	
18	0.355	7.377	-	-	-	-	7.732		5.05	10.10					0.113	2.639	-	-	-	-	2.752	
19	0.117	0.838	0.838	-	-	-	1.794		5.05	7.85	7.85				0.113	0.838	0.838	-	-	-	1.790	
20	0.000	0.000	-	-	-	-	0.000		0.69	0.54					0.000	0.000	-	-	-	-	0.000	
21	0.002	0.005	-	-	-	-	0.008		2.18	2.59					0.002	0.005	-	-	-	-	0.008	
22	0.013	0.020	-	-	-	-	0.032		3.12	3.45					0.013	0.020	-	-	-	-	0.032	
23	0.194	30.785	41.036	-	-	-	72.015		5.05	10.10	10.10				0.113	2.639	2.639	-	-	-	5.391	
24	0.034	0.013	0.012	-	-	-	0.059		3.89	3.12	3.07				0.034	0.013	0.012	-	-	-	0.059	
25	0.077	1.602	-	-	-	-	1.679		4.65	9.05					0.077	1.602	-	-	-	-	1.679	
26	0.207	9.201	10.636	-	-	-	20.044		5.05	10.10	10.10				0.113	2.639	2.639	-	-	-	5.391	
27	0.000	0.001	-	-	-	-	0.001		1.35	1.69					0.000	0.001	-	-	-	-	0.001	
28	0.223	8.588	-	-	-	-	8.811		5.05	10.10					0.113	2.639	-	-	-	-	2.752	
29	0.278	22.210	44.159	16.900	-	-	83.548		5.05	10.10	10.10	10.10			0.113	2.639	2.639	2.639	-	-	8.030	
30	0.001	0.004	-	-	-	-	0.005		1.61	2.43					0.001	0.004	-	-	-	-	0.005	
31	0.070	0.306	-	-	-	-	0.376		4.55	6.29					0.070	0.306	-	-	-	-	0.376	
32	0.099	7.564	-	-	-	-	7.664		4.91	10.10					0.099	2.639	-	-	-	-	2.738	
33	0.039	0.055	0.070	-	-	-	0.165		4.01	4.32	4.55				0.039	0.055	0.070	-	-	-	0.165	
34	0.027	0.035	-	-	-	-	0.062		3.69	3.90					0.027	0.035	-	-	-	-	0.062	
35	0.036	0.020	0.014	-	-	-	0.070		3.93	3.47	3.19				0.036	0.020	0.014	-	-	-	0.070	
36	0.029	0.019	0.017	-	-	-	0.065		3.75	3.40	3.35				0.029	0.019	0.017	-	-	-	0.065	
37	0.291	19.470	33.544	17.053	-	-	70.358		5.05	10.10	10.10	10.10			0.113	2.639	2.639	2.639	-	-	8.030	
38	0.002	0.015	-	-	-	-	0.017		2.15	3.25					0.002	0.015	-	-	-	-	0.017	
39	0.011	0.011	-	-	-	-	0.021		3.01	3.00					0.011	0.011	-	-	-	-	0.021	
40	0.085	0.057	0.007	-	-	-	0.149		4.75	4.35	2.73				0.085	0.057	0.007	-	-	-	0.149	
41	0.046	8.207	-	-	-	-	8.253		4.15	10.10					0.046	2.639	-	-	-	-	2.685	
42	0.009	0.588	-	-	-	-	0.596		2.88	7.26					0.009	0.588	-	-	-	-	0.596	
43	0.049	0.463	-	-	-	-	0.512		4.20	6.89					0.049	0.463	-	-	-	-	0.512	
44	0.002	0.005	-	-	-	-	0.007		2.16	2.55					0.002	0.005	-	-	-	-	0.007	
45	0.006	0.010	-	-	-	-	0.016		2.67	2.98					0.006	0.010	-	-	-	-	0.016	
46	0.163	0.848	6.836	14.513	#####	-	41.831		5.05	7.87	10.10	10.10	10.10		0.113	0.848	2.639	2.639	2.639	-	8.878	
47	0.200	0.457	7.811	33.200	#####	-	58.217		5.05	6.87	10.10	10.10	10.10		0.113	0.457	2.639	2.639	2.639	-	8.487	
48	0.000	0.000	-	-	-	-	0.000		0.82	1.12					0.000	0.000	-	-	-	-	0.000	
49	0.000	0.000	-	-	-	-	0.000		0.89	0.47					0.000	0.000	-	-	-	-	0.000	
50	0.207	0.149	0.195	0.011	0.034	-	0.596		5.05	5.37	5.70	3.00	3.88		0.113	0.149	0.195	0.011	0.034	-	0.502	
51	0.413	45.349	41.036	4.859	-	-	91.658		5.05	10.10	10.10	10.10			0.113	2.639	2.639	2.639	-	-	8.030	
52	0.024	0.039	-	-	-	-	0.064		3.60	4.01					0.024	0.039	-	-	-	-	0.064	
53	0.109	3.095	3.288	-	-	-	6.492		5.01	10.10	10.10				0.109	2.639	2.639	-	-	-	5.387	
54	0.137	9.553	-	-	-	-	9.690		5.05	10.10					0.113	2.639	-	-	-	-	2.752	
55	0.295	4.727	2.165	-	-	-	7.187		5.05	10.10	9.67				0.113	2.639	2.165	-	-	-	4.917	
56	0.001	0.008	-	-	-	-	0.009		1.93	2.83					0.001	0.008	-	-	-	-	0.009	
57	0.036	0.514	-	-	-	-	0.550		3.92	7.05					0.036	0.514	-	-	-	-	0.550	
58	0.014	0.015	0.016	-	-	-	0.044		3.17	3.23	3.29				0.014	0.015	0.016	-	-	-	0.044	
59	0.113	6.187	-	-	-	-	6.300		5.05	10.10					0.113	2.639	-	-	-	-	2.752	
60	0.677	1.141	1.141	-	-	-	2.959		5.05	8.40	8.40				0.113	1.141	1.141	-	-	-	2.395	
61	0.413	0.641	0.641	-	-	-	1.695		5.05	7.40	7.40				0.113	0.641	0.641	-	-	-	1.395	
62	0.016	0.014	-	-	-	-	0.029		3.28	3.17					0.016	0.014	-	-	-	-	0.029	
63	0.027	0.015	0.016	-	-	-	0.058		3.69	3.23	3.29				0.027	0.015	0.016	-	-	-	0.058	
64	0.234	18.419	32.016	12.044	-	-	62.713		5.05	10.10	10.10	10.10			0.113	2.639	2.639	2.639	-	-	8.030	
65	0.027	0.013	-	-	-	-	0.040		3.68	3.15					0.027	0.013	-	-	-	-	0.040	
66	0.000	0.002	-	-	-	-	0.002		1.10	2.10					0.000	0.002	-	-	-	-	0.002	
67	0.019	0.378	-	-	-	-	0.397		3.40	6.59					0.019	0.378	-	-	-	-	0.397	
68	0.313	19.133	35.128	15.014	-	-	69.588		5.05	10.10	10.10	10.10			0.113	2.639	2.639	2.639	-	-	8.030	
69	0.003	0.009	-	-	-	-	0.013		2.35	2.93					0.003	0.009	-	-	-	-	0.013	
70	0.018	0.118	-	-	-	-	0.135		3.36	5.10					0.018	0.118	-	-	-	-	0.135	
71	0.031	0.026	0.017	-	-	-	0.074		3.80	3.66	3.35				0.031	0.026	0.017	-	-	-	0.074	
72	0.043	0.032	-	-	-	-	0.074		4.08	3.82					0.043	0.032	-	-	-	-	0.074	
73	0.125	-	0.125	0.037	0.014	-	0.302		5.05		5.17	3.96	3.19		0.113	-	0.125	0.037	0.014	-	0.289	
74	0.264	10.742	4.156	4.802	-	-	19.964		5.05	10.10	10.10	10.10			0.113	2.639	2.639	2.639	-	-	8.030	
75	0.000	0.001	-	-	-	-	0.001		1.49	1.56					0.000	0.001	-	-	-	-	0.001	
76	0.018	0.007	-	-	-	-	0.025		3.37	2.74					0.018	0.007	-	-	-	-	0.025	
77	0.019	0.035	-	-	-	-	0.055		3.43	3.91					0.019	0.035	-	-	-	-	0.055	
78	0.114	2.046	1.726	-	-	-	3.885		5.05	9.55	9.20				0.113	2.046	1.726	-	-	-	3.884	
79	0.381	1.554	9.948	18.528	#####	-	47.362		5.05	8.99	10.10	10.10	10.10		0.113	1.554	2.639	2.639	2.639	-	9.584	
80	0.002	0.001	-	-	-	-	0.002		1.97	1.64					0.002	0.001	-	-	-	-	0.002	
81	0.264	0.531	0.531	-	-	-	1.326		5.05	7.10	7.10				0.113	0.531	0.531	-	-	-	1.175	
82	0.064	0.545	-	-	-	-	0.609		4.46	7.14					0.064	0.545	-	-	-	-	0.609	
83	0.118	9.618	-	-	-	-	9.736		5.05	10.10					0.113	2.639	-	-	-	-	2.752	
84	0.000	0.000	-	-	-	-	0.000		0.87	1.00					0.000	0.000	-	-	-	-	0.000	
85	0.118	1.931	3.015	-	-	-	5.064		5.05	9.43	10.10				0.113	1.931	2.639	-	-	-	4.683	
86	0.001	0.010	-	-	-	-	0.012		1.90	2.98					0.001	0.010	-	-	-	-	0.012	
87	0.345	3.015	-	-	-	-	3.361		5.05	10.10					0.113	2.639	-	-	-	-	2.752	
88	0.000	0.000	-	-	-	-	0.000		0.75	0.57					0.000	0.000	-	-	-	-	0.000	
89	0.249	0.814	6.787	12.638	#####	-	37.900		5.05	7.80	10.10	10.10	10.10		0.113	0.814	2.639	2.639	2.639	-	8.845	
90	0.000	0.000	-	-	-	-	0.000		1.13	0.93					0.000	0.000	-	-	-	-	0.000	
91	0.136	16.203	27.460	-	-	-	43.798		5.05	10.10	10.10				0.113	2.639	2.639	-	-	-	5.391	
92	0.023	0.011	-	-	-	-	0.033		3.56	3.00					0.023	0.011	-	-	-	-	0.033	
93	0.000	0.000	-	-	-	-	0.000		1.18	1.34					0.000	0.000	-	-	-	-	0.000	
94	0.130	5.093	-	-	-	-	5.223		5.05	10.10					0.113	2.639	-	-	-	-	2.752	
95	0.047	0.258	-	-	-	-	0.305		4.16	6.06					0.047	0.258	-	-	-	-	0.305	
96	0.067	1.634	-	-	-	-	1.701		4.50	9.09					0.067	1.634	-	-	-	-	1.701	
97	0.000	0.000	-	-	-	-	0.000		0.65	0.34					0.000	0.000	-	-	-	-	0.000	
98	0.001	0.001	-	-	-	-	0.001		1.67	1.64					0.001	0.001	-	-	-	-	0.001	
99	0.001	0.001	-	-	-	-	0.002		1.91	1.81					0.001	0.001	-	-	-	-	0.002	

