1. Report No. FHWA/LA.11/445	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle **Characterization and Development of Truck Load Spectra and Growth Factors for Current and Future Pavement Design Practices in Louisiana**	5. Report Date July 2011 6. Performing Organization Code LTRC Project Number: 07-2P State Project Number: 736-99-4411	
7. Author(s) Sherif Ishak, Ph.D., Hak-Chul Shin, Ph.D., Bharath Sridhar	8. Performing Organization Report No. 445	
9. Performing Organization Name and Address Department of Civil and Environmental Engineering Louisiana State University Baton Rouge, LA 70803	10. Work Unit No. 11. Contract or Grant No. 07-2P / 736-99-4411	
12. Sponsoring Agency Name and Address Louisiana Department of Transportation and Development P.O. Box 94245 Baton Rouge, LA 70804-9245	13. Type of Report and Period Covered 3/31/07 – 3/31/09 Final Report 14. Sponsoring Agency Code	

15. Supplementary Notes
Conducted in Cooperation with the U.S. Department of Transportation, Federal Highway Administration

16. Abstract

For pavement design practices, several factors must be considered to ensure good pavement performance over the anticipated life cycle. Such factors include, but are not limited to, the type of paving materials, traffic loading characteristics, prevailing environmental conditions, and others. Traditional pavement design practices have followed the standards set by the American Association of State Highway and Transportation Officials (AASHTO) which require the use of an equivalent single axle load (ESAL), 18 kip single axle load, for design traffic input. The new mechanistic-empirical pavement design guide (MEPDG) was developed to improve pavement design practices. The guide, however, requires the development of truck axle load spectra, which are expressed by the number of load applications of various axle configurations (single, dual, tridem, and quad) within a given weight classification range. This raises the need for more axle load data from new and existing traffic data sources. Such additional data requirements pose a challenge for many states including Louisiana. This research study was conducted for LADOTD to address traffic data needs and requirements for the adoption of the new pavement design guide. The study reviewed current practices of traffic data collection processes adopted by LADOTD as well as existing and newly proposed traffic data collection procedures followed by other states. The study developed a strategic plan for Louisiana to meet the MEPDG traffic data requirements. Two alternative plans were proposed for the addition of new permanent Weigh-in-Motion (WIM) stations on major truck routes as well as utilizing axle load data from the existing weight enforcement sites. Cost estimates were also provided for each plan. In addition, the study developed axle load spectra and vehicle class distributions using screened traffic data collected by portable WIM sites from 2004 to 2006. For current design practices, the study also utilized portable WIM data to update load equivalency factors (LEF) using the Vehicle Travel Information System (VTRIS) software.

17. Key Words Pavement Design, Axle Load Spectra, Mechanistic Empirical Design		18. Distribution Statement Unrestricted. This document is available through the National Technical Information Service, Springfield, VA 21161.	
19. Security Classif. (of this report) not applicable	20. Security Classif. (of this page)	21. No. of Pages 250	22. Price

Project Review Committee

Each research project will have an advisory committee appointed by the LTRC Director. The Project Review Committee is responsible for assisting the LTRC Administrator or Manager in the development of acceptable research problem statements, requests for proposals, review of research proposals, oversight of approved research projects, and implementation of findings.

LTRC appreciates the dedication of the following Project Review Committee Members in guiding this research study to fruition.

LTRC Administrator

Zhongjie "Doc" Zhang, Ph.D., P.E.
Pavement and Geotech Administrator

Members

Jeff Lambert
Kevin Gaspard
Mark Martinez
Ronald J Bertinot
Jim Porter
Leslie W Mix
Sis Guarisco
Philip Arena
Chris Wagner

Directorate Implementation Sponsor

William Temple

Characterization and Development of Truck Load Spectra and Growth Factors for Current and Future Pavement Design Practices in Louisiana

by

Sherif Ishak
Hak-Chul Shin
Bharath Kumar Sridhar

Department of Civil and Environmental Engineering
Louisiana State University
Baton Rouge, LA 70803

LTRC Project No: 07-2P
State Project No: 736-99-1411

conducted for

Louisiana Department of Transportation and Development
Louisiana Transportation Research Center

July 2011

ABSTRACT

For pavement design practices, several factors must be considered to ensure good pavement performance over the anticipated life cycle. Such factors include, but are not limited to, the type of paving materials, traffic loading characteristics, prevailing environmental conditions, and others. Traditional pavement design practices have followed the standards set by the American Association of State Highway and Transportation Officials (AASHTO) which require the use of an equivalent single axle load (ESAL), 18 kip single axle load, for design traffic input. The new mechanistic-empirical pavement design guide (MEPDG) was developed to improve pavement design practices. The guide, however, requires the development of truck axle load spectra, which are expressed by the number of load applications of various axle configurations (single, dual, tridem, and quad) within a given weight classification range. This raises the need for more axle load data from new and existing traffic data sources. Such additional data requirements pose a challenge for many states including Louisiana. This research study was conducted for LADOTD to address traffic data needs and requirements for the adoption of the new pavement design guide. The study reviewed current practices of traffic data collection processes adopted by LADOTD as well as existing and newly proposed traffic data collection procedures followed by other states. The study developed a strategic plan for Louisiana to meet the MEPDG traffic data requirements. Two alternative plans were proposed for the addition of new permanent Weigh-in-Motion (WIM) stations on major truck routes as well as utilizing axle load data from the existing weight enforcement sites. Cost estimates were also provided for each plan. In addition, the study developed axle load spectra and vehicle class distributions using screened traffic data collected by portable WIM sites from 2004 to 2006. For current design practices, the study also utilized portable WIM data to update load equivalency factors (LEF) using the Vehicle Travel Information System (VTRIS) software.

ACKNOWLEDGMENTS

This project was completed under the financial support from the Louisiana Department of Transportation and Development (LADOTD) and the Louisiana Transportation Research Center (LTRC). The research team also gratefully acknowledges the assistance received from the project review committee members and others who participated in the progress meetings for their valuable feedback. The research team also acknowledges the assistance from all other LADOTD personnel involved throughout the course of this project.

IMPLEMENTATION STATEMENT

The study reviewed the current practices for collecting traffic data in Louisiana including portable and permanent WIM locations, the equipment used and their reliability issues, and the adequacy of collected traffic data. In order to address the MEPDG data requirements for pavement design, the study proposed a strategic plan for placing new WIM stations throughout the state along main truck routes in conjunction with a plan to utilize data from existing weight enforcement stations in order to reduce the cost. Two alternative plans are offered. The first one involves construction of new WIM stations to collect the required axle load spectra. The second one involves utilization of data that can be collected from weight enforcement sites in addition to construction of new WIM stations where axle load data are not available. Cost estimates were also provided for each alternative plan to assist the state in making a decision on which plan to implement. Once a plan is selected, the state should set a timeline for the implementation of that plan. This will also require a plan for data collection and analysis in order to develop the axle load spectra at each site as well as integration of the permanent WIM data with the current collected portable WIM data. The implementation of one of the two strategic plans proposed in this study will ensure that axle load data are available to LADOTD when adopting the new pavement design guide. The updated values of the load equivalency factors (LEF) may be used by LADOTD with the current design practices until the transition to the new pavement design practice is over.

TABLE OF CONTENTS

ABSTRACT iii
ACKNOWLEDGMENTS v
IMPLEMENTATION STATEMENT vii
TABLE OF CONTENTS ix
LIST OF TABLES xiii
LIST OF FIGURES xv
INTRODUCTION 1
Literature Review 2
AASHTO Pavement Design Guide 2
Equivalent Single Axle Loads (ESALs) 3
Load Equivalency Factor (LEF) 6
Mechanistic-Empirical Pavement Design Guide 6
Traffic Input for Pavement Design 7
Hierarchical Traffic Input for MEPDG 7
Axle Load Spectra 9
Growth Factors 10
Classification of Traffic Data by Type 11
Traffic Volume 11
Vehicle Classification 11
Axle Configuration and Weight Data 11
Weigh-In-Motion (WIM) Stations 12
Portable WIM Stations 13
Permanent WIM Stations 14
WIM Technologies 15
Piezoelectric Sensor 15
Bending Plate 17
Single Load Cell 19
Data Collection Procedures by Other States 22
Data Collection in Louisiana 34
Portable WIM Sites 35
Truck Routes in Louisiana 40
Weight Enforcement Sites 44
Long Term Pavement Performance (LTPP) Data 48
OBJECTIVES 51
SCOPE 53

METHODOLOGY 55
Current Practices of Traffic Data Collection by LADOTD 55
Evaluation of WIM Data 58
Steering Axle Load Test 58
Gross Vehicle Weight Test 62
Comparison of Truck Traffic Characteristics 64
Testing Similar Single Axle Load Spectra and Vehicle Class Distributions.. 67
DISCUSSION OF RESULTS..73
Vehicle Class Distribution for Functional Class... 73
Truck Traffic Classification Groups 75
Vehicle Class Distribution for TTC Groups 78
Axle Load Spectra for TTC Groups.. 81
Other General Inputs.. 91
Mean Wheel Location.. 91
Traffic Wander Standard Deviation.. 92
Axle Configuration 92
Design Lane Width 92
Wheelbase.. 92
Number of Axle Types per Truck Class 92
Load Equivalency Factors... 93
Strategic Plan for WIM Data Collection Program.. 99
Alternative Plan # 1 101
Alternative Plan # 2 104
Recommended Portable and Permanent Equipment... 105
Cost Estimates for Recommended WIM Equipment.. 105
Criteria for Building a Permanent WIM Station... 107
Implementation Plan 109
Step 1 109
Step 2 110
CONCLUSIONS AND RECOMMENDATIONS 111
Other Findings 112
Recommendations... 112
ACRONYMS, ABBREVIATIONS & SYMBOLS..115
REFERENCES 117

See attached CD for Appendixes

APPENDIX A 119

Vehicle Class Distributions for Functional Classes 119

APPENDIX B 125

Single Axle Load Spectra and Vehicle Class Distributions for WIM Sites Having Similar Characteristics 125

APPENDIX C 137

Vehicle Class Distributions for TTC Groups... 137

APPENDIX D 141

Single Axles per Vehicle Classes, Single Axle Load Spectra for Combined Vehicle Class, and Single Axle Load Spectra for Primary Classes for TTC Groups 141

APPENDIX E 155

Tandem Axles for Individual, Combined, and Primary Classes for Each TTC Group 155

APPENDIX F...169

Tridem Axles per Vehicle Classes, Tridem Axle Load Spectra for Combined Vehicle Class, and Tridem Axle Load Spectra for Primary Classes for TTC Groups........... 169

APPENDIX G 182

Maps Showing Proposed WIM Stations in Different Regions 182

APPENDIX H 187

Axle Load Distribution Factors for TTC Groups 187

APPENDIX I 211

Load Equivalency Factors of Functional Class 211

LIST OF TABLES

Table 1 Input level required for each of the three hierarchical input levels [*1*]........................ 8
Table 2 Traffic data required for each of the three hierarchical input levels [*1*] 9
Table 3 Functions used to forecast truck traffic [*1*].. 10
Table 4 Strengths and weaknesses of the permanent and portable WIM stations 15
Table 5 WIM equipment estimated initial and recurring costs [*5*] 21
Table 6 WIM system accuracy and cost comparison [*5*] 22
Table 7 Mississippi LTPP traffic sites [*6*] 26
Table 8 Monitoring data summary [*6*] 27
Table 9 Estimated total costs ($) for first five years of the program [*7*] 30
Table 10 Estimated WIM program costs in Texas [*10*]... 33
Table 11 Traffic data collected for this study 36
Table 12 Roadway functional classification code (source: Traffic Monitoring Guide [*4*]) ... 36
Table 13 Existing portable WIM sites in Louisiana 36
Table 14 Location of WIM enforcement sites in Louisiana 47
Table 15 Minimum sample size (number of days per year) to estimate the normalized axle load distribution-WIM data (source: NHCRP Report 1-37A) 57
Table 16 Minimum sample size (number of days per year) to estimate the normalized truck traffic distribution-AVC data (source: NHCRP Report 1-37A)............................... 57
Table 17 Minimum sample size (number of days per year) to estimate the total vehicles per day and year-AVC or vehicle count data (source: NHCRP Report 1-37A)............ 57
Table 18 Level of confidence and expected error for current LA traffic data........................ 58
Table 19 WIM sites passing steering axle and gross vehicle tests 64
Table 20 Comparison of portable WIM sites for class 9 vehicles.. 66
Table 21 WIM sites grouped by similar single axle load spectra... 68
Table 22 WIM sites having similar single axle load spectra for classes 5 and 6.................... 70
Table 23 WIM sites in close proximity to proposed permanent WIM sites 71
Table 24 General truck traffic classification descriptions (source: NHCRP Report 1-37A).. 76
Table 25 Functional classification and TTC relationship (source: NHCRP Report 1-37A) .. 76
Table 26 Truck traffic classification group criteria (source: NHCRP Report 1-37A)............ 77
Table 27 Truck traffic classification grouping for WIM sites 79
Table 28 Truck traffic classification grouping for WIM sites 80
Table 29 Default values for the average number of single, tandem, and tridem axles per truck class 93
Table 30 Flexible pavement load equivalency factors for functional class 1 in 2006............ 94
Table 31 Flexible pavement load equivalency factors for functional class 1 in 2005............ 94

Table 32 Flexible pavement load equivalency factors for functional class 1 in 2004 94
Table 33 Rigid pavement load equivalency factors for functional class 1 in 2006 95
Table 34 Rigid pavement load equivalency factors for functional class 1 in 2005 95
Table 35 Rigid pavement load equivalency factors for functional class 1 in 2004 95
Table 36 Abbreviations used in Figure 68 through Figure 70 101
Table 37 Permanent WIM sites replaced by enforcement sites 105
Table 38 Cost for recommended WIM equipment [5] 106
Table 39 Cost for the alternative plans recommended 108
Table 40 Time required in completing the pilot study 109
Table 41 List of prioritized proposed WIM sites for alternative plan #1 110
Table 42 List of prioritized proposed WIM sites for alternative plan #2 110

LIST OF FIGURES

Figure 1 FHWA vehicle classifications [*1*] 12
Figure 2 Piezoelectric scale layout (source: Pat America, www.patamerica.com) 16
Figure 3 Piezoelectric scale layout [*12*] 17
Figure 4 Bending plate layout (source: PAT America, www.patamerica.com) 18
Figure 5 Bending plate installation (source: Oakridge National Laboratory, www.ornl.gov) 18
Figure 6 Bending plate (source: International Road Dynamics Inc., www.irdinc.com) 19
Figure 7 Single load cell installation (source: International Road Dynamics Inc., www.irdinc.com) 20
Figure 8 Single load cell (source: International Road Dynamics Inc., www.irdinc.com) 20
Figure 9 GVW (class 9 vehicle) versus frequency for Station P04 (2000) [*2*] 24
Figure 10 Steering axle weight (class 9 vehicle) versus frequency for Station P04 (2000) [*2*] 25
Figure 11 Arkansas statewide and default single axle load spectra for VC 9 [*9*] 32
Figure 12 Arkansas statewide and default tandem axle load spectra for VC 9 [*9*] 32
Figure 13 Portable WIM data collection sites for year 2006 39
Figure 14 Portable WIM data collection sites for year 2005 39
Figure 15 Portable WIM data collection sites for year 2004 40
Figure 16 Truck routes in northwest region 41
Figure 17 Truck routes southwest region 42
Figure 18 Truck routes in northeast region 43
Figure 19 Truck routes in southeast region 44
Figure 20 Mainline truck sorting at WIM enforcement stations [*12*] 46
Figure 21 WIM enforcement stations in Louisiana 47
Figure 22 Layout of the LTPP WIM site on US-171 in Louisiana [*14*] 49
Figure 23 Steering axle weight (class 9 vehicle) versus frequency for site 38 59
Figure 24 Steering axle weight (class 9 vehicle) versus frequency for site 168 59
Figure 25 Steering axle weight (class 9 vehicle) versus frequency for site 67 60
Figure 26 Steering axle weight (class 9 vehicle) versus frequency for site 53 61
Figure 27 Steering axle weight (class 9 vehicle) versus frequency for site 112 61
Figure 28 Gross vehicle weights (class 9 vehicle) versus number of trucks for site 67 62
Figure 29 Gross vehicle weights (class 9 vehicle) versus number of trucks for site 107 62
Figure 30 Gross vehicle weights (class 9 vehicle) versus number of trucks for site 30 63
Figure 31 Gross vehicle weights (class 9 vehicle) versus number of trucks for site 20 63
Figure 32 Illustration of the sum of squared differences method 65
Figure 33 Comparison of two portable sites with sum of squared differences method 65

Figure 34 Single axle load spectra for sites having dominant class 9 vehicles 67
Figure 35 Group 1 single axle load spectra for class 9 68
Figure 36 Vehicle class distributions for Group 1 69
Figure 37 Group 2 single axle load spectra for class 9 69
Figure 38 Vehicle class distributions for Group 2 69
Figure 39 Vehicle class distribution for functional class 1 73
Figure 40 Vehicle class distribution for functional class 2 74
Figure 41 Vehicle class distribution for functional class 6 75
Figure 42 Vehicle class distribution for TTC 1 80
Figure 43 Vehicle class distribution for TTC 3 81
Figure 44 Single axles per vehicle class for TTC 1 82
Figure 45 Single axle load spectrum for combined vehicle classes for TTC 1 82
Figure 46 Single axle load spectrum for vehicle class 8 for TTC 1 83
Figure 47 Single axle load spectrum for vehicle class 9 for TTC 1 83
Figure 48 Single axles per vehicle class for TTC 3 83
Figure 49 Single axle load spectrum for combined vehicle classes for TTC 3 84
Figure 50 Single axle load spectrum for vehicle class 8 for TTC 3 84
Figure 51 Single axle load spectrum for vehicle class 9 for TTC 3 84
Figure 52 Single axle load spectrum for vehicle class 9 for TTC groups.............................. 85
Figure 53 Single axle load spectrum for vehicle class 5 for TTC groups.............................. 86
Figure 54 Tandem axles per vehicle class for TTC 1 87
Figure 55 Tandem axle load spectrum for combined vehicle classes for TTC 1 88
Figure 56 Tandem axle load spectrum for vehicle class 9 for TTC 1.................................... 88
Figure 57 Tandem axle load spectrum for vehicle class 9 for TTC groups............................ 89
Figure 58 Tridem axles per vehicle class for TTC 1 90
Figure 59 Tridem axle load spectrum for combined vehicle classes for TTC 1..................... 90
Figure 60 Tridem axle load spectrum for vehicle class 10 for TTC 1 90
Figure 61 Tridem axle load spectrum for vehicle class 10 for TTC groups 91
Figure 62 Flexible pavement LEF for FC 1 for 2006, 2003, and 2000 96
Figure 63 Flexible pavement LEF for FC 1 for 2005 and 2002 96
Figure 64 Flexible pavement LEF for FC 1 for 2004 and 2001 97
Figure 65 Rigid pavement LEF for FC 1 for 2006, 2003, and 2000...................................... 97
Figure 66 Rigid pavement LEF for FC 1 for 2005 and 2002... 98
Figure 67 Rigid pavement LEF for FC 1 for 2004 and 2001... 98
Figure 68 Map showing WIM stations in Shreveport region 102
Figure 69 Map showing WIM stations in Minder-Ruston region.. 103
Figure 70 Map showing WIM stations in Monroe-Madison region 104

INTRODUCTION

For pavement design practices, several factors must be considered to ensure good pavement performance over the anticipated life cycle. Such factors include, but are not limited to, the type of paving materials, traffic loading characteristics, prevailing environmental conditions, and others. Current pavement design practices follow standards set by the American Association of State Highway and Transportation Officials (AASHTO) that require the use of an equivalent single axle load (ESAL - 18 kip single axle load) for design traffic input. Since ESALs are affected by pavement type (flexible or rigid), surface thickness, and types of distress, roadways with fairly constant loads and traffic volumes may produce significantly varying ESALs because of the interaction of these factors. This may produce inaccurate predictions of pavement performance. Moreover, current design procedures rely on empirical relationships that were developed more than 40 years ago and may not be accurate for current practices due to changes in vehicle characteristics and configurations.

To improve pavement design and analysis procedures for both new and rehabilitated pavement structures, AASHTO adopted a new mechanistic-empirical pavement design guide (MEPDG) that was developed in a study completed for the National Cooperative Highway Research Program (NCHRP), Project 1-37A. The study emphasized the importance of using truck axle load spectra rather than ESAL for future pavement design practices. This raises the need for full understanding of the characteristics of truck load spectra and the relationship to historical values of ESAL being used in current practices. There is also a need to improve the utilization of existing traffic data for future implementation of MEPDG as well as current pavement design practices and prepare for the transition from the current use of ESAL to axle load spectra. Axle load spectra is different from ESAL in that traffic loading is expressed by the number of load applications of various axle configurations (single, dual, tridem, and quad) within a given weight classification range. In other words, the axle load spectra represent the percentage of the total axle applications within each load interval for single, tandem, tridem, and quad axles with the vehicle classification and numbers. MEPDG also requires additional traffic data that may or may not be readily available.

Traffic data is always one of the most critical inputs for pavement design, and it is often associated with the highest level of uncertainty. Currently, state highway officials collect traffic data from various sources such as static weight stations, automatic vehicles classifiers, WIM sensors, and others. This research study is conducted for LADOTD to address traffic data needs and requirements associated with the adoption of the new pavement design guide. More specifically, this study seeks to develop truck axle load spectra based on data currently collected in Louisiana and to propose improvements to the existing traffic data collection techniques as necessary.

Literature Review

During the course of this study several published research reports and journal manuscripts related to the new MEPDG implementation and its requirements, data collection procedures, evaluation of data, and WIM stations and equipment were compiled. This section presents a summary of the literature review on the main findings of other studies related to the research subject.

AASHTO Pavement Design Guide

AASHTO's Guide for the Design of Pavement Structures is the primary document currently used to design new and rehabilitated highway pavements. It was based on empirical design approaches derived from the AASHO Road Test that included limited structural sections at one location and with limited traffic levels compared with those of the present day [*1*]. For the past four decades, pavement designers have faced the challenge of adequately applying well-recognized design procedures such as the AASHTO guidelines to the conditions of roadway networks [*2*]. The problem facing pavement design and analysis professionals is that the majority of currently accepted design procedures depend on empirical relationships that were developed from field measurements over nearly 40 years ago. In fact, the AASHTO pavement design guide is based on relationships developed at the American Association of State Highway Officials (AASHO) Road Test in the late 1950s and early 1960s. While the relationships between traffic data and pavement performance obtained from the AASHO Road Test are most applicable to conditions under which they were developed, the relationships have also been extrapolated to conditions not included in the original test. Furthermore, pavement damage caused by new vehicle characteristics and configurations may differ from damage experienced at the AASHO Road Test. Therefore, application of such relationships to extrapolated conditions may lead to inaccurate results. The following are some of the limitations caused by the experimental nature of the AASHO Road Test according to the highway research board [*2*]:

1. The experiments tested specific pavement materials and roadbed soils that were not inclusive of all materials used in practice.
2. The test site experienced particular environmental conditions not representative of conditions in all regions.
3. An accelerated two-year test period was extrapolated to longer design periods (15-30 years).

4. Vehicles with similar axle loads and configurations were employed, as opposed to mixed traffic.

To provide more representative estimates of loading conditions, state highway agencies normally collect several types of traffic data. Static weight stations, automatic vehicle classifiers (AVC), automatic traffic recorders (ATR), and more recently WIM sensors are the most typical traffic data collection devices. A common practice of state highway agencies is to use the information provided by these devices to convert mixed traffic data streams into equivalent single axle loads (ESALs) by using equivalency factors [*2*].

Equivalent Single Axle Loads (ESALs)

ESAL is a traffic estimate that is required by most pavement design procedures, including the *AASHTO 1993 Pavement Design Guide*. ESAL is the number and weight of all axle loads from the vehicles expected during the pavement design life expressed in 18 kilo pounds (kips). Current ESALs don't differentiate the loads applied to the pavement and therefore may produce inaccurate predictions of pavement performance. Moreover, ESALs are influenced by pavement type (flexible or rigid), surface thickness, and type of distress or failure [*2*]. Consequently, even roadways with fairly constant loads and traffic volumes may produce significantly varying ESALs along their lengths, depending on the interaction of these factors.

In a study by Washington State, examination and analysis of historical ESAL data from 1960 to 1983 showed: (1) ESALs increased slightly throughout the years; (2) the increment in ESALs varied per vehicle class; (3) the increment in ESALs for the primary vehicle classes (i.e., classes 5, 9, and 10, and multi-trailers) on rural interstate roadways appeared similar; and (4) the increment in ESAL rates for the primary vehicle classes on urban interstate roadways was more variable. Likewise, when the analysis was done for the 1993 WIM data, ESALs for vehicle classes 4 through 7 were consistent throughout the year but changed for the remaining vehicle classes in some months or seasons [*2*]. The study concluded that the use of ESALs with mechanistic-based performance models produces less than desirable predictions and, therefore, recommended the use of axle load and vehicle classification data instead [*2*].

AASHTO ESAL Equation. AASHTO ESALs can be calculated using the following equation for rigid and flexible pavements:

$$\frac{W_x}{W_{18}} = \left[\frac{L_{18}+L_{2s}}{L_x+L_{2x}}\right]^{\alpha}\left[\frac{10^{G/\beta_x}}{10^{G/\beta_{18}}}\right]\left[L_{2x}\right]^{\gamma} \tag{1}$$

where,

W = axle applications inverse of equivalency factors (where, W_{18} = number of 18,000 lb. (80 kN) single axle loads)

L_x = axle load being evaluated (kips)

L_{18} = 18 (standard axle load in kips)

L_2 = code for axle configuration

1 = single axle

2 = tandem axle

3 = triple (tridem) axle (added in the 1986 AASHTO Guide)

x = axle load equivalency factor being evaluated

s = code for standard axle = 1 (single axle)

α = 4.62 for rigid pavement

4.79 for flexible pavement

γ= 3.28 for rigid pavement

4.33 for flexible pavement

G = a function of the ratio of loss in serviceability at time, t, to the potential loss taken at a point

where,

p_t = 1.5

$$G = \log\left(\frac{p_i - p_t}{p_i - 1.5}\right)$$

P_i = 4.5 for rigid pavement

4.2 for flexible pavement

β = function which determines the relationship between serviceability and axle load applications

$$\beta = 1.00 + \left(\frac{3.63(L_x + L_{2x})^{5.20}}{(D+1)^{8.46} L_{2x}{}^{3.52}}\right) \text{ for rigid pavement} \quad (2)$$

$$\beta = 0.4 + \left(\frac{0.081(L_x + L_{2x})^{3.23}}{(SN+1)^{5.19} L_{2x}{}^{3.23}}\right) \text{ for flexible pavement} \quad (3)$$

where,

D = slab thickness in inches

SN = structural number

A sample calculation of an ESAL of a 30,000 lb. (133 kN) single axle load applied on rigid pavement with a thickness of 7 in. and a terminal serviceability index (p_t = 2.5) is as follows:

W_{18} = predicted number of 18,000 lb. (80 kN) single axle load applications

W_{30} = predicted number of 30,000 lb. (133 kN) single axle load applications

L_x = L_{30} = 30

L_{2x} = 1 (single axle)

G = serviceability loss factor for rigid pavement

$$G = \log\left(\frac{4.5-2.5}{4.5-1.5}\right) = -0.1761$$

β = curve slope factor

$$\beta_{30} = 1.00 + \left(\frac{3.63(30+1)^{5.20}}{(7+1)^{8.46}(1)^{3.52}}\right) = 5.7298$$

$$\beta_{18} = 1.00 + \left(\frac{3.63(18+1)^{5.20}}{(7+1)^{8.46}(1)^{3.52}}\right) = 1.3709$$

G/β_{30} = -0.1761/5.7298 = -0.03073

G/β_{18} = -0.1761/1.3709 = -0.12845

$$\frac{W_{30}}{W_{18}} = \left[\frac{18+1}{30+1}\right]^{4.62}\left[\frac{10^{-0.03073}}{10^{-0.12845}}\right][1]^{3.28} = 0.1305$$

and $$\frac{W_{30}}{W_{18}} \cong 13.05\%$$

of W_{18} loads allowable with a 30,000 lb. single axle

Finally, LEF = $$\frac{1}{0.1305} = 7.67 \cong 7.7$$

This result is the same as contained in 1993 AASHTO Guide.

Load Equivalency Factor (LEF)
An LEF represents the equivalent number of ESALs for the given weight-axle combination. In other words, LEF is the ratio of the effect of a specific axle load on pavement serviceability to the effect produced by an 18-kip axle load at the AASHO Road Test. In the past, as per AASHTO procedures, LEFs and ESALs were the most important aspects that were considered for design purposes. In a study conducted by Martinez, Louisiana's LEF tables were revised based on WIM data from 1997 through 1999. However, the study recommended that it would be more economical to apply new practices than to revise the Louisiana's LEF tables periodically [*3*].

Mechanistic-Empirical Pavement Design Guide

To improve pavement design and analysis procedures, a study was conducted under the National Cooperative Highway Research Program (NCHRP) Project 1-37A and a new mechanistic-empirical pavement design guide was developed for new and rehabilitated pavement structures. Because mechanistic approaches more realistically characterize in-service pavements, thus improving the reliability of designs, design approaches based on mechanistic principles are more desirable. However, because gaps exist in the knowledge base, mechanistic design methods need to be supported by empirical relationships, and many issues related to the MEPDG approach need to be better defined before practical and realistic design procedures can be developed and put into use.

The new design guide is based on a thorough review of relevant domestic and overseas literature, research findings, current practices, and databases relative to pavement analysis and design. The new guide provides a uniform basis for the design of flexible, rigid, and composite pavements and employs common design parameters for traffic, subgrade, and the environment. The NCHRP report also produced supporting software to aid in the implementation of the new pavement design procedure, along with related documentation and training materials.

Although the AASHTO guide for the design of pavement structures has been adequate for many years, there have been several limitations that necessitated the use of new practices to make the design procedure more effective and economical. According to the new MEPDG, there has been a substantial increase in the truck traffic volume (about 10 to 20 times more) since the 1960s [*1*]. Therefore, pavement design would not be accurate if traffic loading deficiencies have not been adequately and explicitly addressed.

Traffic Input for Pavement Design

Traffic data are a key element for the design and analysis of pavement structures. According to the new design guide, additional input for traffic characterization is required. Chapter 4 of the final report of the MEPDG includes detailed information on the traffic data requirements [*1*]. More specifically, this chapter discusses traffic design inputs that are required for estimating loads applied to pavement and the frequency of their application throughout the pavement design life. The following are the main traffic data elements required for pavement design purposes as defined by the MEPDG:

- Axle load distribution factors: The axle load distribution factors simply represent the percentage of the total axle application within each load interval for a specific axle type and vehicle class.
- Truck growth factors: The truck growth factor could be used to estimate future truck traffic volumes at a particular age of the pavement.
- Vehicle (truck) class distribution: Normalized vehicle class distribution represents the percentage of each truck class (classes 4 through 13).
- Base year truck-traffic volume: The base year for the traffic inputs is defined as the first year that the roadway segment under design is opened to traffic. The following base year information is required: two-way annual average daily truck traffic, the number of lanes in the design direction, percent of trucks in design direction (also called truck directional distribution factor), percentage of trucks in design lane (also called truck lane distribution factor), and vehicle operational speed.
- Axle and wheel base configurations: These are the data elements that describe the typical tire, axle loads, and vehicle wheelbase that would be applied to the roadway for computing pavement response. These can be obtained directly from the manufacturer's databases or measured directly in the field.
- Tire characteristics and inflation pressure: These are important inputs in the performance prediction models. The MEPDG specified certain values for dimensions and pressures as well as the default values to be used in the accompanied software.

Hierarchical Traffic Input for MEPDG

Axle load distribution factors, vehicle class distribution factors, and truck growth factors are primarily required by the new design guide for pavement design and performance. It is recognized that some agencies may not have the resources needed to collect detailed traffic data over the years to accurately characterize future traffic. Hence, a hierarchical approach was adopted for developing traffic inputs required for new and rehabilitated pavement design. The design guide defines three broad levels of traffic data input (levels 1 through 3) based on the amount of traffic data available (see Table 1 and Table 2) [*1*]. The three hierarchical levels are as follows:

- Level 1 is the most accurate and provides the greatest reliability. It requires extensive traffic knowledge in terms of accurate site specific or near site specific axle load spectra, classification, and volume data, along with a breakdown by lane and direction.
- Level 2 is the transitional design input level and requires considerable traffic data. This requires vehicle classification and volume data, while the vehicle weights are taken from regional weight summaries maintained by each state.
- Level 3 is the least accurate input level and requires only an estimate of the truck volume. This level starts from average annual daily traffic (AADT) and the percentage of trucks with no site specific knowledge of weights and classification. This leads to the utilization of national/default summaries generated through long term pavement performance (LTPP) sites throughout the nation.

Table 1
Input level required for each of the three hierarchical input levels [*1*]

Data Sources		Input Level		
		1	2	3
Traffic load/volume data	WIM data-site/segment specific	x		
	WIM data-regional default summaries		x	
	WIM data-national default summaries			x
	AVC data-site/segment specific	x		
	AVC data-site/regional default summaries		x	
	AVC data-national default summaries			x
	Vehicle counts-site/segment specific[1]		x	x
	Traffic forecasting and trip generation models[2]	x	x	x

1 Level depends on whether regional or national default values are used for the WIM or AVC information

2 Level depends on input data and model accuracy/reliability.

Table 2
Traffic data required for each of the three hierarchical input levels [*1*]

Data Elements/Variables		Input Level		
		1	2	3
Truck Traffic and Tire Factors	Truck directional distribution factor	Site specific WIM or AVC	Regional WIM or AVC	National WIM or AVC
	Truck lane distribution factor	Site specific WIM or AVC	Regional WIM or AVC	National WIM or AVC
	Number of axles by axle type per truck class	Site specific WIM or AVC	Regional WIM or AVC	National WIM or AVC
	Axle and tire spacing	Hierarchical levels not applicable for this input		
	Tire pressure or hot inflation pressure	Hierarchical levels not applicable for this input		
	Truck traffic growth function	Hierarchical levels not applicable for this input		
	Vehicle operational speed	Hierarchical levels not applicable for this input		
	Truck lateral distribution factor	Hierarchical levels not applicable for this input		
	Truck monthly distribution factors	Site specific WIM or AVC	Regional WIM or AVC	National WIM or AVC
	Truck hourly distribution factors	Site specific WIM or AVC	Regional WIM or AVC	National WIM or AVC
Truck traffic distribution and volume variables	AADT or AADTT for base year	Hierarchical levels not applicable for this input		
	Truck distribution/spectra by truck class for base year	Site specific WIM or AVC	Regional WIM or AVC	National WIM or AVC
	Axle load distribution/spectra by truck class and axle type	Site specific WIM or AVC	Regional WIM or AVC	National WIM or AVC
	Truck traffic classification group for pavement design	Hierarchical levels not applicable for this input		
	Percentage of trucks	Hierarchical levels not applicable for this input		

Axle Load Spectra

Axle load spectra classify traffic loading in terms of the number of load applications of various axle configurations (single, dual, tridem, and quad) within a given weight classification range. For load spectra, axle load distribution factors should be determined to represent the percentage of total axle applications within each load interval for a specific axle type (single, tandem, tridem, and quad) and vehicle class (classes 4 to 13). The load intervals for each axle type are defined as follows: single axles (3,000 lb. to 40,000 lb. at 1,000-lb. intervals), tandem axles (6,000 lb. to 80,000 lb. at 2,000-lb. intervals), and tridem and quad axles (12,000 lb. to 102,000 lb. at 3,000-lb. intervals) [*1*].

In research conducted by the University of Washington in March 2005, a process to calculate the axle load spectra was developed for Washington State following the MEPDG procedures. First, the traffic data from the WSDOT Traffic Data Office (TDO) was obtained for the period from January 2000 through April 2003. The stations with unusable data were noted. The traffic data from each station were evaluated to determine the accuracy based on information gathered from the *Traffic Monitoring Guide*, the California Department of Transportation [*4*], and the Washington State Transportation Center (TRAC). Second, the weight of the steering axle for class 9 vehicles versus frequency or average steering axle weights throughout the year was plotted to check the consistency of weight data. Then, raw data were collected and analyzed with Microsoft access. Out of 52 WIM stations, only 11 sites passed through the evaluation process. The selected stations were evaluated to determine whether traffic trends of vehicle classes 4 through 13 were similar and whether the stations had the following loading patterns: (1) seasonal loading pattern (i.e., average ESALs per axle for single, tandem, and tridem axles) and (2) typical axle load spectra for single, tandem, and tridem axles. Finally, seasonal and typical ESALs per axle for each vehicle class were developed to compare with the current ESALs. Typical load spectra that satisfy the requirements of the 2002 design guide were also developed.

In a study conducted by Mississippi State University, axle load spectra for each year of the available monitoring data were analyzed and then averaged to determine base annual axle load spectra for single, tandem, and tridem axles for each vehicle class for the Mississippi LTPP sites. In this study, the development of axle load spectra for a given roadway required WIM data consisting of axle distribution and weight data. Each site had a minimum of several years of WIM data available for analysis. For each vehicle class, WIM data were reviewed and the number of single, tandem, tridem, and quandem axles was determined. In both studies, the procedure described for estimating truck axle load spectra in MEPDG was adopted.

Growth Factors

Traffic growth factors require continuous traffic count data at specific sites over several years in order to capture the actual growth trend in traffic demand. When only shorter-duration counts are available, less reliable estimates of growth factors can be obtained from AADTT values. Since no single procedure is best in all cases for estimating traffic growth factors, it is recommended that all tools and data available be used to examine traffic growth from all perspectives for each given site and to develop a number of growth factors from which appropriate estimates may be derived. Three different traffic growth functions recommended by MEPDG are shown in Table 3. These procedures may be employed for estimating growth factors in Louisiana existing data.

Table 3
Functions used to forecast truck traffic [*1*]

Function Description	Model
No growth	$AADTT_x = 1.0 * AADTT_{BY}$
Linear growth	$AADTT_x = GR * AGE * AADTT_{BY}$
Compound growth	$AADTT_x = AADT_{BY} * (GR)^{AGE}$

where,
$AADTT_X$ is the annual average daily truck traffic at age X,
GR is the traffic growth rate (e.g., GR = 1.1 for 10% growth rate), and
$AADTT_{BY}$ is the base year annual average daily truck traffic.

Classification of Traffic Data by Type

Three types of traffic data are typically collected for pavement design and analysis. A brief description of each type is presented next.

Traffic Volume

Traffic volume counts provide the most commonly employed measure of roadway usage and are needed for the majority of traffic engineering analyses. These counts can be a continuous, seasonal, or short duration. Continuous counts are taken 365 days a year and are the most consistent and accurate types of vehicle count data. Seasonal or control counts are performed usually 2 to 12 times a year for periods of time ranging from 24 hours to 2 weeks. Short duration or coverage counts typically range from 6 hours to 7 days. It should be noted that the average annual daily truck traffic is needed for the base year for levels 1, 2, and 3. For level 3 inputs, where traffic measurements are unavailable for the roadway, these values can be estimated from traffic studies of similar highways or representative regional averages.

Vehicle Classification

Vehicle classification data include the number and types of vehicles over a period of time. Classification is required to determine the normalized truck class distribution all over the state with respect to functional class. Classification data can be broken down by level based on the data source (site-specific, regional/statewide, or national). Vehicle classification counting can be a short or continuous duration. The Federal Highway Administration (FHWA) has developed 13 Vehicle Classifications (VC) to assist agencies in collection and analysis of traffic data (Figure 1).

Axle Configuration and Weight Data

Traffic loading is a critical factor in determining the thickness of pavement sections. Therefore, truck axle weights are significant for the data collection process. This process is the most expensive, time consuming, and complex part compared to other data collection activities. The objective of the truck weight data collection program is to obtain a reliable estimate of the distribution of vehicle and axle loads per vehicle for truck categories within a defined roadway. Axle weight of trucks is measured with reference to the vehicle type, number and axle spacing over a period of time. This is used mainly to determine the normalized axle load distribution or spectra for each axle type and each truck class. The data is particularly measured at weigh-in-motion stations.

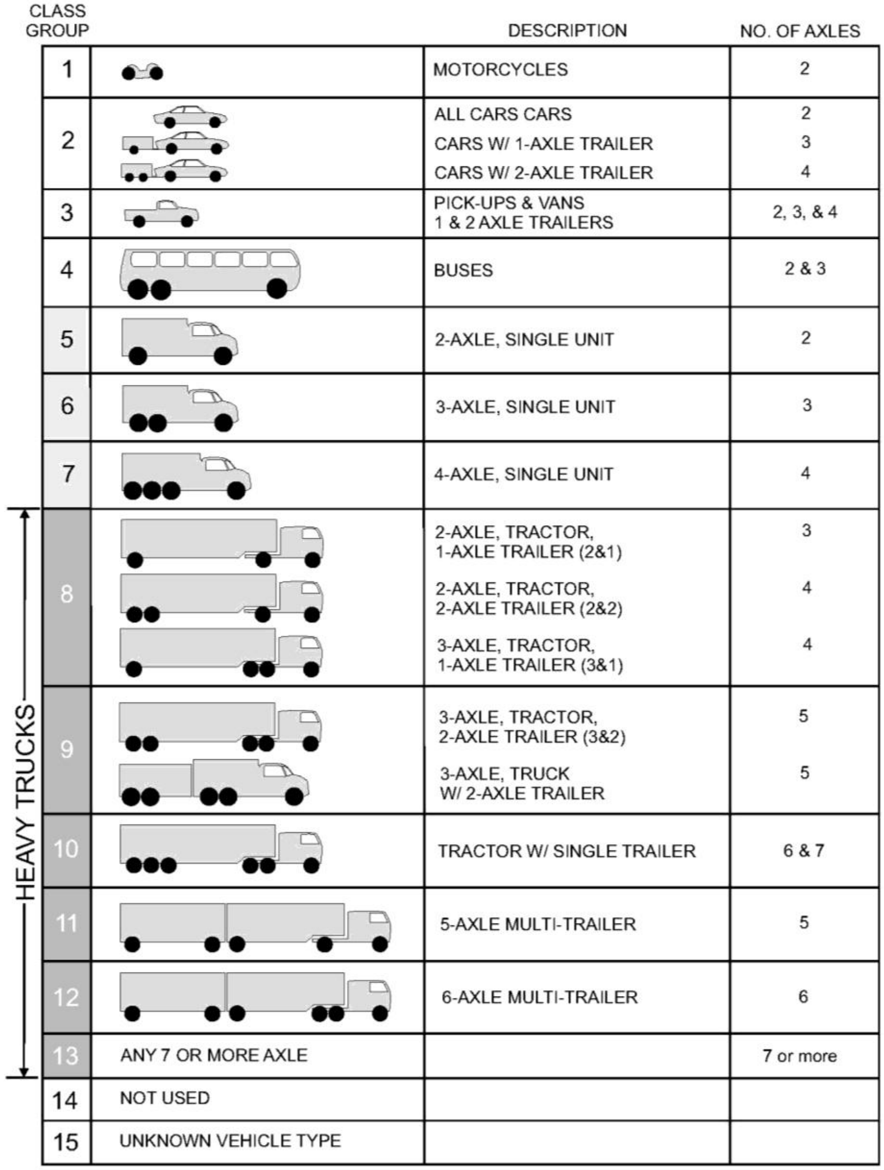

Figure 1
FHWA vehicle classifications [*1*]

Weigh-In-Motion (WIM) Stations

Truck weight data are collected through WIM stations primarily to describe the current traffic stream crossing the design lane for a project and to serve as a baseline to forecast the future traffic stream. There is a need for enhanced weight monitoring equipment as the axle load weights are directly associated with damaging effects on the roadway system.

The need for effective monitoring of axle weights has also been demonstrated in many studies. One of the documents that address data monitoring is the *Traffic Monitoring Guide* (TMG) published by FHWA [*4*]. This guide offers suggestions to improve and advance current programs with a view towards the future of traffic monitoring. The objective of the program was to ensure that each state collects accurate truck weight data to meet agency needs [*4*]. Another related work includes NHCRP report 509 *Equipment for Collecting Traffic Load Data* published by Mark Hallenbeck and Herbert Weinblatt in 2004 [*5*]. This study addresses the key issues and information needed by state or other highway operating agencies to select and operate the equipment and collect data on their axle weights. The data collected by this equipment are specifically required by the mechanistic-empirical pavement design procedures developed under NCHRP Project 1-37A and recently adopted by AASHTO.

Portable WIM Stations

Two technologies, capacitance mats and Brass Linguini (BL)-style piezoelectric sensors, are commonly used in United States for high-speed (i.e., on-highway) portable WIM data collection [*5*]. Both technologies involve mounting a sensor on top of existing pavement. These actions require a temporary lane closure and often work by more than one person. Because the sensor is physically mounted on top of the roadway surface, a bump is created as the tire of each axle passes the weight sensor. This bump causes two physical effects, each of which is detrimental to WIM system accuracy. The first effect is the additional dynamic motion imparted on the vehicle being weighed. This motion makes it much harder for the WIM system to accurately estimate the static weight applied by each axle. The second physical effect is that the need to climb over this bump causes the tire itself to flex, absorbing some of the horizontal force from impact with the bump. This tire flex force is transmitted to the weight sensor, causing additional bias and noise in the measurement process [*5*]. Portable WIM stations rarely achieve the same level of accuracy as a correctly placed permanent scale. This does not mean that weights collected using portable scales are not useful in the traffic load estimation process. Highway agencies must be particularly careful to calibrate portable scales each time they are placed on the roadway and to monitor data produced after scales have been calibrated to ensure that the system is producing reliable results. This type of site is less costly to operate than a continuously operated WIM site (because one set of data collection electronics is used for several data collection sites and also because permanent power and communications are not needed and, therefore, do not need to be constructed).

According to TMG, WIM sites should be monitored no less than 24 consecutive hours to account for time-of-day differences in vehicle weights. Data collection sessions longer than

24 hours are encouraged whenever practical. In particular, when in- ground weight sensors are being used and the data collection electronics can be left safely to operate without on-site staff, a minimum of one-week counts are recommended at all measurement locations that are not being operated continuously [*4*]. If the weight data collection period is only 24-hours or 48-hours long, it assumes that there is no day-of-week difference in the loading condition of trucks passing the site. In other words, trucks traveling on weekends carry the same distribution of payloads as trucks traveling on weekdays. In addition, it is presumed that there are no seasonal differences in truck loading patterns [*4*].

Permanent WIM Stations

The original intent of most continuous monitoring efforts is to understand seasonal, weekly, and yearly traffic volume patterns to help improve the accuracy of traffic estimates used in a variety of analyses. Because of physical problems of portable equipment, the majority of research and development in WIM has been for permanently installed weight sensors. Five technologies are currently in use throughout the United States. The most common permanently mounted weight sensors are bending plates, hydraulic load cells, piezoceramic cables, piezopolymer cables, and piezoquartz sensors. All systems are designed to have sensors permanently installed in or under the roadway. This results in less dynamic vehicle motion and less impact force on sensors than for surface-mounted sensors, which results in more accurate weighing conditions and a longer sensor life [*5*].

The permanent installation of the sensors and frames is normally better for consistent and accurate weighing measurements. The use of permanently installed WIM sensors is recommended by TMG as a means of improving the quality of data. TMG also recommends that vehicle weights within each truck weight group (defined as the group that consist of state roads in categories and each group experiences traffic with reasonably similar characteristics) should be measured by a number of WIM sites located within the truck group. For most truck weight roadway groups, a minimum of six sites should be monitored. At least one of the WIM sites within each group should operate continuously throughout the year to measure temporal changes in the loads carried by trucks operating on those roads [*4*]. Where possible, more locations within each group should be monitored continuously to provide a more reliable measure of seasonal change. A summary of strengths and weaknesses of the permanent and portable WIM stations is presented in Table 4.

Table 4
Strengths and weaknesses of the permanent and portable WIM stations

Permanent WIM station (Strengths)	Portable WIM station (Weaknesses)
1. Permanent WIM is normally better for consistent and accurate weighing results.	1. Portable WIM rarely achieves the same level of accuracy as a correctly placed permanent scale.
2. The use of permanently installed WIM sensors is recommended by TMG as a means of improving the quality of the data.	2. There is a definite bias in the measurement of traffic data by short duration counts.
3. The original intent of most continuous monitoring efforts is to understand seasonal, weekly, and hourly traffic volume patterns	3. Seasonal adjustment is needed and may be inaccurate for design purposes.
4. This has a longer sensor life.	4. This has very short sensor life.
5. There is no adequacy by collecting traffic data from these sources.	5. There will a certain adequacy when the traffic data is analyzed.
6. This results in less dynamic vehicle motion and less impact force on sensors than for surface-mounted sensors.	6. As these are surface mounted sensors, there will be large dynamic vehicle motion and impact force during the traffic count.
7. This is not as temperature sensitive as portable ones but have to be taken care for intrusion of moisture from below.	7. Sensors are temperature sensitive, making it difficult to keep them in calibration when temperature changes during the day.
Permanent WIM station (Weaknesses)	Portable WIM station (Strengths)
1. Permanent counters are expensive to install, operate, and maintain.	1. This type of site is less costly to operate than a continuously operated WIM site.
2. As states cannot afford a large number of these sites, this cannot provide the geographic coverage and traffic characteristics of individual roadways.	2. The short duration counts provide the geographic coverage needed to understand traffic characteristics on individual roadways as well as on specific segments of those roadways
3. This device is not flexible and cannot cover the specific location of interest.	3. Portable devices allow flexibility in collecting data.

WIM Technologies

Various WIM devices are available in North America today including the piezoelectric sensor (Figure 2 and Figure 3), bending plate scale (Figure 4 through Figure 6), and single load cell scale (Figure 7 and Figure 8) [*1*], [*2*], [*3*]. The piezoelectric sensor is the most widely used. Its popularity can be attributed to its relatively low installation cost, low maintenance costs, and simplified installation procedures.

Piezoelectric Sensor

Description. The basic construction of the typical piezoelectric sensor consists of a copper strand surrounded by a piezoelectric material that is covered by a copper sheath. The sensor is embedded in the pavement and produces a charge that is equivalent to the deformation induced by the tire loads on the pavement's surface. It is common to install two inductive loops and two piezoelectric sensors in each monitored lane.

Installation. The piezoelectric sensor is installed by making a relatively small cut on the surface of the monitored lane. The size of the cut varies depending on the sensor being installed but is generally 1in. to 2 in. deep and 1in. to 2 in. wide. The sensor is then placed and covered with a non-toxic resin. A complete lane installation can be accomplished in less than a full day, including resin curing time. The installed cables typically used are not portable, but the low cost of the device allows State Highway Agencies (SHAs) to install the system in several locations and move the electronics from site to site.

Reliability and Cost. A properly installed and calibrated piezoelectric WIM system is expected to provide gross vehicle weights that are within 15 percent of the actual vehicle weight for 95 percent of the measured trucks. However, the popularity of WIM has caused SHAs to install some devices in less than favorable conditions (e.g., rough pavements), which reduces the device's expected precision and results in greater data variation. The approximate cost to supply and install one lane of a piezoelectric system is $9,000. The system is expected to have a 4-year life with an annual net present value (NPV) of $4,750 per lane.

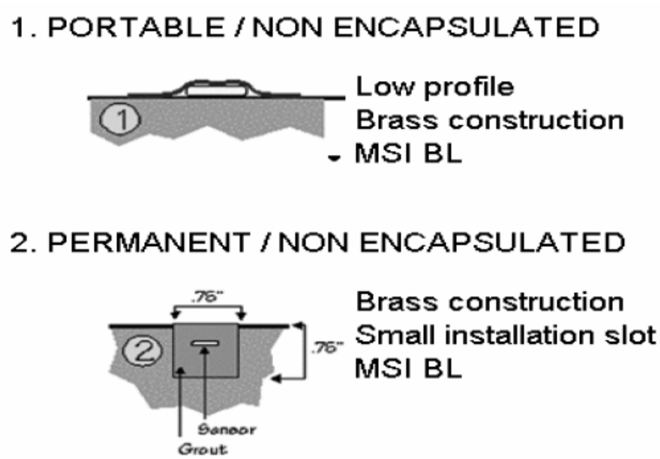

Figure 2
Piezoelectric scale layout (source: Pat America, www.patamerica.com)

Figure 3
Piezoelectric scale layout [*12*]

Bending Plate

Description. The bending scale consists of two steel platforms that are generally 2 ft. by 6 ft., adjacently placed to cover a 12-ft. lane. The plates are instrumented with strain gages that measure tire load-induced plate strains. The measured strains are then analyzed to determine the tire load.

Installation. The installation of the bending plates differs depending on pavement type. Installation in thick concrete roadways is achieved by excavating a sufficient thickness (typically 5 in.) on the surface of the pavement and placing and anchoring the device's frame with anchoring bars and epoxy. In asphalt or thin concrete roadways, the installation is generally accomplished by building a concrete vault that encompasses the device. A cut is made and excavated to form a pit 2 ft., 6 in. deep by 4 ft.,10 in. wide and 13 ft., 10 in. long. The frame is then placed and cast into concrete to form a secure and durable foundation for the device. Installing a complete lane of scales, loops, and axle sensor can be accomplished in one day for thick concrete roadways and in three days for asphalt or thin concrete roadways. The system is considered a permanent scale although the plates may be moved to different locations, provided that frames are present in all locations.

Reliability and Cost. The installation and yearly maintenance costs are significantly greater than that of piezoelectric sensors. The approximate cost for a fully installed lane is $21,500 in conjunction with an annual NPV of $6,400 per lane. However, the system is expected to last for six years and provide gross vehicle weights that are within 10 percent of actual vehicle weight for 95 percent of the trucks measured. The system has a reputation for good performance although its reputation may be partially attributable to the fact that it is usually installed in concrete pavements in excellent condition [*5*].

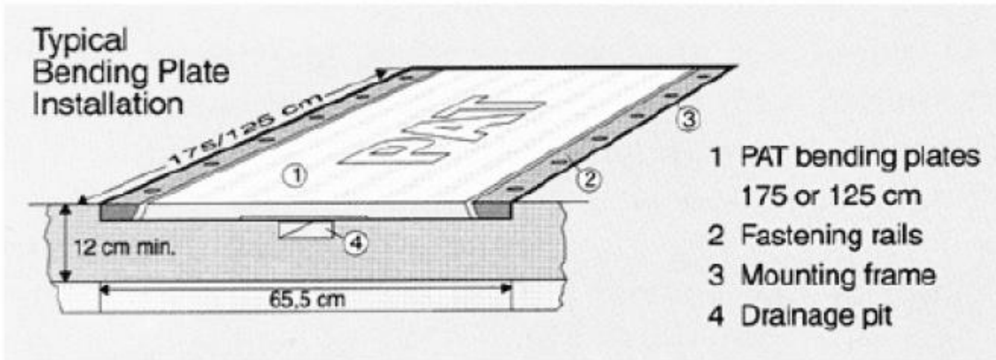

Figure 4
Bending plate layout (source: PAT America, www.patamerica.com)

Figure 5
Bending plate installation (source: Oakridge National Laboratory, www.ornl.gov)

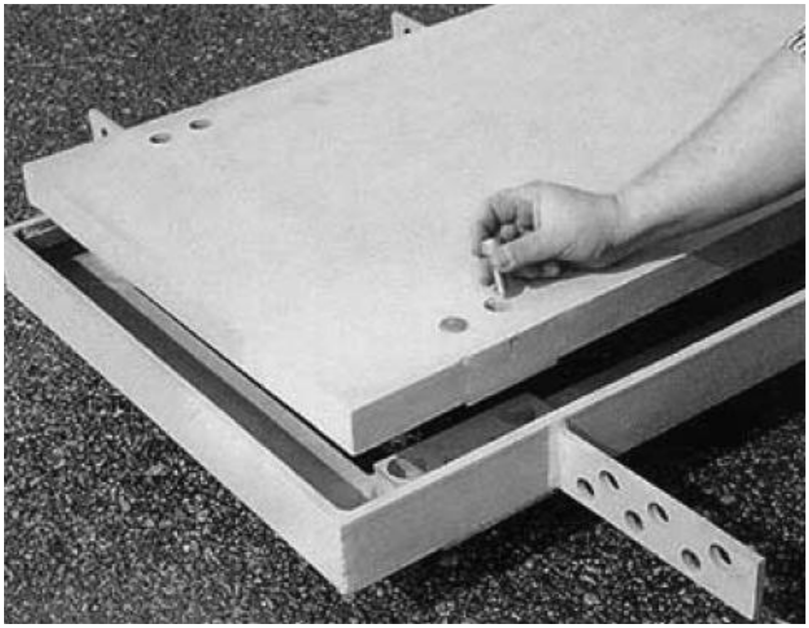

Figure 6
Bending plate (source: International Road Dynamics Inc., www.irdinc.com)

Single Load Cell

Description. This device consists of two 6-ft. x 3-ft., 2-in. platforms placed adjacently to cover the 12-ft. monitored lane. A single hydraulic load cell is installed at the center of each platform to measure the tire load-induced forces that are then transformed into tire loads.

Installation. The installation of this device requires the use of a concrete vault similar to the one used for the bending plate sensor. However, the size of the vault is slightly larger, measuring 3-ft. deep by 13-ft., 9-in. long and 4-ft., 10-in. wide. The device is commonly installed in a lane with two inductive loops and an axle sensor, and installation can be completed in three days. This system is designed only as a permanent station because of the platform's 2,000-lb. weight. Moving the sensor to different locations is not practical.

Reliability and Cost. This system is the most expensive of all three commonly used WIM devices. The approximate cost for a fully installed lane is $48,700, including a mandatory overhaul after six years. Its expected life is 12 years. The NPV annual maintenance cost per lane is $8,300. This significantly higher cost is offset by the device's reliability—it is expected to provide gross vehicle weights that are within 6 percent of actual vehicle weights for 95 percent of measured trucks.

Figure 7
Single load cell installation (source: International Road Dynamics Inc., www.irdinc.com)

Figure 8
Single load cell (source: International Road Dynamics Inc., www.irdinc.com)

NHCRP report 509 stated that when budgeting for new sites is performed, initial costs should also include any necessary pavement rehabilitation costs [*5*]. Generally, accuracy degrades all types of WIM equipment when they are placed on rough pavement. Table 5 provides general equipment costs. Other initial costs include weight sensors, roadside electronics, roadside cabinets, and installation. Annual recurring costs include site maintenance, system maintenance, calibration, and performance evaluation.

Table 6 provides an estimate of system performance, initial cost per lane, and average annual cost per lane (not including pavement rehabilitation costs) for all the WIM systems [*5*]. The estimated initial cost per lane includes the equipment and installation costs, calibration, and initial performance checks. It does not include the cost of traffic control. The estimated average cost per lane is based on a 12-year site design life and includes expected maintenance and the cost of periodic calibration and validation checks.

Table 5
WIM equipment estimated initial and recurring costs [*5*]

Type of cost	Piezoelectric	Bending Plate	Single Load Cell	Piezo Quartz
Initial Sensor costs/lane Road side Electronics Roadside Cabinets	2500 7,500 3,500	10, 000 8,000 3,500	39,000 8,000 3,500	17,000 8,500 3,500
Total	13,500	21,500	50,500	29,000
Installation costs/lane Labor and Materials Calibration Traffic control	6,500 2,600 0.5 days	13,500 2,600 2 days	20,800 2,600 3+ days	12,000 2,600 1 day
Total	9100	16,100	23,400	14,600
Annual Recurring cost/lane Site maintenance Recalibration	4,750 2,600	5,300 2,600	6,200 2,600	7,500 2,600
Total	7,350	7,900	8,800	10,100

Table 6
WIM system accuracy and cost comparison [*5*]

WIM system	Performance (percent error on GVW at highway speed)	Estimated initial cost per lane (equipment and installation only)	Estimated average cost per lane per year (12-year life span including maintenance)
Piezoelectric sensor	± 10%	$22,600	$7,350
Bending plate scale	± 5%	$37,600	$7,900
Piezoquartz sensor	± 5%	$43,600	$10,100
Single load cell	± 3%	$73,900	$8,800

Data Collection Procedures by Other States

In a study by the University of Washington, the main objectives were to develop axle load spectra for improved MEPDG and to determine whether ESALs obtained from developed load spectra significantly differed from historical values. Prior to this study in the late 1980s, WSDOT participated in four programs, namely, the Heavy Vehicle Electronic License Plate project (HELP), the Strategic Highway Research Program (SHRP), the *Traffic Monitoring Guide* (TMG), and the Data Rationalization Study [*2*]. These programs primarily helped in increasing the use of WIM for the data collection process. Truck data can vary from one geographic location to other, and also daily, weekly, seasonally, and yearly. Therefore, it was stated that the variability in the truck traffic data should be measured in order to accurately estimate the loading on the pavement.

For WIM sites, the Washington study reported that the combination of statistics and professional judgment was required to design the short-term and long-term data collection systems [*2*]. In the late 1990s, the following steps were recommended based on their study to help locate data collection sites. These are identical to the course of action defined by TMG to start the data collection process in order to identify the number of WIM sites required within a state.

- Create a group of roadways: This was obtained by dividing state roadways into different groups having similar trucking characteristics. It was mentioned that the need of data collection points would be fewer to estimate the mean population statistics for these roadway groups.
- Determine the homogeneity of groups: This was accomplished by plotting the daily mean ESAL for the most dominant trucks (e.g., class 9 vehicles) over time, and by comparing the plots from different sites within each group. Differences between weekdays and weekends, along with variations throughout the year, were also to be evaluated.

- Determine the number of required sites: It was mentioned that the equation below may be utilized to determine the number of required sites within each truck weight road group:

  $$n = [t * COV] / [d]^2 \quad (4)$$

where,
n = the number of required sites,
t = the student's t-statistic for n-1 degrees of freedom,
COV = the coefficient of variation for the mean ESAL per truck within the sample, and
d = the desired precision or allowable error expressed as a fraction of the mean ESAL per truck.

In this study, research was primarily done on the WIM data from 2000 to 2003 at different stations throughout Washington. All WIM stations sensors were recalibrated before capturing data. It was stated that WSDOT had confidence in data collected from 2000 onward. There were 23 SHRPs/LTPPs and 29 WSDOT WIM stations throughout Washington [*2*]. Apart from this, 600 vehicle count sites measuring 72 hours traffic data were performed yearly within the state and also various permanent and non-permanent vehicle classifiers and traffic recorders were located.

The evaluation process was done on traffic data based on procedures from the TMG, Caltrans, and TRAC. The gross vehicle weight (GVW) for class 9 vehicles was plotted versus the frequency of trucks as shown in Figure 9. The figure exhibits two peaks at 30 to 35 kips and 70 to 75 kips, which corresponds to the peaks of empty and fully loaded trucks. This was performed to check whether the gross vehicle weights of empty loaded trucks fall within the federal weight limit of 28 to 35 kips and for fully loaded trucks of 80 kips. The weights in greater percentage that lie outside the lower/upper limit show possible calibration problems or failure in the WIM equipment.

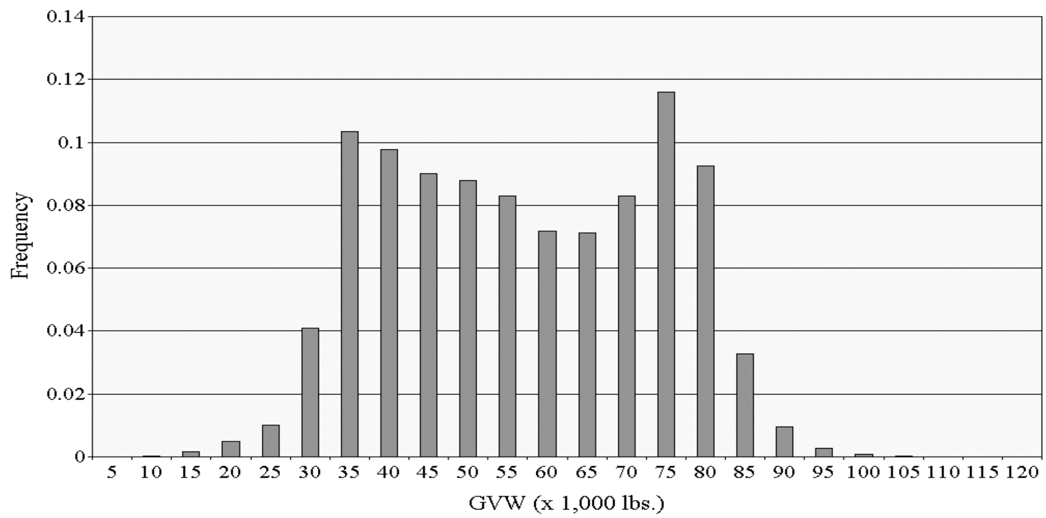

Figure 9
GVW (class 9 vehicle) versus frequency for Station P04 (2000) [*2*]

The weight of the steering axle for class 9 vehicles versus the frequency throughout the year was also plotted to check the consistency of the weight data. The steering axle for class 9 vehicles should have consistent weight ranging from 8,500 to 12,000 lb. as shown in Figure 10. Out of 52 WIM stations located in Washington, only 11 sites passed the evaluation process [*2*]. The data from these 11 sites, which passed the above mentioned tests, were collected and analyzed to develop axle load spectra that satisfy the requirements of the 2002 design guide.

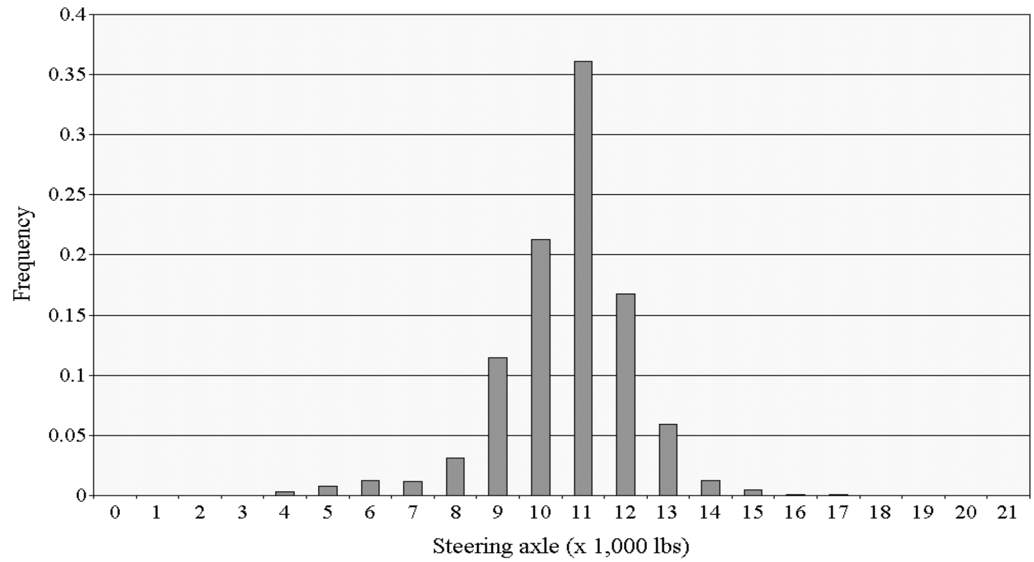

Figure 10
Steering axle weight (class 9 vehicle) versus frequency for Station P04 (2000) [*2*]

In a study by Mississippi State University, the primary objective of their research was to assist MDOT in developing load spectra and other traffic inputs for the new MEPDG. The research was primarily done on WIM data from 1992 through 1998 [*6*]. The study relied totally on the 22 LTPP Mississippi sites traffic data. Table 7 provides detail of the 22 Mississippi LTPP sites with associated routes, location, and highway functional classification. Among these 22 LTPP WIM sites, 14 are located on rural principal arterial-other, 5 on rural principal arterial interstate, 2 on urban principal arterials, and 1 on urban principal interstate. Table 8 illustrates the amount of traffic data monitored and available from each site. This explains the traffic data monitored with respect to the number of days and months for each year from 1992 through 1998 for each site. Each Mississippi LTPP site monitored WIM data in addition to classification and volume data. Traffic data files for volume, classification, and axle weight were typically formatted in accordance with the TMG to be used in analysis.

Table 7
Mississippi LTPP traffic sites [*6*]

LTPP SECTION	ROUTE	FUNCTIONAL CLASSIFICATION	FUNCATIONAL CLASSIFICATION DESCRIPTION	LOCATION
0500	I 55	1	RURAL PRINCIPAL ARTERIAL - INTERSTATE	YAZOO COUNTY
0900	I 55	1	RURAL PRINCIPAL ARTERIAL - INTERSTATE	TATE COUNTY
1001	US 45	2	RURAL PRINCIPAL ARTERIAL - OTHER	VERONA, LEE COUNTY
1016	MS 35	14	URBAN PRINCIPAL ARTERIAL - OTHER	KOSCIUSKO, ATTALA COUNTY
1802	US 84	2	RURAL PRINCIPAL ARTERIAL - OTHER	COLLINS, COVINGSTON COUNTY
2807	MS 6	2	RURAL PRINCIPAL ARTERIAL - OTHER	OXFORD, LAFAYETTE COUNTY
3018	US 72	2	RURAL PRINCIPAL ARTERIAL - OTHER	IUKA, TISHOMINGO COUNTY
3081	US 78	2	RURAL PRINCIPAL ARTERIAL - OTHER	FULTON, ITAWAMBA COUNTY
3082	US 82	2	RURAL PRINCIPAL ARTERIAL - OTHER	WINONA, MONTGOMERY COUNTY
3083	MS 310	2	RURAL PRINCIPAL ARTERIAL - OTHER	HOLLY SPRINGS, MARSHALL COUNTY
3087	MS 7	2	RURAL PRINCIPAL ARTERIAL - OTHER	OXFORD, LAFAYETTE COUNTY
3090	MS 315	2	RURAL PRINCIPAL ARTERIAL - OTHER	SARDIS, PANOLA COUNTY
3091	US 45	2	RURAL PRINCIPAL ARTERIAL - OTHER	LAUDERDALE, LAUDERDALE COUNTY
3093	I 10	2	RURAL PRINCIPAL ARTERIAL - OTHER	GAUTIER, JACKSON COUNTY
3097	I 55	1	RURAL PRINCIPAL ARTERIAL - INTERSTATE	SOUTHAVEN, DESOTO COUNTY
3099	I 20	1	RURAL PRINCIPAL ARTERIAL - INTERSTATE	FOREST, SCOTT COUNTY
4024	MS 1	14	URBAN PRINCIPAL ARTERIAL - OTHER	GREENVILLE, WASHINGTON COUNTY
5006	US 78	2	RURAL PRINCIPAL ARTERIAL - OTHER	SHERMAN, PONTOTOC COUNTY
5025	US 84	2	RURAL PRINCIPAL ARTERIAL - OTHER	BROOKHAVEN, LINCOLN COUNTY
5803	US 78	2	RURAL PRINCIPAL ARTERIAL - OTHER	HOLLY SPRINGS, MARSHALL CO.
5805	I 10	11	URBAN PRINCIPAL ARTERIAL - INTERSTATE	GULFPORT, HARRISON COUNTY
9030	I 20	1	RURAL PRINCIPAL ARTERIAL - INTERSTATE	VICKSBURG, WARREN COUNTY

Table 8
Monitoring data summary [*6*]

LTPP Section	Data Type		1992	1993	1994	1995	1996	1997	1998	Total
0500	AVC	Days		301	86	338				725
		Months		12	3	12				27
	WIM	Days	145	323	85	338				891
		Months	7	12	3	12				34
0900	AVC	Days				57	364	358		779
		Months				2	12	12		26
	WIM	Days				61	366		218	645
		Months				2	12			14
1001	AVC	Days	179	347	353	241	334	148	127	1729
		Months	6	12	12	9	12	6	5	62
	WIM	Days	272	351	361	252	341	149	37	1763
		Months	9	12	12	9	12	6		60
1016	AVC	Days	274	356	360	160				1150
		Months	9	12	12	6				39
	WIM	Days	275	353	362	162				1152
		Months	9	12	12	6				39
1802	AVC	Days	152	345	352	362	356	317	159	2043
		Months	5	12	12	12	12	12	6	71
	WIM	Days	153	348	352	363	300	85	242	1843
		Months	5	12	12	12	12	3		56
2807	AVC	Days	176	321	350	361	334	319		1861
		Months	6	12	12	12	11	12		65
	WIM	Days	177	330	353	364	365	321	268	2178
		Months	6	12	12	12	12	12		66
3018	AVC	Days	243	176	220	339	364	297	203	1842
		Months	9	9	9	12	12	12	9	72
	WIM	Days	249	183	224	265	301	208	231	1661
		Months	9	9	9	9	12	12		60
3081	AVC	Days	152	300	326	225	175			1178
		Months	6	11	12	9	6			44
	WIM	Days	272	356	237	226	181			1272
		Months	9	12	8	9	7			45
3082	AVC	Days	184		243	290	160	213		1090
		Months	7		10	12	6	9		44
	WIM	Days	185	256	250	222		216		1129
		Months	6	9	10	9		9		43
3083	AVC	Days	142	340	354	314	322	357	30	1859
		Months	6	12	12	12	11	12	1	66
	WIM	Days	133	267	358	315	320	355	257	2005
		Months	6	12	12	12	11	12		65
3087	AVC	Days	178	360	354	339	253			1484
		Months	7	12	12	12	9			52
	WIM	Days	178	357	355	337	217			1444
		Months	7	12	12	12	8			51
3090	AVC	Days	175	328	345	356	358	334		1896
		Months	6	12	12	12	12	12		66
	WIM	Days	259	313	181	263	358	286	272	1932
		Months	9	12	6	9	12	10		58
3091	AVC	Days	268	308	251	216	353	325	20	1741
		Months	9	12	10	9	12	12	1	65
	WIM	Days	273	320	254	230	362	293	231	1963
		Months	9	12	10	9	12	10		62
3093	AVC	Days	100	332	319	342	322	352	338	2105
		Months	6	12	12	12	12	12	11	77
	WIM	Days	107	308	321	341	136	183	218	1614
		Months	6	11	12	9	12	6		56
3097	AVC	Days	266	342	258					866
		Months	9	12	10					31
	WIM	Days	260	31	262					553
		Months	9	1	10					20
3099	AVC	Days	257	309	344	363	290	326	319	2208
		Months	9	12	12	12	12	12	12	81
	WIM	Days	263	311	349	269	297	332	233	2054
		Months	9	11	12	9	12	12		65
4024	AVC	Days	254	303	353	364		193		1467
		Months	9	10	12	12		7		50
	WIM	Days	255	301	358	360	364	324	270	2232
		Months	9	11	12	12	12	12		68
5006	AVC	Days	250	352	337	364	364	323	268	2258
		Months	9	12	12	12	12	12	9	78
	WIM	Days	235	328	345	361		326	163	1758
		Months	9	12	12	12		12		57
5025	AVC	Days	185	176	333	356	199			1249
		Months	8	8	12	12	8			48
	WIM	Days	215	209	346	280	206			1256
		Months	8	8	12	12	8			48
5803	AVC	Days	152	44	307		349	292	140	1284
		Months	5	3	11		12	12	6	49
	WIM	Days	155	51	312		244	279	301	1342
		Months	8	3	11		8	11		41
5805	AVC	Days	266	361	351	363	160			1501
		Months	9	12	12	12	6			51
	WIM	Days	177	333	351	361	161			1383
		Months	6	11	12	12	6			47
9030	AVC	Days	271	262	252	341	348	333	320	2127
		Months	9	9	11	12	12	12	12	77
	WIM	Days	183	264	265	357	281	332	266	1948
		Months	6	9	11	12	10	11		59

In a study by the University of Virginia, the main purpose of their research was to develop a plan to position Virginia Department of Transportation (VDOT) to collect traffic and truck axle weight data to support Level 2 pavement designs. This plan was considered as the basis for implementing and maintaining the truck weight program necessary for the new pavement design approach. Virginia comprised 270 continuous volume count locations supported by approximately 17,000 short term coverage counts [*7*]. Truck axle weight data were collected at a relatively small number of locations designed to be representative of much larger groups of roads. The reason for using a few WIM sites was stated as expensive weight data collection and the limitations observed in the available WIM equipment.

VDOT had extensive experience with piezoelectric sensors based on WIM systems for a 10-year period beginning in 1990. Piezoelectric sensors were installed at 13 locations for the collection of truck weight data to support LTPP. It was noticed that piezoelectric output changed greatly with temperature variance, pavement wear, roadway bending, site smoothness, vehicle tire type, air pressure, and piezoelectric sensor aging [*7*]. Temperature change was the single biggest issue that made the performance of piezoelectric sensor difficult to predict. Several auto calibration methods were used in an attempt to resolve the temperature issue, but none were able to produce data results that consistently met the standards of the American Society of Testing and Materials (ASTM); therefore, it was stated that the portable WIM systems cannot provide reliable and accurate data.

Currently, VDOT does not collect weight data. This function is performed by the Virginia Department of Motor Vehicles (DMV) for weight enforcement purposes only. Virginia's DMV has static weigh stations supplemented by WIM at some locations for screening trucks for static weighing. Several other WIM systems are either planned, under construction, or non-functional. Although their DMV does not store WIM data generated at the weigh stations, they have provided VDOT access to some WIM data. Therefore, VDOT may be able to use the DMV truck weight data in the short term and perhaps long term, depending on the quality of the data. From the experiences of VDOT, it was stated that the only method to collect reliable, long-term truck weigh data is through the use of bending plate scales or single load cell WIM [*7*]. Understanding all the concerns, five tasks were undertaken to achieve the purpose of this study. The plan included developing truck weight groups, developing the criteria for site selection, developing the site selection process, estimating the cost to implement the plan, and defining the benefits of implementing the traffic data plan.

The procedures in this state for forming the truck weight groups were adopted from the TMG. To do this, the team utilized the highway functional classifications traffic data. The focus was mainly on roads that had most of the truck traffic volumes. Truck volumes on interstate and principal arterial roads were examined using the 2001 vehicle classification count data. Each direction of a route was analyzed. Class 9 trucks were the predominant class and were used to represent truck traffic [*7*]. Upon the analysis, about 40 percent of the interstate and arterial road sites had less than 200 trucks on average per day. Upon the consideration of the other 60 percent, a possible dividing point to form two truck weight groups was found to be 1,000 truck units per day [*7*]. The volumes were for one direction only. The truck weight groups shown below were proposed:

- Interstate and arterials with high truck volumes (1,000 or more tractor-trailers per day)
- Interstate and arterials with low truck volumes (fewer than 1,000 tractor-trailers per day)
- Minor arterials and major collectors

VDOT planned to use permanent WIM systems for continuous operations. It was mentioned that bending plates have been associated with safety issues on high-volume roads. The plate has a tendency to move out of its position in the pavement and create a hazard. In a neighboring state to Virginia, a bending plate came out of the road one week after it was field inspected [*7*]. A bending plate weighs 200 lb. to 400 lb. compared to a load cell, which weighs 4,500 lb. and would not move from its position. Considering all this, a load cell was preferred with respect to a bending plate. The bending plate was mentioned to be more economical for shorter-term data collection needs (5 years or less) [*7*]. The load cell being more expensive and durable was suggested for use in higher truck volume locations and on sites where data were required for longer duration. Therefore, a single load cell was recommended for Groups 1 and 2 (interstate and principal arterials), which had the majority of the truck loading in the state. For the minor arterials and major collectors within truck weight Group 3, six sites were required but were not given the priorities and were anticipated to be part of future phases. It was also assumed that a reliable portable WIM system would be available in the next five years and could be used for those sites [*7*].

The cost for installing the load cell and vehicle classification equipment for one lane was estimated to be $150,000, and the cost for building the concrete section for two lanes (based on a 300-ft. section of jointed concrete) was anticipated to be $230,000 [*7*]. In addition, cost for vehicle classification equipment only for second lane was observed to be $10,000. The total cost estimate to install load cell WIM and vehicle classification at five sites for truck weight Groups 1 and 2 was $1.95 million, and it was expected that the installations would be phased over five years.

The operating and maintenance costs were estimated based on the average annual costs for operating the WIM and vehicle classification systems for five years. The total annual cost for operating and maintaining was calculated to be $23,000 (load cell being $21,000 and vehicle classification being $2,000) [*7*]. It was also estimated that the cost for maintaining the bending plate system would be about the same as the costs for the load cell system. It was assumed that by the end of year 1, two WIM sites would be installed; at the end of year 2, three; at the end of year 4, five; and at the end of year 5, seven [*7*]. To ensure proper program management, three employees were recommended that the state could recruit. The annual cost for these three employees who would work on contract was estimated to be $150,000. Approximately seven more temporary contract employees were also recommended to perform the installation, maintenance, and calibration functions.

By combining the initial, personnel, operating, and maintenance costs, the total cost to implement the program is shown in Table 9. The annual cost increases from $509,000 to $701,000 over the 5-year period for truck weight Groups 1 and 2. At the end of year 5, it was mentioned that the program would be evaluated to determine if these two truck weight groups were sufficient for the interstate and arterial systems [*7*].

Table 9
Estimated total costs ($) for first five years of the program [*7*]

Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Installation	390,000	390,000	390,000	390,000	390,000	1,950,000
Personnel	50,000	100,000	100,000	150,000	150,000	550,000
Operating and Maintenance	69,000	92,000	115,000	138,000	161,000	575,000
Total	509,000	582,000	605,000	678,000	701,000	3,075,000

The magnitude of the potential savings was also illustrated. It was stated that, if 10 percent of more than 1,000 miles paved annually could be reduced by 0.5 in. (10 percent of 1,000 miles multiplied by $15,000 per mile), $1.5 million could be saved per year. With 5 percent, the potential savings would be $750,000 per year [*7*]. This does not include the benefits of not under-designing a highway. At 5 percent, it was stated that the potential benefit would exceed the cost of implementing the program for each of the first five years.

In a study by the University of Arkansas, the primary objective of their research was to develop statewide axle load spectra. The study also included quality control evaluation of traffic data collected at the different WIM sites. The traffic monitoring program in Arkansas is being conducted in accordance with the guidelines contained in the TMG. Two traffic count programs were performed, namely, the continuous count program and short-duration count program. The continuous count program included 79 automated traffic data collection sites. Among the 79 automated sites, 55 sites featured WIM technology, which were used to continuously collect traffic volume, vehicle classification and vehicle weight [*8*], [*9*]. All WIM sites in Arkansas used piezoelectric sensors and calibrated every three years. The calibration was performed in accordance with the guidelines contained in the TMG. For developing axle load spectra, 25 WIM sites were selected, including 18 sites in rural areas and 7 sites in urban areas. The traffic data from the 25 WIM sites were collected from 2003 through 2005. Among the 25 sites, only 10 stations provided WIM data suitable for the development of statewide axle load spectra. For each of these 10 stations, a minimum sample size of 270 days in each of three years from 2003 through 2005 was available [*8*], [*9*].

The evaluation of WIM data before developing axle load distribution factors was performed. These evaluation/quality control checks were performed on the traffic data collected at the calibrated WIM stations. These checks were based on procedures recommended by the LTPP and FHWA. Initially, the evaluation of the Automatic Vehicle Classification (AVC) data was carried out in three steps as follows [*8*], [*9*]:

1. A comparison of the manual hourly classification counts and AVC data was done and verified to see the difference, which had to be less than five percent for each of the primary vehicle categories.
2. A check on the reported number of unclassified vehicles. If more than five percent of recorded vehicles were unclassified, it was said that the equipment may have axle sensing malfunctions that prevent the equipment from measuring all appropriate axle pulses.
3. A comparison of the current truck percentages by class with the corresponding historical percentages was performed to determine if significant change occurred in vehicle classification.

Only WIM data collected in those months which had AVC data suitable for the development of traffic inputs were included in further evaluation process. Upon the completion of the AVC data check, the front axle and drive tandem weights of class 9 trucks were evaluated to eliminate the WIM sites that produced incorrect data. It was mentioned that the front axle weight would be heavier when a truck is loaded and should be in a range of 8,000 and 12,000 lb. (similar to Figure 10) [*8*, *9*]. If most of the recorded front axle weights of class 9 trucks were out of this range, the WIM scale was checked. The drive tandems of a fully loaded class 9 truck should be between 30,000 lb. and 36,000 lb. The gross vehicle weight distribution of class 9 trucks vs. frequency was also performed. This step required a histogram plot of the gross vehicle weights of class 9 trucks using a 4,000-lb. increment. The histogram plot should have two peaks for most sites. One represents unloaded class 9 trucks and should be between 28,000 lb. and 36,000 lb. and the other for loaded class 9 trucks, the weight range from 72,000 lb. to 80,000 lb. (similar to Figure 9) [*8*], [*9*]. These limits were based on extensive analyses of vehicle weight data in the LTPP database. It was also stated that if both peaks shift from their expected location in the same direction, the scale was most likely out of calibration. The state should then recalibrate that scale at that site and collect new data. If a plot shows one peak correctly located but the other peak shifted from its expected location, the site should be reviewed for other potential scale problems [*8*], [*9*].

Statewide axle load spectra were compared to the default values. Figure 11 shows the difference between statewide and default single axle load spectra for class 9 trucks. It was stated that the distribution of loading was higher in the range between 8,000 lb.-12,000 lb. for the statewide single axle load spectra. Figure 12 shows the difference between the statewide and default tandem axle load spectra for class 9 trucks. From Figure 12, it was concluded that peaks representing unloaded and loaded trucks on the statewide and default distribution curves were different.

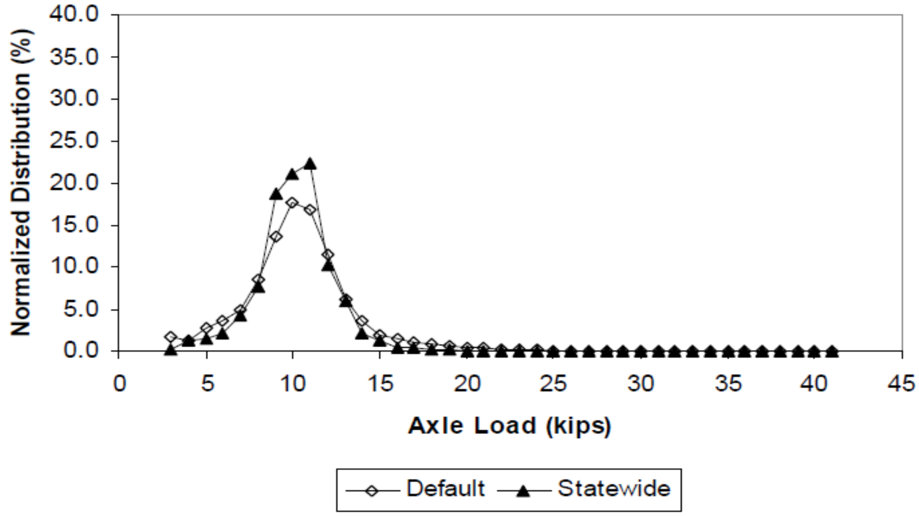

Figure 11
Arkansas statewide and default single axle load spectra for VC 9 [*9*]

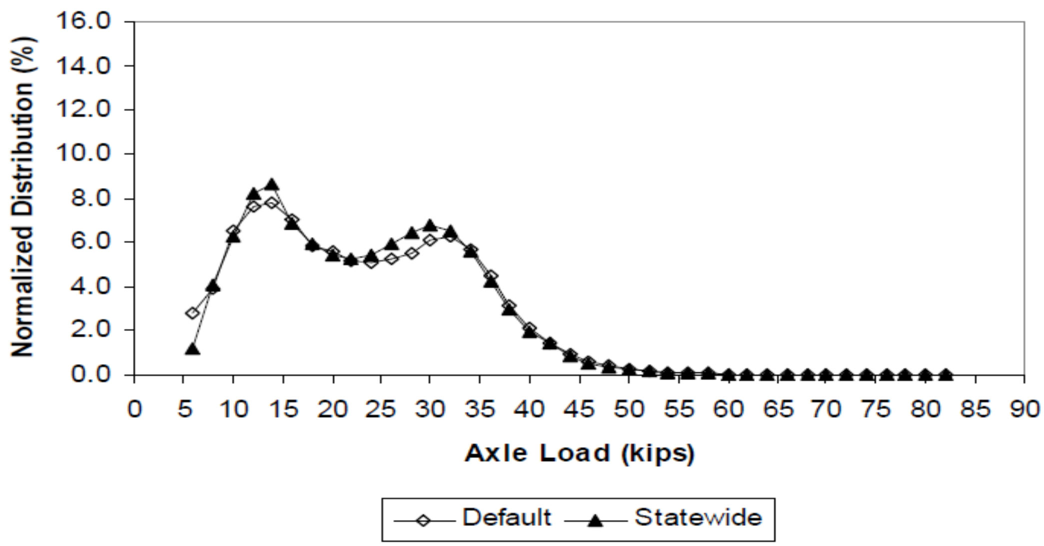

Figure 12
Arkansas statewide and default tandem axle load spectra for VC 9 [*9*]

In a study done by the Texas Department of Transportation (TxDOT), a systematic review of the statewide data collection systems was performed in 2002 [*10*]. This was initially started with an evaluation of the WIM program and resulted in a strategic plan that outlined varying needs for an expanded WIM program. TxDOT used two types of WIM technology, namely, bending plate and piezoelectric. In August 2002, TxDOT had 17 WIM data sites statewide. These sites covered 68 lanes of travel (5 bending plate sites covered 20 lanes, and 12 piezoelectric sites covered 48 lanes) for use in federal reporting and pavement design. Of the 17 WIM sites, 16 were located in rural areas, and 11 of those were located on interstates or freeways [*10*]. Upon the completion of the study, TxDOT had a goal of installing 133 new sites statewide across various roadway functional classifications. A five-year program schedule was set to complete the deployment of the 133 additional WIM data collection sites. This plan included an estimate of the WIM program cost and expected operating and maintenance cost. The estimated total cost for deploying 133 additional sites was estimated to be $32.6 million. The estimated annual operating and maintenance cost for the total 150 site system was $2.5 million. A breakdown of these costs is displayed in Table 10.

Truck weight group in the state of Texas was developed primarily using three variables, namely, geographic region, roadway functional classification, and similar truck volumes. A review of 1999 functionally classified traffic data was made to examine, by functional class and region, on-system centerline roadway mileage, total vehicle-miles traveled (VMT), and truck VMT [*10*]. The result was 25 truck weight groups with 150 sites to meet TMG recommendations. With 150 WIM sites recommended, an additional 133 sites were required to be installed beyond the current 17 sites. As of May 2004, 12 additional WIM data collection sites covering an additional 48 lanes of travel, located in rural locations with two located on the interstate, were identified by TxDOT. These were either installed, under construction, or were in design [*10*].

Table 10
Estimated WIM program costs in Texas [*10*]

PHASE	ESTIMATED COST ($)
Deployment	32,600,000
Site Construction and Rehabilitation	24,000,000
Equipment Purchase and Installation	8,400,000
Other	200,000
Annual Operating and Maintenance	2,500,000
Office Staff and Program Management	500,000
Power and Communications	100,000
Sensor Replacement and Pavement Rehabilitation	1,000,000
Calibration	900,000

In a study by the University of California, the main focus was on characterizing truck traffic in California in terms of truck composition, volume, speed, and axle load spectrum to provide traffic inputs for MEPDG procedures. For this study, WIM data was obtained from the Caltrans Office of Truck Services for all WIM stations installed before 2001. The WIM data was collected from 1991 to 2001 at 98 WIM stations [*11*]. In some cases, two WIM stations were installed at the same highway site but in opposite travel directions. Therefore, the 98 WIM stations actually represented 72 WIM sites. As of 2006, more than 110 WIM stations were installed on the California highway system.

A preliminary analysis of data from a few WIM stations revealed a significant difference in traffic pattern between weekdays and weekends but little difference between weeks in the same month. Therefore, it was decided to sample one week's data from each month for each WIM station. Eighty-six daily data files were sampled from each year for each WIM station and 0.7 billion trucks were included in the analysis [*11*]. Erroneous records were eliminated by an unknown method (not mentioned) although all data sampled for the analysis had passed the Caltrans routine validation check. It was stated that the conventional way to form truck weight road groups was by categorizing highway sections into different groups carrying similar traffic characteristics. The determination of grouping, however, was difficult because traffic streams on highways typically had vehicles with diverse origin destination areas. Therefore, a hierarchical cluster analysis was applied to group the data into useful clusters. The distance between each pair of clusters was calculated by an average linkage method [*11*]. Several traffic data distribution factors such as truck volume including hourly and monthly distribution, direction and lane distribution, growth rate, and axle load spectra were analyzed through the clustering process. This was done individually to group WIM sites into relatively homogeneous clusters, from which influential factors and common traits were extracted.

Data Collection in Louisiana

This study is primarily conducted to estimate the truck axle load spectra in Louisiana using the available traffic data and to develop a strategic plan for a traffic data monitoring program. In order to calculate the load spectra, two types of data must be collected and analyzed: (1) truck weight data and (2) vehicle classification data. To develop a strategic plan, information on portable WIM stations, official truck routes, weight enforcement sites, and LTPP sites is reviewed in this section. All sources of data were considered in the development of the strategic plan.

Portable WIM Sites

The traffic data sampling information was provided by LADOTD, and the data was collected for a rotating period of three years. The sampling procedures adopted by LADOTD in gathering traffic data over a three-year period are as follows:

- 100 WIM sites that collect both weight and vehicle classification data
- 200 Automatic Vehicle Classification (AVC) sites that collect vehicle classification data
- 5,000 sites that collect traffic volume data

Portable sensors were primarily used to collect weight data and vehicle classification data at sites monitored continuously for 48 hours. Inductance loop and road tube are used for classifying vehicle class, and quartz piezoelectric sensor is currently used for collecting weight data at portable WIM stations. It was noted that there were technical problems with the present equipment used to collect traffic data at portable sites. Examples of such problems, as provided by the planning section of LADOTD, are listed below:

- Pneumatic tubes should be of same length when replaced in order to get accurate readings.
- The piezoelectric cables, which are used at WIM stations, are designed so that they are temperature sensitive (variation of temperature can affect the signal readings). Usually, this results in over-weighing lighter vehicles and under-weighing heavier vehicles.

For this study, considerable efforts were made to collect the maximum possible truck traffic data for weight and classification from all available sites in the state. Most of the data available for this study was in the *Traffic Monitoring Guide* (TMG) format and site specific. Vehicle Travel Information Systems (VTRIS) data was also obtained to perform the needed analysis on developing axle load spectra and other inputs. Table 11 presents a summary of traffic data collected for this study.

Table 11
Traffic data collected for this study

	Year						
Types of Data	2000	2001	2002	2003	2004	2005	2006
Weight (WIM)	VTRIS	VTRIS	VTRIS	TMG/ VTRIS	TMG/ VTRIS	TMG/ VTRIS	TMG/ VTRIS
Vehicle Classification	TMG/ VTRIS	TMG/ VTRIS	TMG/ VTRIS	—	TMG/ VTRIS	TMG	—
Stations	TMG	TMG	TMG	—	TMG	TMG	—

On review of WIM traffic data collected over 3 years, 33 portable WIM stations were monitored in 2006, 30 stations in 2005, and 33 stations in 2004. Table 12 shows the functional classification code for each designated road [4]. Figure 13 through Figure 15 show the approximate portable WIM site locations for years 2006, 2005, and 2004. Table 13 provides a list of existing portable WIM sites in Louisiana along with the station ID, the number of class 9 trucks monitored in a period of 48 hours, the functional class of the site, and the physical address of the site location.

Table 12
Roadway functional classification code (source: Traffic Monitoring Guide [*4*])

Location	Functional classification	Code
RURAL	Principal Arterial - Interstate	1
	Principal Arterial - Other	2
	Minor Arterial	6
	Major Collector	7
	Minor Collector	8
	Local System	9
URBAN	Principal Arterial - Interstate	11
	Principal Arterial - Other Freeways or Expressways	12
	Principal Arterial - Other	14
	Minor Arterial	16
	Collector	17
	Local System	19

Table 13
Existing portable WIM sites in Louisiana

Site #	No. of class 9 trucks	Functional Classification	Location of the site
313	60	Missing	Missing
21	6264	1	1.0 mi. W of LA 63, Livingston, Livingston Parish
49	3294	1	1.0 mi. N of Rest Area, Slidell
67	4256	1	E of Rest Area near Slidell
105	6099	1	0.2 mi. W of LA 26, Jennings Jefferson Davis
107	5985	1	1.0 mi. W of US 80 near ada Bienville
109	4601	1	0.2 mi. W of LA 9,Bienville

(continued)

Site #	No. of class 9 trucks	Functional Classification	Location of the site
111	1261	1	0.2 mi. W of Greenwood interch, Caddo
155	4560	1	1.0 mi. W of US 11, Slidell - St. Tammany
168	2782	1	2.0 mi. N of LA 41 Spur, Pearl River - St. Tammany
20	2078	1	at the Avoyelles-Rapides Line Rapides
150	5985	1	Between LA 7 and LA 531,Webster
102	7547	1	0.2 mi. W of LA 328, Breaux Bridge
106	9277	1	2.0 mi. W of LA 91, Egan Acadia
154	6328	1	4.5 mi. E of LA 157 at Haugton - Bossier
156	1970	1	7.5 mi. N of LA 6 at Natchitoches - Natchitoches
162	6379	1	1.0 mi. W of LA 415, near Port Allen - WBR
22	367	2	Riverton
33	359	2	2.7 mi. N of LA 4, Winnsboro
38	378	2	2.0 mi. S of US 84, Winnfield
50	197	2	0.2 mi. N of LA 992-3, Plaquemine-Iberville
10	580	2	0.5 mi. E of LA 1205, Libuse Rapides
25	237	2	at the Texas State Line - Many-Sabine
77	1154	2	0.5 mi.. S OF LA 83, New Iberia
123	1297	2	7.0 mi. N OF LA 14 AT New Iberia
16	1729	2	0.2 mi. W of LA 415, Lobdell, WBR
32	116	2	2.0 mi. W of LA 8, Jena. Lasalle
130	171	2	0.3 mi. W of LA 772, at Trout - LaSalle
41	18	6	1.4 mi. W of LA 448, Darlington St. Helena
45	294	6	1.3 mi. N of US 190, Covington
46	35	6	0.3 mi. E of LA 433, Rigolets
73	76	6	0.5 mi. S OF LA 1126, Jennings
119	0	6	0.2 mi. N of LA 102, Hathaway - Jefferson Davis
30	353	6	1.2 mi. N of LA 112, Lecompte Rapides
35	88	6	Missing
34	290	6	4.1 mi. N of US 80, Delhi
55	230	6	0.1 mi. E of LA 97, Basile
60	220	6	0.6 mi. N of LA 6, Clarence Natchitoches
70	516	6	0.4 mi. W OF LA 109, Starks
72	173	6	5.4 mi. S OF LA 104, Mamou
127	359	6	3.7 mi. W of LA 389 at Dequincy Calcasieu
11	24	7	0.8 mi. NW of US 165, Grayson. Caldwell
37	80	7	Missing
40	0	7	1.4 mi. S of LA 10, Clinton
108	246	7	0.1 mi. S of LA 155, Mt. Olive Bienville/Jackson
7	0	7	LA 463 2.7 mi. S of LA 121, Hineston Rapides
9	181	7	1.0 mi. NW of Oberlin. Allen
31	45	7	0.8 mi. W of US 165, Pollock
57	110	7	1.0 mi. S of LA 10, Morganza Pointe Coupee
59	30	7	0.9 mi. NE of US 71, Coushatta Red River
61	45	7	0.6 mi. S of LA 120, Belmont
62	75	7	0.6 mi. NE of Gardner, Rapides
134	2	7	N of Patterson City Limits - St. Mary
135	33	7	S City Limits of New Iberia - Iberia
144	64	7	1.5 mi. N of LA 14, New Iberia - Iberia

(continued)

Site #	No. of class 9 trucks	Functional Classification	Location of the site
166	56	7	0.5 mi. S of Main St., Colfax - Grant
14	61	7	1.5 mi. W of US 165 - Iowa
36	327	7	2.3 mi. N of I-20, Arcadia, Claiborne
114	24	7	Lasalle Parish Line, Catahoula
133	130	7	0.1 mi. W of LA 1141, Cameron - Cameron Ph
136	134	7	0.2 mi. S. of LA 134, Swartz, Ouachita
142	63	7	7.5 mi. W of Vermilion Ph. L - Cameron
147	4	7	0.2 mi. E of LA 15, Mangham - Richland
148	44	7	0.3 mi. E of LA 27, S Calcasieu
153	11	7	0.1 mi. N of LA 355 at Cecelia - St. Martin
171	4	7	Legion St. 0.1 mi. W of I-210 - Calcasieu
17	26	8	0.3 mi. E of LA 154, Sparta Bienville
145	70	8	0.5 mi. N of LA 92, Youngsville - Lafayette
132	7	9	Bet. LA 20 and LA 641, Lutcher - St. James
53	1777	11	5.5 mi. N of I-10, Carencro
126	0	11	Bet. Stonewall & LA 526, Caddo
157	4280	11	1.0 mi. E of US 11, Slidell - St. Tammany
24	264	11	Ryan Street overpass, Lake Charles, Calcasieu
65	5887	11	0.6 mi. E of I-220, Bossier City - Bossier
143	1401	12	Missing
51	1533	14	10.0 mi. S of I-10, Broussard
112	553	14	0.1 mi. N of US 90, Lafayette
124	37	14	0.1 mi. W of LA 15, Winnsboro - Franklin
4	140	14	0.3 mi. N of Chippewa St Baton Rouge
18	180	14	6.4 mi. E of US 61, B R, EBR
52	167	14	0.2 mi. W of LA 14 Bus, Abbeville, Vermilion
56	655	14	S City Limits of Oakdale Allen
64	995	14	1.0 mi. W of US 61, Baton Rouge EBR
115	399	14	E of US 51, Laplace St. John
138	55	14	0.1 mi. W of LA 3249 , W Monroe- Ouachita
139	757	14	0.2 mi. N of LA 840-6, Monroe - Ouachita
164	9	14	0.1 mi. W of Lakeshore Dr. L C - Calcasieu
27	260	16	Missing
121	49	16	N City Limits of New Iberia - Iberia
131	26	16	0.2 mi. W of LA 182, N. of St. Mary
160	7	16	0.2 mi. N of LA 3092 Calcasieu.
163	631	16	0.8 mi. N of I-10, Port Allen - W. B. R.
167	57	16	LA 1 Bus 0.5 mi. W of LA 6, Natch. -Natc
172	37	16	1.8 mi. S of LA 384, Lake Charles - Calcasieu
68	15	17	0.3 mi. W. of US 71- Near Sern Univ. - S'port
128	7	17	0.1 mi. S of Pinhook, Lafayette - Lafayette
113	77	17	Bet. US 61 & LA 44, Laplace, St. John

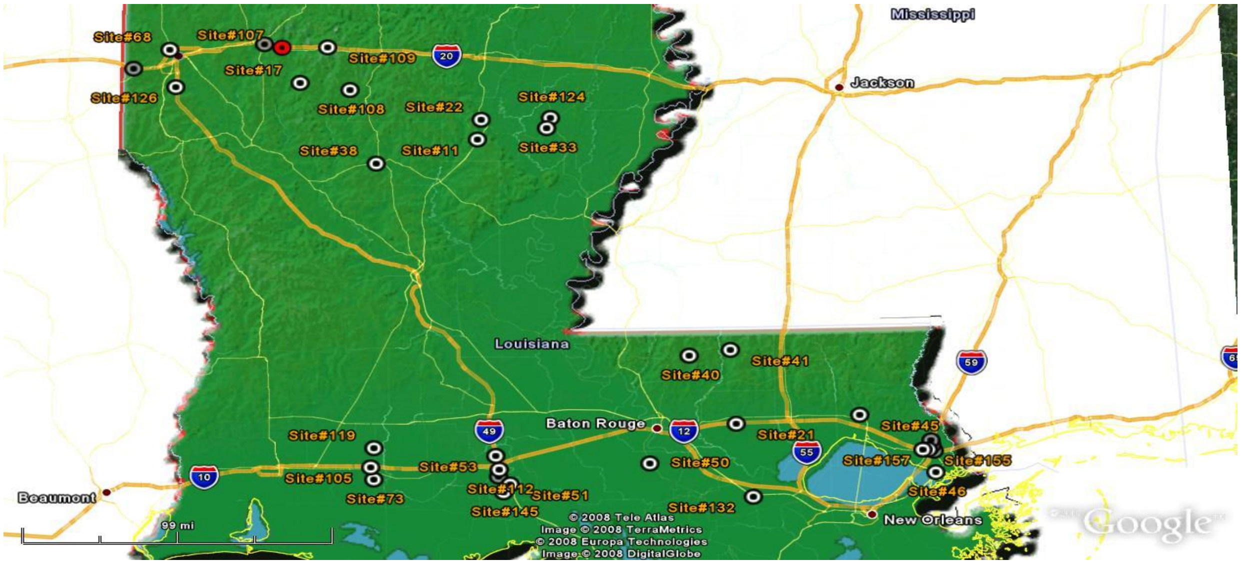

Figure 13
Portable WIM data collection sites for year 2006

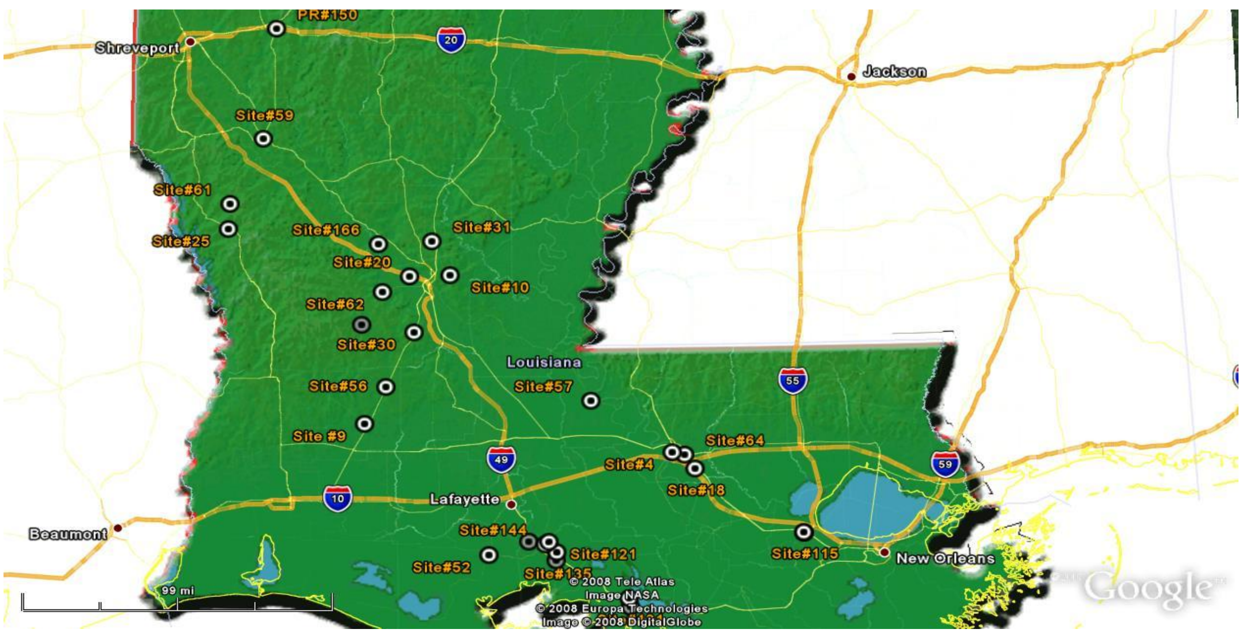

Figure 14
Portable WIM data collection sites for year 2005

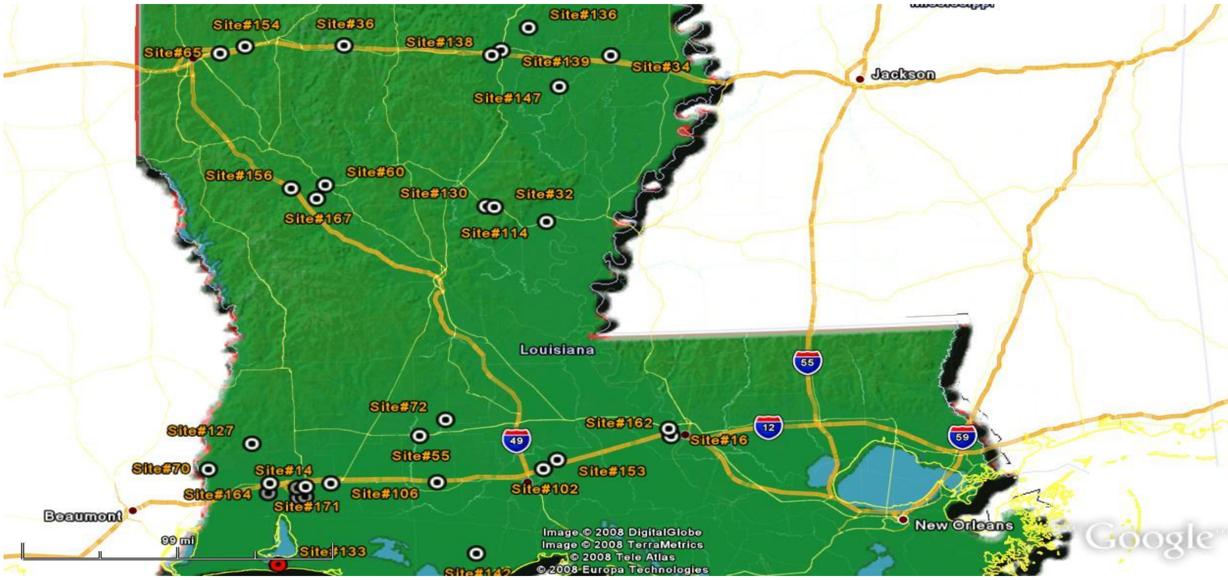

Figure 15
Portable WIM data collection sites for year 2004

Some characteristics of data collected from WIM stations are as follows:

- Most of the data were collected on the outermost lane of travel
- Most stations used a portable vehicle classification device
- Only one lane was used for monitoring truck weight
- Method of truck weighing was done only by a portable WIM system
- Most of the weight data was not adequately calibrated
- Inductance loop, road tube and quartz piezoelectric are the three types of sensors that are currently used

Truck Routes in Louisiana

The officially designated truck route map was obtained from LADOTD. The maps shown in Figure 16 through Figure 19 highlight designated truck routes within Louisiana. The state map is divided into four regions, namely, the northwest region shown in Figure 16, the southwest region shown in Figure 17, the northeast region shown in Figure 18, and the southeast region shown in Figure 19. This information was used to locate any WIM station required on a particular road section.

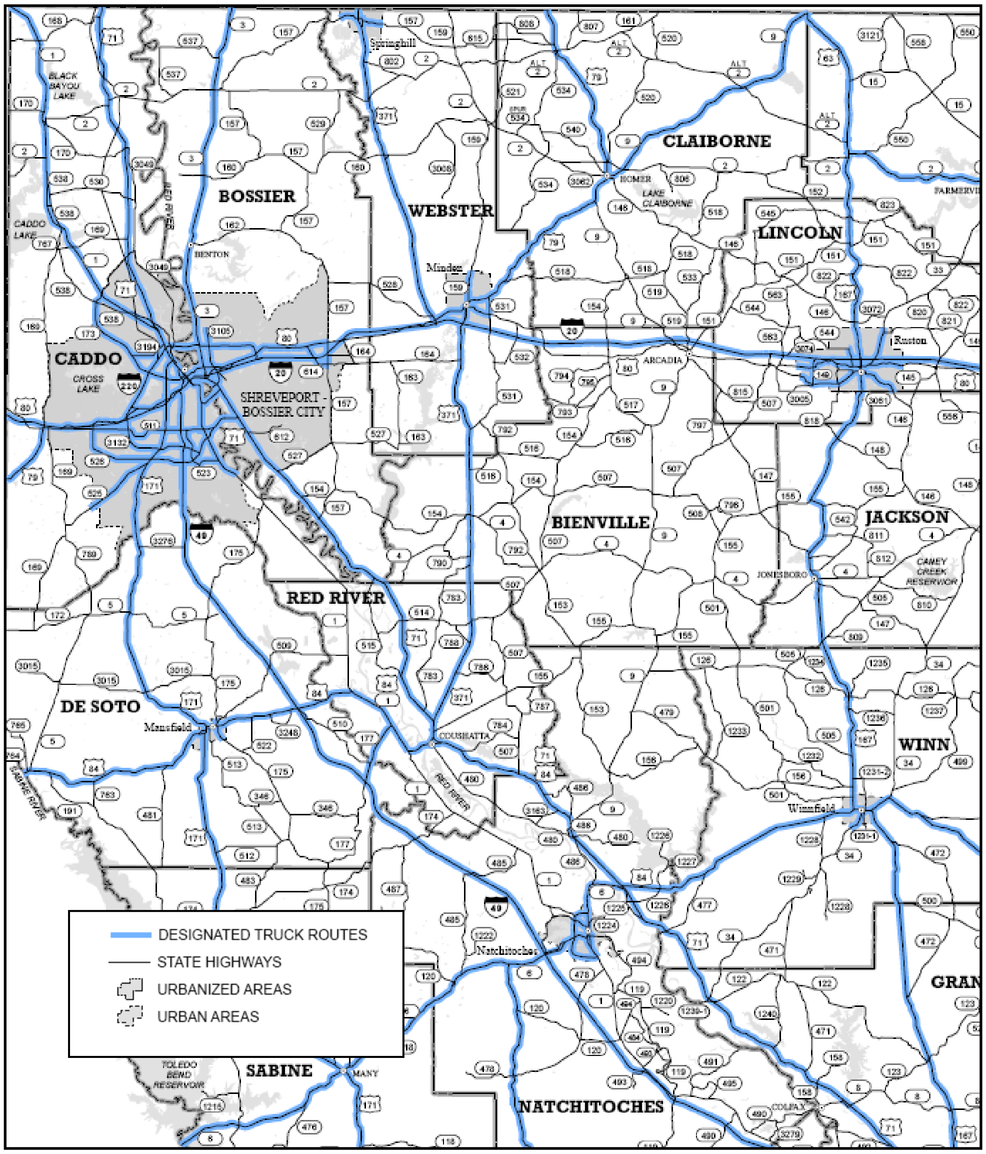

Figure 16
Truck routes in northwest region

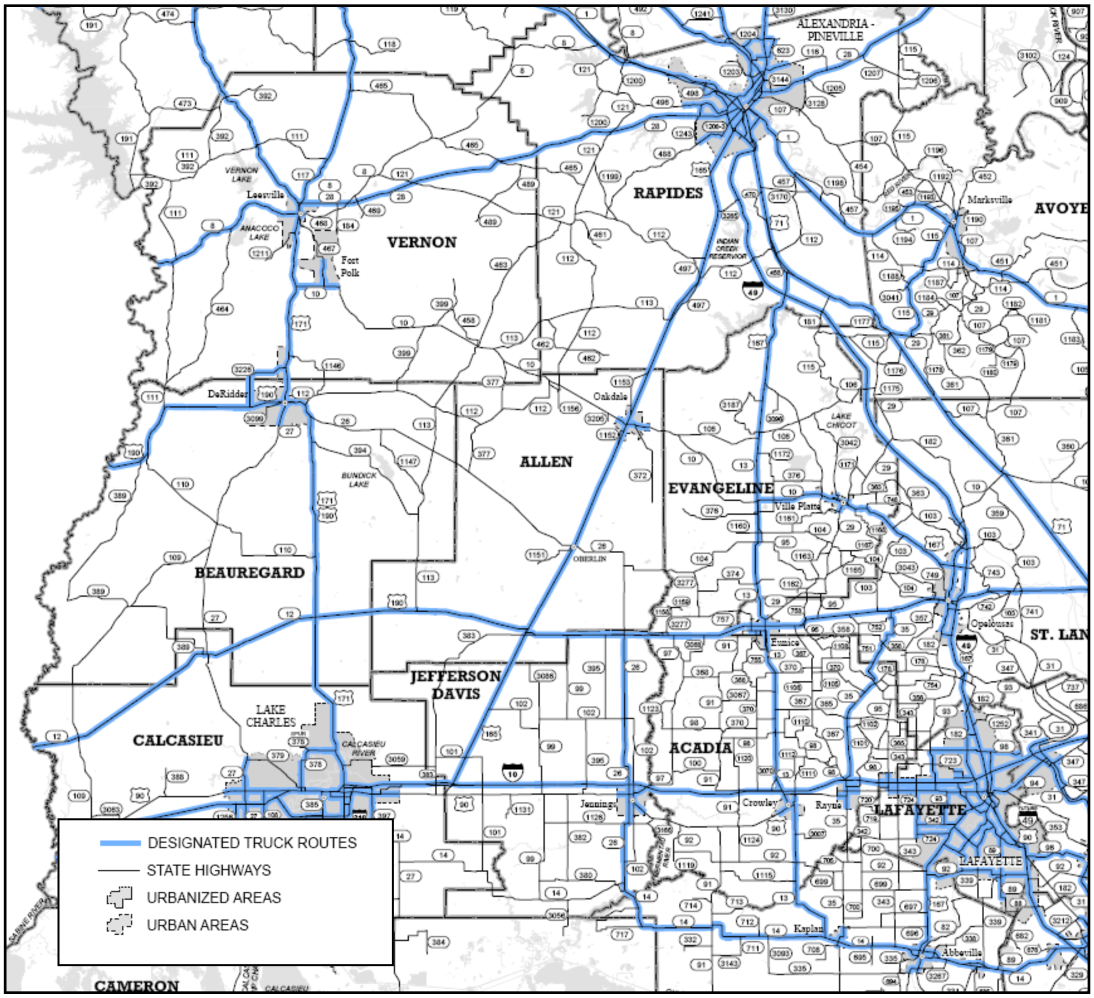

Figure 17
Truck routes southwest region

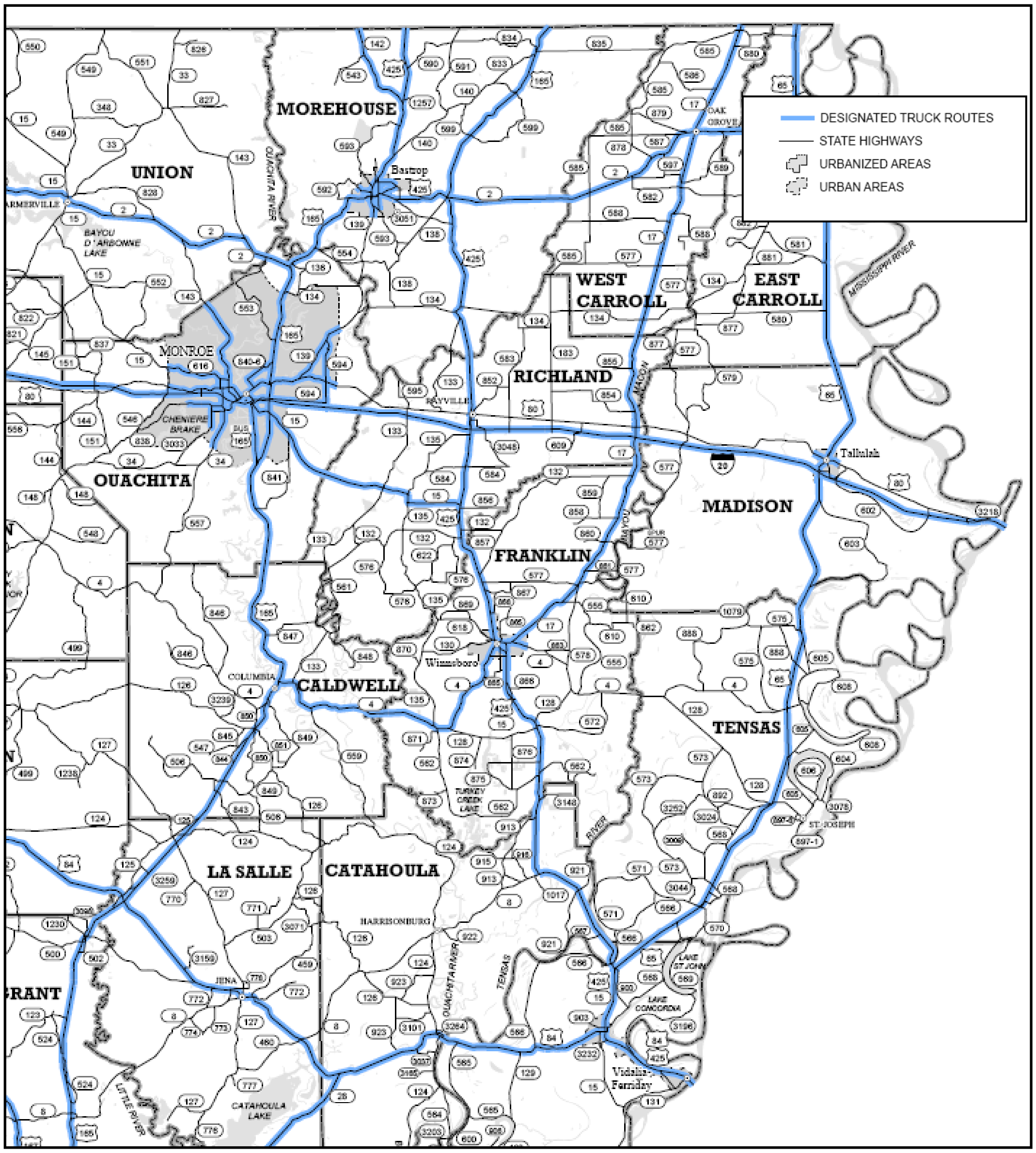

Figure 18
Truck routes in northeast region

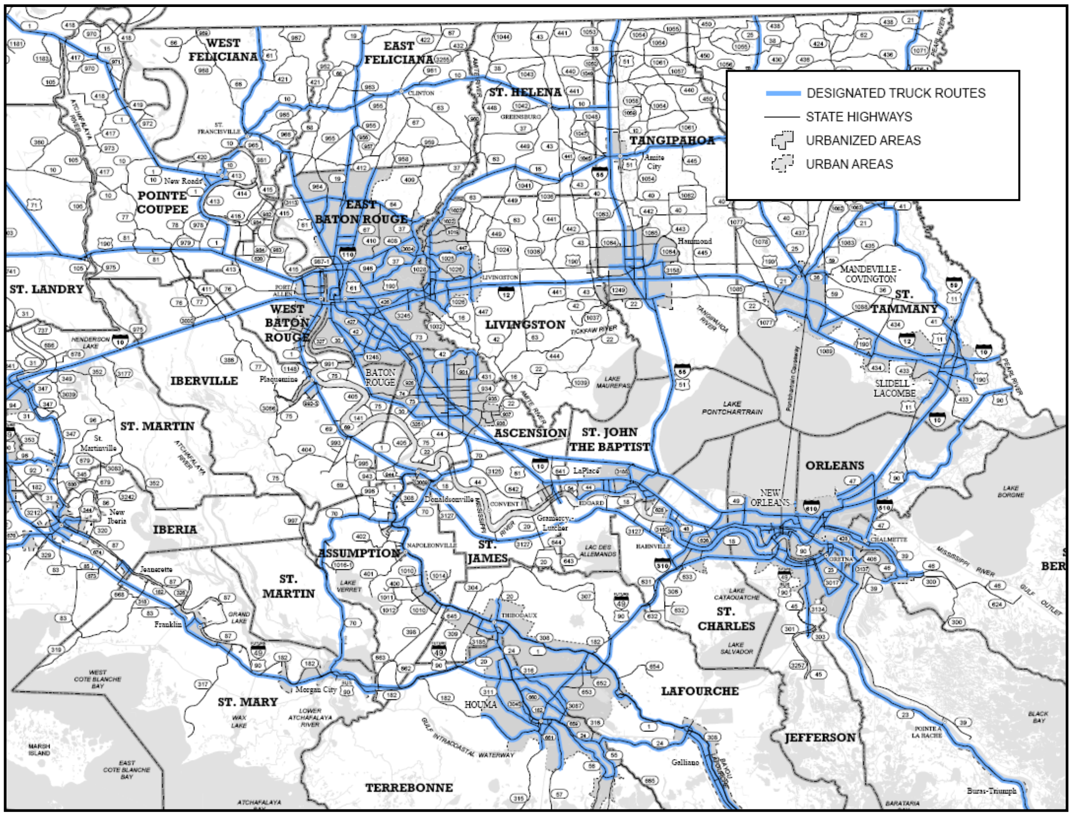

Figure 19
Truck routes in southeast region

Weight Enforcement Sites

The main objective of the truck weight enforcement program is to monitor the commercial traffic stream and violation of weight and dimension laws to improve public safety on the highways. These WIM scales operate continuously upstream of static enforcement scales. International Road Dynamics (IRD), Inc. provides WIM mainline and ramp sorting systems to pre-weigh and pre-sort trucks prior to weigh stations. At weigh stations, WIM systems provide preliminary dynamic weight readings that can be used to pre-clear and automatically sort vehicles. Only trucks that are potentially in violation of weight regulations are directed to report to the station for further inspection [*12*].

IRD's WIM systems vary widely in functionality and complexity using piezoelectric and quartz WIM sensors, slow speed WIM scales, bending plate WIM scales, or single load cell WIM scales. The typical layout of a WIM enforcement station is illustrated in Figure 20. Initially, all trucks heading toward the truck inspection area are directed to use the outermost lanes. With the help of mainline WIM/AVC sensors and electronics, the weight of the truck, axle spacing, vehicle height, classification, and several other data is screened. Based on the weight and credential information, the truck is allowed to either bypass or forced to report to the truck inspection station. The decision to bypass or report is communicated to truck drivers with the help of roadside message signs [*12*]. Using this process, trucks that are not pre-cleared must report to the truck inspection station. Additionally, on lanes excluding the outermost lane, AVC sensors are placed in order to detect violations of trucks travelling those lanes. Trucks are also tracked through tracking sensors placed on the road in order to verify the correct lane use.

In Louisiana, there are currently 13 enforcement stations located primarily on the interstates and other principal arterials. These stations are set according to IRD standards as described in the previous paragraph and also make use of IRD software for their calculations and analysis. These stations are federally funded to operate and maintain. Steel single load cell sensors are used for monitoring truck weights throughout Louisiana and are accurate within a range of +/- 6% with respect to corresponding axle. For example, in case of steering axles, the maximum value used for verification is 12,000 lb., 20,000 lb. for single axles, 34,000 lb. for tandem axles, and 80,000 lb. for gross vehicle weight of the truck. This is the same equipment that is being utilized by other states at most of the permanent WIM stations. The data collected by this equipment appears to be very similar to what would be obtained by permanent WIM stations. The data collected using WIM/AVI sensors is only stored for three months as it is used for sorting purposes only. This information was provided by LADOTD personnel, working under the WIM enforcement program.

If data are collected and stored on a regular basis from each station, it could be used for design purposes. Given that there are no permanent WIM stations in Louisiana, the weight enforcement stations can be used as a viable substitute. This can be achieved by connecting the LADOTD network to all the WIM enforcement sites and downloading data periodically. Data may be stored into the database server at the Louisiana Transportation Research Center (LTRC). The conversion of raw data to useful data can be done with proper licensing and using IRD software.

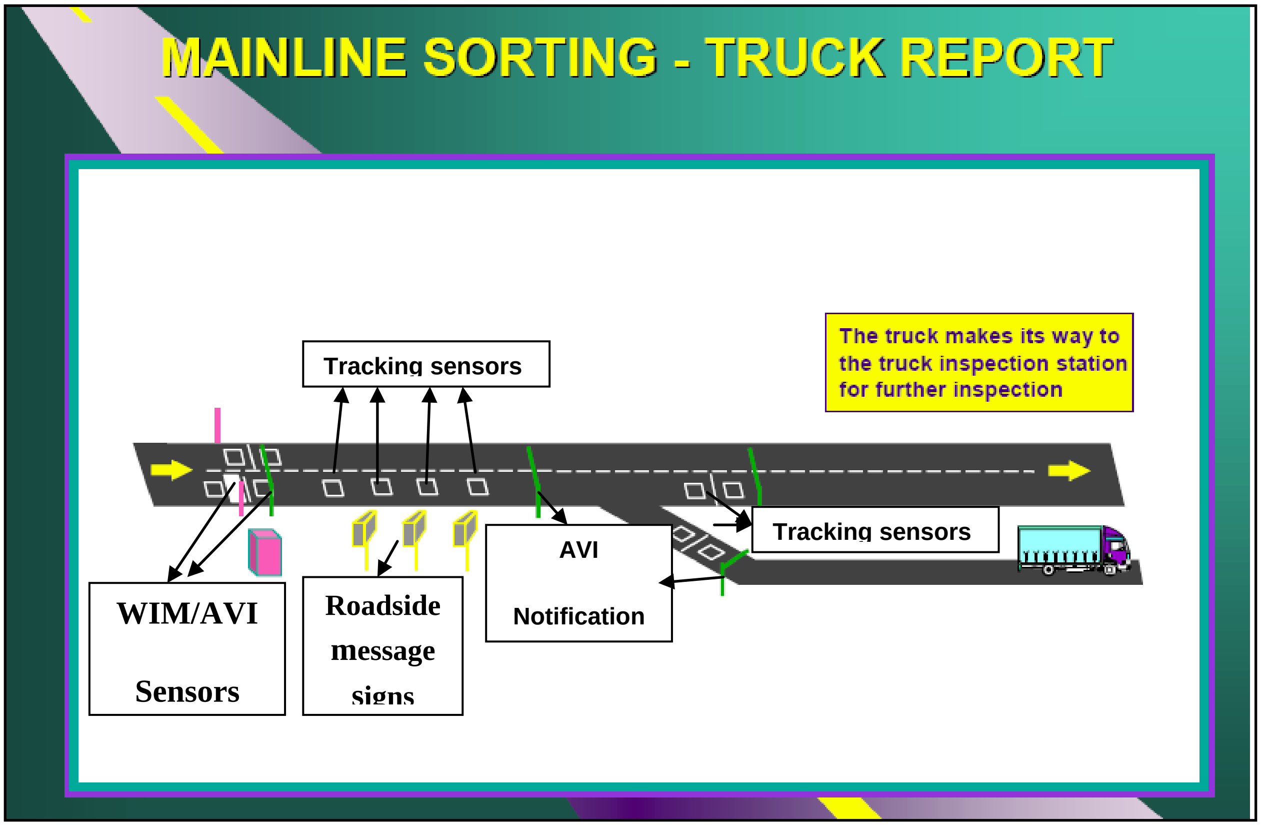

Figure 20
Mainline truck sorting at WIM enforcement stations [*12*]

Since weight data is collected in conjunction with enforcement activity, the state must be careful to ensure that data are not biased measures of actual truck weights. Sometimes, truckers are aware that enforcement is taking place, and many trucks that are over the weight limit will attempt to avoid the weight scales. As a result, data collected may not always be representative of the complete truck population. It should be noted that enforcement site avoidance is not necessarily a problem for all sites. For example, in many western states, there are few or no by-pass routes around port of entry scales. Thus, the scale collects a true measure of the truck and axle weights passing through [*12*].

The other potential problem is that weight data are monitored only on the outermost lane as trucks are required to travel on outermost lane while approaching the enforcement station. But in real conditions, trucks might travel in either of the lanes before approaching the enforcement station. Therefore, axle load data used for design purposes may not be representative of real traffic conditions if the lane distribution factor is not known. To overcome these problems, the enforcement stations should be located where no by-pass routes are available for truckers, and the lane distribution factor should be calculated. Table

14 provides approximate locations of the existing weight enforcement stations; Table 14 illustrates the location of the enforcement stations on a map.

Table 14
Location of WIM enforcement sites in Louisiana

Site No.	Highway	Location	Direction
EN1	I-20	Greenwood, Caddo Parish, LA	East/West
EN2	I-20	Delta, Madison Parish, LA	East/West
EN3	US-71	Pineville, Rapides Parish, LA	North/South
EN4	LA-12	Starks, Calcasieu Parish, LA	East/West
EN5	I-10	Toomey, Calcasieu Parish, LA	East/West
EN6	I-10	Breaux Bridge, St. Martin parish, LA	East/West
EN7	I-55	Kentwood, Tangipahoa parish, LA	North/South
EN8	I-12	Baptist, Tangipahoa Parish, LA	East/West
EN9	I-10	Laplace, St. John Parish, LA	East/West
EN10	US-61	Laplace, St. John Parish, LA	North/South
EN11	I-59	LA/MS Joint port at border	South Bound only
EN12	I-10	LA/MS Joint port at border	West Bound only
EN13	I-10	I-10 West, Slidell, LA	North/South

Figure 21
WIM enforcement stations in Louisiana

Long Term Pavement Performance (LTPP) Data

LTTP is a program that collects and processes data describing the structure, service conditions, and performance of 2,513 pavement test sections in North America to better understand pavement performance [*13*]. Highway engineers use these data and their analyzed results to make decisions that lead to more cost-effective and better performing pavements. The LTPP program was designed as a 20-year Strategic Highway Research Program (SHRP) project in 1987 [*13*].

In Louisiana, a LTPP site having a permanent WIM scale is located along US-171, in the outside north-bound lane near Moss Buff in Calcasieu Parish [*14*]. This site was recently established and is the first permanent WIM site in Louisiana. The existing roadway along the WIM site is asphalt concrete and its lane width is 12 ft. The shoulder is also asphalt concrete with 10 ft. width. The site is instrumented with the Kistler Quartz WIM system [*14*]. This equipment is reliable and automated for data collection that determines vehicle weights and dimensions, classifies vehicles according to a pre-defined set of criteria, and archives vehicle records for future analysis. The layout of the site is shown in Figure 22.

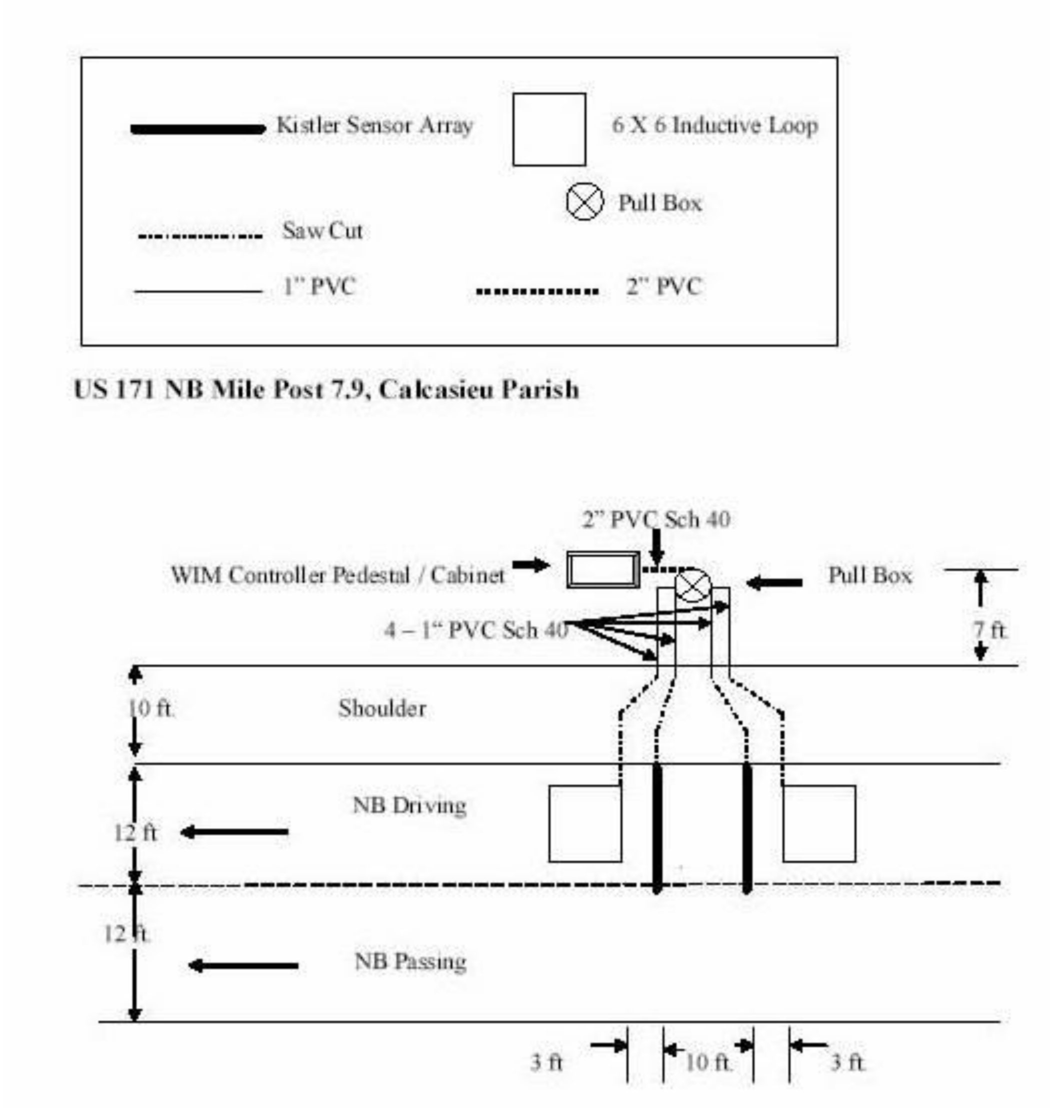

Figure 22
Layout of the LTPP WIM site on US-171 in Louisiana [*14*]

OBJECTIVES

This study primarily addresses the current traffic characterization techniques used in Louisiana for pavement design practices in order to identify critical changes needed, as well as certain gaps and areas of potential development, in the traffic monitoring process statewide. In addition, the study aims to develop Louisiana's traffic load spectra from the available truck traffic data sources (e.g., WIM stations) and to establish Louisiana's load equivalency factor (LEF) tables. The traffic load spectra and LEF tables are required for the current pavement design guide and for possible future implementation of the new pavement design guide. More specifically, the research objectives of this study are to:

1. Review the current practices adopted by Louisiana on traffic data collection within the scope of this study.
2. Develop a strategic plan to improve the current traffic data monitoring program.
3. Evaluate the quality of Louisiana's traffic data.
4. Develop traffic load spectra and update current LEF tables in Louisiana using available traffic data.
5. Make recommendations on future implementation of the Mechanistic-Empirical Pavement Design Guide in Louisiana.

SCOPE

The scope of the study is limited to current practices and the traffic monitoring system within Louisiana. All findings and guidelines are geared towards the needs of LADOTD with the purpose of improving traffic data quality for current and future pavement design practices. Appropriate statistical models and procedures are applied to reveal the main traffic characteristics based on current traffic data sources. A strategic plan is also proposed to improve the quantity and quality of traffic data by adding new as well as utilizing existing weigh-in-motion stations.

METHODOLOGY

The following tasks were carried out to achieve the objectives of this study:

- Reviewing the current practices of traffic data collection*:* This task reviewed in detail the existing traffic practices in Louisiana, the inadequacy in LADOTD traffic data sample, and the reliability issues that need to be addressed. Through this process, the traffic data collection program was understood, and the limitations were identified.
- Evaluating WIM data*:* The quality control tests including the Steering Axle and Gross Vehicle Weight tests were performed to check the consistency of the WIM data captured at WIM stations. This process evaluates the quality of data collected by the portable WIM stations to ensure that only valid traffic data is used to develop axle load spectra and vehicle class distributions. The validation process also helps identify possible calibration problems at the sites that did not pass the validation tests.
- Comparing truck traffic characteristics*:* The truck traffic characteristics were compared with the sum of squared differences method. This process provides WIM stations comprising similar axle load spectra and vehicle classification and reduces the number of permanent WIM sites required.
- Developing axle load spectra: The axle load spectra and vehicle class distribution were developed with the help of existing traffic data that had valid WIM data.
- Updating Load Equivalency Factors (LEF): The load equivalency factors were developed for functional class with the help of the Vehicle Travel Information Systems (VTRIS) program.
- Devising a strategic plan for the WIM data collection program*:* Upon reviewing current practices of the traffic data collection process adopted by LADOTD, the existing and proposed traffic data collection procedures followed by other states, and the axle load spectra, a strategic plan was developed. This is mainly required to improve the traffic data collection process that needs to be enhanced with time and advanced technologies for design and analysis of pavement structures.

Current Practices of Traffic Data Collection by LADOTD

The characteristics of current practices in collecting traffic data were reviewed. This section discusses in detail existing traffic data collection practices in Louisiana, the inadequacy in LADOTD traffic data sample, and the reliability issues that need to be addressed. In Louisiana, LADOTD collects traffic loading data using portable WIM stations. It was observed that there were certain limitations in the current traffic data and in the data collection procedures. A few of these limitations are listed as follows:

- For WIM sites where less than a year of data is collected, the assumption is that the time period measured gives an accurate measurement of weights for the entire year.
- If the weight data collection period is only 24 or 48 hours long, it assumes the weekly and seasonal differences in truck loading patterns do not exist.
- The axle weight data (48 hours sample) is inadequate to compare two sites with axle load distribution factors and to build several truck weight roadway groups of similar characteristics. Due to this, it is also not possible to develop axle load spectra and to characterize traffic loads accurately.
- There has not been any WIM data collected over a continuous period of time. Moreover, since the equipment used to collect short-term data from portable WIM sites was not adequately calibrated, the axle load spectra developed from this data may not be representative of actual Louisiana traffic loadings.
- The portable WIM equipment used in this state have plenty of issues and might give inaccurate readings. This may lead to the use of erroneous data that are required by MEPDG as inputs for design purposes.

Some of the criteria (TMG and MEPDG) not followed by LADOTD data collection processes are described as follows:

- A monitoring period of seven continuous days for portable WIM sites is not followed at any of the WIM sites of Louisiana.
- According to TMG, there should be at least six WIM sites per truck weight roadway group (grouping the roads into categories experiencing similar traffic loading characteristics), and one of them should be a permanent site collecting continuous data. This site should be maintained in a calibrated condition, while the remaining sites can have either short duration counts or additional continuous counts.

The minimum sample size (number of days per year) required to estimate the normalized axle load distribution for WIM, AVC, and vehicle count data is specified in Table 15 through Table 17. According to MEPDG, tables can be used as guidance for selecting the number of days required to collect an adequate amount of data from the traffic population for a specific site with the expected error and level of confidence in the data. The number of days for sampling the traffic was based on analyses of LTPP traffic data using the predominant truck type and load for the site. Based on the minimum sample size suggested by MEPDG, it can be concluded that Louisiana traffic data has significant error and low confidence level in WIM and AVC data. This is summarized in Table 18.

Table 15
Minimum sample size (number of days per year) to estimate the normalized axle load distribution-WIM data (source: NHCRP Report 1-37A)

Expected Error (± Percent)	Level of Confidence or Significance, Percent				
	80	90	95	97.5	99
20	1	1	1	1	1
10	1	1	2	2	3
5	2	3	5	7	10
2	8	19	30	43	61
1	32	74	122	172	242

Table 16
Minimum sample size (number of days per year) to estimate the normalized truck traffic distribution-AVC data (source: NHCRP Report 1-37A)

Expected Error (± Percent)	Level of Confidence or Significance, Percent				
	80	90	95	97.5	99
20	1	1	1	2	2
10	1	2	3	5	6
5	3	8	12	17	24
2	20	45	74	105	148
1	78	180	295	—	—

Table 17
Minimum sample size (number of days per year) to estimate the total vehicles per day and year-AVC or vehicle count data (source: NHCRP Report 1-37A)

Expected Error (± Percent)	Level of Confidence or Significance, Percent				
	80	90	95	97.5	99
20	3	7	12	16	23
10	12	27	45	64	90
5	47	109	179	254	—
2	292	—	—	—	—
1	—	—	—	—	—

— Continuous sampling is required for these conditions.

Table 18
Level of confidence and expected error for current LA traffic data

Data Type	Expected Error (+/– %)	Level of confidence(%)
WIM data	5-10	80-97.5
AVC data	10-20	90-99
AVC or Volume count data	N/A	N/A

Evaluation of WIM Data

As mentioned earlier, WSDOT and ARDOT performed two quality control tests to check the consistency of WIM data monitored at WIM stations. In Louisiana, all portable WIM sites employed from 2004 through 2006 were evaluated in this study. Traffic weight data was captured at 96 portable WIM stations within these three years. The number of vehicles passing each site was not included as a factor for eliminating WIM sites since LADOTD collects only two days worth of WIM data and might have recorded less or more trucks within that 48 hours. Only the sites passing these two tests were included for the development of axle load spectra and other inputs required by MEPDG. The following are the two quality control checks.

Steering Axle Load Test

In this test, the front axle or the steering axle weights of class 9 trucks with respect to the number of trucks was analyzed. This was performed by checking if the steering axle weights monitored at each portable site falls within the range of 8,000 lb. to 12,000 lb. The distribution of front axle weights for class 9 trucks at selected sites is used for illustration here. In Figure 23, most of the steering axle loads measured at site 38 fall well within the practical range of 8,000 lb. to 12,000 lb. Based on this test, the portable WIM scale at this site appears to function properly; therefore, the data may be used to develop the axle load spectra and other general factors at this WIM station. Similarly, for sites 168 and 67, the highest frequencies of front axle weights fall within the same range of 8,000 lb. -12,000 lb. as shown in Figure 24 and Figure 25. These data from these two sites also coincide with the acceptable steering axle trend characterized by LTPP and FHWA.

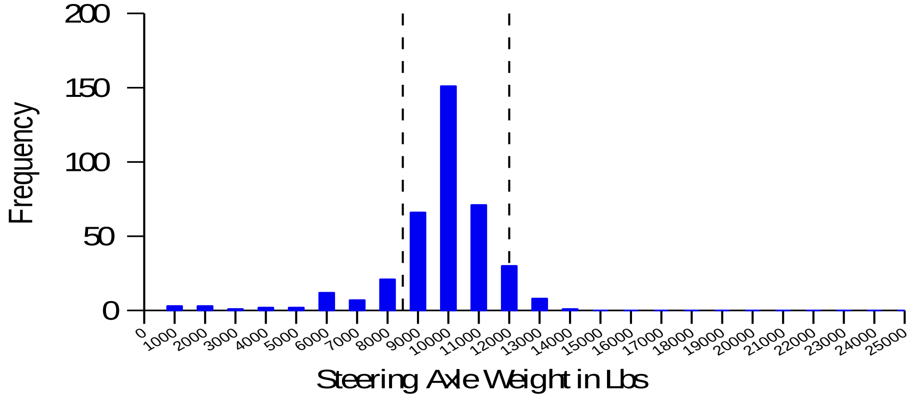

Figure 23
Steering axle weight (class 9 vehicle) versus frequency for site 38

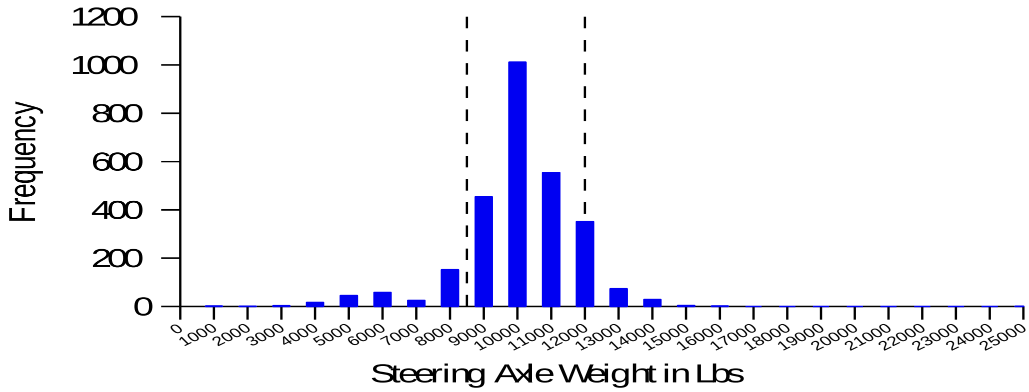

Figure 24
Steering axle weight (class 9 vehicle) versus frequency for site 168

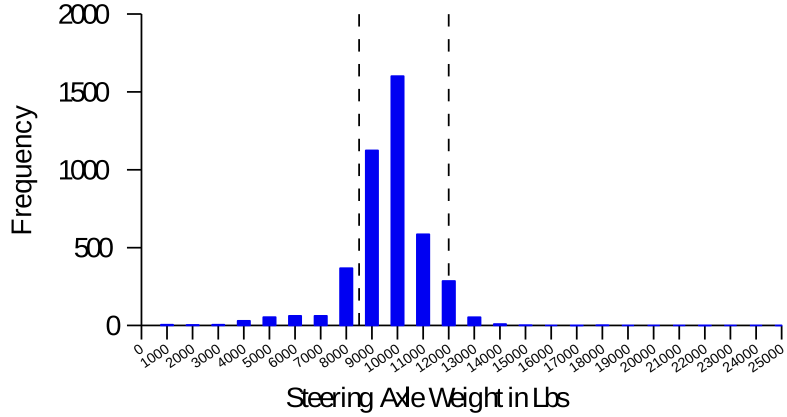

Figure 25
Steering axle weight (class 9 vehicle) versus frequency for site 67

Another example that shows sites failing to pass the steering axle load test is depicted in Figure 26 and Figure 27. The front axle load distribution for two sites (53 and 112) clearly shows that the high frequencies of observations fall outside the practical range of 8,000 lb.-12,000 lb. For site 53, most observations appear to exceed the maximum practical limit of 12,000 lb. (only 20.48 percent within practical range), while for site 112, most observations fall below the minimum practical limit of 8,000 lb. (only 6.32 percent within practical range). In either case, this implies a calibration problem that resulted in underestimating or overestimating the front axle loads. For the purpose of screening the portable WIM data for development of axle load spectra, a threshold of 60 percent was arbitrarily selected for the steering axle weight test. This implies that at least 60 percent of the front axle load observations must fall within the practical range of 80,000 lb. to 12,000 lb. for the site to pass this test.

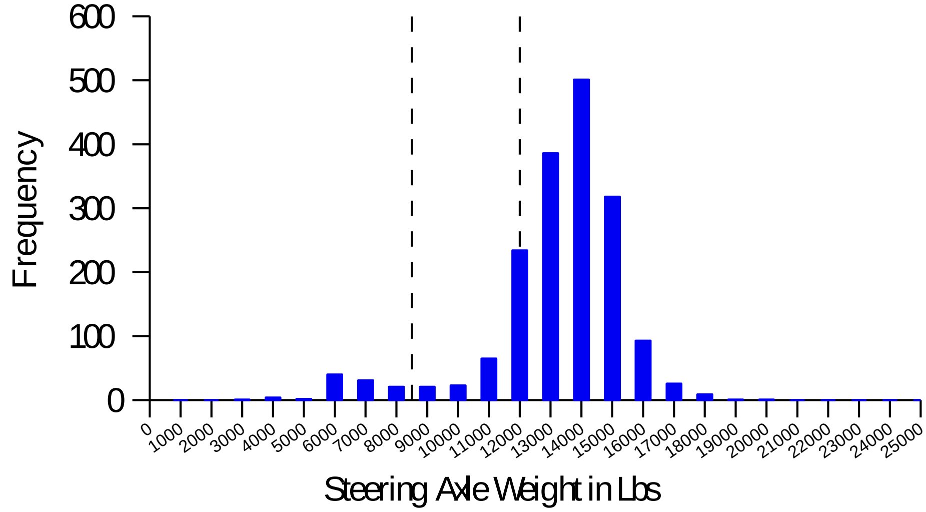

Figure 26
Steering axle weight (class 9 vehicle) versus frequency for site 53

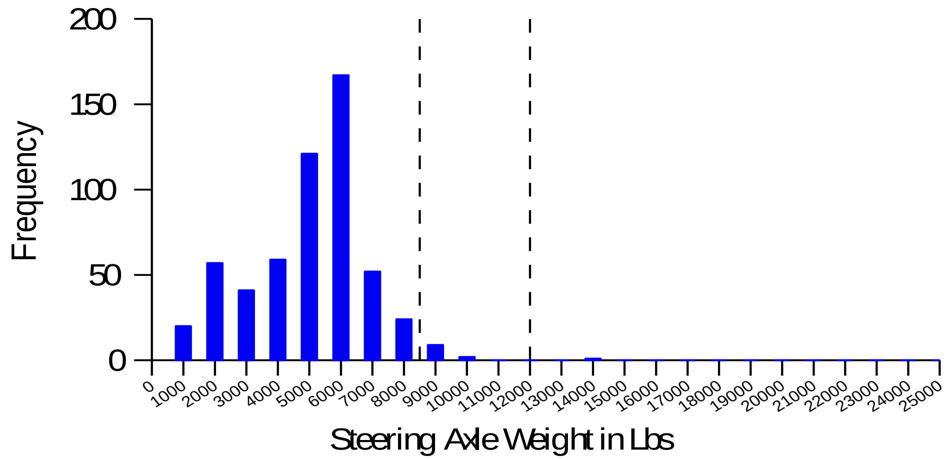

Figure 27
Steering axle weight (class 9 vehicle) versus frequency for site 112

Gross Vehicle Weight Test

In this test, the gross vehicle weight of class 9 trucks is verified by comparing it to the practical range of 28,000 lb. to 36,000 lb. (if unloaded) or 72,000 lb. to 80,000 lb. (if loaded). To demonstrate how this test can be applied, gross vehicle weights for class 9 trucks at selected sites are examined in this section. Figure 28 and Figure 29 show the gross weight distribution for class 9 at sites 67 and 107. The figures show that the majority of weight observations fall between 30,000 lb. and 80,000 lb., while exhibiting two peaks in the neighborhood of the unloaded and loaded weight limits. This is because the majority of trucks travel either fully loaded (up to the federal limit) or fully unloaded (after shipment delivery).

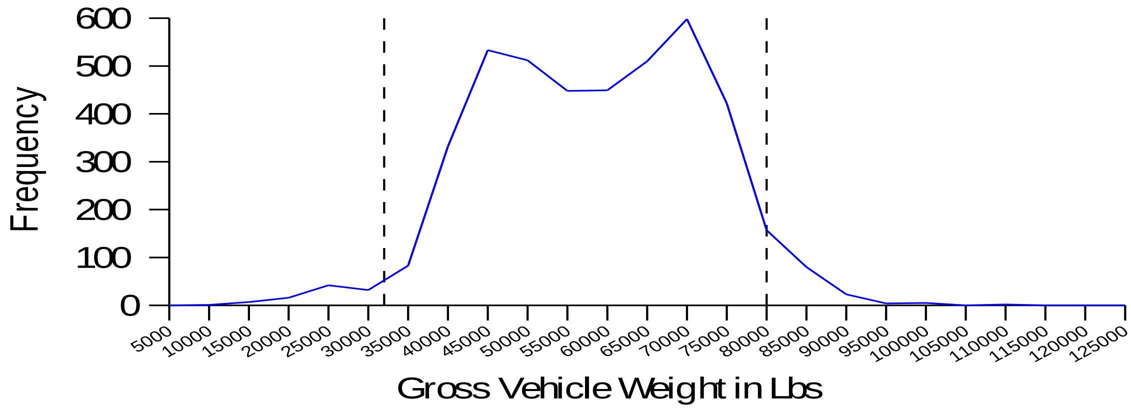

Figure 28
Gross vehicle weights (class 9 vehicle) versus number of trucks for site 67

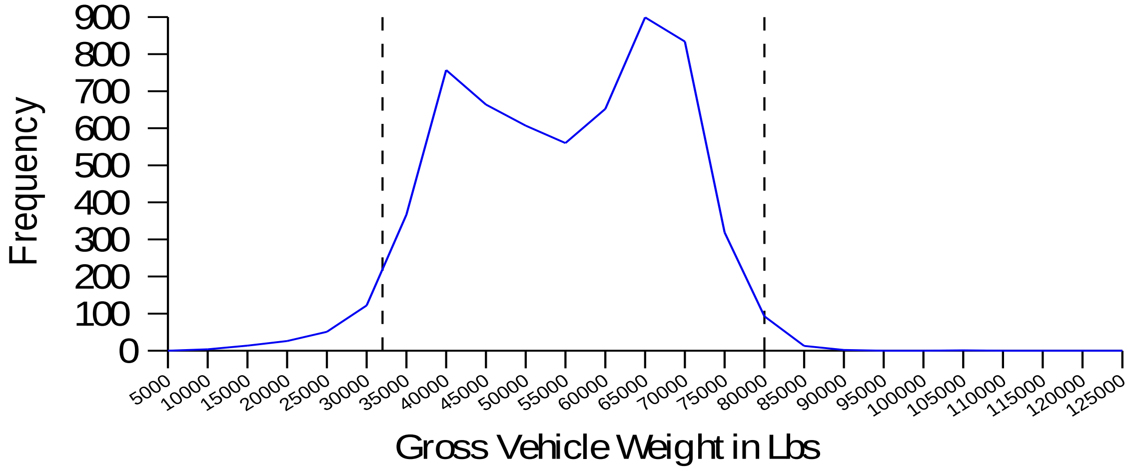

Figure 29
Gross vehicle weights (class 9 vehicle) versus number of trucks for site 107

Another example of the two-peak characteristics of gross vehicle weight distribution is shown in Figure 30 and Figure 31. The figures show the distribution for class 9 trucks at sites 30 and 20. Unlike the previous two sites, the weight distributions at these two sites show the two peaks to exceed both unloaded and loaded weight limits. This observation may be attributed to the lack of calibration of the scales, which may have resulted in overestimating the gross vehicle weights. In this study, sites that exhibited similar characteristics were eliminated from the data because of potential calibration issues. In order for the weight distribution to pass this test, both peaks must be observed in the vicinity of the unloaded and loaded weight limits, and at least 60 percent of the observations must fall within those limits.