APPENDIX – D: DATA COLLECTION SHEET USED IN QUESTIONNAIRE SURVEY

Cost Tables for A004 & A006 Road

Carrying Commodity	Axle Type	Vehicle Type	Dimentions of Container (Length * Width * Height)	Carrying Tonnage						From	To	Normal Hire Charge	Hire Charge when at low loads	Rate /km	Rate/km for lower loads	Rate/Km.Ton					
				Acctual	LL	10%	20%	30%	40%							Actual	LL	10%	20%	30%	40%
	1.1			1.5	1.5	1.5	1.5	1.5	1.5			80.00		80	80	53.33	53.33	53.33	53.33	53.33	53.33
Arrack	1.2	6 Wheel Large Lorry	20' length conttainer	8.58	8.275	9.8	11.33	12.86	14.36			150/km		150		17.48	17.48	17.48	17.48	17.48	17.48
Arrack	1.22	10 wheel Lorry	40' Length container	15.84	11.8	13.93	16.06	18.19	20.32			180/km		180		11.36	11.36	11.36	11.36	11.36	11.36
Cement	1.2	6 Wheel Large Lorry	20' length conttainer	20	8.275	9.8	11.33	12.86	14.36		160	20,000.00	18,000.00	125.00	112.50	6.25	13.60	11.48	11.03	9.72	8.70
	1.22	10 wheel Lorry	20' Length container	32.5	11.8	13.93	16.06	18.19	20.32		160	26,000.00	23,000.00	162.50	143.75	5.00	12.18	10.32	10.12	8.93	8.00
	1.2-2.2	4 Axle	40' Length container	40	13.3	16.28	19.26	22.4	25.22		160	40,000.00	35,000.00	250.00	218.75	6.25	16.45	13.44	12.98	11.16	9.91
	1.2.2-2.2	5 Axle	40' Length container	42	19.2	22.87	26.54	30.21	33.9		110	45,000.00	40,000.00	409.09	363.64	9.74	18.94	15.90	15.41	13.54	12.07
	1.2.2-2.2.2	6 Axle	40' Length container	50	24	28.25	32.5	36.75	41		110	50,000.00	45,000.00	454.55	409.09	9.09	17.05	14.48	13.99	12.37	11.09
	1.2	6 Wheel Large Lorry	20' length conttainer	20	8.275	9.8	11.33	12.86	14.36		160	20,000.00	18,000.00	125.00	112.5	6.25	13.60	11.48	11.03	9.72	8.70
Fertlizer	1.22	10 wheel Lorry	20' Length container	33.5	11.8	13.93	16.06	18.19	20.32		160	26,000.00	23,000.00	162.50	143.75	4.85	12.18	10.32	10.12	8.93	8.00
	1.2-2.2	4 Axle	40' Length container	40	13.3	16.28	19.26	22.4	25.22		160	40,000.00	35,000.00	250.00	218.75	6.25	16.45	13.44	12.98	11.16	9.91
	1.2.2-2.2	5 Axle	40' Length container	42	19.2	22.87	26.54	30.21	33.9		110	45,000.00	40,000.00	409.09	363.64	9.74	18.94	15.90	15.41	13.54	12.07
	1.2.2-2.2.2	6 Axle	40' Length container	55	24	28.25	32.5	36.75	41		110	50,000.00	45,000.00	454.55	409.09	8.26	17.05	14.48	13.99	12.37	11.09
Flour	1.2 (Type 8)			10	10	10	10	10	10		170	14,000.00	14,000.00	90	90.00	9.00	9.00	9.00	9.00	9.00	9.00
	1.2	6 Wheel Large Lorry	20' length conttainer	17.5	8.275	9.8	11.33	12.86	14.36		160	17,500.00	16,000.00	109.38	100.00	6.25	12.08	10.20	9.65	8.51	7.62
	1.22	10 wheel Lorry	20' Length container	30	11.8	13.93	16.06	18.19	20.32		160	24,000.00	22,000.00	150	137.50	5	11.65	9.87	9.34	8.25	7.38
	1.2-2.2	4 Axle	40' Length container	40	13.3	16.28	19.26	22.4	25.22		160	36,000.00	35,000.00	225	218.75	5.63	16.45	13.44	11.68	10.04	8.92
	1.2.2-2.2	5 Axle	40' Length container	42	19.2	22.87	26.54	30.21	33.9		110	45,000.00	40,000.00	409.09	363.64	9.74	18.94	15.90	15.41	13.54	12.07
	1.2.2-2.2.2	6 Axle	40' Length container	55	24	28.25	32.5	36.75	41		110	50,000.00	45,000.00	454.55	409.09	8.26	17.05	14.48	13.99	12.37	11.09
Petrolium	1.2	6 Wheel Large Lorry	13200LTR	11.22	8.275	9.8	11.33	12.86	14.36					147	147	13.1	17.76	15	12.97	12.97	12.97
	1.22	10 wheel Lorry	19200 LTR	18.5	11.8	13.93	16.06	18.19	20.32					177	177	9.57	15	12.71	11.02	11.02	11.02
	1.2-2.2	4 Axle	33000 LTR	25.5	13.3	16.28	19.26	22.4	25.22		160	52,000.00	50,000.00	325	312.5	12.75	23.5	19.2	16.87	14.51	12.89
Cha-Coal	1.2	6-Wheel		14	8.275	9.8	11.33	12.86	14.36			180/km		180	160	12.86	19.34	16.33	15.89	14.00	12.53
	1.22	10-Wheel		24.5	11.8	13.93	16.06	18.19	20.32			220/km		220	200	8.98	16.95	14.36	13.70	12.09	10.83
Soil/Sand	1.2 (8 Type)			3.5	3.5	3.5	3.5	3.5	3.5			200.00	200.00	200	200	57.14	57.14	57.14	57.14	57.14	57.14
	1.2	6-Wheel		13.5	8.275	9.8	11.33	12.86	14.36					140	130	10.37	15.71	13.27	12.36	10.89	9.75
	1.22	10-Wheel		33.5	11.8	13.93	16.06	18.19	20.32					180	170	5.37	14.41	12.2	11.21	9.90	8.86
Metal	1.2	6-Wheel		14	8.275	9.8	11.33	12.86	14.36					120	120	8.57	14.5	12.24	10.59	9.33	8.36
	1.22	10-Wheel		24.5	11.8	13.93	16.06	18.19	20.32					180	180	7.35	15.25	12.92	11.21	9.90	8.86
Asphalt	1.2	6-Wheel		20	8.275	9.8	11.33	12.86	14.36					160	150	8.00	18.13	15.31	14.12	12.44	11.14
	1.22	10-Wheel		35	11.8	13.93	16.06	18.19	20.32					200	180	5.71	15.25	12.92	12.45	11.00	9.84
Boulders	1.2	6-Wheel		12	8.275	9.8	11.33	12.86	14.36					180	160	15.00	19.34	16.33	15.89	14.00	12.53
	1.22	10-Wheel		21	11.8	13.93	16.06	18.19	20.32					200	180	9.52	15.25	12.92	12.45	11.00	9.84
Rice/ Paddy	1.2	Type 8		10	10	10	10	10	10		160	13,000.00	13,000.00	81.25	81.25	8.13	8.13	8.13	8.13	8.13	8.13
	1.2	6-Wheel		17.5	8.275	9.8	11.33	12.86	14.36		160	17,500.00	16,000.00	109.38	100	6.25	12.08	10.2	9.65	8.51	7.62
	1.22	10-Wheel		28	11.8	13.93	16.06	18.19	20.32		160	24,000.00	22,000.00	150	137.5	5.36	11.65	9.87	9.34	8.25	7.38
Bricks	1.2<8.5Ton	6-wheel thattu		8.74	8.5	8.74	8.74	8.74	8.74		170	16,000.00	16,000.00	94.12	94.12	10.77	11.07	10.77	10.77	10.77	10.77
	1.2>8.5Ton	6-wheel trucks		17	8.5	10.05	11.58	13.11	14.6		170	20,000.00	20,000.00	117.65	117.65	6.92	13.84	11.71	10.16	8.97	8.06
	1.22	10-wheel		23	11	13	15	17	19		170	24,000.00	22,000.00	141.18	129.41	6.14	11.76	9.95	9.41	8.3	7.43
Cocounut	1.1	7		1.5	1.5	1.5	1.5	1.5	1.5		170	11,000.00	11,000.00	64.71	64.71	43.14	43.14	43.14	43.14	43.14	43.14
Dry Fish	1.2	8		3.5	3.5	3.5	3.5	3.5	3.5		170	12,800.00	12,800.00	75.29	75.29	21.51	21.51	21.51	21.51	21.51	21.51
Fruits/Vegetables	1.1	7		1.5	1.5	1.5	1.5	1.5	1.5		170	11,000.00	11,000.00	64.71	64.71	43.14	43.14	43.14	43.14	43.14	43.14
	1.2	8		3.5	3.5	3.5	3.5	3.5	3.5		170	14,500.00	14,500.00	85.29	85.29	24.37	24.37	24.37	24.37	24.37	24.37

APPENDIX – E: Cost tables for A004 & A006 road / Calculation of Average Cost Values/ Adjustments to MCC & ADT data/ Calculation of Cumulative user cost

A 004 Road 22nd km - Cost incured for a vehicle in Rs. Per ton per km						Loading Scenario		Actual Condition	
	Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Vehicle Articulated	Vehicle Articulated	Vehicle Articulated	Farm Vehicles
CODE LO_TYPE	5	6	7	8	9	10	12	13	14	15
1 Arrack/Beer			53.33		17.5	11.36				
2 Asphalt					8.00	5.71				
4 Bricks				10.77	6.92	6.14				
6 Cement				6.7	8	6.98	9	8		
7 Cement Prod/Terras				16.25	8.9	6.98				
9 Charcoal/Coal			22	18.75	9.25	7.25				
10 Chemicals			29.15		13.5	12.25				
13 Coconuts			43.14							
15 Concrete Beams/PSC				16.25	8.9	6.98				
17 Earth/Soil/Clay				57.14	10.37	5.37				
18 Electric Post					8.9					
19 Electrical Goods			29.15	18.75		12.25				
26 Fertiliser				8.13	10	7.7				
27 Fish/dry Fish				21.51						
28 Flour				9	6.25	5	5.63	9.74	8.26	
29 Food Items			29.15	18.75	13.5					
30 Fruits			43.14	24.37						
32 Glass			43.14		16.29					
34 Groceries			29.15	18.75	13.5	12.25				
35 Hardwere Items			29.15	18.75	13.5					
37 Lime/Lime Stones					13.33	8.57				
39 Machines				16.25	11.00		9.91			
40 Medince			29.15	18.75						
41 Matal			22	57.14	9.25	7.25				
42 Milk				13						
46 Motor/Foot Cycle				18.75	13.5					
47 Motor Spare Parts			29.15							
48 Non Durable Items			22	57.14						

49	Paper/Stationary			29.15	18.75	16.29	12	11			
50	Passengers	65	75		75						
51	Faultry Foods				18.75	16.29					
52	Petroleum Product			22	16.75	11.5	10.25	9.5			
53	Plastic Product			47	50	52					
54	PVC Product			47		52					
55	Rice/Paddy			16.875	8.13	6.25	5.36				
56	Rock Boulders				57.14	15	9.52				
57	Rubber/Rubber Prod				18.75						
58	Salt Bags				18.75						
59	Sand				57.14	10.37	5.37				
60	Soap				18.75		12				
61	Soft Drinks			29.15							
62	Steel Prod			29.15	18.75	16.29					
63	Steel/Bars			150		10					
65	Suger Cane				18.75						
66	Tea			43.14		16.29					
67	Textiles			43.14	18.75	16.29					
68	Tile				18.75	16.29					
69	Timber,T/Logs,Trun			22	16.25	8.9	6.98				
71	Vegetables			43.14	25.5	21.1					
72	Water			47	33.5						35
73	Wooden Prod			29.15	18.75	16.29	12				
74	Plants			29.15							

A 004 Road 22nd km - Cost incured for a vehicle in Rs. Per ton per km	Loading Scenario	Legal Limit

CODE	LO_TYPE	Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Vehicle Articulated	Vehicle Articulated	Vehicle Articulated	Farm Vehicles
		5	6	7	8	9	10	12	13	14	15
1	Arrack/Beer			53.33		17.5	11.36				
2	Asphalt					18.13	15.25				
4	Bricks				11.07	13.84	11.76				
6	Cement				7.70	15.50	13.00	18.00	19.00	18.75	
7	Cement Prod/Terras				16.25	15.50	13.00	18.00			
9	Charcoal/Coal			22	18.75	20.51	16.15				
10	Chemicals			29.15		13.50	12.25				
13	Coconuts			43.14							
15	Concrete Beams/PSC				16.25	15.50	13.00	18.00			
17	Earth/Soil/Clay				57.14	15.71	14.41				
18	Electric Post					15.50					
19	Electrical Goods			29.15	18.75		12.25				
26	Fertiliser				8.13	19.30	14.60				
27	Fish/dry Fish				21.51						
28	Flour				9.00	10.20	9.87	13.44	15.90	14.48	
29	Food Items			29.15	18.75	13.50					
30	Fruits			43.14	24.37						
32	Glass			43.14		16.29					
34	Groceries			29.15	18.75	13.50	12.25				
35	Hardwere Items			29.15	18.75	13.50					
37	Lime/Lime Stones					18.13	13.56				
39	Machines				16.25	12.00		18.00			
40	Medince			29.15	18.75						
41	Matal			22	57.14	13.60	14.60				
42	Milk				13						
46	Motor/Foot Cycle				18.75	13.5					
47	Motor Spare Parts			29.15							
48	Non Durable Items			22	57.14						

49	Paper/Stationary			29.15	18.75	16.29	12	11			
50	Passengers	65.00	75.00		75.00						
51	Faultry Foods				18.75	16.29					
52	Petroleum Product			22	16.75	14.47	13.65	14.80			
53	Plastic Product			47	50.00	52.00					
54	PVC Product			47		52					
55	Rice/Paddy			16.875	8.13	12.08	11.65				
56	Rock Boulders				57.14	19.34	15.25				
57	Rubber/Rubber Prod			29.15	18.75	16.29	12				
58	Salt Bags				18.75						
59	Sand				57.14	15.71	14.41				
60	Soap				18.75		12.00				
61	Soft Drinks			29.15							
62	Steel Prod			29.15	18.75	16.29					
63	Steel/Bars			150		13.5					
65	Suger Cane				18.75						
66	Tea			43.14		16.29					
67	Textiles			43.14	18.75	16.29					
68	Tile				18.75	16.29					
69	Timber,T/Logs,Trun			22	16.25	8.9	6.98				
71	Vegetables			43.14	25.5	21.1					
72	Water			47	33.5						35.00
73	Wooden Prod			29.15	18.75	16.29	12				
74	Plants			29.15							

A 004 Road 22nd km - Cost incured for a vehicle in Rs. Per ton per km						Loading Scenario			10% than Legal Limit	
						9.8	13.93	16.28	22.87	28.25	
CODE	LO_TYPE	Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Vehicle Articulated	Vehicle Articulated	Vehicle Articulated	Farm Vehicles
		5	6	7	8	9	10	12	13	14	15
1	Arrack/Beer			53.33		17.5	11.36				
2	Asphalt					15.31	12.92				
4	Bricks				10.77	11.71	9.95				
6	Cement				7.70	15.30	13.00	14.70	15.60	16.00	
7	Cement Prod/Terras				16.25	15.30	13.00	18.00			
9	Charcoal/Coal			22	18.75	18.36	15.80				
10	Chemicals			29.15		13.5	12.25				
13	Coconuts			43.14							
15	Concrete Beams/PSC				16.25	15.3	13				
17	Earth/Soil/Clay				57.14	13.27	12.20				
18	Electric Post					15.3					
19	Electrical Goods			29.15	18.75		12.25				
26	Fertiliser				8.13	18.40	14.60				
27	Fish/dry Fish				21.51						
28	Flour				9.00	10.20	9.87	13.44	15.90	14.48	
29	Food Items			29.15	18.75						
30	Fruits			43.14	24.37						
32	Glass			43.14		16.29					
34	Groceries			29.15	18.75	13.5	12.25				
35	Hardwere Items			29.15	18.75						
37	Lime/Lime Stones					15.31	11.49				
39	Machines				16.25	11.00		9.91			
40	Medince			29.15	18.75						
41	Matal			22	57.14	12.24	12.85				
42	Milk				13						
46	Motor/Foot Cycle				18.75	13.5					
47	Motor Spare Parts			29.15							

48	Non Durable Items			22	57.14						
49	Paper/Stationary			29.15	18.75	16.29	12	11			
50	Passengers	65.00	75.00		75.00						
51	Faultry Foods				18.75	16.29					
52	Petroleum Product			22	16.75	14.47	13.65	14.80			
53	Plastic Product			47	50.00	52.00					
54	PVC Product			47		52					
55	Rice/Paddy			16.875	8.13	10.20	9.87				
56	Rock Boulders				57.14	16.33	12.92				
57	Rubber/Rubber Prod			29.15	18.75	16.29	12				
58	Salt Bags				18.75						
59	Sand				57.14	13.27	12.20				
60	Soap				18.75		12.00				
61	Soft Drinks			29.15							
62	Steel Prod			29.15	18.75	16.29					
63	Steel/Bars			150		12					
65	Suger Cane				18.75						
66	Tea			43.14		16.29					
67	Textiles			43.14	18.75	16.29					
68	Tile				18.75	16.29					
69	Timber,T/Logs,Trun			22	16.25	8.9	6.98				
71	Vegetables			43.14	25.5	21.1					
72	Water			47	33.5						35.00
73	Wooden Prod			29.15	18.75	16.29	12				
74	Plants			29.15							

A 004 Road 22nd km - Cost incured for a vehicle in Rs. Per ton per km						Loading Scenario			20% than Legal Limit	
		20% of LL				11.33	16.06	19.26	26.54	32.5	
CODE	LO_TYPE	Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Vehicle Articulated	Vehicle Articulated	Vehicle Articulated	Farm Vehicles
		5	6	7	8	9	10	12	13	14	15
1	Arrack/Beer			53.33		17.5	11.36				
2	Asphalt					14.12	12.45				
4	Bricks				10.77	10.16	9.41				
6	Cement				7.70	11.03	10.12	12.98	10.60	9.62	
7	Cement Prod/Terras				16.25	11.03	10.12	18.00			
9	Charcoal/Coal			22	18.75	15.89	13.70				
10	Chemicals			29.15		13.5	12.25				
13	Coconuts			43.14							
15	Concrete Beams/PSC				16.25	11.03	10.12	18.00			
17	Earth/Soil/Clay				57.14	12.36	11.21				
18	Electric Post					11.03					
19	Electrical Goods			29.15	18.75		12.25				
26	Fertiliser				8.13	11.03	10.12				
27	Fish/dry Fish				21.51						
28	Flour				9.00	9.65	9.34	11.68	15.41	13.99	
29	Food Items			29.15	18.75	13.50	12.25				
30	Fruits			43.14	24.37						
32	Glass			43.14		16.29					
34	Groceries			29.15	18.75	13.5	12.25				
35	Hardwere Items			29.15	18.75						
37	Lime/Lime Stones					14.12	11.21				
39	Machines				16.25	11.00		9.91		13.99	
40	Medince			29.15	18.75						
41	Matal			22	57.14	10.59	11.12				
42	Milk				13						
46	Motor/Foot Cycle				18.75	13.5					
47	Motor Spare Parts			29.15							

48	Non Durable Items			22	57.14						
49	Paper/Stationary			29.15	18.75	16.29	12	11			
50	Passengers	65.00	75.00	75	75.00						
51	Faultry Foods				18.75	16.29					
52	Petroleum Product			22	16.75	12.97	11.02	14.80			
53	Plastic Product			47	50.00	52.00					
54	PVC Product			47		52					
55	Rice/Paddy			16.875	8.13	9.65	9.34				
56	Rock Boulders				57.14	15.89	12.45				
57	Rubber/Rubber Prod			29.15	18.75	16.29	12				
58	Salt Bags				18.75						
59	Sand				57.14	12.36	11.21				
60	Soap				18.75		12.00				
61	Soft Drinks			29.15							
62	Steel Prod			29.15	18.75	16.29					
63	Steel/Bars			150		10					
65	Suger Cane				18.75						
66	Tea			43.14		16.29					
67	Textiles			43.14	18.75	16.29					
68	Tile				18.75	16.29					
69	Timber,T/Logs,Trun			22	16.25	8.9	6.98				
71	Vegetables			43.14	25.5	21.1					
72	Water			47	33.5						35.00
73	Wooden Prod			29.15	18.75	16.29	12				
74	Plants			29.15							

A 004 Road 22nd km - Cost incured for a vehicle in Rs. Per ton per km	Loading Scenario	30% than Legal Limit

				30% LL		11.33	16.06	19.26	26.54	32.5	
CODE	LO_TYPE		Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Vehicle Articulated	Vehicle Articulated	Vehicle Articulated	Farm Vehicles
			5	6	7	8	9	10	12	13	14	15
1	Arrack/Beer				53.33		17.5	11.36				
2	Asphalt						12.44	11				
4	Bricks					10.77	8.97	8.3				
6	Cement					7.70	9.72	8.93	11.16	9.31	8.50	
7	Cement Prod/Terras					16.25	9.72	8.93	11.16			
9	Charcoal/Coal				22	18.75	14.00	12.09				
10	Chemicals				29.15		13.5	12.25				
13	Coconuts				43.14							
15	Concrete Beams/PSC					16.25	9.72	8.93	11.16			
17	Earth/Soil/Clay					57.14	10.89	9.90				
18	Electric Post						9.72					
19	Electrical Goods				29.15	18.75		12.25				
26	Fertiliser					8.13	9.72	8.93				
27	Fish/dry Fish					21.51						
28	Flour					9.00	8.51	8.25	10.04	13.54	12.37	
29	Food Items				29.15	18.75	13.50	12.25				
30	Fruits				43.14	24.37						
32	Glass				43.14		16.29					
34	Groceries				29.15	18.75	13.5	12.25				
35	Hardwere Items				29.15	18.75	13.50					
37	Lime/Lime Stones						12.44	9.9				
39	Machines					16.25	11.00		9.91		13.99	
40	Medince				29.15	18.75						
41	Matal				22	57.14	9.33	9.90				
42	Milk					13						
46	Motor/Foot Cycle					18.75	13.5					
47	Motor Spare Parts				29.15							
48	Non Durable Items				22	57.14						

49	Paper/Stationary			29.15	18.75	16.29	12	11			
50	Passengers	65.00	75.00	75	75.00	75.00					
51	Faultry Foods				18.75	16.29					
52	Petroleum Product			22	16.75	12.97	11.02	14.51			
53	Plastic Product			47	50.00	52.00					
54	PVC Product			47		52					
55	Rice/Paddy			16.875	8.13	8.51	8.25				
56	Rock Boulders				57.14	14.00	11.00				
57	Rubber/Rubber Prod			29.15	18.75	16.29	12				
58	Salt Bags				18.75						
59	Sand				57.14	10.89	9.90				
60	Soap				18.75		12.00				
61	Soft Drinks			29.15							
62	Steel Prod			29.15	18.75	16.29					
63	Steel/Bars			150		10					
65	Suger Cane				18.75						
66	Tea			43.14		16.29					
67	Textiles			43.14	18.75	16.29					
68	Tile				18.75	16.29					
69	Timber,T/Logs,Trun			22	16.25	8.9	6.98				
71	Vegetables			43.14	25.5	21.1					
72	Water			47	33.5						35.00
73	Wooden Prod			29.15	18.75	16.29	12				
74	Plants			29.15							

A 004 Road 22nd km - Cost incured for a vehicle in Rs. Per ton per km						Loading Scenario	40% than Legal Limit			
		40% LL				11.33	16.06	19.26	26.54	32.5	
CODE	LO_TYPE	Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Vehicle Articulated	Vehicle Articulated	Vehicle Articulated	Farm Vehicles
		5	6	7	8	9	10	12	13	14	15
1	Arrack/Beer			53.33		17.5	11.36				
2	Asphalt					11.14	9.84				
4	Bricks				10.77	8.06	7.43				
6	Cement				7.70	8.70	8.00	9.91	8.30	7.62	
7	Cement Prod/Terras				16.25	8.10	8.00	9.91			
9	Charcoal/Coal			22	18.75	12.53	10.89				
10	Chemicals			29.15		13.5	12.25				
13	Coconuts			43.14							
15	Concrete Beams/PSC				16.25	8.10	8.00				
17	Earth/Soil/Clay				57.14	9.75	8.86				
18	Electric Post					8.1					
19	Electrical Goods			29.15	18.75		12.25				
26	Fertiliser				8.13	8.70	8.00				
27	Fish/dry Fish				21.51						
28	Flour				9.00	7.62	7.38	8.92	12.07	11.09	
29	Food Items			29.15	18.75	13.50	12.25				
30	Fruits			43.14	24.37						
32	Glass			43.14		16.29					
34	Groceries			29.15	18.75	13.5	12.25				
35	Hardwere Items			29.15	18.75	13.50					
37	Lime/Lime Stones					11.14	8.86				
39	Machines				16.25	11.00		9.91		13.99	
40	Medince			29.15	18.75						
41	Matal			22	57.14	8.36	8.86				
42	Milk				13						
46	Motor/Foot Cycle				18.75	13.5					
47	Motor Spare Parts			29.15							

48	Non Durable Items			22	57.14						
49	Paper/Stationary			29.15	18.75	16.29	12	11			
50	Passengers	65.00	75.00	75	75.00	75.00					
51	Faultry Foods				18.75	16.29					
52	Petroleum Product			22	16.75	12.97	11.02	12.89			
53	Plastic Product			47	50.00	52.00					
54	PVC Product			47		52					
55	Rice/Paddy			16.875	8.13	7.62	7.38				
56	Rock Boulders				57.14	12.53	9.84				
57	Rubber/Rubber Prod			29.15	18.75	16.29	12				
58	Salt Bags				18.75						
59	Sand				57.14	9.75	8.86				
60	Soap				18.75		12.00				
61	Soft Drinks			29.15							
62	Steel Prod			29.15	18.75	16.29					
63	Steel/Bars			150		10					
65	Suger Cane				18.75						
66	Tea			43.14		16.29					
67	Textiles			43.14	18.75	16.29					
68	Tile				18.75	16.29					
69	Timber,T/Logs,Trun			22	16.25	8.9	6.98				
71	Vegetables			43.14	25.5	21.1					
72	Water			47	33.5						35.00
73	Wooden Prod			29.15	18.75	16.29	12				
74	Plants			29.15							

A 006 Road 196th km - Cost incured for a vehicle in Rs. Per ton per km						Loading Scenario			Actual Condition	
Normal Rates	Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Axles Vehicle Articulate	Vehicle Articulate d	Vehicle Articulate d	Farm Vehicles
CODE LO_TYPE	5	6	7	8	9	10	12	13	14	15
1 Arrack/Beer					17.5	11.36				
6 Cement				6.7	8	6.98	9	8		
7 Cement Prod/Terras				16.25	8.9	6.98				
9 Charcoal/Coal			22	18.75	9.25	7.25				
10 Chemicals			29.15							
17 Earth/Soil/Clay					11	9				
19 Electrical Goods				18.75						
26 Fertiliser					10	7.7				
28 Flour						7.7		10	9.09	
29 Food Items			29.15	18.75						
34 Groceries			29.15	18.75						
35 Hardwere Items				18.75						
39 Machines					9					
40 Medince				18.75						
41 Matal			22		9.25	7.25				
48 Non Durable Items			22							
50 Passengers	65	75		75						
52 Petroleum Product			22	16.75	11.5	10.25	9.5			
53 Plastic Product			52							
55 Rice/Paddy			16.875		7.14	4.8				
56 Rock Boulders					9					
57 Rubber/Rubber Prod				18.75						
58 Salt Bags				18.75						
60 Soap				18.75						
62 Steel Prod				13.2						
69 Timber,T/Logs,Trun			22							
71 Vegetables				25.5						
72 Water				33.5						35
73 Wooden Prod					7.5					
74 Plants			29.15							

A 006 Road 196th km - Cost incured for a vehicle in Rs. Per ton per km						Loading Scenario			Legal Limit	
Legal Limit Rates	Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Axles Vehicle Articulate	Vehicle Articulated	Vehicle Articulated	Farm Vehicles
CODE **LO_TYPE**	5	6	7	8	9	10	12	13	14	15
1 Arrack/Beer					18.12	15.25				
6 Cement				7.70	15.50	13.00	18.00	19.00	18.75	
7 Cement Prod/Terras				16.25	15.50	13.00	18.00			
9 Charcoal/Coal			22	18.75	20.51	16.15				
10 Chemicals			29.15							
17 Earth/Soil/Clay					11.00	9.00				
19 Electrical Goods				18.75						
26 Fertiliser					19.30	14.60				
28 Flour						14.60		19.00	18.75	
29 Food Items			29.15	18.75						
34 Groceries			29.15	18.75						
35 Hardwere Items				18.75						
39 Machines					12.00					
40 Medince				18.75						
41 Matal			22		13.60	14.60				
48 Non Durable Items			22							
50 Passengers	65.00	75.00		75.00						
52 Petroleum Product			22	16.75	14.47	13.65	14.80			
53 Plastic Product			52							
55 Rice/Paddy			16.875		19.30	14.60				
56 Rock Boulders					13.60					
57 Rubber/Rubber Prod				18.75						
58 Salt Bags				18.75						
60 Soap				18.75						
62 Steel Prod				13.20						
69 Timber,T/Logs,Trun			22							
71 Vegetables				25.50						
72 Water				33.50						35.00
73 Wooden Prod					11.00					
74 Plants			29.15							

A 006 Road 196th km - Cost incured for a vehicle in Rs. Per ton per km						Loading Scenario			10% than Legal Limit	
					9.8	13.93	16.28	22.87	28.25	
10% Than LL	Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Axles Vehicle Articulate	Vehicle Articulated	Vehicle Articulated	Farm Vehicles
CODE LO_TYPE	5	6	7	8	9	10	12	13	14	15
1 Arrack/Beer					15.30	12.93				
6 Cement				7.70	15.30	13.00	14.70	15.60	16.00	
7 Cement Prod/Terras				16.25	15.30	13.00	18.00			
9 Charcoal/Coal			22	18.75	18.36	15.80				
10 Chemicals			29.15							
17 Earth/Soil/Clay					11.00	9.00				
19 Electrical Goods				18.75						
26 Fertiliser					18.40	14.60				
28 Flour						14.60		16.55	15.93	
29 Food Items			29.15	18.75						
34 Groceries			29.15	18.75						
35 Hardwere Items				18.75						
39 Machines					11.00					
40 Medince				18.75						
41 Matal			22		12.24	12.85				
48 Non Durable Items			22							
50 Passengers	65.00	75.00		75.00						
52 Petroleum Product			22	16.75	14.47	13.65	14.80			
53 Plastic Product			52							
55 Rice/Paddy			16.875		16.32	13.60				
56 Rock Boulders					13.60					
57 Rubber/Rubber Prod				18.75						
58 Salt Bags				18.75						
60 Soap				18.75						
62 Steel Prod				13.20						
69 Timber,T/Logs,Trun			22							
71 Vegetables				25.50						
72 Water				33.50						35.00
73 Wooden Prod					11.00					
74 Plants			29.15							