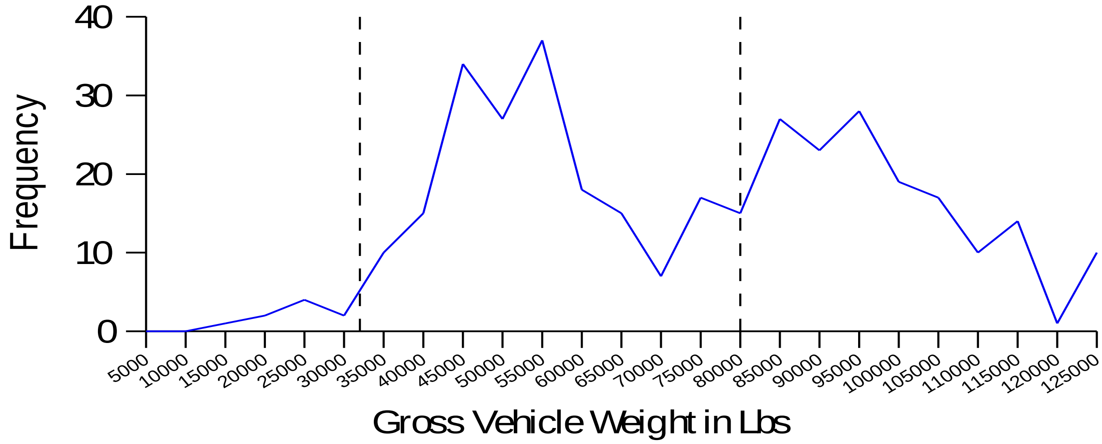

Figure 30
Gross vehicle weights (class 9 vehicle) versus number of trucks for site 30

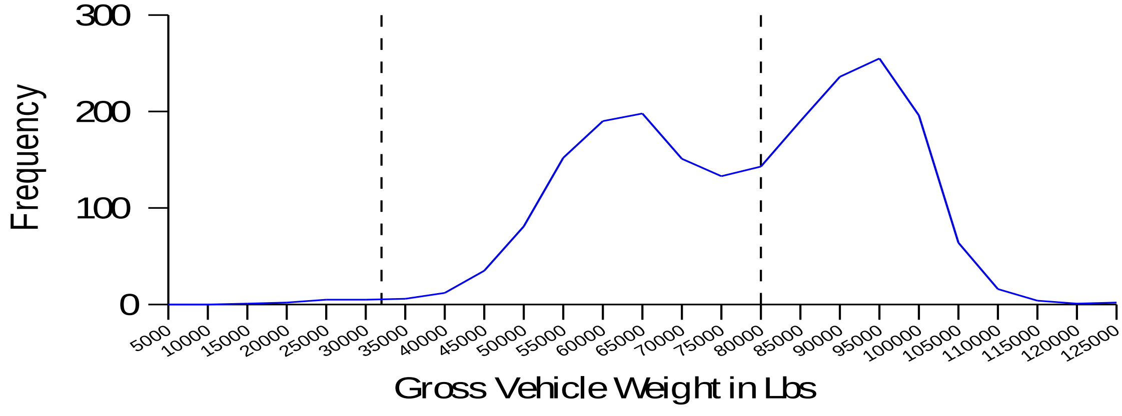

Figure 31
Gross vehicle weights (class 9 vehicle) versus number of trucks for site 20

The previous two tests were applied to all sites; the sites that passed both tests are listed in Table 19 with respect to the roadway functional class. Out of the 96 portable WIM stations, 51 sites passed both tests; therefore, WIM data from those sites were further used to develop axle load spectra for each functional class.

Table 19
WIM sites passing steering axle and gross vehicle tests

FUNCTIONAL CLASS	SITE NUMBER
1	21 , 49, 67, 102, 105, 106, 107, 109, 111, 150, 154, 155, 156, 162, 168
2	16, 22, 25, 32, 33, 38, 50, 77, 123
6	41, 45, 127
7	14, 31, 57, 59, 108, 133, 135, 142, 144, 148, 153, 171
11	24, 65, 157
14	18, 51, 64, 124, 138, 139
16	27, 163
17	68

Comparison of Truck Traffic Characteristics

In order to reduce the number of required permanent WIM sites, truck traffic characteristics at the portable WIM sites were compared for similarity. One of the commonly used procedures to compare vehicle class distributions is the sum of squared differences method. Figure 32 shows an example of two vehicle class distributions observed at two different sites. This does not include any calculated results and is for an illustration purpose only. The two distributions appear to be similar. However, in order to quantify the proximity of the two distributions, the sum of squared differences method is applied. This is done by squaring the differences between the two distributions at all points along the x-axis and then summing them all. This summed value is an indication of the degree of proximity of the two distributions. Smaller values imply close proximity. The sum of squared differences between two distributions can be calculated using the following equation:

$$S = \sum_{i=1}^{n} (x_i - y_i)^2 \quad (5)$$

where,
S = Sum of squared differences between the two distribution curves,
x_i = Observed frequency of vehicle class i for site 1, and
y_i = Observed frequency of vehicle class i for site 2.

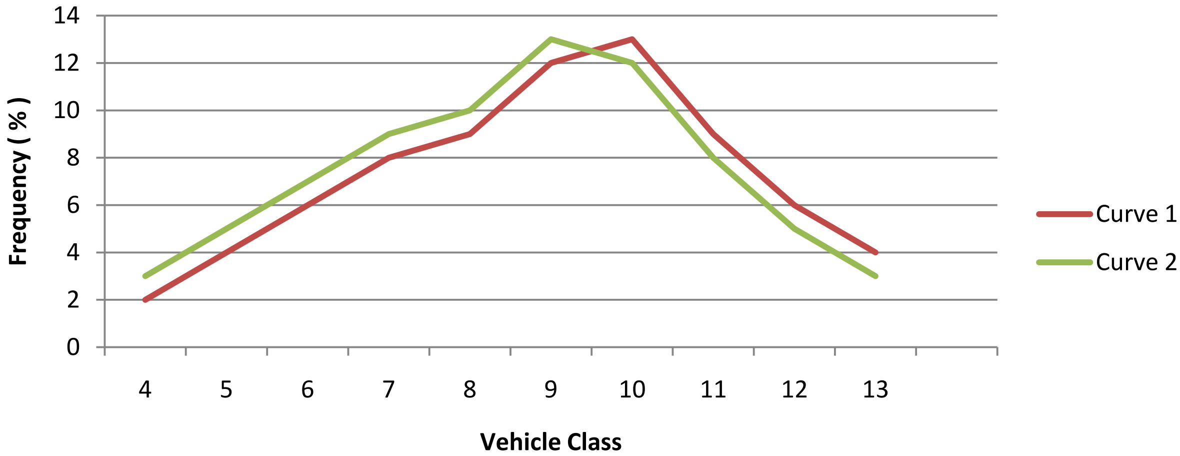

Figure 32
Illustration of the sum of squared differences method

Figure 33 illustrates two single axle load distributions observed at sites 16 and 65. Table 20 demonstrates the procedure to calculate the sum of squared differences between two portable WIM single load spectra. This difference showed the proximity between the two axle load spectra and assisted in grouping portable WIM sites into different categories. This comparison between axle load spectra and grouping WIM sites are discussed further in this section.

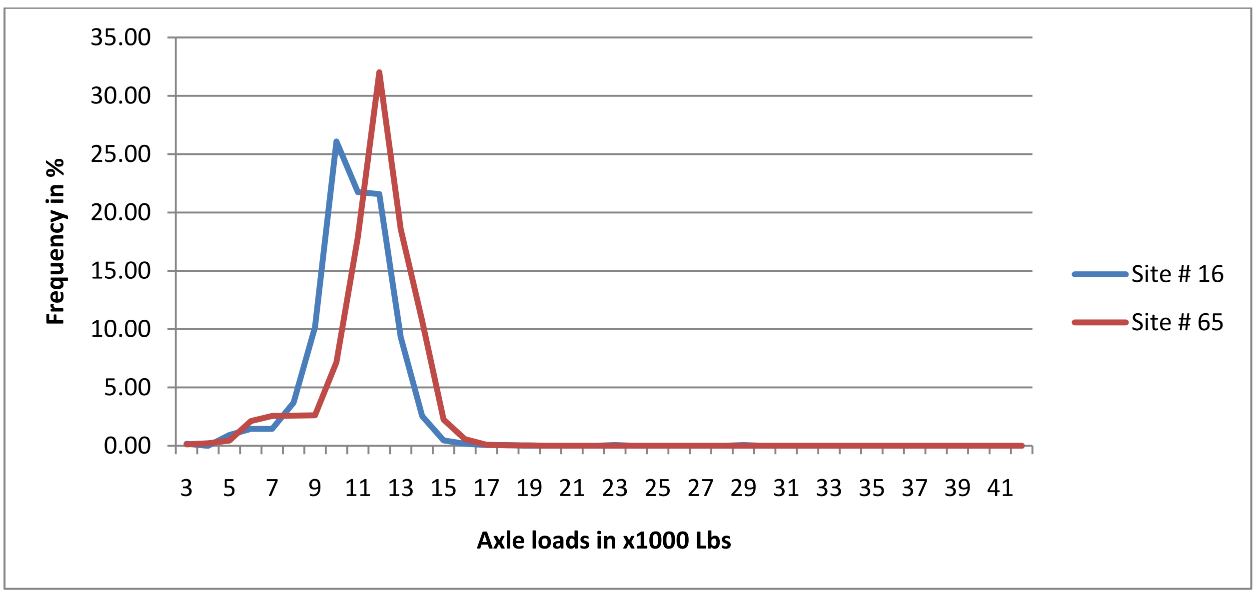

Figure 33
Comparison of two portable sites with sum of squared differences method

Table 20
Comparison of portable WIM sites for class 9 vehicles

Load Group in Lb.	Site 16	In % (A)	Site 65	In % (B)	C= SQRT(ABS(A-B))
3000	3	0.17	7	0.12	0.23
4000	0	0.00	13	0.22	0.47
5000	16	0.93	26	0.44	0.70
6000	25	1.45	125	2.12	0.82
7000	25	1.45	151	2.56	1.06
8000	64	3.70	152	2.58	1.06
9000	176	10.18	154	2.62	2.75
10000	451	26.08	422	7.17	4.35
11000	376	21.75	1053	17.89	1.96
12000	373	21.57	1885	32.02	3.23
13000	161	9.31	1093	18.57	3.04
14000	44	2.54	631	10.72	2.86
15000	8	0.46	132	2.24	1.33
16000	3	0.17	34	0.58	0.64
17000	1	0.06	5	0.08	0.16
18000	1	0.06	2	0.03	0.15
19000	0	0.00	2	0.03	0.18
20000	0	0.00	0	0.00	0.00
21000	0	0.00	0	0.00	0.00
22000	0	0.00	0	0.00	0.00
23000	1	0.06	0	0.00	0.24
24000	0	0.00	0	0.00	0.00
25000	0	0.00	0	0.00	0.00
26000	0	0.00	0	0.00	0.00
27000	0	0.00	0	0.00	0.00
28000	0	0.00	0	0.00	0.00
29000	1	0.06	0	0.00	0.24
30000	0	0.00	0	0.00	0.00
31000	0	0.00	0	0.00	0.00
32000	0	0.00	0	0.00	0.00
33000	0	0.00	0	0.00	0.00
34000	0	0.00	0	0.00	0.00
35000	0	0.00	0	0.00	0.00
36000	0	0.00	0	0.00	0.00
37000	0	0.00	0	0.00	0.00
38000	0	0.00	0	0.00	0.00
39000	0	0.00	0	0.00	0.00
40000	0	0.00	0	0.00	0.00
41000	0	0.00	0	0.00	0.00
42000	0	0.00	0	0.00	0.00
Total	1729	100.00	5887	100.00	**25.49**

Testing Similar Single Axle Load Spectra and Vehicle Class Distributions

All WIM sites passing steering and GVW tests were included in the analysis. Since the dominant vehicle class at some of the WIM sites may be different, which would result in different axle load spectra, these WIM sites were separated into different categories. WIM sites were categorized for vehicle class 9, class 5, and class 6. Figure 34 illustrates the single axle load spectra for sites having vehicle class 9 as their dominant vehicle type. It can be observed that the single axle load spectra are completely different for different sites. These sites were checked with the sum of the squared differences method to determine similar axle load spectra. This resulted in seven groups for vehicle class 9. Table 21 lists the WIM sites in groups that were similar in single axle load spectra under the vehicle class 9 category.

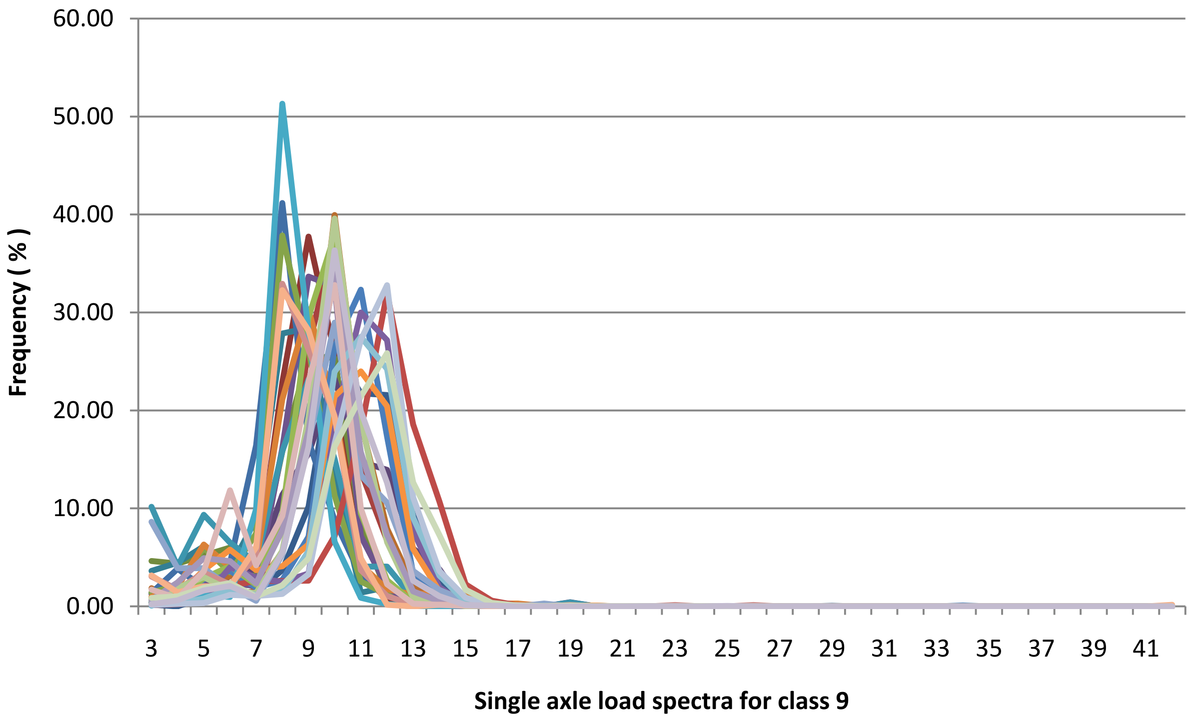

Figure 34
Single axle load spectra for sites having dominant class 9 vehicles

Table 21
WIM sites grouped by similar single axle load spectra

Group # under class 9	WIM site #
Group 1	139, 163, 33
Group 2	154, 156, 38, 67, 168, 102, 155
Group 3	150, 106
Group 4	16, 162
Group 5	77,123
Group 6	22, 108
Group 7	49, 105

Figure 35 illustrates single axle load spectra for WIM sites within Group 1 that were similar to each other. These WIM sites were again evaluated to check the similarity in vehicle class distribution. Figure 36 illustrates the vehicle class distribution for WIM sites within Group 1. There is a minor difference in the percentage of trucks, but the trend appears to agree with each other. Likewise, Figure 37 and Figure 38 illustrate single axle load spectra for WIM sites within Group 2 and their vehicle class distributions, respectively. It can be observed that these sites have good agreement with each other with a slight variance. Similarly, groups under vehicle classes 5 and 6 were categorized and are shown in Table 22.

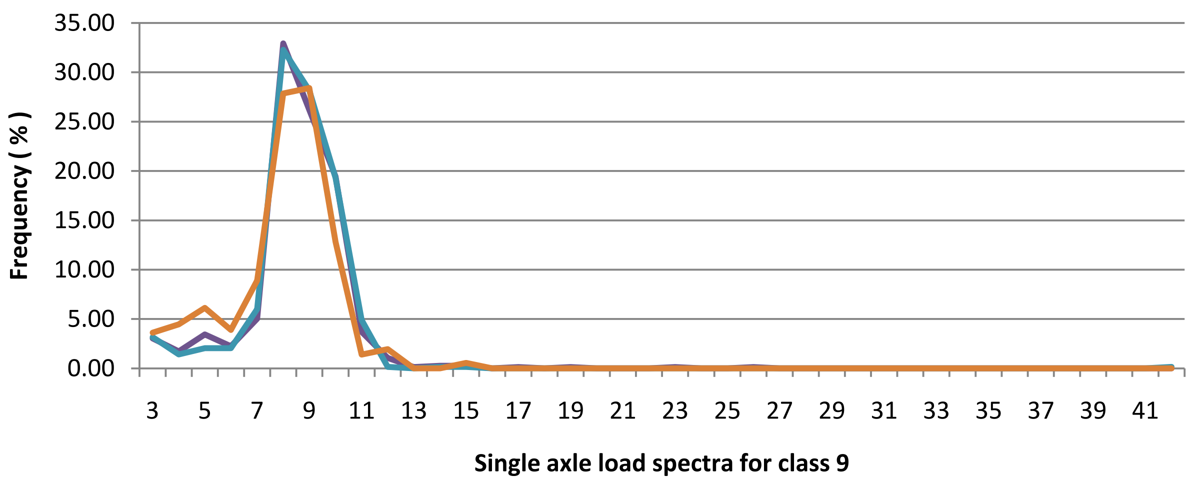

Figure 35
Group 1 single axle load spectra for class 9

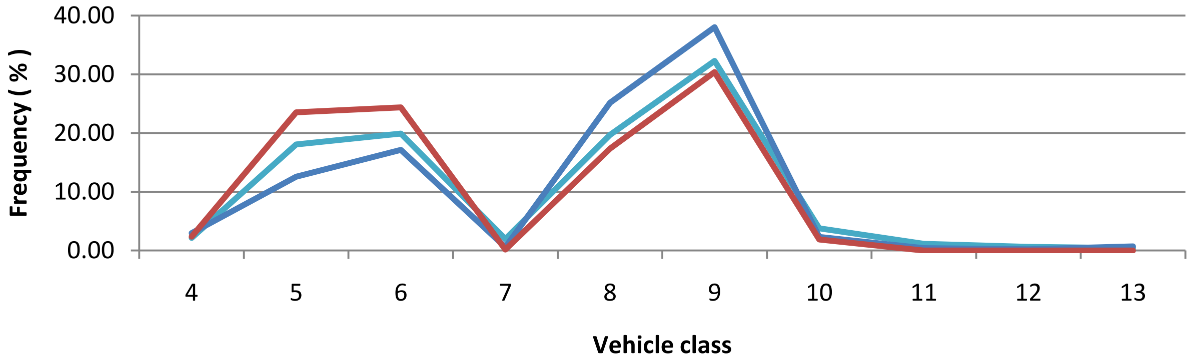

Figure 36
Vehicle class distributions for Group 1

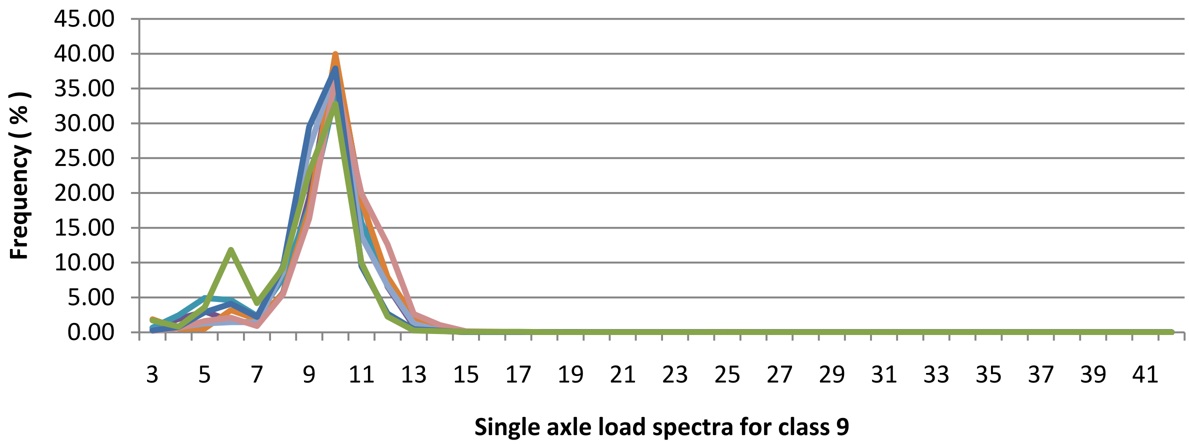

Figure 37
Group 2 single axle load spectra for class 9

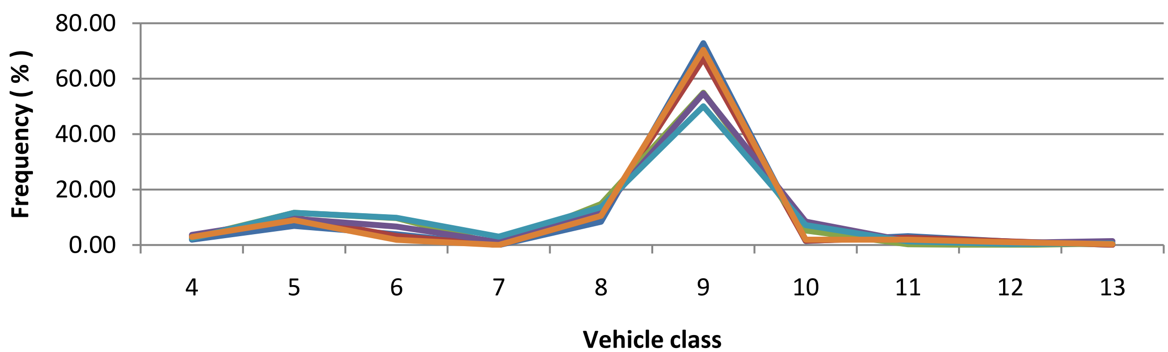

Figure 38
Vehicle class distributions for Group 2

Table 22
WIM sites having similar single axle load spectra for classes 5 and 6

Grouping for class 5	**WIM site #**
Group 8	133, 124
Group 9	24, 148, 144
Group 10	14, 27, 50
Grouping for class 6	**WIM site #**
Group 11	59, 135
Group 12	138, 31

These grouped sites were checked against permanent WIM sites proposed in the strategic plan. This was performed to see if two or more of the newly proposed permanent WIM sites are located in close proximity to existing portable WIM sites with similar truck traffic characteristics. This could possibly reduce the number of newly proposed WIM sites. Table 23 lists the proposed permanent WIM sites located in close proximity to existing portable WIM sites within each group. Based on similar truck traffic characteristics of each group, only one permanent WIM station in the vicinity of that group could be used. For instance in Group 2, there were five permanent WIM stations proposed next to the portable sites belonging to that group. As such, only one of the five proposed WIM stations should be installed, while keeping the other portable WIM sites to supplement additional WIM data for the axle load spectra development. For Group 3, however, there was only one permanent WIM station (PMI 4) proposed close to site 150. Therefore, it is proposed to keep PMI 4 in addition to both portable sites 150 and 106. In some groups, there were no proposed permanent sites located close to the existing portable WIM sites; therefore, these existing portable sites should be operated as practiced. Permanent WIM sites that are not listed in Table 23 are assumed to have distinctive truck traffic characteristics and are still required. The next section of the report provides an implementation plan that LADOTD can follow.

Table 23
WIM sites in close proximity to proposed permanent WIM sites

Grouping for class 9	WIM site	Proposed WIM site
Group 1	139, 163, 33	PMA 7 is next to 139
Group 2	154, 156, 38, 67, 168, 102, 155	PMI 2 is next to 154 PMI 7 is next to 156 PMI 14 is next to 67 PMI 15 is next to 168 PMI 11 is next to 102
Group 3	150, 106	PMI 4 is next to 150
Group 4	16, 162	PMA 2 is next to 16
Group 5	77,123	PMA 1 is next to 123
Group 6	22, 108	N/A
Group 7	49, 105	N/A
Grouping for class 5	**WIM site**	**Proposed WIM site**
Group 8	133, 124	N/A
Group 9	24, 148, 144	N/A
Group 10	14, 27, 50	N/A
Grouping for class 6	**WIM site**	**Proposed WIM site**
Group 11	59, 135	N/A
Group 12	138, 31	N/A

DISCUSSION OF RESULTS

In this section, axle load spectra and vehicle class distributions based on truck traffic classification groups were developed with the help of existing traffic data that had valid WIM data. Vehicle class distributions based on roadway functional class and load equivalency factors with the help of Vehicle Travel Information Systems (VTRIS) data were also developed.

Vehicle Class Distribution for Functional Class

Vehicle class distributions within the same functional class may or may not have similar distributions over time. Therefore, this analysis is required to understand the vehicle class distributions when WIM stations are grouped by functional class. Figure 39 illustrates the vehicle class distribution for 15 WIM sites that were monitored on Functional Class 1 (Principal Arterial-Interstate Rural). It can be observed that the vehicle class distribution is relatively consistent for all 15 sites with vehicle class 9 (trucks) being the dominant class. However, there is a slight variability in percentage of trucks for vehicle classes 5, 9, and 11. Figure 40 illustrates the vehicle class distribution for nine WIM sites that were monitored for Functional Class 2 (Principal Arterial-Other Rural). It can be observed that, all nine WIM sites reveal dissimilar vehicle class distributions with significant variability. Vehicle classes 5, 6, 8, and 9 appear to be more dominant among all classes, with 9 being the most dominant class.

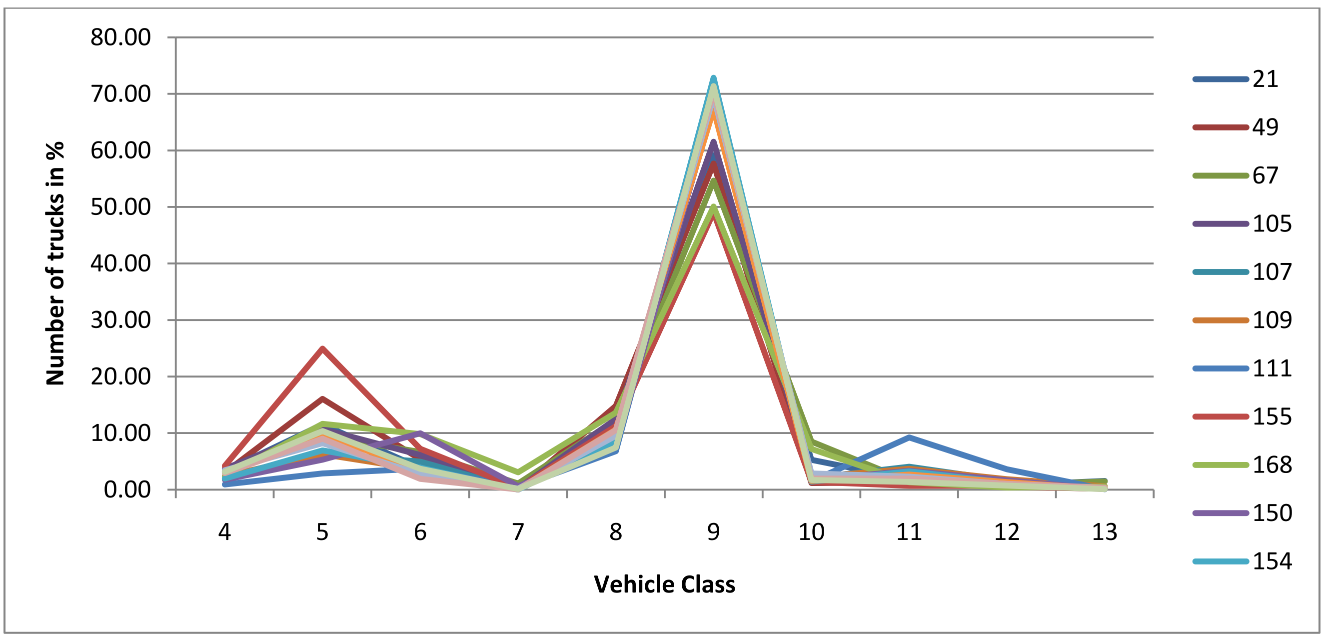

Figure 39
Vehicle class distribution for functional class 1

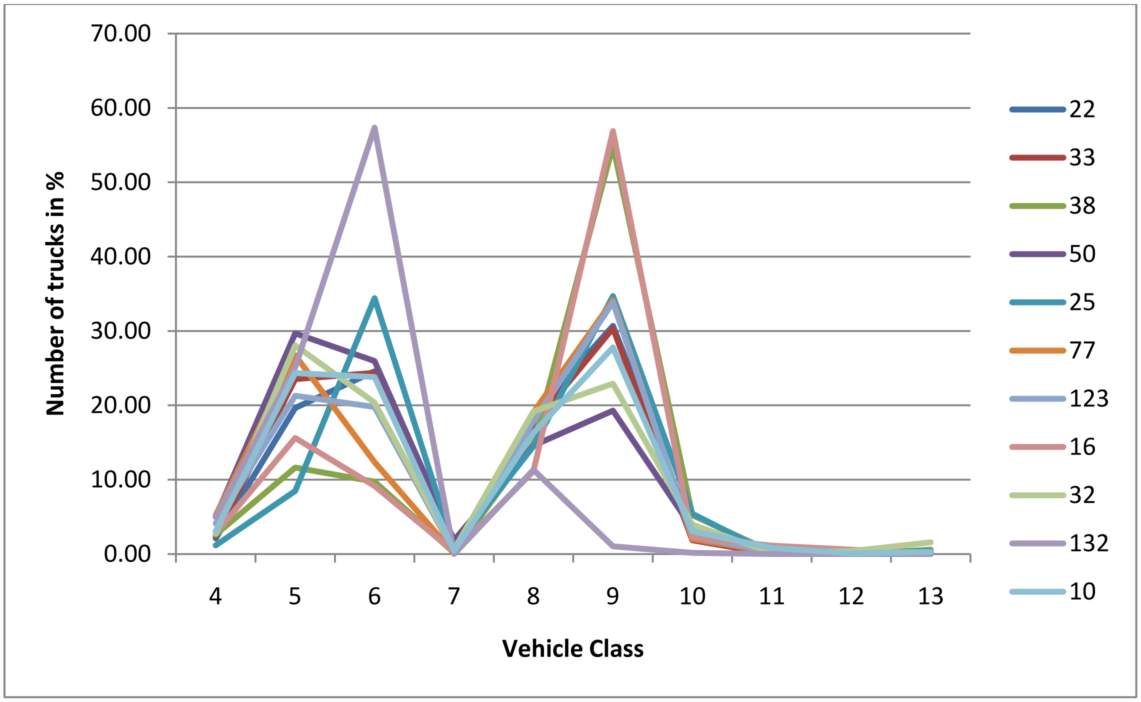

Figure 40
Vehicle class distribution for functional class 2

Figure 41 illustrates the vehicle class distribution for three WIM sites that were monitored on functional class 6 (Minor Arterial-Rural). It can be observed that all three WIM sites demonstrate dissimilar vehicle class distributions with significant variability. There is no evidence of the dominant class; however, within this functional class, it has a mixed traffic composition with vehicle classes 5, 6, 8, and 9. From all these analyses, it can be observed that there exists significant variability in vehicle class distribution within the same functional classification (except functional class 1). Therefore, it is not recommended to group highways based on their functional classification for developing axle load spectra. The vehicle class distributions for the other functional class have been illustrated in the appendix.

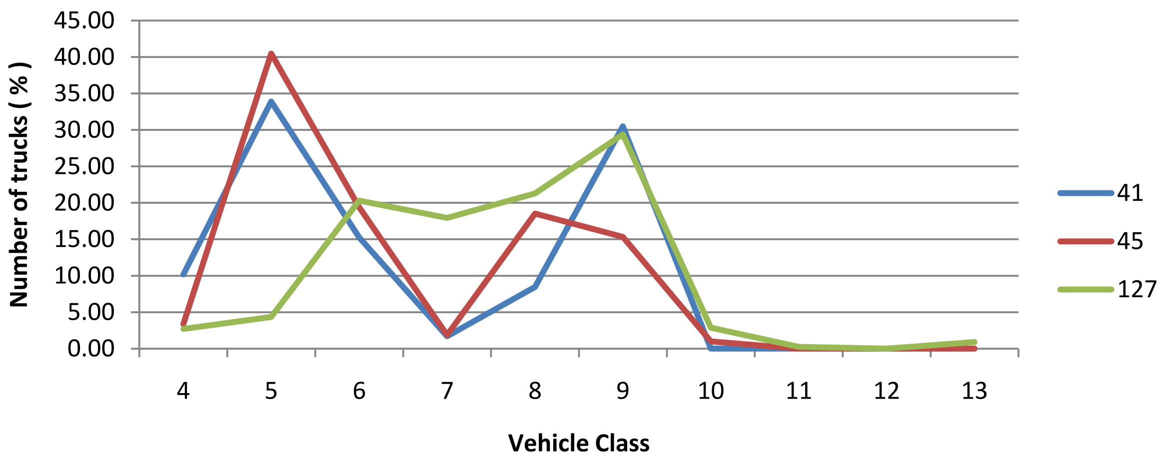

Figure 41
Vehicle class distribution for functional class 6

Truck Traffic Classification Groups

A previous analysis showed that there exists a significant variation in truck distribution for highways within the same functional classification. Therefore, functional class grouping is not recommended for developing axle load spectra and other inputs required by MEPDG. Truck traffic classification (TTC) group system is a new method recommended by MEPDG to group highways, which is a function of the normalized VC distribution for FHWA classes 4 through 13 [*1*]. Table 24 lists the 17 TTC groups developed on the basis of buses, single-unit trucks, single-trailer trucks, and multi-trailer trucks.

Table 25 defines the relationship between roadway functional class and TTC. This table explains the functional class that is applicable under different TTC groups. Table 26 is the criterion table followed to classify and group the sites into different TTC groups.

Table 24
General truck traffic classification descriptions (source: NHCRP Report 1-37A)

TTC	Description
1	Major Single-Trailer Route (Type I)
2	Major Single-Trailer Route (Type II)
3	Major Single and Multi-Trailer Truck Route (Type I)
4	Major Single-Trailer Truck Route (Type III)
5	Major Single and Multi-Trailer Truck Route (Type II)
6	Intermediate Light and Single-Trailer Truck Route (Type I)
7	Major Mixed Truck Route (Type I)
8	Major Multi-Trailer Truck Route (Type I)
9	Intermediate Light and Single-Trailer Truck Route (Type II)
10	Major Mixed Truck Route (Type II)
11	Major Multi-Trailer Truck Route (Type II)
12	Intermediate Light and Single-Trailer Truck Route (Type III)
13	Major Mixed Truck Route (Type III)
14	Major Light Truck Route (Type I)
15	Major Light Truck Route (Type II)
16	Major Light and Multi-Trailer Truck Route
17	Major Bus Route

Table 25
Functional classification and TTC relationship (source: NHCRP Report 1-37A)

Highway Functional Classification Descriptions	Suggested Traffic Classification Number
Principal Arteries – Interstate and Defense Routes	1,2,3,4,5,8,11,13
Principal Arteries – Intrastate Routes, including Freeways and Expressways	1,2,3,4,6,7,8,9,10,11,12,14,16
Minor Arteries	4,6,8,9,10,11,12,15,16,17
Major Collectors	6,9,.12,14,15,17
Minor Collectors	9,12,14,17
Local Routes and Streets	9,12,14,17

Table 26
Truck traffic classification group criteria (source: NHCRP Report 1-37A)

Buses in Traffic Stream	Commodities being Transported by Type of Truck		TTC
	Multi-Trailer	Single-Trailers & Single-Units	
Low to None (<2%)	Relatively High Amount of Multi-Trailer Trucks (>10%)	Predominantly single-trailer trucks	5
		High percentage of single-trailer trucks, but some single-unit trucks	8
		Mixed truck traffic with a higher percentage of single-trailer trucks	11
		Mixed truck traffic with about equal percentages of single-unit and single-trailer trucks	13
		Predominantly single-unit trucks	16
	Moderate Amount of Multi-Trailer Trucks (2-10%)	Predominantly single-trailer trucks	3
		Mixed truck traffic with a higher percentage of single-trailer trucks	7
		Mixed truck traffic with about equal percentages of single-unit and single-trailer trucks	10
		Predominantly single-unit trucks	15
Low to Moderate (>2%)	Low to None (<2%)	Predominantly single-trailer trucks	1
		Predominantly single-trailer trucks, but with a low percentage of single-unit trucks	2
		Predominantly single-trailer trucks with a low to moderate amount of single-unit trucks	4
		Mixed truck traffic with a higher percentage of single-trailer trucks	6
		Mixed truck traffic with about equal percentages of single-unit and single-trailer trucks	9
		Mixed truck traffic with a higher percentage of single-unit trucks	12
		Predominantly single-unit trucks	14
Major Bus Route (>25%)	Low to None (<2%)	Mixed truck traffic with about equal single-unit and single-trailer trucks	17

The valid WIM data passing quality control tests were utilized and truck class distributions (i.e., the number of trucks vs. frequency) were developed for each WIM site. These truck class distributions were further categorized to buses only, single unit trucks, single trailer trucks, single unit + single trailer trucks, and multiple-trailers trucks. With the help of Table 26, the truck traffic classification grouping criteria, each portable WIM site was assigned a TTC group, which represents a traffic stream with unique truck traffic characteristics. This method of grouping is recommended by MEPDG and present level 3 output.

Based on TTC grouping, all the WIM sites were classified and are listed in Table 27. WIM sites were classified into eight groups, including TTC 1, TTC 3, TTC 4, TTC 5, TTC 6, TTC 9, TTC 12, and TTC 14. The majority of WIM sites were classified as TTC 12, which are intermediate light and single trailer truck routes. These sites encompass low to moderate level of buses but low to none multi-trailer trucks. Most interstates were classified into TTC 1 and TTC 3 groups. The WIM sites in both the groups encompass predominantly single-trailer trucks. The only difference is that TTC 1 has low to none percentage of buses and moderate amount of multi-trailer trucks. On the other hand, TTC 3 has low to moderate amount of buses and low to none percentage of multi-trailer trucks. Likewise, WIM sites are classified into TTC 4, TTC 5, TTC 6, TTC 9, and TTC 14 with a fewer number of sites within a group, comprising of unique traffic characteristics.

Vehicle Class Distribution for TTC Groups

The vehicle class distribution for each developed TTC group was examined. Figure 42 illustrates vehicle class distribution for the TTC 1 group and appears to have good consistency within the sites. Figure 43 illustrates vehicle class distribution for the TTC 3 group and has excellent agreement within the sites. Other TTC groups, 4, 5, 6, 9, 12, and 14, with vehicle class distributions have been illustrated in the Appendix. The other sites have a slight variation within each TTC group but otherwise appear to have good agreement. The vehicle class distribution for TTC groups was compared with the default TTC group distribution and can be seen in Figure 42 and Figure 43. All TTC groups have a good agreement and follow default values well. This shows that the TTC method offers a superior way to group sites when compared to functional class grouping. Vehicle class distribution for all TTC groups is summarized in Table 28.

Table 27
Truck traffic classification grouping for WIM sites

Year	Site #	Functional Class	Buses	Single Unit	Single Trailer	Single Unit + Single Trailer	Multiple-Trailers	TTC Group
			VC 4	VC 5-7	VC 8-10	VC 5-10	VC 11-13	
2004	14	7	2.06	66.36	31.58	97.94	0.00	12
	16	2	2.80	25.07	70.32	95.39	1.81	4
	24	11	5.05	60.64	34.01	94.65	0.30	12
	32	2	2.77	49.01	46.05	95.06	2.17	9
	65	11	2.33	17.63	75.84	93.47	4.21	3
	102	1	2.92	10.91	82.85	93.76	3.32	3
	106	1	3.15	14.14	80.54	94.69	2.16	1
	127	6	2.70	42.59	53.56	96.15	1.15	6
	133	7	6.40	54.08	39.04	93.12	0.48	12
	138	14	1.16	73.87	24.98	98.84	0.00	14
	139	14	2.96	30.24	65.49	95.73	1.31	4
	142	7	3.98	62.69	32.95	95.64	0.38	12
	148	7	1.82	72.87	25.10	97.98	0.20	14
	153	7	19.58	59.79	20.28	80.07	0.35	12
	154	1	1.96	10.82	82.64	93.46	4.58	3
	156	1	3.21	13.25	79.45	92.69	4.10	3
	162	1	3.43	11.13	81.93	93.07	3.50	3
	163	16	2.15	39.92	55.78	95.70	2.15	6
	171	7	8.28	68.05	23.67	91.72	0.00	12
2005	18	14	7.18	62.65	30.00	92.65	0.17	12
	25	2	1.17	43.78	54.61	98.39	0.44	6
	27	16	4.07	59.03	36.58	95.61	0.32	12
	31	7	13.88	54.55	31.58	86.12	0.00	12
	57	7	2.51	62.27	34.96	97.23	0.26	12
	59	7	1.58	75.69	22.53	98.22	0.20	14
	64	14	2.66	46.98	49.16	96.15	1.19	9
	77	2	5.21	39.16	55.22	94.38	0.41	6
	123	2	4.10	41.38	54.05	95.43	0.47	6
	135	7	3.21	79.94	16.85	96.79	0.00	14
	144	7	3.97	77.83	18.20	96.03	0.00	14
	150	1	1.75	15.87	77.27	93.14	5.12	3
2006	21	1	3.30	16.28	76.30	92.58	4.13	3
	22	2	2.09	44.40	52.76	97.16	0.75	6
	33	2	2.37	48.05	49.58	97.63	0.00	9
	38	2	2.62	21.51	75.00	96.51	0.87	1
	41	6	10.17	50.85	38.98	89.83	0.00	12
	45	6	3.39	61.76	34.85	96.61	0.00	12
	49	1	2.99	21.43	73.63	95.06	1.94	1
	50	2	5.00	57.49	37.32	94.81	0.20	12
	51	14	4.90	46.78	47.66	94.44	0.66	9
	67	1	3.66	17.23	75.41	92.64	3.70	3
	68	17	19.15	67.88	12.97	80.85	0.00	12
	105	1	3.68	17.08	76.42	93.50	2.81	1
	107	1	1.89	11.42	80.95	92.37	5.74	3
	108	7	3.81	43.73	52.04	95.78	0.41	6
	109	1	2.38	9.86	81.63	91.49	6.13	3
	111	1	0.90	7.03	79.19	86.22	12.88	5

(continued)

Year	Site #	Functional Class	Buses	Single Unit	Single Trailer	Single Unit + Single Trailer	Multiple-Trailers	TTC Group
			VC 4	VC 5-7	VC 8-10	VC 5-10	VC 11-13	
	124	14	3.22	68.53	28.25	96.78	0.00	12
	155	1	4.20	32.42	61.67	94.09	1.71	4
	157	11	3.58	18.77	75.12	93.90	2.53	1
	168	1	2.38	24.51	70.88	95.39	2.23	1

Table 28
Truck traffic classification grouping for WIM sites

Vehicle Class	TTC 1	TTC 3	TTC 4	TTC 5	TTC 6	TTC 9	TTC 12	TTC 14
Class 4	3.22	2.67	3.73	0.90	3.61	3.89	5.86	2.44
Class 5	11.59	8.13	21.23	2.87	19.18	22.60	37.55	31.59
Class 6	5.83	5.04	9.00	3.71	19.89	21.35	22.54	44.56
Class 7	0.70	0.35	0.33	0.45	2.17	3.12	1.42	0.26
Class 8	12.47	9.71	13.16	6.81	18.61	17.77	15.64	14.47
Class 9	60.48	66.74	49.18	70.92	33.01	26.25	14.64	5.81
Class 10	3.36	2.97	1.70	1.46	2.75	4.21	2.16	0.82
Class 11	1.31	2.71	0.74	9.22	0.42	0.43	0.02	0.00
Class 12	0.66	1.19	0.59	3.60	0.12	0.12	0.03	0.00
Class 13	0.38	0.50	0.34	0.06	0.25	0.26	0.14	0.05

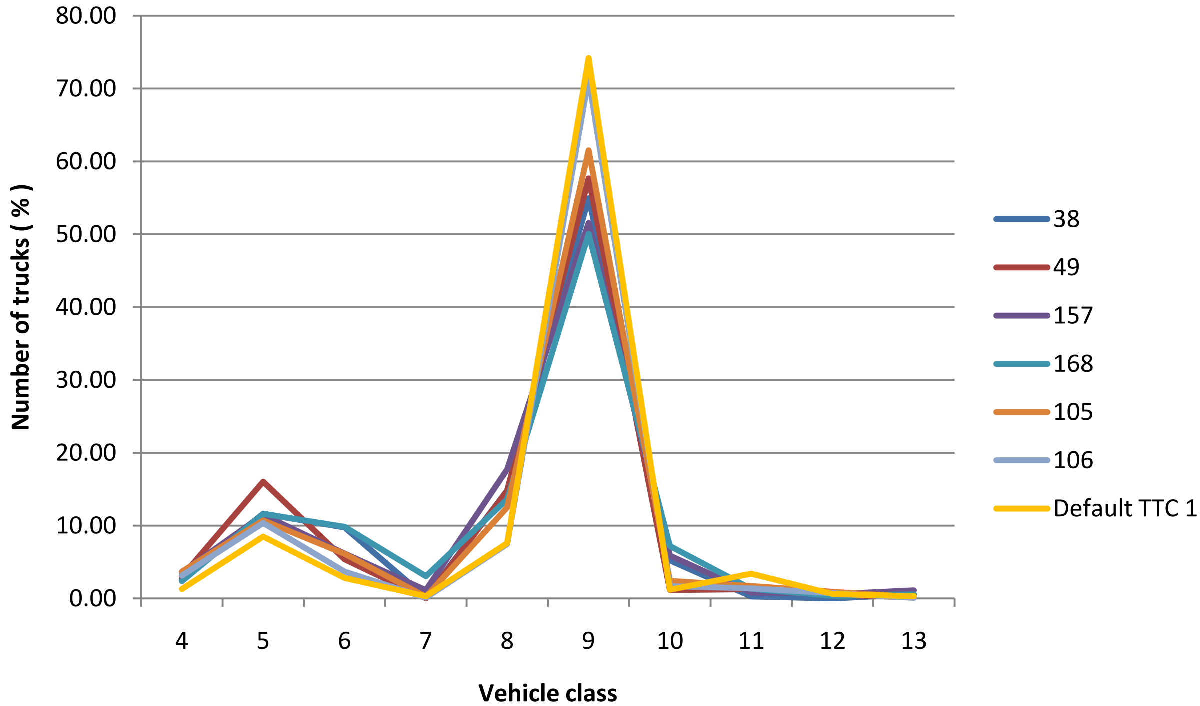

Figure 42
Vehicle class distribution for TTC 1

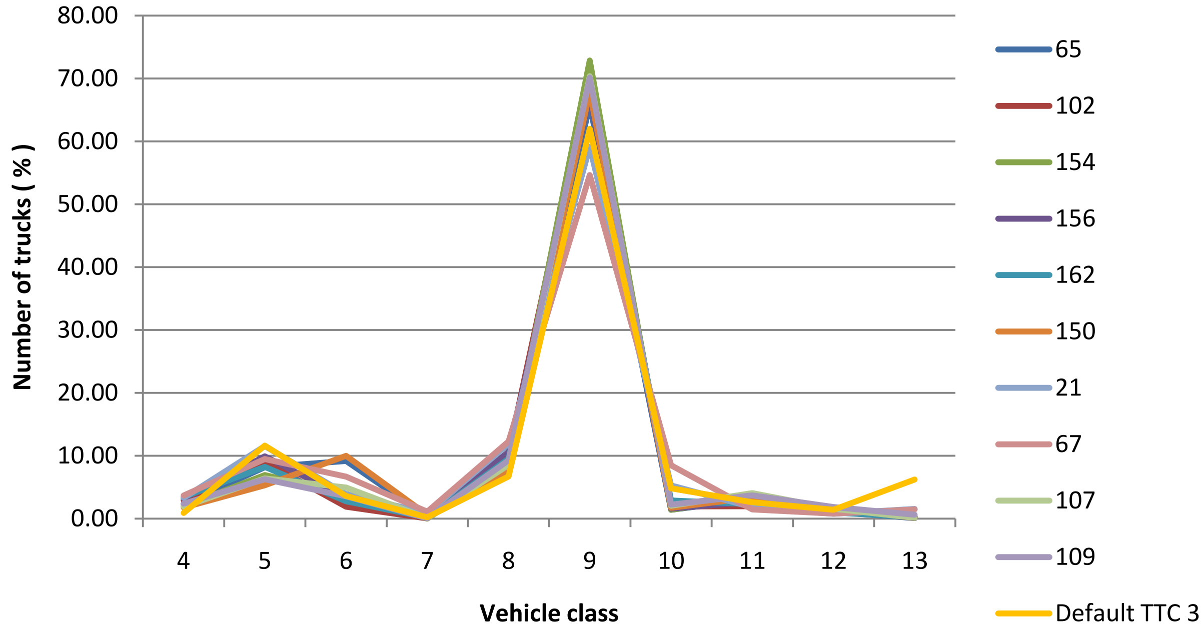

Figure 43
Vehicle class distribution for TTC 3

Axle Load Spectra for TTC Groups

Initially, primary vehicle classes with respect to single, tandem, tridem axles for all TTC groups were examined to observe the trend in the number of axles associated with each vehicle class. Thereafter, axle load spectra for single, tandem, tridem axles for combined and primary vehicle classes for each TTC group were developed. The normalized axle load spectra were calculated using the ratio of axles within each weight category to the total number of axles observed. The axle load spectra with frequencies of axle weights for each vehicle class for TTC groups are shown in separate tables in the Appendix. The tandem and tridem axle load spectra for some of the vehicle classes were observed to be zero.

Single Axle Load Spectra for TTC Groups. Figure 44 illustrates the average single axles monitored in each vehicle class for TTC 1. The majority of single axles in TTC 1 appear to be in class 8 and 9. Therefore, single axle load spectra were developed for combined classes, class 8 and class 9 for TTC 1.

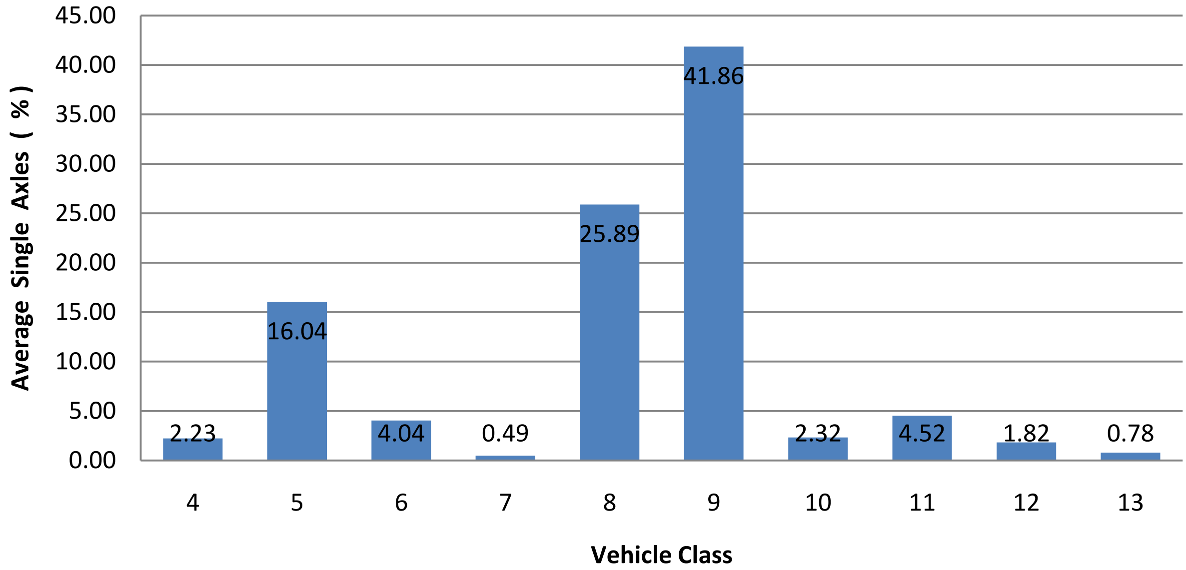

Figure 44
Single axles per vehicle class for TTC 1

Figure 45 shows the single axle load spectrum for TTC 1. The majority of the weight for combined axle load spectra were influenced from vehicle class 8 and 9 as observed in Figure 44. Figure 46 and Figure 47 show the single axle load spectra within TTC 1 for vehicle classes 8 and 9, respectively. Likewise, Figure 48 illustrates the average single axles monitored in each vehicle class for TTC 3. Figure 49, Figure 50, and Figure 51 show the single axle load spectra within TTC 3 for vehicle classes 8 and 9 combined, respectively.

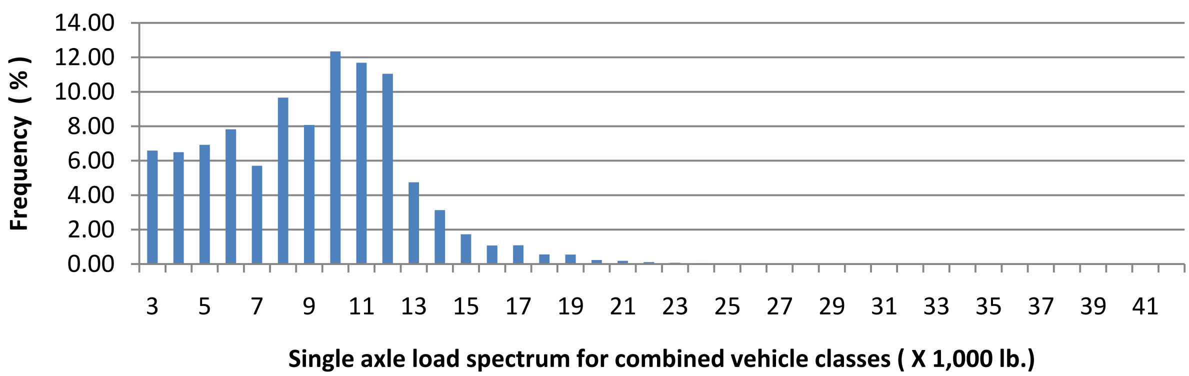

Figure 45
Single axle load spectrum for combined vehicle classes for TTC 1

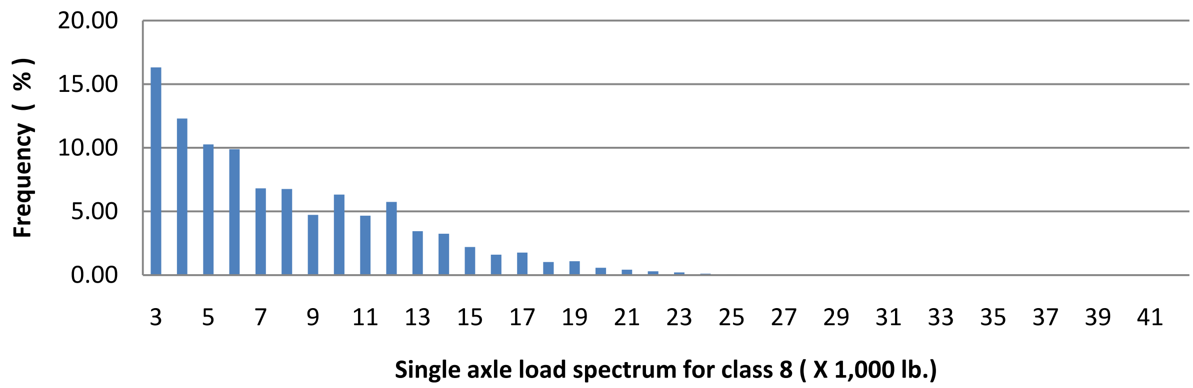

Figure 46
Single axle load spectrum for vehicle class 8 for TTC 1

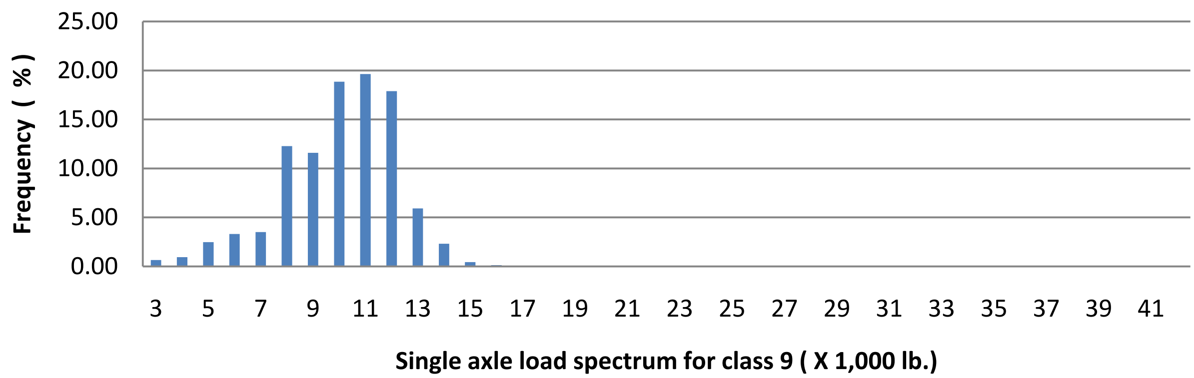

Figure 47
Single axle load spectrum for vehicle class 9 for TTC 1

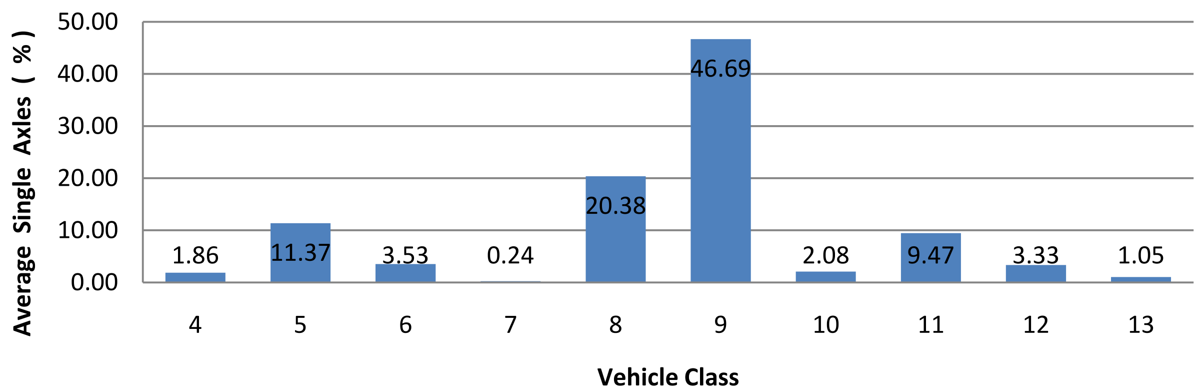

Figure 48
Single axles per vehicle class for TTC 3

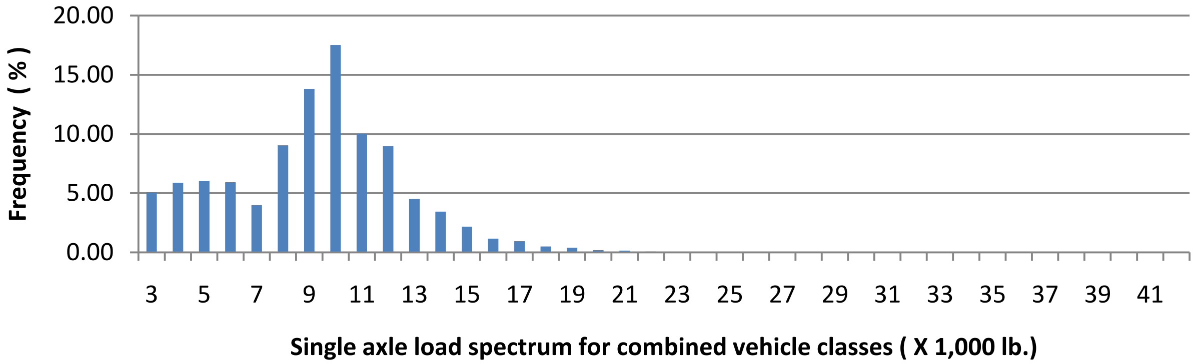

Figure 49
Single axle load spectrum for combined vehicle classes for TTC 3

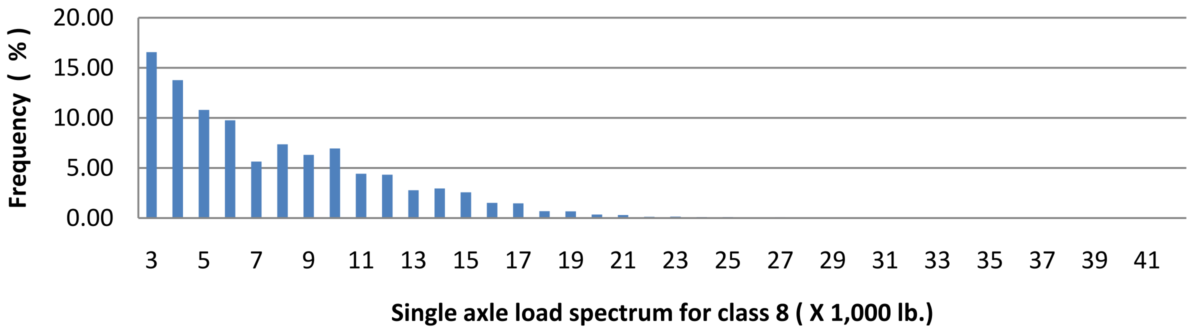

Figure 50
Single axle load spectrum for vehicle class 8 for TTC 3

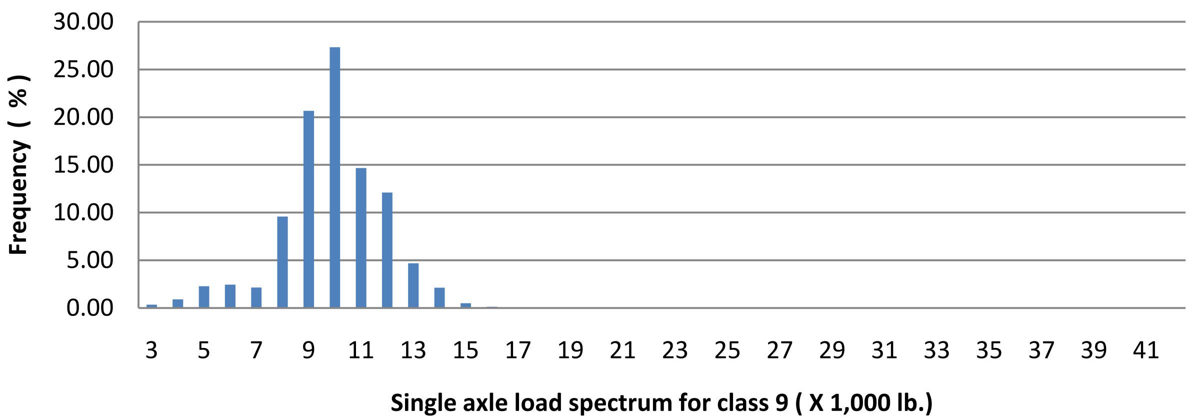

Figure 51
Single axle load spectrum for vehicle class 9 for TTC 3

Figure 52 illustrates single axle load spectra for vehicle class 9 for all TTC groups. Most of the TTC groups appear to have good agreement with one another, except TTC 5 and TTC 9. The peak for most of the TTC groups is observed to be close to 10,000 lb., whereas, TTC 5 has a lower peak axle load close to 8,000 lb. and TTC 9 has higher peak axle load close to 13,000 lb. Similarly, Figure 53 illustrates single axle load spectra for vehicle class 5 for all TTC groups. All TTC groups appear to have peak axle load at 6,000 lb. except TTC 5 which is uneven and significantly different.

In Figure 52, default single axle load spectra for class 9 have a good agreement with most of the TTC groups except TTC 5. This default spectrum has a lower peak frequency than the rest. Similarly in Figure 53, the default single axle load spectra for class 5 closely follows the others but with a slightly lower peak frequency.

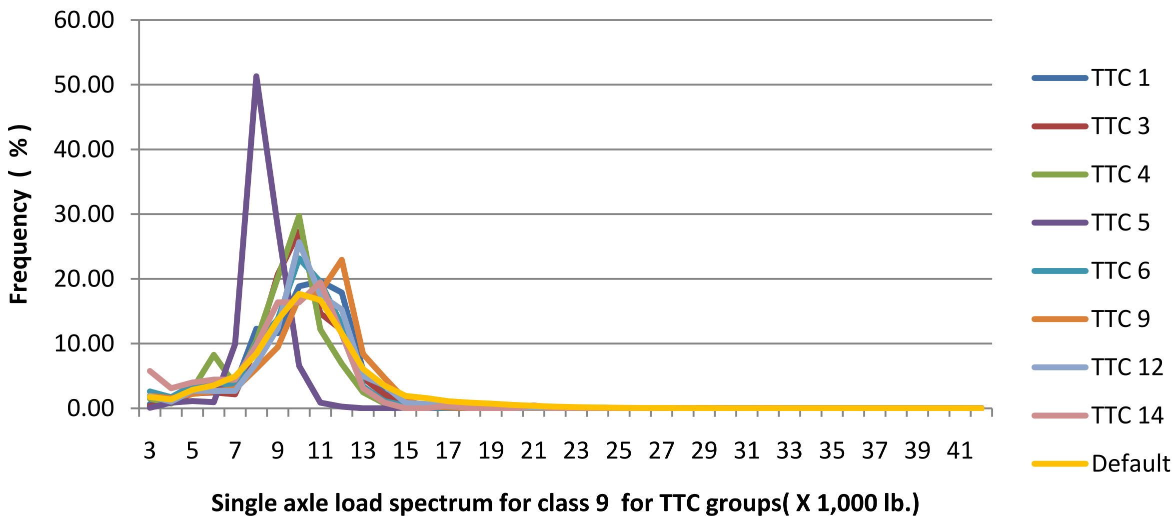

Figure 52
Single axle load spectrum for vehicle class 9 for TTC groups

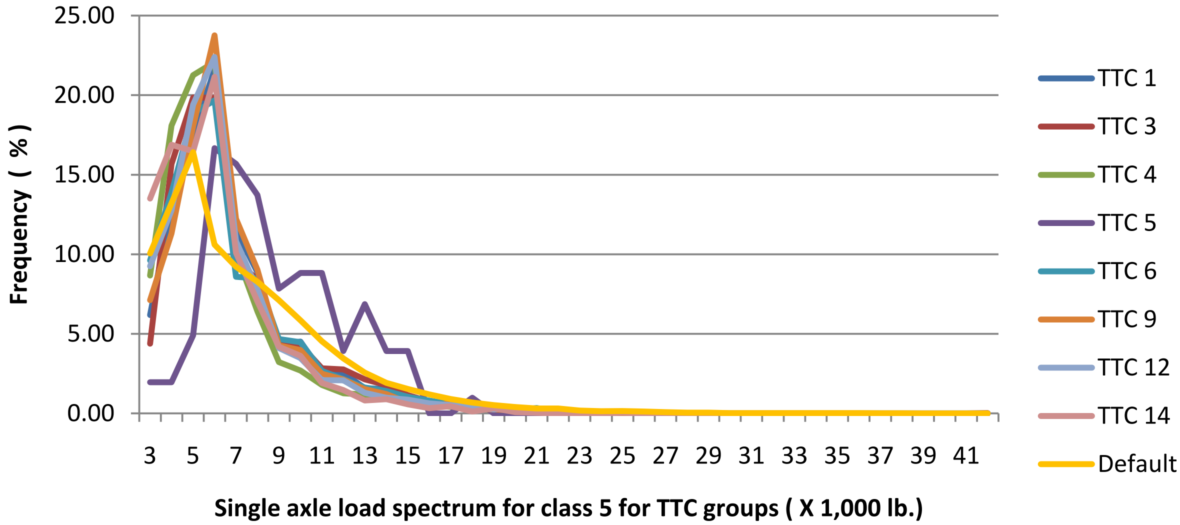

Figure 53
Single axle load spectrum for vehicle class 5 for TTC groups

Tandem Axle Load Spectra for TTC Groups. Figure 54 illustrates the average tandem axles monitored in each vehicle class for TTC 1. The majority of tandem axles in TTC 1 appear to be in class 9. Therefore, tandem axle load spectra were developed only for combined classes and class 9 for TTC 1

.

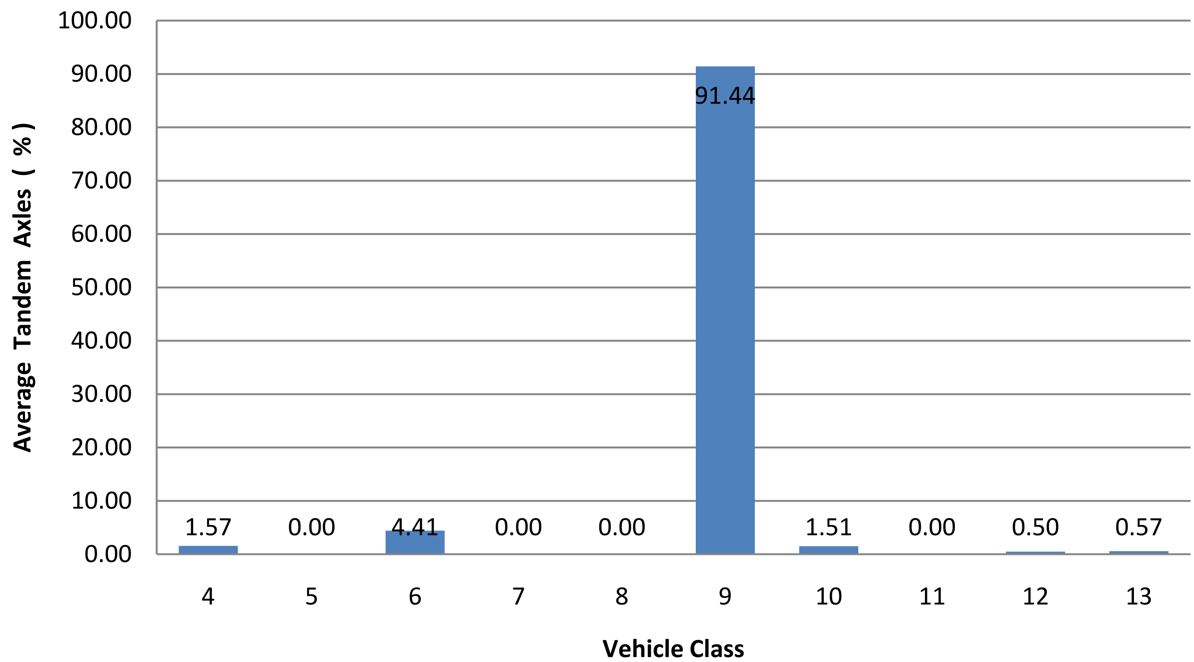

Figure 54
Tandem axles per vehicle class for TTC 1

Figure 55 shows combined vehicle classes tandem axle load spectra for TTC 1. The majority of the weight for combined axle load spectra appears to be from vehicle class 9 as observed in Figure 54. Figure 56 shows the tandem axle load spectra for vehicle class 9 for TTC 1. The loading in both the plots appear to be similar and is because vehicle class 9 comprises 91.44 percent of the total tandem axles. Likewise, the average tandem axles monitored in each vehicle class, tandem axle load spectra for other TTC groups, have been showed in the Appendix.

Figure 57 illustrates tandem axle load spectra for vehicle class 9 for all TTC groups. Most TTC groups appear to have a low peak load of unloaded trucks at 10,000 lb. and a high peak load of loaded trucks at 16,000 lb. Conventionally, the tandem axle load distribution should contain two peaks, one for unloaded trucks and other for loaded trucks. There exists a two peak pattern in the plot but is not smooth because of the 48-hr. truck weight data. Also, all these groups have different percentages of tandem axles and do not have good agreement with one another. TTC 5 is entirely different and has a very unique loading characteristic with just one peak close to 14,000 lb.

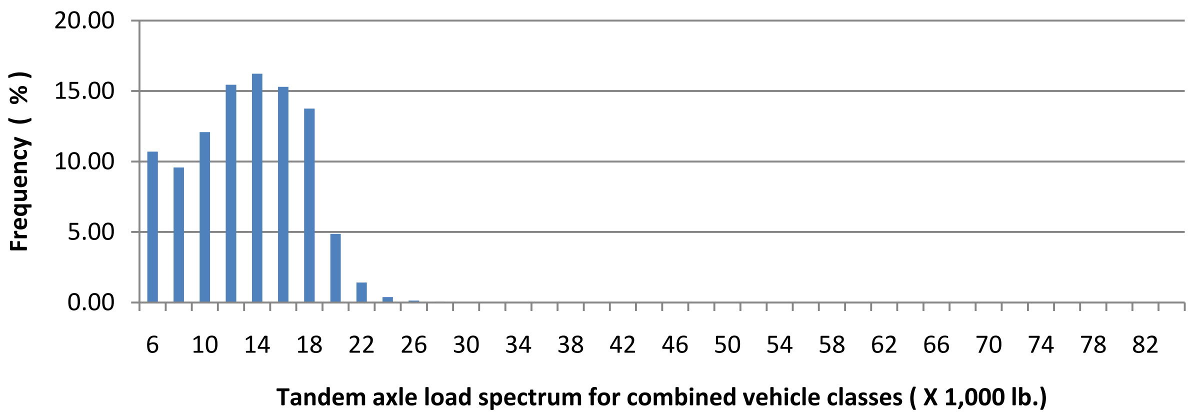

Figure 55
Tandem axle load spectrum for combined vehicle classes for TTC 1

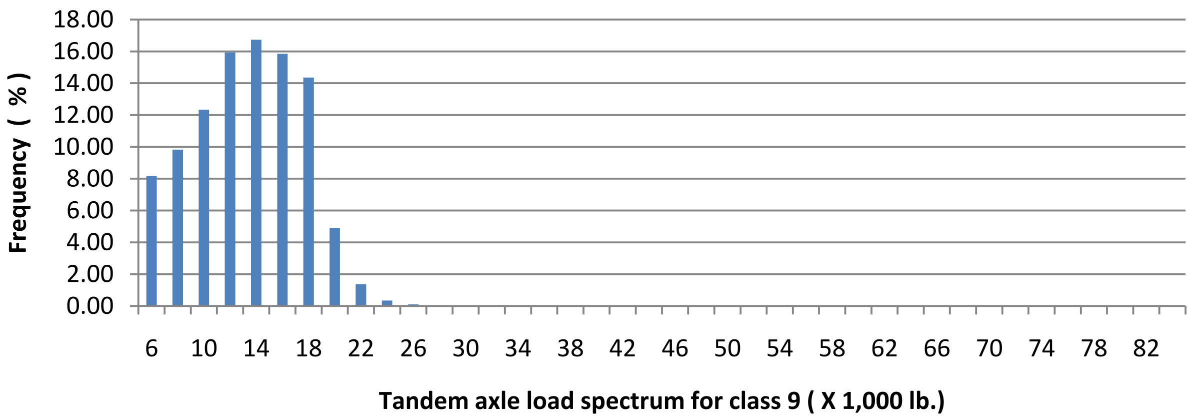

Figure 56
Tandem axle load spectrum for vehicle class 9 for TTC 1

In Figure 57, a default tandem axle load spectrum for class 9 is entirely different and does not have any agreement with TTC groups. This default spectrum consists of two peaks, one for the unloaded trucks around 14,000 lb. and the other for loaded trucks around 33,000 lb. TTC groups have lower loads compared to the default value, and the two peaks are unseen.

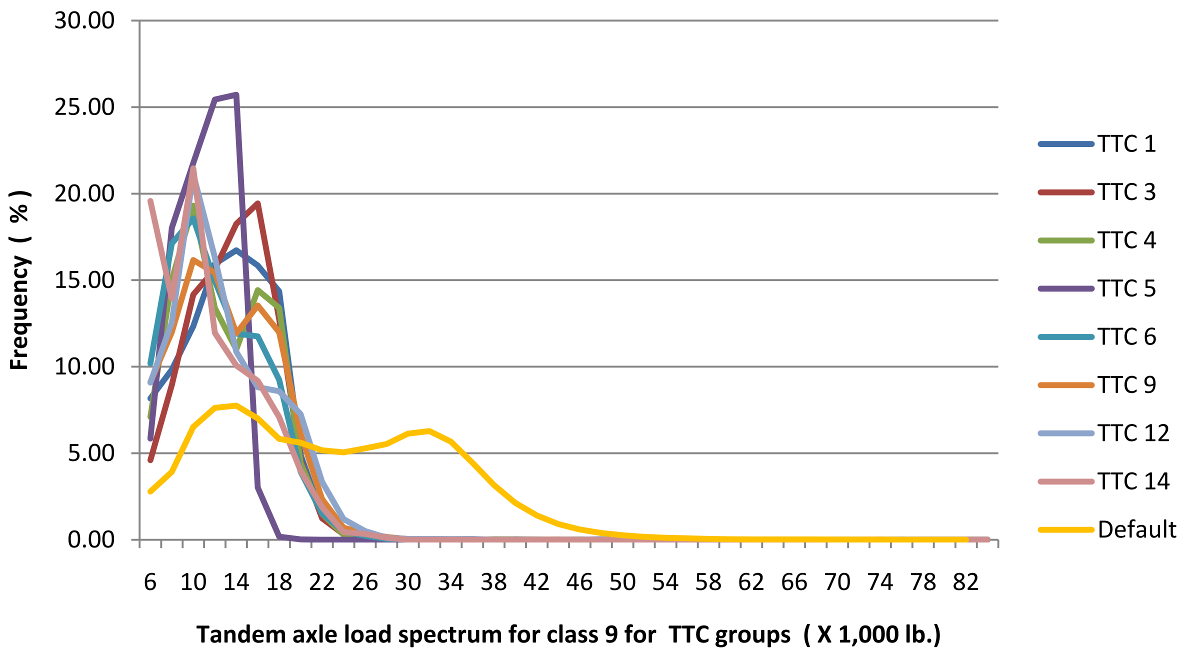

Figure 57
Tandem axle load spectrum for vehicle class 9 for TTC groups

Tridem Axle Load Spectra for TTC Groups. Figure 58 illustrates the average tridem axles monitored in each vehicle class for TTC 1. There were no tridem axles recorded at any site other than vehicle classes 7 and 10. The majority of tridem axles in TTC 1 appear to be in class 10. Therefore, tridem axle load spectra were developed only for combined classes and class 10 for TTC 1. Figure 59 shows combined vehicle classes tridem axle load spectra for TTC 1. The majority of the weight for combined axle load spectra appears to be from vehicle class 10. Figure 60 shows the tridem axle load spectra for vehicle class 10 for TTC 1. Loading in both the plots appears to be similar and is because vehicle class 10 comprises of 82.66 percent of the total tridem axles. Likewise, the average tridem axles monitored in vehicle class 7, tridem axle load spectra for other TTC groups, are shown in the Appendix.