A 006 Road 196th km - Cost incured for a vehicle in Rs. Per ton per km

						Loading Scenario			20% than Legal Limit	
20% Than LL		Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Axles Vehicle Articulate	Vehicle Articulated	Vehicle Articulated	Farm Vehicles
CODE	**LO_TYPE**	5	6	7	8	9	10	12	13	14	15
1	Arrack/Beer					17.48	11.36				
6	Cement				7.70	11.03	10.12	12.98	10.60	9.62	
7	Cement Prod/Terras				16.25	11.03	10.12	18.00			
9	Charcoal/Coal			22	18.75	15.89	13.70				
10	Chemicals			29.15							
17	Earth/Soil/Clay					11.00	9.00				
19	Electrical Goods				18.75						
26	Fertiliser					11.03	10.12				
28	Flour						9.34		10.60	9.62	
29	Food Items			29.15	18.75						
34	Groceries			29.15	18.75						
35	Hardwere Items				18.75						
39	Machines					11.00					
40	Medince				18.75						
41	Matal			22		10.59	11.12				
48	Non Durable Items			22							
50	Passengers	65.00	75.00		75.00						
52	Petroleum Product			22	16.75	12.97	11.02	14.80			
53	Plastic Product			52							
55	Rice/Paddy			16.875		9.65	9.73				
56	Rock Boulders					13.60					
57	Rubber/Rubber Prod				18.75						
58	Salt Bags				18.75						
60	Soap				18.75						
62	Steel Prod				13.20						
69	Timber,T/Logs,Trun			22							
71	Vegetables				25.50						
72	Water				33.50						35.00
73	Wooden Prod					10.00					
74	Plants			29.15							

A 006 Road 196th km - Cost incured for a vehicle in Rs. Per ton per km

						Loading Scenario			30% than Legal Limit	
					11.33	16.06	19.26	26.54	32.5	
30% Than LL		Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Axles Vehicle Articulate	Vehicle Articulated	Vehicle Articulated	Farm Vehicles
CODE	**LO_TYPE**	5	6	7	8	9	10	12	13	14	15
1	Arrack/Beer					17.48	11.36				
6	Cement				7.70	9.72	8.93	11.16	9.31	8.50	
7	Cement Prod/Terras				16.25	9.72	8.93	11.16			
9	Charcoal/Coal			22	18.75	14.00	12.09				
10	Chemicals			29.15							
17	Earth/Soil/Clay					11.00	9.00				
19	Electrical Goods				18.75						
26	Fertiliser					9.72	8.93				
28	Flour						8.25		9.31	8.50	
29	Food Items			29.15	18.75						
34	Groceries			29.15	18.75						
35	Hardwere Items				18.75						
39	Machines					11.00					
40	Medince				18.75						
41	Matal			22		9.33	9.90				
48	Non Durable Items			22							
50	Passengers	65.00	75.00		75.00						
52	Petroleum Product			22	16.75	12.97	11.02	14.51			
53	Plastic Product			52							
55	Rice/Paddy			16.875		8.51	8.25				
56	Rock Boulders					11.00					
57	Rubber/Rubber Prod				18.75						
58	Salt Bags				18.75						
60	Soap				18.75						
62	Steel Prod				13.20						
69	Timber,T/Logs,Trun			22							
71	Vegetables				25.50						
72	Water				33.50						35.00
73	Wooden Prod					9.00					
74	Plants			29.15							

A 006 Road 196th km - Cost incured for a vehicle in Rs. Per ton per km

						Loading Scenario			40% than Legal Limit	
					11.33	16.06	19.26	26.54	32.5	
40% Than LL		Medium Bus	Large Bus	Light Goods Vehicle	Goods Vehicle (<8.5 T)	Large Lorries (>8.5 T)	Axles Vehicle Combined	Axles Vehicle Articulate	Vehicle Articulated	Vehicle Articulated	Farm Vehicles
CODE	**LO_TYPE**	5	6	7	8	9	10	12	13	14	15
1	Arrack/Beer					17.48	11.36				
6	Cement				7.70	8.70	8.00	9.91	8.30	7.62	
7	Cement Prod/Terras				16.25	8.10	8.00	9.91			
9	Charcoal/Coal			22	18.75	12.53	10.89				
10	Chemicals			29.15							
17	Earth/Soil/Clay					11.00	9.00				
19	Electrical Goods				18.75						
26	Fertiliser					8.70	8.00				
28	Flour						7.62		8.30	7.62	
29	Food Items			29.15	18.75						
34	Groceries			29.15	18.75						
35	Hardwere Items				18.75						
39	Machines					11.00					
40	Medince				18.75						
41	Matal			22		8.36	8.86				
48	Non Durable Items			22							
50	Passengers	65.00	75.00		75.00						
52	Petroleum Product			22	16.75	12.97	11.02	12.89			
53	Plastic Product			52							
55	Rice/Paddy			16.875		7.62	7.38				
56	Rock Boulders					11.00					
57	Rubber/Rubber Prod				18.75						
58	Salt Bags				18.75						
60	Soap				18.75						
62	Steel Prod				13.20						
69	Timber,T/Logs,Trun			22							
71	Vegetables				25.50						
72	Water				33.50						35.00
73	Wooden Prod					8.75					
74	Plants			29.15							

A004 - 22km	Loading Scenario - Actual Condition			Calculation of Average cost incurred per a vehicle							
Sumif fun	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
Nu Of Empty Veh	3	1	88	66	80	13	7	1	1	0	
Total Cost	114,985.00	424,425.00	70,761.88	319,335.47	623,176.90	121,150.13	56,381.80	983.74	34,247.52	-	**1,765,447.43**
Nu Of Vehicles	33	131	78	105	122	29	2	1	1	0	
Total Vehicles	36	132	166	171	202	42	9	2	2	0	
Avg Cost Incured per veh	3,194.03	3,215.34	426.28	1,867.46	3,085.03	2,884.53	6,264.64	491.87	17,123.76	-	
Avg km Travelled by veh	50.00	43.00	24.00	40.00	72.00	59.00	166.00	137.00	53.00	-	
Total km Travelled without empties	1,769.00	5,659.00	1,920.00	5,396.00	9,281.00	1,476.00	460.00	5.00	96.00		
AVG Cost per km travelled without empties	65.00	75.00	36.86	59.18	67.15	82.08	122.57	196.75	356.75	-	
AVG Cost per km travelled	**63.88**	**74.78**	**17.76**	**46.69**	**42.85**	**48.89**	**37.74**	**3.59**	**323.09**	**0.00**	

A004 - 22km	Loading Scenario - Legal Limit			Calculation of Average cost incurred per a vehicle							
Legal Limit											
Nu Of Empty Veh	3	1	92	66	81	13	7	1	1.00	0	
Total Cost	114,985.00	424,425.00	62,194.99	319,413.63	707,033.79	158,119.98	56,381.80	1,605.90	39,168.00	-	**1,883,328.09**
Nu Of Vehicles	33	131	74	105	121	29	2	1	1.00	0	
Avg Cost Incured per veh	3,484.39	3,239.89	840.47	3,042.03	5,843.25	5,452.41	28,190.90	1,605.90	-	-	
Nu of added vehicles	0	-	-	0	44	20	0	13	2	0	
Cost For Added Vehicles	-	-	-	-	479,922.21	143,296.36	-	1,604.31	14,899.20	-	
Total Cost	114,985.00	424,425.00	62,194.99	319,413.63	1,186,956.00	301,416.34	56,381.80	3,210.21	54,067.20	-	
Total Nu of Vehicles	33	131.00	74	105	165	49	2	14	3.00	0	
Avg Cost	3,484.39	3,239.89	840.47	3,042.03	7,193.67	6,151.35	28,190.90	229.30	18,022.40	-	
Total Nu of Vehicles with empties	36.00	132.00	166.00	171.00	246.00	62.00	9.00	15.00	4.00	-	
Avg Cost with empty veh	3,194.03	3,215.34	374.67	1,867.92	4,825.02	4,861.55	6,264.64	214.01	13,516.80	-	
Avg km Travelled by veh	49.56	42.91	23.99	46.57	80.17	58.78	165.89	18.62	36.20	-	From Data Sheet
AVG Cost per km travelled	**64.45**	**74.93**	**15.62**	**40.11**	**60.19**	**82.71**	**37.76**	**11.50**	**373.39**	**0.00**	
Total km Travelled	1,784.00	5,664.00	3,982.00	7,964.00	14,459.00	2,458.00	1,493.00	274.00	106.00		From Data Sheet
Total km Travelled without empties	1,769.00	5,659.00	1,920.00	5,396.00	9,281.00	1,476.00	460.00	5.00	96.00		
Km travelled by Added Vehicles	-	-	-	-	5,262.31	1,186.12	-	5.26	38.80		
Avg km without empties	53.61	43.20	25.95	51.39	88.14	54.33	230.00	0.73	44.93	-	
AVG Cost per km travelled without empties	65.00	75.00	32.39	59.19	81.62	113.22	122.57	313.03	401.09		
AVG Cost per km travelled	64.45	74.93	15.62	40.11	60.19	82.71	37.76	11.50	373.39	-	

A004 - 22km	Loading Scenario - 10% than Legal Limit				Calculation of Average cost incurred per a vehicle						

Overloaded 10% than Legal Limit

Nu Of Empty Veh	3	1	88	66	80.00	13	7	1	1.00	0	
Total Cost	114,985.00	424,425.00	70,761.88	319,335.47	766,950.98	171,954.13	56,381.80	1,897.67	41,354.88	-	**1,968,046.79**
Nu Of Vehicles	33	131	78	105	122.00	29	2	1	1.00	0	
Avg Cost Incured per veh	3,484.39	3,239.89	907.20	3,041.29	6,286.48	5,929.45	28,190.90	1,897.67	41,354.88	-	
Nu of added vehicles	0	-	-	0	29.00	14	0	1	1.00	0	
Cost For Added Vehicles	-	-	-	-	360,435.76	113,190.72	-	1,312.55	7,575.94	-	
Total Cost	114,985.00	424,425.00	70,761.88	319,335.47	1,127,386.73	285,144.85	56,381.80	3,210.21	48,930.82	-	
Total Nu of Vehicles	33	131	78	105	151.00	43	2	2	2	0	
Avg Cost	3,484.39	3,239.89	907.20	3,041.29	7,466.14	6,631.28	28,190.90	1,605.11	24,465.41	-	
Total Nu of Vehicles with empti	36.00	132.00	166.00	171.00	231.00	56.00	9.00	3.00	3.00	-	
Avg Cost with empty veh	3,194.03	3,215.34	426.28	1,867.46	4,880.46	5,091.87	6,264.64	1,070.07	16,310.27	-	
Avg km Travelled by veh	49.56	42.91	23.99	46.57	78.14	59.11	165.89	92.54	41.51	#DIV/0!	
AVG Cost per km travelled	64.45	74.93	17.77	40.10	62.46	86.14	37.76	11.56	392.95	#DIV/0!	
Total km Travelled	1,784.00	5,664.00	3,982.00	7,964.00	14,459.00	2,458.00	1,493.00	274.00	106.00		From Data Sheet
Total km Travelled without empties	1,769.00	5,659.00	1,920.00	5,396.00	9,281.00	1,476.00	460.00	5.00	96.00		
Km travelled by Added Vehicles	-	-	-	-	3,591.87	852.17	-	3.61	18.52		
Avg km without empties	53.61	43.20	24.62	51.39	85.25	54.14	230.00	4.30	57.26	-	
AVG Cost per km travelled without empties	65.00	75.00	36.86	59.18	87.58	122.48	122.57	372.87	427.27		
AVG Cost per km travelled	64.45	74.93	17.77	40.10	62.46	86.14	37.76	11.56	392.95	-	

A004 - 22km	Loading Scenario - 20% than Legal Limit			Calculation of Average cost incurred per a vehicle							

Overloaded 20% than Legal Limit

Nu Of Empty Veh	3	1	88	66	86	13	7	1	1.00	0	
Total Cost	114,985.00	424,425.00	70,761.88	319,335.47	818,932.67	181,876.44	56,381.80	2,121.96	45,663.36	-	**2,034,483.57**
Nu Of Vehicles	33	131	78	105	116	29	2	1	1.00	0	
Avg Cost Incured per veh	3,484.39	3,239.89	907.20	3,041.29	7,059.76	6,271.60	28,190.90	2,121.96	45,663.36	#DIV/0!	
Nu of added vehicles	0	-	-	0	19	9	0	1	1.00	0	
Cost For Added Vehicles	-	-	-	-	264,383.27	90,115.74	-	989.32	1,611.65	-	
Total Cost	114,985.00	424,425.00	70,761.88	319,335.47	1,083,315.94	271,992.18	56,381.80	3,111.28	47,275.01	-	
Total Nu of Vehicles	33	131	78	105	135	38	2	2	2	0	
Avg Cost	3,484.39	3,239.89	907.20	3,041.29	8,024.56	7,157.69	28,190.90	1,555.64	23,637.50	#DIV/0!	
Total Nu of Vehicles with empti	36.00	132.00	166.00	171.00	221.00	51.00	9.00	3.00	3.00	-	
Avg Cost with empty veh	3,194.03	3,215.34	426.28	1,867.46	4,901.88	5,333.18	6,264.64	1,037.09	15,758.34	-	
Avg km Travelled by veh	49.56	42.91	23.99	46.57	76.21	60.16	165.89	92.14	36.52	#DIV/0!	
AVG Cost per km travelled	64.45	74.93	17.77	40.10	64.32	88.64	37.76	11.26	431.56	-	
Total km Travelled	1,784.00	5,664.00	3,982.00	7,964.00	14,459.00	2,458.00	1,493.00	274.00	106.00		From Data Sheet
Total km Travelled without empties	1,769.00	5,659.00	1,920.00	5,396.00	9,281.00	1,476.00	460.00	5.00	96.00		
Km travelled by Added Vehicles	-	-	-	-	2,382.50	610.41	-	2.42	3.55		
Avg km without empties	53.61	43.20	24.62	51.39	86.40	54.91	230.00	3.71	49.77	-	
AVG Cost per km travelled without empties	65.00	75.00	36.86	59.18	92.88	130.36	122.57	419.37	474.91		
AVG Cost per km travelled	64.45	74.93	17.77	40.10	64.32	88.64	37.76	11.26	431.56	-	

A004 - 22km	Loading Scenario - 30% than Legal Limit			Calculation of Average cost incurred per a vehicle							