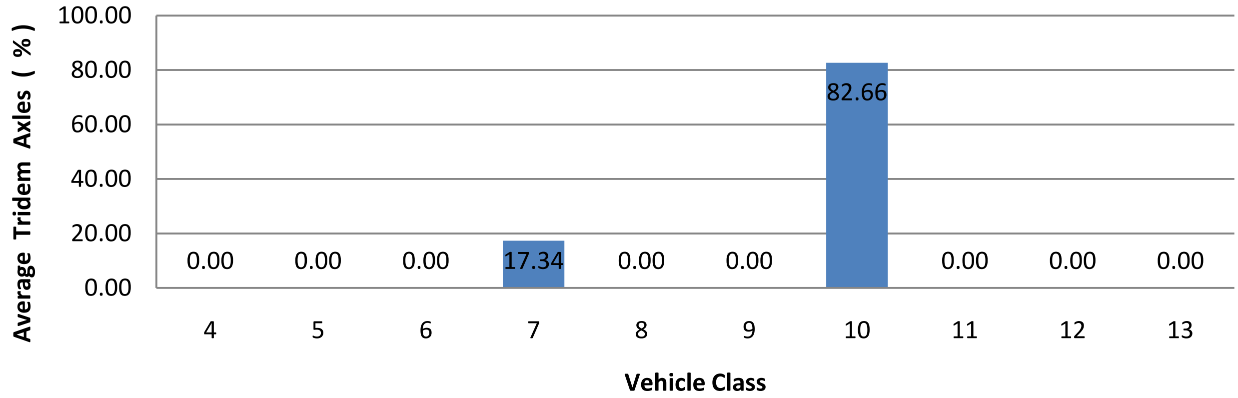

Figure 58
Tridem axles per vehicle class for TTC 1

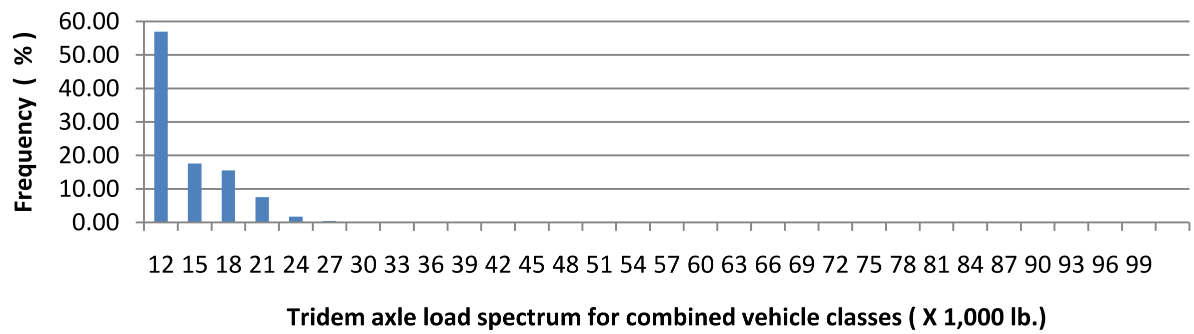

Figure 59
Tridem axle load spectrum for combined vehicle classes for TTC 1

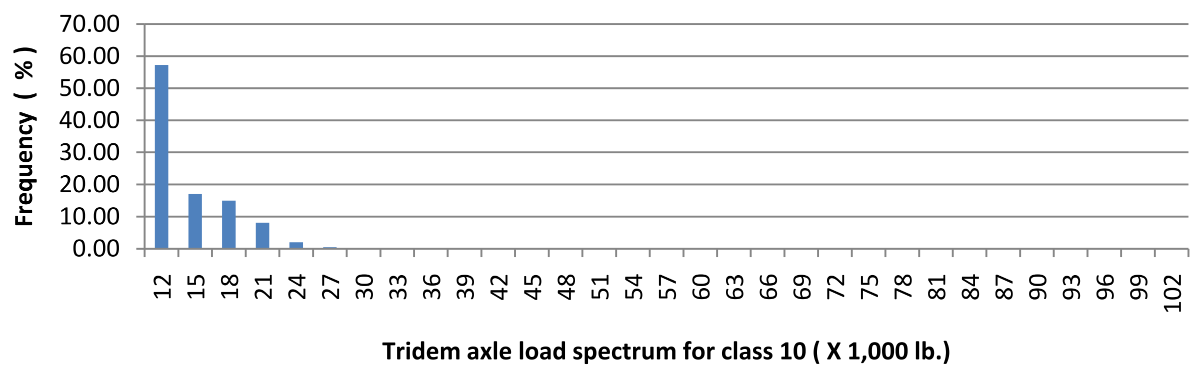

Figure 60
Tridem axle load spectrum for vehicle class 10 for TTC 1

Figure 61 illustrates tridem axle load spectra for vehicle class 10 for all TTC groups. All TTC groups appear to have low peak loads close to 12,000 lb. and have good agreement with one another. This plot may not truly represent actual conditions due to the low volume of tridem axles monitored. In Figure 61, a default tandem axle load spectrum for class 10 is entirely different and highly variable than TTC groups. This default spectrum varies from 12,000 lb. to 50,000 lb. with low frequency, whereas, TTC groups have low axle load values with the maximum at 20,000 lb.

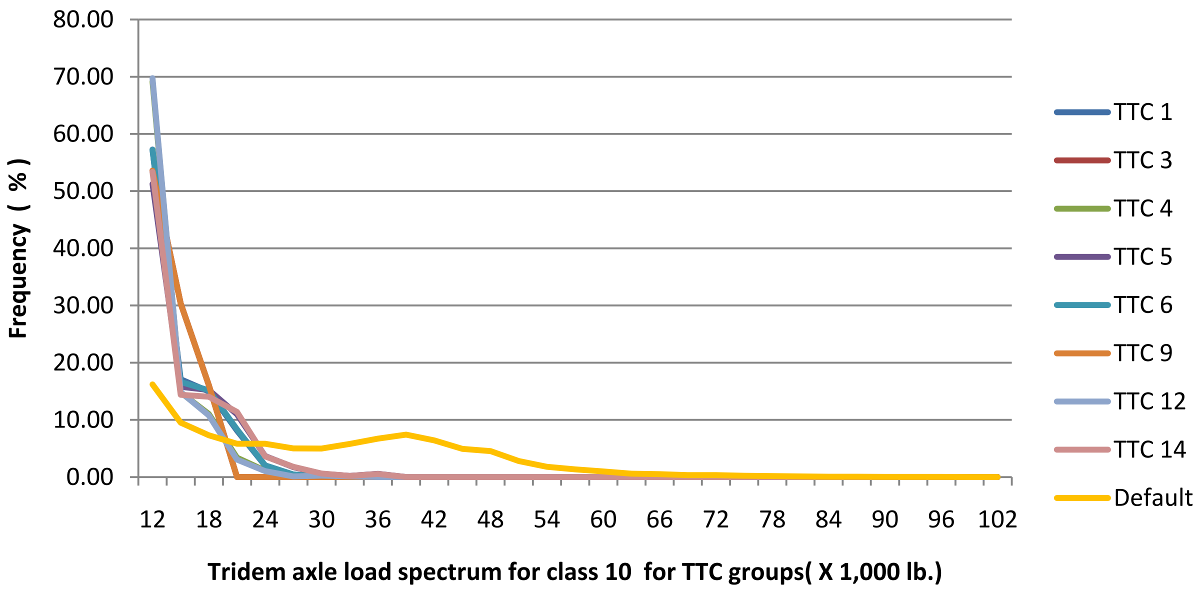

Figure 61
Tridem axle load spectrum for vehicle class 10 for TTC groups

Other General Inputs

The new design guide requires other general traffic inputs and most of the inputs under this category to define the axle load configuration and loading details used for calculating pavement responses. These inputs are mean wheel location, traffic wander standard deviation, design lane width, number of axle types per truck class, axle configuration, and wheelbase. These are described as follows.

Mean Wheel Location

This is defined as the distance from the outer edge of the wheel to the pavement marking of the highway. A default (Level 3) mean wheel location provided by design guide is 18 in. [1]. This is recommended since more accurate information is not available.

Traffic Wander Standard Deviation

This is the standard deviation of the lateral traffic wander. The wander is used to determine the number of axle load applications over a point for predicting distress and performance. A default (Level 3) mean traffic wander standard deviation provided by design guide is 10 in. [*1*]. This is recommended since more accurate information is not available.

Axle Configuration

A series of data elements are needed to describe configurations of typical tire and axle loads that would be applied to the roadway because computed pavement responses are generally sensitive to both wheel locations and the interaction between various wheels on a given axle. Average axle width is the distance between two outside edges of an axle. For typical trucks, 8.5 ft. may be assumed for axle width. Dual tire spacing is the distance between centers of a dual tire. Typical dual tire spacing for trucks is 12 in. Axle spacing is the distance between two consecutive axles of a tandem, tridem, or quad. The average axle spacing is 51.6 in. for tandem and 49.2 in. for tridem and quad axles [*1*].

Design Lane Width

This parameter refers to the actual traffic lane width. The default value for standard-width lanes is 12 ft. [*1*].

Wheelbase

Wheelbase is the distance between the steering axle and the first drive axle and is defined by two parameters, average axle spacing, and the percentage of trucks with given axle spacing. Recommended average axle spacing values are 12, 15, and 18 ft. for short, medium, and long axle spacing, respectively. It is recommended to use a uniform distribution of 33 and 34 percentage trucks for short, medium, and large axle spacing if accurate vehicle distribution data are not available [*1*].

Number of Axle Types per Truck Class

This input represents the average number of axles for each truck class (class 4 to 13) for each axle type (single, tandem, tridem, and quad). Default values for the average number of single, tandem, and tridem axles per truck class specified by design guide are shown in Table 29 [*1*].

Table 29
Default values for the average number of single, tandem, and tridem axles per truck class

Truck Class	Number of Single Axles per Truck	Number of Tandem Axles per Truck	Number of Tridem Axle per Truck
4	1.62	0.39	0.00
5	2.00	0.00	0.00
6	1.02	0.99	0.00
7	1.00	0.26	0.83
S	2.38	0.67	0.00
9	1.13	1.93	0.00
10	1.19	1.09	0.89
11	4.29	0.26	0.06
12	3.52	1.14	0.06
13	2.15	2.13	0.35

Load Equivalency Factors

A load equivalency factor (LEF) represents the equivalent number of ESALs for the given weight-axle combination. In other words, LEF is the ratio of the effect of a specific axle load on pavement serviceability to the effect produced by an 18-kip axle load at the AASHO road test. The Vehicle Travel Information System (VTRIS) follows the procedures outlined in the AASHTO guide for design of pavement and utilized in the analysis to derive LEF. VTRIS functions as a database management system for vehicle classification and truck weight data. It is based on the TMG and includes data conversion, validation, and data summarization capabilities. It is also able to produce all standard TMG reports (W-1 through W-7 tables) with a great deal of flexibility in data organization and presentation.

In this study, Louisiana's WIM data were examined for the years 2004 through 2006. Table 30, Table 31, and Table 32 summarize LEF factors for flexible pavement derived from the W-4 report of VTRIS software for years 2006, 2005 and 2004, respectively. Similarly, Table 33, Table 34, and Table 35 represent LEF factors for rigid pavements for years 2006, 2005, and 2004, respectively. These LEF values represent revised factors for present conditions for each vehicle class. LEF values were calculated using all WIM data collected from 2004 to 2006. While some of the portable WIM sites did not pass data quality tests presented earlier, it was not possible to exclude the data from those sites when generating LEF tables by VITRIS. This is primarily caused by software limitation that does not provide an explicit way to eliminate certain sites from database files. However, methods to overcome such limitation will be sought in future applications of VTRIS.

In Table 30, FC1 represents the functional classification 1, Pt represents the teminal serviceability index (calculated for conditions 2.0 and 2.5), and SN is the structural number (calculated for SN = 2 , 3, 4 , 5, and 6). In Table 33, D is the thickness of the pavement and LEF is calculated for the thickness of D = 6, 7, 8, 9, 10, and 11 in. The remaining LEF tables for each year and all years combined are summerrized in Appendix I.

Table 30
Flexible pavement load equivalency factors for functional class 1 in 2006

FC 1	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.3185	0.3269	0.3187	0.3094	0.3048	0.3432	0.3663	0.3447	0.321	0.3094
Class 5	0.0577	0.059	0.0567	0.0545	0.0534	0.0667	0.0701	0.0634	0.0578	0.0549
Class 6	0.3654	0.3699	0.3607	0.3534	0.3509	0.3883	0.4027	0.3787	0.3591	0.352
Class 7	0.9643	0.9593	0.934	0.923	0.9269	0.9866	0.9855	0.9298	0.8994	0.9027
Class 8	0.4104	0.4156	0.405	0.3963	0.3933	0.4355	0.4518	0.4249	0.402	0.3936
Class 9	0.6888	0.7105	0.6967	0.6771	0.6657	0.7391	0.7959	0.7584	0.7085	0.6809
Class 10	1.028	1.0427	1.0227	1.0039	0.9963	1.0773	1.1204	1.0698	1.0207	1.0005
Class 11	0.8394	0.8715	0.8523	0.8242	0.8074	0.912	0.9956	0.9427	0.8711	0.8309
Class 12	0.5893	0.618	0.5969	0.5697	0.5539	0.6665	0.7429	0.6837	0.614	0.5759

Table 31
Flexible pavement load equivalency factors for functional class 1 in 2005

FC 1	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.7294	0.7392	0.7285	0.7179	0.7136	0.755	0.7827	0.7561	0.7282	0.7168
Class 5	0.2029	0.2062	0.201	0.1962	0.1941	0.2193	0.2288	0.2145	0.2019	0.1965
Class 6	0.2959	0.3011	0.2949	0.289	0.2864	0.3123	0.3271	0.3112	0.2955	0.2887
Class 7	0.8076	0.8265	0.8147	0.7979	0.7882	0.8496	0.8995	0.8675	0.8246	0.8012
Class 8	0.7448	0.73	0.7014	0.6904	0.6957	0.7589	0.7353	0.6755	0.6487	0.655
Class 9	1.5919	1.6045	1.5848	1.5688	1.5639	1.6323	1.6711	1.6225	1.5794	1.565
Class 10	2.595	2.5413	2.4764	2.4705	2.501	2.5939	2.4957	2.3618	2.3395	2.3934
Class 11	1.4885	1.5353	1.5141	1.4771	1.4543	1.5701	1.6898	1.6339	1.5406	1.4863
Class 12	1.2235	1.2711	1.2463	1.2072	1.1837	1.3154	1.4388	1.3719	1.273	1.2166

Table 32
Flexible pavement load equivalency factors for functional class 1 in 2004

FC 1	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.5358	0.5462	0.5374	0.527	0.5219	0.5621	0.5904	0.5674	0.5406	0.5276
Class 5	0.1331	0.1353	0.1315	0.1281	0.1265	0.1456	0.1518	0.1413	0.1324	0.1283
Class 6	0.5202	0.5295	0.5196	0.5095	0.5047	0.5486	0.5747	0.5486	0.522	0.5098
Class 7	0.5789	0.5907	0.5826	0.572	0.566	0.6064	0.6377	0.6159	0.5885	0.5739
Class 8	0.6418	0.6427	0.6284	0.6208	0.6208	0.6652	0.6732	0.6385	0.6172	0.6146
Class 9	1.3348	1.3539	1.3384	1.3201	1.3109	1.3799	1.4317	1.3917	1.3443	1.3213
Class 10	2.1047	2.0829	2.0466	2.0428	2.0576	2.1229	2.0882	2.0065	1.9886	2.0146
Class 11	1.6887	1.715	1.692	1.6662	1.6539	1.7523	1.8243	1.7656	1.6984	1.6672
Class 12	1.1902	1.2308	1.2083	1.1738	1.1533	1.2735	1.3791	1.3182	1.2309	1.1816

Table 33
Rigid pavement load equivalency factors for functional class 1 in 2006

FC 1	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.393	0.387	0.384	0.384	0.385	0.385	0.403	0.389	0.383	0.382	0.383	0.384
Class 5	0.058	0.057	0.056	0.056	0.055	0.055	0.062	0.059	0.057	0.056	0.056	0.055
Class 6	0.552	0.543	0.543	0.547	0.550	0.553	0.548	0.529	0.528	0.536	0.543	0.549
Class 7	1.690	1.660	1.660	1.676	1.695	1.712	1.621	1.558	1.560	1.592	1.630	1.665
Class 8	0.498	0.491	0.489	0.490	0.492	0.493	0.505	0.488	0.484	0.486	0.489	0.491
Class 9	1.155	1.146	1.146	1.149	1.152	1.153	1.158	1.137	1.136	1.143	1.148	1.151
Class 10	1.674	1.657	1.663	1.676	1.686	1.692	1.645	1.608	1.620	1.647	1.668	1.681
Class 11	0.864	0.846	0.834	0.829	0.826	0.825	0.916	0.875	0.847	0.834	0.829	0.826
Class 12	0.721	0.704	0.693	0.688	0.685	0.684	0.770	0.731	0.705	0.693	0.688	0.685

Table 34
Rigid pavement load equivalency factors for functional class 1 in 2005

FC 1	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.88	0.88	0.88	0.88	0.88	0.88	0.89	0.87	0.87	0.87	0.88	0.88
Class 5	0.20	0.20	0.20	0.20	0.20	0.20	0.21	0.20	0.20	0.20	0.20	0.20
Class 6	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.43	0.43	0.43	0.44	0.44
Class 7	1.20	1.19	1.19	1.20	1.20	1.21	1.20	1.17	1.17	1.18	1.20	1.20
Class 8	0.88	0.86	0.86	0.86	0.87	0.88	0.86	0.82	0.81	0.83	0.84	0.86
Class 9	2.64	2.62	2.64	2.67	2.69	2.71	2.56	2.50	2.54	2.61	2.66	2.69
Class 10	4.47	4.39	4.41	4.48	4.55	4.60	4.22	4.04	4.09	4.23	4.38	4.49
Class 11	1.53	1.50	1.49	1.48	1.48	1.47	1.60	1.54	1.50	1.49	1.48	1.48
Class 12	1.50	1.48	1.47	1.46	1.46	1.46	1.56	1.51	1.48	1.47	1.46	1.46

Table 35
Rigid pavement load equivalency factors for functional class 1 in 2004

FC 1	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.672	0.665	0.663	0.665	0.667	0.668	0.677	0.660	0.657	0.660	0.664	0.666
Class 5	0.134	0.131	0.130	0.130	0.130	0.130	0.139	0.134	0.131	0.130	0.130	0.130
Class 6	0.778	0.769	0.770	0.774	0.778	0.780	0.774	0.755	0.756	0.764	0.772	0.777
Class 7	1.002	0.989	0.993	1.003	1.012	1.018	0.979	0.950	0.958	0.980	0.999	1.010
Class 8	0.807	0.795	0.795	0.800	0.806	0.810	0.800	0.773	0.772	0.783	0.795	0.803
Class 9	2.256	2.240	2.256	2.278	2.293	2.301	2.195	2.159	2.192	2.239	2.272	2.290
Class 10	3.747	3.690	3.720	3.784	3.839	3.875	3.550	3.434	3.494	3.625	3.742	3.819
Class 11	1.705	1.685	1.675	1.672	1.672	1.672	1.750	1.704	1.680	1.674	1.672	1.672
Class 12	1.447	1.428	1.416	1.411	1.409	1.408	1.499	1.455	1.427	1.416	1.411	1.409

Several examples illustrating LEF for different years are shown in the next section. Figure 62 shows LEF values for flexible pavement for Functional Classification 1 for years 2006, 2003, and 2000. For flexible pavement, it is assumed that the structural number is 5 and the terminal serviceability index is 2.5. The number and location of WIM sites are identical for the most part each year. Similarly, Figure 65 represents LEF values for a rigid pavement for Functional Classification 1 for years 2006, 2003, and 2000. For rigid pavement, it is assumed that the thickness is 9 in. and terminal serviceability index is 2.5. Figure 63 and Figure 66 show LEF values for flexible and rigid pavements, respectively, for 2005 and 2002. Figure 64 and Figure 67 show LEF values for flexible and rigid pavements, respectively, for 2004 and 2001. Generally, all LEF values were consistent and within practical range. There are some WIM sites which were not monitored every three years and may be the reason for slight difference in LEF.

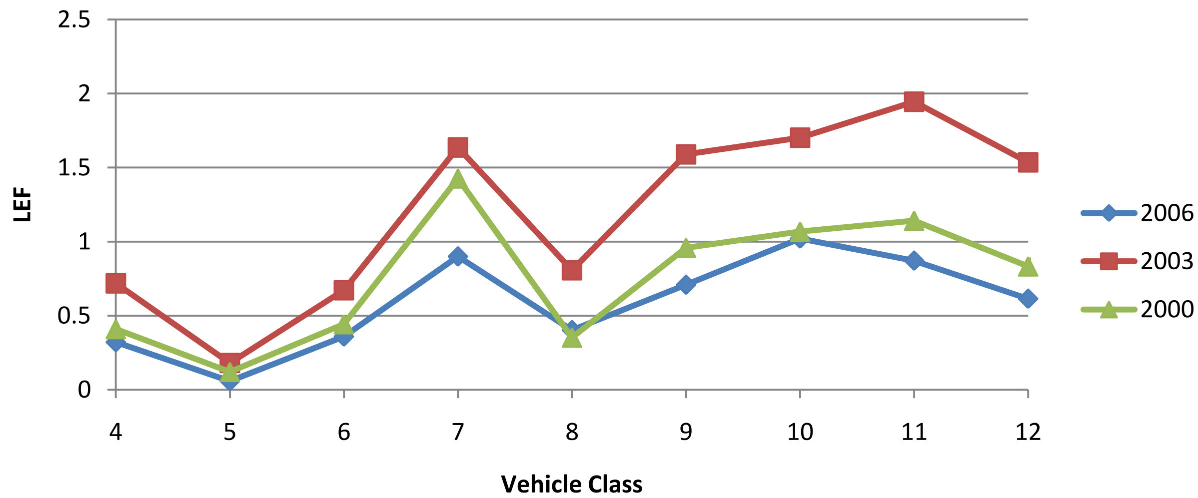

Figure 62
Flexible pavement LEF for FC 1 for 2006, 2003, and 2000

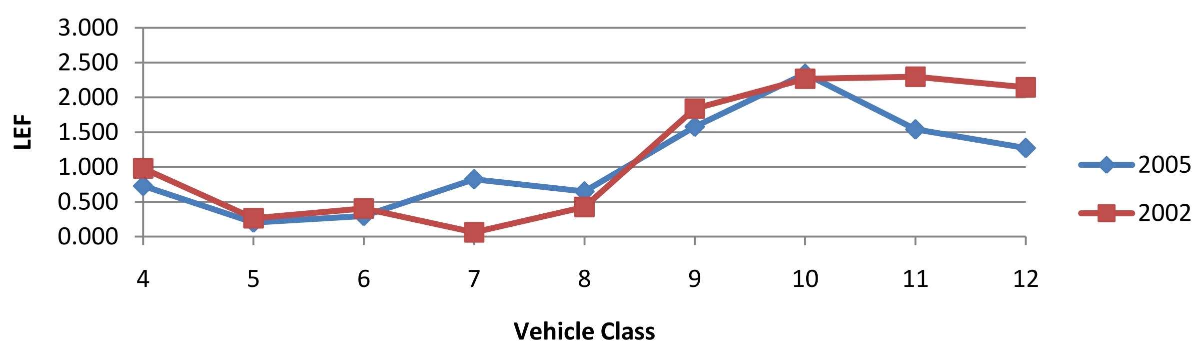

Figure 63
Flexible pavement LEF for FC 1 for 2005 and 2002

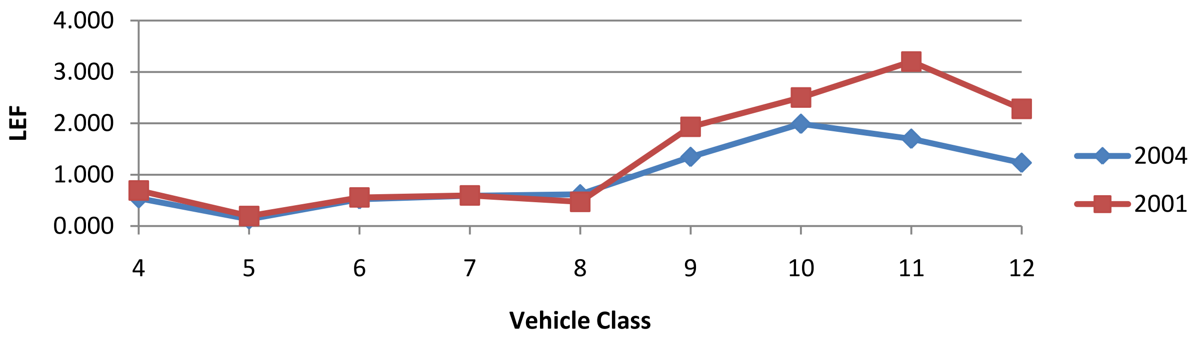

Figure 64
Flexible pavement LEF for FC 1 for 2004 and 2001

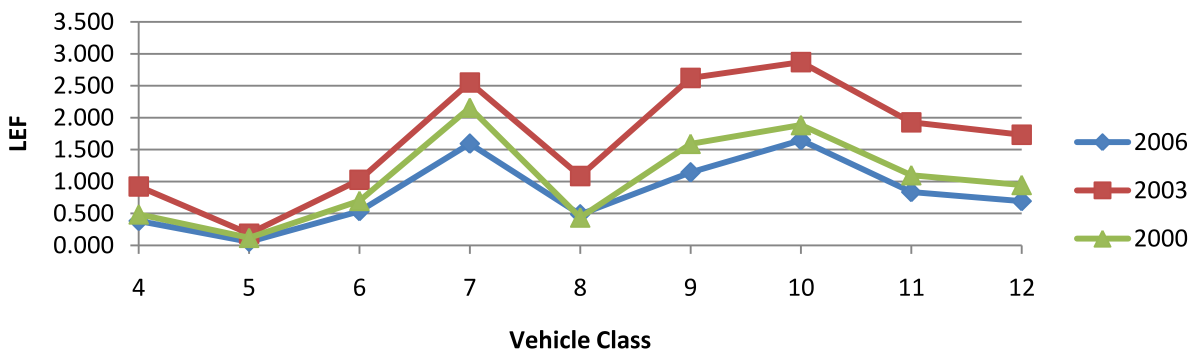

Figure 65
Rigid pavement LEF for FC 1 for 2006, 2003, and 2000

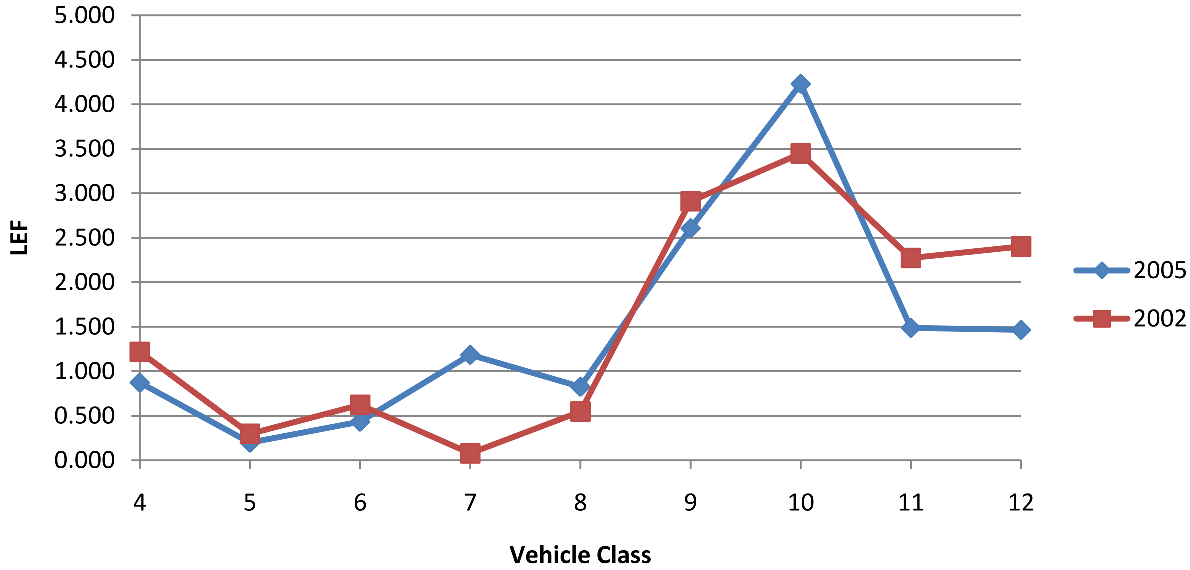

Figure 66
Rigid pavement LEF for FC 1 for 2005 and 2002

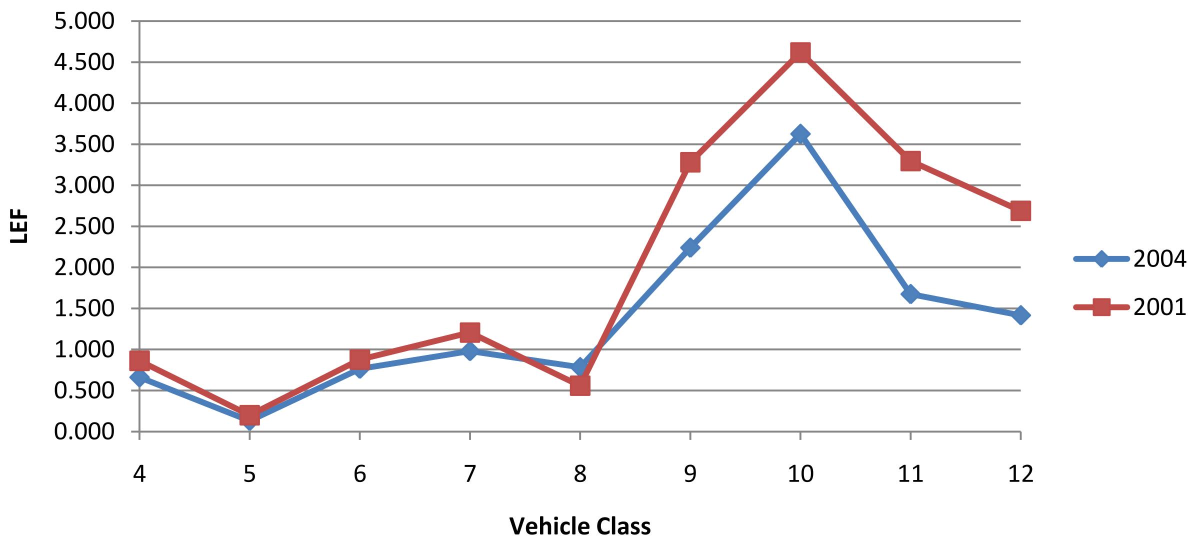

Figure 67
Rigid pavement LEF for FC 1 for 2004 and 2001

Strategic Plan for WIM Data Collection Program

Upon reviewing the current practices of the traffic data collection process adopted by LADOTD and the existing and proposed traffic data collection procedures followed by other states, a full understanding of all the elements required to develop a strategic plan were recognized. The main objective of this task was to improve the traffic data collection process for pavement design practices. This task is required because the traffic data collection process needs to be enhanced with time and advanced technologies for design and analysis of pavement structures.

According to previous studies and literature research, the traffic data collection process can be improved only by making traffic data more reliable, adequate, and accurate and by using superior technologies. Based on the current traffic data collection procedures adopted in Louisiana and other states and the traffic data inputs required by the new MEPDG, it is recommended that a combination of permanent and portable WIM stations would provide the best possible plan for the data collection process in Louisiana. Permanent devices provide more extensive datasets and are generally necessary for collecting data needed to understand weekly and monthly changes in traffic patterns. Portable devices allow flexibility in collecting data and help ensure that data is collected from specific locations of interest. Portable devices also tend to lower the cost of collecting the geographically diverse and site-specific data needed to develop accurate pavement design loads. Therefore, a combination of devices (WIM and classification; permanent and portable) is needed to meet the traffic data collection needs for pavement design. In this section, two alternative plans are proposed that could be adopted by LADOTD for traffic data collection process. These plans describe the process to estimate the number of the WIM stations needed within Louisiana and also locate WIM stations on the appropriate truck route.

Of all traffic monitoring methods, WIM requires sophisticated data collection sensors, controlled operating environment (strong, smooth, and level pavement in good condition), and expensive equipment set up and calibration. WIM systems are designed to measure the vertical forces applied by axles to sensors in a roadway. This measurement helps estimate the weight of those axles if the truck being weighed is stationary. The site should be selected and designed to reduce the dynamic motion of passing vehicles [*4*]. TMG also recommends that WIM sites cannot be selected in a purely random fashion because WIM equipment only works accurately on level ground, with good pavement, and with little or no roadway curvature [*4*]. This eliminates many potential roadway segments from consideration for truck weight data collection locations. The selection of new WIM sites should be based on the needs of the data collection program and the site characteristics of the roadway sections. The needs of the data collection program include, but are not limited to, the following [*4*]:

- Obtain more vehicle weight data on roads within a given truck weight roadway group
- Collect data in geographic regions that are poorly represented in the existing WIM data collection effort
- Collect data on specific facilities of high importance (e.g., interstate highways or other National Highway System routes)
- Collect data for specific research projects or other special needs of the state
- Collect weight information on specific commodity movements of importance to the state

Most of the states have adopted the procedure identified by TMG for grouping roadways. According to TMG, truck weight road groups should be based on a combination of known geographic, industrial, agricultural, and commercial patterns, along with knowledge of truck loading characteristics that occur on specific roads. It was stated that truck weight roadway groups can also be formed based on the percentage of through-trucks that exist on a roadway [*4*]. The truck weight road groups in Texas were developed primarily using three variables, namely, geographic region, roadway functional classification, and similar truck volumes. Twenty-five groups were formed and these lead to 150 WIM stations (six sites per group in compliance with TMG). Similarly, truck volumes on interstate and arterial roads were examined using vehicle classification count data in Virginia. Three groups were formed with 1000 truck trailers or more per day for group 1 with less than 1000 truck trailers per day for group 2 (both group 1 and group 2 were for interstate and major arterials) and with minor arterials and collectors for group 3. Each group was recommended with six WIM sites and most were permanent.

In Louisiana, current portable WIM station data, the LTPP site location, WIM enforcement site locations, and official designated truck routes were utilized in recommending the number and location of permanent WIM sites needed. Weight data collected from portable WIM sites proved to be suspicious and, therefore, only vehicle classification data was utilized in recommending permanent WIM sites as this data was more accurate in terms of through truck volume. Initially, all existing portable WIM sites were located on maps to examine the trend in truck volume based on functional classification. This showed that truck volumes on minor arterials, collectors, and local roads were insignificant and therefore, only the truck volumes monitored on interstates and principal arterials were considered. Two alternative plans were established considering available traffic data. Each plan provides a set of permanent WIM stations in addition to existing and/or proposed portable sites. For each alternative, portable sites with the class 9 (most dominant) truck volumes, WIM enforcement site locations, and truck route zones were examined. This assisted in locating the permanent and/or portable WIM needed and in eliminating unnecessary portable sites situated in the vicinity of proposed WIM sites. These alternatives are described next.

Alternative Plan # 1

In this alternative, only current portable WIM data and truck route data within Louisiana were utilized to develop this plan. WIM enforcement data was assumed not available for this alternative. All portable WIM stations located on interstates and principal arterials along with class 9 truck volumes captured for 48 hours at each portable WIM site were examined. Entry and exit points along the state boundary line and the roads carrying heavy truck volume were located and examined. This process guided in distinguishing the roads that had significant truck volumes. Some of the roads that did not have truck volumes were also scrutinized with official truck routes.

In this alternative, 29 permanent WIM stations are estimated for the entire state, out of which 17 are proposed on interstates and 12 on principal arterials. These WIM sites cover most of the highway sections on interstates and principal arterials. Also, there is a need for 15 additional portable sites proposed on principal arterials. Some of the existing portable sites located in the vicinity of the permanent sites should be eliminated to reduce the cost. All the other portable sites should be monitored in the same position as currently located.

The permanent WIM sites should be monitored continuously to determine the monthly, seasonally, and yearly trends of the truck axle load distributions. The existing portable WIM sites are to be monitored continuously for a week to determine the weekly differences of traffic loadings. In order to determine seasonal traffic loadings, existing portable WIM sites are recommended to be monitored every quarter of a year. The recommended WIM sites within each region are illustrated in Figure 68 through Figure 70. This includes regions from Baton Rouge, Lafayette, Lake Charles, Shreveport, Slidell, Laplace, Monroe-Madison, Minden-Ruston, Natchitoches, Alexandria, Evangeline, Feliciana-Saint Helena, and Tangipahoa, respectively. The abbreviations in Table 36 were used to denote the proposed and existing WIM sites shown in Figure 68 through Figure 70.

Table 36
Abbreviations used in Figure 68 through Figure 70

PMI ( )	Proposed permanent WIM sites on interstates
PMA ( )	Proposed permanent WIM sites on principal arterials
PR ( )	Proposed portable WIM stations
Site ( )	Existing portable WIM sites on interstates and principal arterials

Figure 68 shows the Shreveport region and the surrounding area. Four permanent WIM stations PMI #1, PMI #2, PMI #3, and PMA #9 are recommended on interstates, principal arterials. The site PMI #1 is proposed on I-20, west of Shreveport, controls the entry and exit of trucks near the

Louisiana-Texas border, and monitors truck movement between Shreveport and the Louisiana/Texas border. PMI #2 is proposed on the stretch between Shreveport and Eastwood on I-20 and captures traffic generated from the Shreveport region including traffic merging into I-20. PMI #3 is proposed on I-49 to the south of Shreveport and monitors traffic generated from the Shreveport region including traffic merging from I-20 E, I-20 W, and US-71 into I-49. PMA #9 is proposed to the east of Shreveport near Eastwood and examines traffic on US-79.

Figure 68
Map showing WIM stations in Shreveport region

Also, PR2 and PR11 are new portable sites recommended. Portable sites PR2 and PR11 are to be placed on US-79/80 and US-71, respectively, in order to monitor truck traffic conditions. The existing portable WIM sites numbered 65, 111, 126, and 154 are expected to be decommissioned as these are in close proximity to the permanent WIM sites.

Figure 69 depicts the region around Minden and Ruston on the east side of Shreveport. One permanent WIM station, PMI #4, is recommended on the interstate. PMI #4 is proposed on the stretch between Minden and Arcadia on I-20 and examines traffic generated from surrounding regions including traffic merging into I-20 from US-79, US-63, and LA-7. In addition, PR3, PR9, and PR10 are new portable sites recommended to be placed on US-80, US-79, and US-371, respectively, as shown in Figure 69 in order to monitor truck traffic conditions. The existing portable WIM site #107 may not be required in this case.

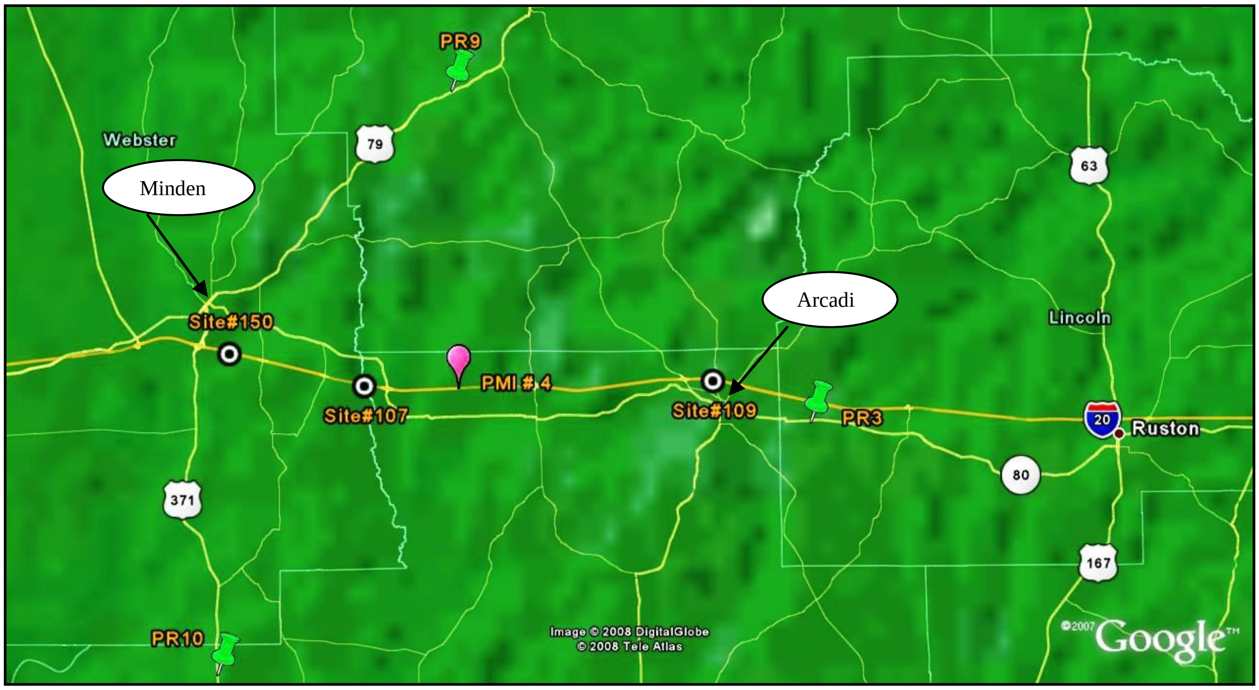

Figure 69
Map showing WIM stations in Minder-Ruston region

Figure 70 depicts the region around northeast Louisiana near Monroe and Madison. Three permanent WIM stations PMI #5, PMI #6, and PMA #6 are recommended in this region. PMI #5 is proposed on the stretch between Monroe and Rayville on I-20, and captures traffic generated from the Monroe region including traffic merging into I-20 from US-61, US-80, and US-65. The site PMI#6 is proposed on I-20, and controls the entry and exit of trucks near the Louisiana-Mississippi border and monitors truck movement between Tallulah and Louisiana border. PMA #6 is proposed to the north of Monroe on US-165 and captures the traffic merging into I-20 from US-165 and traffic departing from Monroe. Also, PR4 is a new portable site proposed on US-65 as shown in Figure 70 in order to monitor truck traffic conditions. The existing portable WIM site #139 may not be required in this case. Similarly, new permanent WIM and portable sites are proposed on interstates and principal arterials in other regions including Natchitoches, Central Louisiana near Alexandria, Evangeline, southwest Louisiana near Lake Charles, Lafayette, Baton Rouge, East/West Feliciana, Saint Helena, Slidell, and Washington parishes. These are shown in the Appendix.

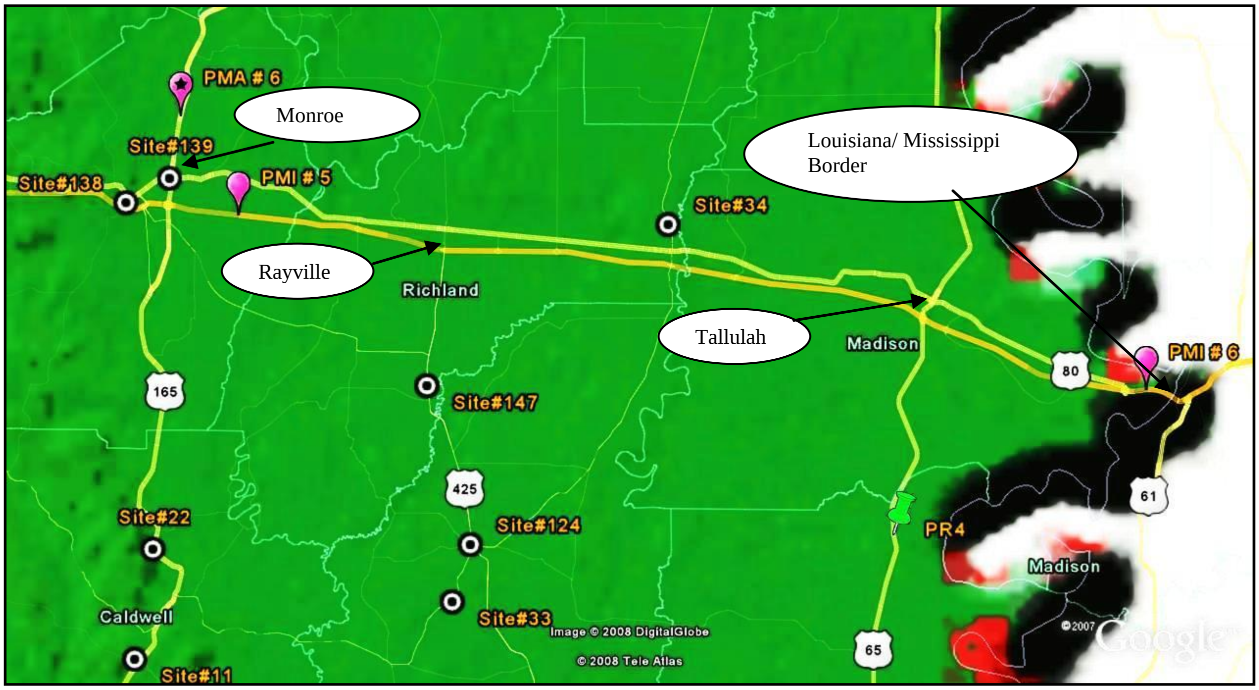

Figure 70
Map showing WIM stations in Monroe-Madison region

Alternative Plan # 2

This alternative assumes that WIM data from weight enforcement stations is available. This enforcement data is supplementary to data used in alternative #1. Utilizing enforcement WIM site locations, the number of proposed permanent WIM sites under alternative #1 is minimized as enforcement scales substitute some proposed WIM sites. Also the cost of the traffic data collection is reduced in comparison to alternative #1. There is no change in the location of the proposed WIM sites in alternative #1. However, 12 of proposed permanent WIM sites in alternative #1 can be eliminated and substituted with enforcement sites, as shown in Table 37. In this alternative, 17 permanent WIM stations are estimated for the entire state, out of which 7 are proposed on interstates and 10 on principal arterials.

Table 37
Permanent WIM sites replaced by enforcement sites

Permanent WIM station number	Substituted by Enforcement station number/Location
PMI 1 (I-20)	EN 1, Greenwood, Caddo Parish, LA
PMI 6 (I-20)	EN 2, Delta, Madison Parish, LA
PMI 9 (I-10)	EN 5, Toomey, Calcasieu Parish, LA
PMI 11 (I-10)	EN 6, Breaux Bridge, St. Martin parish, LA
PMI 12 (I-10)	EN 9, Laplace, St. John Parish, LA
PMI 13 (I-12)	EN 8, Baptist, Tangipahoa Parish, LA
PMI 14 (I-10)	EN 12, LA/MS Joint port at border
PMI 15 (I-59)	EN 11, LA/MS Joint port at border
PMI 16 (I-10)	EN 13, 55501, I-10 West, Slidell, LA
PMI 17 (I-55)	EN 7, Kentwood, Tangipahoa parish, LA
PMA 3 (LA-12)	EN 4, Starks, Calcasieu Parish, LA
PMA 5 (US-61)	EN 10, Laplace, St. John Parish, LA

Recommended Portable and Permanent Equipment

Upon review of the sensors from Virginia, Washington, and NHCRP Report 509, the single load cell was seen to be the most accurate and reliable equipment. This single load cell provides gross vehicle weights that are within 6 percent of actual vehicle weights for 95 percent of measured trucks. On the other hand, gross vehicle weight (GVW) is within 10 percent for bending plates and within 15 percent for piezoelectric sensors for 95 percent of the measured trucks [*2*]. Bending plates could be used under shorter-term data collection needs (5 years or less) and where traffic volume is relatively low. This is because bending plates have safety issues on high volume roads and a tendency to move out of its position in the pavement creating a hazard. Piezoelectric sensors are extremely temperature sensitive, hence they cannot be utilized for a WIM site, which records higher truck volumes. The only limitation with the single load cell is that it is cost prohibitive. The cost for installing, operating, and maintaining the equipment will be discussed in the next section of the report.

In alternative plans, all proposed permanent WIM sites on interstates are recommended to utilize a single load cell; principal arterials are recommended with either single load cells or bending plates, and the portable WIM should continue to have piezoelectric sensors for traffic monitoring purposes. As the traffic volume is relatively low on principal arterials (other highways) than interstate highways, there is a possibility of adopting a bending plate sensor instead of a single load cell.

Cost Estimates for Recommended WIM Equipment

On reviewing costs required for WIM sites from studies conducted in Virginia, Texas, and Washington and NHCRP Report 509, substantial insight into the expenditures needed for WIM sites were acquired. By summarizing costs for installing, operating, and maintaining WIM stations inferred from the literature review, a conservative estimate is shown in Table 38.

In Table 38, it is evident that the estimated initial average costs for the three equipment types vary by a big margin. The primary cause for the price variation among the three equipments is attributed to the sensor cost only, as the roadside electronics and cabinets cost the same for all sensors. The labor and material cost for piezoelectric sensors is approximately one-third the cost of single load cells and half the cost of bending plates. For the annual recurring costs, the calibration cost is same for all the sensors, while there is a slight difference in price for maintaining the site. Traffic needs to be regulated during installation for half a day for piezoelectric sensors, two days for bending plates, and three days or more for single load cells. These costs are cited from the NHCRP report 509 that was published in 2004 and, therefore, do not reflect the actual cost today [*5*].

Table 38
Cost for recommended WIM equipment [*5*]

Site costs	Piezoelectric (in $)	Bending Plate (in $)	Single Load Cell (in $)
Initial			
Sensor costs/lane	2500	10, 000	39,000
Road side Electronics	7,500	8,000	8,000
Roadside Cabinets	3,500	3,500	3,500
Total	13,500	21,500	50,500
Installation costs/lane			
Labor and Materials	6,500	13,500	20,800
Calibration	2,600	2,600	2,600
Traffic control	0.5 days	2 days	3+ days
Total	9100	16,100	23,400
Annual Recurring costs/lane			
Site maintenance	4,750	5,300	6,200
Recalibration	2,600	2,600	2,600
Total	7,350	7,900	8,800
Overall Total	29,950	45,500	82,700

In Table 39, the costs for the recommended alternative plans have been estimated approximately based on the figures from Table 38. Table 39 provides different options of either installing all the recommended permanent WIM sites with single load cells or with the combination of single load cells on interstate highways and bending plates on principal arterials. The cost for building a concrete section for two lanes (based on a 300-ft section of jointed concrete) is estimated to be $230,000 based on Virginia’s study. Depending upon site conditions, this should be added to the total cost if necessary [*7*].

Criteria for Building a Permanent WIM Station

WIM sites should have the following characteristics prior to the construction of any site [*4*]:

- Smooth, flat (in all planes) pavement
- Pavement in good condition and that has enough strength to adequately support axle weight sensors
- Vehicles traveling at constant speeds over the sensors
- Access to power and communications

In many cases, highway agencies have found it to be a wise investment to build 300-ft. concrete pavement sections into which WIM scales are placed. This gives agencies smooth, strong, maintainable platforms to place sensors. Strong concrete pavements generally do not change structural strength with changing temperatures and tend to deteriorate slowly. Thus, strong concrete pavements are generally considered to be good locations for scale sensors. Pavements with high-durability characteristics provide a long design life and low maintenance costs for the scale system [*5*].

Table 39
Cost for the alternative plans recommended

Plans	Equipment	Initial Costs (A)	Installation Costs (B)	Annual Recurring costs/lane (C= 1st year)	Quantity (D)	Amount (A+B+C) * D	Total Costs
Alternative # 1 (without enforcement sites)	29 Permanent sites with single load cell	$50,500 (Single Load Cell)	$23,400	$8,800	29	$2,398,300	$2,398,300
	17 Permanent sites (interstate) with single load cell and remaining 12 with bending plate	$50,500 (Single Load Cell)	$23,400	$8,800	17	$1,405,900	$1,951,900
		$21,500 (Bending Plate)	$16,100	$7,900	12	$546,000	
Alternative # 2 (with enforcement sites)	17 Permanent sites with single load cell	$50,500 (Single Load Cell)	$23,400	$8,800	17	$1,405,900	$1,405,900
	7 Permanent sites (interstate) with single load cell and remaining 10 sites with bending plate	$50,500 (Single Load Cell)	$23,400	$8,800	7	$578,900	$1,033,900
		$21,500 (Bending Plate)	$16,100	$7,900	10	$455,000	

Implementation Plan

The implementation plan for alternative plans #1 and #2 with an assumption of building 2 WIM sites each year have been listed and described in this section. In other words, all the recommended WIM sites are listed in a prioritized order so that LADOTD can follow up with it. The plan is as follows:

Step 1

Initially perform a pilot study scheduled on all the recommended permanent sites for a time period of seven days a week every quarter for a year. Repeat the analysis process, such as perform the sum of squared differences for truck traffic characteristics, compare the sites with each other, and find similarities between them. Cluster them into different groups and make a list of the permanent WIM sites within each group in a prioritized order that LADOTD can follow to build. Operate only one permanent WIM within each group and the rest with portable WIM for seven days a week in a year. Table 40 describes the time required to complete the pilot study with the number of WIM equipment employed. It is assumed that portable WIM is required for ten days at one site, out of which seven days are required for monitoring truck traffic and the remaining three days are required to uninstall the equipment and install at the next site. In each quarter of the year, there are 90 days and, therefore, minimum number for WIM equipment required in alternative #1 is 4 in order to monitor 29 proposed WIM sites, and for alternative #2, the minimum number of WIM equipment required is two to monitor 17 proposed sites. In other words, within 73 days, traffic data can be collected from all the 29 WIM sites for alternative #1 with the help of four WIM portable equipment.

Table 40
Time required in completing the pilot study

No. of WIM equipment employed	No. of days required (For Alternative #1)	No. of days required (For Alternative #2)
1	(29* 10)/ 1= 290	(17* 10)/ 1= 170
2	(29*10)/2 = 145	(17*10)/2 = 85
3	(29*10)/3 = 97	(17*10)/3 = 57
4	(29*10)/4 = 73	(17*10)/4 = 43
5	(29*10)/5 = 58	(17*10)/5 = 34
6	(29*10)/6 = 49	(17*10)/6 = 29

Step 2

This step provides a list of prioritized recommended WIM sites that LADOTD can follow. This list is based on the analysis of truck volume frequencies, truck routes, geographic zones, current axle load spectra, and vehicle class distribution. The WIM sites proposed in alternative plans #1 or #2 are to be built and should collect traffic data, such as truck axle weights, vehicle classification, and volume counts. Table 41 lists the prioritized proposed WIM sites for alternative plan #1. Interstates should be given first priority. In Table 41, PMI 11 is proposed in 2009 because the truck traffic characteristics of this site are similar to four other proposed WIM sites and, therefore, should be built in the first year. It was also considered that the two WIM sites proposed each year were not in the same region. The sites proposed well within the state were given more priority than the sites proposed at the border.

Table 41
List of prioritized proposed WIM sites for alternative plan #1

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Proposed WIM #	PMI 11	PMI 8	PMI 10	PMI 3	PMI 9	PMI 6	PMI 1	PMA 7	PMA 4	PMA 5	PMA 12	PMA 3	PMA 8
	PMI 4	PMI 12	PMI 13	PMI 5	PMI 17	PMI 16	PMA 1	PMA 2	PMA 9	PMA 11	PMA 10	PMA 6	—

Table 42 lists the prioritized proposed WIM sites for alternative plan #2. In this plan, some of the proposed WIM sites are replaced by permanent enforcement sites and, therefore, would need a lesser number of years to execute the plan.

Table 42
List of prioritized proposed WIM sites for alternative plan #2

Year	2009	2010	2011	2012	2013	2014	2015	2016
Proposed WIM #	PMI 8	PMI 10	PMI 3	PMA 7	PMA 4	PMA 12	PMA 8	PMA 6
	PMI 4	PMI 5	PMA 1	PMA 2	PMA 9	PMA 11	PMA 10	—

CONCLUSIONS AND RECOMMENDATIONS

This research study primarily addresses the current traffic characterization techniques used in Louisiana for pavement design practices in order to identify critical changes needed as well as certain gaps and areas of potential development in the traffic monitoring process statewide. To achieve this, the characteristics of current practices of collecting traffic data were reviewed including WIM locations, adequacy of collected traffic data by LADOTD, existing equipment used, and reliability issues. This study also examined current and anticipated data collection procedures adopted by other states in order to have full understanding of the all elements required to improve the data collection process in Louisiana. This study also developed a strategic plan to initiate a WIM data collection program to improve the traffic data collection process required to adopt the new pavement design guide. To achieve this, geographic zones, truck routes, WIM enforcement locations, and truck volumes were identified to determine the number and location of permanent and portable WIM sites needed. Also, guidelines and cost estimates to build permanent WIM stations were proposed. Based on a thorough review of the current and anticipated data needs, two alternative plans were proposed: Plan #1 requires the construction of 29 new permanent WIM sites, while Plan #2 requires the construction of only 17 new permanent WIM sites in addition to the utilization of axle load data from the existing weight enforcement stations.

This study also sought to develop the truck axle load spectra based on the data currently collected in Louisiana from portable WIM stations. Before developing axle load spectra, some of the WIM sites were evaluated against the steering axle test and gross vehicle weight test to eliminate erroneous traffic data. Out of 96 portable WIM stations, 51 sites passed quality control tests and comprised valid weight data. WIM sites with underestimated and/or overestimated steering and GVW distributions were eliminated and not used for developing axle load spectra and vehicle class distributions. Forty-five WIM sites that were not included for developing axle load spectra showed piezoelectric sensors were out of calibration or failed. WIM data passing the evaluation tests were further utilized to compare similarities in truck traffic characteristics and to develop axle load spectra and vehicle class distributions based on the truck traffic classification method recommended by the Mechanistic-Empirical Pavement Design Guide. To reduce the number of proposed WIM sites in the strategic plan, some of the existing WIM sites having similar truck traffic characteristics were grouped together using the sum of squared differences method. This grouping, however, was based on data collected in 48 hours only. Seven groups were formed under dominant vehicle class 9 category sites, three for vehicle class 5, and two for vehicle class 6. It was concluded that each group may be represented by only one permanent WIM station. Some WIM sites were not grouped as it had unique truck traffic characteristics.

Moreover, single, tandem, and tridem axle load spectra and vehicle class distributions were developed in this study with the truck traffic classification procedure. There was no quad axles monitored at portable WIM sites. All the WIM sites when grouped with truck traffic classification procedure had good agreement with vehicle class distribution and single axle load spectra default values. Default tandem and tridem axle load specta were entirely different when compared to the TTC groups. It was observed that there exists a significant variability in vehicle class distribution within the same functional classification. The study also applied the portable WIM data in order to estimate the load equivalency factors (LEFs) for both flexible and rigid pavements observed in 2004, 2005, and 2006. The LEF results are tabulated and shown in Appendix I.

Other Findings

Collecting 48-hour traffic data does not provide an accurate estimate of yearly, seasonal, and daily changes in vehicle characteristics. The axle weight data from a 48-hour sample is inadequate to compare two sites with axle load distribution factors and to build several truck weight roadway groups of similar characteristics. As a result, it is also not possible to develop axle load spectra for each site and to characterize traffic loads accurately. It was also noted that equipment used to collect the 48-hour data was not routinely calibrated, therefore the quality of data may be suspicious. It is also concluded that the axle load spectra developed by using weight data collected from portable WIM stations might not represent the actual Louisiana truck traffic loadings well and, therefore, is not recommended for use. The strategic plans proposed in this study are strongly recommended to meet axle load data requirements of the new pavement design guide.

Recommendations

The following list of recommendations is proposed to support the implementation of the new pavement design guide in the state of Louisiana:

- Portable WIM equipment used at sites that did not pass the data validation tests should be calibrated on a regular basis to ensure more accurate axle load spectra.
- The traffic data from weight enforcement stations should be collected and utilized for development of axle load spectra.
- A pilot study is recommended for implementing proposed permanent WIM sites. In this test, the proposed sites are recommended to be monitored for seven continuous days in every quarter of the year with calibrated piezoelectric sensors.
- All other proposed and existing portable WIM sites should continue with piezoelectric sensors for traffic monitoring.

- A monitoring period of seven continuous days for portable WIM sites is recommended instead of the current 48-hour period.
- Existing portable WIM sites in close proximity of newly proposed permanent WIM sites should be eliminated.
- Single load cells are recommended for proposed permanent WIM sites located on interstates and bending plates are recommended for sites located on principal arterials.
- It is not recommended to group highways based on their functional classification for developing axle load spectra and other factors. Instead, the truck traffic classification (TTC) system is recommended for grouping highways for present conditions.
- For low-volume roads, it is recommended that calibrated portable WIM sensors are used and evaluation tests are performed periodically.
- Default values for general traffic inputs such as axle per vehicle, mean wheel location, traffic wander, design lane width, tire pressure, axle configuration, and wheelbase should be used unless specific information is obtained.

ACRONYMS, ABBREVIATIONS & SYMBOLS

AADTT	Average Annual Daily Truck Traffic
AASHTO	American Association of State Highway and Transportation Officials
ASTM	American Society of Testing and Materials
ATR	Automatic Traffic Recorders
AVC	Automatic Vehicle Classifiers
BL	Brass Linguini
DMV	Department of Motor Vehicles
ESAL	Equivalent Single Axle Load
FHWA	Federal Highway Administration
GVW	Gross Vehicle Weight
HELP	Heavy-Vehicle Electronic License Plate
IRD	International Road Dynamics
LADOTD	Louisiana Department of Transportation and Development
LEF	Load Equivalency Factor
LTPP	Long Term Pavement Performance
LTRC	Louisiana Transportation Research Center
MEPDG	Mechanistic-Empirical Pavement Design Guide
NHCRP	National Cooperative Highway Research Program
NPV	Net Present Value
SHA	State Highway Agency
SHRP	State Highway Research Program
TDO	Traffic Data Office
TRAC	Washington State Transportation Center
TMG	Traffic Monitoring Guide
TTC	Truck Traffic Classification
TXDOT	Texas Department of Transportation
VC	Vehicle Classifications
VMT	Vehicle Miles Traveled
WSDOT	Washington State Department of Transportation
VTRIS	Vehicle Travel Information System
WIM	Weigh-In-Motion

REFERENCES

1. "Development of the 2002 Guide for the Design of New and Rehabilitated Pavement Structures: Phase II," National Cooperative Highway Research Program, Project 1-37A, 2004.

2. "Improving Traffic Characterization to Enhance Pavement Design and Performance: Load Spectra Development," Washington State Transportation Center TRAC Report, Seattle, WA, 2005.

3. "Evaluation of LADOTD Traffic Load Data for Determination of Traffic Load Equivalency Factors," Louisiana Department of Transportation Development (LADOTD) and Louisiana Transportation Research Center (LTRC) Report, LA, 2000.

4. Traffic Monitoring Guide, U.S. Department of Transportation, Federal Highway Administration, 2001.

5. Hallenbeck, M. and Weinblatt, H. "Equipment for Collecting Traffic Load Data," NHCRP REPORT 509, Washington, D.C., 2004.

6. Traffic load spectra development for the 2002 AASHTO pavement design Guide, Mississippi State University Report, Jackson, Mississippi, 2004.

7. Cottrell, B.H. Jr.; Schinkel, T.O.; and Clark, T.M. "A Traffic Data Plan for Mechanistic-Empirical Pavement Designs (2002 Pavement Design Guide)." Virginia Department of Transportation and the University of Virginia report, Charlottesville, Virginia, 2003.

8. Tran, N.H. and Hall, K.D. "Evaluation of Weigh-In-Motion Data for Developing Axle Load Distribution Factors for Mechanistic Empirical Pavement Design Guide." Paper presented at 86th Annual Meeting of Transportation Research Board, Washington D.C., 2007.

9. Tran, N.H. and Hall, K.D. "Development and Influence of Statewide Axle Load Spectra on Flexible Pavement Performance." Paper presented at 86th Annual Meeting of Transportation Research Board, Washington D.C., 2007.

10. Neidigh, J.D. and Crawford, J.A. "Expanding the Texas Weigh-In-Motion program to meet AASHTO 2002 traffic data needs," Paper presented at 83rd Annual Meeting of Transportation Research Board, Washington D.C., 2004.

11. Lu, Q. and Harvey, J.T. "Characterization of Truck Traffic in California for Mechanistic-Empirical Design." Paper presented at 84th Annual Meeting of Transportation Research Board, Washington D.C., 2006.

12. Mainline sorting truck report, International Road Dynamics Inc., 1998.

13. Guide to LTPP Traffic Data Collection and Processing, Federal Highway Administration FHWA, Washington, D.C., 2001.

14. LTPP WIM data collection systems report for Louisiana, International Road Dynamics, 2007.

15. A Policy on Geometric Design of Highways and Streets, American Association of State Highways and Transportation Officials AASHTO, Washington, D.C., 1990.

16. Traffic Data Collection, Analysis, and Forecasting for Mechanistic Pavement Design, NHCRP REPORT 538, Cambridge Systematics Inc., Washington State Transportation Center and Chaparral Systems Corporation, Washington, D.C., 2005.

17. Kim, J.R.; Titus-Glover, L.; Darter, M.I.; and Kumapley, R. K. "Axle Load Distribution Characterization for Mechanistic Pavement Design," Transportation Research Record No. 1629, Washington D.C., pp 13-23, 1998.

18. Haider, S. W.; and Harichandran, R. S. "Characterizing axle load spectra by using gross vehicle weights and truck traffic volumes." Paper presented at 86th Annual Meeting of Transportation Research Board, Washington D.C., 2007.

19. Wang, Y.; Hancher, D. E.; and Mahboub, K. "Axle Load Distribution for Mechanistic–Empirical Pavement Design," Journal of Transportation Engineering, ASCE, Vol. 133, Issue 8, pp. 469-479, 2007.

APPENDIX A

Vehicle Class Distributions for Functional Classes

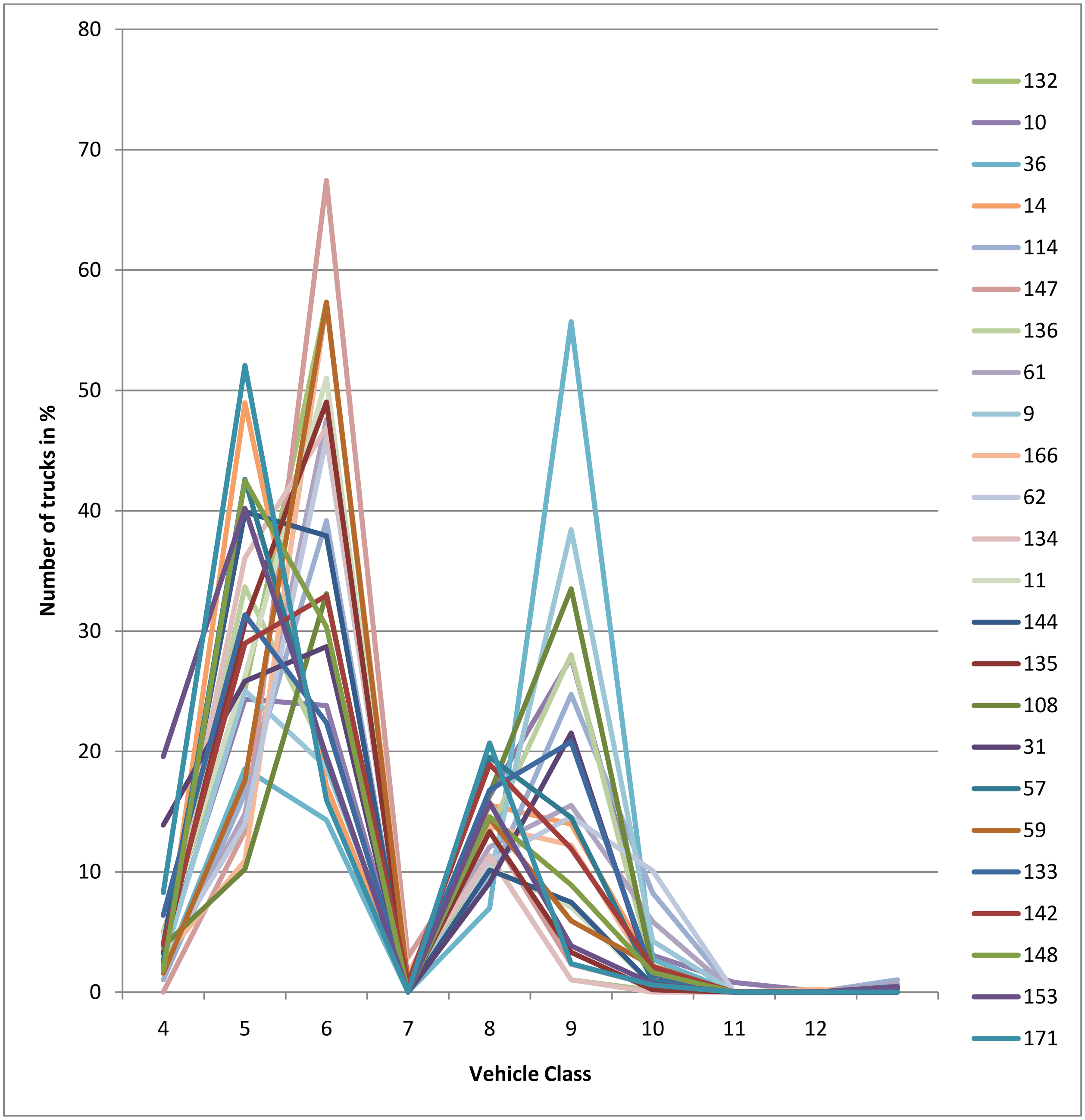

Figure 71
Vehicle class distribution for functional class 7

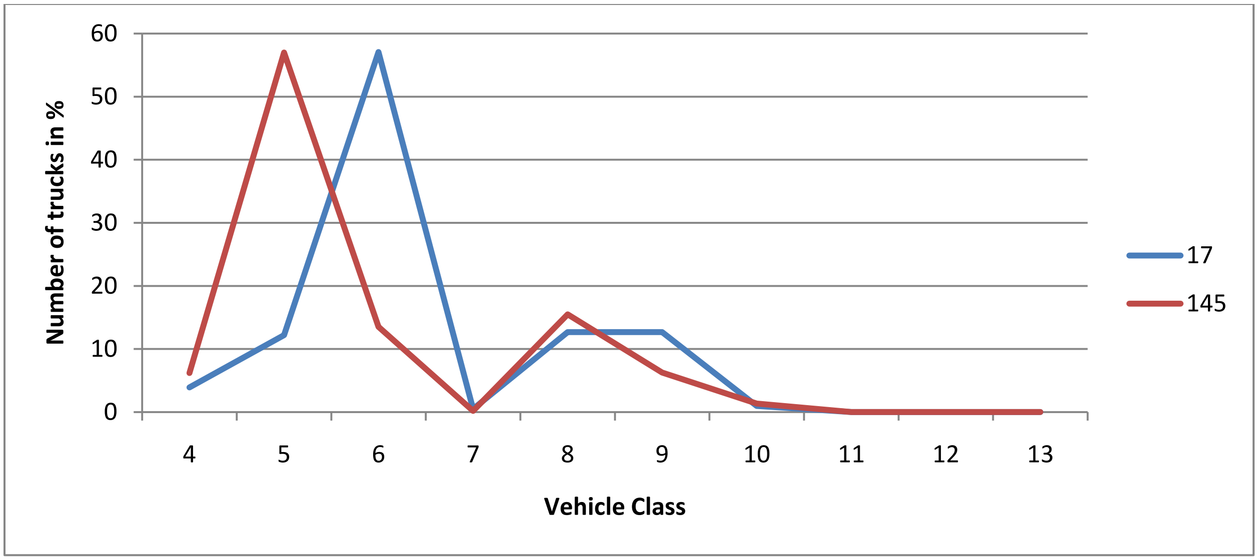

Figure 72
Vehicle class distribution for functional class 8

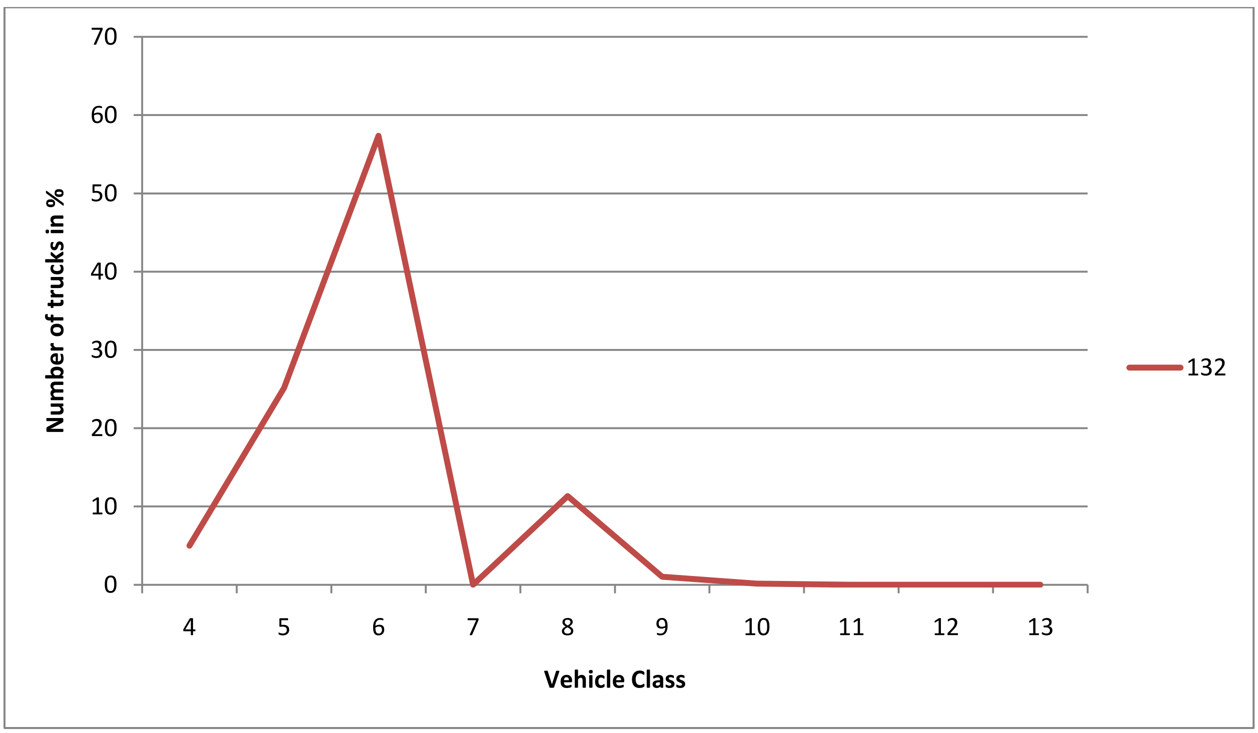

Figure 73
Vehicle class distribution for functional class 9

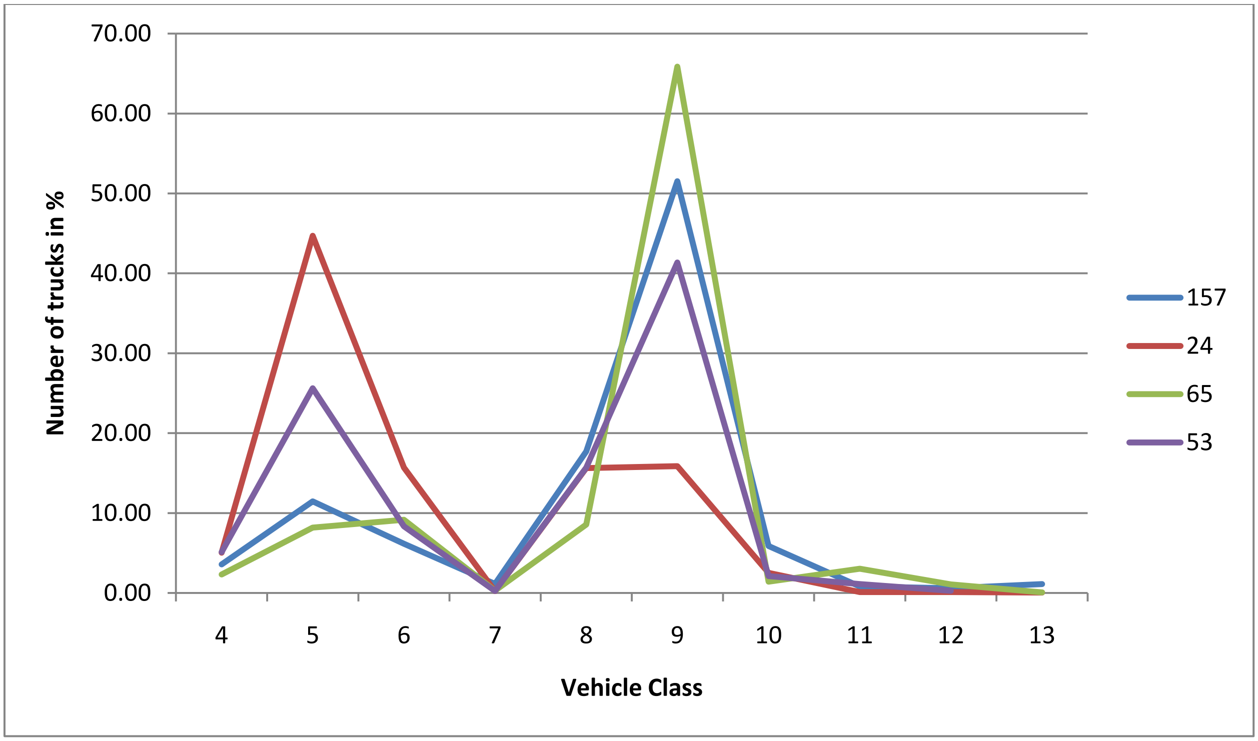

Figure 74
Vehicle class distribution for functional class 11

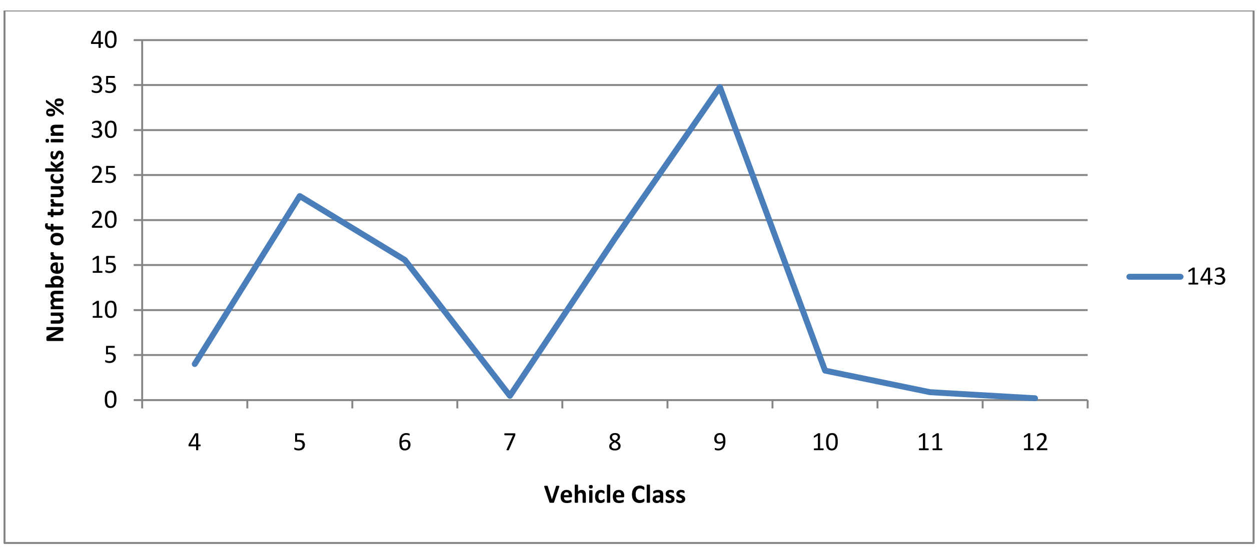

Figure 75
Vehicle Class Distribution for functional class 12

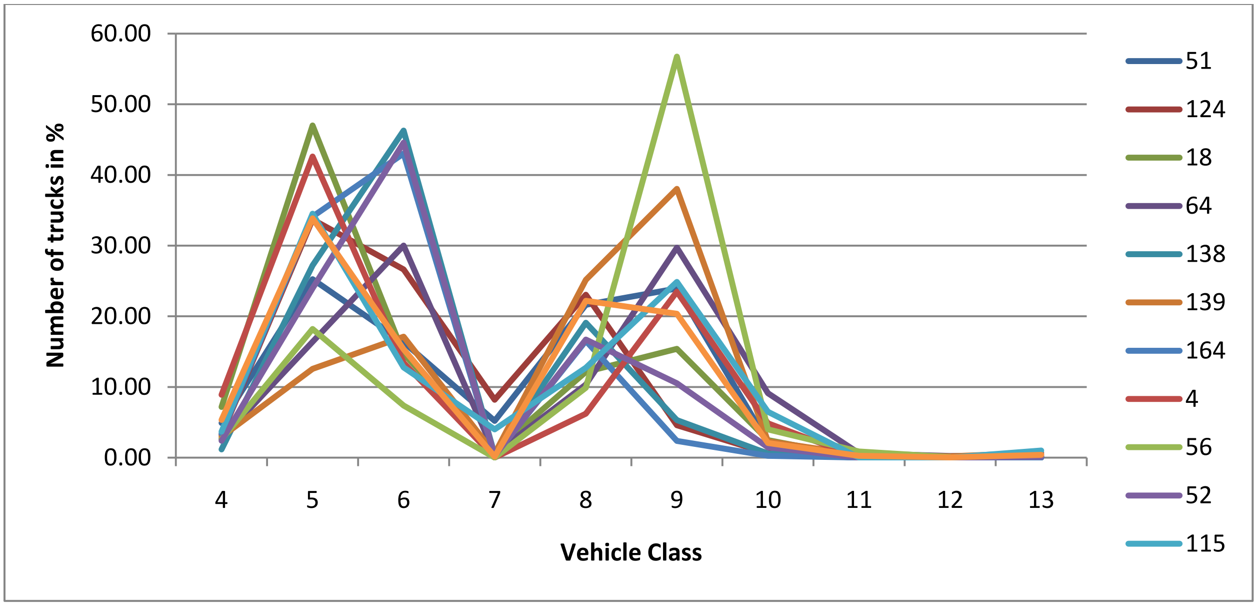

Figure 76
Vehicle class distribution for functional class 14

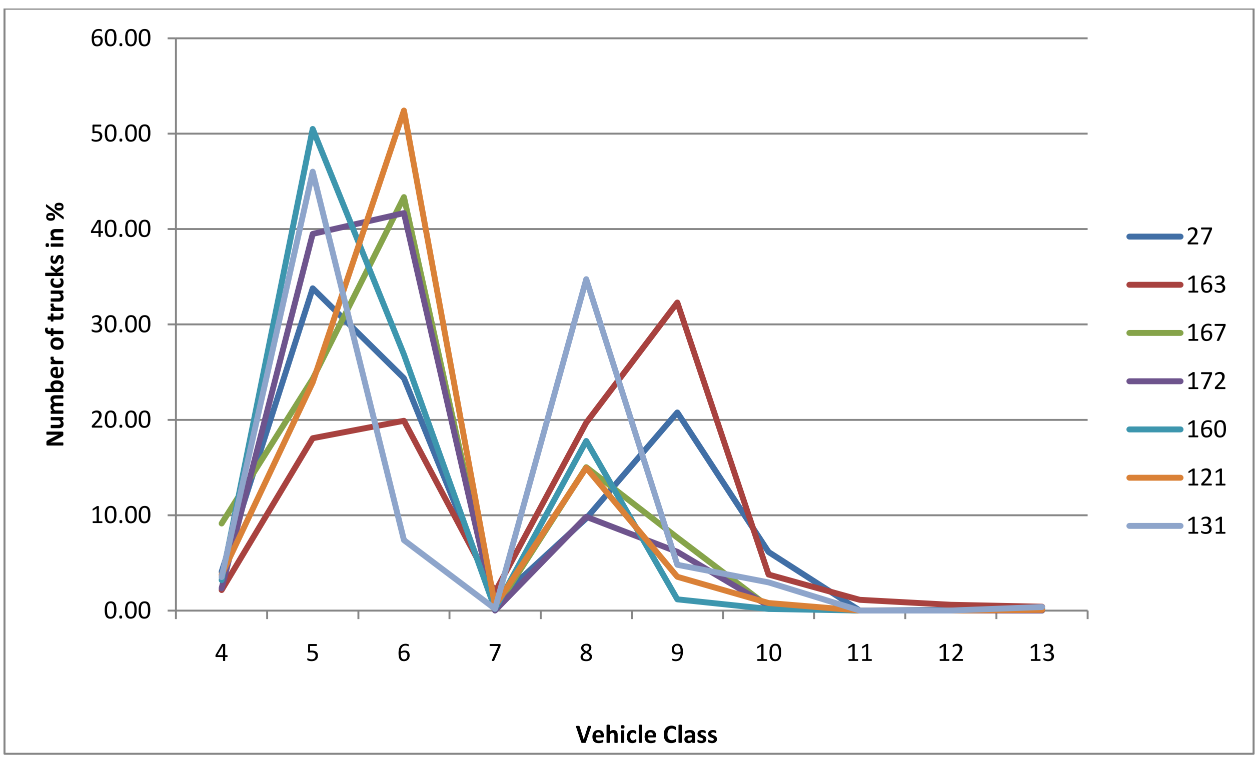

Figure 77
vehicle class distribution for functional class 16

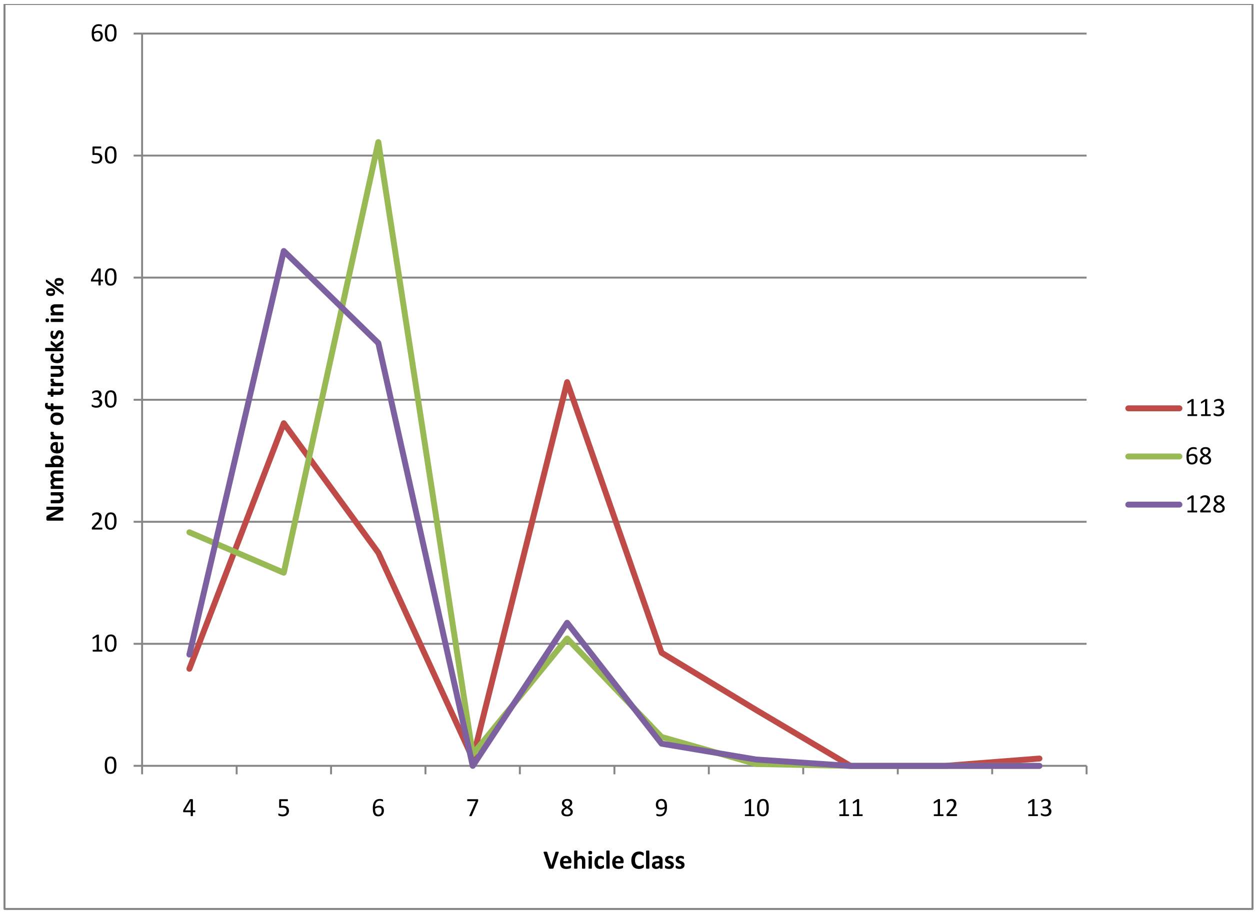

Figure 78
Vehicle class distribution for functional class 17

APPENDIX B

Single Axle Load Spectra and Vehicle Class Distributions for WIM Sites Having Similar Characteristics

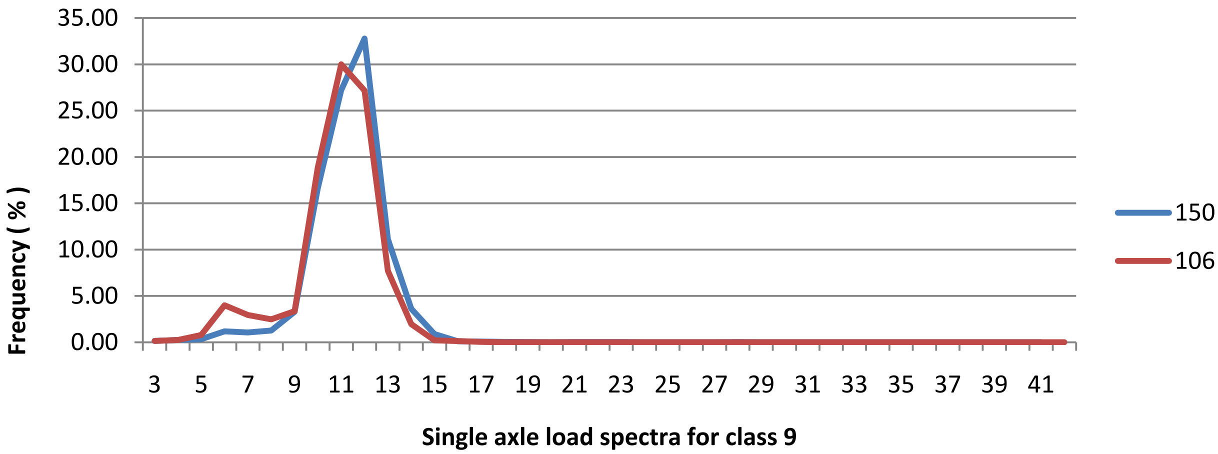

Figure 79
Group 3 single axle load spectra for class 9

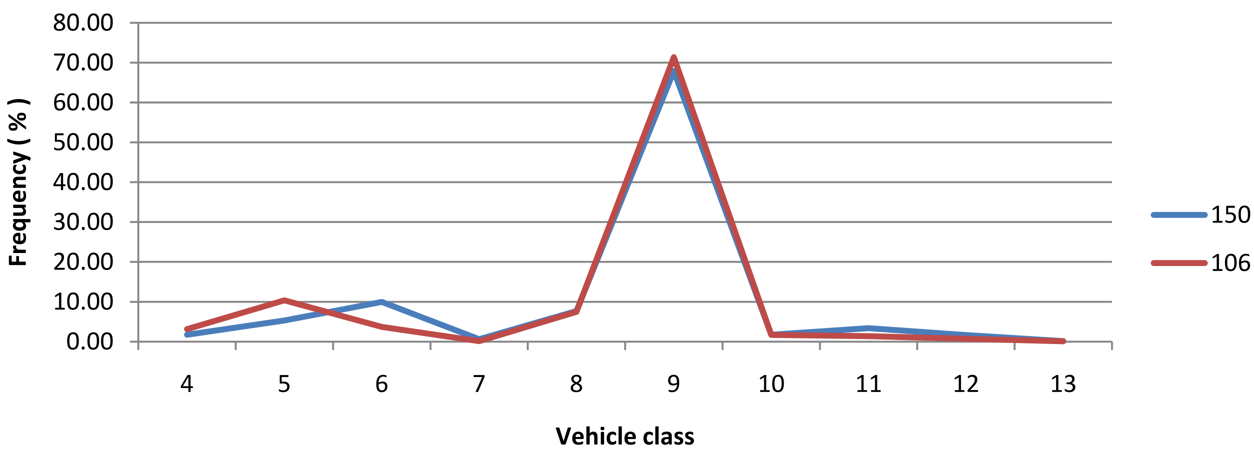

Figure 80
Vehicle class distribution for Group 3

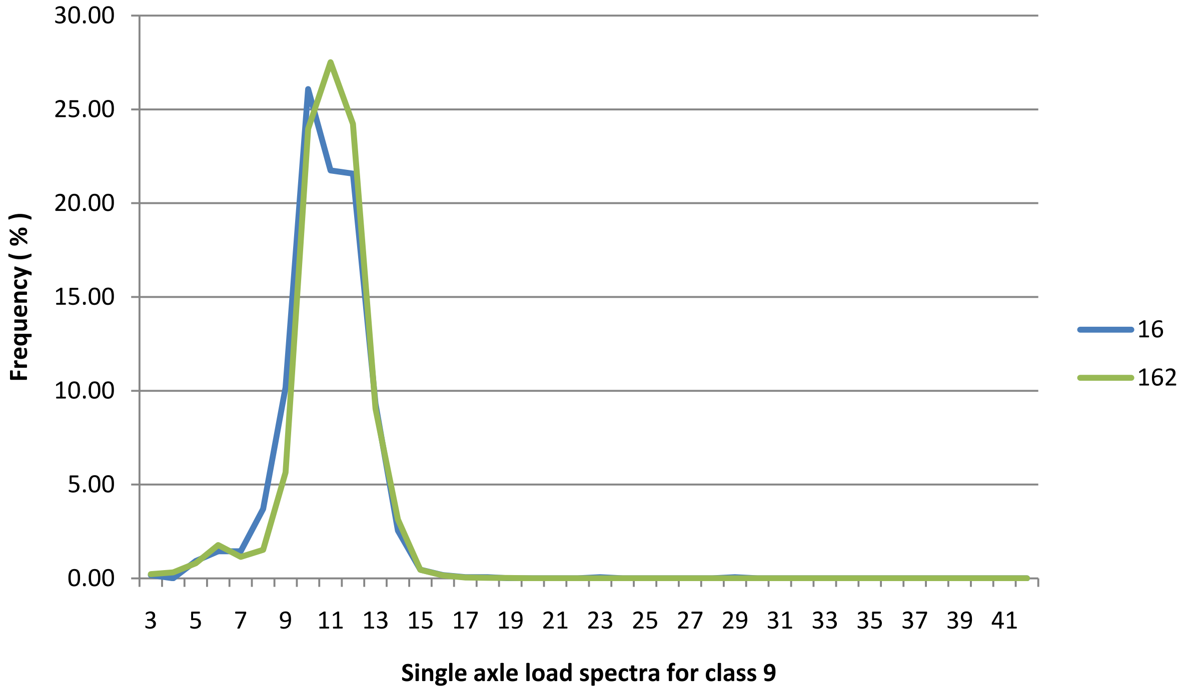

Figure 81
Group 4 single axle load spectra for class 9

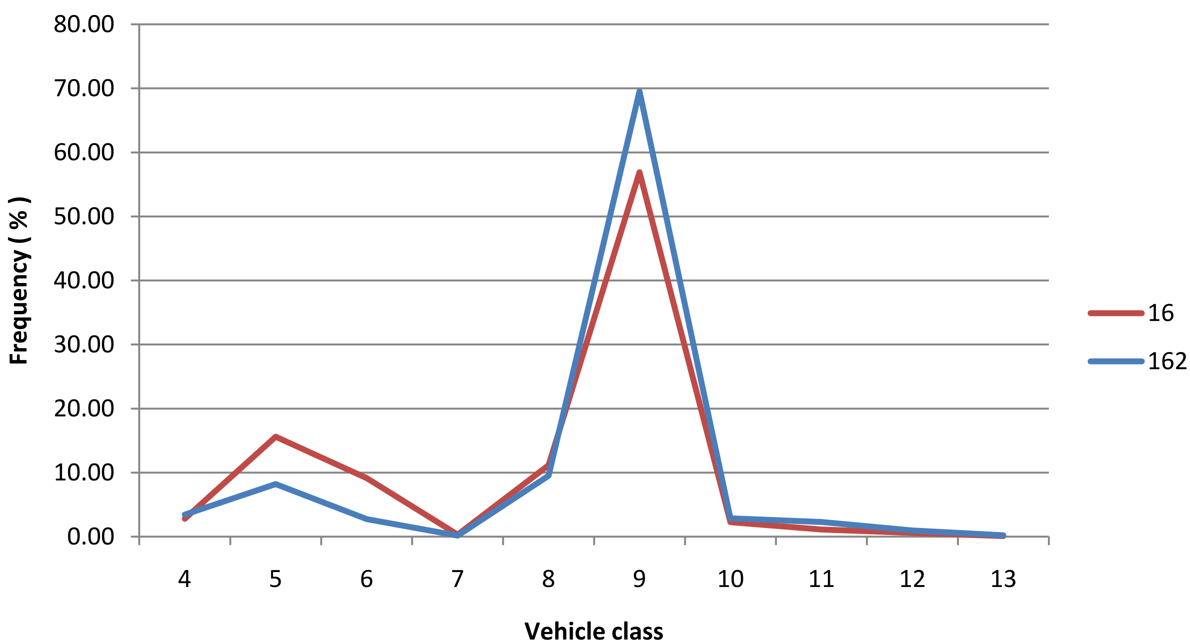

Figure 82
Vehicle class distribution for Group 4

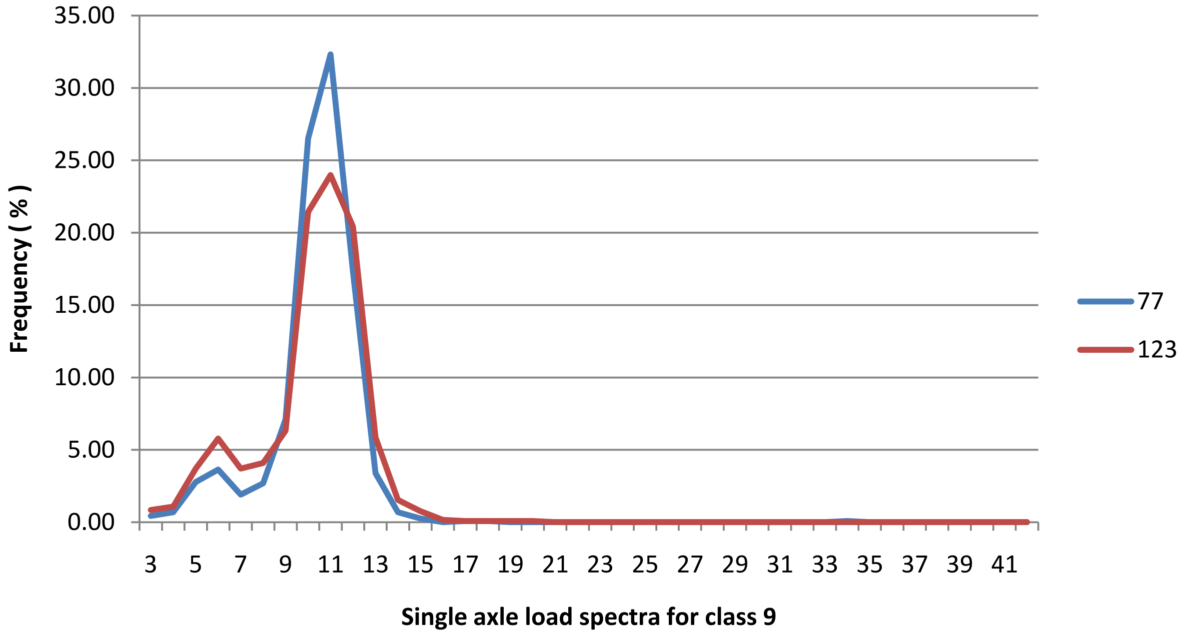

Figure 83
Group 5 single axle load spectra for class 9

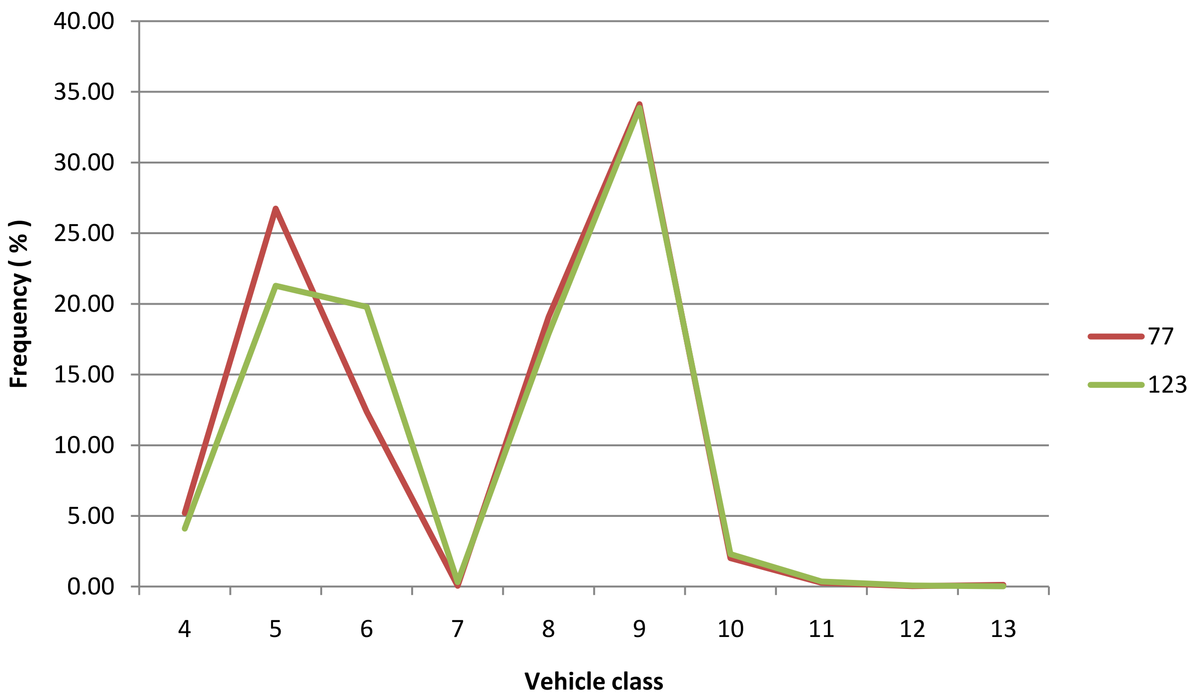

Figure 84
Vehicle class distribution for Group 5

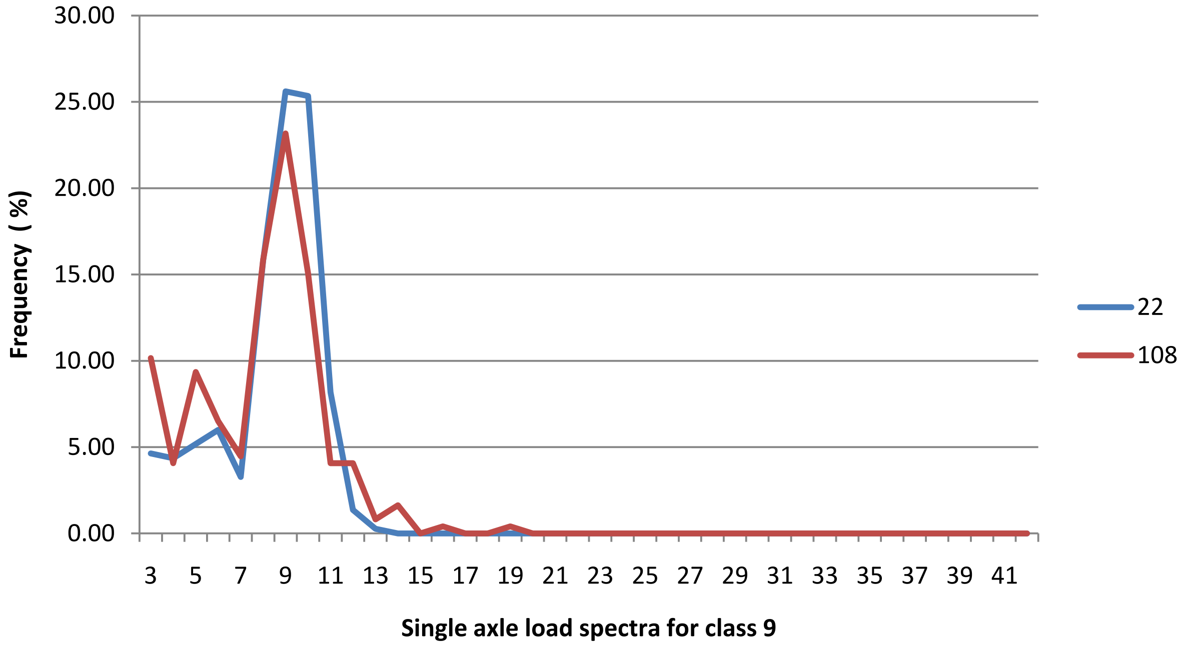

Figure 85
Group 6 single axle load spectra for class 9

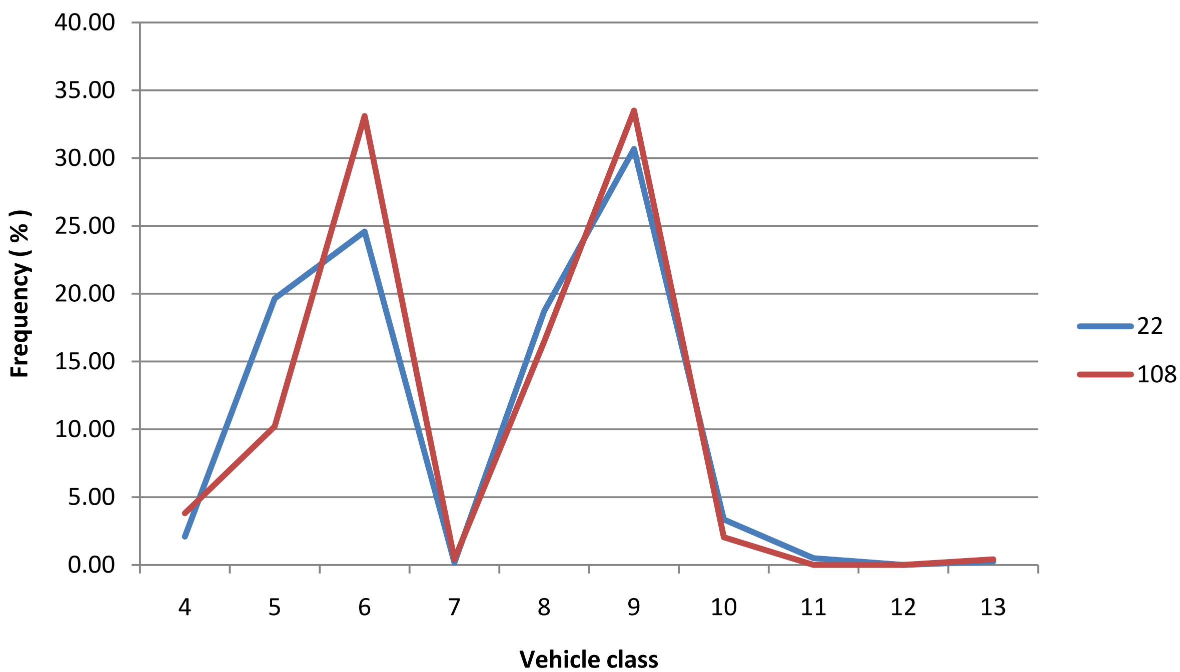

Figure 86
Vehicle class distribution for Group 6

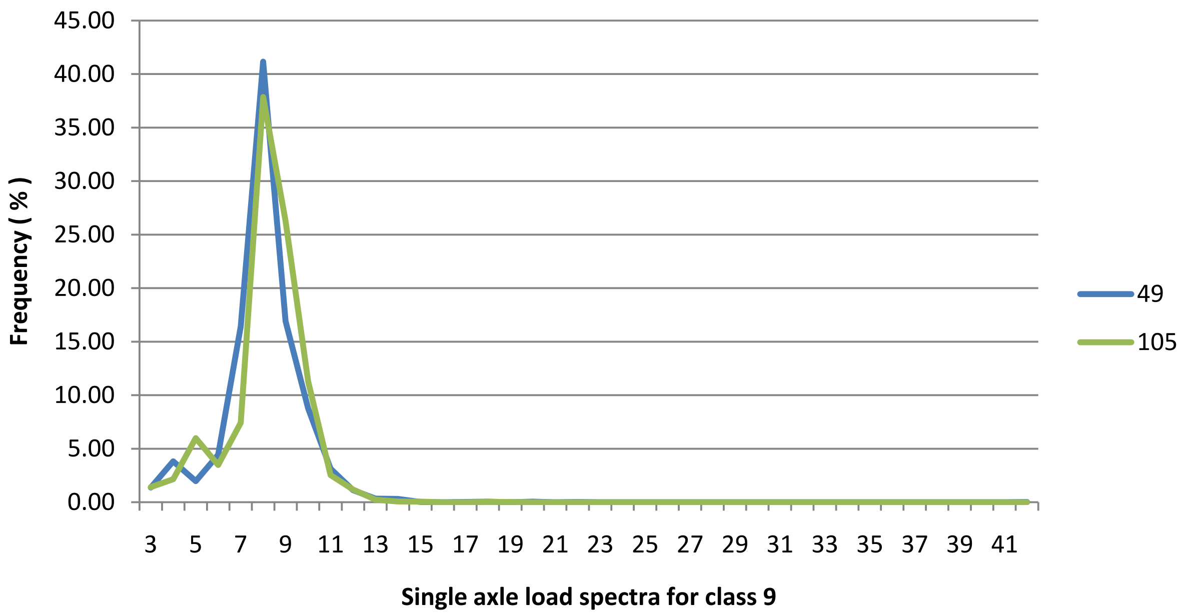

Figure 87
Group 7 single axle load spectra for class 9

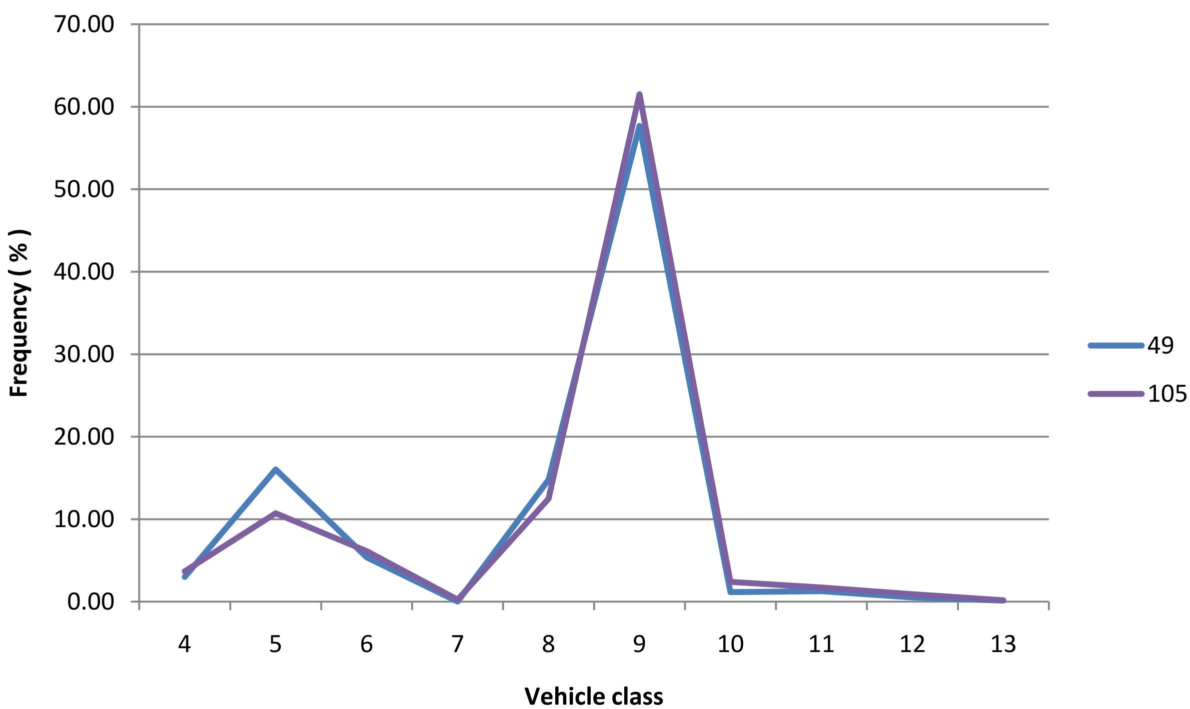

Figure 88
Vehicle class distribution for Group 7

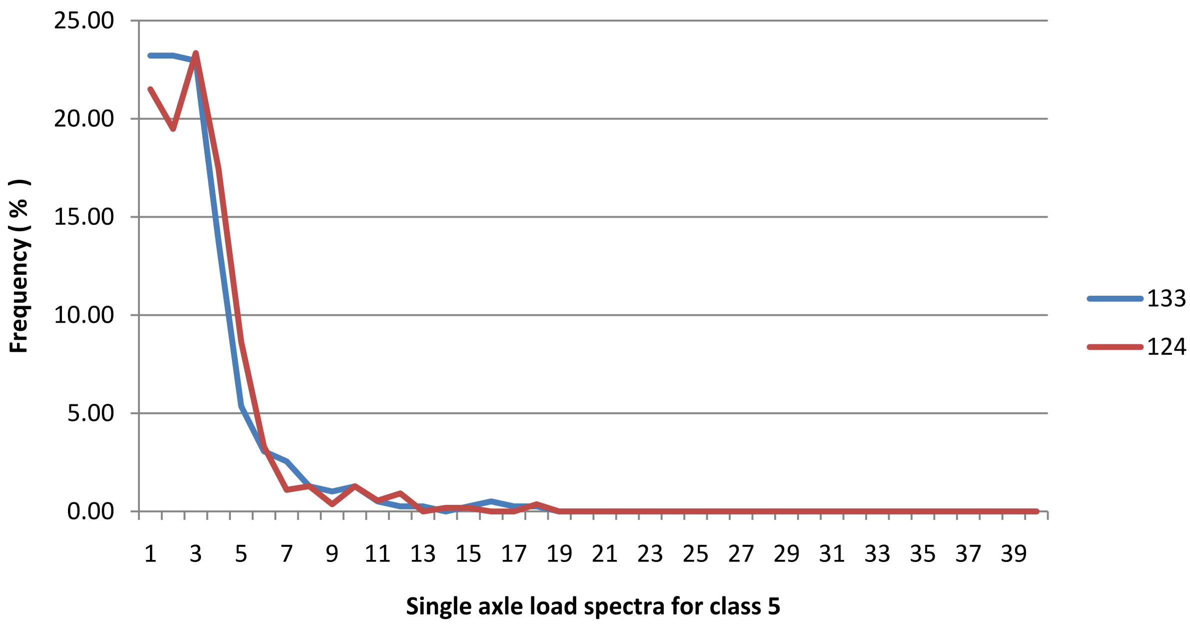

Figure 89
Group 8 single axle load spectra for class 5

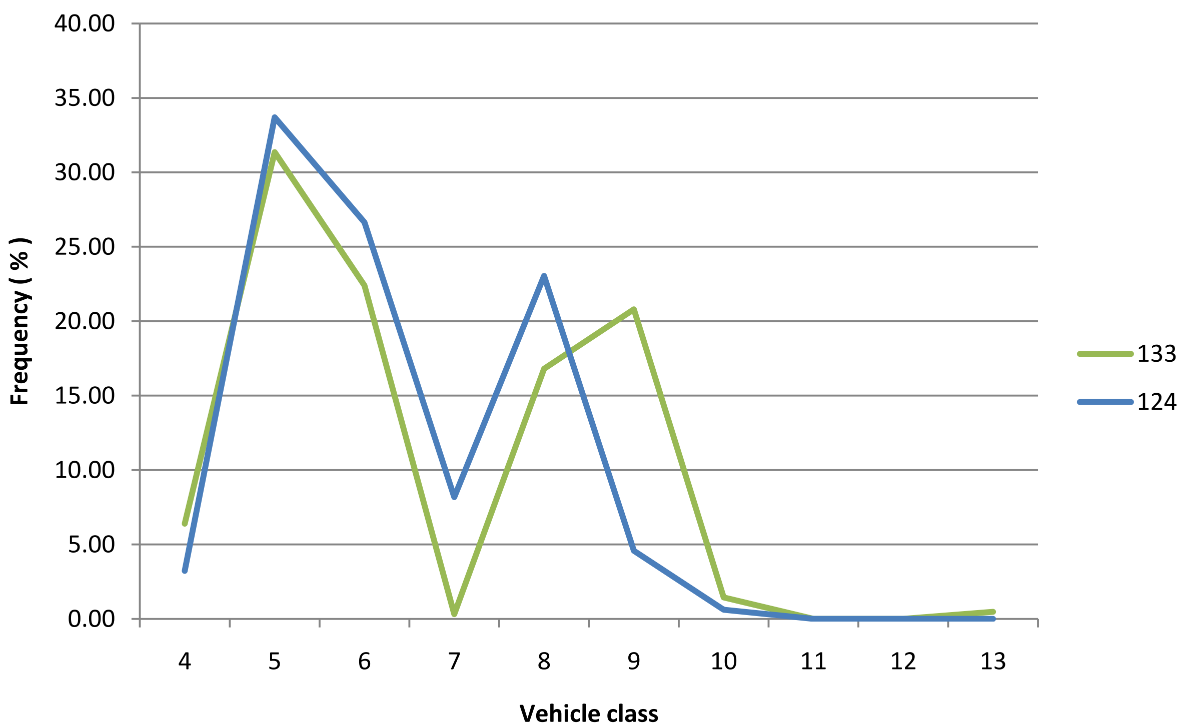

Figure 90
Vehicle class distribution for Group 8

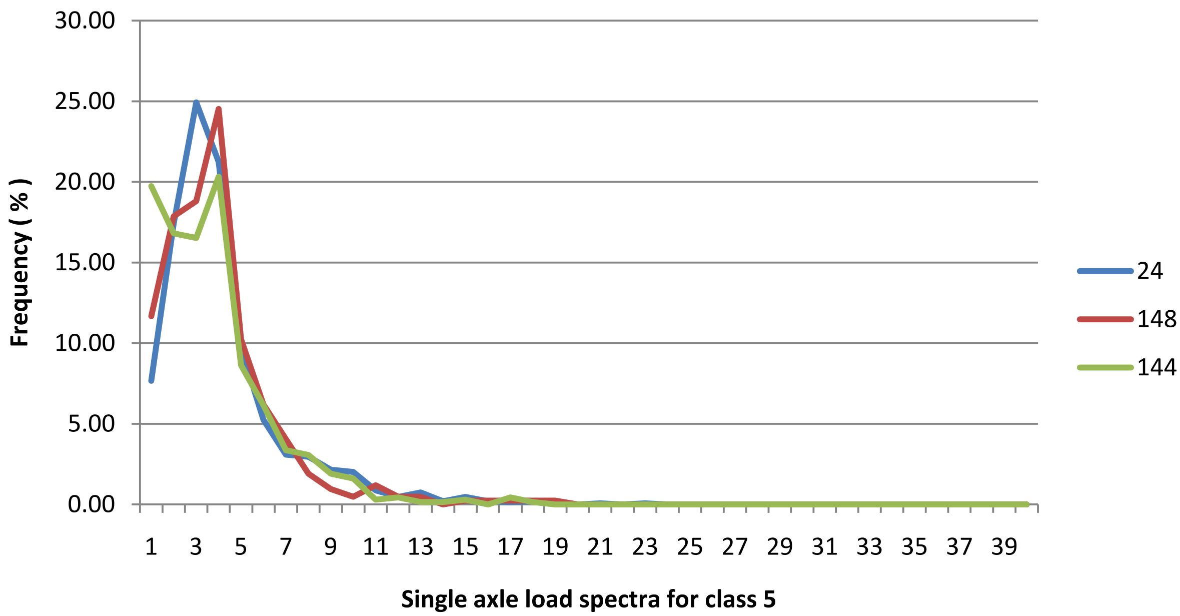

Figure 91
Group 9 single axle load spectra for class 5

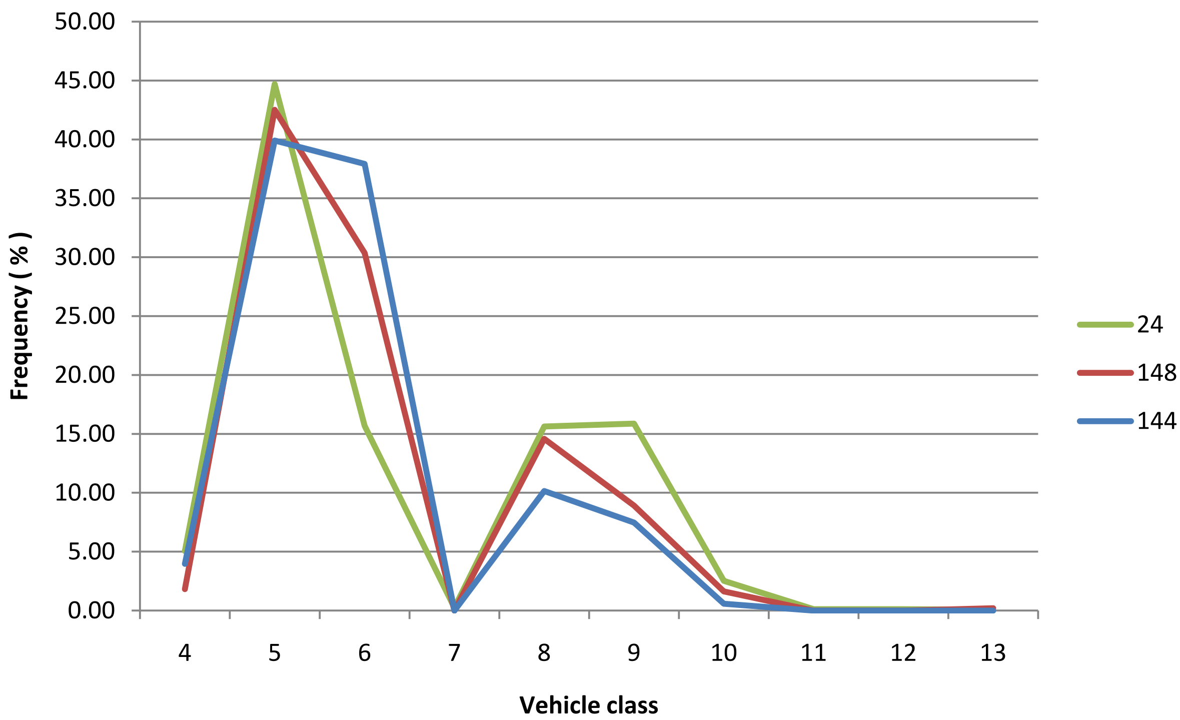

Figure 92
Vehicle class distribution for Group 9

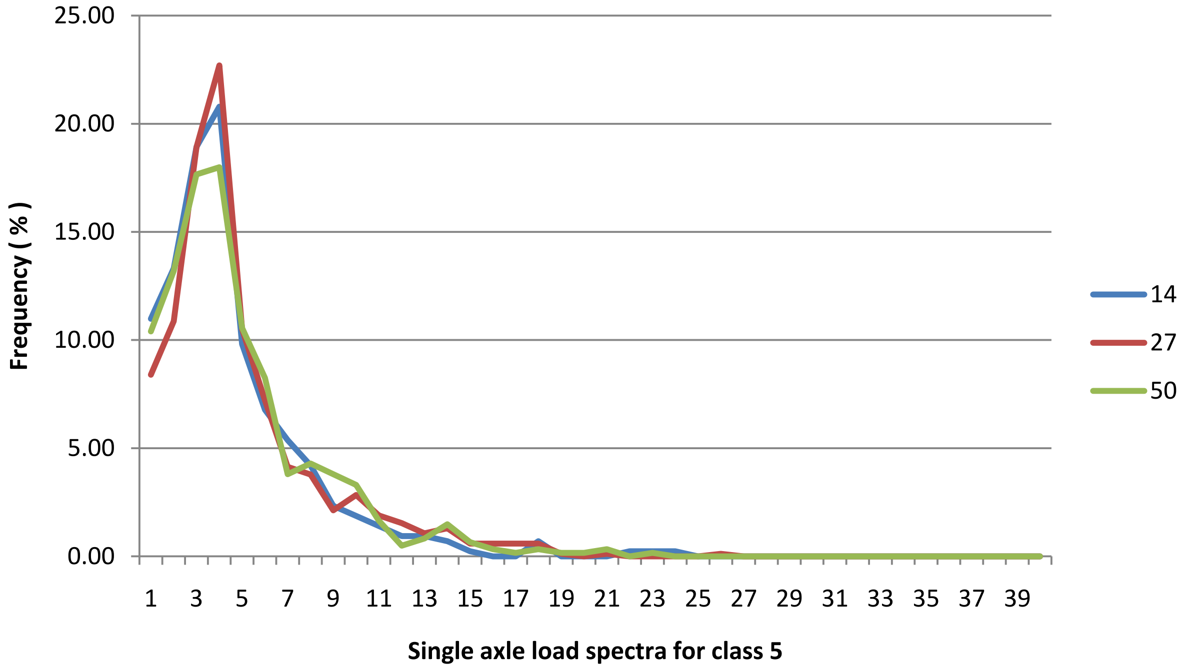

Figure 93
Group 10 single axle load spectra for class 5

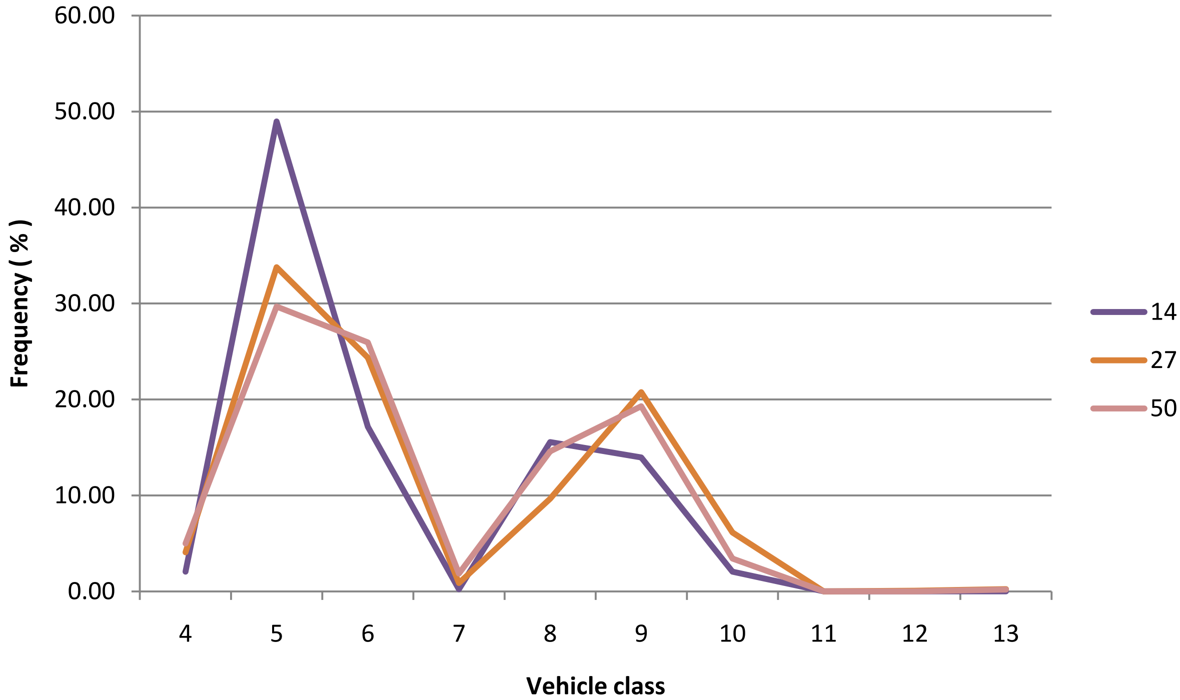

Figure 94
Vehicle class distribution for Group 10

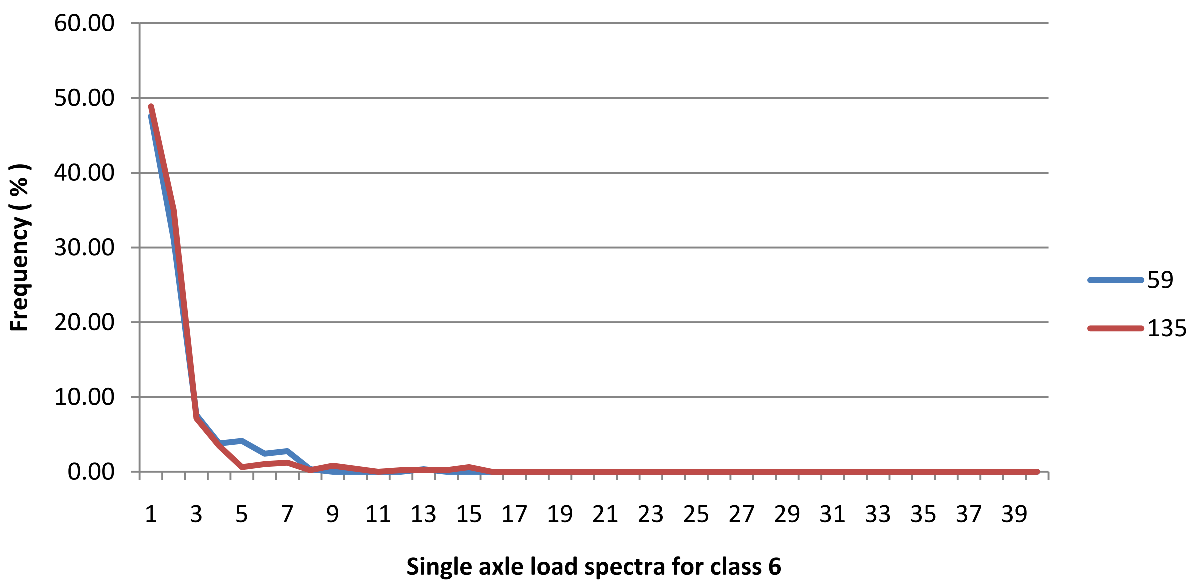

Figure 95
Group 11 single axle load spectra for class 6

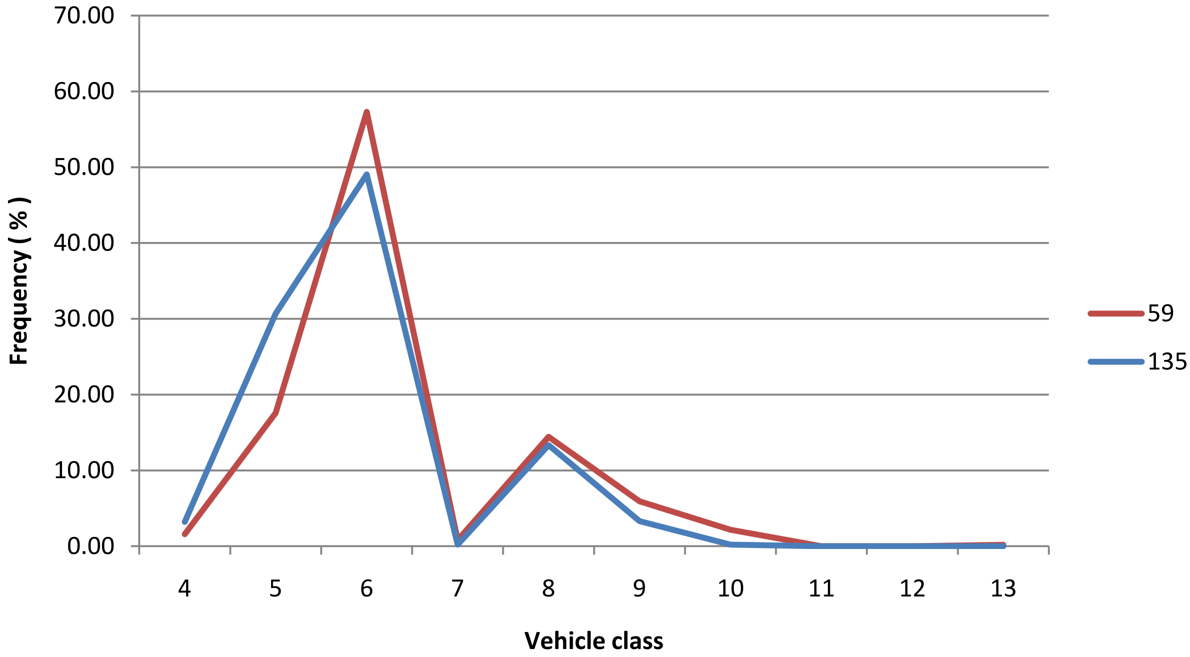

Figure 96
Vehicle class distribution for Group 11

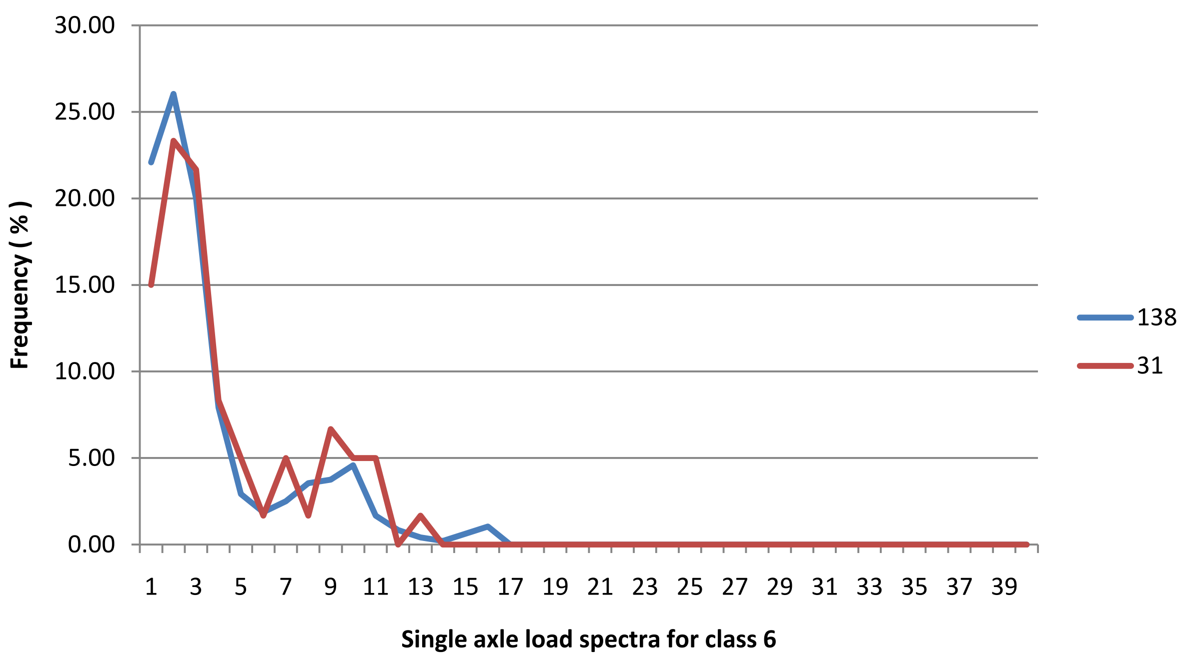

Figure 97
Group 12 single axle load spectra for class 6

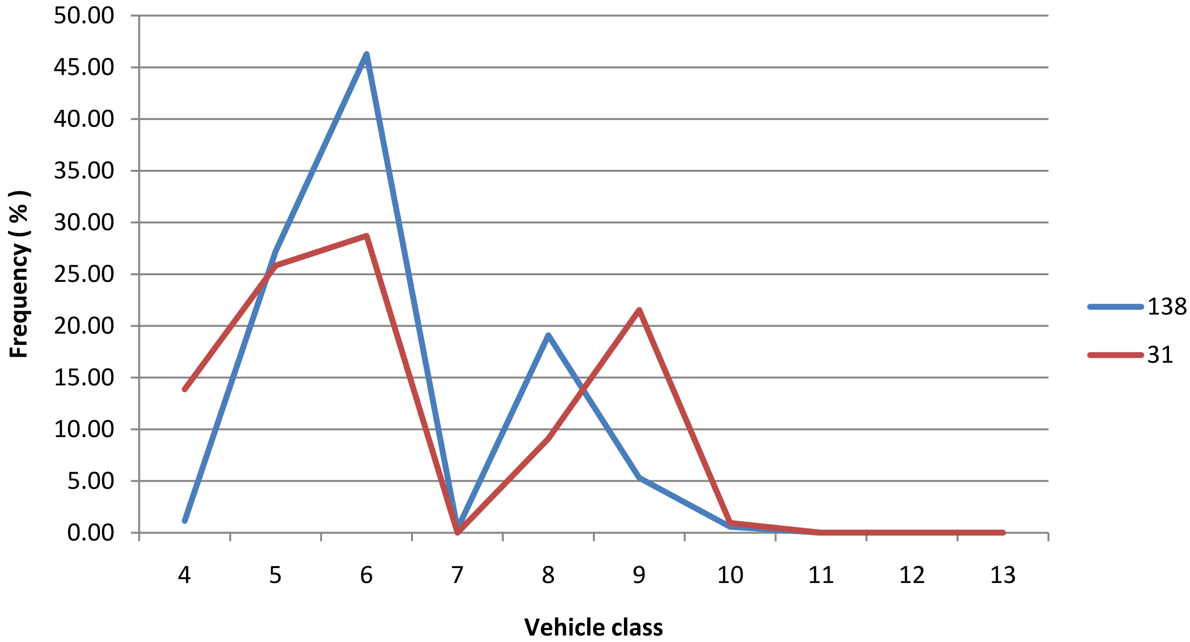

Figure 98
Vehicle class distribution for Group 12

APPENDIX C

Vehicle Class Distributions for TTC Groups

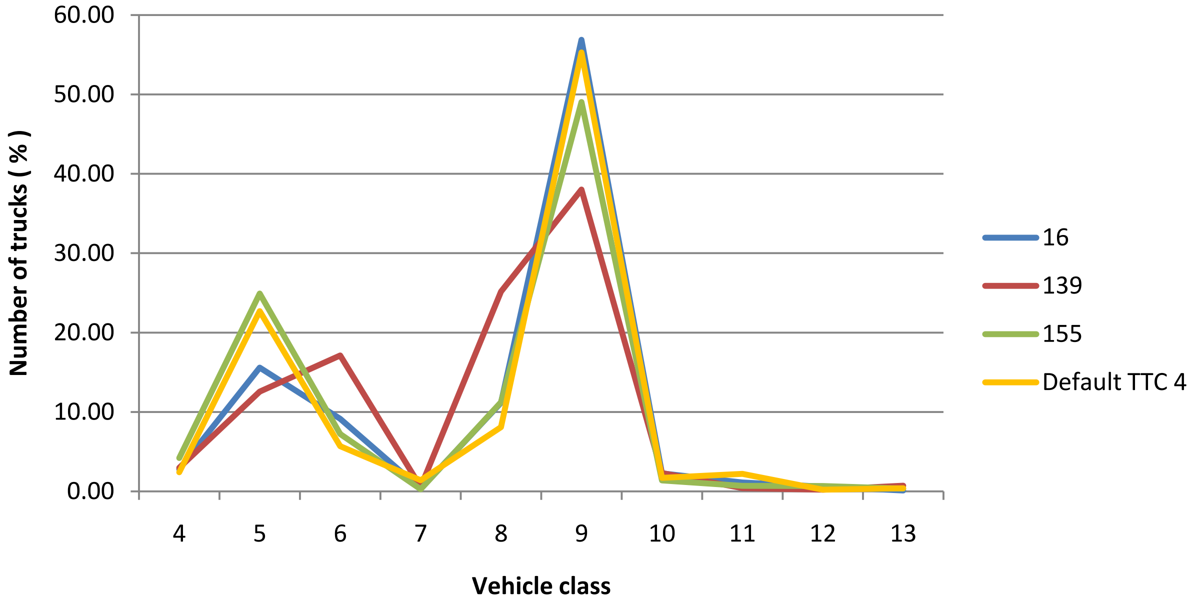

Figure 99
Vehicle Class Distribution for TTC 4

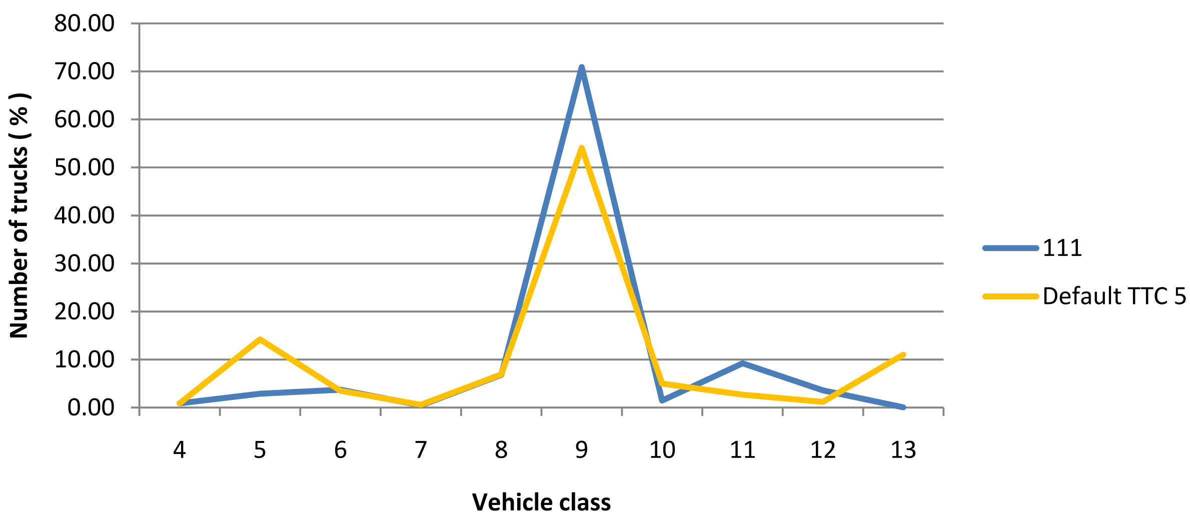

Figure 100
Vehicle Class Distribution for TTC 5

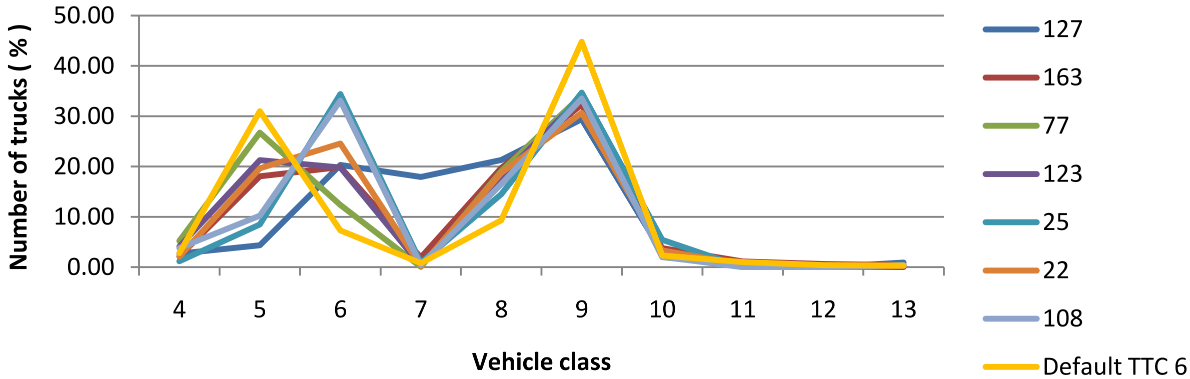

Figure 101
Vehicle Class Distribution for TTC 6

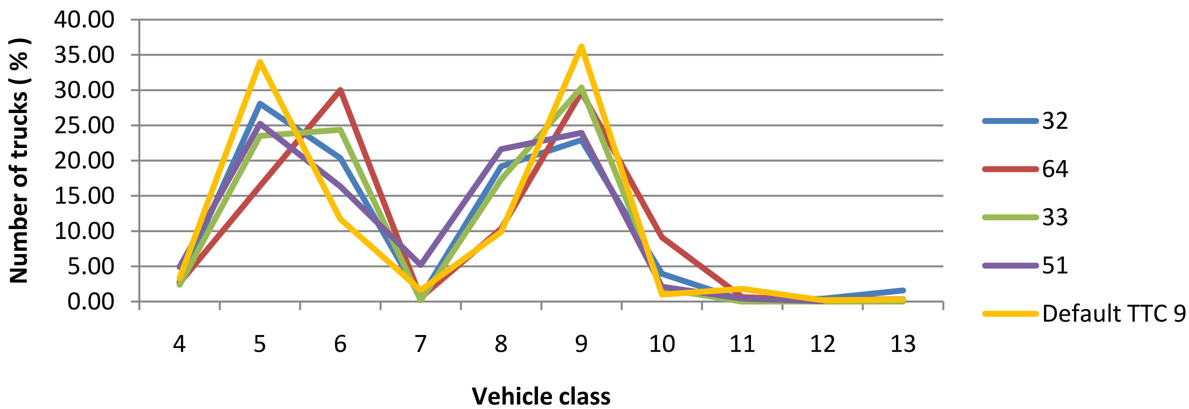

Figure 102
Vehicle Class Distribution for TTC 9

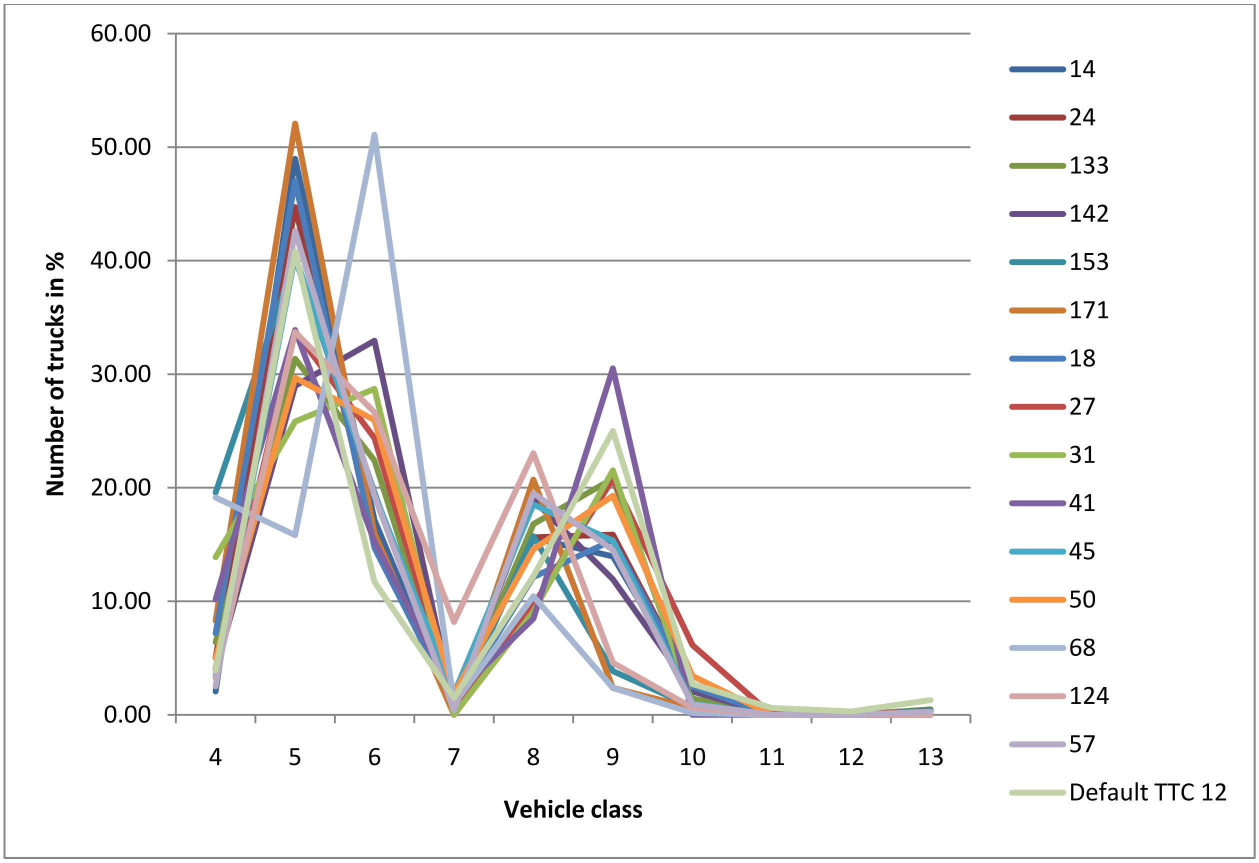

Figure 103
Vehicle Class Distribution for TTC 12

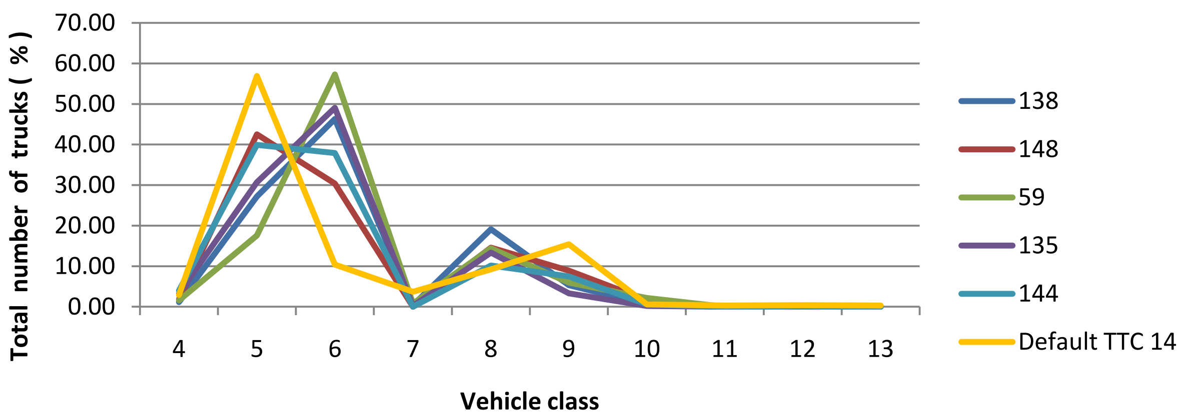

Figure 104
Vehicle Class Distribution for TTC 14

APPENDIX D

Single Axles per Vehicle Classes, Single Axle Load Spectra for Combined Vehicle Class, and Single Axle Load Spectra for Primary Classes for TTC Groups