Overloaded 30% than Legal Limit

Nu Of Empty Veh	3	1	88	66	80	13	7	1	1.00	2	
Total Cost	114,985.00	424,425.00	70,761.88	319,335.47	883,930.86	191,047.75	56,381.80	2,112.92	47,275.01	-	**2,110,255.69**
Nu Of Vehicles	33	131	78	105	122	29	2	1	1.00	0	
Avg Cost Incured per veh	3,484.39	3,239.89	907.20	3,041.29	7,245.33	6,587.85	28,190.90	2,112.92	47,275.01	#DIV/0!	
Nu of added vehicles	0	-	-	0	12	7	0	1	-	0	
Cost For Added Vehicles	-	-	-	-	180,657.28	68,144.15	-	620.81	-	-	
Total Cost	114,985.00	424,425.00	70,761.88	319,335.47	1,064,588.14	259,191.90	56,381.80	2,733.73	47,275.01	-	
Total Nu of Vehicles	33	131	78	105	134	36	2	2	1	0	
Avg Cost	3,484.39	3,239.89	907.20	3,041.29	7,944.69	7,199.78	28,190.90	1,366.86	47,275.01	#DIV/0!	
Total Nu of Vehicles with empti	36.00	132.00	166.00	171.00	214.00	49.00	9.00	3.00	2.00	2.00	
Avg Cost with empty veh	3,194.03	3,215.34	426.28	1,867.46	4,974.71	5,289.63	6,264.64	911.24	23,637.50	-	
Avg km Travelled by veh	49.56	42.91	23.99	46.57	74.53	58.95	165.89	91.84	53.00	-	
AVG Cost per km travelled	64.45	74.93	17.77	40.10	66.75	89.73	37.76	9.92	445.99	-	
Total km Travelled	1,784.00	5,664.00	3,982.00	7,964.00	14,459.00	2,458.00	1,493.00	274.00	106.00		From Data Sheet
Total km Travelled without empties	1,769.00	5,659.00	1,920.00	5,396.00	9,281.00	1,476.00	460.00	5.00	96.00		
Km travelled by Added Vehicles	-	-	-	-	1,490.77	430.65	-	1.52	-		
Avg km without empties	53.61	43.20	24.62	51.39	80.39	52.96	230.00	3.26	96.00	-	
AVG Cost per km travelled without empties	65.00	75.00	36.86	59.18	98.83	135.94	122.57	419.43	492.45	-	
AVG Cost per km travelled	64.45	74.93	17.77	40.10	66.75	89.73	37.76	9.92	445.99	-	

A004 - 22km	Loading Scenario - 40% than Legal Limit			Calculation of Average cost incurred per a vehicle							

Overloaded 40% than Legal Limit

Nu Of Empty Veh	3	1	88	66	80	13	7	1	2.00	2	
Total Cost	114,985.00	424,425.00	70,761.88	319,335.47	922,502.72	199,322.79	56,381.80	2,106.22	47,275.01	-	**2,157,095.88**
Nu Of Vehicles	33	131	78	105	122	29	2	1	1.00	0	
Avg Cost Incured per veh	3,484.39	3,239.89	907.20	3,041.29	7,561.50	6,873.20	28,190.90	2,106.22	47,275.01	-	
Nu of added vehicles	0	-	-	0	11	6	0	1	-	0	
Cost For Added Vehicles	-	-	-	-	115,797.16	49,815.39	-	330.72	-	-	
Total Cost	114,985.00	424,425.00	70,761.88	319,335.47	1,038,299.88	249,138.18	56,381.80	2,436.93	47,275.01	-	
Total Nu of Vehicles	33	131	78	105	133	35	2	2	1	0	
Avg Cost	3,484.39	3,239.89	907.20	3,041.29	7,806.77	7,118.23	28,190.90	1,218.47	47,275.01	-	
Total Nu of Vehicles with empti	36.00	132.00	166.00	171.00	213.00	48.00	9.00	3.00	3.00	2.00	
Avg Cost with empty veh	3,194.03	3,215.34	426.28	1,867.46	4,874.65	5,190.38	6,264.64	812.31	15,758.34	-	
Avg km Travelled by veh	49.56	42.91	23.99	46.57	72.04	57.36	165.89	91.63	35.33	-	
AVG Cost per km travelled	64.45	74.93	17.77	40.10	67.66	90.49	37.76	8.87	445.99	-	
Total km Travelled	1,784.00	5,664.00	3,982.00	7,964.00	14,459.00	2,458.00	1,493.00	274.00	106.00		From Data Sheet
Total km Travelled without empties	1,769.00	5,659.00	1,920.00	5,396.00	9,281.00	1,476.00	460.00	5.00	96.00		
Km travelled by Added Vehicles	-	-	-	-	886.56	295.36	-	0.89	-		
Avg km without empties	53.61	43.20	24.62	51.39	76.45	50.61	230.00	2.95	96.00	-	
AVG Cost per km travelled without empties	65.00	75.00	36.86	59.18	102.12	140.65	122.57	413.74	492.45	-	
AVG Cost per km travelled	64.45	74.93	17.77	40.10	67.66	90.49	37.76	8.87	445.99	-	

Road : A006 - 196km	Average Cost Incured per a vehicle							Loading Scenario - Actual			
Nu Of Empty Veh	3	0	10	13	35	25	2	6	2	1	
Total Cost	48,425.00	325,425.00	36,899.65	81,019.86	508,256.72	1,044,354.58	362,539.08	1,292,520.82	129,689.30	4,163.25	**3,833,293.26**
Nu Of Vehicles	3	26	15	19	37	39	5	15	1	1	
Avg Cost Incured per veh	16,141.67	12,516.35	2,459.98	4,264.20	13,736.67	26,778.32	72,507.82	86,168.05	129,689.30	4,163.25	
Avg km Travelled by veh	248.33	166.88	95.87	127.79	158.38	172.21	311.40	251.47	255.00	39.00	
AVG Cost per km travelled	**65.00**	**75.00**	**25.66**	**33.37**	**86.73**	**155.50**	**232.84**	**342.66**	**508.59**	**106.75**	

Road : A006 - 196km	Average Cost Incured per a vehicle							Loading Scenario - Actual			
Nu Of Empty Veh	3	0	10	13	35	25	1	6	2.00	1	
Total Cost	48,425.00	325,425.00	36,899.65	81,019.86	541,910.13	1,031,073.45	373,230.00	1,447,693.60	121,921.88	4,163.25	**4,011,761.81**
Nu Of Vehicles	3	26	15	19	37	39	6	15	1.00	1	
Avg Cost Incured per veh	16,141.67	12,516.35	2,459.98	4,264.20	14,646.22	26,437.78	62,205.00	96,512.91	121,921.88	4,163.25	
Nu of added vehicles	0	-	-	0	8	26	13	18	2.00	0	
Cost For Added Vehicles	-	-	-	-	132,924.79	774,389.31	608,270.04	1,572,184.26	145,589.06	-	
Total Cost	48,425.00	325,425.00	36,899.65	81,019.86	674,834.92	1,805,462.77	981,500.04	3,019,877.86	267,510.94	4,163.25	
Total Nu of Vehicles	3	26	15	19	45	65	19	33	3	1	
Avg Cost	16,141.67	12,516.35	2,459.98	4,264.20	14,996.33	27,776.35	51,657.90	91,511.45	89,170.31	4,163.25	
Avg km Travelled by veh	248.33	166.88	95.87	127.79	155.13	177.37	234.95	244.88	192.83	39	
AVG Cost per km travelled	**65.00**	**75.00**	**25.66**	**33.37**	**96.67**	**156.60**	**219.87**	**373.70**	**462.43**	**106.75**	

Road : A006 - 196km	Average Cost Incured per a vehicle							Loading Scenario - 10% than LL			
Nu Of Empty Veh	3	0	10	13	35	25	1	6	2.00	1	
Total Cost	48,425.00	325,425.00	36,899.65	81,019.86	602,071.81	1,186,414.11	389,724.67	1,410,596.46	120,848.96	4,163.25	**4,205,588.77**
Nu Of Vehicles	3	26	15	19	37	39	6	15	1.00	1	
Avg Cost Incured per veh	16,141.67	12,516.35	2,459.98	4,264.20	16,272.21	30,420.87	64,954.11	94,039.76	120,848.96	4,163.25	
Nu of added vehicles	0	-	-	0	3	18	9	12	1.00	0	
Cost For Added Vehicles	-	-	-	-	62,365.44	612,474.22	473,552.52	1,078,854.03	106,428.33	-	
Total Cost	48,425.00	325,425.00	36,899.65	81,019.86	664,437.25	1,798,888.33	863,277.19	2,489,450.48	227,277.29	4,163.25	
Total Nu of Vehicles	3	26	15	19	40	57	15	27	2	1	
Avg Cost	16,141.67	12,516.35	2,459.98	4,264.20	16,610.93	31,559.44	57,551.81	92,201.87	113,638.65	4,163.25	
Avg km Travelled by veh	248.33	166.88	95.87	127.79	157.85	179.52	246.79	251.29	245.75	39	
AVG Cost per km travelled	65.00	75.00	25.66	33.37	105.23	175.80	233.20	373.60	452.22	16.94	

Road : A006 - 196km	Average Cost Incured per a vehicle						Loading Scenario - 20% than LL				
Nu Of Empty Veh	3	0	10	13	35	25	1	6	2.00	1	
Total Cost	48,425.00	325,425.00	36,899.65	81,019.86	569,377.88	1,007,787.23	418,747.83	1,101,137.33	83,405.40	4,163.25	**3,676,388.43**
Nu Of Vehicles	3	26	15	19	37	39	6	15	1.00	1	
Avg Cost Incured per veh	16,141.67	12,516.35	2,459.98	4,264.20	15,388.59	25,840.70	69,791.31	73,409.16	83,405.40	4,163.25	
Nu of added vehicles	0	-	-	0	1	12	7	9	1.00	0	
Cost For Added Vehicles	-	-	-	-	11,552.79	348,002.73	377,525.48	583,636.64	53,845.55	-	
Total Cost	48,425.00	325,425.00	36,899.65	81,019.86	580,930.66	1,355,789.96	796,273.31	1,684,773.96	137,250.95	4,163.25	
Total Nu of Vehicles	3	26	15	19	38	51	13	24	2	1	
Avg Cost	16,141.67	12,516.35	2,459.98	4,264.20	15,287.65	26,584.12	61,251.79	70,198.92	68,625.47	4,163.25	
Avg km Travelled by veh	248.33	166.88	95.87	127.79	154.79	174.71	243.37	243.61	213.61	39	
AVG Cost per km travelled	65.00	75.00	25.66	33.37	98.76	152.16	251.68	288.45	281.70	19.49	

Road : A006 - 196km	Average Cost Incured per a vehicle						Loading Scenario - 30% than LL				
Nu Of Empty Veh	3	0	10	13	35	25	1	6	2.00	1	
Total Cost	48,425.00	325,425.00	36,899.65	81,019.86	566,437.14	991,347.58	391,383.46	1,096,011.56	82,906.88	4,163.25	**3,624,019.37**
Nu Of Vehicles	3	26	15	19	37	39	6	15	1.00	1	
Avg Cost Incured per veh	16,141.67	12,516.35	2,459.98	4,264.20	15,309.11	25,419.17	65,230.58	73,067.44	82,906.88	4,163.25	
Nu of added vehicles	0	-	-	0	1	9	5	6	1.00	0	
Cost For Added Vehicles	-	-	-	-	83.79	244,040.75	244,502.02	383,728.59	38,364.75	-	
Total Cost	48,425.00	325,425.00	36,899.65	81,019.86	566,520.92	1,235,388.33	635,885.48	1,479,740.15	121,271.63	4,163.25	
Total Nu of Vehicles	3	26	15	19	38	48	11	21	2	1	
Avg Cost	16,141.67	12,516.35	2,459.98	4,264.20	14,908.45	25,737.26	57,807.77	70,463.82	60,635.81	4,163.25	
Avg km Travelled by veh	248.33	166.88	95.87	127.79	154.23	171.99	252.91	244.59	188.9	39	
AVG Cost per km travelled	65.00	75.00	25.66	33.37	96.66	149.64	228.57	288.09	239.75	17.02	

Road : A006 - 196km | **Average Cost Incured per a vehicle** | **Loading Scenario - 40% than LL**

Nu Of Empty Veh	3	0	10	13	35	25	1	6	2.00	1	
Total Cost	48,425.00	325,425.00	36,899.65	81,019.86	557,351.94	977,377.77	388,294.50	1,089,672.14	82,581.75	4,163.25	**3,591,210.87**
Nu Of Vehicles	3	26	15	19	37	39	6	15	1.00	1	
Avg Cost Incured per veh	16,141.67	12,516.35	2,459.98	4,264.20	15,063.57	25,060.97	64,715.75	72,644.81	82,581.75	4,163.25	
Nu of added vehicles	0	-	-	0	0	6	4	4	1.00	0	
Cost For Added Vehicles	-	-	-	-	-	172,235.30	179,422.97	229,537.66	26,134.70	-	
Total Cost	48,425.00	325,425.00	36,899.65	81,019.86	557,351.94	1,149,613.07	567,717.47	1,319,209.80	108,716.45	4,163.25	
Total Nu of Vehicles	3	26	15	19	37	45	10	19	2	1	
Avg Cost	16,141.67	12,516.35	2,459.98	4,264.20	15,063.57	25,546.96	56,771.75	69,432.09	54,358.22	4,163.25	
Avg km Travelled by veh	248.33	166.88	95.87	127.79	158.38	173.12	247.81	241.46	169.33	39	
AVG Cost per km travelled	65.00	75.00	25.66	33.37	95.11	147.57	229.09	287.55	321.02	106.75	

A004 Loading Scenario - Actual Condition

Adjustments to MCC & ADT

	Vehicle Classification		Both Direction		*Original Traffic Composition*	% of Weighted Vehicles from MCC	Revised # of Weighted Vehicles	Revised Traffic Volm (MCC)	Revised Traffic Composition	ADT 2013
	Code	***Name***	***# of Vehicle weighted***	***Traffic Volume (MCC)***						
	4	Van		1895	9.173%					42306
	5	Medium Bus	36	91	0.440%	39.56%				
	6	Large Bus	132	1441	6.975%	9.16%				
	7	Light Goods Vehicle	166	648	3.137%	25.62%				
	8	Medium Goods Vehicle (<8.5 T)	171	1258	6.089%	13.59%				
	9	Large Lorries (>8.5 T)	202	434	2.101%	46.54%				
	10	Three Axles Vehicle Combined	42	42	0.203%	100.00%				
	11	Three Axles Vehicle Articulated								
	12	Four Axles Vehicle Articulated	9	10	0.048%	90.00%				
	13	Five Axles Vehicle Articulated	2	2	0.010%	100.00%				
	14	Six Axles Vehicle Articulated	2	2	0.010%	100.00%				
	15	Farm Vehicles	4	4	0.019%	100.00%				
TOTAL			766	5827						
	1	Motor Cycle		6106						
	2	Three Wheel		3834						
	3	Car		4892						
GRAND TOTAL				20659						

A004 Loading Scenario - Legal Limit

Adjustments to MCC & ADT

	Vehicle Classification		Both Direction		*Original Traffic Composition*	% of Weighted Vehicles from MCC	Revised # of Weighted Vehicles	Revised MCC Value (MCC)	Revised Traffic Composition	ADT 2013	Original Traffic Voulme	Revised Traffic Volume	Revised ADT
	Code	***Name***	***# of Vehicle weighted***	***Traffic Volume (MCC)***									
	4	Van		1895	9.173%			1895	9.11%	42306	3881	3881	42605
	5	Medium Bus	36	91	0.440%	39.56%	36	91	0.44%		186	186	
	6	Large Bus	132	1441	6.975%	9.16%	132	1441	6.92%		2951	2951	
	7	Light Goods Vehicle	166	648	3.137%	25.62%	166	648	3.11%		1327	1327	
	8	Medium Goods Vehicle (<8.5 T)	171	1258	6.089%	13.59%	171	1258	6.05%		2576	2576	
	9	Large Lorries (>8.5 T)	202	434	2.101%	46.54%	246	529	2.54%		889	1075	
	10	Three Axles Vehicle Combined	42	42	0.203%	100.00%	62	62	0.30%		86	127	
	11	Three Axles Vehicle Articulated											
	12	Four Axles Vehicle Articulated	9	10	0.048%	90.00%	22	25	0.12%		20	51	
	13	Five Axles Vehicle Articulated	2	2	0.010%	100.00%	22	22	0.11%		4	47	
	14	Six Axles Vehicle Articulated	2	2	0.010%	100.00%	2	2	0.01%		4	4	
	15	Farm Vehicles	4	4	0.019%	100.00%	4	4	0.02%		8	8	
TOTAL			766	5827									
	1	Motor Cycle		6106	29.556%			6106	29.34%		12504	12504	
	2	Three Wheel		3834	18.558%			3834	18.42%		7851	7851	
	3	Car		4892	23.680%			4892	23.51%		10018	10018	
GRAND TOTAL				20659	100.000%			20809	100.00%		42306	42605	

A004 Loading Scenario - 10% than LL

Adjustments to MCC & ADT

	Vehicle Classification		Both Direction		*Original Traffic Composition*	% of Weighted Vehicles from MCC	Revised # of Weighted Vehicles with added	Revised Traffic Volm (MCC)	Revised Traffic Composition	ADT 2013	Original Traffic '	Revised Traffic	Revised ADT
	Code	***Name***	***# of Vehicle weighted***	***Traffic Volume (MCC)***									
	4	Van		1895	9.173%			1895	9.14%	42306	3881	3881	42461
	5	Medium Bus	36	91	0.440%	39.56%	36	91	0.44%		186	186	
	6	Large Bus	132	1441	6.975%	9.16%	132	1441	6.95%		2951	2951	
	7	Light Goods Vehicle	166	648	3.137%	25.62%	166	648	3.12%		1327	1327	
	8	Medium Goods Vehicle (<8.5 T)	171	1258	6.089%	13.59%	171	1258	6.07%		2576	2576	
	9	Large Lorries (>8.5 T)	202	434	2.101%	46.54%	231	497	2.40%		889	1015	
	10	Three Axles Vehicle Combined	42	42	0.203%	100.00%	56	56	0.27%		86	114	
	11	Three Axles Vehicle Articulated											
	12	Four Axles Vehicle Articulated	9	10	0.048%	90.00%	9	10	0.05%		20	20	
	13	Five Axles Vehicle Articulated	2	2	0.010%	100.00%	3	3	0.01%		4	4	
	14	Six Axles Vehicle Articulated	2	2	0.010%	100.00%	3	3	0.01%		4	4	
	15	Farm Vehicles	4	4	0.019%	100.00%	4	4	0.02%		8	8	
TOTAL			766	5827									
	1	Motor Cycle		6106	29.556%			6106	29.44%		12504	12504	
	2	Three Wheel		3834	18.558%			3834	18.49%		7851	7851	
	3	Car		4892	23.680%			4892	23.59%		10018	10018	
GRAND TOTAL				20659	100.000%			20738	100.00%		42306	42461	

A004 Loading Scenario - 20% than LL

Adjustments to MCC & ADT

	Vehicle Classification		Both Direction		*Original Traffic Composition*	% of Weighted Vehicles from MCC	Revised # of Weighted Vehicles	Revised Traffic Volm (MCC)	Revised Traffic Composition	ADT 2013	Original Traffic Voulme	Revised Traffic Volume	Revised ADT
	Code	***Name***	***# of Vehicle weighted***	***Traffic Volume (MCC)***									
	4	Van		1895	9.173%			1895	9.15%	42306	3881	3881	42406
	5	Medium Bus	36	91	0.440%	39.56%	36	91	0.44%		186	186	
	6	Large Bus	132	1441	6.975%	9.16%	132	1441	6.96%		2951	2951	
	7	Light Goods Vehicle	166	648	3.137%	25.62%	166	648	3.13%		1327	1327	
	8	Medium Goods Vehicle (<8.5 T)	171	1258	6.089%	13.59%	171	1258	6.07%		2576	2576	
	9	Large Lorries (>8.5 T)	202	434	2.101%	46.54%	221	475	2.29%		889	969	
	10	Three Axles Vehicle Combined	42	42	0.203%	100.00%	51	51	0.25%		86	106	
	11	Three Axles Vehicle Articulated											
	12	Four Axles Vehicle Articulated	9	10	0.048%	90.00%	9	10	0.05%		20	20	
	13	Five Axles Vehicle Articulated	2	2	0.010%	100.00%	3	3	0.01%		4	4	
	14	Six Axles Vehicle Articulated	2	2	0.010%	100.00%	3	3	0.01%		4	4	
	15	Farm Vehicles	4	4	0.019%	100.00%	4	4	0.02%		8	8	
TOTAL			766	5827									
	1	Motor Cycle		6106	29.556%			6106	29.48%		12504	12504	
	2	Three Wheel		3834	18.558%			3834	18.51%		7851	7851	
	3	Car		4892	23.680%			4892	23.62%		10018	10018	
GRAND TOTAL				20659	100.000%			20711	99.99%		42306	42406	

A004 Loading Scenario - 30% than LL

Adjustments to MCC & ADT

	Vehicle Classification		Both Direction		*Original Traffic Composition*	% of Weighted Vehicles from MCC	Revised # of Weighted Vehicles	Revised Traffic Volm (MCC)	Revised Traffic Composition	ADT 2013	Original Traffic Voulme	Revised Traffic Volume	Revised ADT
	Code	***Name***	***# of Vehicle weighted***	***Traffic Volume (MCC)***									
	4	Van		1895	9.173%			1895	9.16%	42306	3881	3881	42372
	5	Medium Bus	36	91	0.440%	39.56%	36	91	0.44%		186	186	
	6	Large Bus	132	1441	6.975%	9.16%	132	1441	6.96%		2951	2951	
	7	Light Goods Vehicle	166	648	3.137%	25.62%	166	648	3.13%		1327	1327	
	8	Medium Goods Vehicle (<8.5 T)	171	1258	6.089%	13.59%	171	1258	6.08%		2576	2576	
	9	Large Lorries (>8.5 T)	202	434	2.101%	46.54%	214	460	2.22%		889	939	
	10	Three Axles Vehicle Combined	42	42	0.203%	100.00%	49	49	0.24%		86	102	
	11	Three Axles Vehicle Articulated											
	12	Four Axles Vehicle Articulated	9	10	0.048%	90.00%	9	10	0.05%		20	20	
	13	Five Axles Vehicle Articulated	2	2	0.010%	100.00%	3	3	0.01%		4	4	
	14	Six Axles Vehicle Articulated	2	2	0.010%	100.00%	2	2	0.01%		4	4	
	15	Farm Vehicles	4	4	0.019%	100.00%	4	4	0.02%		8	8	
TOTAL			766	5827									
	1	Motor Cycle		6106	29.556%			6106	29.51%		12504	12504	
	2	Three Wheel		3834	18.558%			3834	18.53%		7851	7851	
	3	Car		4892	23.680%			4892	23.64%		10018	10018	
GRAND TOTAL				20659	100.000%			20693	100.00%		42306	42372	

A004 Loading Scenario - 40% than LL

Adjustments to MCC & ADT

	Vehicle Classification		Both Direction		*Original Traffic Composition*	% of Weighted Vehicles from MCC	Revised # of Weighted Vehicles	Revised Traffic Volm (MCC)	Revised Traffic Composition	ADT 2013	Original Traffi	Revised Traffi	Revised ADT
	Code	***Name***	***# of Vehicle weighted***	***Traffic Volume (MCC)***									
	4	Van		1895	9.173%			1895	9.16%	42306	3881	3881	42364
	5	Medium Bus	36	91	0.440%	39.56%	36	91	0.44%		186	186	
	6	Large Bus	132	1441	6.975%	9.16%	132	1441	6.96%		2951	2951	
	7	Light Goods Vehicle	166	648	3.137%	25.62%	166	648	3.13%		1327	1327	
	8	Medium Goods Vehicle (<8.5 T)	171	1258	6.089%	13.59%	171	1258	6.08%		2576	2576	
	9	Large Lorries (>8.5 T)	202	434	2.101%	46.54%	213	458	2.21%		889	935	
	10	Three Axles Vehicle Combined	42	42	0.203%	100.00%	48	48	0.23%		86	97	
	11	Three Axles Vehicle Articulated											
	12	Four Axles Vehicle Articulated	9	10	0.048%	90.00%	9	10	0.05%		20	20	
	13	Five Axles Vehicle Articulated	2	2	0.010%	100.00%	3	3	0.01%		4	4	
	14	Six Axles Vehicle Articulated	2	2	0.010%	100.00%	2	2	0.01%		4	4	
	15	Farm Vehicles	4	4	0.019%	100.00%	4	4	0.02%		8	8	
TOTAL			766	5827									
	1	Motor Cycle		6106	29.556%			6106	29.51%		12504	12504	
	2	Three Wheel		3834	18.558%			3834	18.53%		7851	7851	
	3	Car		4892	23.680%			4892	23.64%		10018	10018	
GRAND TOTAL				20659	100.000%			20690	99.98%		42306	42364	

A004 -22km
User cost per km for entire design life - Actual

ACTUAL TRAFFIC 2013	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AG3	AG4	AG5	AG6	FVH	Total	AADT
	3,881	186	2,951	1,327	2,576	889	86	0	20	4	4	8	11933	42306
% of Vehicle	9.17%	0.44%	6.98%	3.14%	6.09%	2.10%	0.20%	0.00%	0.05%	0.01%	0.01%	0.02%	28.21%	

11,932.67

Private Vehicle Public Vehicles Frieght

Design Life from 2013 to 2022

Calculation of Cumulative nos. of ESAL (for both lanes)

2010-2012
2016-2020
2021-2025

Growth Rate & Average ESA												
Vehicle	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH
GR 2010-2012	2.4	2.4	2.4	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
GR 2013 - 2017	2.90	2.90	2.90	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
GR 2017 - 2022	2.30	2.30	2.30	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
GR 2022 - 2027	2.1	2.1	2.1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Average ESA		0.009	0.286	0.002	0.060	8.867	12.332	0.000	0.516	15.831	5.870	0.000
Avg Cost 2013		52.55	61.52	14.60	38.41	35.26	40.22		31.05	2.95	265.81	-
Avg Cost 2014		55.18	64.60	15.33	40.33	37.02	42.23		32.60	3.10	279.10	-
Avg Cost 2015		57.94	67.83	16.10	42.35	38.87	44.34		34.23	3.26	293.05	-
Avg Cost 2016		60.84	71.22	16.91	44.47	40.81	46.56		35.94	3.42	307.70	-
Avg Cost 2017		63.88	74.78	17.76	46.69	42.85	48.89		37.74	3.59	323.09	0
Avg Cost 2018		67.07	78.52	18.65	49.02	44.99	51.33		39.63	3.77	339.24	-
Avg Cost 2019		70.42	82.45	19.58	51.47	47.24	53.90		41.61	3.96	356.20	-
Avg Cost 2020		73.94	86.57	20.56	54.04	49.60	56.60		43.69	4.16	374.01	-
Avg Cost 2021		77.64	90.90	21.59	56.74	52.08	59.43		45.87	4.37	392.71	-
Avg Cost 2022		81.52	95.45	22.67	59.58	54.68	62.40		48.16	4.59	412.35	-
Avg Tonnage as it is	0	1.235	4.391	1.423	2.358	7.638	18.917	0	20.405	44.030	46.170	

		Year	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH		No.of ESALs	Cum. No. of ESALs	Cost	Cum Cost	Tonnage	Cum Tonnage
	1	2011	3974	191	3022	1396	2711	935	91	0	22	5	5	9		Constrction					
0.005284	2	2012	4070	196	3095	1469	2852	984	96	0	23	5	5	10		Constrction					
0.502914	1	2013	4189	202	3185	1562	3032	1046	103	0	25	6	6	11		4,302,404	4,302,404	142,070,428.25	142,070,428.25	12,627,580.52	12,627,580.52
0.000372	2	2014	4310	208	3278	1660	3223	1112	109	0	26	6	6	12		4,557,207	8,859,611	155,846,875.10	297,917,303.35	13,227,501.82	25,855,082.33
0.029444	3	2015	4435	214	3373	1765	3426	1182	116	0	28	7	7	13		4,838,044	13,697,655	171,118,475.10	469,035,778.45	13,903,019.36	39,758,101.69
2.607278	4	2016	4564	220	3470	1876	3642	1257	123	0	30	7	7	13		5,127,642	18,825,297	187,785,999.35	656,821,777.80	14,577,063.77	54,335,165.46
8.545115	5	2017	4696	227	3571	1994	3871	1336	131	0	32	7	7	14		5,435,397	24,260,694	205,757,533.55	862,579,311.35	15,290,850.47	69,626,015.92
	1	2018	4805	233	3654	2124	4123	1423	140	0	35	8	8	15		5,780,284	30,040,978	226,153,835.75	1,088,733,147.10	16,070,944.16	85,696,960.08
24.79968	2	2019	4915	238	3738	2262	4391	1516	149	0	37	8	8	16		6,136,938	36,177,917	247,952,011.70	1,336,685,158.80	16,846,472.07	102,543,432.15
22.78953	3	2020	5028	244	3824	2409	4676	1614	159	0	39	9	9	17		6,522,789	42,700,705	272,095,221.40	1,608,780,380.20	17,698,729.19	120,242,161.34
21.88932	4	2021	5144	249	3912	2566	4980	1719	169	0	42	10	10	19		6,932,113	49,632,818	298,703,162.95	1,907,483,543.15	18,602,250.55	138,844,411.89
0.014522	5	2022	5262	255	4001	2732	5304	1831	180	0	44	10	10	20		7,361,037	56,993,856	327,868,305.45	2,235,351,848.60	19,515,762.33	158,360,174.22
																	57.0		**2,235.35**		**158.36**
															Directional Distribution Factor		**0.5**		**0.50**		**0.50**
															Lane distribution Factor		**1**		**1.00**		**1.00**
															Cumalative Number of Standard Axles (msa)		**28.50**		**1,117.68**		**79.18**