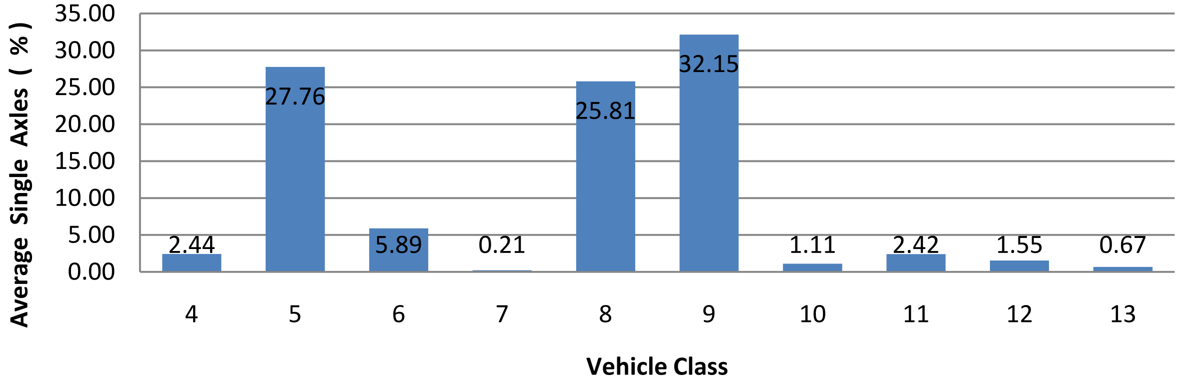

Figure 105
Single axles per vehicle class for TTC 4

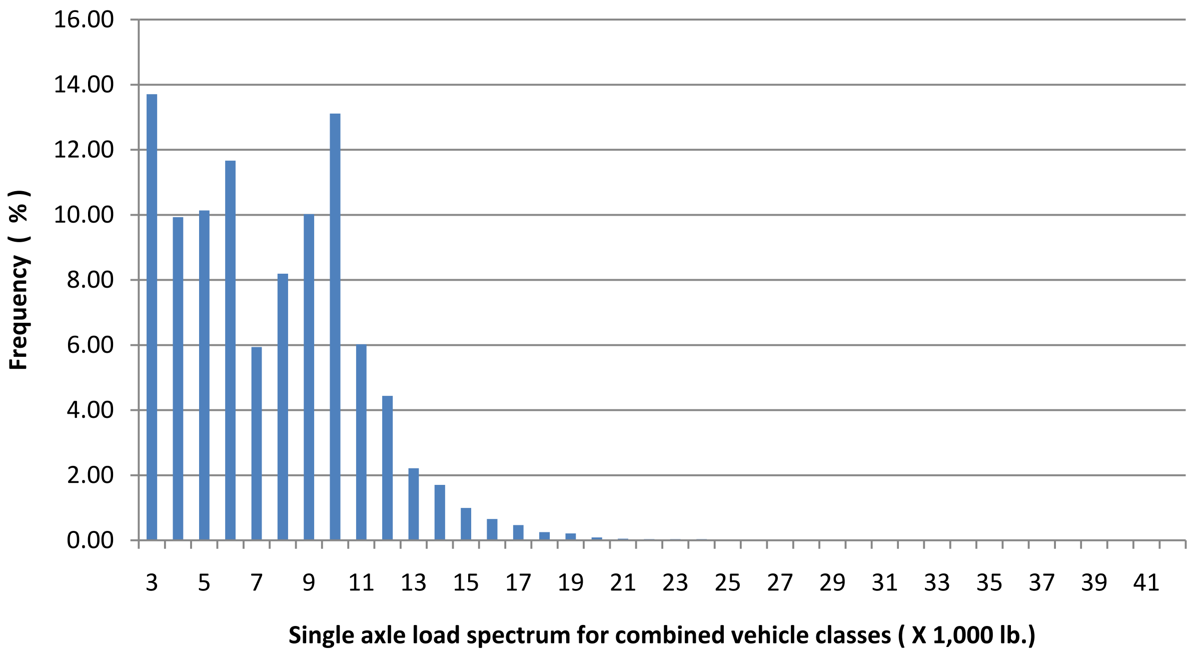

Figure 106
Single axle load spectrum for combined vehicle classes for TTC 4

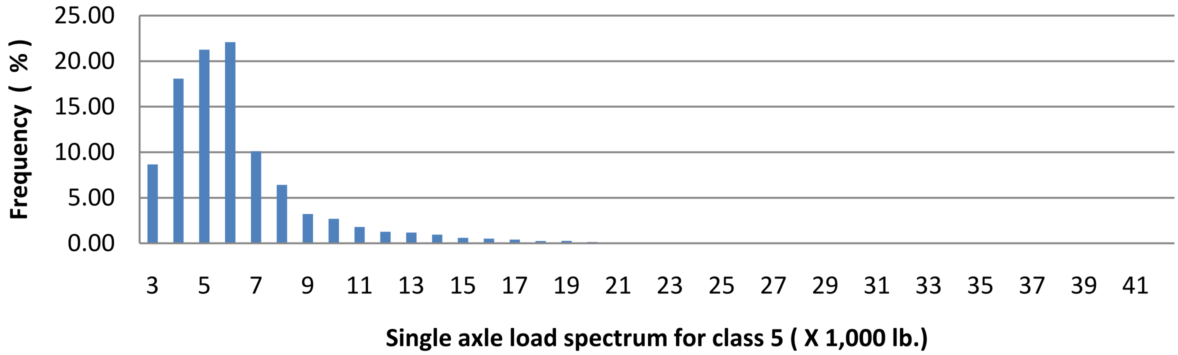

Figure 107
Single axle load spectrum for vehicle class 5 for TTC 4

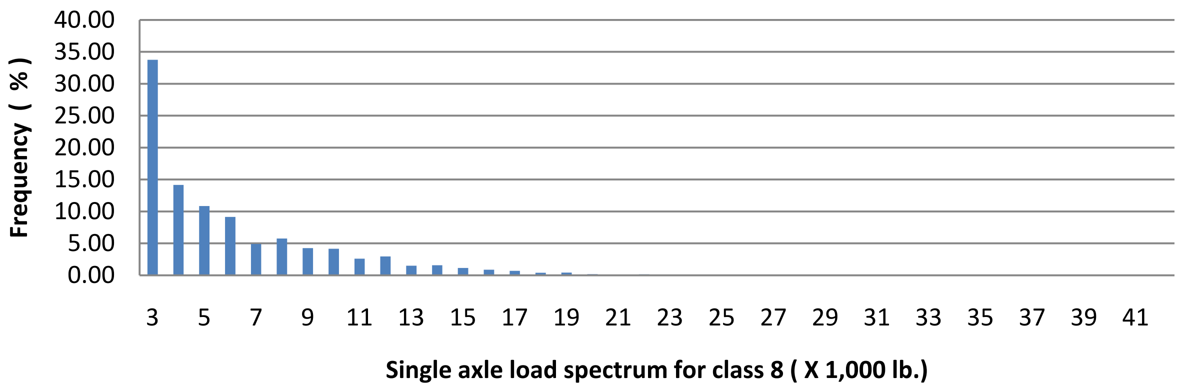

Figure 108
Single axle load spectrum for vehicle class 8 for TTC 4

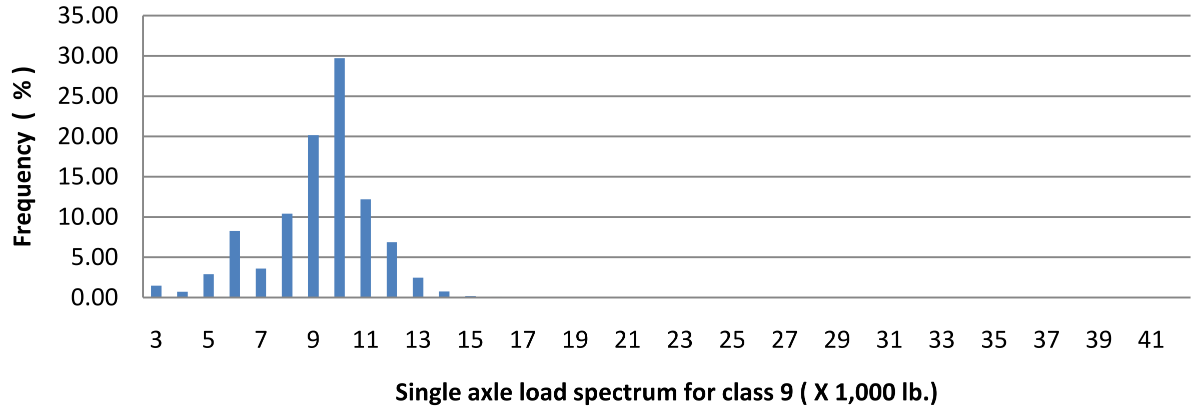

Figure 109
Single axle load spectrum for vehicle class 9 for TTC 4

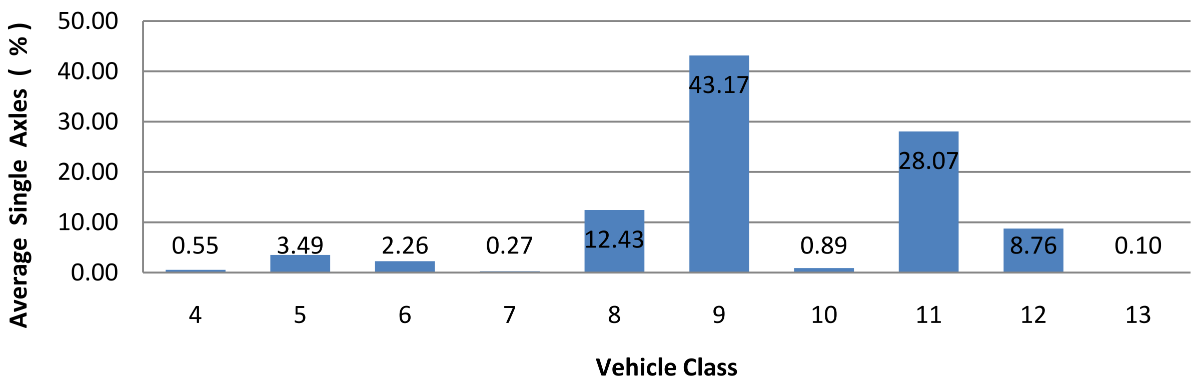

Figure 110
Single axles per vehicle class for TTC 5

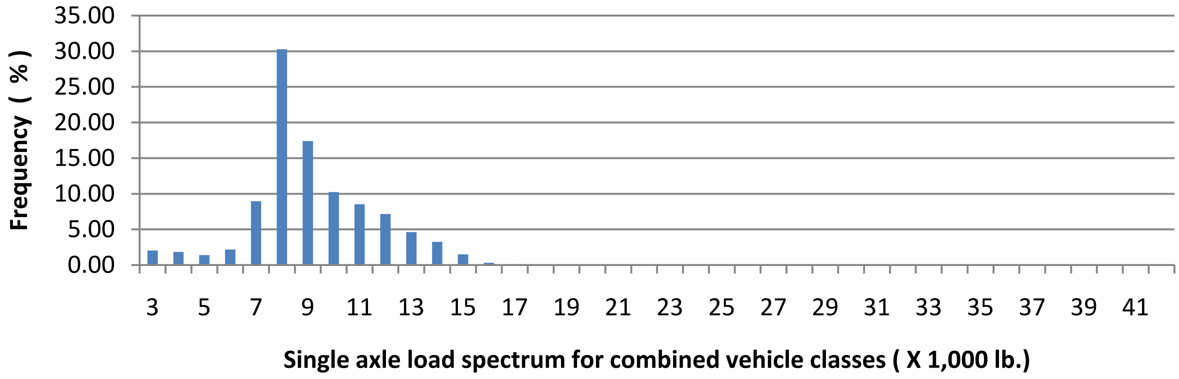

Figure 111
Single axle load spectrum for combined vehicle classes for TTC 5

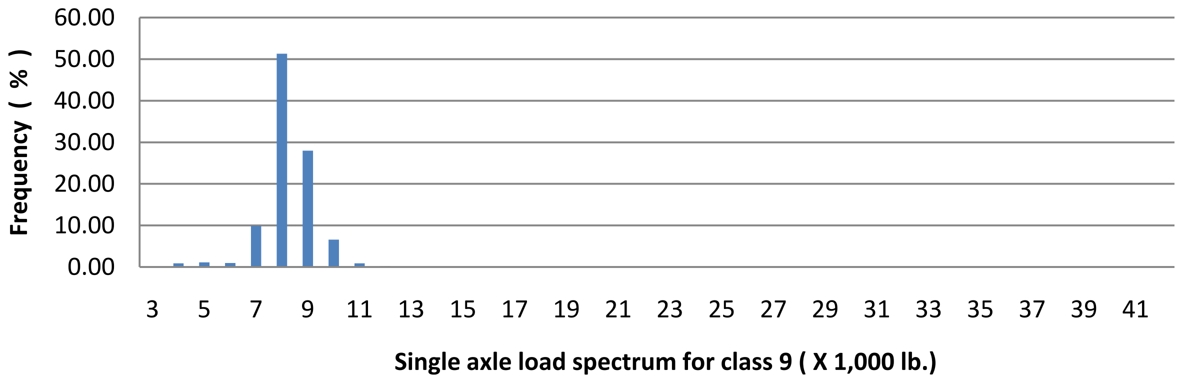

Figure 112
Single axle load spectrum for vehicle class 9 for TTC 5

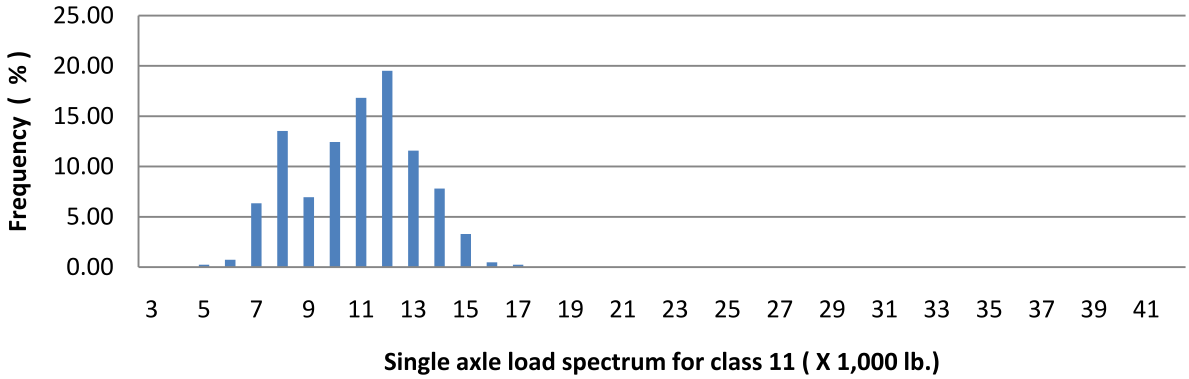

Figure 113
Single axle load spectrum for vehicle class 11 for TTC 5

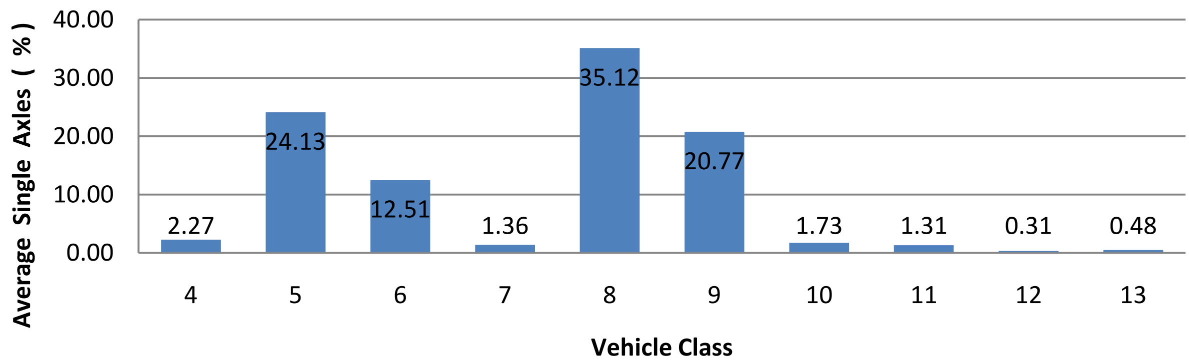

Figure 114
Single axles per vehicle class for TTC 6

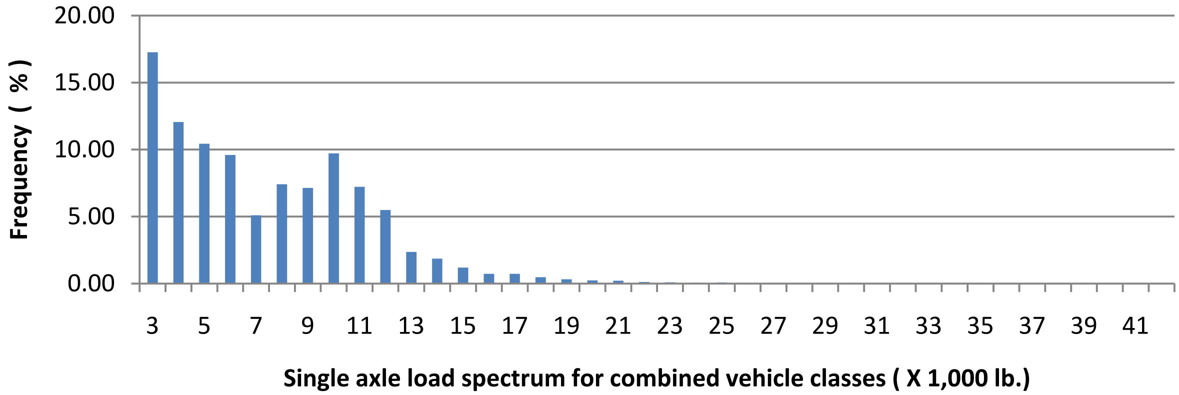

Figure 115
Single axle load spectrum for combined vehicle classes for TTC 6

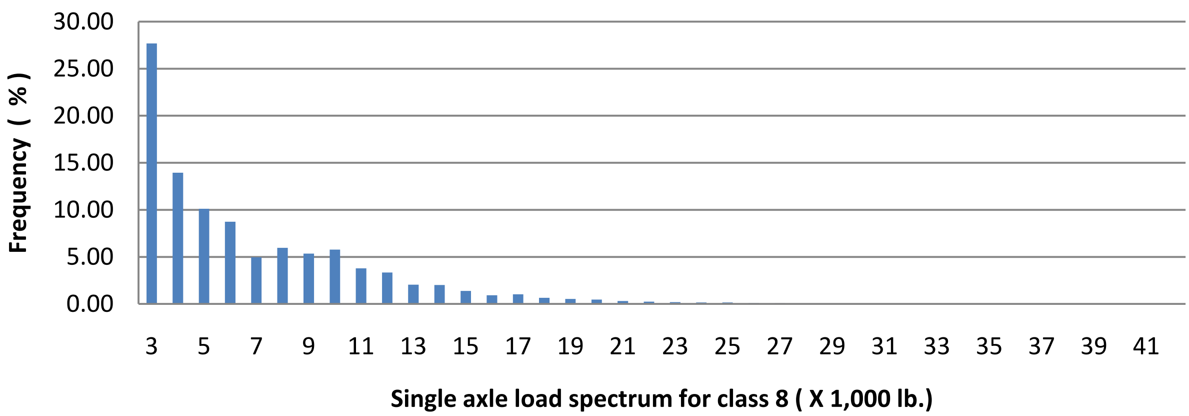

Figure 116
Single axle load spectrum for vehicle class 8 for TTC 6

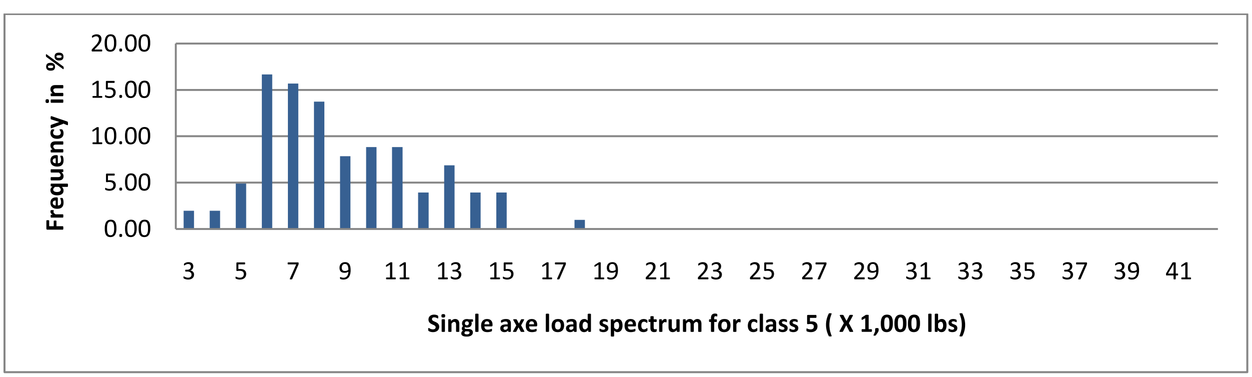

Figure 117
Single axle load spectrum for vehicle class 5 for TTC 6

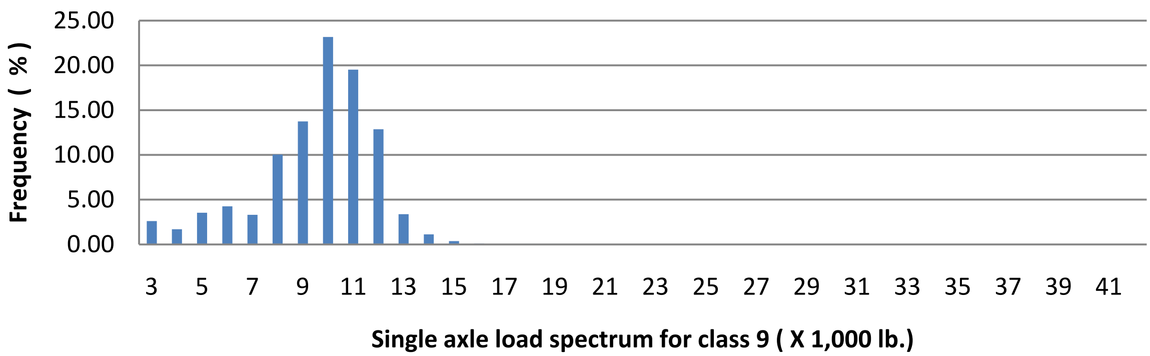

Figure 118
Single axle load spectrum for vehicle class 9 for TTC 6

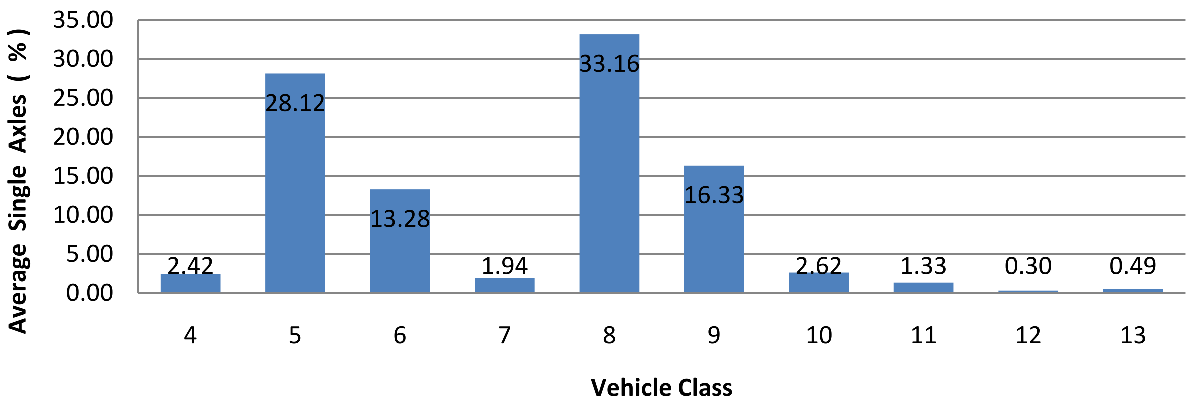

Figure 119
Single axles per vehicle class for TTC 9

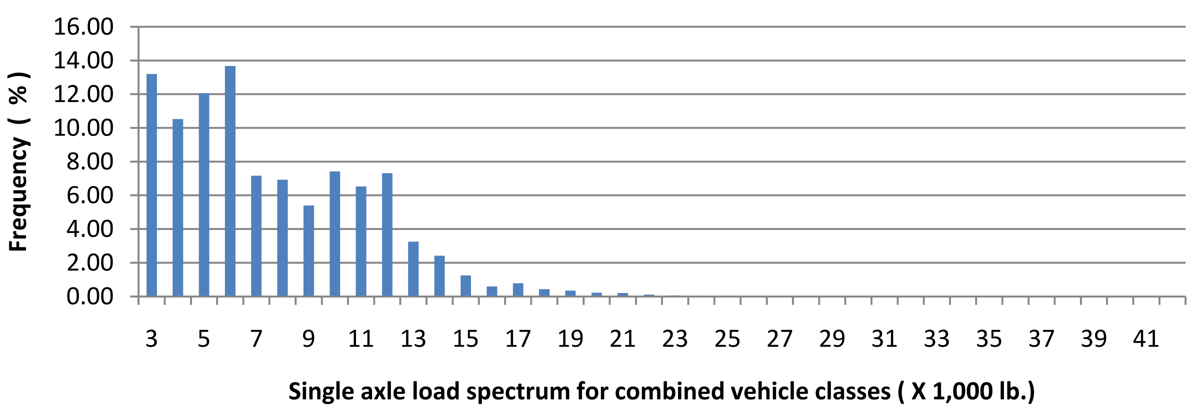

Figure 120
Single axle load spectrum for combined vehicle classes for TTC 9

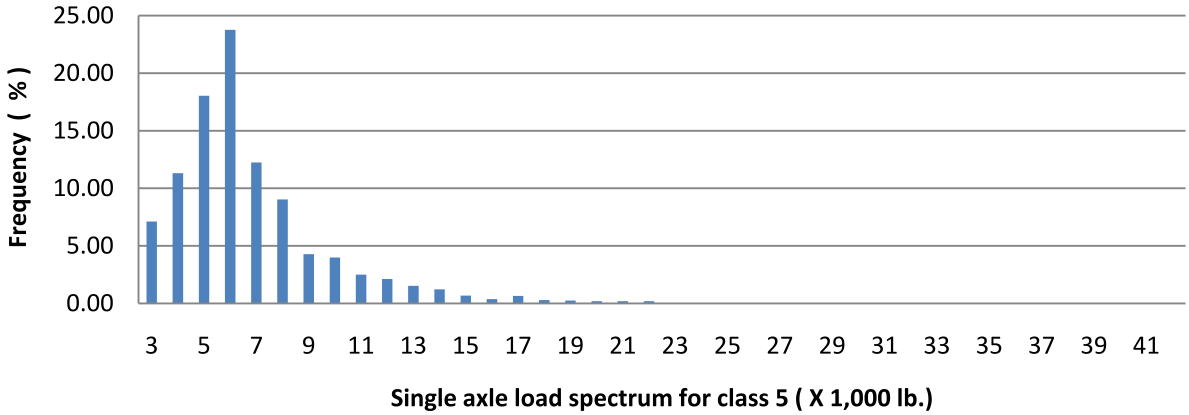

Figure 121
Single axle load spectrum for vehicle class 5 for TTC 9

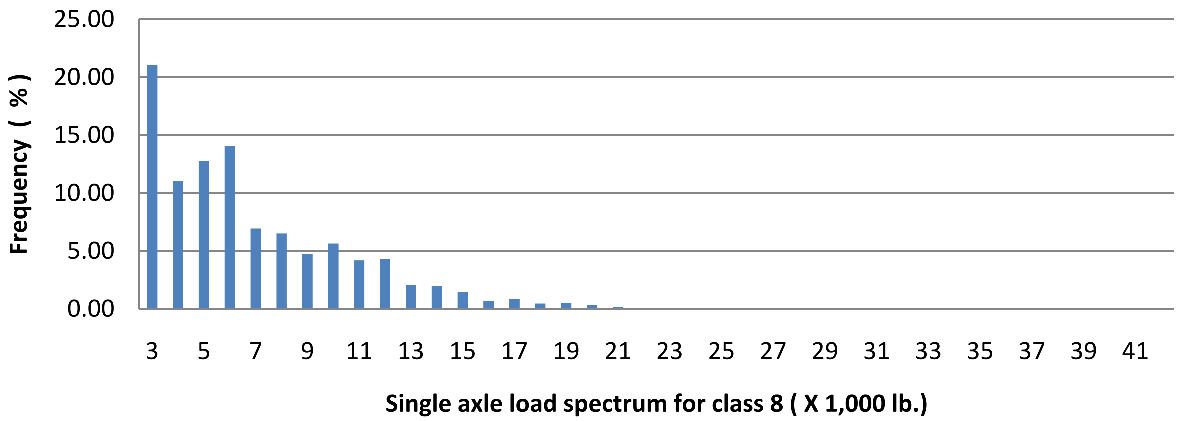

Figure 122
Single axle load spectrum for vehicle class 8 for TTC 9

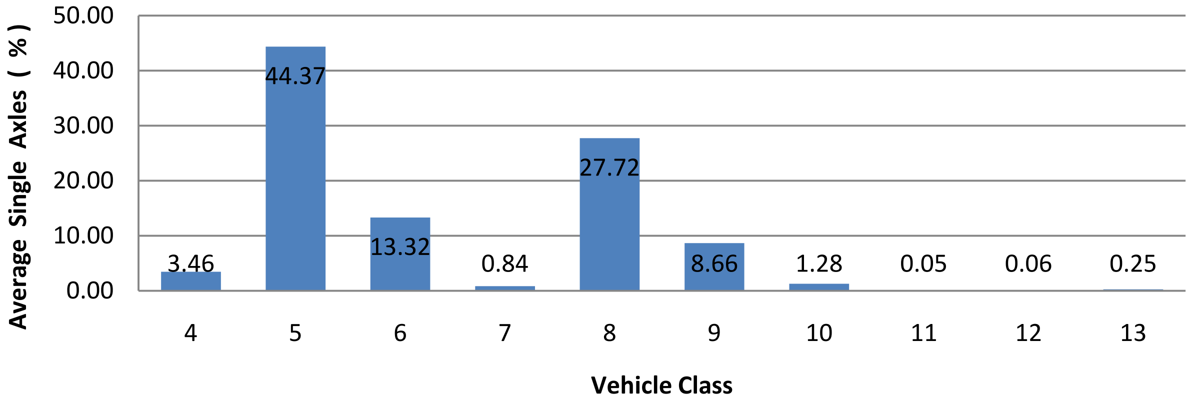

Figure 123
Single axles per vehicle class for TTC 12

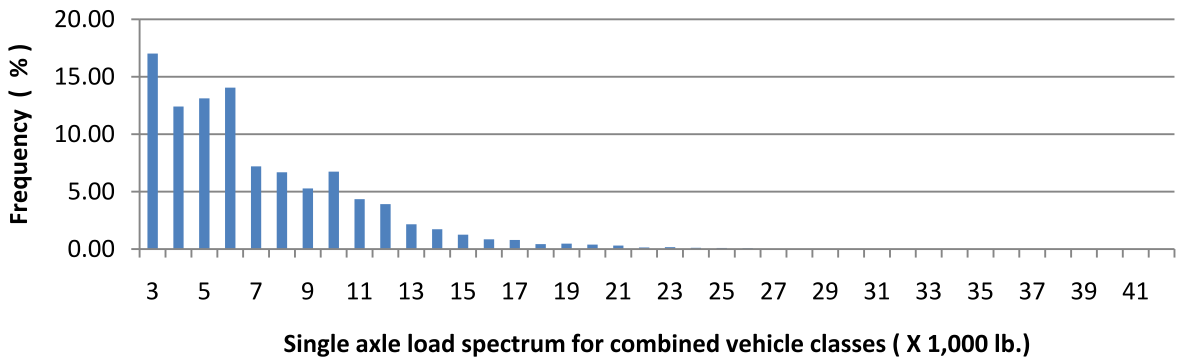

Figure 124
Single axle load spectrum for combined vehicle classes for TTC 12

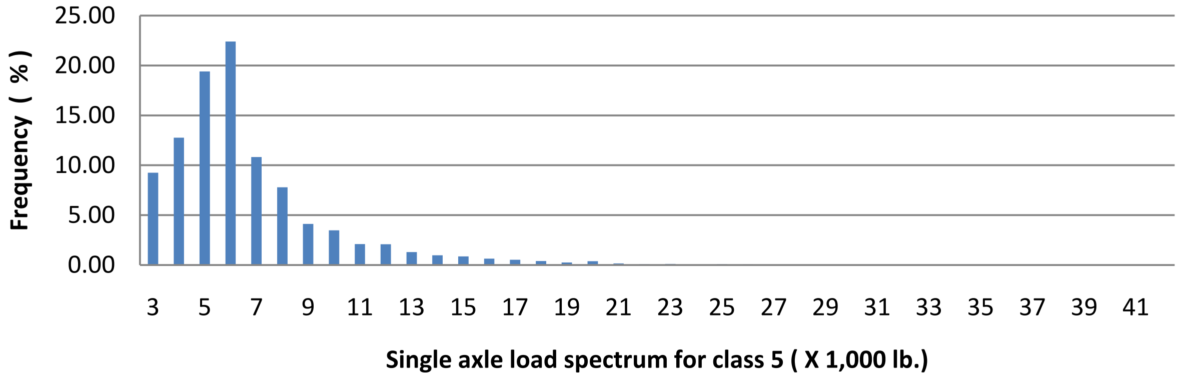

Figure 125
Single axle load spectrum for vehicle class 5 for TTC 12

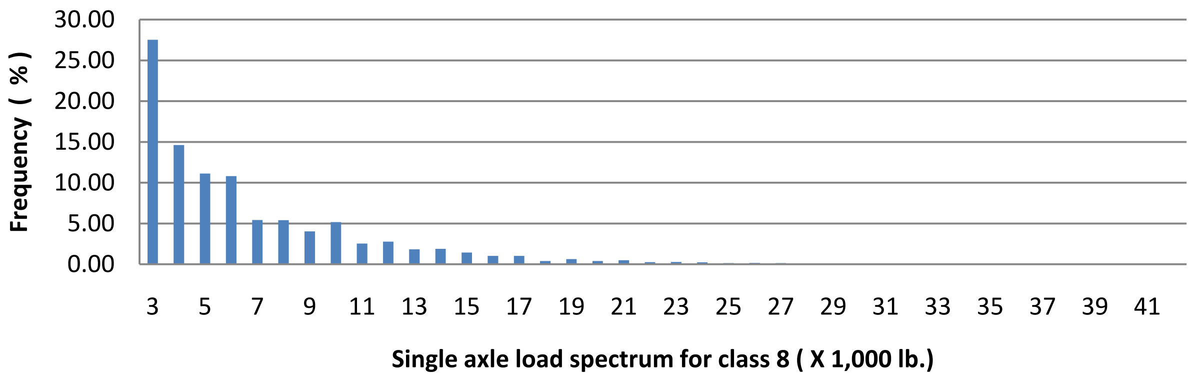

Figure 126
Single axle load spectrum for vehicle class 8 for TTC 12

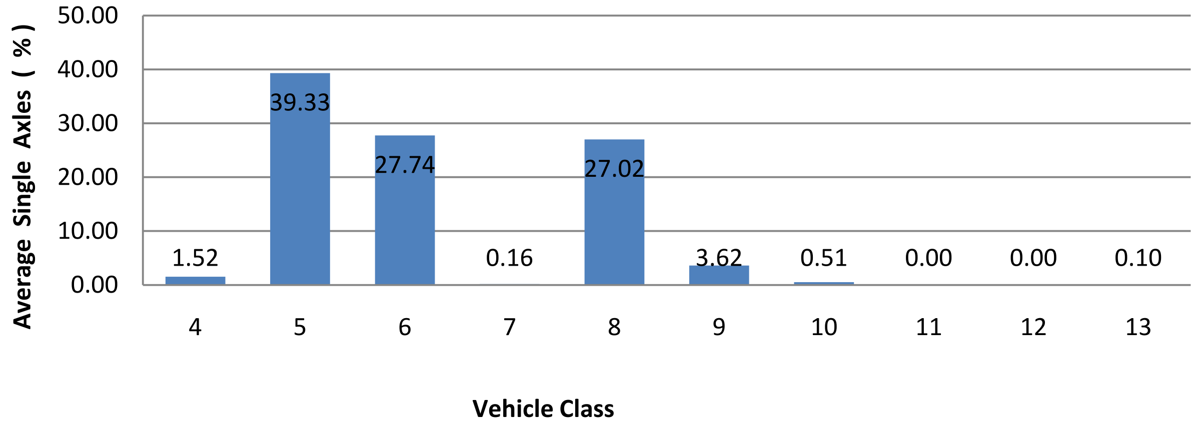

Figure 127
Single axles per vehicle class for TTC 14

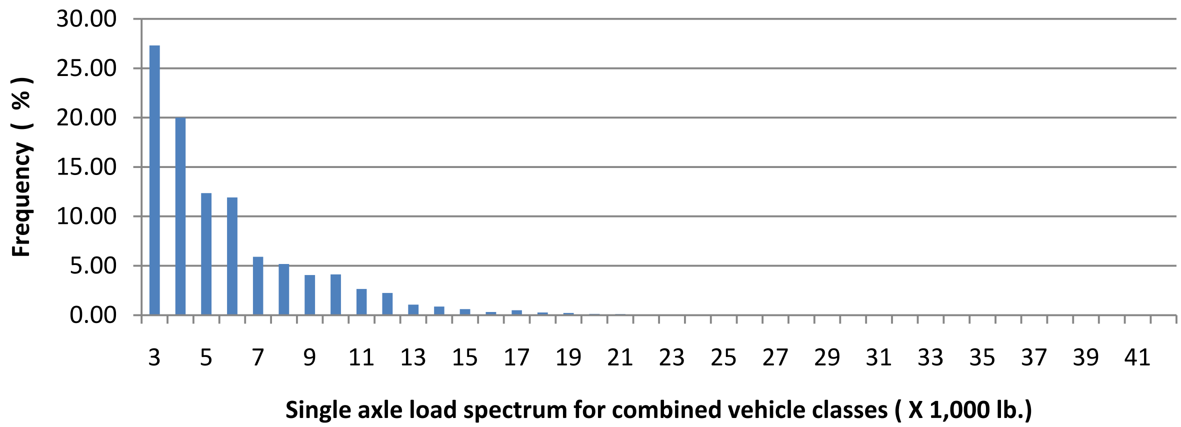

Figure 128
Single axle load spectrum for combined vehicle classes for TTC 14

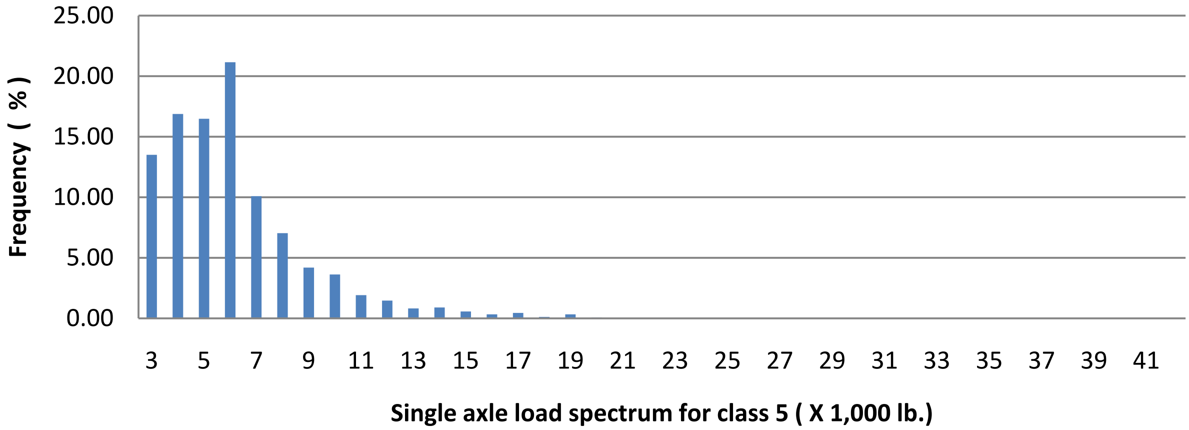

Figure 129
Single axle load spectrum for vehicle class 5 for TTC 14

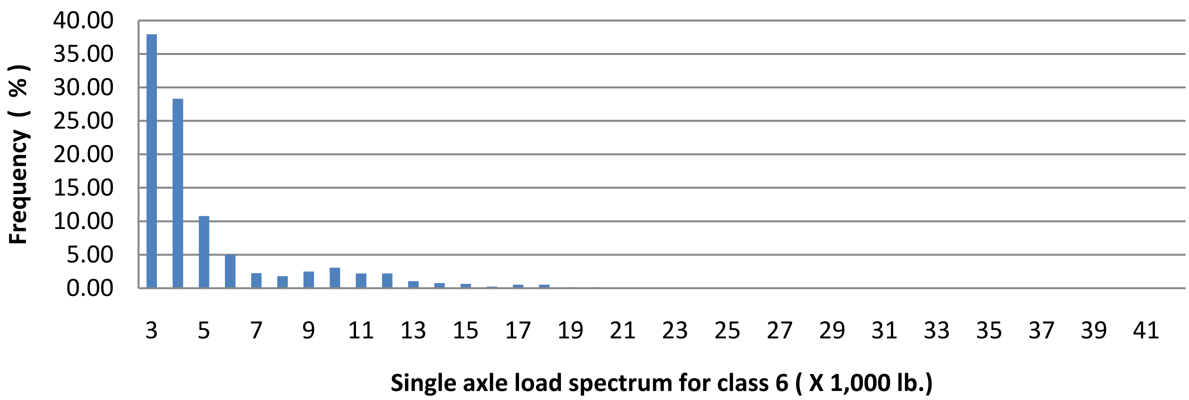

Figure 130
Single axle load spectrum for vehicle class 6 for TTC 14

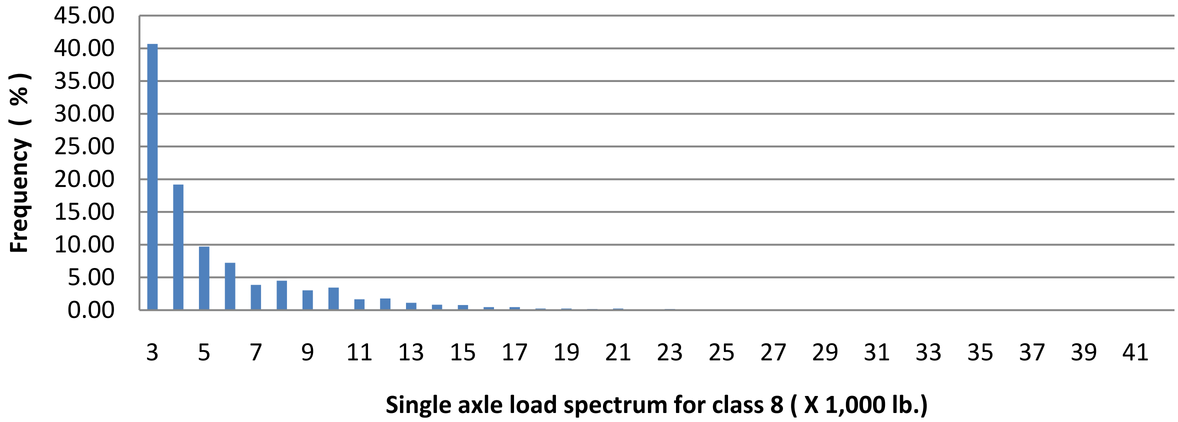

Figure 131
Single axle load spectrum for vehicle class 8 for TTC 14

APPENDIX E

Tandem Axles for Individual, Combined, and Primary Classes for Each TTC Group

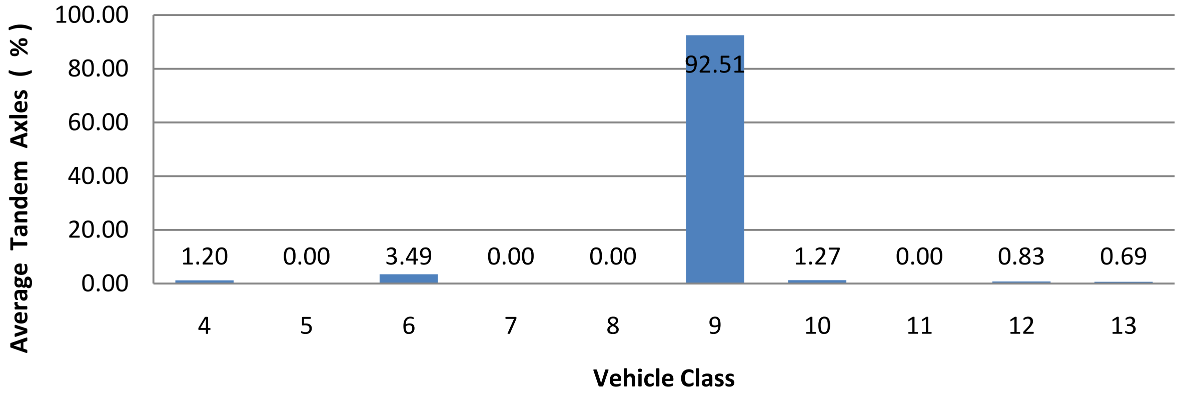

Figure 132
Tandem axles per vehicle class for TTC 3

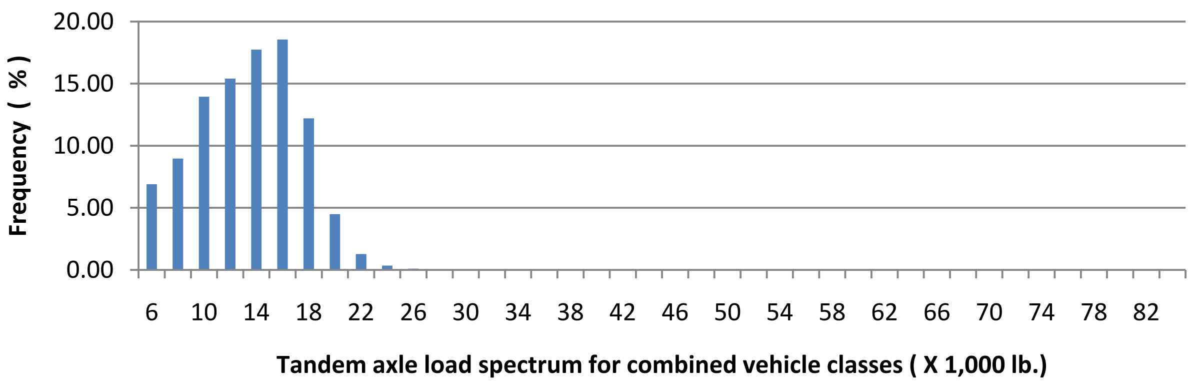

Figure 133
Tandem axle load spectrum for combined vehicle classes for TTC 3

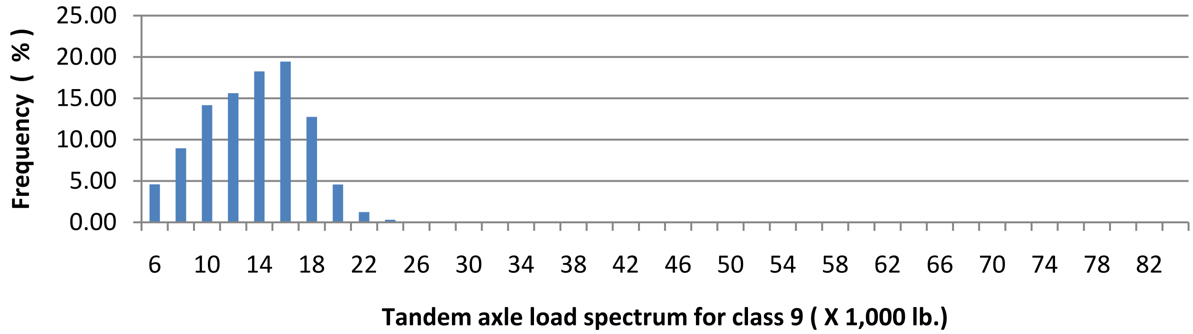

Figure 134
Tandem axle load spectrum for vehicle class 9 for TTC 3

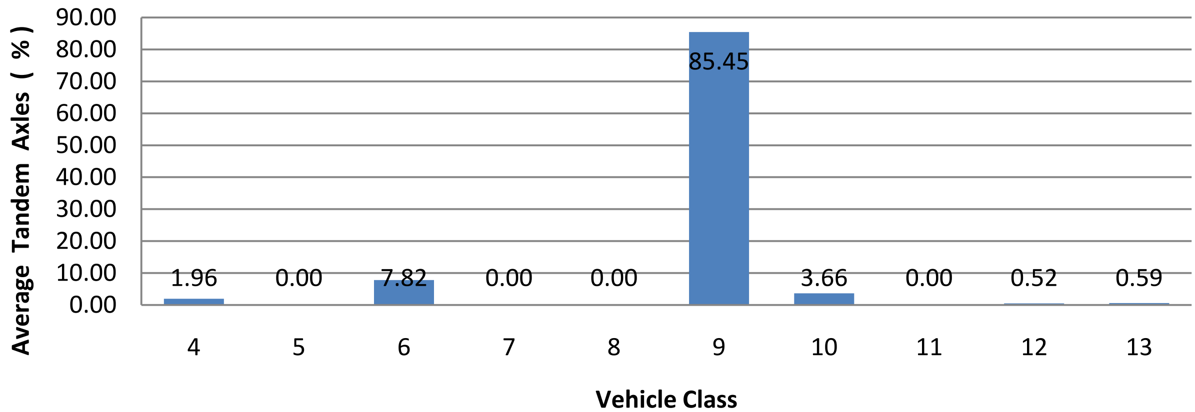

Figure 135
Tandem axles per vehicle class for TTC 4

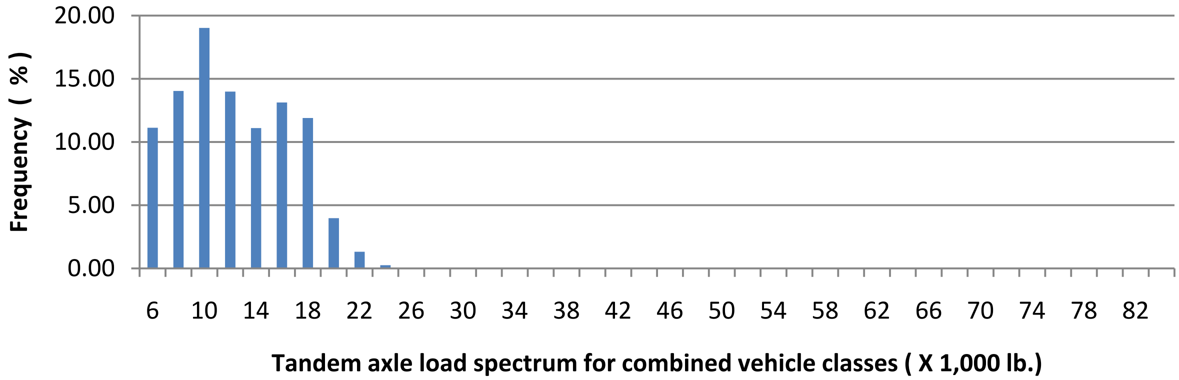

Figure 136
Tandem axle load spectrum for combined vehicle classes for TTC 4

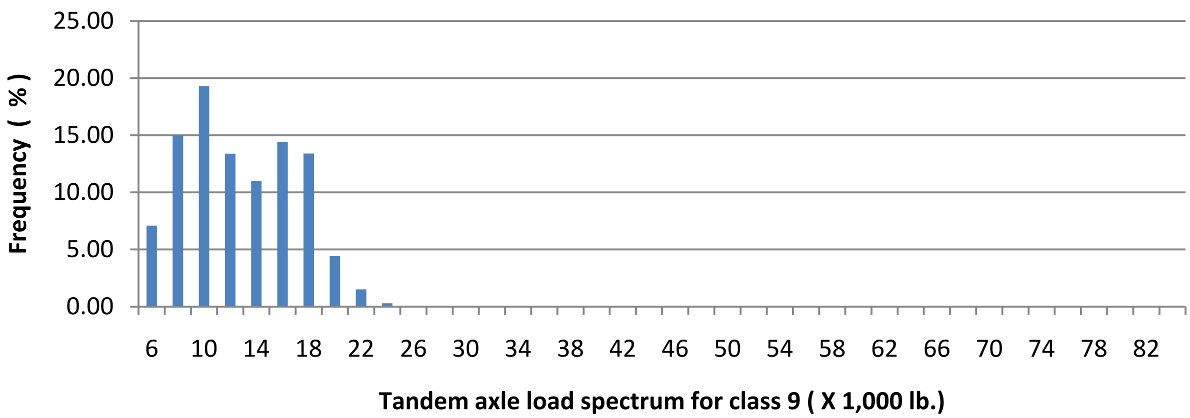

Figure 137
Tandem axle load spectrum for vehicle class 9 for TTC 4

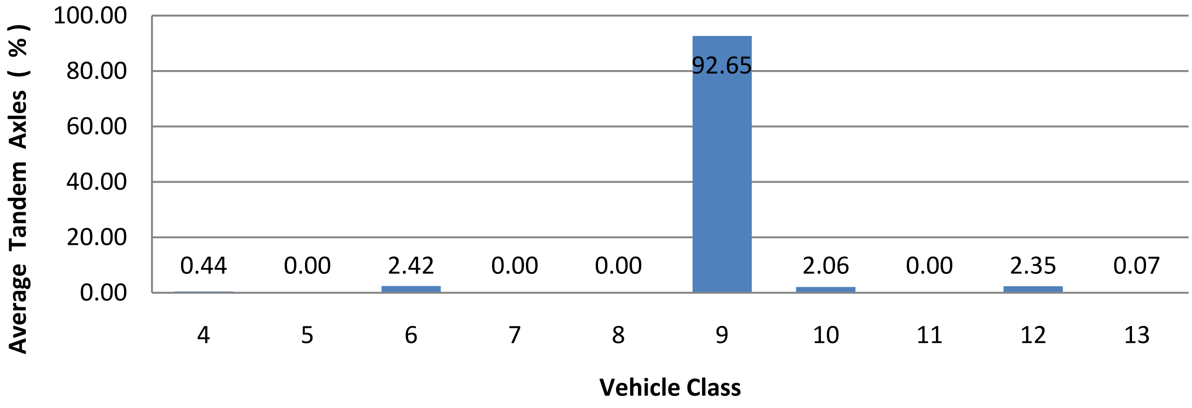

Figure 138
Tandem axles per vehicle class for TTC 5

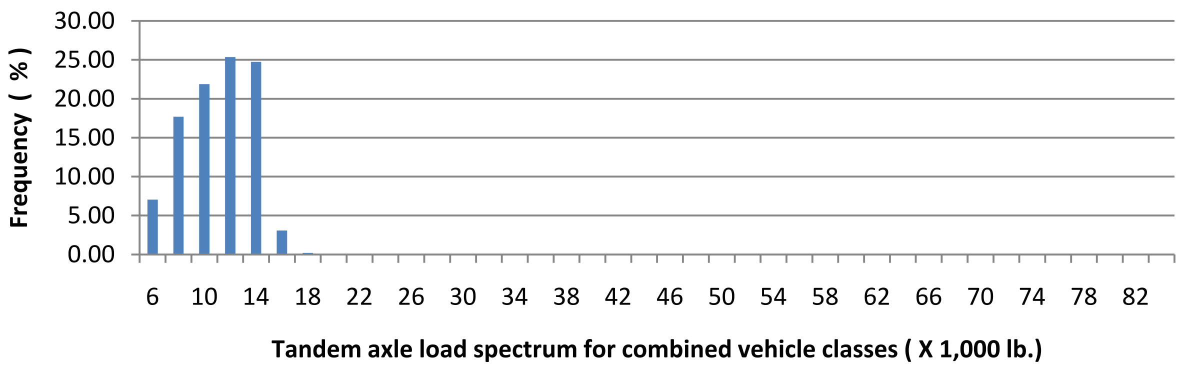

Figure 139
Tandem axle load spectrum for combined vehicle classes for TTC 5

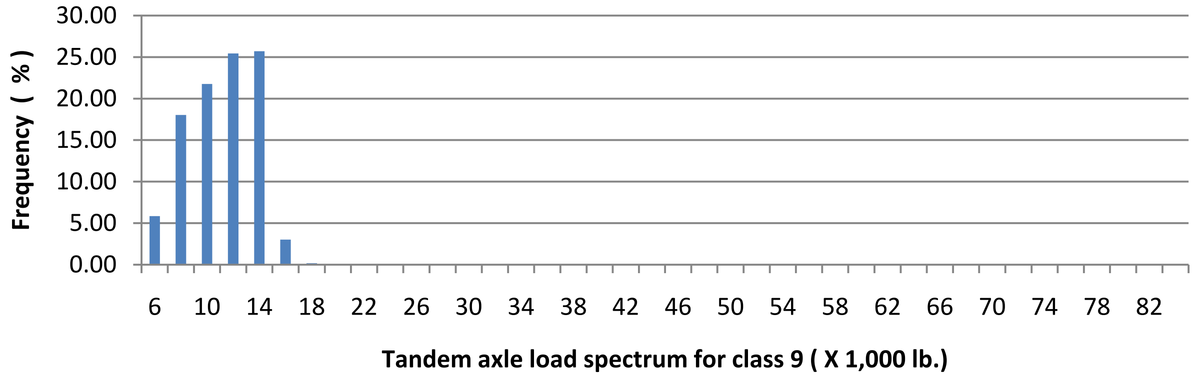

Figure 140
Tandem axle load spectrum for vehicle class 9 for TTC 5

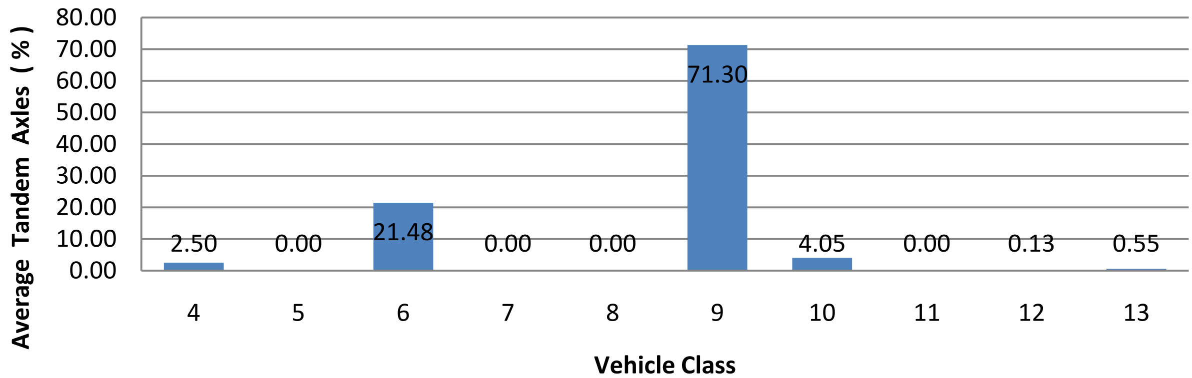

Figure 141
Tandem axles per vehicle class for TTC 6

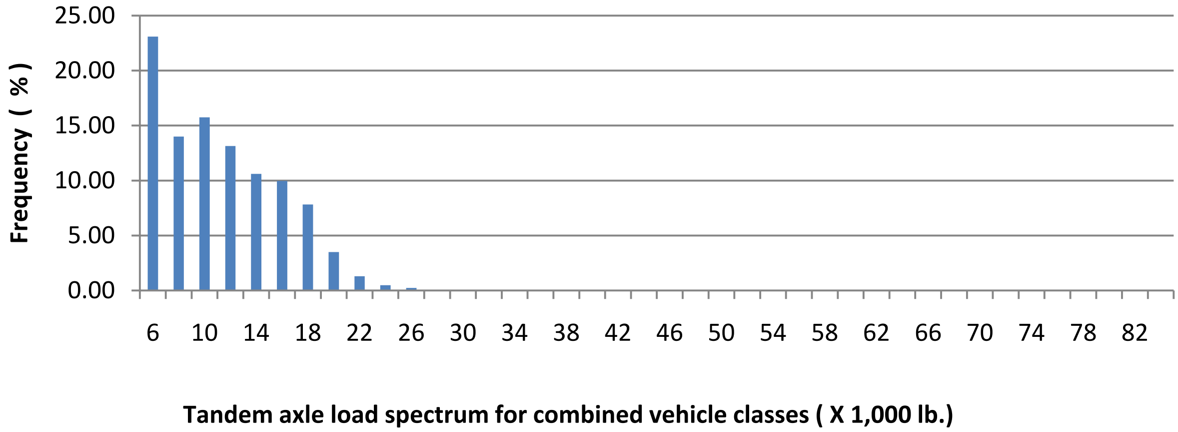

Figure 142
Tandem axle load spectrum for combined vehicle classes for TTC 6

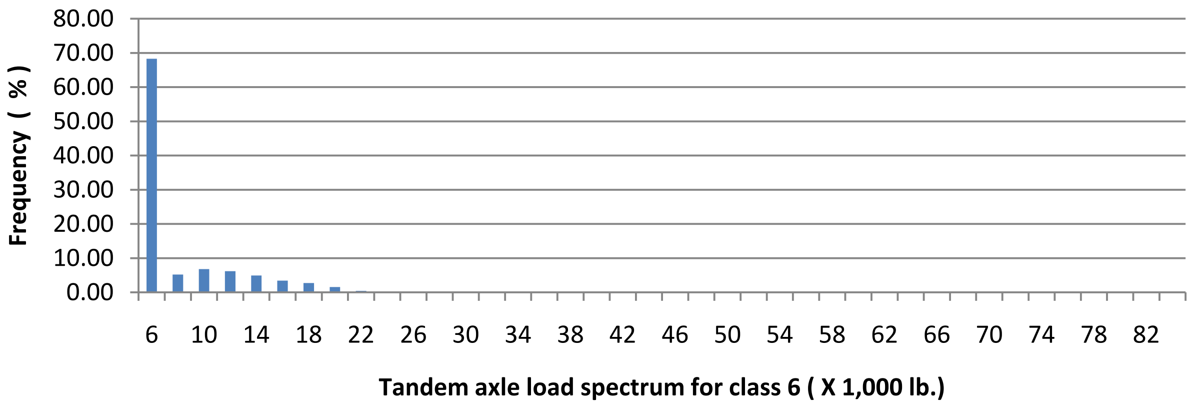

Figure 142
Tandem axle load spectrum for vehicle class 6 for TTC 6

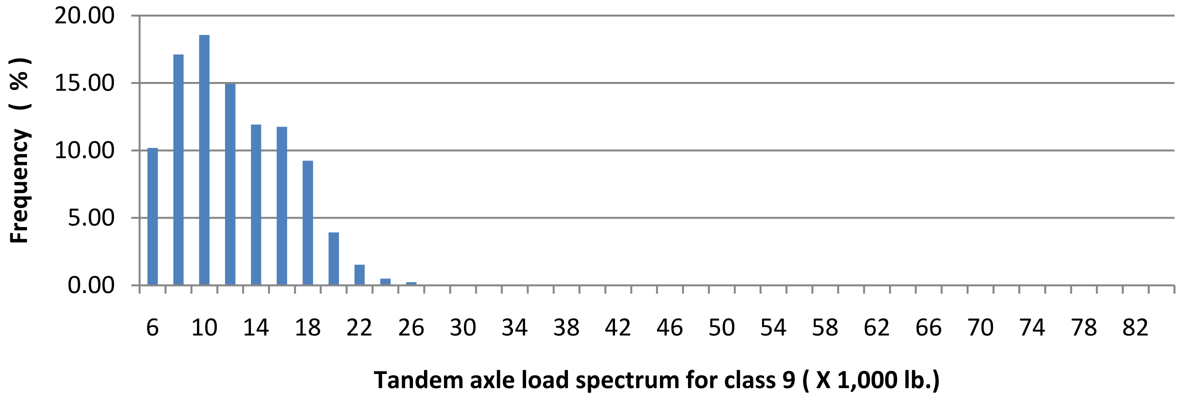

Figure 143
Tandem axle load spectrum for vehicle class 9 for TTC 6

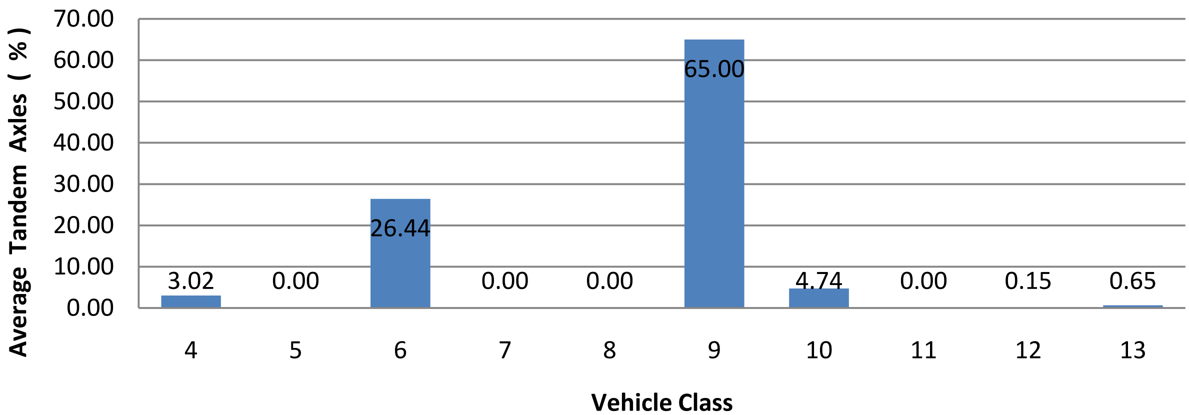

Figure 144
Tandem axles per vehicle class for TTC 9

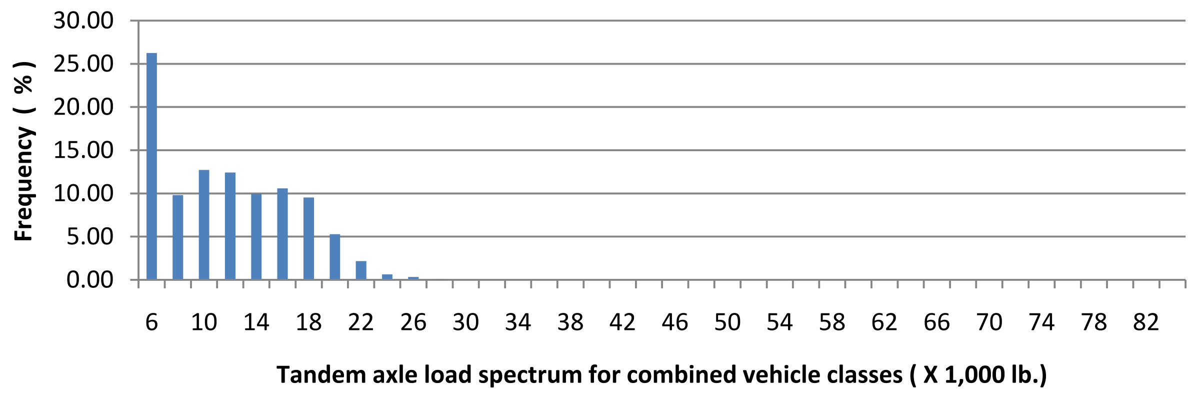

Figure 145
Tandem axle load spectrum for combined vehicle classes for TTC 9

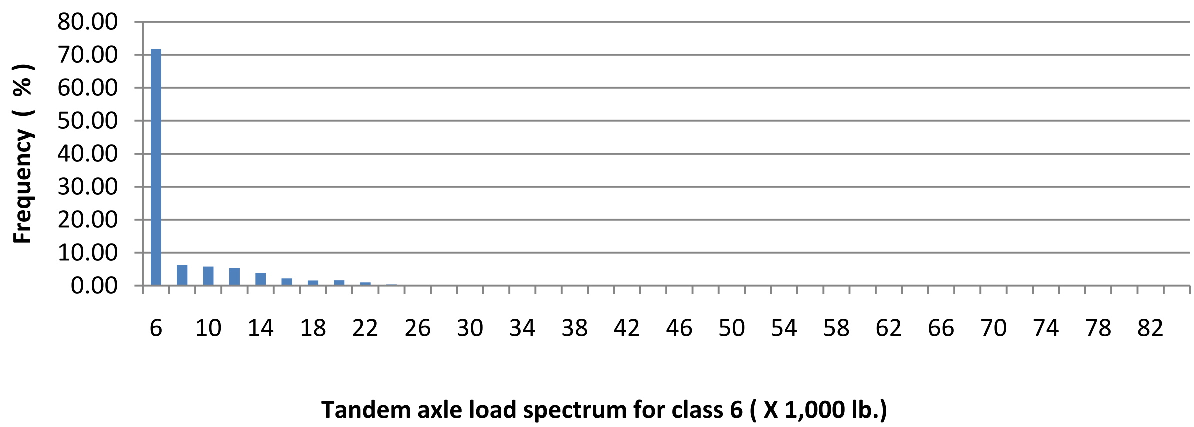

Figure 146
Tandem axle load spectrum for vehicle class 6 for TTC 9

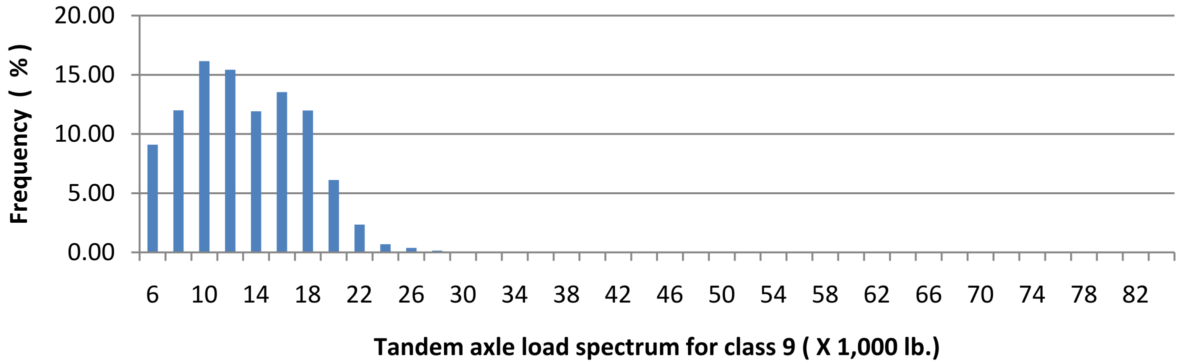

Figure 147
Tandem axle load spectrum for vehicle class 9 for TTC 9

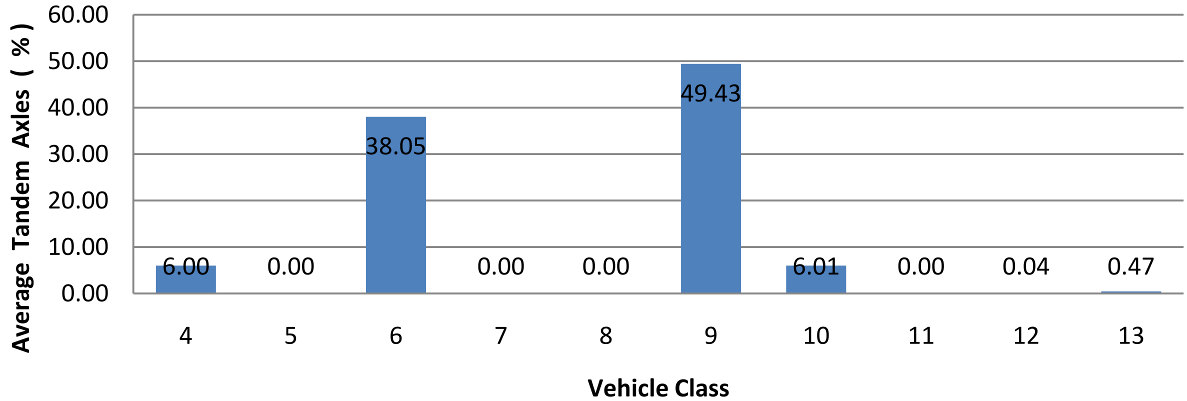

Figure 148
Tandem axles per vehicle class for TTC 12

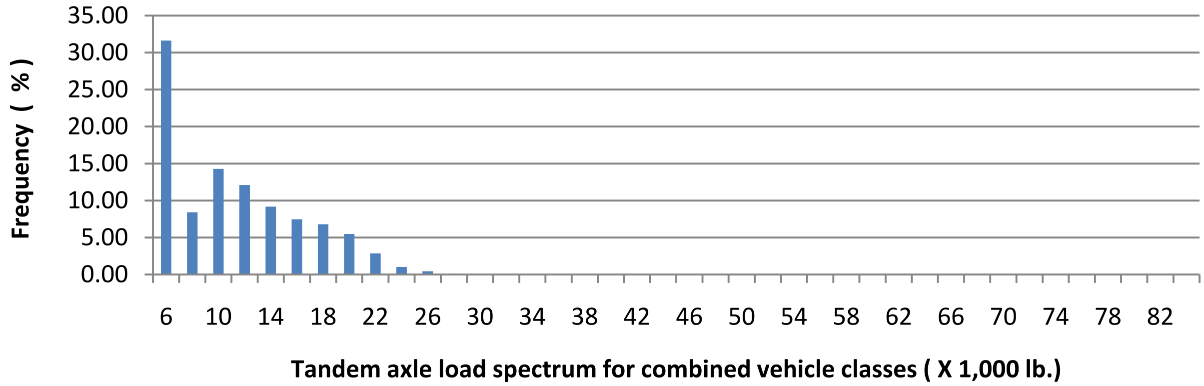

Figure 149
Tandem axle load spectrum for combined vehicle classes for TTC 12

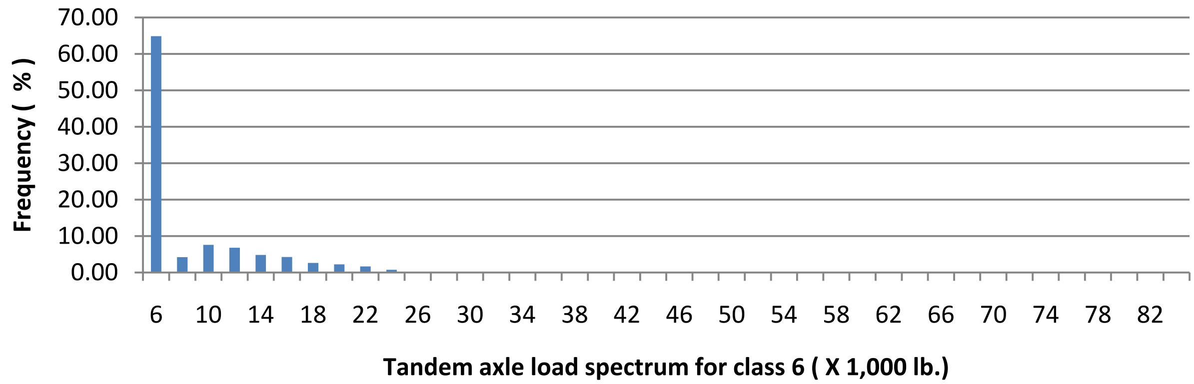

Figure 150
Tandem axle load spectrum for vehicle class 6 for TTC 12

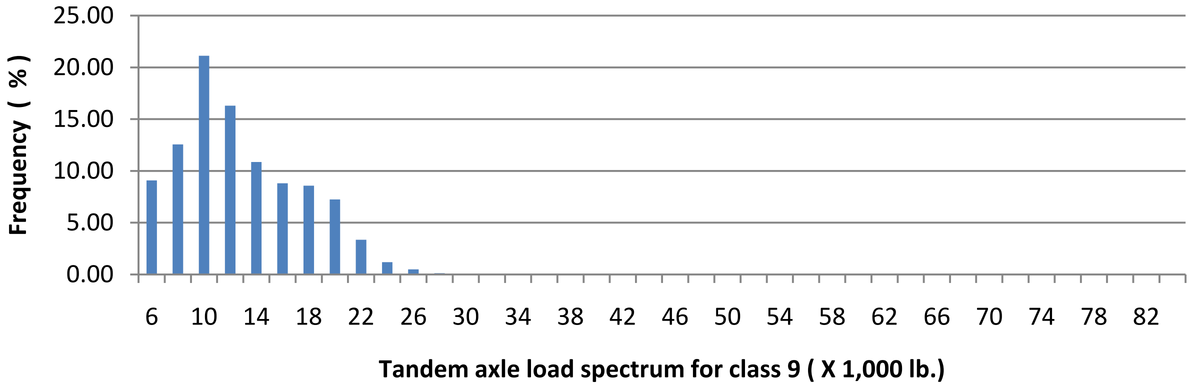

Figure 151
Tandem axle load spectrum for vehicle class 9 for TTC 12

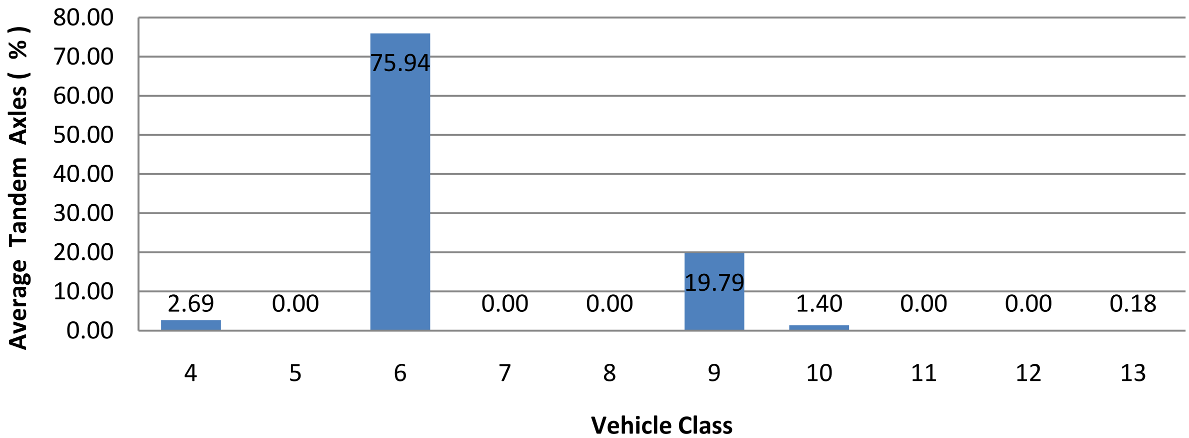

Figure 152
Tandem axles per vehicle class for TTC 14

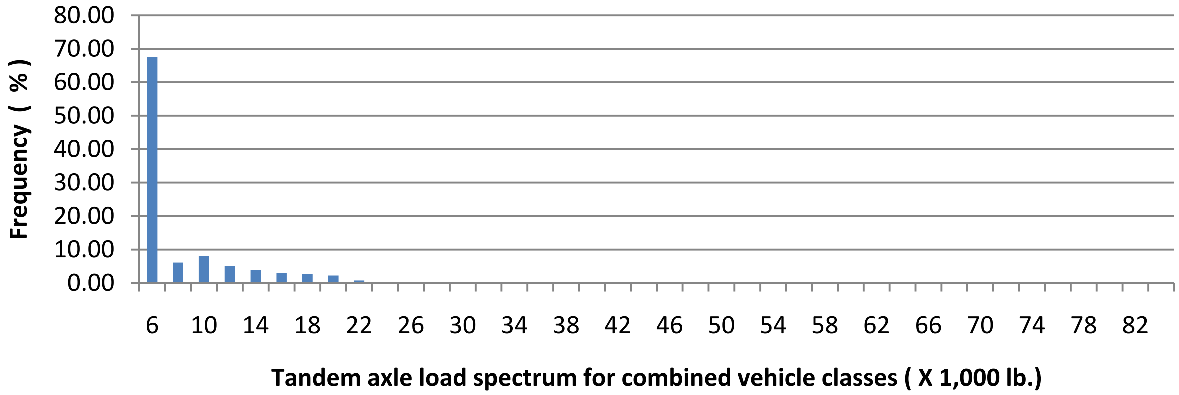

Figure 153
Tandem axle load spectrum for combined vehicle classes for TTC 14

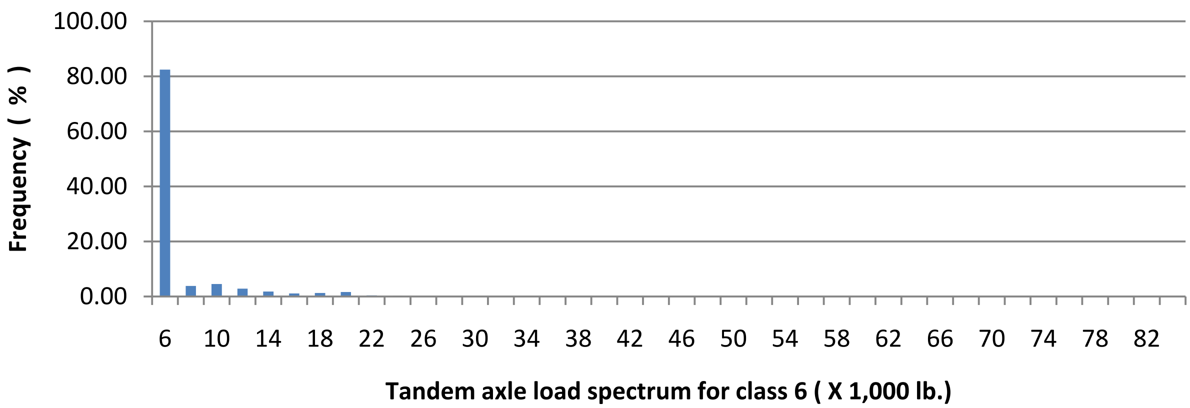

Figure 154
Tandem axle load spectrum for vehicle class 6 for TTC 14

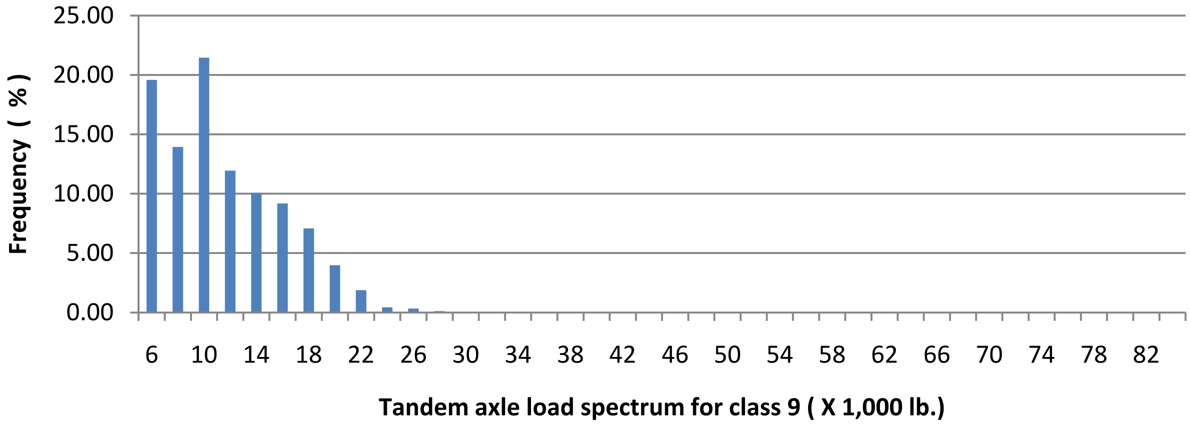

Figure 155
Tandem axle load spectrum for vehicle class 9 for TTC 14

APPENDIX F

Tridem Axles per Vehicle Classes, Tridem Axle Load Spectra for Combined Vehicle Class, and Tridem Axle Load Spectra for Primary Classes for TTC Groups