						NPV (at 10%)	NPV (at -2.27%)
						1405200652	2,531,500,537.27
5.22%							
0.96%	0.005	0.005	0.005			1,405.20	2,531.50

A004 -22km -LL
User cost per km for entire design life - Legal Limit

ACTUAL TRAFFIC 2013		VAN	MBU	LBU	LGV	MG1	MG2	HG3	AG3	AG4	AG5	AG6	FVH	Total	AADT
		3,881	187	2,948	1,325	2,578	1,082	128	0	51	47	4	9	12240	42605
	% of Vehicle	9.11%	0.44%	6.92%	3.11%	6.05%	2.54%	0.30%	0.00%	0.12%	0.11%	0.01%	0.02%	28.73%	

12,240.42

Private Vehicle Public Vehicles Frieght

Design Life from 2013 to 2022

Calculation of Cumulative nos. of ESAL (for both lanes)

2010-2012
2016-2020
2021-2025

Growth Rate & Average ESA												
Vehicle	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH
GR 2010-2012	2.4	2.4	2.4	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
GR 2013 - 2017	2.90	2.90	2.90	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
GR 2017 - 2022	2.30	2.30	2.30	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
GR 2022 - 2027	2.1	2.1	2.1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Average ESA		0.009	0.286	0.002	0.060	0.932	1.241	0.000	1.917	2.480	2.062	0.000
Avg Cost 2013		53.03	61.64	12.86	33.00	49.51	68.05		31.07	9.46	307.19	-
Avg Cost 2014		55.68	64.72	13.50	34.65	51.99	71.45		32.62	9.93	322.55	-
Avg Cost 2015		58.46	67.96	14.17	36.38	54.59	75.02		34.25	10.43	338.68	-
Avg Cost 2016		61.38	71.36	14.88	38.20	57.32	78.77		35.96	10.95	355.61	-
Avg Cost 2017		64.45	74.93	15.62	40.11	60.19	82.71		37.76	11.5	373.39	0
Avg Cost 2018		67.67	78.68	16.40	42.12	63.20	86.85		39.65	12.08	392.06	-
Avg Cost 2019		71.05	82.61	17.22	44.23	66.36	91.19		41.63	12.68	411.66	-
Avg Cost 2020		74.60	86.74	18.08	46.44	69.68	95.75		43.71	13.31	432.24	-
Avg Cost 2021		78.33	91.08	18.98	48.76	73.16	100.54		45.90	13.98	453.85	-
Avg Cost 2022		82.25	95.63	19.93	51.20	76.82	105.57		48.20	14.68	476.54	-
Avg Tonnage as it is	0	1.235	4.391	1.423	2.358	7.638	18.917	0	20.405	44.030	46.170	

		Year	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH		No.of ESALs	Cum. No. of ESALs	Cost	Cum Cost	Tonnage	Cum Tonnage
	1	2011	3975	192	3020	1394	2712	1139	135	0	54	50	5	9		Constrction					
0.005284	2	2012	4070	197	3092	1467	2853	1198	142	0	57	52	5	10		Constrction					
0.502914	1	2013	4189	203	3182	1560	3033	1274	151	0	61	56	6	11		1,000,073	1,000,073	147,705,874.95	147,705,874.95	14,661,774.43	14,661,774.43
0.000372	2	2014	4310	209	3274	1658	3224	1354	161	0	65	59	6	12		1,051,210	2,051,283	162,119,998.70	309,825,873.65	15,397,298.34	30,059,072.76
0.029444	3	2015	4435	215	3369	1763	3427	1439	171	0	69	63	7	13		1,106,286	3,157,569	178,104,173.60	487,930,047.25	16,198,456.55	46,257,529.31
2.607278	4	2016	4564	221	3467	1874	3643	1530	182	0	73	67	7	13		1,163,706	4,321,276	195,604,069.40	683,534,116.65	17,025,507.86	63,283,037.16
8.545115	5	2017	4696	228	3568	1992	3873	1627	193	0	78	71	7	14		1,224,495	5,545,771	222,579,102.40	906,113,219.05	17,897,678.28	81,180,715.44
	1	2018	4805	234	3651	2122	4125	1733	206	0	84	76	8	15		1,290,217	6,835,988	235,951,738.80	1,142,064,957.85	18,844,987.60	100,025,703.03
24.79968	2	2019	4915	239	3735	2260	4393	1846	219	0	89	81	8	16		1,357,326	8,193,314	258,874,603.85	1,400,939,561.70	19,806,589.95	119,832,292.98
22.78953	3	2020	5028	245	3820	2407	4679	1966	234	0	95	86	9	17		1,429,682	9,622,996	284,341,851.05	1,685,281,412.75	20,848,036.79	140,680,329.77
21.88932	4	2021	5144	250	3908	2563	4983	2094	249	0	101	92	10	19		1,506,376	11,129,372	312,378,687.30	1,997,660,100.05	21,952,381.52	162,632,711.28
0.014522	5	2022	5262	256	3998	2730	5307	2230	265	0	107	98	10	20		1,586,150	12,715,522	343,157,717.45	2,340,817,817.50	23,095,664.81	185,728,376.09
																	12.7		**2,340.82**		**185.73**
															Directional Distribution Factor		**0.5**		**0.50**		**0.50**
															Lane distribution Factor		**1**		**1.00**		**1.00**
															Cumalative Number of Standard Axles (msa)		**6.36**		**1,170.41**		**92.86**

									NPV	NPV (at -2.27%)
									147705875	147705875
								1	147381817	165936539.1
								2	147193531.9	186588541.2
								3	146960232.5	209746245
								4	152024521.8	244290248.8
								5	146507465.8	265063765.7
								6	146127965	297661088.1
								7	145912329.2	334640761.8
								8	145726963	376291913.8
								9	145532370.7	423099680.1
									1471073072	2651024658
									1,471.07	2,651.02

5.22%

0.96% 0.005 0.005 0.005

A004 -22km
User cost per km for entire design life - 10% than LL

ACTUAL TRAFFIC 2013	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AG3	AG4	AG5	AG6	FVH	Total	AADT
	3,881	187	2,951	1,325	2,577	1,019	115	0	21	4	4	8	12093	42461
% of Vehicle	9.14%	0.44%	6.95%	3.12%	6.07%	2.40%	0.27%	0.00%	0.05%	0.01%	0.01%	0.02%	28.48%	

12,092.89

Private Vehicle Public Vehicles Frieght

Design Life from 2013 to 2022

Calculation of Cumulative nos. of ESAL (for both lanes)

2010-2012
2016-2020
2021-2025

Growth Rate & Average ESA												
Vehicle	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH
GR 2010-2012	2.4	2.4	2.4	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
GR 2013 - 2017	2.90	2.90	2.90	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
GR 2017 - 2022	2.30	2.30	2.30	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
GR 2022 - 2027	2.1	2.1	2.1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Average ESA		0.009	0.286	0.002	0.060	1.296	1.793	0.000	0.516	3.719	3.770	0.000
Avg Cost 2013		53.03	61.64	14.61	32.99	51.39	70.87		31.07	9.51	323.29	-
Avg Cost 2014		55.68	64.72	15.34	34.64	53.96	74.41		32.62	9.99	339.45	-
Avg Cost 2015		58.46	67.96	16.11	36.37	56.66	78.13		34.25	10.49	356.42	-
Avg Cost 2016		61.38	71.36	16.92	38.19	59.49	82.04		35.96	11.01	374.24	-
Avg Cost 2017		64.45	74.93	17.77	40.1	62.46	86.14		37.76	11.56	392.95	0
Avg Cost 2018		67.67	78.68	18.66	42.11	65.58	90.45		39.65	12.14	412.60	-
Avg Cost 2019		71.05	82.61	19.59	44.22	68.86	94.97		41.63	12.75	433.23	-
Avg Cost 2020		74.60	86.74	20.57	46.43	72.30	99.72		43.71	13.39	454.89	-
Avg Cost 2021		78.33	91.08	21.60	48.75	75.92	104.71		45.90	14.06	477.63	-
Avg Cost 2022		82.25	95.63	22.68	51.19	79.72	109.95		48.20	14.76	501.51	-
Avg Tonnage as it is	0	1.235	4.391	1.423	2.358	7.638	18.917	0	20.405	44.030	46.170	

		Year	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH		No.of ESALs	Cum. No. of ESALs	Cost	Cum Cost	Tonnage	Cum Tonnage
	1	2011	3975	192	3022	1394	2712	1073	121	0	23	5	5	9		Constrction					
0.005284	2	2012	4070	196	3095	1467	2853	1128	127	0	24	5	5	10		Constrction					
0.502914	1	2013	4189	202	3185	1560	3033	1200	136	0	26	6	6	11		1,078,657	1,078,657	147,458,784.55	147,458,784.55	13,292,037.47	13,292,037.47
0.000372	2	2014	4310	208	3278	1658	3224	1275	144	0	28	6	6	12		1,133,730	2,212,388	161,830,312.80	309,289,097.35	13,938,306.83	27,230,344.30
0.029444	3	2015	4435	214	3373	1763	3427	1355	153	0	29	7	7	13		1,194,844	3,407,232	177,781,006.25	487,070,103.60	14,648,064.66	41,878,408.96
2.607278	4	2016	4564	220	3470	1874	3643	1441	163	0	31	7	7	13		1,257,404	4,664,636	195,226,152.05	682,296,255.65	15,373,489.75	57,251,898.71
8.545115	5	2017	4696	227	3571	1992	3873	1532	173	0	33	7	7	14		1,323,061	5,987,697	214,121,187.35	896,417,443.00	16,135,400.97	73,387,299.68
	1	2018	4805	233	3654	2122	4125	1632	185	0	36	8	8	15		1,395,815	7,383,512	235,479,468.95	1,131,896,911.95	16,972,451.09	90,359,750.77
24.79968	2	2019	4915	238	3738	2260	4393	1738	197	0	38	8	8	16		1,468,942	8,852,454	258,338,053.85	1,390,234,965.80	17,804,935.43	108,164,686.19
22.78953	3	2020	5028	244	3824	2407	4679	1851	209	0	40	9	9	17		1,548,727	10,401,181	283,709,324.30	1,673,944,290.10	18,713,680.67	126,878,366.86
21.88932	4	2021	5144	249	3912	2563	4983	1971	223	0	43	10	10	19		1,633,927	12,035,108	311,699,206.95	1,985,643,497.05	19,686,119.51	146,564,486.37
0.014522	5	2022	5262	255	4001	2730	5307	2099	238	0	46	10	10	20		1,721,386	13,756,493	342,388,757.35	2,328,032,254.40	20,679,823.25	167,244,309.62
																	13.8		**2,328.03**		**167.24**
															Directional Distribution Factor		**0.5**		**0.50**		**0.50**
															Lane distribution Factor		**1**		**1.00**		**1.00**
															Cumalative Number of Standard Axles (msa)		**6.88**		**1,164.02**		**83.62**

						NPV	NPV (at -2.27%)
						147458784.6	147458784.6
					1	147118466.2	165640033.6
					2	146926451.4	186249979
					3	146676297.6	209341004.2
					4	146247652	235007319
					5	146214223.4	264533226.6
					6	145825096.5	297044148.3
					7	145587743	333896343.7
					8	145409980.4	375473410.6
					9	145206256.5	422151583.2
5.22%						1462670952	2636795833
0.96%	0.005	0.005	0.005			1,462.67	2636.795833
3.55%	0.441	0.441	0.441				

A004 -22km
User cost per km for entire design life - 20%

ACTUAL TRAFFIC 2013	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AG3	AG4	AG5	AG6	FVH	Total	AADT
	3,880	187	2,951	1,327	2,574	971	106	0	21	4	4	8	12035	42406
% of Vehicle	9.15%	0.44%	6.96%	3.13%	6.07%	2.29%	0.25%	0.00%	0.05%	0.01%	0.01%	0.02%	28.38%	

12,034.82

Private Vehicle Public Vehicles Frieght

Design Life from 2013 to 2022
Calculation of Cumulative nos. of ESAL (for both lanes)

2010-2012
2016-2020
2021-2025

Growth Rate & Average ESA												
Vehicle	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH
GR 2010-2012	2.4	2.4	2.4	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
GR 2013 - 2017	2.90	2.90	2.90	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
GR 2017 - 2022	2.30	2.30	2.30	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
GR 2022 - 2027	2.1	2.1	2.1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Average ESA		0.009	0.286	0.002	0.060	1.809	2.492	0.000	0.516	6.092	6.432	0.000
Avg Cost 2013		53.03	61.64	14.61	32.99	52.91	72.92		31.07	9.26	355.05	-
Avg Cost 2014		55.68	64.72	15.34	34.64	55.56	76.57		32.62	9.72	372.80	-
Avg Cost 2015		58.46	67.96	16.11	36.37	58.34	80.40		34.25	10.21	391.44	-
Avg Cost 2016		61.38	71.36	16.92	38.19	61.26	84.42		35.96	10.72	411.01	-
Avg Cost 2017		64.45	74.93	17.77	40.1	64.32	88.64		37.76	11.26	431.56	0
Avg Cost 2018		67.67	78.68	18.66	42.11	67.54	93.07		39.65	11.82	453.14	-
Avg Cost 2019		71.05	82.61	19.59	44.22	70.92	97.72		41.63	12.41	475.80	-
Avg Cost 2020		74.60	86.74	20.57	46.43	74.47	102.61		43.71	13.03	499.59	-
Avg Cost 2021		78.33	91.08	21.60	48.75	78.19	107.74		45.90	13.68	524.57	-
Avg Cost 2022		82.25	95.63	22.68	51.19	82.10	113.13		48.20	14.36	550.80	-
Avg Tonnage as it is	0	1.235	4.391	1.423	2.358	7.638	18.917	0	20.405	44.030	46.170	