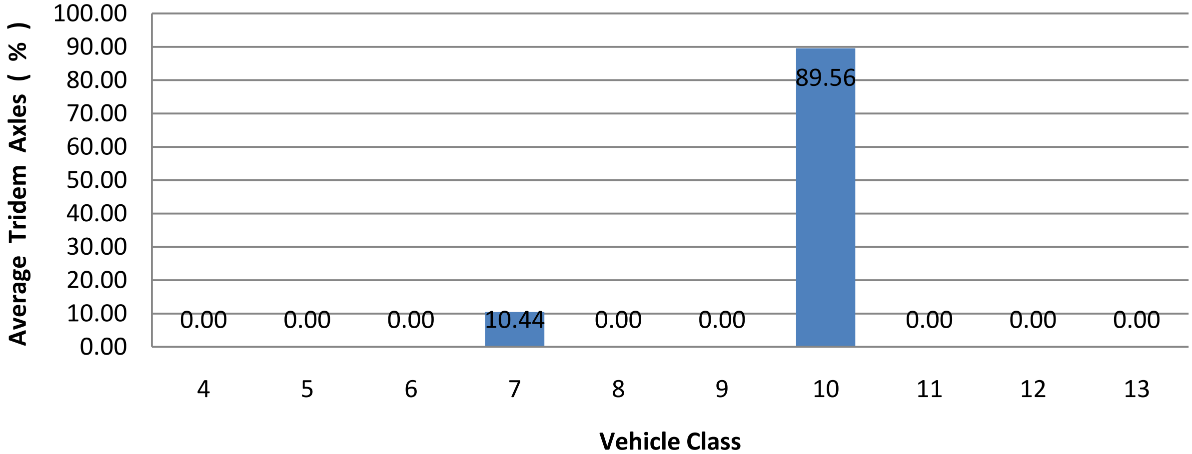

Figure 156
Tridem axles per vehicle class for TTC 3

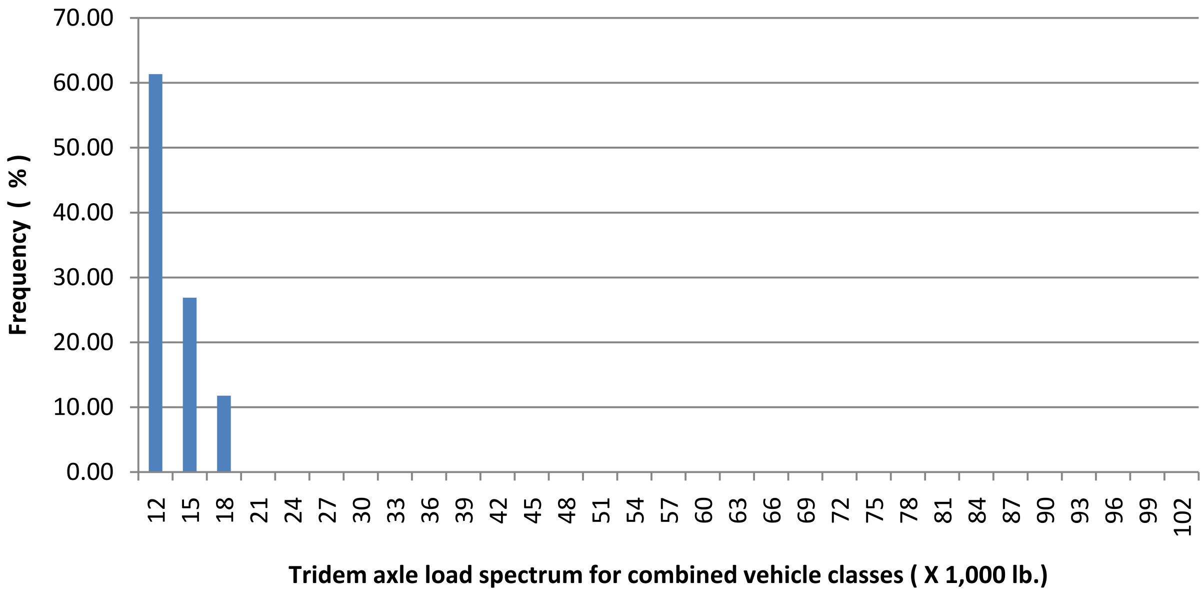

Figure 157
Tridem axle load spectrum for combined vehicle class for TTC 3

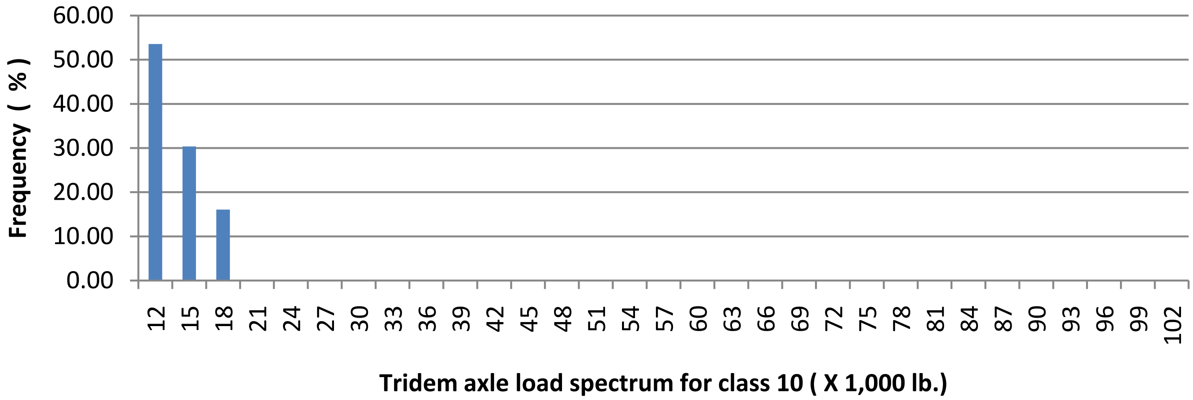

Figure 158
Tridem axle load spectrum for vehicle class 10 for TTC 3

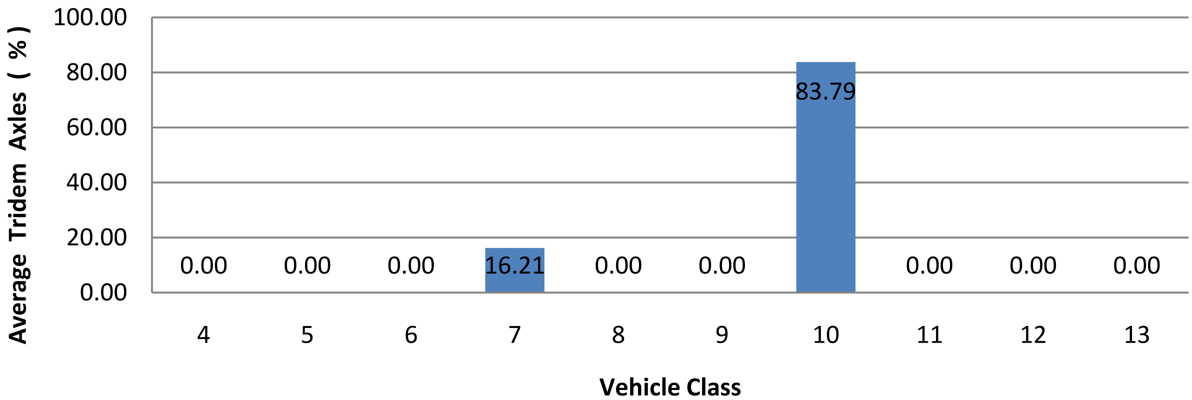

Figure 159
Tridem axles per vehicle class for TTC 4

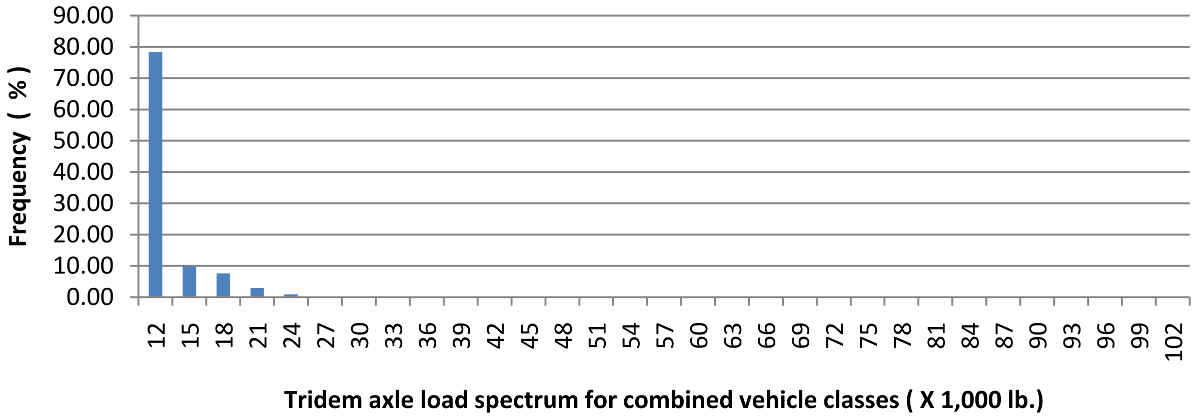

Figure 160
Tridem axle load spectrum for combined vehicle classes for TTC 4

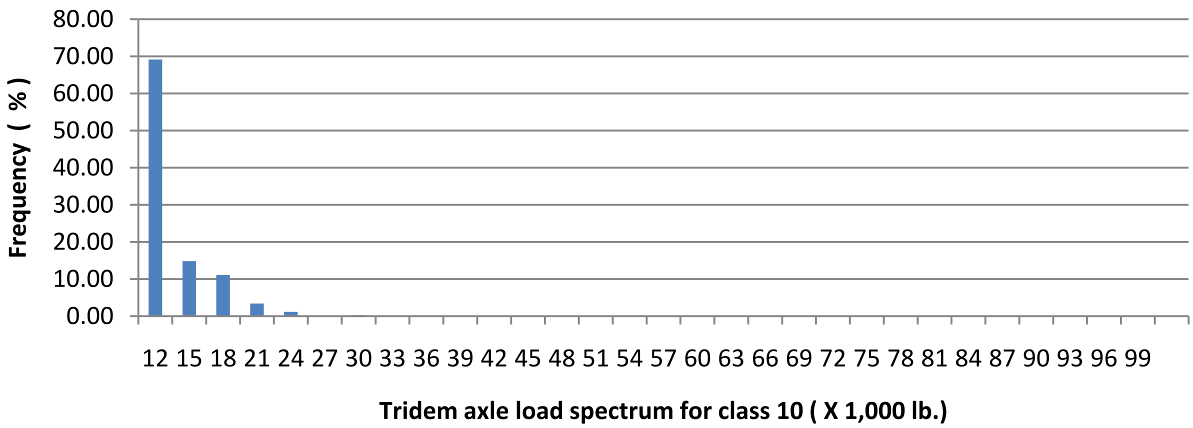

Figure 161
Tridem axle load spectrum for vehicle class 10 for TTC 4

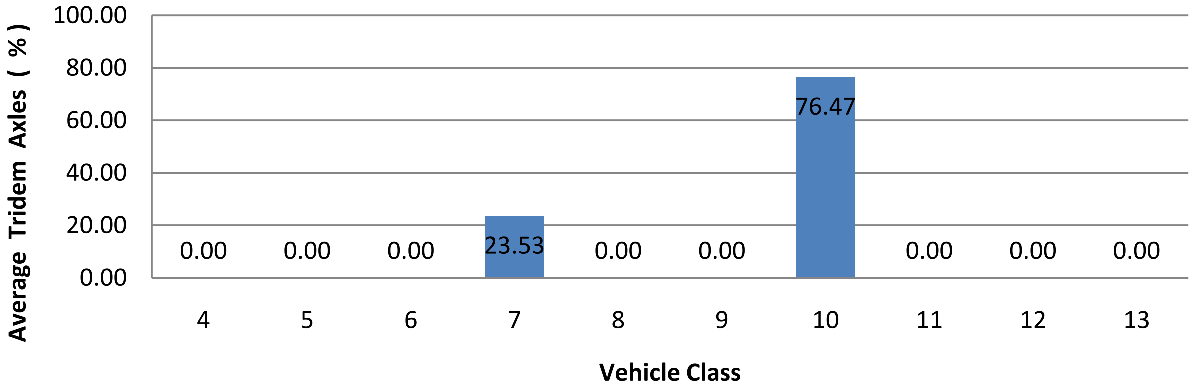

Figure 162
Tridem axles per vehicle class for TTC 5

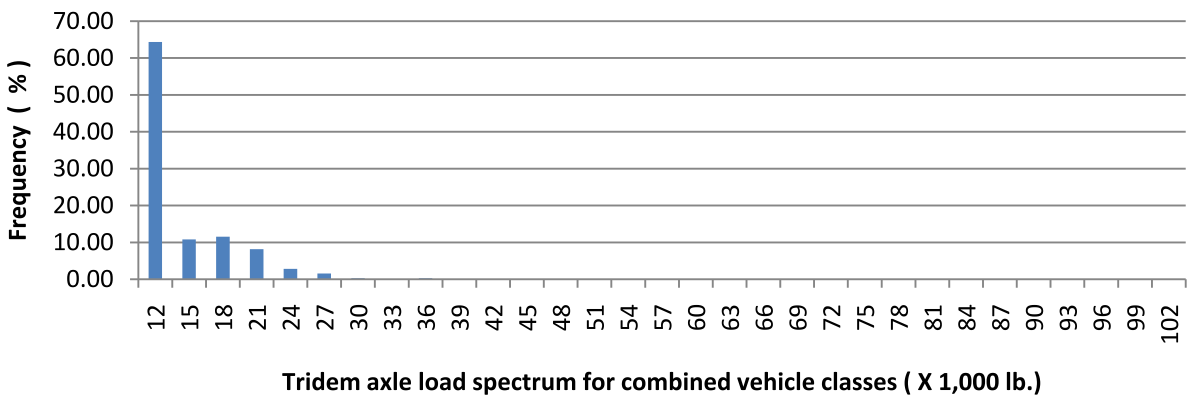

Figure 163
Tridem axle load spectrum for combined vehicle classes for TTC 5

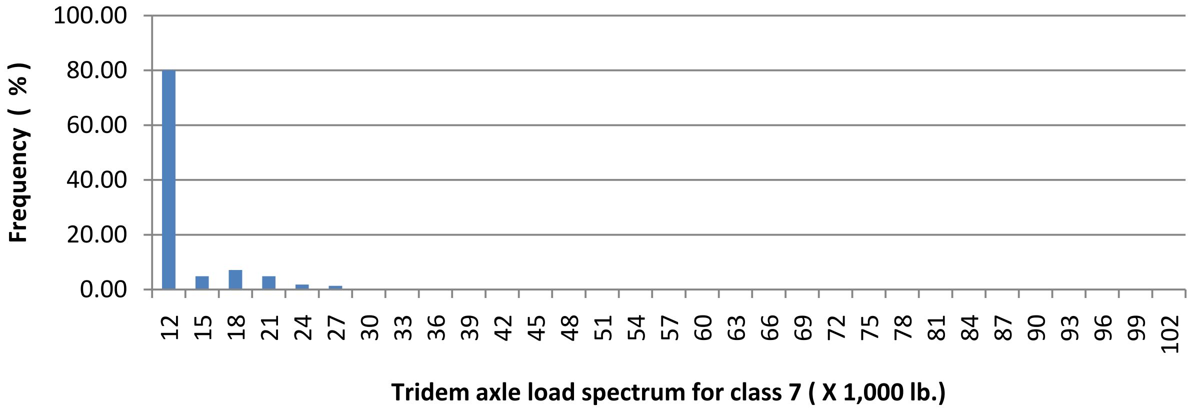

Figure 164
Tridem axle load spectrum for vehicle class 7 for TTC 5

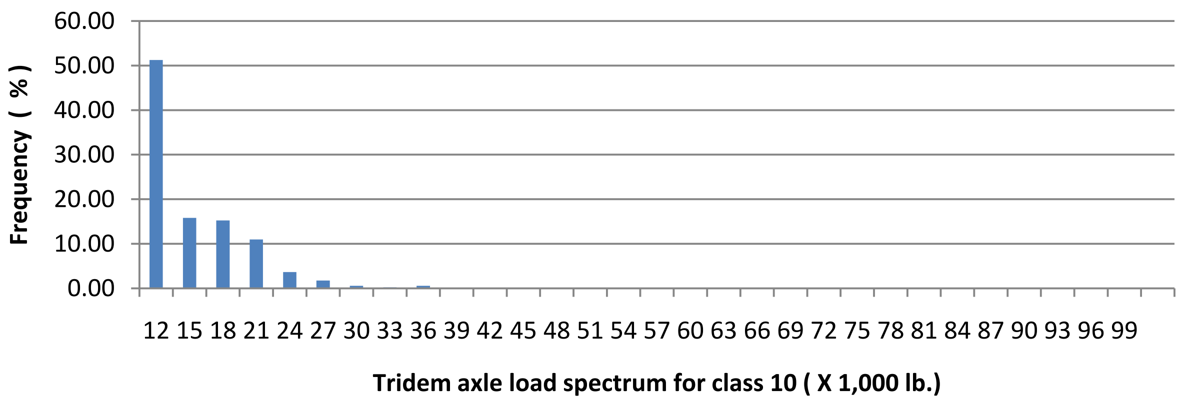

Figure 165
Tridem axle load spectrum for vehicle class 10 for TTC 5

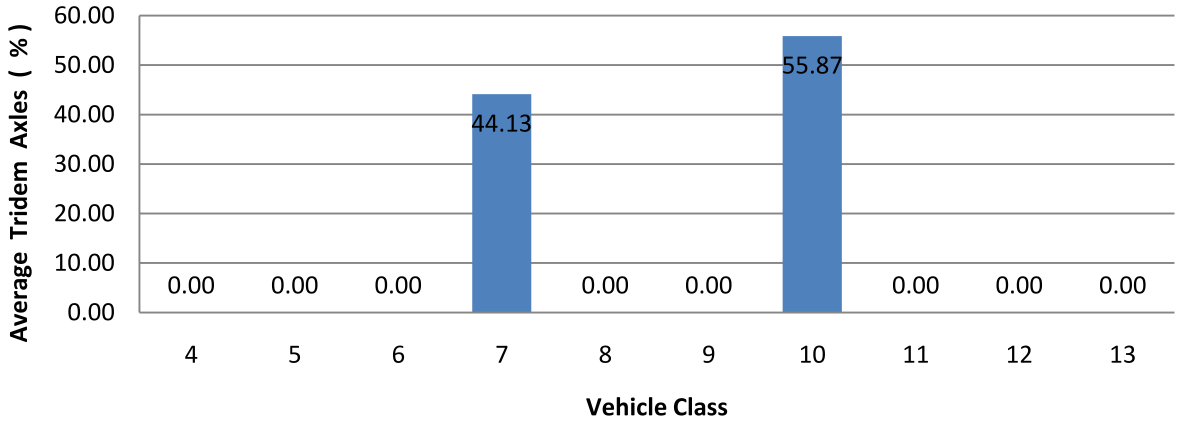

Figure 166
Tridem axles per vehicle class for TTC 6

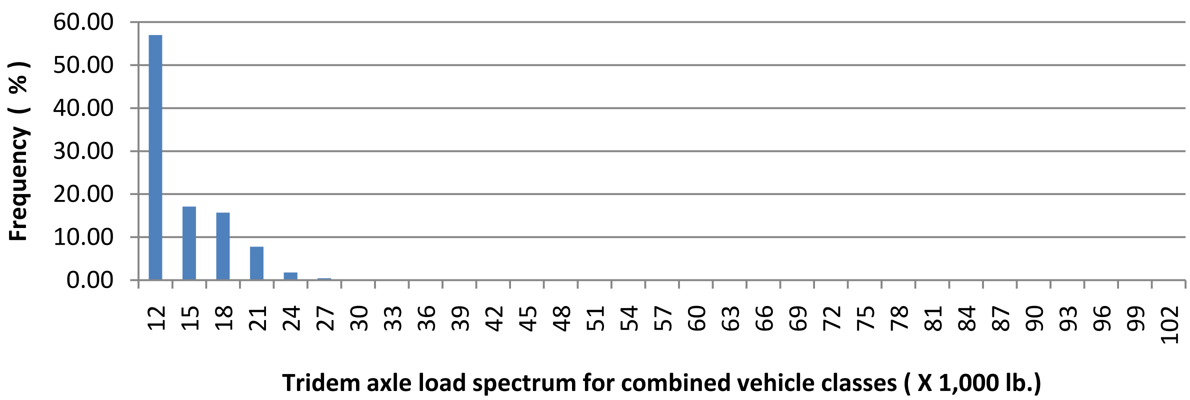

Figure 167
Tridem axle load spectrum for combined vehicle classes for TTC 6

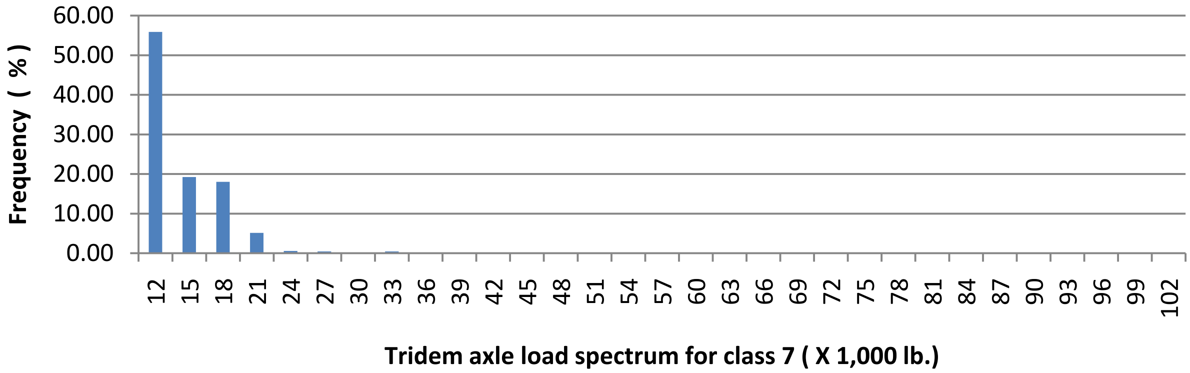

Figure 168
Tridem axle load spectrum for vehicle class 7 for TTC 6

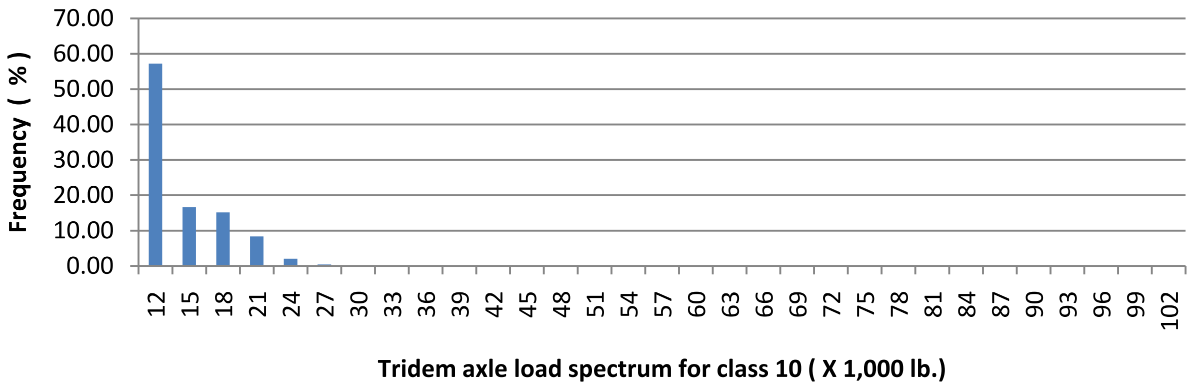

Figure 169
Tridem axle load spectrum for vehicle class 10 for TTC 6

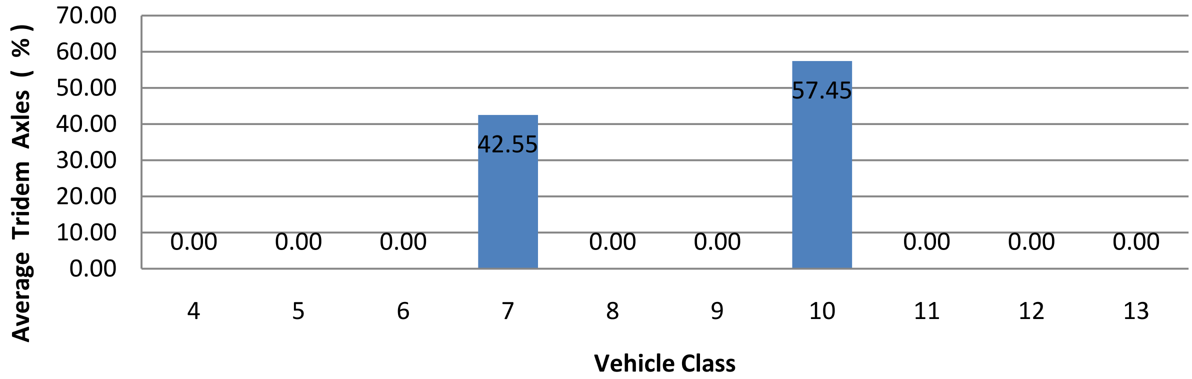

Figure 170
Tridem axles per vehicle class for TTC 9

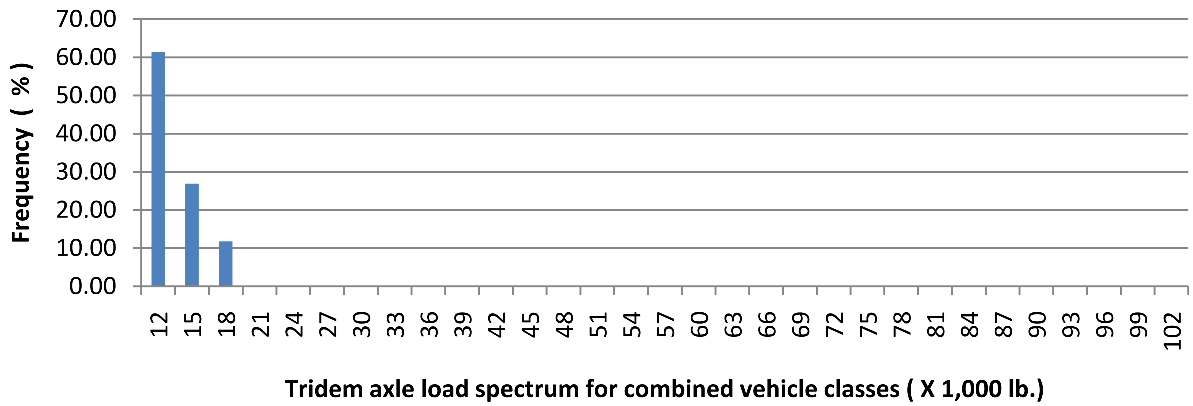

Figure 171
Tridem axle load spectrum for combined vehicle class for TTC 9

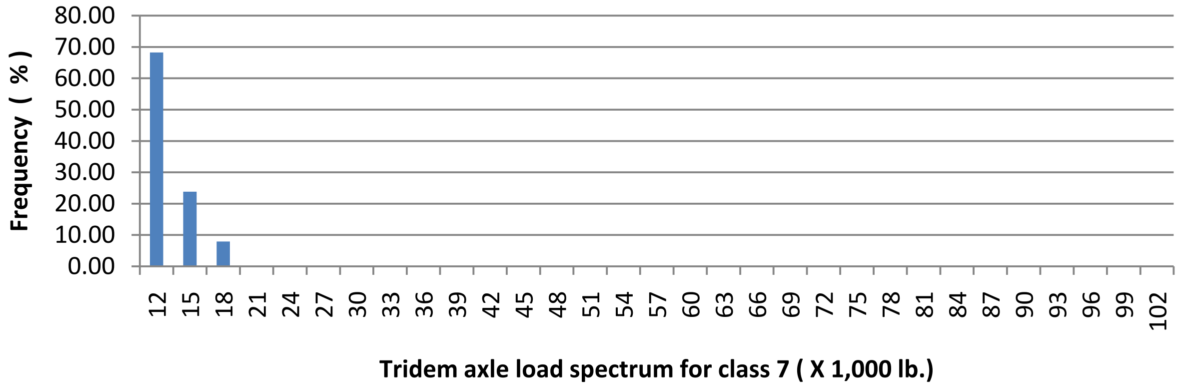

Figure 172
Tridem axle load spectrum for vehicle class 7 for TTC 9

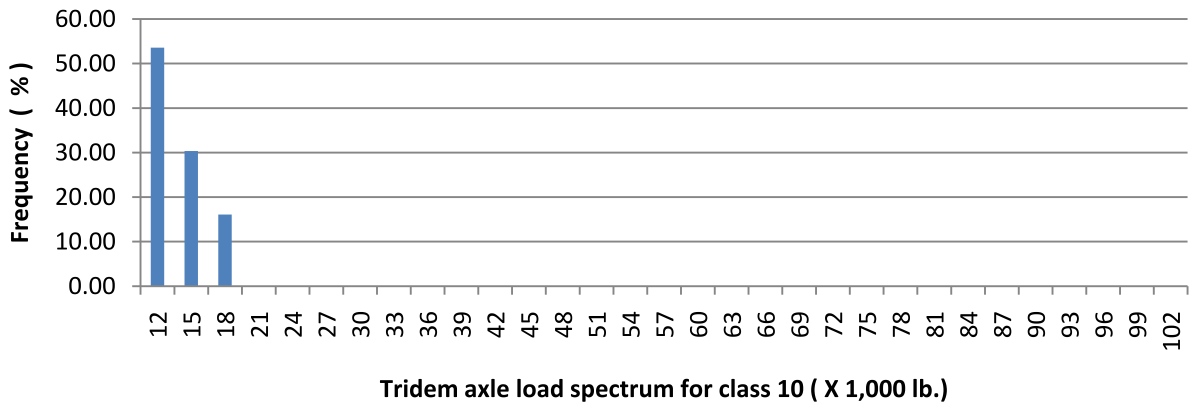

Figure 173
Tridem axle load spectrum for vehicle class 10 for TTC 9

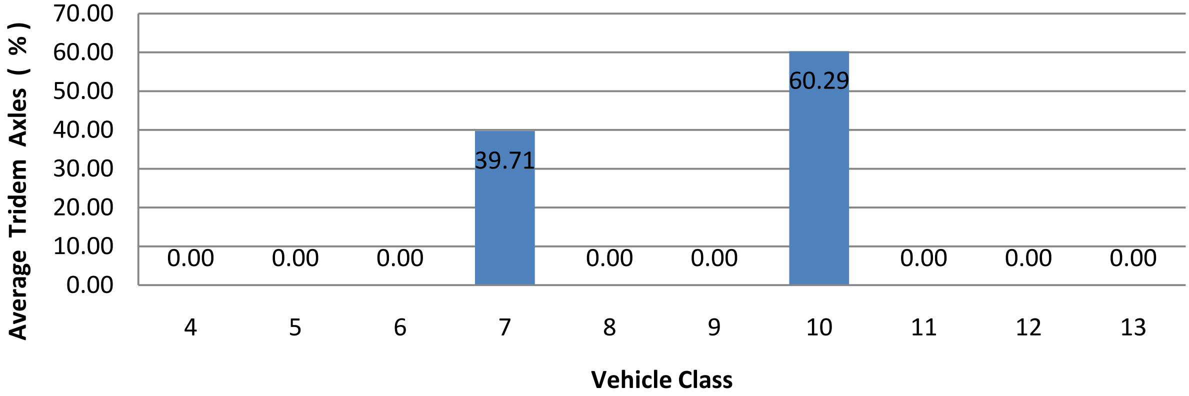

Figure 174
Tridem axles per vehicle class for TTC 12

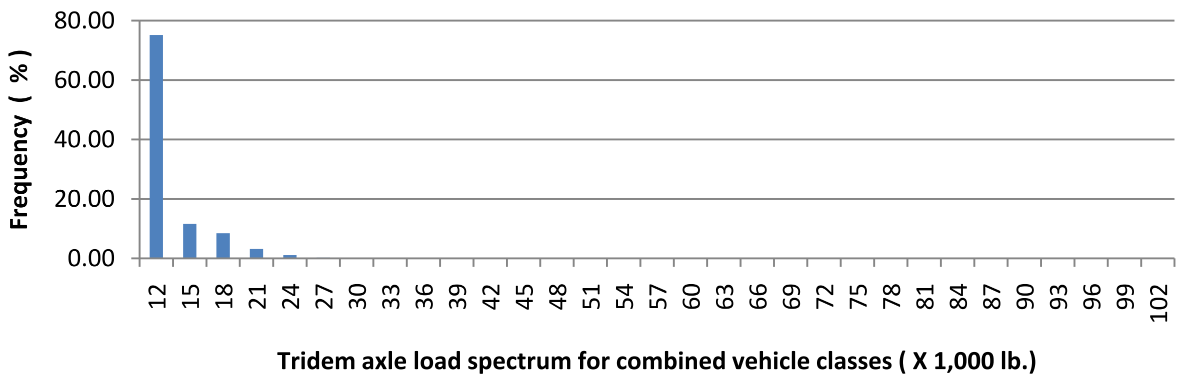

Figure 175
Tridem axle load spectrum for combined vehicle classes for TTC 12

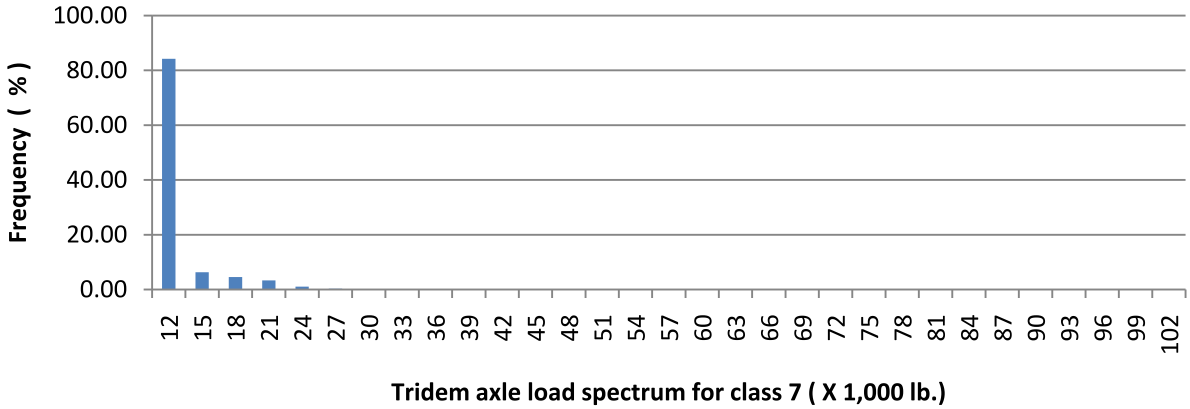

Figure 176
Tridem axle load spectrum for vehicle class 7 for TTC 12

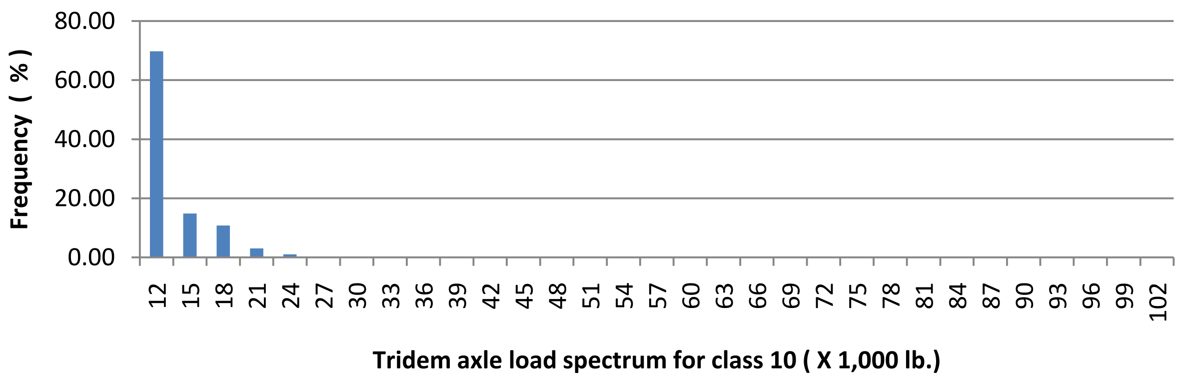

Figure 177
Tridem axle load spectrum for vehicle class 10 for TTC 12

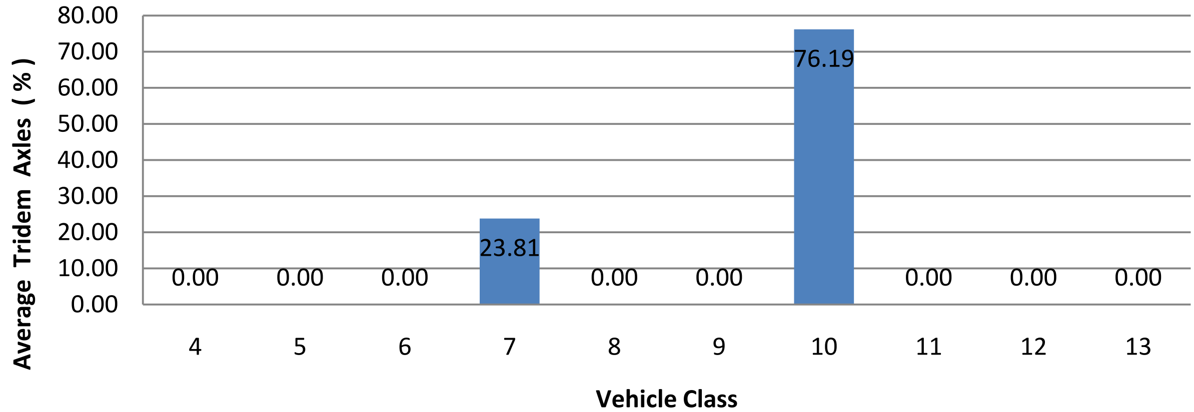

Figure 178
Tridem axles per vehicle class for TTC 14

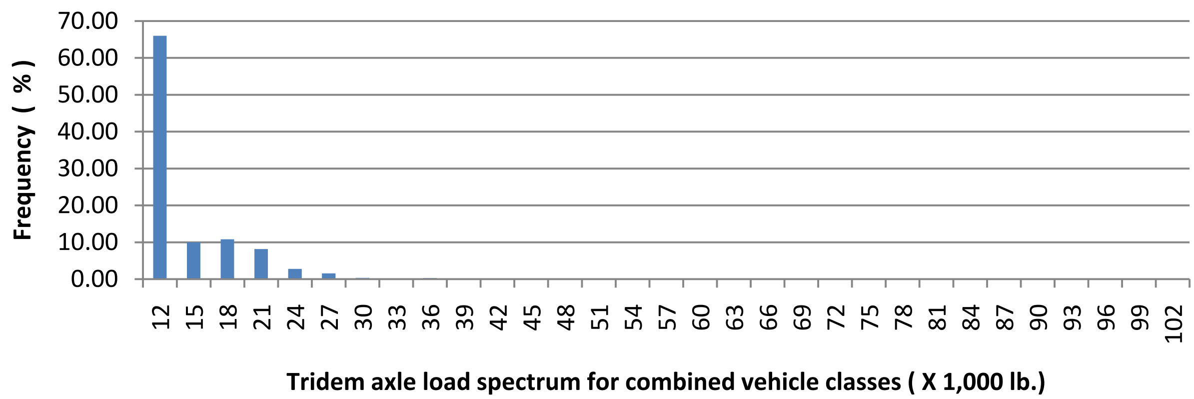

Figure 179
Tridem axle load spectrum for combined vehicle classes for TTC 14

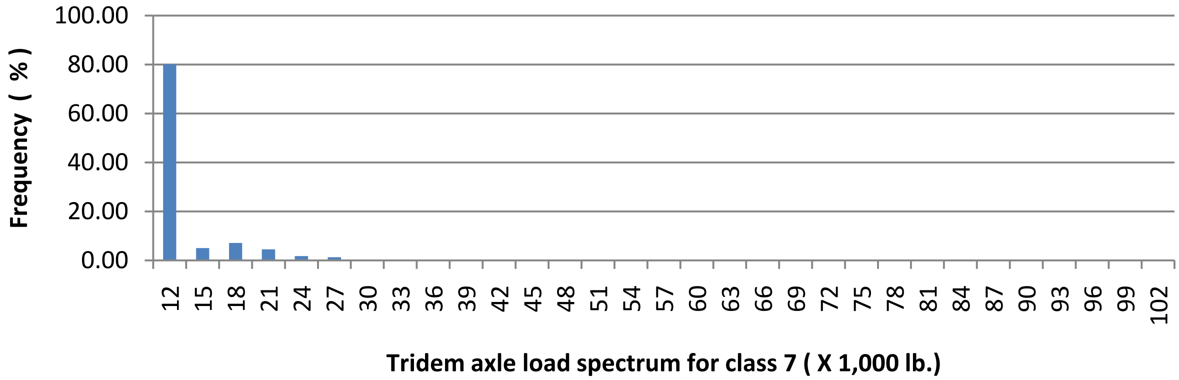

Figure 180
Tridem axle load spectrum for vehicle class 7 for TTC 14

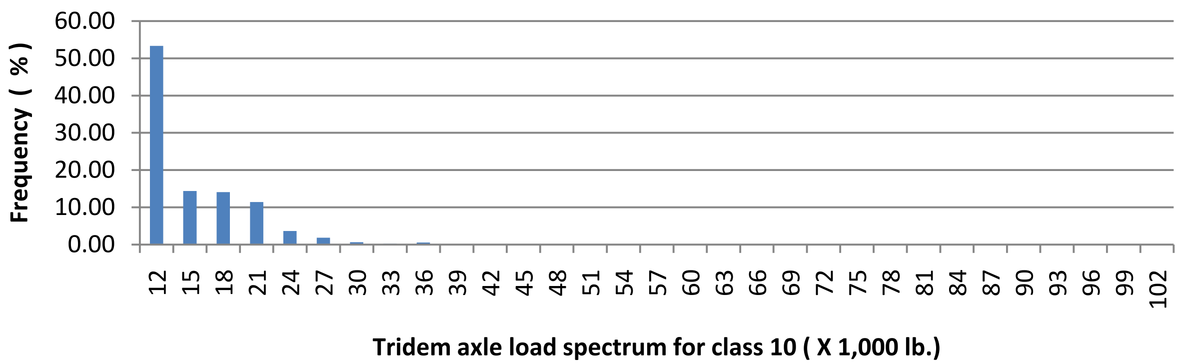

Figure 181
Tridem axle load spectrum for vehicle class 10 for TTC 14

APPENDIX G

Maps Showing Proposed WIM Stations in Different Regions

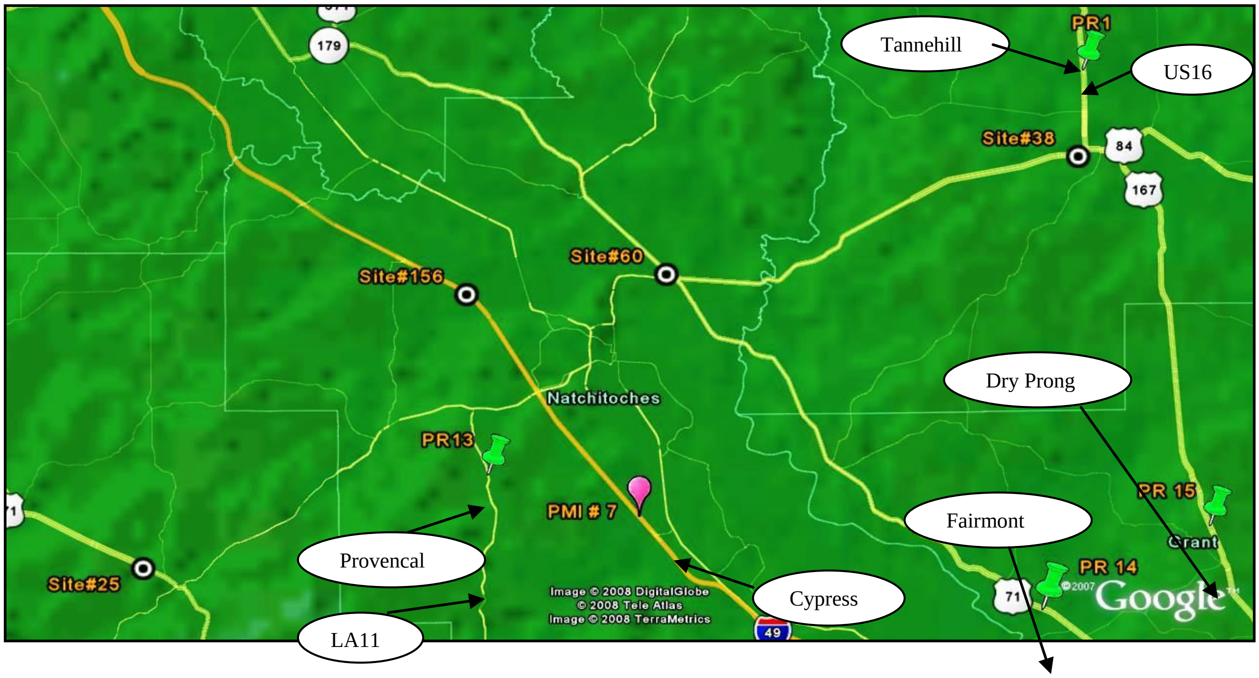

Figure 182
Map showing WIM stations in Natchitoches region

Figure 183
Map showing WIM stations in Alexandria region

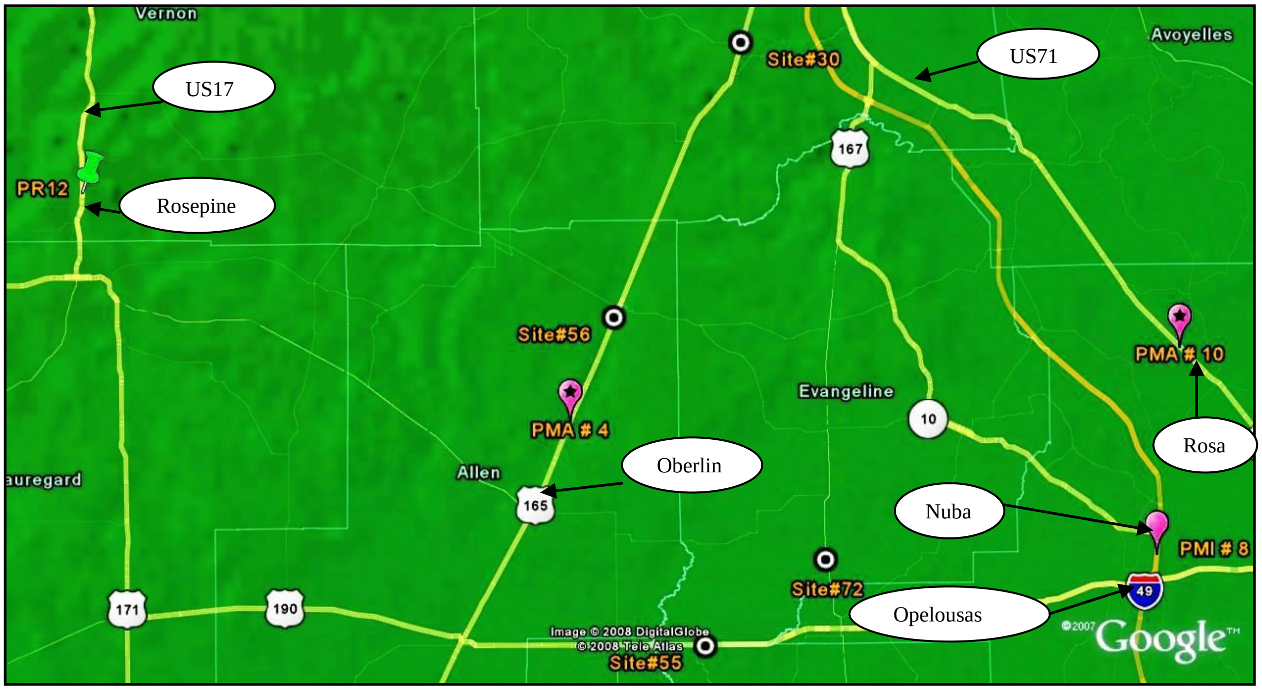

Figure 184
Map showing WIM stations in Evangeline region

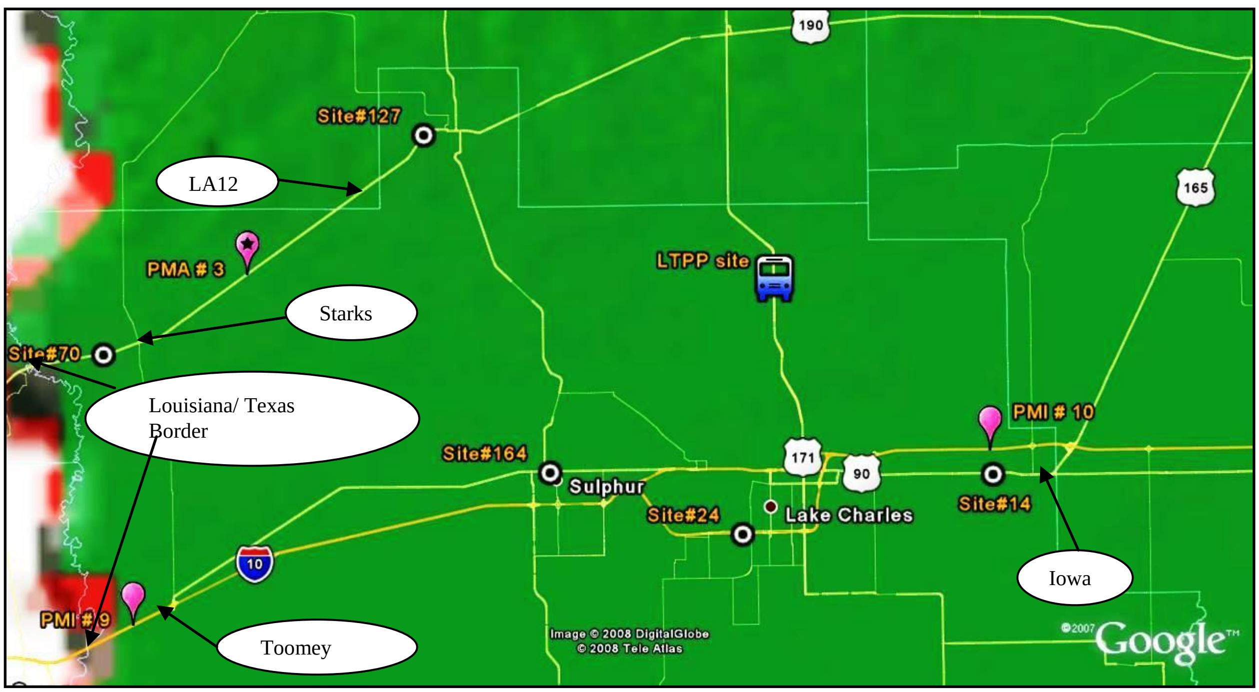

Figure 185
Map showing WIM stations in Lake Charles region

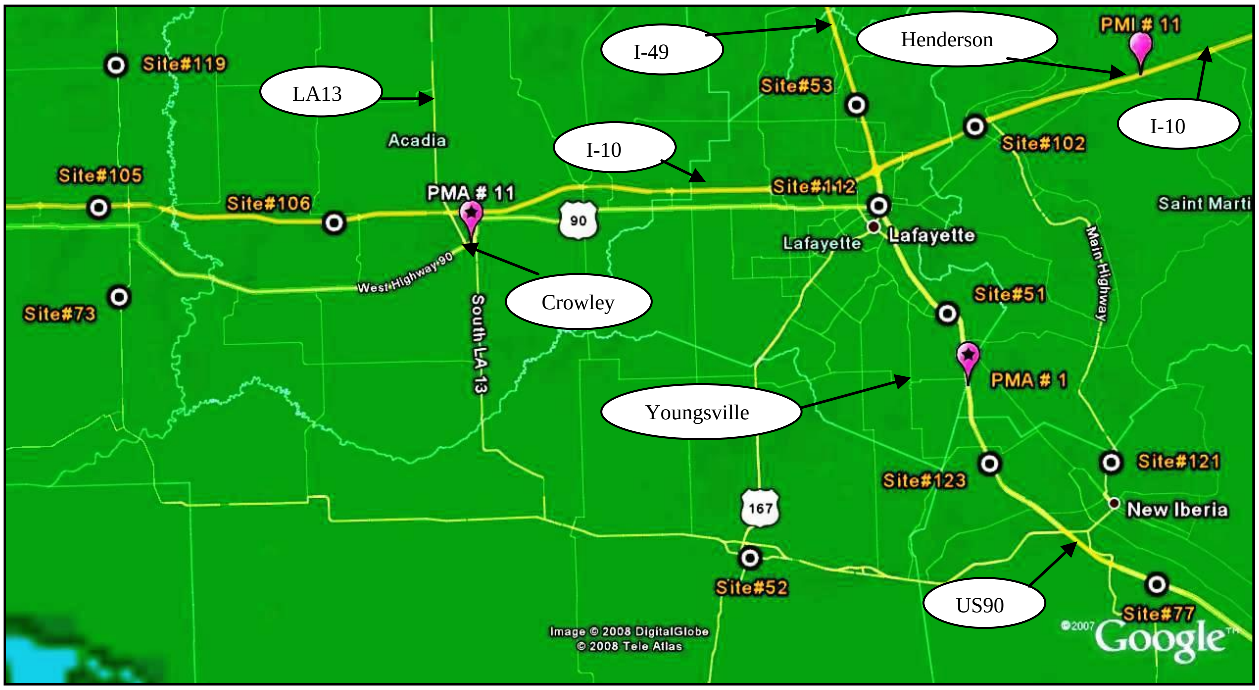

Figure 186
Map showing WIM stations in Lafayette region

Figure 187
Map showing WIM stations in Baton Rouge region

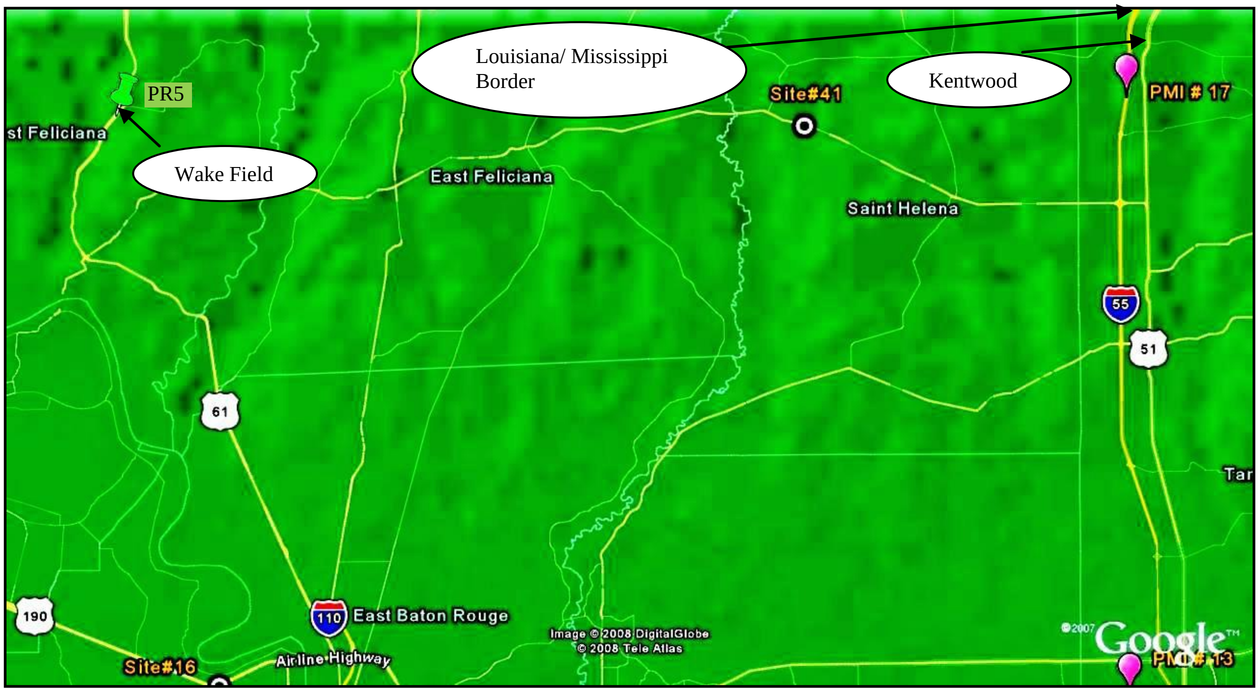

Figure 188
Map showing WIM stations in Feliciana-Saint Helena region

Figure 189
Map showing WIM stations in Slidell region

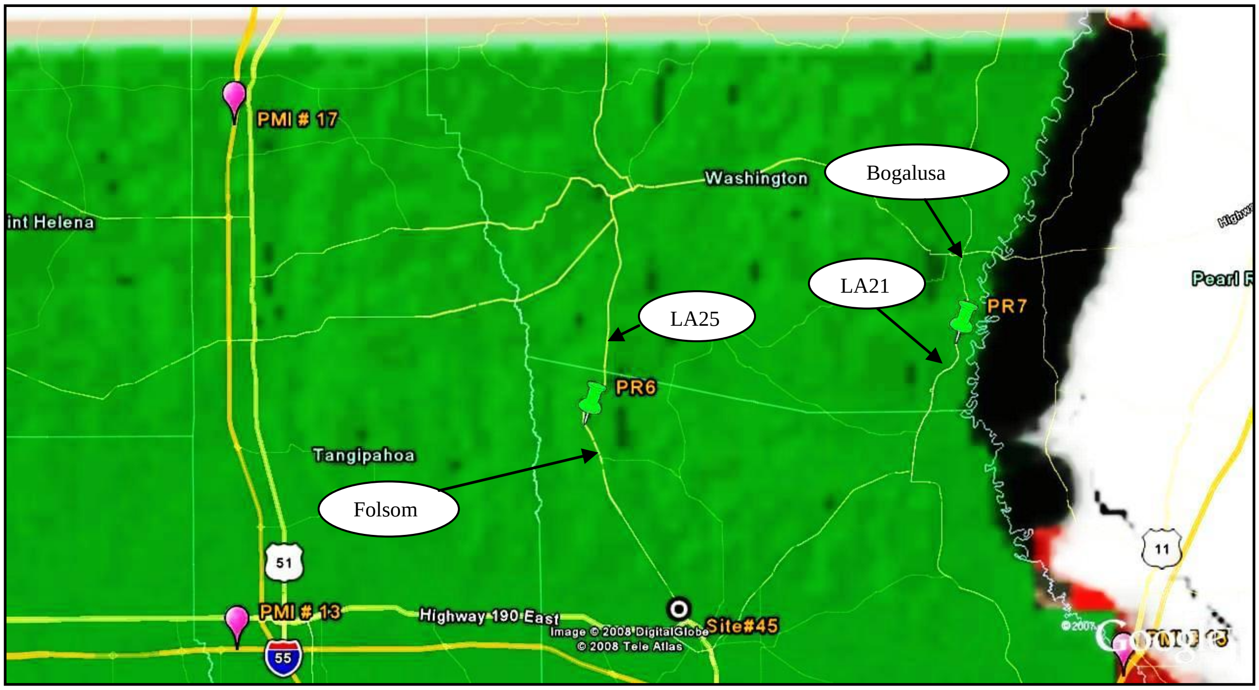

Figure 190
Map showing WIM stations in Tangipahoa region

APPENDIX H

Axle Load Distribution Factors for TTC Groups

Table 43
Normalized Single axle load distribution factors for TTC Group 1

Axle load	Vehicle truck class								
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
3000.00	3.19	6.18	23.26	14.85	16.32	0.65	1.23	0.20	0.59	7.31
4000.00	2.13	13.09	17.65	13.20	12.30	0.95	1.74	0.33	0.59	6.24
5000.00	3.19	17.59	8.51	6.27	10.27	2.48	2.17	0.57	0.98	3.23
6000.00	7.70	21.59	4.48	1.65	9.90	3.31	3.18	1.43	3.35	4.73
7000.00	10.73	11.56	2.85	1.98	6.82	3.51	2.68	3.79	4.33	2.58
8000.00	18.84	8.87	5.02	0.99	6.77	12.29	8.32	6.35	9.94	4.52
9000.00	14.58	4.37	4.66	0.66	4.73	11.59	12.00	5.30	8.46	4.73
10000.00	15.48	4.51	7.60	3.96	6.32	18.85	20.17	10.67	14.86	7.53
11000.00	6.96	2.58	6.56	3.63	4.67	19.63	20.32	10.75	11.52	9.03
12000.00	5.73	2.53	6.33	10.89	5.75	17.89	15.04	9.69	10.63	12.69
13000.00	3.03	1.59	3.76	10.56	3.45	5.92	6.94	8.39	11.32	6.45
14000.00	3.77	1.53	2.67	11.88	3.25	2.31	4.34	10.51	9.55	6.88
15000.00	2.21	1.09	1.76	6.27	2.20	0.43	1.08	10.43	6.59	4.09
16000.00	0.74	0.64	1.04	6.60	1.60	0.12	0.22	7.13	2.95	4.95
17000.00	1.31	0.78	1.45	3.63	1.77	0.03	0.14	6.84	2.76	3.23
18000.00	0.16	0.48	0.68	0.99	1.02	0.01	0.14	3.14	0.59	3.23
19000.00	0.16	0.39	0.90	0.66	1.09	0.02	0.22	2.73	0.79	2.15
20000.00	0.00	0.18	0.36	0.33	0.57	0.00	0.00	0.69	0.10	1.51
21000.00	0.00	0.27	0.23	0.00	0.42	0.00	0.00	0.37	0.10	1.51
22000.00	0.00	0.07	0.14	0.00	0.30	0.00	0.00	0.33	0.00	0.65
23000.00	0.00	0.04	0.05	0.33	0.21	0.00	0.00	0.24	0.00	0.86
24000.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.12	0.00	0.65
25000.00	0.00	0.02	0.05	0.33	0.05	0.00	0.00	0.00	0.00	0.00
26000.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.43
27000.00	0.00	0.01	0.00	0.00	0.03	0.00	0.07	0.00	0.00	0.00
28000.00	0.00	0.02	0.00	0.33	0.02	0.00	0.00	0.00	0.00	0.00
29000.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.43
30000.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
31000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22
32000.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.22
33000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37000.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 44
Normalized Single axle load distribution factors for TTC Group 3

Axle load	Vehicle truck class								
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
3000.00	1.41	4.38	24.08	6.64	16.57	0.35	1.30	0.15	0.18	9.20
4000.00	1.86	15.67	19.84	18.18	13.78	0.90	0.90	0.33	0.30	3.55
5000.00	2.54	19.85	8.28	9.09	10.81	2.27	1.79	0.63	0.91	3.07
6000.00	6.39	19.83	4.82	2.45	9.77	2.44	1.96	1.04	1.85	3.95
7000.00	13.42	9.73	3.00	5.59	5.64	2.14	2.73	1.87	2.64	4.52
8000.00	21.41	8.36	6.38	12.94	7.36	9.58	15.00	7.49	9.62	11.46
9000.00	13.83	4.46	7.34	10.49	6.30	20.67	23.59	8.41	11.73	14.29
10000.00	13.24	4.31	8.73	13.29	6.96	27.33	25.71	11.30	15.76	11.86
11000.00	7.85	2.83	5.42	9.44	4.43	14.67	11.94	8.97	12.36	6.30
12000.00	6.67	2.76	4.92	4.20	4.32	12.10	8.72	11.80	14.44	5.25
13000.00	3.76	2.14	1.92	2.10	2.79	4.67	3.83	9.68	10.43	4.04
14000.00	3.45	1.78	1.92	1.40	2.96	2.12	1.26	11.61	9.26	6.70
15000.00	1.59	1.15	1.20	1.75	2.58	0.50	0.65	10.31	5.33	3.71
16000.00	0.63	0.75	0.67	0.70	1.52	0.12	0.12	5.90	2.36	3.39
17000.00	0.59	0.63	0.41	0.70	1.48	0.05	0.24	4.60	1.52	2.74
18000.00	0.41	0.43	0.29	0.35	0.70	0.03	0.04	2.52	0.48	1.69
19000.00	0.41	0.36	0.36	0.00	0.67	0.02	0.04	1.68	0.46	0.97
20000.00	0.05	0.22	0.17	0.35	0.36	0.01	0.00	0.65	0.18	1.29
21000.00	0.14	0.13	0.19	0.00	0.31	0.00	0.04	0.47	0.18	0.73
22000.00	0.09	0.09	0.02	0.00	0.13	0.00	0.00	0.26	0.00	0.40
23000.00	0.00	0.04	0.02	0.35	0.15	0.01	0.00	0.17	0.00	0.08
24000.00	0.05	0.04	0.00	0.00	0.10	0.00	0.00	0.08	0.00	0.08
25000.00	0.05	0.01	0.00	0.00	0.10	0.00	0.00	0.06	0.00	0.08
26000.00	0.09	0.01	0.00	0.00	0.05	0.00	0.00	0.02	0.00	0.08
27000.00	0.00	0.00	0.02	0.00	0.06	0.00	0.08	0.00	0.00	0.16
28000.00	0.00	0.01	0.00	0.00	0.02	0.00	0.04	0.00	0.00	0.08
29000.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.08
30000.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.08
31000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
32000.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
33000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34000.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
35000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.05	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00

Table 45
Normalized Single axle load distribution factors for TTC Group 4

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
3000	3.00	8.66	27.60	2.13	33.76	1.48	12.76	0.00	1.76	36.73
4000	3.37	18.09	13.33	0.00	14.15	0.71	3.70	0.00	0.00	18.37
5000	3.93	21.26	4.34	0.00	10.84	2.91	4.12	1.13	2.35	6.12
6000	6.74	22.08	3.57	6.38	9.14	8.26	3.29	2.08	2.06	2.04
7000	15.36	10.11	2.64	4.26	4.90	3.61	1.65	2.26	2.65	8.16
8000	26.22	6.41	7.13	17.02	5.75	10.42	10.70	6.79	8.24	10.88
9000	14.79	3.22	6.98	21.28	4.24	20.17	20.16	11.70	12.65	4.08
10000	11.05	2.70	9.69	12.77	4.16	29.72	24.28	12.08	18.24	3.40
11000	5.06	1.79	6.05	8.51	2.60	12.19	7.41	6.42	12.35	1.36
12000	5.06	1.27	7.44	6.38	2.95	6.87	7.41	9.43	13.82	2.72
13000	2.06	1.18	4.26	4.26	1.50	2.47	1.23	10.00	8.53	0.68
14000	1.31	0.95	3.10	2.13	1.57	0.75	2.47	16.23	8.53	2.72
15000	0.94	0.61	1.94	8.51	1.15	0.18	0.00	10.00	4.71	0.00
16000	0.75	0.51	1.01	4.26	0.87	0.09	0.41	5.47	2.65	0.00
17000	0.00	0.41	0.47	2.13	0.69	0.07	0.41	3.96	1.18	0.68
18000	0.19	0.25	0.23	0.00	0.39	0.03	0.00	1.70	0.29	1.36
19000	0.00	0.26	0.08	0.00	0.42	0.01	0.00	0.75	0.00	0.68
20000	0.00	0.15	0.08	0.00	0.18	0.00	0.00	0.00	0.00	0.00
21000	0.19	0.05	0.08	0.00	0.11	0.00	0.00	0.00	0.00	0.00
22000	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00
23000	0.00	0.00	0.00	0.00	0.11	0.03	0.00	0.00	0.00	0.00
24000	0.00	0.03	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00
25000	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00
26000	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00
27000	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
28000	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
29000	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.00
30000	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
31000	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
32000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34000	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00
35000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37000	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
38000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 46
Normalized Single axle load distribution factors for TTC Group 5

Axle load	Vehicle truck class								
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
3000	0.00	1.96	36.36	0.00	8.82	0.08	3.85	0.00	0.00	0.00
4000	0.00	1.96	7.58	25.00	9.37	0.87	0.00	0.00	0.00	0.00
5000	0.00	4.90	4.55	0.00	4.68	1.11	0.00	0.24	0.00	0.00
6000	12.50	16.67	3.03	12.50	5.79	0.95	3.85	0.73	0.78	0.00
7000	12.50	15.69	9.09	0.00	10.47	9.91	7.69	6.34	8.20	0.00
8000	25.00	13.73	16.67	0.00	10.74	51.31	23.08	13.54	20.31	33.33
9000	18.75	7.84	10.61	25.00	8.82	27.99	34.62	6.95	14.45	0.00
10000	18.75	8.82	4.55	25.00	11.02	6.58	15.38	12.44	20.70	0.00
11000	12.50	8.82	1.52	12.50	10.19	0.87	7.69	16.83	18.75	0.00
12000	0.00	3.92	3.03	0.00	3.58	0.24	0.00	19.51	10.55	0.00
13000	0.00	6.86	1.52	0.00	4.96	0.00	0.00	11.59	5.08	33.33
14000	0.00	3.92	0.00	0.00	6.89	0.00	3.85	7.80	0.39	0.00
15000	0.00	3.92	1.52	0.00	2.20	0.08	0.00	3.29	0.78	33.33
16000	0.00	0.00	0.00	0.00	1.38	0.00	0.00	0.49	0.00	0.00
17000	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.24	0.00	0.00
18000	0.00	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19000	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00
20000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23000	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00
24000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 47
Normalized Single axle load distribution factors for TTC Group 6

Axle load	Vehicle truck class								
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
3000	5.12	9.61	31.49	29.79	27.68	2.61	5.88	0.37	0.00	23.23
4000	4.05	13.88	22.05	39.36	13.95	1.70	2.80	0.37	0.00	3.03
5000	5.97	18.87	9.98	8.87	10.11	3.54	3.64	0.74	1.56	2.02
6000	6.18	19.68	5.03	0.71	8.74	4.26	4.20	1.85	0.00	4.04
7000	6.61	8.58	2.40	0.00	4.96	3.31	5.32	1.11	4.69	5.05
8000	14.71	8.48	3.56	1.06	5.97	10.04	9.52	8.89	17.19	12.12
9000	15.14	4.67	3.56	1.77	5.35	13.75	15.97	11.48	9.38	3.03
10000	14.93	4.47	6.15	2.84	5.77	23.18	17.93	16.67	15.63	15.15
11000	8.74	2.67	4.22	2.13	3.79	19.52	15.69	7.78	12.50	5.05
12000	9.81	2.15	3.79	2.13	3.35	12.86	11.48	10.74	14.06	3.03
13000	4.05	1.62	1.86	3.19	2.04	3.38	2.52	7.04	10.94	2.02
14000	2.13	1.40	2.32	2.84	2.01	1.12	1.68	11.11	9.38	1.01
15000	2.13	1.04	1.43	2.48	1.38	0.37	1.40	5.19	1.56	5.05
16000	0.43	0.80	0.43	1.77	0.92	0.09	0.28	5.93	0.00	3.03
17000	0.00	0.58	0.77	0.71	1.02	0.05	1.12	4.81	3.13	4.04
18000	0.00	0.54	0.50	0.35	0.65	0.07	0.00	1.85	0.00	2.02
19000	0.00	0.28	0.04	0.00	0.52	0.07	0.28	2.22	0.00	2.02
20000	0.00	0.16	0.19	0.00	0.47	0.02	0.28	0.00	0.00	1.01
21000	0.00	0.34	0.04	0.00	0.30	0.00	0.00	0.74	0.00	1.01
22000	0.00	0.08	0.00	0.00	0.25	0.00	0.00	0.00	0.00	1.01
23000	0.00	0.06	0.04	0.00	0.19	0.00	0.00	0.37	0.00	1.01
24000	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.37	0.00	0.00
25000	0.00	0.02	0.08	0.00	0.17	0.00	0.00	0.37	0.00	1.01
26000	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00
27000	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00
28000	0.00	0.00	0.04	0.00	0.03	0.00	0.00	0.00	0.00	0.00
29000	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
30000	0.00	0.00	0.04	0.00	0.01	0.00	0.00	0.00	0.00	0.00
31000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34000	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
35000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
37000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00

Table 48
Normalized Single axle load distribution factors for TTC Group 9

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
3000	3.15	7.12	26.98	4.76	21.05	1.93	2.90	0.41	0.00	13.33
4000	3.37	11.31	20.38	30.25	11.02	1.57	1.87	0.00	0.00	1.11
5000	5.17	18.04	12.44	26.89	12.76	2.20	2.70	0.00	0.00	3.33
6000	11.69	23.76	8.64	18.77	14.07	2.63	2.70	1.22	3.57	1.11
7000	7.42	12.24	3.85	7.00	6.94	2.96	3.94	0.41	1.79	0.00
8000	14.16	9.03	4.09	3.08	6.51	6.13	8.09	2.45	5.36	4.44
9000	12.36	4.27	3.07	1.12	4.71	9.46	11.00	2.45	1.79	6.67
10000	11.91	3.98	4.30	2.80	5.64	17.12	18.46	10.61	12.50	12.22
11000	8.99	2.49	3.97	1.96	4.18	17.98	17.63	15.10	10.71	5.56
12000	9.21	2.13	3.93	2.52	4.30	22.94	17.22	13.47	21.43	11.11
13000	5.17	1.53	1.84	0.28	2.05	8.39	7.47	10.20	10.71	6.67
14000	3.37	1.22	1.72	0.56	1.95	4.73	3.32	11.02	16.07	10.00
15000	2.25	0.68	1.06	0.00	1.44	1.23	1.66	7.35	8.93	2.22
16000	0.22	0.37	0.65	0.00	0.67	0.33	0.21	6.53	1.79	5.56
17000	0.45	0.66	1.02	0.00	0.87	0.13	0.41	7.35	3.57	4.44
18000	0.45	0.29	0.86	0.00	0.46	0.03	0.00	4.90	0.00	1.11
19000	0.22	0.25	0.37	0.00	0.51	0.03	0.00	2.04	0.00	3.33
20000	0.00	0.19	0.20	0.00	0.33	0.03	0.00	2.04	0.00	1.11
21000	0.00	0.19	0.29	0.00	0.16	0.03	0.41	2.04	0.00	2.22
22000	0.00	0.19	0.12	0.00	0.08	0.00	0.00	0.00	1.79	1.11
23000	0.00	0.04	0.08	0.00	0.07	0.07	0.00	0.00	0.00	1.11
24000	0.00	0.02	0.00	0.00	0.07	0.03	0.00	0.41	0.00	0.00
25000	0.00	0.00	0.04	0.00	0.08	0.00	0.00	0.00	0.00	0.00
26000	0.00	0.00	0.08	0.00	0.03	0.00	0.00	0.00	0.00	0.00
27000	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	2.22
28000	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
29000	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32000	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
33000	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00

Table 49
Normalized Single axle load distribution factors for TTC Group 12

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
3000	4.44	9.25	34.96	15.85	27.53	1.89	6.83	0.00	0.00	39.58
4000	2.81	12.77	17.19	16.46	14.62	1.01	4.02	0.00	0.00	10.42
5000	2.22	19.41	7.77	3.66	11.12	2.72	4.02	0.00	0.00	2.08
6000	5.18	22.40	4.69	3.66	10.81	2.66	3.21	0.00	0.00	4.17
7000	7.10	10.83	2.62	5.49	5.43	2.66	0.80	0.00	0.00	4.17
8000	19.53	7.79	2.54	3.66	5.41	6.98	4.82	20.00	0.00	6.25
9000	17.46	4.11	3.12	8.54	4.03	12.37	11.65	20.00	25.00	2.08
10000	15.68	3.47	5.23	6.71	5.17	25.68	17.27	0.00	8.33	8.33
11000	8.58	2.09	4.42	6.10	2.53	17.51	17.67	40.00	16.67	6.25
12000	6.21	2.08	3.58	2.44	2.77	15.27	14.46	10.00	0.00	0.00
13000	3.40	1.29	2.81	7.32	1.83	4.97	6.83	0.00	0.00	6.25
14000	2.07	0.98	2.27	4.27	1.88	3.55	2.81	10.00	0.00	4.17
15000	1.63	0.87	2.31	1.83	1.44	0.83	1.61	0.00	8.33	0.00
16000	0.89	0.63	1.27	1.22	1.02	0.65	0.80	0.00	8.33	2.08
17000	0.44	0.52	1.46	4.27	1.02	0.36	0.40	0.00	8.33	0.00
18000	0.59	0.39	0.73	0.61	0.39	0.12	0.80	0.00	8.33	2.08
19000	0.44	0.25	1.00	1.22	0.63	0.30	0.80	0.00	0.00	0.00
20000	0.00	0.38	0.65	1.83	0.39	0.06	0.00	0.00	16.67	0.00
21000	0.00	0.15	0.50	3.05	0.50	0.12	0.40	0.00	0.00	0.00
22000	0.30	0.07	0.15	0.61	0.26	0.06	0.00	0.00	0.00	0.00
23000	0.00	0.10	0.31	0.61	0.28	0.00	0.00	0.00	0.00	0.00
24000	0.30	0.01	0.19	0.00	0.24	0.12	0.00	0.00	0.00	0.00
25000	0.30	0.07	0.08	0.00	0.15	0.00	0.40	0.00	0.00	0.00
26000	0.00	0.06	0.08	0.61	0.17	0.00	0.00	0.00	0.00	0.00
27000	0.00	0.01	0.00	0.00	0.15	0.00	0.40	0.00	0.00	0.00
28000	0.00	0.01	0.04	0.00	0.04	0.06	0.00	0.00	0.00	0.00
29000	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00
30000	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31000	0.15	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00
32000	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	2.08
33000	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34000	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
35000	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00
36000	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00

Table 50
Normalized Single axle load distribution factors for TTC Group 14

Axle load	Vehicle truck class								
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
3000	10.53	13.51	37.95	0.00	40.67	5.75	15.63	0.00	0.00	33.33
4000	7.37	16.88	28.32	30.00	19.18	3.10	9.38	0.00	0.00	0.00
5000	3.16	16.48	10.78	0.00	9.71	3.98	6.25	0.00	0.00	33.33
6000	5.26	21.16	5.02	0.00	7.22	4.42	3.13	0.00	0.00	0.00
7000	4.21	10.09	2.25	10.00	3.85	4.42	6.25	0.00	0.00	0.00
8000	21.05	7.04	1.79	0.00	4.50	9.73	6.25	0.00	0.00	0.00
9000	11.58	4.19	2.48	20.00	3.02	16.37	18.75	0.00	0.00	16.67
10000	13.68	3.62	3.06	20.00	3.43	16.37	15.63	0.00	0.00	16.67
11000	6.32	1.91	2.19	0.00	1.66	19.47	9.38	0.00	0.00	0.00
12000	5.26	1.46	2.19	20.00	1.78	11.50	9.38	0.00	0.00	0.00
13000	3.16	0.81	1.04	0.00	1.12	3.10	0.00	0.00	0.00	0.00
14000	3.16	0.90	0.75	0.00	0.83	0.88	0.00	0.00	0.00	0.00
15000	0.00	0.57	0.63	0.00	0.77	0.00	0.00	0.00	0.00	0.00
16000	0.00	0.33	0.23	0.00	0.47	0.00	0.00	0.00	0.00	0.00
17000	2.11	0.45	0.52	0.00	0.47	0.44	0.00	0.00	0.00	0.00
18000	1.05	0.12	0.52	0.00	0.24	0.00	0.00	0.00	0.00	0.00
19000	0.00	0.33	0.12	0.00	0.24	0.00	0.00	0.00	0.00	0.00
20000	1.05	0.08	0.12	0.00	0.18	0.00	0.00	0.00	0.00	0.00
21000	0.00	0.04	0.06	0.00	0.24	0.44	0.00	0.00	0.00	0.00
22000	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23000	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00
24000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25000	0.00	0.04	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
26000	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
27000	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
28000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31000	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
32000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 51
Normalized Tandem axle load distribution factors for TTC Group 1

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
6000.00	15.61	0.00	57.91	0.00	0.00	8.17	14.36	0.00	4.75	28.68
8000.00	7.02	0.00	7.13	0.00	0.00	9.83	6.21	0.00	10.74	8.44
10000.00	12.15	0.00	7.87	0.00	0.00	12.33	8.84	0.00	21.48	11.50
12000.00	16.33	0.00	7.01	0.00	0.00	15.94	10.08	0.00	22.71	16.41
14000.00	16.95	0.00	8.09	0.00	0.00	16.73	12.36	0.00	22.01	9.51
16000.00	13.55	0.00	6.02	0.00	0.00	15.85	15.29	0.00	12.15	6.90
18000.00	8.86	0.00	3.08	0.00	0.00	14.36	17.09	0.00	3.87	7.82
20000.00	5.85	0.00	1.57	0.00	0.00	4.91	9.08	0.00	2.29	4.29
22000.00	1.67	0.00	0.75	0.00	0.00	1.37	3.76	0.00	0.00	3.68
24000.00	0.89	0.00	0.30	0.00	0.00	0.34	1.73	0.00	0.00	1.23
26000.00	0.78	0.00	0.22	0.00	0.00	0.11	0.69	0.00	0.00	0.61
28000.00	0.17	0.00	0.02	0.00	0.00	0.04	0.28	0.00	0.00	0.15
30000.00	0.17	0.00	0.00	0.00	0.00	0.01	0.07	0.00	0.00	0.61
32000.00	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.00	0.00	0.00
34000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.15
36000.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
40000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
68000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74000.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 52
Normalized Tandem axle load distribution factors for TTC Group 3

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
6000.00	8.00	0.00	59.67	0.00	0.00	4.59	16.38	0.00	2.28	24.58
8000.00	4.66	0.00	10.97	0.00	0.00	8.94	7.14	0.00	6.70	17.92
10000.00	12.24	0.00	7.86	0.00	0.00	14.16	12.01	0.00	20.41	16.53
12000.00	20.10	0.00	6.40	0.00	0.00	15.63	13.91	0.00	29.24	11.74
14000.00	19.83	0.00	5.15	0.00	0.00	18.25	14.83	0.00	25.23	9.62
16000.00	14.47	0.00	3.97	0.00	0.00	19.43	12.42	0.00	11.42	7.69
18000.00	10.57	0.00	3.03	0.00	0.00	12.75	10.32	0.00	3.96	5.33
20000.00	5.50	0.00	1.73	0.00	0.00	4.58	6.49	0.00	0.56	2.85
22000.00	2.99	0.00	0.80	0.00	0.00	1.24	3.04	0.00	0.15	1.27
24000.00	0.73	0.00	0.25	0.00	0.00	0.31	1.94	0.00	0.00	1.09
26000.00	0.63	0.00	0.12	0.00	0.00	0.07	0.63	0.00	0.05	0.85
28000.00	0.17	0.00	0.05	0.00	0.00	0.02	0.57	0.00	0.00	0.42
30000.00	0.00	0.00	0.00	0.00	0.00	0.01	0.20	0.00	0.00	0.06
32000.00	0.07	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.06
34000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
68000.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
76000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 53
Normalized Tandem axle load distribution factors for TTC Group 4

Axle load	Vehicle truck class								
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
6000.00	9.30	0.00	40.87	0.00	0.00	7.09	26.09	0.00	0.00	22.06
8000.00	4.07	0.00	9.45	0.00	0.00	15.02	6.96	0.00	4.55	8.82
10000.00	16.86	0.00	17.93	0.00	0.00	19.31	18.26	0.00	6.82	13.24
12000.00	20.93	0.00	16.40	0.00	0.00	13.38	15.22	0.00	34.09	23.53
14000.00	22.09	0.00	8.48	0.00	0.00	10.99	11.30	0.00	40.91	27.94
16000.00	9.88	0.00	3.96	0.00	0.00	14.42	13.04	0.00	9.09	1.47
18000.00	14.53	0.00	1.37	0.00	0.00	13.40	6.09	0.00	4.55	2.94
20000.00	2.33	0.00	1.13	0.00	0.00	4.43	2.61	0.00	0.00	0.00
22000.00	0.00	0.00	0.32	0.00	0.00	1.50	0.43	0.00	0.00	0.00
24000.00	0.00	0.00	0.08	0.00	0.00	0.29	0.00	0.00	0.00	0.00
26000.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
28000.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
30000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
40000.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
44000.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
46000.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
50000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
68000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 54
Normalized Tandem axle load distribution factors for TTC Group 5

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
6000.00	8.33	0.00	59.85	0.00	0.00	5.85	3.85	0.00	0.78	0.00
8000.00	12.50	0.00	12.12	0.00	0.00	18.02	15.38	0.00	12.50	0.00
10000.00	29.17	0.00	6.82	0.00	0.00	21.77	26.92	0.00	39.06	0.00
12000.00	16.67	0.00	11.36	0.00	0.00	25.44	32.69	0.00	35.16	25.00
14000.00	12.50	0.00	7.58	0.00	0.00	25.71	13.46	0.00	11.72	0.00
16000.00	20.83	0.00	2.27	0.00	0.00	3.01	7.69	0.00	0.78	25.00
18000.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	50.00
20000.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
22000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
68000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 55
Normalized Tandem axle load distribution factors for TTC Group 6

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
6000.00	15.61	0.00	68.30	0.00	0.00	10.19	12.75	0.00	0.00	26.52
8000.00	4.15	0.00	5.18	0.00	0.00	17.12	11.76	0.00	9.38	12.12
10000.00	10.30	0.00	6.81	0.00	0.00	18.57	16.81	0.00	18.75	18.18
12000.00	17.77	0.00	6.19	0.00	0.00	14.95	16.11	0.00	46.88	4.55
14000.00	18.60	0.00	4.91	0.00	0.00	11.91	14.15	0.00	12.50	6.82
16000.00	12.79	0.00	3.44	0.00	0.00	11.75	11.90	0.00	9.38	9.85
18000.00	11.63	0.00	2.71	0.00	0.00	9.23	8.26	0.00	3.13	6.82
20000.00	4.82	0.00	1.53	0.00	0.00	3.93	6.30	0.00	0.00	5.30
22000.00	2.33	0.00	0.43	0.00	0.00	1.52	0.56	0.00	0.00	6.06
24000.00	1.50	0.00	0.25	0.00	0.00	0.50	0.56	0.00	0.00	2.27
26000.00	0.50	0.00	0.15	0.00	0.00	0.23	0.42	0.00	0.00	1.52
28000.00	0.00	0.00	0.06	0.00	0.00	0.05	0.14	0.00	0.00	0.00
30000.00	0.00	0.00	0.02	0.00	0.00	0.03	0.14	0.00	0.00	0.00
32000.00	0.00	0.00	0.00	0.00	0.00	0.01	0.14	0.00	0.00	0.00
34000.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
36000.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00
38000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
68000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 56
Normalized Tandem axle load distribution factors for TTC Group 9

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
6000.00	24.51	0.00	71.72	0.00	0.00	9.10	10.89	0.00	3.57	28.33
8000.00	2.50	0.00	6.24	0.00	0.00	12.00	5.29	0.00	3.57	6.67
10000.00	8.05	0.00	5.77	0.00	0.00	16.16	8.92	0.00	10.71	4.17
12000.00	13.42	0.00	5.36	0.00	0.00	15.43	9.34	0.00	35.71	13.33
14000.00	20.57	0.00	3.83	0.00	0.00	11.92	9.75	0.00	21.43	15.83
16000.00	13.95	0.00	2.21	0.00	0.00	13.54	14.00	0.00	21.43	10.00
18000.00	9.30	0.00	1.56	0.00	0.00	11.98	20.12	0.00	3.57	7.50
20000.00	4.47	0.00	1.62	0.00	0.00	6.12	13.90	0.00	0.00	8.33
22000.00	1.79	0.00	0.98	0.00	0.00	2.35	6.22	0.00	0.00	2.50
24000.00	0.89	0.00	0.33	0.00	0.00	0.69	1.24	0.00	0.00	0.83
26000.00	0.18	0.00	0.25	0.00	0.00	0.38	0.10	0.00	0.00	2.50
28000.00	0.00	0.00	0.04	0.00	0.00	0.16	0.00	0.00	0.00	0.00
30000.00	0.18	0.00	0.02	0.00	0.00	0.04	0.00	0.00	0.00	0.00
32000.00	0.00	0.00	0.00	0.00	0.00	0.02	0.21	0.00	0.00	0.00
34000.00	0.18	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
38000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000.00	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
44000.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
46000.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52000.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
56000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
68000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74000.00	0.00	0.00	0.04	0.00	0.00	0.02	0.00	0.00	0.00	0.00
76000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 57
Normalized Tandem axle load distribution factors for TTC Group 12

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
6000.00	13.01	0.00	64.88	0.00	0.00	9.08	17.06	0.00	0.00	25.00
8000.00	3.05	0.00	4.18	0.00	0.00	12.57	6.78	0.00	0.00	3.57
10000.00	7.57	0.00	7.56	0.00	0.00	21.13	5.61	0.00	0.00	3.57
12000.00	13.94	0.00	6.77	0.00	0.00	16.30	8.41	0.00	16.67	10.71
14000.00	22.18	0.00	4.80	0.00	0.00	10.86	10.05	0.00	0.00	12.50
16000.00	15.67	0.00	4.24	0.00	0.00	8.81	8.18	0.00	33.33	14.29
18000.00	12.75	0.00	2.63	0.00	0.00	8.58	16.59	0.00	33.33	7.14
20000.00	6.37	0.00	2.23	0.00	0.00	7.26	14.25	0.00	0.00	8.93
22000.00	3.72	0.00	1.63	0.00	0.00	3.35	7.24	0.00	0.00	7.14
24000.00	0.27	0.00	0.73	0.00	0.00	1.19	2.34	0.00	16.67	3.57
26000.00	0.93	0.00	0.21	0.00	0.00	0.50	0.70	0.00	0.00	1.79
28000.00	0.00	0.00	0.02	0.00	0.00	0.12	1.64	0.00	0.00	0.00
30000.00	0.27	0.00	0.04	0.00	0.00	0.05	0.23	0.00	0.00	1.79
32000.00	0.00	0.00	0.02	0.00	0.00	0.05	0.93	0.00	0.00	0.00
34000.00	0.13	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
36000.00	0.13	0.00	0.02	0.00	0.00	0.05	0.00	0.00	0.00	0.00
38000.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
50000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
68000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74000.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76000.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 58
Normalized Tandem axle load distribution factors for TTC Group 14

Axle load	Vehicle truck class								
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
6000.00	24.39	0.00	82.47	0.00	0.00	19.58	26.56	0.00	0.00	37.50
8000.00	7.32	0.00	3.81	0.00	0.00	13.94	15.63	0.00	0.00	12.50
10000.00	8.13	0.00	4.50	0.00	0.00	21.46	10.94	0.00	0.00	37.50
12000.00	17.89	0.00	2.83	0.00	0.00	11.95	6.25	0.00	0.00	12.50
14000.00	16.26	0.00	1.79	0.00	0.00	10.07	4.69	0.00	0.00	0.00
16000.00	13.01	0.00	1.07	0.00	0.00	9.18	4.69	0.00	0.00	0.00
18000.00	6.50	0.00	1.24	0.00	0.00	7.08	9.38	0.00	0.00	0.00
20000.00	1.63	0.00	1.59	0.00	0.00	3.98	15.63	0.00	0.00	0.00
22000.00	1.63	0.00	0.40	0.00	0.00	1.88	3.13	0.00	0.00	0.00
24000.00	0.81	0.00	0.23	0.00	0.00	0.44	0.00	0.00	0.00	0.00
26000.00	1.63	0.00	0.06	0.00	0.00	0.33	3.13	0.00	0.00	0.00
28000.00	0.00	0.00	0.03	0.00	0.00	0.11	0.00	0.00	0.00	0.00
30000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32000.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
68000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 59
Normalized Tridem axle load distribution factors for TTC Group 1

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
12000.00	0.00	0.00	0.00	55.59	0.00	0.00	57.27	0.00	0.00	0.00
15000.00	0.00	0.00	0.00	19.74	0.00	0.00	17.11	0.00	0.00	0.00
18000.00	0.00	0.00	0.00	17.87	0.00	0.00	14.97	0.00	0.00	0.00
21000.00	0.00	0.00	0.00	5.15	0.00	0.00	8.11	0.00	0.00	0.00
24000.00	0.00	0.00	0.00	0.55	0.00	0.00	1.99	0.00	0.00	0.00
27000.00	0.00	0.00	0.00	0.44	0.00	0.00	0.43	0.00	0.00	0.00
30000.00	0.00	0.00	0.00	0.11	0.00	0.00	0.10	0.00	0.00	0.00
33000.00	0.00	0.00	0.00	0.44	0.00	0.00	0.03	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
39000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
87000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
96000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
102000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 60
Normalized Tridem axle load distribution factors for TTC Group 3

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
12000.00	0.00	0.00	0.00	68.25	0.00	0.00	53.57	0.00	0.00	0.00
15000.00	0.00	0.00	0.00	23.81	0.00	0.00	30.36	0.00	0.00	0.00
18000.00	0.00	0.00	0.00	7.94	0.00	0.00	16.07	0.00	0.00	0.00
21000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
87000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
96000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
102000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 61
Normalized Tridem axle load distribution factors for TTC Group 4

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
12000.00	0.00	0.00	0.00	87.00	0.00	0.00	69.13	0.00	0.00	0.00
15000.00	0.00	0.00	0.00	5.08	0.00	0.00	14.81	0.00	0.00	0.00
18000.00	0.00	0.00	0.00	4.37	0.00	0.00	11.04	0.00	0.00	0.00
21000.00	0.00	0.00	0.00	2.60	0.00	0.00	3.39	0.00	0.00	0.00
24000.00	0.00	0.00	0.00	0.71	0.00	0.00	1.13	0.00	0.00	0.00
27000.00	0.00	0.00	0.00	0.24	0.00	0.00	0.13	0.00	0.00	0.00
30000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00
33000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
87000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
96000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
102000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 62
Normalized Tridem axle load distribution factors for TTC Group 5

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
12000.00	0.00	0.00	0.00	80.00	0.00	0.00	51.25	0.00	0.00	0.00
15000.00	0.00	0.00	0.00	4.83	0.00	0.00	15.80	0.00	0.00	0.00
18000.00	0.00	0.00	0.00	7.13	0.00	0.00	15.22	0.00	0.00	0.00
21000.00	0.00	0.00	0.00	4.83	0.00	0.00	10.98	0.00	0.00	0.00
24000.00	0.00	0.00	0.00	1.84	0.00	0.00	3.66	0.00	0.00	0.00
27000.00	0.00	0.00	0.00	1.38	0.00	0.00	1.73	0.00	0.00	0.00
30000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00
33000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00
39000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
87000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
96000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
102000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 63
Normalized Tridem axle load distribution factors for TTC Group 6

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
12000.00	0.00	0.00	0.00	55.89	0.00	0.00	57.22	0.00	0.00	0.00
15000.00	0.00	0.00	0.00	19.25	0.00	0.00	16.61	0.00	0.00	0.00
18000.00	0.00	0.00	0.00	18.01	0.00	0.00	15.16	0.00	0.00	0.00
21000.00	0.00	0.00	0.00	5.16	0.00	0.00	8.36	0.00	0.00	0.00
24000.00	0.00	0.00	0.00	0.56	0.00	0.00	2.06	0.00	0.00	0.00
27000.00	0.00	0.00	0.00	0.45	0.00	0.00	0.44	0.00	0.00	0.00
30000.00	0.00	0.00	0.00	0.11	0.00	0.00	0.10	0.00	0.00	0.00
33000.00	0.00	0.00	0.00	0.45	0.00	0.00	0.03	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
39000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
87000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
96000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
102000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 64
Normalized Tridem axle load distribution factors for TTC Group 9

Axle load	Vehicle truck class								
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
12000.00	0.00	0.00	0.00	68.25	0.00	0.00	53.57	0.00	0.00	0.00
15000.00	0.00	0.00	0.00	23.81	0.00	0.00	30.36	0.00	0.00	0.00
18000.00	0.00	0.00	0.00	7.94	0.00	0.00	16.07	0.00	0.00	0.00
21000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
87000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
96000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
102000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 65
Normalized Tridem axle load distribution factors for TTC Group 12

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
12000.00	0.00	0.00	0.00	84.26	0.00	0.00	69.76	0.00	0.00	0.00
15000.00	0.00	0.00	0.00	6.30	0.00	0.00	14.86	0.00	0.00	0.00
18000.00	0.00	0.00	0.00	4.56	0.00	0.00	10.77	0.00	0.00	0.00
21000.00	0.00	0.00	0.00	3.37	0.00	0.00	3.05	0.00	0.00	0.00
24000.00	0.00	0.00	0.00	1.09	0.00	0.00	1.04	0.00	0.00	0.00
27000.00	0.00	0.00	0.00	0.43	0.00	0.00	0.13	0.00	0.00	0.00
30000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.00
33000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
87000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
96000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
102000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 66
Normalized Tridem axle load distribution factors for TTC Group 14

Axle load	Vehicle truck class									
In Lbs	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
12000.00	0.00	0.00	0.00	80.17	0.00	0.00	53.35	0.00	0.00	0.00
15000.00	0.00	0.00	0.00	5.02	0.00	0.00	14.38	0.00	0.00	0.00
18000.00	0.00	0.00	0.00	7.17	0.00	0.00	14.06	0.00	0.00	0.00
21000.00	0.00	0.00	0.00	4.54	0.00	0.00	11.40	0.00	0.00	0.00
24000.00	0.00	0.00	0.00	1.79	0.00	0.00	3.62	0.00	0.00	0.00
27000.00	0.00	0.00	0.00	1.31	0.00	0.00	1.81	0.00	0.00	0.00
30000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.00	0.00	0.00
33000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00
36000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	0.00
39000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
87000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
96000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
102000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

APPENDIX I

Load Equivalency Factors of Functional Class

Table 67
Rigid pavement LEF for functional class 2 in 2006

FC 2	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.852	0.841	0.843	0.851	0.858	0.862	0.836	0.812	0.816	0.831	0.846	0.855
Class 5	0.093	0.091	0.090	0.090	0.089	0.089	0.097	0.092	0.090	0.090	0.090	0.089
Class 6	1.095	1.081	1.087	1.100	1.111	1.118	1.063	1.032	1.043	1.070	1.093	1.108
Class 7	3.016	2.994	3.026	3.067	3.096	3.112	2.886	2.841	2.906	2.994	3.056	3.091
Class 8	0.547	0.538	0.537	0.540	0.544	0.547	0.543	0.524	0.521	0.528	0.536	0.542
Class 9	1.879	1.851	1.859	1.880	1.901	1.916	1.811	1.753	1.767	1.812	1.855	1.886
Class 10	4.265	4.181	4.204	4.279	4.354	4.410	4.006	3.835	3.882	4.035	4.191	4.309
Class 11	0.772	0.755	0.743	0.737	0.735	0.734	0.825	0.784	0.756	0.743	0.737	0.735
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 68
Rigid pavement LEF for functional class 6 in 2006

FC 6	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	1.346	1.314	1.310	1.325	1.346	1.365	1.288	1.223	1.215	1.245	1.286	1.325
Class 5	0.115	0.112	0.112	0.112	0.113	0.113	0.117	0.111	0.110	0.111	0.112	0.113
Class 6	1.605	1.579	1.586	1.608	1.629	1.644	1.538	1.485	1.498	1.543	1.587	1.619
Class 7	1.078	1.065	1.068	1.075	1.081	1.084	1.072	1.042	1.046	1.061	1.073	1.080
Class 8	0.467	0.454	0.449	0.450	0.455	0.461	0.455	0.427	0.417	0.419	0.428	0.440
Class 9	1.193	1.177	1.178	1.186	1.193	1.198	1.184	1.147	1.148	1.165	1.180	1.191
Class 10	4.733	4.618	4.620	4.690	4.778	4.856	4.426	4.196	4.202	4.344	4.523	4.684
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 69
Rigid pavement LEF for functional class 7 in 2006

FC 7	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	1.063	1.044	1.050	1.067	1.084	1.094	1.013	0.973	0.985	1.020	1.054	1.077
Class 5	0.035	0.034	0.033	0.033	0.032	0.032	0.038	0.035	0.034	0.033	0.033	0.032
Class 6	0.852	0.837	0.837	0.846	0.856	0.863	0.829	0.799	0.798	0.815	0.835	0.851
Class 7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 8	3.714	3.640	3.667	3.744	3.816	3.864	3.476	3.324	3.379	3.535	3.685	3.789
Class 9	3.010	2.966	2.991	3.042	3.086	3.115	2.851	2.761	2.812	2.918	3.011	3.072
Class 10	7.170	7.042	7.110	7.266	7.406	7.497	6.668	6.413	6.553	6.873	7.166	7.362
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 70
Rigid pavement LEF for functional class 8 in 2006

FC 8	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	1.109	1.083	1.077	1.085	1.098	1.111	1.080	1.025	1.013	1.028	1.055	1.081
Class 5	0.101	0.099	0.097	0.097	0.096	0.096	0.108	0.102	0.098	0.097	0.097	0.096
Class 6	5.173	5.033	5.021	5.086	5.176	5.263	4.801	4.521	4.503	4.636	4.816	4.994
Class 7	1.177	1.163	1.152	1.146	1.144	1.143	1.222	1.191	1.165	1.152	1.147	1.144
Class 8	0.716	0.701	0.699	0.706	0.715	0.721	0.702	0.670	0.665	0.679	0.697	0.710
Class 9	3.399	3.333	3.344	3.394	3.448	3.488	3.234	3.099	3.120	3.222	3.332	3.417
Class 10	2.543	2.512	2.524	2.553	2.578	2.594	2.466	2.401	2.423	2.483	2.537	2.571
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 71
Rigid pavement LEF for functional class 9 in 2006

FC 9	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	1.403	1.379	1.382	1.399	1.417	1.430	1.356	1.306	1.311	1.346	1.383	1.410
Class 5	0.076	0.074	0.073	0.073	0.072	0.072	0.082	0.077	0.074	0.073	0.073	0.072
Class 6	1.009	0.995	1.005	1.016	1.023	1.027	0.968	0.955	0.976	0.999	1.014	1.022
Class 7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 8	0.302	0.298	0.300	0.304	0.307	0.309	0.292	0.284	0.288	0.296	0.303	0.307
Class 9	2.237	2.209	2.229	2.264	2.290	2.305	2.142	2.084	2.125	2.197	2.252	2.285
Class 10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 72
Rigid pavement LEF for functional class 11 in 2006

FC 11	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.970	0.958	0.957	0.963	0.968	0.972	0.965	0.938	0.936	0.947	0.957	0.965
Class 5	0.180	0.177	0.176	0.175	0.175	0.175	0.187	0.180	0.177	0.176	0.175	0.175
Class 6	1.306	1.290	1.296	1.310	1.321	1.328	1.274	1.240	1.251	1.279	1.303	1.318
Class 7	1.924	1.883	1.886	1.916	1.950	1.978	1.816	1.733	1.739	1.798	1.869	1.927
Class 8	1.302	1.284	1.286	1.298	1.308	1.315	1.273	1.235	1.239	1.262	1.284	1.299
Class 9	2.780	2.752	2.773	2.808	2.834	2.849	2.682	2.623	2.667	2.740	2.795	2.828
Class 10	4.461	4.387	4.419	4.497	4.567	4.615	4.214	4.062	4.129	4.288	4.435	4.537
Class 11	2.065	2.045	2.034	2.030	2.029	2.029	2.115	2.066	2.040	2.032	2.030	2.029
Class 12	1.878	1.858	1.846	1.843	1.841	1.841	1.927	1.881	1.854	1.845	1.842	1.841

Table 73
Rigid pavement LEF for functional class 14 in 2006

FC 14	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.473	0.465	0.464	0.466	0.470	0.472	0.472	0.454	0.450	0.455	0.462	0.468
Class 5	0.057	0.056	0.055	0.055	0.055	0.055	0.061	0.058	0.056	0.055	0.055	0.055
Class 6	0.855	0.843	0.847	0.857	0.865	0.870	0.832	0.807	0.814	0.834	0.851	0.862
Class 7	0.621	0.611	0.608	0.609	0.610	0.610	0.635	0.613	0.606	0.607	0.608	0.609
Class 8	0.322	0.317	0.316	0.316	0.317	0.318	0.328	0.316	0.312	0.313	0.315	0.317
Class 9	1.505	1.490	1.496	1.507	1.516	1.521	1.482	1.449	1.459	1.483	1.502	1.513
Class 10	3.620	3.567	3.596	3.656	3.707	3.742	3.430	3.322	3.381	3.504	3.613	3.687
Class 11	1.121	1.102	1.090	1.085	1.083	1.082	1.174	1.129	1.100	1.089	1.085	1.083
Class 12	1.023	1.006	0.994	0.988	0.986	0.985	1.075	1.034	1.006	0.994	0.988	0.986

Table 74
Rigid pavement LEF for functional class 17 in 2006

FC 17	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.546	0.537	0.534	0.534	0.537	0.539	0.552	0.533	0.524	0.525	0.530	0.534
Class 5	0.063	0.062	0.062	0.062	0.063	0.063	0.064	0.062	0.061	0.062	0.062	0.063
Class 6	0.356	0.350	0.348	0.349	0.349	0.349	0.364	0.352	0.347	0.348	0.348	0.349
Class 7	1.941	1.920	1.936	1.964	1.985	1.997	1.862	1.818	1.851	1.908	1.953	1.980
Class 8	0.373	0.368	0.370	0.374	0.376	0.377	0.367	0.357	0.361	0.367	0.373	0.375
Class 9	0.453	0.447	0.444	0.443	0.442	0.442	0.468	0.454	0.447	0.444	0.443	0.442
Class 10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 75
Rigid pavement LEF for functional class 2 in 2005

FC 2	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.571	0.564	0.561	0.561	0.562	0.562	0.583	0.566	0.559	0.559	0.560	0.561
Class 5	0.123	0.121	0.119	0.119	0.119	0.119	0.128	0.123	0.120	0.119	0.119	0.119
Class 6	0.801	0.791	0.794	0.801	0.807	0.811	0.785	0.764	0.769	0.784	0.797	0.805
Class 7	4.105	4.010	4.018	4.086	4.164	4.227	3.855	3.663	3.680	3.817	3.976	4.108
Class 8	0.454	0.446	0.446	0.448	0.451	0.453	0.453	0.436	0.434	0.439	0.445	0.450
Class 9	1.979	1.954	1.964	1.984	2.001	2.012	1.919	1.867	1.885	1.927	1.963	1.987
Class 10	3.084	3.040	3.063	3.110	3.151	3.177	2.945	2.854	2.899	2.997	3.083	3.139
Class 11	1.991	1.971	1.961	1.958	1.957	1.957	2.037	1.991	1.967	1.960	1.958	1.957
Class 12	1.259	1.244	1.235	1.231	1.229	1.228	1.300	1.265	1.243	1.234	1.231	1.229

Table 76
Rigid pavement LEF for functional class 6 in 2005

FC 6	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	1.908	1.862	1.859	1.882	1.915	1.945	1.804	1.712	1.705	1.753	1.819	1.880
Class 5	0.263	0.259	0.259	0.261	0.263	0.264	0.261	0.252	0.252	0.256	0.260	0.263
Class 6	2.493	2.440	2.452	2.499	2.546	2.580	2.345	2.236	2.260	2.356	2.454	2.525
Class 7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 8	3.300	3.202	3.186	3.226	3.287	3.349	3.076	2.880	2.850	2.930	3.052	3.177
Class 9	5.670	5.547	5.581	5.695	5.809	5.891	5.286	5.037	5.106	5.338	5.574	5.749
Class 10	7.512	7.316	7.319	7.435	7.577	7.708	6.961	6.570	6.583	6.818	7.107	7.374
Class 11	2.036	2.018	2.013	2.014	2.015	2.016	2.064	2.021	2.008	2.010	2.013	2.015
Class 12	1.504	1.484	1.469	1.463	1.460	1.458	1.567	1.519	1.485	1.469	1.463	1.460

Table 77
Rigid pavement LEF for functional class 7 in 2005

FC 7	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.879	0.862	0.861	0.871	0.881	0.889	0.858	0.822	0.819	0.838	0.860	0.876
Class 5	0.093	0.091	0.090	0.090	0.090	0.090	0.096	0.092	0.090	0.090	0.090	0.090
Class 6	0.912	0.900	0.905	0.918	0.928	0.935	0.878	0.852	0.864	0.890	0.912	0.925
Class 7	1.130	1.112	1.112	1.122	1.130	1.135	1.121	1.081	1.080	1.100	1.117	1.128
Class 8	1.282	1.252	1.254	1.276	1.299	1.318	1.210	1.149	1.154	1.196	1.245	1.284
Class 9	2.822	2.777	2.799	2.846	2.886	2.912	2.684	2.591	2.634	2.731	2.816	2.872
Class 10	6.696	6.549	6.587	6.722	6.861	6.962	6.231	5.937	6.015	6.289	6.576	6.790
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	6.342	6.195	6.251	6.405	6.545	6.635	5.891	5.590	5.700	6.016	6.309	6.503

Table 78
Rigid pavement LEF for functional class 14 in 2005

FC 14	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.785	0.776	0.777	0.781	0.785	0.787	0.782	0.762	0.762	0.771	0.779	0.784
Class 5	0.174	0.171	0.170	0.170	0.170	0.171	0.178	0.171	0.169	0.169	0.170	0.170
Class 6	1.365	1.334	1.331	1.344	1.361	1.377	1.296	1.233	1.228	1.255	1.289	1.321
Class 7	6.692	6.507	6.508	6.623	6.765	6.888	6.178	5.809	5.816	6.047	6.336	6.590
Class 8	0.721	0.705	0.701	0.704	0.711	0.718	0.704	0.670	0.662	0.669	0.681	0.695
Class 9	3.528	3.462	3.479	3.534	3.588	3.629	3.337	3.202	3.236	3.349	3.462	3.547
Class 10	5.524	5.407	5.432	5.529	5.631	5.712	5.156	4.920	4.973	5.170	5.381	5.551
Class 11	1.913	1.893	1.881	1.877	1.876	1.875	1.964	1.916	1.890	1.880	1.877	1.876
Class 12	1.908	1.889	1.880	1.878	1.877	1.877	1.951	1.906	1.884	1.879	1.877	1.877

Table 79
Rigid pavement LEF for functional class 16 in 2005

FC 16	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	2.90	2.82	2.81	2.84	2.89	2.95	2.71	2.55	2.53	2.60	2.71	2.81
Class 5	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.15	0.15	0.15	0.15	0.15
Class 6	1.58	1.55	1.55	1.57	1.60	1.62	1.50	1.43	1.44	1.48	1.53	1.57
Class 7	2.25	2.24	2.25	2.27	2.28	2.28	2.20	2.17	2.20	2.24	2.26	2.28
Class 8	0.29	0.28	0.28	0.29	0.29	0.29	0.29	0.27	0.27	0.28	0.28	0.29
Class 9	3.19	3.15	3.17	3.22	3.27	3.29	3.05	2.95	3.00	3.11	3.20	3.25
Class 10	0.94	0.93	0.93	0.94	0.95	0.96	0.91	0.88	0.88	0.91	0.93	0.95
Class 11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Class 12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 80
Rigid pavement LEF for functional class 17 in 2005

FC 17	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.298	0.293	0.290	0.289	0.288	0.288	0.312	0.300	0.293	0.290	0.289	0.288
Class 5	0.098	0.097	0.096	0.095	0.095	0.095	0.102	0.098	0.096	0.096	0.095	0.095
Class 6	4.462	4.364	4.399	4.499	4.595	4.661	4.138	3.941	4.011	4.215	4.416	4.557
Class 7	2.554	2.537	2.565	2.598	2.620	2.631	2.452	2.417	2.474	2.545	2.591	2.616
Class 8	0.201	0.195	0.193	0.196	0.200	0.204	0.189	0.176	0.174	0.179	0.188	0.196
Class 9	4.355	4.285	4.323	4.405	4.478	4.527	4.089	3.946	4.025	4.194	4.347	4.451
Class 10	2.387	2.311	2.301	2.339	2.396	2.451	2.193	2.044	2.026	2.100	2.215	2.327
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 81
Rigid pavement LEF for functional class 2 in 2004

FC 2	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.597	0.589	0.586	0.587	0.588	0.589	0.608	0.589	0.583	0.584	0.586	0.588
Class 5	0.138	0.135	0.134	0.133	0.133	0.133	0.144	0.138	0.135	0.134	0.133	0.133
Class 6	0.613	0.603	0.599	0.600	0.602	0.603	0.625	0.603	0.595	0.596	0.599	0.601
Class 7	1.018	0.999	0.999	1.007	1.015	1.020	1.014	0.972	0.969	0.986	1.003	1.013
Class 8	0.562	0.552	0.551	0.555	0.559	0.561	0.562	0.540	0.537	0.544	0.552	0.557
Class 9	2.268	2.243	2.257	2.283	2.304	2.317	2.194	2.141	2.169	2.223	2.267	2.296
Class 10	2.913	2.868	2.886	2.931	2.971	2.998	2.780	2.687	2.723	2.815	2.899	2.956
Class 11	1.592	1.568	1.551	1.543	1.539	1.538	1.665	1.609	1.569	1.551	1.543	1.539
Class 12	1.444	1.421	1.404	1.396	1.392	1.391	1.517	1.462	1.423	1.404	1.396	1.392

Table 82
Rigid pavement LEF for functional class 6 in 2004

FC 6	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.630	0.622	0.623	0.627	0.631	0.633	0.623	0.607	0.608	0.616	0.624	0.630
Class 5	0.203	0.200	0.200	0.201	0.202	0.202	0.205	0.198	0.197	0.198	0.200	0.202
Class 6	0.718	0.707	0.711	0.721	0.729	0.734	0.694	0.671	0.679	0.699	0.716	0.727
Class 7	2.510	2.487	2.518	2.558	2.585	2.600	2.389	2.342	2.405	2.489	2.548	2.580
Class 8	1.322	1.293	1.296	1.317	1.340	1.358	1.252	1.192	1.198	1.240	1.288	1.325
Class 9	4.389	4.313	4.346	4.423	4.495	4.545	4.134	3.979	4.045	4.205	4.354	4.460
Class 10	4.874	4.753	4.751	4.816	4.899	4.975	4.564	4.322	4.319	4.452	4.620	4.775
Class 11	1.954	1.930	1.928	1.935	1.940	1.942	1.972	1.916	1.909	1.922	1.932	1.939
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 83
Rigid pavement LEF for functional class 7 in 2004

FC 7	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.875	0.859	0.859	0.866	0.875	0.882	0.858	0.825	0.822	0.838	0.856	0.870
Class 5	0.113	0.111	0.111	0.111	0.111	0.111	0.116	0.111	0.110	0.111	0.111	0.111
Class 6	1.210	1.189	1.193	1.208	1.223	1.233	1.169	1.126	1.133	1.163	1.194	1.216
Class 7	2.028	2.013	2.033	2.057	2.073	2.082	1.956	1.925	1.965	2.016	2.052	2.071
Class 8	0.476	0.467	0.466	0.469	0.473	0.475	0.474	0.455	0.452	0.458	0.465	0.471
Class 9	5.412	5.293	5.327	5.439	5.550	5.628	5.046	4.806	4.874	5.102	5.333	5.500
Class 10	5.730	5.630	5.681	5.796	5.898	5.965	5.366	5.163	5.268	5.504	5.717	5.861
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 84
Rigid pavement LEF for functional class 11 in 2004

FC 11	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.810	0.801	0.800	0.802	0.804	0.805	0.817	0.797	0.793	0.797	0.801	0.804
Class 5	0.142	0.139	0.138	0.137	0.137	0.138	0.147	0.140	0.137	0.137	0.137	0.137
Class 6	1.244	1.229	1.236	1.250	1.261	1.267	1.210	1.178	1.191	1.220	1.244	1.258
Class 7	2.612	2.552	2.547	2.576	2.615	2.654	2.472	2.349	2.342	2.400	2.479	2.557
Class 8	0.827	0.816	0.815	0.819	0.823	0.826	0.826	0.802	0.799	0.807	0.816	0.822
Class 9	2.319	2.302	2.317	2.339	2.353	2.361	2.263	2.225	2.257	2.302	2.333	2.351
Class 10	3.856	3.790	3.815	3.881	3.942	3.983	3.651	3.515	3.566	3.701	3.828	3.917
Class 11	1.559	1.534	1.516	1.507	1.504	1.502	1.636	1.578	1.536	1.516	1.507	1.504
Class 12	1.699	1.676	1.660	1.653	1.649	1.648	1.767	1.714	1.677	1.660	1.653	1.650

Table 85
Rigid pavement LEF for functional class 14 in 2004

FC 14	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.383	0.378	0.375	0.375	0.375	0.375	0.394	0.381	0.376	0.375	0.375	0.375
Class 5	0.086	0.084	0.083	0.082	0.082	0.082	0.091	0.086	0.083	0.082	0.082	0.082
Class 6	0.832	0.823	0.826	0.833	0.838	0.841	0.820	0.800	0.805	0.819	0.830	0.837
Class 7	2.022	1.995	2.009	2.038	2.061	2.074	1.948	1.891	1.919	1.979	2.027	2.056
Class 8	0.178	0.175	0.174	0.175	0.176	0.177	0.178	0.171	0.170	0.172	0.174	0.176
Class 9	1.126	1.116	1.118	1.125	1.130	1.133	1.116	1.093	1.098	1.111	1.122	1.129
Class 10	0.737	0.733	0.735	0.739	0.741	0.742	0.731	0.720	0.725	0.733	0.738	0.741
Class 11	0.769	0.753	0.741	0.735	0.732	0.731	0.820	0.781	0.753	0.741	0.735	0.732
Class 12	1.064	1.050	1.040	1.035	1.033	1.033	1.108	1.073	1.050	1.040	1.035	1.033

Table 86
Rigid pavement LEF for functional class 16 in 2004

FC 16	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.668	0.660	0.657	0.657	0.657	0.657	0.682	0.665	0.657	0.656	0.657	0.657
Class 5	0.107	0.105	0.104	0.104	0.103	0.103	0.112	0.107	0.105	0.104	0.103	0.103
Class 6	1.126	1.112	1.118	1.130	1.140	1.146	1.094	1.066	1.077	1.102	1.122	1.136
Class 7	1.471	1.459	1.465	1.476	1.485	1.490	1.445	1.418	1.430	1.454	1.472	1.483
Class 8	0.254	0.250	0.249	0.249	0.249	0.249	0.260	0.251	0.248	0.248	0.248	0.249
Class 9	1.021	1.011	1.011	1.015	1.019	1.021	1.021	0.998	0.998	1.007	1.014	1.018
Class 10	1.608	1.585	1.591	1.609	1.626	1.637	1.557	1.509	1.521	1.558	1.593	1.618
Class 11	1.074	1.057	1.045	1.039	1.037	1.036	1.126	1.085	1.057	1.045	1.039	1.037
Class 12	0.924	0.905	0.892	0.885	0.882	0.881	0.982	0.937	0.906	0.892	0.885	0.882

Table 87
Flexible pavement LEF for functional class 2 in 2006

FC 2	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.7215	0.7145	0.6959	0.6893	0.6934	0.7343	0.7255	0.6851	0.6668	0.672
Class 5	0.0921	0.0936	0.0908	0.0884	0.0872	0.1017	0.106	0.0981	0.0915	0.0885
Class 6	0.7678	0.7629	0.7486	0.7453	0.7488	0.7827	0.7779	0.7438	0.7319	0.7374
Class 7	2.1303	2.1003	2.0727	2.0789	2.0983	2.1228	2.0651	2.0062	2.0136	2.0518
Class 8	0.4053	0.4075	0.3971	0.3905	0.3893	0.4267	0.436	0.4098	0.3916	0.3872
Class 9	1.1634	1.1558	1.1281	1.1167	1.1207	1.1907	1.1844	1.1218	1.0907	1.0941
Class 10	2.655	2.5726	2.4906	2.4866	2.5285	2.6338	2.4743	2.3109	2.2961	2.3717
Class 11	0.7487	0.7806	0.7615	0.7333	0.7163	0.8224	0.9058	0.8527	0.781	0.7403
Class 12	0	0	0	0	0	0	0	0	0	0

Table 88
Flexible pavement LEF for functional class 6 in 2006

FC 6	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	1.064	1.033	0.9972	0.995	1.0132	1.0632	1.0056	0.9316	0.9211	0.9535
Class 5	0.1174	0.1166	0.1122	0.11	0.1101	0.1273	0.1266	0.1152	0.1092	0.1084
Class 6	1.2154	1.1857	1.1503	1.1457	1.1609	1.2161	1.1611	1.0884	1.0745	1.1008
Class 7	0.6011	0.6234	0.6105	0.5913	0.5798	0.6498	0.708	0.6723	0.6236	0.596
Class 8	0.4446	0.4271	0.4002	0.3875	0.3899	0.4507	0.4195	0.3668	0.3408	0.3419
Class 9	0.7481	0.7576	0.7382	0.7229	0.7179	0.7932	0.824	0.7739	0.7332	0.719
Class 10	3.012	2.8849	2.7615	2.7578	2.8279	2.9685	2.7206	2.4792	2.4601	2.5852
Class 11	0	0	0	0	0	0	0	0	0	0
Class 12	0	0	0	0	0	0	0	0	0	0

Table 89
Flexible pavement LEF for functional class 7 in 2006

FC 7	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.8062	0.787	0.7686	0.7717	0.7835	0.8066	0.7696	0.7291	0.7317	0.7546
Class 5	0.0339	0.0352	0.0335	0.0318	0.0308	0.0406	0.0438	0.0391	0.0346	0.0322
Class 6	0.611	0.6037	0.5875	0.5842	0.5892	0.6243	0.614	0.5768	0.5651	0.5731
Class 7	0	0	0	0	0	0	0	0	0	0
Class 8	2.6771	2.5758	2.5076	2.5354	2.5962	2.6284	2.4207	2.2805	2.3306	2.4522
Class 9	1.7635	1.7406	1.7117	1.7121	1.7266	1.7736	1.7324	1.6677	1.6613	1.6883
Class 10	4.1824	4.063	3.9925	4.0336	4.1069	4.1094	3.8609	3.7182	3.7965	3.946
Class 11	0	0	0	0	0	0	0	0	0	0
Class 12	0	0	0	0	0	0	0	0	0	0

Table 90
Flexible pavement LEF for functional class 8 in 2006

FC 8	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	1.0609	1.0306	0.9833	0.9647	0.9746	1.0643	1.012	0.92	0.879	0.8912
Class 5	0.1005	0.1032	0.0988	0.0946	0.0925	0.1167	0.1242	0.1116	0.1006	0.0953
Class 6	3.4673	3.2935	3.1438	3.1378	3.2207	3.3756	3.0274	2.748	2.7364	2.8856
Class 7	0.9307	0.9656	0.9507	0.9235	0.9063	0.991	1.0799	1.04	0.9718	0.931
Class 8	0.6019	0.5925	0.5729	0.5673	0.5726	0.6167	0.6025	0.559	0.5424	0.5501
Class 9	2.1014	2.0681	2.0173	2.0116	2.0338	2.1132	2.0577	1.9489	1.925	1.9638
Class 10	1.4846	1.4975	1.4768	1.46	1.4552	1.5258	1.5658	1.5152	1.47	1.4555
Class 11	0	0	0	0	0	0	0	0	0	0
Class 12	0	0	0	0	0	0	0	0	0	0

Table 91
Flexible pavement LEF for functional class 9 in 2006

FC 9	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	1.2374	1.2091	1.1776	1.1778	1.1953	1.2353	1.1823	1.1168	1.1114	1.1434
Class 5	0.0751	0.0777	0.0746	0.0713	0.0694	0.087	0.0941	0.0851	0.0765	0.072
Class 6	0.7733	0.7658	0.7568	0.7577	0.7621	0.7796	0.766	0.744	0.7435	0.7522
Class 7	0	0	0	0	0	0	0	0	0	0
Class 8	0.2152	0.2142	0.2113	0.2106	0.211	0.2207	0.2191	0.2118	0.2092	0.2096
Class 9	1.4243	1.4155	1.3981	1.3966	1.4024	1.4407	1.4283	1.3858	1.3771	1.3877
Class 10	0	0	0	0	0	0	0	0	0	0
Class 11	0	0	0	0	0	0	0	0	0	0
Class 12	0	0	0	0	0	0	0	0	0	0

Table 92
Flexible pavement LEF for functional class 11 in 2006

FC 11	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.815	0.8195	0.8057	0.7954	0.7934	0.8363	0.853	0.8211	0.7945	0.7874
Class 5	0.1794	0.182	0.1776	0.1736	0.1717	0.194	0.2015	0.1892	0.1786	0.1738
Class 6	0.8973	0.9006	0.8872	0.8795	0.8788	0.9191	0.9331	0.9006	0.8787	0.875
Class 7	1.1179	1.095	1.0649	1.0619	1.0768	1.1176	1.0763	1.0151	1.0027	1.0287
Class 8	1.0372	1.03	1.0084	1.0009	1.0053	1.0546	1.047	0.9988	0.9773	0.9829
Class 9	1.7153	1.7219	1.7003	1.6867	1.6849	1.7501	1.7756	1.7238	1.6862	1.6785
Class 10	2.6489	2.6058	2.5566	2.5586	2.5859	2.6511	2.5719	2.4661	2.4598	2.5108
Class 11	2.0451	2.0755	2.0525	2.0247	2.0109	2.1096	2.1917	2.1333	2.0613	2.0267
Class 12	1.522	1.5709	1.5495	1.511	1.4869	1.6077	1.7326	1.6754	1.5786	1.5213

Table 93
Flexible pavement LEF for functional class 14 in 2006

FC 14	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.4009	0.4004	0.3882	0.3813	0.3815	0.4164	0.4201	0.3924	0.3742	0.3722
Class 5	0.0573	0.0584	0.0561	0.0541	0.0531	0.0659	0.0689	0.0623	0.0569	0.0544
Class 6	0.6072	0.6052	0.5942	0.5901	0.5916	0.6217	0.6218	0.5953	0.5828	0.5843
Class 7	0.4319	0.4479	0.4363	0.4213	0.4125	0.4741	0.5167	0.4844	0.4458	0.4246
Class 8	0.2697	0.2738	0.2671	0.2613	0.259	0.2883	0.3004	0.2828	0.2674	0.2611
Class 9	0.9497	0.966	0.9513	0.9346	0.9265	0.9925	1.0373	0.999	0.9558	0.9352
Class 10	1.9996	1.9828	1.9488	1.9423	1.9543	2.0176	1.9931	1.9182	1.8952	1.9149
Class 11	1.0976	1.1301	1.1092	1.0803	1.0642	1.1684	1.2539	1.1984	1.1247	1.0853
Class 12	0.7986	0.8374	0.8162	0.7834	0.7635	0.8801	0.9805	0.9222	0.8392	0.7917

Table 94
Flexible pavement LEF for functional class 17 in 2006

FC 17	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.5475	0.5469	0.5327	0.5236	0.5233	0.5635	0.5676	0.5366	0.514	0.5103
Class 5	0.0653	0.0646	0.062	0.061	0.061	0.0711	0.0702	0.0635	0.0603	0.0601
Class 6	0.2951	0.2972	0.2884	0.2827	0.2813	0.3161	0.3245	0.3012	0.2855	0.2811
Class 7	1.3336	1.3162	1.2973	1.3004	1.3113	1.34	1.3082	1.2639	1.2655	1.287
Class 8	0.2877	0.2877	0.2815	0.2784	0.2784	0.2979	0.3002	0.2855	0.2764	0.2755
Class 9	0.291	0.3016	0.2924	0.2811	0.2745	0.3267	0.3549	0.3285	0.2995	0.2836
Class 10	0	0	0	0	0	0	0	0	0	0
Class 11	0	0	0	0	0	0	0	0	0	0
Class 12	0	0	0	0	0	0	0	0	0	0

Table 95
Flexible pavement LEF for functional class 2 in 2005

FC 2	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.4935	0.5043	0.4954	0.4849	0.4796	0.5204	0.5496	0.5263	0.4992	0.4858
Class 5	0.1222	0.1244	0.1208	0.1174	0.1158	0.1349	0.1411	0.1309	0.122	0.1179
Class 6	0.5265	0.5311	0.5218	0.5146	0.5127	0.5458	0.5606	0.5375	0.5183	0.5123
Class 7	2.6826	2.5971	2.521	2.5301	2.5815	2.6513	2.4833	2.3299	2.3388	2.4356
Class 8	0.3655	0.3668	0.3574	0.3515	0.3504	0.3851	0.3919	0.368	0.352	0.348
Class 9	1.2496	1.2506	1.2244	1.2083	1.2071	1.2838	1.2975	1.2374	1.1961	1.1886
Class 10	1.8218	1.8089	1.777	1.7702	1.7798	1.8462	1.8307	1.7573	1.7332	1.7488
Class 11	1.9723	2.0002	1.9784	1.9526	1.9397	2.0342	2.1095	2.0539	1.9868	1.9546
Class 12	1.0492	1.0805	1.0623	1.0347	1.0181	1.1205	1.2015	1.1511	1.0811	1.0413

Table 96
Flexible pavement LEF for functional class 6 in 2005

FC 6	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	1.9268	1.8231	1.7238	1.7077	1.7515	1.8798	1.6747	1.4905	1.4594	1.5342
Class 5	0.2723	0.2671	0.2587	0.2572	0.26	0.2798	0.2706	0.2514	0.2461	0.2506
Class 6	1.6828	1.6275	1.5784	1.5861	1.6198	1.6673	1.5588	1.457	1.4655	1.5298
Class 7	0	0	0	0	0	0	0	0	0	0
Class 8	2.6748	2.5217	2.3814	2.3675	2.4378	2.6043	2.2998	2.0369	2.0084	2.1318
Class 9	3.51	3.3883	3.2983	3.3236	3.3947	3.4558	3.2095	3.0264	3.0697	3.209
Class 10	4.4307	4.2372	4.0723	4.0755	4.1756	4.3371	3.95	3.6351	3.636	3.8189
Class 11	2.0357	2.0488	2.0229	2.0043	1.9996	2.0863	2.1289	2.065	2.0137	1.999
Class 12	1.2128	1.2603	1.2372	1.1988	1.1752	1.3017	1.4241	1.3616	1.2648	1.2086

Table 97
Flexible pavement LEF for functional class 7 in 2005

FC 7	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.8526	0.8307	0.799	0.7916	0.8034	0.8568	0.818	0.7539	0.7338	0.7523
Class 5	0.0919	0.0928	0.0899	0.0877	0.0868	0.101	0.1039	0.0958	0.0898	0.0875
Class 6	0.6255	0.619	0.6066	0.6043	0.6086	0.6332	0.6234	0.5955	0.5874	0.5945
Class 7	0.8081	0.8169	0.8006	0.7886	0.7848	0.8438	0.8724	0.8303	0.7974	0.7867
Class 8	1.0488	1.0047	0.9656	0.9678	0.9917	1.036	0.9484	0.8701	0.8707	0.9151
Class 9	1.7658	1.739	1.7024	1.6994	1.715	1.7781	1.7311	1.6507	1.6367	1.6645
Class 10	3.9499	3.8177	3.7193	3.7484	3.8285	3.887	3.6199	3.4208	3.4693	3.6263
Class 11	0	0	0	0	0	0	0	0	0	0
Class 12	3.8259	3.6976	3.6133	3.6558	3.7325	3.7784	3.5161	3.3327	3.4093	3.5667

Table 98
Flexible pavement LEF for functional class in 2005

FC 14	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.6819	0.6835	0.6703	0.6627	0.6626	0.7007	0.7099	0.6792	0.6585	0.6556
Class 5	0.1751	0.1759	0.171	0.1679	0.1672	0.1873	0.1905	0.1777	0.1692	0.1668
Class 6	0.941	0.9108	0.873	0.8629	0.8744	0.939	0.883	0.809	0.7865	0.8047
Class 7	3.8914	3.7125	3.5696	3.5821	3.6762	3.7936	3.4324	3.1608	3.1822	3.3588
Class 8	0.6145	0.6004	0.5756	0.5663	0.5713	0.6258	0.6023	0.5506	0.5284	0.5345
Class 9	2.3493	2.2833	2.2116	2.2026	2.2329	2.3386	2.2133	2.0698	2.0464	2.0999
Class 10	3.1713	3.0734	2.9857	2.9916	3.0469	3.135	2.9421	2.7677	2.7712	2.8739
Class 11	1.889	1.9211	1.8992	1.871	1.856	1.9554	2.0411	1.9844	1.9117	1.8748
Class 12	1.5528	1.597	1.5745	1.5382	1.517	1.6336	1.7477	1.6889	1.5972	1.5458

Table 99
Flexible pavement LEF for functional class 16 in 2005

FC 16	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	2.416	2.288	2.173	2.169	2.236	2.353	2.097	1.882	1.870	1.988
Class 5	0.155	0.155	0.149	0.146	0.146	0.167	0.169	0.155	0.146	0.144
Class 6	1.263	1.210	1.158	1.148	1.166	1.241	1.138	1.041	1.022	1.054
Class 7	1.551	1.571	1.559	1.542	1.533	1.591	1.643	1.612	1.569	1.546
Class 8	0.263	0.259	0.250	0.248	0.250	0.274	0.267	0.247	0.239	0.242
Class 9	2.006	1.985	1.952	1.951	1.966	2.021	1.987	1.912	1.900	1.927
Class 10	0.621	0.617	0.603	0.600	0.602	0.641	0.636	0.603	0.590	0.594
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 100
Flexible pavement LEF for functional class 17 in 2005

FC 17	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.289	0.297	0.291	0.284	0.280	0.308	0.330	0.315	0.296	0.286
Class 5	0.098	0.099	0.097	0.094	0.093	0.107	0.111	0.104	0.098	0.095
Class 6	2.751	2.653	2.595	2.627	2.686	2.693	2.488	2.370	2.432	2.552
Class 7	1.249	1.281	1.274	1.252	1.237	1.289	1.365	1.348	1.295	1.260
Class 8	0.165	0.156	0.147	0.146	0.150	0.164	0.147	0.129	0.126	0.134
Class 9	2.583	2.529	2.486	2.497	2.531	2.566	2.459	2.367	2.385	2.450
Class 10	1.659	1.550	1.458	1.458	1.514	1.603	1.384	1.212	1.210	1.311
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 101
Flexible pavement LEF for functional class 2 in 2004

FC 2	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.500	0.512	0.504	0.493	0.487	0.527	0.559	0.537	0.510	0.495
Class 5	0.137	0.140	0.135	0.131	0.130	0.151	0.159	0.147	0.137	0.132
Class 6	0.416	0.430	0.419	0.406	0.399	0.451	0.487	0.458	0.425	0.408
Class 7	0.671	0.683	0.666	0.652	0.645	0.714	0.752	0.707	0.668	0.651
Class 8	0.453	0.455	0.442	0.435	0.434	0.476	0.486	0.455	0.435	0.431
Class 9	1.345	1.354	1.333	1.318	1.314	1.385	1.414	1.363	1.322	1.311
Class 10	1.631	1.624	1.596	1.588	1.594	1.661	1.657	1.591	1.565	1.574
Class 11	1.551	1.599	1.579	1.541	1.517	1.632	1.756	1.702	1.607	1.551
Class 12	1.172	1.226	1.201	1.158	1.131	1.271	1.410	1.342	1.233	1.169

Table 102
Flexible pavement LEF for functional class 6 in 2004

FC 6	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.578	0.573	0.559	0.554	0.558	0.589	0.583	0.552	0.538	0.543
Class 5	0.209	0.207	0.200	0.198	0.199	0.219	0.216	0.201	0.194	0.195
Class 6	0.502	0.498	0.489	0.487	0.489	0.513	0.508	0.485	0.477	0.481
Class 7	1.831	1.799	1.773	1.781	1.802	1.821	1.756	1.701	1.714	1.754
Class 8	0.992	0.959	0.929	0.931	0.950	0.986	0.923	0.860	0.861	0.896
Class 9	2.736	2.673	2.613	2.617	2.653	2.722	2.600	2.475	2.475	2.543
Class 10	2.952	2.849	2.743	2.734	2.786	2.924	2.724	2.516	2.489	2.581
Class 11	1.973	1.975	1.936	1.918	1.921	2.025	2.047	1.954	1.902	1.901
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 103
Flexible pavement LEF for functional class 7 in 2004

FC 7	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.701	0.697	0.681	0.675	0.678	0.717	0.716	0.678	0.660	0.663
Class 5	0.115	0.115	0.111	0.109	0.109	0.125	0.125	0.115	0.110	0.108
Class 6	0.776	0.772	0.755	0.749	0.752	0.796	0.794	0.753	0.735	0.739
Class 7	1.205	1.211	1.196	1.187	1.185	1.234	1.254	1.217	1.191	1.184
Class 8	0.374	0.374	0.364	0.358	0.358	0.392	0.399	0.373	0.357	0.354
Class 9	3.261	3.155	3.077	3.103	3.166	3.218	3.005	2.843	2.885	3.011
Class 10	3.207	3.143	3.090	3.103	3.143	3.189	3.064	2.950	2.970	3.047
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 104
Flexible pavement LEF for functional class 11 in 2004

FC 11	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.682	0.693	0.683	0.672	0.667	0.708	0.738	0.714	0.686	0.673
Class 5	0.143	0.144	0.139	0.136	0.134	0.155	0.160	0.148	0.138	0.134
Class 6	0.803	0.808	0.797	0.789	0.786	0.827	0.845	0.816	0.793	0.786
Class 7	1.582	1.545	1.490	1.476	1.497	1.585	1.519	1.411	1.374	1.406
Class 8	0.678	0.683	0.670	0.661	0.659	0.703	0.719	0.687	0.663	0.657
Class 9	1.397	1.420	1.404	1.383	1.372	1.445	1.506	1.465	1.412	1.385
Class 10	2.241	2.205	2.153	2.145	2.165	2.251	2.189	2.080	2.054	2.089
Class 11	1.515	1.566	1.546	1.506	1.481	1.600	1.731	1.676	1.576	1.517
Class 12	1.377	1.434	1.411	1.367	1.339	1.473	1.617	1.555	1.445	1.379

Table 105
Flexible pavement LEF for functional class 14 in 2004

FC 14	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.306	0.316	0.310	0.300	0.295	0.331	0.357	0.339	0.315	0.302
Class 5	0.085	0.087	0.084	0.081	0.079	0.097	0.102	0.093	0.085	0.081
Class 6	0.540	0.547	0.536	0.527	0.523	0.565	0.586	0.560	0.535	0.525
Class 7	1.244	1.244	1.226	1.219	1.221	1.268	1.277	1.234	1.213	1.213
Class 8	0.144	0.145	0.140	0.138	0.137	0.153	0.156	0.145	0.138	0.136
Class 9	0.670	0.684	0.670	0.655	0.647	0.712	0.751	0.715	0.675	0.656
Class 10	0.385	0.398	0.390	0.379	0.372	0.415	0.447	0.426	0.398	0.382
Class 11	0.746	0.777	0.758	0.731	0.714	0.818	0.898	0.848	0.778	0.738
Class 12	0.860	0.892	0.874	0.845	0.828	0.935	1.018	0.966	0.894	0.852

Table 106
Flexible pavement LEF for functional class 16 in 2004

FC 16	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.583	0.597	0.590	0.578	0.571	0.610	0.647	0.627	0.597	0.581
Class 5	0.107	0.108	0.105	0.102	0.101	0.118	0.123	0.114	0.106	0.102
Class 6	0.729	0.730	0.715	0.706	0.705	0.752	0.761	0.725	0.701	0.696
Class 7	0.763	0.787	0.774	0.754	0.743	0.807	0.868	0.834	0.785	0.758
Class 8	0.211	0.216	0.211	0.205	0.203	0.228	0.239	0.226	0.212	0.206
Class 9	0.615	0.631	0.617	0.601	0.592	0.661	0.702	0.665	0.624	0.603
Class 10	0.926	0.928	0.907	0.896	0.896	0.960	0.972	0.922	0.891	0.887
Class 11	1.049	1.081	1.063	1.035	1.019	1.119	1.202	1.153	1.082	1.042
Class 12	0.728	0.766	0.742	0.709	0.689	0.815	0.914	0.848	0.763	0.716

Table 107
Flexible pavement LEF for functional class 1 (combined years)

FC 1	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.528	0.537	0.528	0.518	0.513	0.553	0.580	0.556	0.530	0.518
Class 5	0.131	0.134	0.130	0.126	0.125	0.144	0.150	0.140	0.131	0.127
Class 6	0.394	0.400	0.392	0.384	0.381	0.416	0.435	0.413	0.392	0.384
Class 7	0.784	0.792	0.777	0.764	0.760	0.814	0.841	0.804	0.771	0.759
Class 8	0.599	0.596	0.578	0.569	0.570	0.620	0.620	0.580	0.556	0.554
Class 9	1.205	1.223	1.207	1.189	1.180	1.250	1.300	1.258	1.211	1.189
Class 10	1.909	1.889	1.849	1.839	1.852	1.931	1.901	1.813	1.783	1.803
Class 11	1.339	1.374	1.353	1.323	1.305	1.411	1.503	1.447	1.370	1.328
Class 12	1.001	1.040	1.017	0.984	0.964	1.085	1.187	1.125	1.039	0.991

Table 108
Flexible pavement LEF for functional class 2 (combined years)

FC 2	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.572	0.577	0.565	0.556	0.553	0.594	0.611	0.583	0.559	0.551
Class 5	0.117	0.119	0.116	0.112	0.111	0.129	0.135	0.125	0.117	0.113
Class 6	0.570	0.575	0.563	0.555	0.553	0.593	0.609	0.580	0.558	0.552
Class 7	1.828	1.794	1.753	1.754	1.775	1.829	1.767	1.681	1.673	1.713
Class 8	0.408	0.410	0.399	0.392	0.391	0.429	0.438	0.411	0.393	0.389
Class 9	1.253	1.253	1.228	1.214	1.214	1.287	1.299	1.241	1.203	1.198
Class 10	2.036	2.002	1.955	1.948	1.968	2.047	1.987	1.886	1.865	1.898
Class 11	1.424	1.460	1.440	1.409	1.391	1.496	1.590	1.536	1.458	1.415
Class 12	0.740	0.769	0.754	0.731	0.716	0.797	0.871	0.831	0.771	0.737

Table 109
Flexible pavement LEF for functional class 6 (combined years)

FC 6	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	1.190	1.143	1.093	1.086	1.107	1.177	1.088	0.991	0.973	1.010
Class 5	0.199	0.197	0.190	0.188	0.190	0.209	0.204	0.189	0.183	0.185
Class 6	1.133	1.104	1.072	1.073	1.090	1.132	1.076	1.010	1.006	1.037
Class 7	0.811	0.807	0.794	0.791	0.794	0.824	0.821	0.791	0.779	0.783
Class 8	1.370	1.303	1.237	1.229	1.259	1.347	1.214	1.088	1.070	1.123
Class 9	2.331	2.273	2.216	2.221	2.255	2.324	2.211	2.092	2.093	2.157
Class 10	3.465	3.324	3.192	3.189	3.263	3.410	3.132	2.877	2.862	2.995
Class 11	1.336	1.341	1.320	1.308	1.307	1.370	1.392	1.340	1.305	1.300
Class 12	0.404	0.420	0.412	0.400	0.392	0.434	0.475	0.454	0.422	0.403

Table 110
Flexible pavement LEF for functional class 7 (combined years)

FC 7	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.787	0.772	0.749	0.746	0.755	0.794	0.768	0.720	0.709	0.723
Class 5	0.080	0.081	0.078	0.076	0.076	0.089	0.091	0.083	0.078	0.076
Class 6	0.671	0.665	0.650	0.646	0.650	0.684	0.677	0.642	0.629	0.635
Class 7	0.671	0.676	0.666	0.658	0.657	0.693	0.709	0.682	0.663	0.657
Class 8	1.366	1.318	1.279	1.287	1.315	1.352	1.256	1.175	1.186	1.240
Class 9	2.263	2.212	2.164	2.171	2.203	2.257	2.156	2.054	2.061	2.121
Class 10	3.780	3.675	3.600	3.628	3.693	3.728	3.515	3.363	3.412	3.540
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	1.275	1.233	1.204	1.219	1.244	1.259	1.172	1.111	1.136	1.189

Table 111
Flexible pavement LEF for functional class 8 (combined years)

FC 8	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.808	0.802	0.779	0.767	0.768	0.824	0.820	0.771	0.741	0.740
Class 5	0.139	0.141	0.136	0.133	0.131	0.153	0.158	0.146	0.136	0.132
Class 6	1.737	1.671	1.605	1.596	1.627	1.714	1.585	1.458	1.439	1.492
Class 7	2.135	2.074	2.003	1.994	2.026	2.123	2.011	1.870	1.843	1.899
Class 8	0.632	0.625	0.606	0.598	0.601	0.648	0.641	0.599	0.578	0.580
Class 9	1.949	1.924	1.878	1.866	1.880	1.966	1.926	1.828	1.794	1.816
Class 10	2.299	2.259	2.205	2.199	2.222	2.304	2.232	2.121	2.099	2.139
Class 11	1.135	1.162	1.148	1.126	1.112	1.185	1.257	1.220	1.163	1.131
Class 12	0.977	1.010	0.995	0.968	0.952	1.035	1.122	1.081	1.014	0.975

Table 112
Flexible Pavement LEF for Functional Class 9 (combined years)

FC 9	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	1.320	1.271	1.220	1.216	1.242	1.307	1.212	1.112	1.099	1.145
Class 5	0.105	0.107	0.103	0.099	0.098	0.117	0.122	0.111	0.103	0.099
Class 6	0.859	0.841	0.817	0.811	0.817	0.862	0.830	0.782	0.767	0.777
Class 7	0.931	0.938	0.929	0.921	0.918	0.953	0.973	0.949	0.927	0.920
Class 8	0.207	0.206	0.201	0.199	0.199	0.216	0.214	0.201	0.195	0.196
Class 9	1.367	1.361	1.340	1.334	1.338	1.391	1.389	1.337	1.318	1.324
Class 10	0.335	0.338	0.331	0.326	0.325	0.352	0.361	0.343	0.329	0.325
Class 11	0.249	0.259	0.253	0.244	0.238	0.273	0.299	0.283	0.259	0.246
Class 12	0.287	0.297	0.291	0.282	0.276	0.312	0.339	0.322	0.298	0.284

Table 113
Flexible pavement LEF for functional class 11 (combined years)

FC 11	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.562	0.571	0.562	0.552	0.548	0.585	0.610	0.588	0.563	0.551
Class 5	0.128	0.130	0.126	0.123	0.122	0.140	0.145	0.136	0.127	0.124
Class 6	1.459	1.428	1.399	1.404	1.423	1.455	1.394	1.332	1.337	1.374
Class 7	1.044	1.054	1.038	1.023	1.019	1.071	1.103	1.066	1.028	1.015
Class 8	0.471	0.467	0.455	0.451	0.453	0.482	0.478	0.451	0.439	0.441
Class 9	1.638	1.627	1.601	1.595	1.603	1.659	1.646	1.585	1.565	1.577
Class 10	1.745	1.694	1.641	1.638	1.665	1.738	1.642	1.533	1.520	1.569
Class 11	1.031	1.052	1.039	1.020	1.010	1.076	1.131	1.095	1.048	1.023
Class 12	0.750	0.779	0.764	0.740	0.725	0.808	0.882	0.841	0.781	0.746

Table 114
Flexible pavement LEF for functional class 14 (combined years)

FC 14	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.401	0.400	0.388	0.381	0.382	0.416	0.420	0.392	0.374	0.372
Class 5	0.057	0.058	0.056	0.054	0.053	0.066	0.069	0.062	0.057	0.054
Class 6	0.607	0.605	0.594	0.590	0.592	0.622	0.622	0.595	0.583	0.584
Class 7	0.432	0.448	0.436	0.421	0.413	0.474	0.517	0.484	0.446	0.425
Class 8	0.270	0.274	0.267	0.261	0.259	0.288	0.300	0.283	0.267	0.261
Class 9	0.950	0.966	0.951	0.935	0.927	0.993	1.037	0.999	0.956	0.935
Class 10	2.000	1.983	1.949	1.942	1.954	2.018	1.993	1.918	1.895	1.915
Class 11	1.098	1.130	1.109	1.080	1.064	1.168	1.254	1.198	1.125	1.085
Class 12	0.799	0.837	0.816	0.783	0.764	0.880	0.981	0.922	0.839	0.792

Table 115
Flexible pavement LEF for functional class 17 (combined years)

FC 17	Pt= 2.0					Pt= 2.5				
	SN=2	SN=3	SN=4	SN=5	SN=6	SN=2	SN=3	SN=4	SN=5	SN=6
Class 4	0.548	0.547	0.533	0.524	0.523	0.564	0.568	0.537	0.514	0.510
Class 5	0.065	0.065	0.062	0.061	0.061	0.071	0.070	0.064	0.060	0.060
Class 6	0.295	0.297	0.288	0.283	0.281	0.316	0.325	0.301	0.286	0.281
Class 7	1.334	1.316	1.297	1.300	1.311	1.340	1.308	1.264	1.266	1.287
Class 8	0.288	0.288	0.282	0.278	0.278	0.298	0.300	0.286	0.276	0.276
Class 9	0.291	0.302	0.292	0.281	0.275	0.327	0.355	0.329	0.300	0.284
Class 10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 116
Rigid pavement LEF for functional class 1 (combined years)

FC 1	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.650	0.642	0.641	0.643	0.644	0.645	0.656	0.638	0.635	0.638	0.642	0.644
Class 5	0.132	0.129	0.128	0.128	0.128	0.128	0.138	0.132	0.129	0.128	0.128	0.128
Class 6	0.590	0.583	0.583	0.587	0.590	0.592	0.587	0.570	0.570	0.578	0.585	0.589
Class 7	1.298	1.280	1.282	1.293	1.304	1.312	1.266	1.226	1.229	1.252	1.275	1.293
Class 8	0.729	0.716	0.714	0.718	0.724	0.728	0.722	0.694	0.689	0.698	0.709	0.718
Class 9	2.018	2.001	2.013	2.032	2.046	2.053	1.970	1.933	1.957	1.996	2.026	2.043
Class 10	3.297	3.244	3.263	3.312	3.358	3.390	3.138	3.028	3.066	3.167	3.262	3.331
Class 11	1.365	1.345	1.332	1.327	1.325	1.324	1.421	1.374	1.344	1.332	1.327	1.325
Class 12	1.223	1.204	1.192	1.186	1.184	1.183	1.277	1.232	1.203	1.191	1.186	1.184

Table 117
Rigid pavement LEF for functional class 2 (combined years)

FC 2	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.673	0.665	0.664	0.666	0.669	0.671	0.676	0.656	0.653	0.658	0.664	0.668
Class 5	0.118	0.115	0.114	0.114	0.114	0.114	0.123	0.118	0.115	0.114	0.114	0.114
Class 6	0.836	0.825	0.827	0.834	0.840	0.844	0.824	0.800	0.802	0.817	0.830	0.838
Class 7	2.713	2.668	2.681	2.720	2.758	2.786	2.585	2.492	2.518	2.599	2.678	2.737
Class 8	0.521	0.512	0.511	0.514	0.518	0.520	0.520	0.500	0.497	0.504	0.511	0.516
Class 9	2.042	2.016	2.026	2.049	2.068	2.081	1.975	1.920	1.941	1.988	2.028	2.056
Class 10	3.421	3.363	3.384	3.440	3.492	3.528	3.244	3.125	3.168	3.282	3.391	3.468
Class 11	1.452	1.432	1.418	1.413	1.410	1.409	1.509	1.461	1.431	1.418	1.413	1.410
Class 12	0.901	0.888	0.880	0.875	0.874	0.873	0.939	0.909	0.889	0.879	0.875	0.874

Table 118
Rigid pavement LEF for functional class 6 (combined years)

FC 6	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	1.294	1.266	1.264	1.278	1.297	1.314	1.238	1.181	1.176	1.205	1.243	1.278
Class 5	0.194	0.190	0.190	0.191	0.193	0.193	0.194	0.187	0.186	0.189	0.191	0.192
Class 6	1.605	1.575	1.583	1.609	1.635	1.653	1.526	1.464	1.479	1.532	1.585	1.623
Class 7	1.196	1.184	1.195	1.211	1.222	1.228	1.154	1.128	1.150	1.184	1.207	1.220
Class 8	1.696	1.649	1.643	1.664	1.694	1.722	1.594	1.500	1.488	1.530	1.589	1.647
Class 9	3.751	3.679	3.701	3.768	3.832	3.878	3.534	3.388	3.433	3.569	3.703	3.800
Class 10	5.706	5.562	5.563	5.647	5.752	5.846	5.317	5.029	5.034	5.205	5.416	5.611
Class 11	1.330	1.316	1.314	1.316	1.318	1.319	1.345	1.312	1.306	1.311	1.315	1.318
Class 12	0.501	0.495	0.490	0.488	0.487	0.486	0.522	0.506	0.495	0.490	0.488	0.487

Table 119
Rigid pavement LEF for functional class 7 (combined years)

FC 7	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.939	0.922	0.923	0.935	0.947	0.955	0.910	0.873	0.876	0.899	0.923	0.941
Class 5	0.080	0.079	0.078	0.078	0.078	0.078	0.083	0.079	0.078	0.078	0.078	0.078
Class 6	0.991	0.975	0.979	0.991	1.002	1.010	0.959	0.926	0.931	0.956	0.980	0.997
Class 7	1.053	1.042	1.048	1.060	1.068	1.072	1.026	1.002	1.015	1.039	1.056	1.066
Class 8	1.824	1.786	1.796	1.829	1.863	1.886	1.720	1.643	1.661	1.730	1.799	1.848
Class 9	3.748	3.679	3.706	3.776	3.841	3.885	3.527	3.386	3.440	3.584	3.720	3.815
Class 10	6.532	6.407	6.459	6.595	6.722	6.808	6.088	5.838	5.945	6.222	6.487	6.671
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	2.114	2.065	2.084	2.135	2.182	2.212	1.964	1.863	1.900	2.005	2.103	2.168

Table 120
Rigid pavement LEF for functional class 8 (combined years)

FC 8	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.901	0.887	0.885	0.889	0.896	0.901	0.893	0.861	0.856	0.865	0.878	0.889
Class 5	0.139	0.136	0.135	0.135	0.135	0.135	0.144	0.138	0.135	0.134	0.134	0.135
Class 6	2.594	2.532	2.529	2.560	2.599	2.636	2.436	2.311	2.307	2.370	2.449	2.524
Class 7	3.493	3.407	3.402	3.448	3.508	3.561	3.290	3.117	3.108	3.200	3.320	3.430
Class 8	0.755	0.741	0.739	0.743	0.750	0.755	0.744	0.714	0.709	0.718	0.731	0.742
Class 9	3.082	3.032	3.047	3.089	3.130	3.159	2.944	2.842	2.871	2.958	3.042	3.105
Class 10	3.974	3.903	3.923	3.987	4.050	4.096	3.757	3.612	3.654	3.785	3.915	4.013
Class 11	1.157	1.142	1.132	1.128	1.126	1.126	1.200	1.165	1.142	1.132	1.128	1.126
Class 12	1.202	1.188	1.180	1.177	1.176	1.175	1.239	1.207	1.187	1.180	1.177	1.176

Table 121
Rigid pavement LEF for functional class 9 (combined years)

FC 9	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	1.56	1.52	1.52	1.54	1.56	1.58	1.49	1.41	1.41	1.44	1.49	1.53
Class 5	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.10	0.10	0.10	0.10	0.10
Class 6	1.14	1.12	1.13	1.14	1.15	1.16	1.09	1.06	1.07	1.10	1.12	1.14
Class 7	1.42	1.41	1.42	1.43	1.45	1.45	1.38	1.36	1.37	1.41	1.43	1.44
Class 8	0.26	0.25	0.25	0.26	0.26	0.26	0.25	0.24	0.24	0.25	0.25	0.26
Class 9	2.19	2.16	2.17	2.20	2.23	2.24	2.10	2.04	2.07	2.14	2.19	2.22
Class 10	0.56	0.55	0.55	0.56	0.57	0.57	0.55	0.53	0.54	0.55	0.56	0.56
Class 11	0.26	0.25	0.25	0.24	0.24	0.24	0.27	0.26	0.25	0.25	0.24	0.24
Class 12	0.35	0.35	0.35	0.35	0.34	0.34	0.37	0.36	0.35	0.35	0.35	0.34

Table 122
Rigid pavement LEF for functional class 11 (combined years)

FC 11	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.645	0.637	0.635	0.636	0.638	0.639	0.653	0.634	0.629	0.631	0.634	0.637
Class 5	0.128	0.126	0.125	0.125	0.125	0.125	0.133	0.128	0.126	0.125	0.125	0.125
Class 6	2.298	2.256	2.271	2.313	2.352	2.378	2.169	2.082	2.113	2.199	2.280	2.337
Class 7	1.983	1.960	1.972	1.997	2.018	2.033	1.904	1.856	1.881	1.932	1.978	2.009
Class 8	0.585	0.576	0.576	0.581	0.586	0.590	0.574	0.554	0.554	0.563	0.573	0.581
Class 9	2.719	2.682	2.702	2.743	2.777	2.799	2.597	2.522	2.563	2.647	2.719	2.766
Class 10	2.818	2.761	2.771	2.815	2.863	2.901	2.655	2.539	2.559	2.649	2.748	2.827
Class 11	1.046	1.034	1.026	1.023	1.022	1.022	1.080	1.050	1.032	1.026	1.023	1.022
Class 12	0.934	0.921	0.913	0.909	0.908	0.907	0.970	0.939	0.920	0.912	0.909	0.908

Table 123
Rigid pavement LEF for functional class 14 (combined years)

FC 14	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.473	0.465	0.464	0.466	0.470	0.472	0.472	0.454	0.450	0.455	0.462	0.468
Class 5	0.057	0.056	0.055	0.055	0.055	0.055	0.061	0.058	0.056	0.055	0.055	0.055
Class 6	0.855	0.843	0.847	0.857	0.865	0.870	0.832	0.807	0.814	0.834	0.851	0.862
Class 7	0.621	0.611	0.608	0.609	0.610	0.610	0.635	0.613	0.606	0.607	0.608	0.609
Class 8	0.322	0.317	0.316	0.316	0.317	0.318	0.328	0.316	0.312	0.313	0.315	0.317
Class 9	1.505	1.490	1.496	1.507	1.516	1.521	1.482	1.449	1.459	1.483	1.502	1.513
Class 10	3.620	3.567	3.596	3.656	3.707	3.742	3.430	3.322	3.381	3.504	3.613	3.687
Class 11	1.121	1.102	1.090	1.085	1.083	1.082	1.174	1.129	1.100	1.089	1.085	1.083
Class 12	1.023	1.006	0.994	0.988	0.986	0.985	1.075	1.034	1.006	0.994	0.988	0.986

Table 124
Rigid pavement LEF for functional class 17 (combined years)

FC 17	Pt= 2.0						Pt= 2.5					
	D=6	D=7	D=8	D=9	D=10	D=11	D=6	D=7	D=8	D=9	D=10	D=11
Class 4	0.546	0.537	0.534	0.534	0.537	0.539	0.552	0.533	0.524	0.525	0.530	0.534
Class 5	0.063	0.062	0.062	0.062	0.063	0.063	0.064	0.062	0.061	0.062	0.062	0.063
Class 6	0.356	0.350	0.348	0.349	0.349	0.349	0.364	0.352	0.347	0.348	0.348	0.349
Class 7	1.941	1.920	1.936	1.964	1.985	1.997	1.862	1.818	1.851	1.908	1.953	1.980
Class 8	0.373	0.368	0.370	0.374	0.376	0.377	0.367	0.357	0.361	0.367	0.373	0.375
Class 9	0.453	0.447	0.444	0.443	0.442	0.442	0.468	0.454	0.447	0.444	0.443	0.442
Class 10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Class 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000