	Year	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH		No.of ESALs	Cum. No. of ESALs	Cost	Cum Cost	Tonnage	Cum Tonnage
	1	2011	3974	192	3023	1397	2708	1022	112	0	23	5	5	9		Constrction					
0.005284	2	2012	4069	196	3095	1469	2849	1075	118	0	24	5	5	10		Constrction					
0.502914	1	2013	4188	202	3185	1562	3029	1143	126	0	26	6	6	11		1,302,258	1,302,258	146,890,862.80	146,890,862.80	13,061,677.94	13,061,677.94
0.000372	2	2014	4309	208	3278	1660	3220	1215	134	0	28	6	6	12		1,371,435	2,673,693	161,225,266.90	308,116,129.70	13,699,583.69	26,761,261.63
0.029444	3	2015	4434	214	3373	1765	3423	1292	142	0	29	7	7	13		1,448,772	4,122,465	177,121,746.90	485,237,876.60	14,394,073.21	41,155,334.83
2.607278	4	2016	4562	220	3470	1876	3638	1373	151	0	31	7	7	13		1,525,753	5,648,218	194,444,336.65	679,682,213.25	15,097,793.57	56,253,128.40
8.545115	5	2017	4695	227	3571	1994	3867	1460	161	0	33	7	7	14		1,608,338	7,256,556	213,260,740.00	892,942,953.25	15,847,692.64	72,100,821.04
	1	2018	4803	233	3654	2124	4119	1555	172	0	36	8	8	15		1,700,504	8,957,060	234,522,931.70	1,127,465,884.95	16,663,898.71	88,764,719.75
24.79968	2	2019	4914	238	3738	2262	4387	1656	183	0	38	8	8	16		1,792,330	10,749,390	257,261,380.50	1,384,727,265.45	17,475,538.99	106,240,258.73
22.78953	3	2020	5027	244	3824	2409	4672	1764	195	0	40	9	9	17		1,894,850	12,644,240	282,548,784.90	1,667,276,050.35	18,369,484.21	124,609,742.94
21.88932	4	2021	5143	249	3912	2566	4975	1879	208	0	43	10	10	19		2,003,697	14,647,937	310,414,655.15	1,977,690,705.50	19,320,737.72	143,930,480.66
0.014522	5	2022	5261	255	4001	2732	5299	2001	221	0	46	10	10	20		2,113,168	16,761,105	340,895,246.70	2,318,585,952.20	20,283,385.44	164,213,866.10
																	16.8		**2,318.59**		**164.21**
														Directional Distribution Factor			**0.5**		**0.50**		**0.50**
														Lane distribution Factor			**1**		**1.00**		**1.00**
														Cumalative Number of Standard Axles (msa)			**8.38**		**1,159.29**		**82.11**

	NPV	NPV (at -2.27%)
	146890862.8	146890862.8
1	146568424.5	165020744
2	146381609	185559314.5
3	146088908.1	208502663.6
4	145659954.9	234062940.6
5	145620289	263458670.5
6	145217342.5	295806159.9
7	144992202.8	332530509.6
8	144810727.6	373926037.2
9	144572862.2	420310144.5
	1456803183	2626068047
	1,456.80	2,626.07

5.22%
0.96% 0.005 0.005 0.005
3.55% 0.441 0.441 0.441

A004 -22km

User cost per km for entire design life - 30%

ACTUAL TRAFFIC 2013

	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AG3	AG4	AG5	AG6	FVH	Total	AADT
	3,881	186	2,949	1,326	2,576	941	102	0	21	4	4	8	12000	42372
% of Vehicle	9.16%	0.44%	6.96%	3.13%	6.08%	2.22%	0.24%	0.00%	0.05%	0.01%	0.01%	0.02%	28.32%	

11,999.75

Private Vehicle Public Vehicles Frieght

Design Life from 2013 to 2022

Calculation of Cumulative nos. of ESAL (for both lanes)

2010-2012
2016-2020
2021-2025

Growth Rate & Average ESA												
Vehicle	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH
GR 2010-2012	2.4	2.4	2.4	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
GR 2013 - 2017	2.90	2.90	2.90	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
GR 2017 - 2022	2.30	2.30	2.30	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
GR 2022 - 2027	2.1	2.1	2.1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Average ESA		0.009	0.286	0.002	0.060	2.672	3.640	0.000	0.516	10.660	5.870	0.000
Avg Cost 2013		53.03	61.64	14.61	32.99	54.91	73.82		31.07	8.16	366.91	-
Avg Cost 2014		55.68	64.72	15.34	34.64	57.66	77.51		32.62	8.57	385.26	-
Avg Cost 2015		58.46	67.96	16.11	36.37	60.54	81.39		34.25	9.00	404.52	-
Avg Cost 2016		61.38	71.36	16.92	38.19	63.57	85.46		35.96	9.45	424.75	-
Avg Cost 2017		64.45	74.93	17.77	40.1	66.75	89.73		37.76	9.92	445.99	0
Avg Cost 2018		67.67	78.68	18.66	42.11	70.09	94.22		39.65	10.42	468.29	-
Avg Cost 2019		71.05	82.61	19.59	44.22	73.59	98.93		41.63	10.94	491.70	-
Avg Cost 2020		74.60	86.74	20.57	46.43	77.27	103.88		43.71	11.49	516.29	-
Avg Cost 2021		78.33	91.08	21.60	48.75	81.13	109.07		45.90	12.06	542.10	-
Avg Cost 2022		82.25	95.63	22.68	51.19	85.19	114.52		48.20	12.66	569.21	-
Avg Tonnage as it is	0	1.235	4.391	1.423	2.358	7.638	18.917	0	20.405	44.030	46.170	

		Year	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH		No.of ESALs	Cum. No. of ESALs	Cost	Cum Cost	Tonnage	Cum Tonnage
	1	2011	3975	191	3020	1396	2711	990	107	0	23	5	5	9		Constrction					
0.005284	2	2012	4070	196	3093	1468	2852	1042	113	0	24	5	5	10		Constrction					
0.502914	1	2013	4189	202	3183	1561	3032	1108	121	0	26	6	6	11		1,682,946	1,682,946	146,939,805.65	146,939,805.65	12,928,436.15	12,928,436.15
0.000372	2	2014	4310	208	3275	1659	3223	1178	128	0	28	6	6	12		1,774,770	3,457,716	161,240,326.80	308,180,132.45	13,552,258.74	26,480,694.89
0.029444	3	2015	4435	214	3370	1764	3426	1252	136	0	29	7	7	13		1,878,251	5,335,966	177,138,263.15	485,318,395.60	14,238,384.65	40,719,079.53
2.607278	4	2016	4564	220	3468	1875	3642	1331	145	0	31	7	7	13		1,982,693	7,318,660	194,526,965.35	679,845,360.95	14,938,992.66	55,658,072.19
8.545115	5	2017	4696	227	3569	1993	3871	1415	154	0	33	7	7	14		2,092,618	9,411,278	213,312,201.35	893,157,562.30	15,673,623.41	71,331,695.60
	1	2018	4805	233	3652	2123	4123	1507	165	0	36	8	8	15		2,217,855	11,629,133	234,611,119.35	1,127,768,681.65	16,481,465.87	87,813,161.46
24.79968	2	2019	4915	238	3736	2261	4391	1605	175	0	38	8	8	16		2,341,850	13,970,983	257,336,544.95	1,385,105,226.60	17,277,837.83	105,090,999.29
22.78953	3	2020	5028	244	3821	2408	4676	1710	187	0	40	9	9	17		2,481,850	16,452,833	282,630,763.90	1,667,735,990.50	18,161,816.73	123,252,816.02
21.88932	4	2021	5144	249	3909	2564	4980	1821	199	0	43	10	10	19		2,628,622	19,081,454	310,487,706.25	1,978,223,696.75	19,095,355.33	142,348,171.35
0.014522	5	2022	5262	255	3999	2731	5304	1939	211	0	46	10	10	20		2,776,845	21,858,299	340,994,676.35	2,319,218,373.10	20,042,068.97	162,390,240.32
																	21.9		**2,319.22**		**162.39**
															Directional Distribution Factor		**0.5**		**0.50**		**0.50**
															Lane distribution Factor		**1**		**1.00**		**1.00**
															Cumalative Number of Standard Axles (msa)		**10.93**		**1,159.61**		**81.20**

	NPV	NPV (at -2.27%)
	146939805.7	146939805.7
1	146582115.3	165036158.4
2	146395258.8	185576617.5
3	146150988.2	208591266.3
4	145695103.7	234119421.7
5	145675046.6	263557738.9
6	145259770.9	295892586
7	145034271	332626990.4
8	144844806.4	374014034.7
9	144615030.1	420432737.3
	1457192197	2626787357
	1,457.19	2,626.79

5.22%

0.96% 0.005 0.005 0.005

A004 -22km
User cost per km for entire design life - 40%

ACTUAL TRAFFIC 2013	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AG3	AG4	AG5	AG6	FVH	Total	AADT
	3,881	186	2,949	1,326	2,576	936	97	0	21	4	4	8	11989	42364
% of Vehicle	9.16%	0.44%	6.96%	3.13%	6.08%	2.21%	0.23%	0.00%	0.05%	0.01%	0.01%	0.02%	28.30%	

11,989.01

Private Vehicle Public Vehicles Frieght

Design Life from 2013 to 2022
Calculation of Cumulative nos. of ESAL (for both lanes)

2010-2012
2016-2020
2021-2025

Growth Rate & Average ESA												
Vehicle	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH
GR 2010-2012	2.4	2.4	2.4	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
GR 2013 - 2017	2.90	2.90	2.90	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
GR 2017 - 2022	2.30	2.30	2.30	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
GR 2022 - 2027	2.1	2.1	2.1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Average ESA		0.009	0.286	0.002	0.060	3.875	5.069	0.000	0.516	11.934	5.870	0.000
Avg Cost 2013		53.03	61.64	14.61	32.99	54.88	74.12		31.07	7.30	366.91	-
Avg Cost 2014		55.68	64.72	15.34	34.64	57.62	77.83		32.62	7.67	385.26	-
Avg Cost 2015		58.46	67.96	16.11	36.37	60.50	81.72		34.25	8.05	404.52	-
Avg Cost 2016		61.38	71.36	16.92	38.19	63.52	85.81		35.96	8.45	424.75	-
Avg Cost 2017		64.45	74.93	17.77	40.1	66.7	90.1		37.76	8.87	445.99	0
Avg Cost 2018		67.67	78.68	18.66	42.11	70.04	94.61		39.65	9.31	468.29	-
Avg Cost 2019		71.05	82.61	19.59	44.22	73.54	99.34		41.63	9.78	491.70	-
Avg Cost 2020		74.60	86.74	20.57	46.43	77.22	104.31		43.71	10.27	516.29	-
Avg Cost 2021		78.33	91.08	21.60	48.75	81.08	109.53		45.90	10.78	542.10	-
Avg Cost 2022		82.25	95.63	22.68	51.19	85.13	115.01		48.20	11.32	569.21	-
Avg Tonnage as it is	0	1.235	4.391	1.423	2.358	7.638	18.917	0	20.405	44.030	46.170	

		Year	VAN	MBU	LBU	LGV	MG1	MG2	HG3	AH3	AG4	AG5	AG6	FVH		No.of ESALs	Cum. No. of ESALs	Cost	Cum Cost	Tonnage	Cum Tonnage
	1	2011	3974	191	3020	1395	2710	985	103	0	23	5	5	9		Constrction					
0.005284	2	2012	4070	196	3092	1468	2851	1037	108	0	24	5	5	10		Constrction					
0.502914	1	2013	4189	202	3182	1561	3031	1103	115	0	26	6	6	11		2,217,065	2,217,065	146,642,020.40	146,642,020.40	12,870,605.18	12,870,605.18
0.000372	2	2014	4310	208	3274	1659	3222	1172	123	0	28	6	6	12		2,343,714	4,560,779	160,931,613.45	307,573,633.85	13,498,544.61	26,369,149.79
0.029444	3	2015	4435	214	3369	1764	3425	1246	130	0	29	7	7	13		2,482,475	7,043,254	176,784,395.65	484,358,029.50	14,177,765.81	40,546,915.60
2.607278	4	2016	4564	220	3467	1875	3641	1325	138	0	31	7	7	13		2,624,450	9,667,703	194,120,304.25	678,478,333.75	14,871,469.12	55,418,384.72
8.545115	5	2017	4696	227	3568	1993	3870	1408	147	0	33	7	7	14		2,774,539	12,442,242	212,851,918.10	891,330,251.85	15,603,312.00	71,021,696.72
	1	2018	4805	233	3651	2123	4122	1500	157	0	36	8	8	15		2,944,524	15,386,766	234,104,561.40	1,125,434,813.25	16,404,249.75	87,425,946.47
24.79968	2	2019	4915	238	3735	2261	4390	1597	167	0	38	8	8	16		3,115,352	18,502,119	256,778,952.70	1,382,213,765.95	17,197,833.85	104,623,780.31
22.78953	3	2020	5028	244	3820	2408	4675	1701	178	0	40	9	9	17		3,304,916	21,807,035	281,979,965.25	1,664,193,731.20	18,072,120.17	122,695,900.48
21.88932	4	2021	5144	249	3908	2564	4979	1812	190	0	43	10	10	19		3,507,152	25,314,187	309,806,021.30	1,973,999,752.50	19,005,658.77	141,701,559.25
0.014522	5	2022	5262	255	3998	2731	5303	1930	202	0	46	10	10	20		3,713,448	29,027,634	340,274,009.40	2,314,273,761.90	19,952,372.41	161,653,931.66
																	29.0		**2,314.27**		**161.65**
															Directional Distribution Factor		**0.5**		**0.50**		**0.50**
															Lane distribution Factor		**1**		**1.00**		**1.00**
															Cumalative Number of Standard Axles (msa)		**14.51**		**1,157.14**		**80.83**

	NPV	NPV (at -2.27%)
	146642020.4	146642020.4
1	146301466.8	164720177.5
2	146102806.3	185205892.8
3	145845457.7	208155203.6
4	145380724.1	233614240.8
5	145360514	262988681.2
6	144945024.6	295251451.2
7	144700308.3	331861068.1
8	144526795.4	373192875.8
9	144309397	419544183.9
	1454114515	2621175795
	1,454.11	2,621.18

5.22%
0.96% 0.005 0.005 0.005
3.55% 0.441 0.441 0.441